

CERTIFICATE

This is to certify that the investigation entitled "Development of methods for the isolation and characterization of policosanol from natural waxes" submitted by Ms. Abha Vikas V (VM20FPT001) during February 2022 to July 2022, in partial fulfilment for award of the degree of Master of Vocational studies in Food Processing and Technology from St. Teresa's college, Eranakulam, Kerala is the result of investigation carried out by her in department of Spice and Flavour Sciences, at CSIR- Central Food Technological Research Institute, Mysore, under the guidance of Dr. K. ANIL KUMAR.

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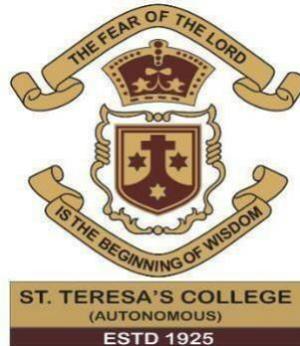
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MRS.DALLOWAY: A READING OF POST-WAR TRAUMA.



*Project submitted to St. Teresa's College (Autonomous) in partial fulfillment
of the requirement for the degree of BACHELOR OF ARTS in English*

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DECLARATION

I hereby declare that this project entitled "Mrs. Dalloway: a reading of post-war trauma".
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CERTIFICATE

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**Mrs. Dalloway: a reading of post-war
trauma.**

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Mrs.Dalloway is a circadian novel written by Virginia Woolf. Novel details a day in the life of characters named Clarissa Dalloway and Septimus Warren Smith,Who represent the sanity and insanity in the novel. The novel emphasizes the political turmoil and the psychotic Chaos of people who survived World War. This project is an attempt to understand how the war destroyed peace of land by reading the text in the light of trauma theory. The aim of the project is to identify how the war made an impact on the psychological wellbeing of people and the reality of survival.

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Introduction

Mrs Dalloway is a psychological fiction written by Virginia Woolf ,that delineate the life of two individuals, Mrs. Clarissa Dalloway and Septimus Warren Smith who lived in the post-World War I world. The whole story unravels on a single day in the month of June in the city of London. Mrs.Dalloway explores various topics by using the technique of stream of consciousness. This technique helps the readers to read the mind and heart of each and every character. The novel throws light on depression, suicidal tendency and PTSD and is considered to be one of early works which deals with trauma and mental health..

Roger Poole observes that Mrs.Dalloway is the “finest war novel that world war one produced “ (Poole 79). The lack of awareness about mental health create a hurricane in the psychological wellbeing of people, especially after a traumatic episode such as world war I.

On the fourteenth of October 1922, Virginia Woolf writes in her diary that ‘ I adumbrate here a study of insanity and suicide; the world seen by the sane and the insane side by side – something like that.’ This later branched into a book called Mrs.Dalloway.

This project tries to analyze the psychological impact of the Great war on Europeans through a detailed study of Mrs. Dalloway.

This research runs into two chapters. The first chapter explains trauma studies in literature. The second Chapter focuses on how this theory can be used to study Mrs. Dalloway to

show the impact and reality of war. It also attempts to give a moderate comparison of pre-war period, war period and post-war period. This comparison shows the hike in the number of people psychologically affected following World War One.

Chapter 1

Frame of reference in trauma.

Trauma is described as an individual's subjective experience of an event or situation; it ultimately turns out to be a threat to the mental stability of the people. Events such as accident, injuries, violence, rape, war, losing loved ones can cause trauma. Especially such events which happened during someone's childhood. Human Body has the tendency to remember the trauma and slowly goes into a threatening state within them. So, they only respond to another incident with the new strategies that got realized during the previous terrific or life-threatening incident.

Substance Abuse and Mental Health Service Administration (SAMHSA) describes trauma as resulting from an event or series of events, or set of circumstances that is experienced by an individual as physically or emotionally harmful or life threatening and that has lasting adverse effects on the individual's functioning and mental, physical, social and emotional make up.

Trauma theory asserts that trauma creates a speechless fright that divides or destroys identity. Trauma theory is not a stand-alone theory; it comprises many other theories. Trauma theory emerged in the 1990s as a result of the study of cultural effects of trauma done by a group of critics. Cathy Carruth was one of the most prominent critics. In her book *Exploration in memory* (1995) she explores the aspects of trauma by Combining the essays and interviews of professionals in the department of psychiatry, literature media and sociology. The concept of trauma itself portrays the actual disruptive events or experience that adversely affect one's own emotional level and perception of the external world. Trauma theories are paired with many other theoretical frameworks; post structural, post-colonial, socio-cultural are some of them. Cathy Carruth, Shoshana Felman, Geoffrey Hartman

are some of the prominent critics who introduced trauma study in literature by examining the concept of trauma and its role in society and literature.

Trauma studies can't be limited to psychology, it has social, political and historical dimensions. Trauma studies have a significant role in interpreting literature. In the past two decades different kinds of traumas and trauma related responses have emerged. This led to the expansion of trauma theory over the time. Trauma in literature is concerned about the actual traumatic events as compared to designed stories. Trauma theory mainly focuses on the mental wellbeing of an individual or a group of individuals in the society. In contemporary literature trauma is one of the main themes in popular fiction. The novels *Saturday* by Ian McEwan, *Swimming Home* by Deborah Levy, *White Teeth* by Zadie Smith and *Satin Island* by Tom McCarthy are some of the books concerned with both large-scale and small-scale traumatic events. Trauma can occur in multiple ways. It is essential to be aware of the commonalities and the patterns that are associated with trauma related responses.

Mrs Dalloway is a post war novel since it deals with the psychological chaos in life of people following World War One. What has doubled the troubles of the entire nation is that rather than the financial crisis and disintegration of development, people started diagnosing different kinds of maladies as compared to the pre war period. People started showing the symptoms of depression, trauma, anxiety and different kinds of psychotic disorder, including the veterans of war. Most of the soldiers were doomed to depression by experiencing the horrors of war. Veterans returned back traumatized from the war treated with derision and in an inadequate way. People were not aware about the fact that trauma or mental health conditions during the era could lead to psychotic instability which would directly fall for worse. Not only veterans, ordinary people too who witnessed horrific war started going through mental health issues. A good medical support wasn't provided to the citizens over that time as doctors themselves didn't give much importance to their mental health.

Through the book *Mrs Dalloway* Virginia Woolf manifests psychotic chaos in the life of people following World War one. By comparing the pre war period and post war period there is a tremendous rise in the people who got affected by psychotic disorders. Mrs. Dalloway is the classical example of this kind of psychological chaos in the post World War One period. Even though it is a circadian novel which portrays the life of an upper middle-class woman and the veteran who was affected with PTSD, Virginia Woolf consciously incorporates the impact of World War One throughout the novel. By overlapping the characters and incidents with the trauma theory, it is obvious that how World War One affect the mental health of the people in the post war period

Chapter 2

Overlapping context within the trauma theory

Mrs. Dalloway can purport to be a war novel that illustrates the chaotic life of people, especially the psychological chaos after World War One. By overlapping the theory of trauma with the novel it reveals how the consternation and overwhelming grief of the war adversely affected every aspect of post-war life. While it is obvious that this novel is an eloquent condemnation of war and post war. The textual analysis of this book shows how the Great war created an intense consciousness of death and time.

The importance of war in the novel delineates a proper channeling to narrate the situation of Europe in that particular era Which raises the consciousness of uneasiness of people Following the world war one. Even though the main theme of the novel is a single personality named Mrs. Dalloway who is constantly influenced by the people and situations she surrounded and also Woolf gives a parallel theme of war in the novel. Through the depiction of some characters who are seen as a foil and painting some situations Woolf gives the awareness of political turmoil, disintegration of imperialist power and fragmentation of Europe after world war one . One of the main protagonists of the novel Clarrisa Dalloway resided in the neighborhood of Westminster. The major conflict was going on there, every character was trying to preserve and oppress their soul from the fragmentation of war. Woolf is zooming out on the struggles that were carried out by the war. Woolf's writing reveals the hidden changes that took place in people during world war one, paradoxically she refers to the aftermath of war.

world war one is also known as the great war. It is an international conflict between Europe and Russia, the United States, the Middle East along with Germany, Austria, Italy, Japan

etc. War created a political turmoil within and outside the countries. Many countries were destroyed and lost their power. Some others gained more and more power during the war. The great war was known as one of the great wars of 20 century. It lasted from 28 July 1914 to 11 November 1918 it caused large-scale destruction worldwide, so it is also known as the “war to end all wars”. Millions of people felt relief and peace after the end of the war, but life after the war was not easy. Many people lost their home place, jobs and loved ones. The stability of the country was disintegrated, it was not only politically and financially but also mentally. People also suffered a lot: a generation has grown up only by knowing the war and its side effects. The horror of war haunted them throughout their lives. The people started living a life in a state of constant fear. Most of the people experienced mental instability, both civilians and not civilians becoming the pay of the great war. People started suffering many kinds of mental disorders such as shell-shock, depression and anxiety and many others many people have the tendency to do suicide as a symbol of “Death is more inevitable than living a life as a living corpse.

While talking about the pre-war and the war period it is important to know the fragmentation of physical health in the pre war period. As per the analysis more than 70% of individuals had witnessed at least one kind of traumatic event and 35% had been exposed to four or more than four. Most of the traumatic experiences emerge from witnessing the death of loved ones, accidents, threatening illness or injury etc. The Industrial Revolution in the 18th century created class distinction between people. The exacerbate the live hood or ordinary people by physically, sexually and emotionally. Women and children became the prey of this cruelty. Elizabeth Barrett Browning and Charles Dickens wrote about the appalling condition of women and children in their book. These slowly shake the mental

stability of people. Motor vehicle accidents are another reason that coiled with trauma.

Very first case of trauma was recognized in 1813 by Joseph Frank, a Viennese medical professor. It was diagnosed in a fourteen years old girl who witnessed threatening her father by Napoleon forces. Apparently, it is evident that as compared to the post war period the psychological issues of the pre-war period are less.

In the post-war period, many people especially soldiers showed a wide variety of symptoms of shell shock, depression, anxiety, violence, hallucination and nightmare about the flashbacks are some of the indications of shell shock or post traumatic disorder in the soldiers (PTSD). People are more exposed to traumatic events which gradually change their life from normal to clearly abnormal. People started facing different kinds of anxiety and depression , not only the soldiers but most of the people who witnessed the war started facing troubles , even the small ones. War adversely affects the civilians too, especially women and children. As we look back, we can see the war has an important role in the psychotic history of London. War has a catastrophic effect on the health and well being of a nation.

Through the characters in the novel Woolf represents different ideologies of war in Britain society. Clarissa Dalloway represents the epitome of depression and denial. She tries to hide the ugliness of pain with the flowers. On the surface Septimus delineates the collapse of imperialist pride of England that fell after World War One. Peter Walsh tries to maintain a naive attachment to pre-war England. Another opposing character of Clarissa was Mrs. Killman who represented the working class or ordinary people who opposed the war. Doctor Holmes and Bradshaw represent firm supporters of the pre-war empire. Through

these characters Woolf manifested the loss of pre-war identity, cultural superiority and psychological stability. In the opening page an airplane flying over the London sky creates a panic inside every individual. That indicates how war affected after the war also. When the car vanishes down the street, there is a disturbance among the people who had witnessed the event. The appearance of royalty driving through the city creates a stir among the common people and causes them to think "of the dead; of the flag; of the Empire" (Woolf 18). The intrigue surrounding the motorcar evokes a response of uprising in the crowd of people, for the ones who rebelled against the aristocracy and the ones who upheld the tenets of pre-war society. The House of Windsor is insulted in a bar room and a fight ensues. The car and what the power represents causes a ripple of "agitation" amongst the crowd of common people and touches upon emotions that are "very profound" (Woolf 18).

For a moment, the people in the street, with the exception of Septimus, collectively communicate their shared experience. The crowd responds with loyal veneration. That veneration is the people's "programmed response" of patriotism, what society believes is the acceptable reaction to royalty and the symbol of their imperial power. But the people seem to make no connections between the aristocracy and accountability for "feeding three million sons into the war machine" (Larson 197). The car snatches the whole crowd's attention. Woolf represents the cartoon show how the power of aristocracy is diminished in the common people's reality. But for Septimus it metaphors the death of soldiers that was caused by the aristocracy. The passing of cars evokes the past memories and fear of war.

Not only the characters, the entire book shares the theme of war in the novel and highlights the expansion of psychotic disorders as compared to the pre-war period. As per the research

the era after the war headed to more traumatic events.

The most unnoticed aspect in the society is that the people who faced All kinds of trauma during the war period should also be brought into the light about when, how and where they suffered the most at times. This uneasy life of people after the war was represented by a character named Septimus Warren Smith from the novel *Mrs. Dalloway*. *Mrs Dalloway* is a war novel that reveals how the consternation and overwhelming grief of the war adversely affected every aspect of post war life. The novel makes its own contribution to the proliferation and memorization of war and military strategy.

Septimus Warren Smith is a veteran of the great war. He leads an uneasy life, because war has made him numb. He removed himself from the physical world, perhaps he believes that outside words will injure him. He kept himself away from the outside world and remained in the internal world that was made by his own. Sometimes he tries to overcome the internal world and enjoy the beauty of the outer world but the state of constant fear never lets him do that. He considered that people are monsters who are always trying to hurt him. This is a kind of fear that people had after the World War because they had a constant fear. Many of them are mentally broken people started to fall into many kinds of mental issues most of the soldiers were diagnosed by shell shock. Septimus offers a contrast between the constant struggle of working-class people and blind brutality and unkindness of war. He went to war to prove himself a man because he faced constant failure in his career. He lost his friend events during the war that made him more depressed he led a sexual kind of feelings to events then a normal friendship. Because of that he felt it was very difficult to overcome the emotional feelings that he was suffering from that war. He strongly believed himself that the people have no capacity for kindness and humanity. He suppressed all his

feelings, emotions, fear and they last took into the form of shell shock. The people who were not part of the war also suffered because of losing their loved ones. Here he represents both civilians as non-civilians. War can actually be said to be a total brutality that makes the mind of the people to a psychotic turbulent state.

Nineteenth and twentieth century was marked by the horrors and devastation of war. Soldiers or veterans in the war faced different kinds of psychological disorders. One of the prominent one is shell-shock and PTSD, hysteria etc. This century has seen usher in hiking of disorder level. Through applying the trauma theory, it is evident that the people are going through psychotic trauma for example the character Septimus portrayed as the epitome of psychological chaos. Even though Clarissa is affected by the trauma she consciously avoids the feeling by suppressing the actual feeling. She has no connection with veterans who died in the war. The lack of communication with the dead people in the war. She has no sentiments for others, she barely acknowledged the effect of the death of people. She also constantly has the tendency to do suicide. But she suppressed her feelings and partied at home. But the death of Septimus created her mind turbulent by questioning her existence.

The most highlighted thing in this era is this generation is not aware of the mental health issue. The affected persons are struggling to communicate the repressed feeling to others. But unaware about the mental trauma they take it as simple. In Septimus' case he is under treatment, even though he didn't have any kind of cure.

Septimus went to war in order to protect his own country. He didn't do not give any importance to the after effects and consequences. He was ready for the battle but he failed and lost his dear one. If Clarissa is simply surrendering under the incompatibility, Septimus

tried hard in the battle and then failed. Reactions of both about their life are similar, even though Septimus's is wider and more intense. Their issues are fitting in the aspects of gender roles too. The image of rational men and emotional women gets questioned in the novel.

Judith Herman (1992) states that "traumatic events destroy the victim's fundamental assumptions about the safety of the world; positive value of self, and the meaningful order of creation "

(Herman 5).

Once a person was victimized by this, illogical thoughts or cognitive biases seem to dominate thinking. Victimized persons are more prone towards illogical thinking and non-practical activities. These kinds of people have automatic thinking. The person who has a negative automatic thinking process becomes depressed one. Therefore, victimized persons show these kinds of symptoms towards depression. They fail to find happiness in everyday life. There are people who always run away from fraternization and remain in solitude. These dysfunctional thoughts lead to extreme emotions which lead to exhibit high maladaptive behaviors. Which slowly leads to death in the end. This is how the character Septimus in the novel did suicide in the end of the novel by throwing self out of the window. This shows the darkest phase of traumatic events. These all are examples of increased traumatic life and reality of war in the post-war period.

Conclusion

Mrs. Dalloway is a classical novel in the Victorian ideal written by Virginia Woolf . It is also known as one of the best novels in the career of Virginia woolf. It examines a day in the life of Clarissa Dalloway an upper class non civilian woman and Septimus Warren Smith a veteran in world war 1. This novel is known as the classical example of stream of consciousness . This novel is the celebration of life and death. On the other surface this novel can be said to be a war novel where Virginia Woolf tries to explore the aftermath of war. Not only socially, financially the country bursted out after the war , but also mentally. The character named Septimus shows wide ranges of mental illness that can be the after effect of the great war.

As we saw earlier the aim of the project is to understand the after effects of the great war and especially how it affected the mental health of the people through analyzing the text in war perspective with the help of trauma theory . Septimus portrays the fine line of brutality and suffering . He is a person who stood for the country. But the country itself made him numb by the adverse effect of war and death of his friend Evans. Life after the war was burdened by fear, anxiety and depression. He eliminates himself from the otherworld as a protection for himself. Because he believed that the outer world would hurt him and erase the rest of his humanity. Not only Septimus, every character shows the imbalanced life after the war. Trauma theory helps to understand the symptoms that these characters are going through and how it will contribute to the aftermath of the great war. Through analysis the past events that Septimus comes through and death of the loved ones and mental outburst after that were the fine symptoms of depression. He constantly have the tendency to commit

suicide. Unfortunately we can see at the end of the novel that he commit suicide as an escape from the life and death made his life even beautiful.

Therefore it is clear that life in the postwar period was not easy. Many people are strangled by mental breakdowns. Some of them are aware and many of them are not. Even though Clarissa was aware of the trauma she consciously suppressed. Worldwide war came to an end but led a life equal to war after the end of the war also. By applying the trauma theory to the characters it was clear that they represent the psychotic chaos of the people in the post war period . There is no difference between civilians and non-civilians in the war

. Both parties have passed through the brutality of the great war.

Therefore it is clear that by taking the text *Mrs.Dalloway* as a classic example to show how the war sowed the seed of destruction in the mind and life of people. And how people live a life alienating themselves from the outer world. The story goes on another way but Woolf overlaps the theme of war with every character throughout the text in order to show how the war made an impact on the life of people . By analyzing the context with the trauma theory it untangles the evidence of how the war made an impact on people and made people psychologically unstable.

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Project Report

On

**AIR POLLUTION VARIATION DUE TO
LOCKDOWN IN KOCHI**

Submitted

in partial fulfilment of the requirements for the degree of

BACHELOR OF SCIENCE

in

MATHEMATICS

by

P.I ABNA MEHDI

(AB19AMAT058)

Under the Supervision of

DR. SUSAN MATHEW PANAKKAL



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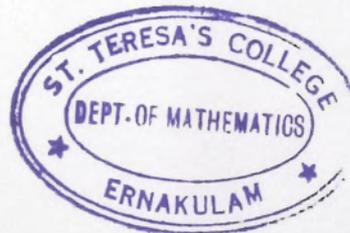
CERTIFICATE

This is to certify that the dissertation entitled, **AIR POLLUTION VARIATION DUE TO LOCKDOWN IN KOCHI** is a bonafide record of the work done by Ms. **P.I ABNA MEHDI** under my guidance as partial fulfillment of the award of the degree of **Bachelor of Science in Mathematics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

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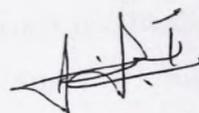
2:

DECLARATION

I hereby declare that the work presented in this project is based on the original work done by me under the guidance of Dr Susan Mathew Panakkal, Assistant Professor, Department of Mathematics, St. Teresa's College(Autonomous), Ernakulam and has not been included in any other project submitted previously for the award of any degree.

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Date: 4-03-2022

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AB19AMAT058

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Chapter 1

Introduction

1.1 Air Pollution

Air pollution is one of the major environmental problems all over the world, which affects human health, vegetation, materials, and ecosystems as a whole. Air pollution is caused due to a mixture of solid particles and molecules in the air, called *air pollutants*. It is caused by people, taking the form of emissions from factories, cars, aerosol cans, secondhand cigarette smoke, etc. The combined effects of outdoor and household air pollution cause millions of premature deaths every year, largely because of increased mortality from stroke, heart disease, chronic obstructive pulmonary disease, lung cancer, and acute respiratory infections.

Rapid urbanization, industrialization, vehicular growth, and population growth are responsible for the increase in Air pollution. According to the World Health Organization (WHO), each year air pollution is responsible for the death of seven million around the globe. India is the second most populated country . In order to meet the demands of the Increasing population, industries have increased their production leading to a higher amount of pollution. WHO has suggested India reduce its pollution by 15% every year.

1.2 Air Pollution in Ernakulam District

Kerala's most polluted cities include Kochi and Thiruvananthapuram. Since these cities are highly populated the amount of pollution in these cities is very high. The number of vehicles running on the roads of these cities and various factories contributing majorly to the pollution.

Some of the major factories contributing to air pollution in the Ernakulam district include

1. Eloor FACT
2. Hindalco Alupuram factory & works
3. Hindalco Industries Limited
4. Cochin Petromins factory
5. Hindustan Insecticide Limited
6. Cochin Chemical Industries etc.

1.2.1 Newspaper Article

Our motive for selecting this topic is this [Newspaper article](#) that was published in Hindustan Times, New Delhi by Trisha Sengupta on 4th April 2020. This article pointed out that the residents of Jalandhar, Punjab woke up to the sight of a mountain range peeking from behind the clouds. The only thing is that this mountain range is not located in the land of five rivers but is over 200 km away from the state of Punjab. What people saw from Jalandhar is the mighty Dhauladhar range in Himachal Pradesh. People who shared the images of the incredible sight claimed that the incident took place almost after 30 years. The mighty Dhauladhar range was visible due to the reduction in air pollution during the lockdown period.



1.2.2 Objective

To study the variation in air pollution due to lockdown. The target is to find the difference in air pollution before and during Lockdown. We find declines in the population-weighted concentration of 5 pollutant parameters - Nitrogen dioxide [NO_2], Sulphur dioxide [SO_2] PM 2.5 (Particulate Matter of 2.5 units diameter) , PM 10 (Particulate Matter of 10 units diameter) , Carbon monoxide [CO] . Our goal is to show the difference in the amount of air pollution in Kochi.

1.2.3 Literature Review

There is a lot of research that has been done to evaluate the ambient air quality of various places in Kerala and hence we found out in order to show the intensity of air pollution in those places. A case study of Kerala by using air quality index [2017] on 24 hours basis by Jyothis N, Kishan Kartha, Divesh, Adarsh Mohan, Jithin Pai, Geena Prasad reported that the industrial and residential areas of Ernakulam district have the highest air quality index and Kollam has the lowest air quality index among all the six areas studied, [2017], air quality is determined by the particular matter [PM10] concentration.

1.2.4 Prerequisite Knowledge

Data Collection

We have used secondary data in our project. Secondary data is the data collected by another person other than the primary user. Examples of secondary data include government records, census, journals, etc.

The secondary data we have used is a government publication. We have collected the data from the *Central Pollution Control Board* 's [CPCB] official website.

The Central Pollution Control Board has several stations across all states in India. Since our study is concentrated in the Ernakulam district, we have chosen the Central Pollution Control boards station in Kacheripady in Ernakulam. There are two more stations in Ernakulam, one in Vytilla and the other in Eloor.

The concentration of each pollutant is collected on a 24 hour basis in the Central Pollution Control Board's official website.

Statistical Interference

Statistical inference is the process of drawing conclusions about an underlying population based on a sample or subset of the data. Testing of hypotheses basically deals with choosing an appropriate test statistic and dividing its range of variation into acceptance and rejection regions based on the significance level. The significance level is the probability of rejecting the null hypothesis when it is true denoted by alpha (α). We have chosen the significance level to be 5% or 0.05.

Chapter 2

Definitions and Terminologies

2.1 Air Pollutants

Air pollutants are hazardous and toxic substances released from factories, smoke, etc present in the air that causes air pollution.

There are different types of air pollutants, such as gases (including Ammonia, Carbon monoxide, Sulfur dioxide, Nitrous oxides, Methane, Carbon dioxide, and Chlorofluorocarbons), particulates (both organic and inorganic), and biological molecules.

Since it is not practical to study all the pollutants, we have studied the variation in the population-weighted concentration of 5 major pollutants namely:

1. PM 2.5
2. PM 10
3. SO_2
4. NO_2
5. CO

PM 2.5

Particulate matter of 2.5 units diameter contains microscopic particles and liquid droplets which when inhaled causes health issues like shortness of breath as these particles are able to travel directly into the lungs, eye irritation, nose irritation, etc. They are emitted directly from sources like unpaved roads, construction sites, fields, or fires.

PM 10

Particulate matter of 10 units diameter contains solid or liquid particles which are very small and hence PM 10 particles effectively act as gas. Continuous exposure to PM 10 causes serious health issues like asthma, high blood pressure, bronchitis, etc.

SO₂

Sulfur dioxide is an air pollutant in gaseous form that is formed by the reaction between sulfur and oxygen. It is formed when fossil fuels like coal or diesel are burned. Continued exposure at high levels reduces the working capacity of the lungs.

NO₂

Nitrogen dioxide is also a gaseous pollutant that consists of nitrogen and oxygen. It is formed when fossil fuels like oil, coal, or diesel are burned at high temperatures. Continuous exposure to *NO₂* causes serious health issues like asthma attacks.

CO

Carbon monoxide is produced mainly by vehicles and is very toxic. Continuous exposure to CO causes headaches, nausea, vomiting, etc.

2.1.1 Air Quality Index

The air quality index (AQI) is the measure of the amount of air pollutant in the atmosphere. The value of AQI lets us understand how much it can affect human's health. The higher the AQI value, the greater the level of air pollution and the greater the health concerns. Since the AQI value is an index there are six categories which can be broadly classified into Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. Each category corresponds to a different level of health concern. AQI value is calculated for major pollutants namely :

1. Ground-level Ozone
2. Particle Pollution (also known as particulate matter, including PM 2.5 and PM 10)
3. Carbon monoxide
4. Sulfur dioxide
5. Nitrogen dioxide

Chapter 3

Data Analysis

3.1 AQI Calculations

The AQI can be calculated in two ways - manually and by using an online AQI calculator. AQI values are usually measured on a 500-point scale, which consists of 6 divisions.

1. Good(0-50)
2. Satisfactory(51-100)
3. Moderately polluted (101-200)
4. Poor (201-300)
5. Very Poor (301-400)
6. Severe (401-500),

wherein rating between 0 and 50 is considered good. Rating between 301 to 500 range is severe.

The equation for computing AQI :

$$I = \frac{(I_{high}) - (I_{low})}{(C_{high}) - (C_{low})} \times (C - C_{low}) + (I_{low})$$

AQI Category	AQI	Concentration range*							
		PM ₁₀	PM _{2.5}	NO ₂	O ₃	CO	SO ₂	NH ₃	Pb
Good	0 - 50	0 - 50	0 - 30	0 - 40	0 - 50	0 - 1.0	0 - 40	0 - 200	0 - 0.5
Satisfactory	51 - 100	51 - 100	31 - 60	41 - 80	51 - 100	1.1 - 2.0	41 - 80	201 - 400	0.5 - 1.0
Moderately polluted	101 - 200	101 - 250	61 - 90	81 - 180	101 - 168	2.1 - 10	81 - 380	401 - 800	1.1 - 2.0
Poor	201 - 300	251 - 350	91 - 120	181 - 280	169 - 208	10 - 17	381 - 800	801 - 1200	2.1 - 3.0
Very poor	301 - 400	351 - 430	121 - 250	281 - 400	209 - 748*	17 - 34	801 - 1600	1200 - 1800	3.1 - 3.5
Severe	401 - 500	430 - 500	250+	400+	748+*	34+	1600+	1800+	3.5+

* CO in mg/m³ and other pollutants in µg/m³; 2h-hourly average values for PM₁₀, PM_{2.5}, NO₂, SO₂, NH₃, and Pb, and 8-hourly values for CO and O₃.

Example :

Suppose a value of PM 2.5 of concentration 41.23 micrograms per cubic meter. Then the AQI is calculated using the AQI Formula rounds to 115, and corresponds to the "UNHEALTHY FOR SENSITIVE GROUPS" range.

3.1.1 Z-Test

Z-test is a statistical test to determine whether two population mean are different when the variance is unknown and the sample size is large. It is a hypothesis test that follows *anormal distribution*.

We have done testing of equality of means of two samples. We chose this test because our sample size is large (>30). We have considered two samples, one the period before lockdown and the other sample is the period during the lockdown. The first phase of lockdown was from 23 March 2020 to 17 May 2020 and the second phase was from 8 May 2021 to 9 June 2021 which adds up to a total of 89 days. This period of 89 days has been considered as during the lockdown period (sample 1). We have considered an equivalent number of days before lockdown and this period has been taken as the before lockdown period (sample 2). Here

$$n_1 = 89, n_2 = 89$$

Z -Test: For Two-Sample Mean:

$$Z = \frac{(\bar{x}_1 - \bar{x}_2)}{\left(\sqrt{\left(\frac{s_1^2}{n_1}\right) + \left(\frac{s_2^2}{n_2}\right)}\right)}$$

(\bar{x}_1) -Mean of the sample before lockdown

(\bar{x}_2) -Mean of the sample during lockdown

s_1 - Standard Deviation before lockdown

s_2 - Standard Deviation during lockdown

n_1, n_2 - Sample Size

3.1.2 PM 2.5

Null Hypothesis H_0 : There is no variation in the concentration of PM 2.5 before and during the lockdown.

$$H_0 : \mu_1 = \mu_2$$

Alternative Hypothesis H_1 : The concentration of PM 2.5 has reduced during the lockdown.

$$H_1 : \mu_1 > \mu_2$$

	BEFORE LOCKDOWN	DURING LOCKDOWN
Mean	39.53574713	14.84356322
Known Variance	163.4295712	45.31769995
Observations	87	87
Hypothesized Mean Difference	0	
z	15.94074908	
z Critical one tail	1.644853627	
z Critical two tail	1.959963985	

OBSERVATIONS
$\alpha = 0.05$
$z = 15.9407490843669$
$z \alpha = 1.65$

RESULTS
Since $z > z\alpha$, we reject H_0 .
Hence, the concentration of PM 2.5 has reduced during lockdown.

3.1.3 PM 10

Null Hypothesis H_0 : There is no variation in the concentration of PM 10 before and during the lockdown.

$$H_0 : \mu_1 = \mu_2$$

Alternative Hypothesis H_1 :The concentration of PM 10 has reduced during the lockdown.

$$H_1 : \mu_1 > \mu_2$$

	BEFORE LOCKDOWN	DURING LOCKDOWN
Mean	69.42574713	33.29045977
Known Variance	295.7989	148.8987
Observations	87	87
Hypothesized Mean Difference	0	
z	15.94074908	
z Critical one-tail	1.644853627	
z Critical two-tail	1.959963985	

OBSERVATIONS
$\alpha = 0.05$
$z = 15.9830164407676$
$z \alpha = 1.65$

RESULTS
Since $z > z\alpha$, we reject H_0 .
Hence, the concentration of PM 10 has reduced during lockdown.

3.1.4 NO_2

Null Hypothesis H_0 : There is no variation in the concentration of NO_2 before and during the lockdown.

$$H_0 : \mu_1 = \mu_2$$

Alternative Hypothesis H_1 : The concentration of NO_2 has reduced during the lockdown.

$$H_1 : \mu_1 > \mu_2$$

	BEFORE LOCKDOWN	DURING LOCKDOWN
Mean	5.006190476	2.732222222
Known Variance	23.60916	0.880134
Observations	63	63
Hypothesized Mean Difference	0	
z	3.647258454	
z Critical one-tail	1.644853627	
z Critical two-tail	1.959963985	

OBSERVATIONS
$\alpha = 0.05$
$z = 3.647258454$
$z_{\alpha} = 1.65$

RESULTS
Since $z > z_{\alpha}$, we reject H_0 .
Hence, the concentration of NO_2 has reduced during lockdown.

3.1.5 SO_2

Null Hypothesis H_0 : There is no variation in the concentration of SO_2 before and during the lockdown.

$$H_0 : \mu_1 = \mu_2$$

Alternative Hypothesis H_1 : The concentration of SO_2 has reduced during the lockdown.

$$H_1 : \mu_1 > \mu_2$$

	BEFORE LOCKDOWN	DURING LOCKDOWN
Mean	3.622183908	4.973563218
Known Variance	1.906027	8.46366
Observations	87	87
Hypothesized Mean Difference	0	
z	-3.914299641	
z Critical one-tail	1.644853627	
z Critical two-tail	1.959963985	

OBSERVATIONS
$\alpha = 0.05$
$z = -3.91429964106938$
$z\alpha = 1.65$

RESULTS
Since $z < z\alpha$, we accept H_0 .
Hence, there is no variation in the concentration of SO_2

3.1.6 CO

Null Hypothesis H_0 : There is no variation in the concentration of CO before and during the lockdown.

Alternative Hypothesis H_1 : The concentration of CO has reduced during the lockdown.

$$H_1 : \mu_1 > \mu_2$$

	BEFORE LOCKDOWN	DURING LOCKDOWN
Mean	1.299655172	1.176091954
Known Variance	0.152315	0.231294
Observations	87	87
Hypothesized Mean Difference	0	
z	1.860820338	
z Critical one-tail	1.644853627	
z Critical two-tail	1.959963985	

OBSERVATIONS
$\alpha = 0.05$
$z = 1.86082033794505$
$z\alpha = 1.65$

RESULTS
Since $z > z\alpha$, we reject H_0 .
Hence, the concentration of CO has reduced during lockdown.

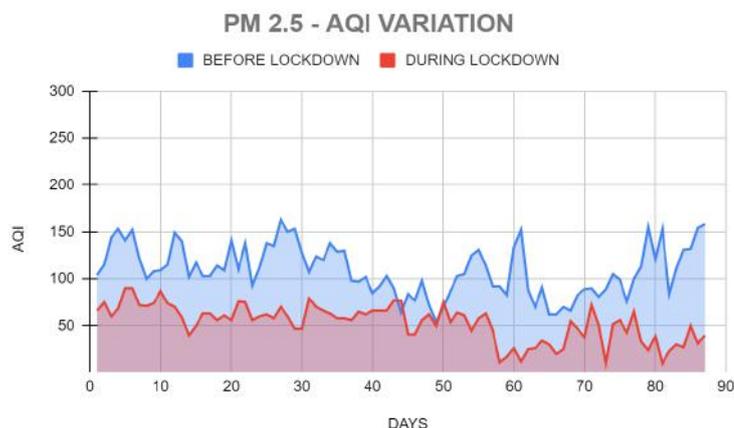
Chapter 4

Graphical Representation

We have not considered AQI values for the z test since AQI is an index, we have represented the variation in AQI values diagrammatically using Area graphs. The AQI values are represented on the y axis and days are represented on the x-axis. We have plotted graphs separately to show the variation in the concentration of the 5 pollutants we have considered before and during the lockdown. Finally, we have also plotted the overall variation in the concentration of all pollutants before and during the lockdown.

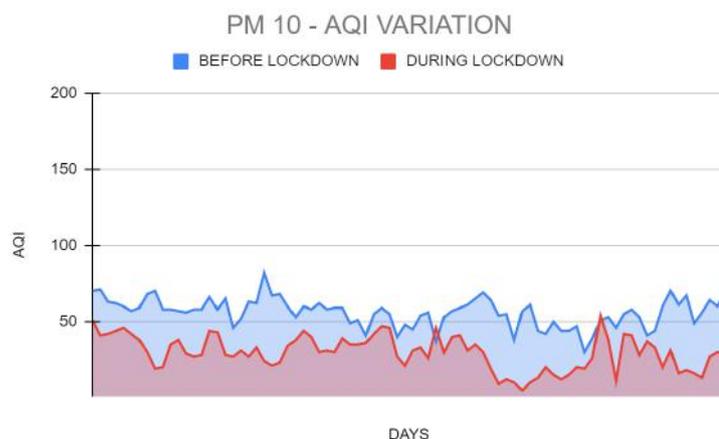
4.0.1 Variations in PM 2.5

Variations in PM 2.5. We took 87 days both before and during lockdown to check whether PM 2.5 is decreased or increased in lockdown. In general, a decrease in PM 2.5 can be observed across during lockdown. The amount of PM 2.5 was increased before lockdown .In which the level of PM 2.5 is varying between $(50 - 100)\frac{g}{m^3}$, $(100 - 150)\frac{g}{m^3}$, $(150 - 200)\frac{g}{m^3}$ in before lockdown. During lockdown load the value of PM 2.5 varying between $(0 - 50)\frac{g}{m^3}$ and $(50 - 100)\frac{g}{m^3}$. However, it has been noted that the value of PM 2.5 has been reduced by 34.75% .



4.0.2 Variations in PM 10

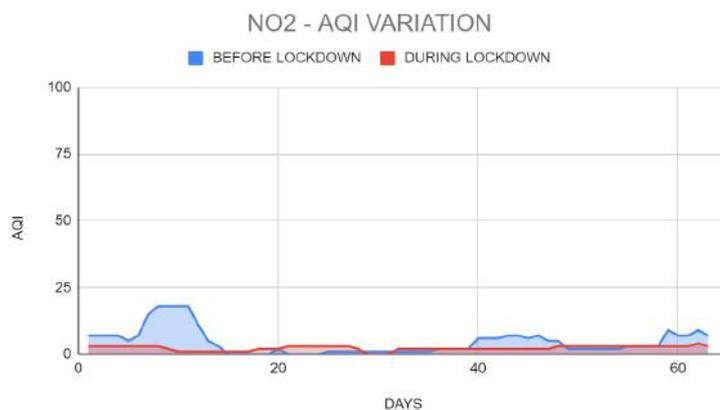
The variation in PM 10. A decrease in PM 10 was observed during the lockdown. This could be due to the decrease in usage of vehicles and the reduction in industrial production .where the level of value of PM 10 between $(0 - 50) \frac{g}{m^3}$, $(50 - 10) \frac{g}{m^3}$, before lockdown. The concentration PM 10 during lockdown is between $(0 - 50) \frac{g}{m^3}$. Hence the amount of PM 10 has been reduced during lockdown by 30.74%.



4.0.3 Variations in NO_2

NO_2 variation before and during lockdown is depicted in figure 3. NO_2 is emitted from fossil fuels like petroleum and diesel and petrol and biogenic sources like soil and lightening, pyrogenic sources like natural fires. NO_2 controls the formation of O_3 where the level of value of NO_2

is between $(0 - 50) \frac{g}{m^3}$ before lockdown. During the lockdown, the level of value of NO_2 is between $(0 - 25) \frac{g}{m^3}$. However, the value of NO_2 has been reduced by 40% in during the lockdown.



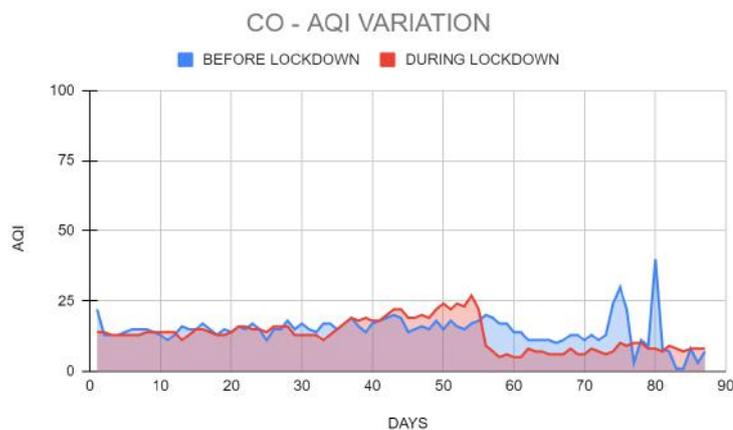
4.0.4 Variations in SO_2

The variation in SO_2 before and during lockdown is shown in figure 4. The primary source of SO_2 is the combustion of sulfur-containing fuels, ie, coals, and diesel used in thermal power plants, industries, and transport. SO_2 can also be sourced from volcanic eruptions and wildfires. The level of value of SO_2 is between $(0 - 25) \frac{g}{m^3}$. During the lockdown, the level of value of SO_2 is also between the range of $(0 - 25) \frac{g}{m^3}$. There is an increase in the value of SO_2 during lockdown by 0.27%.

4.0.5 Variations in CO

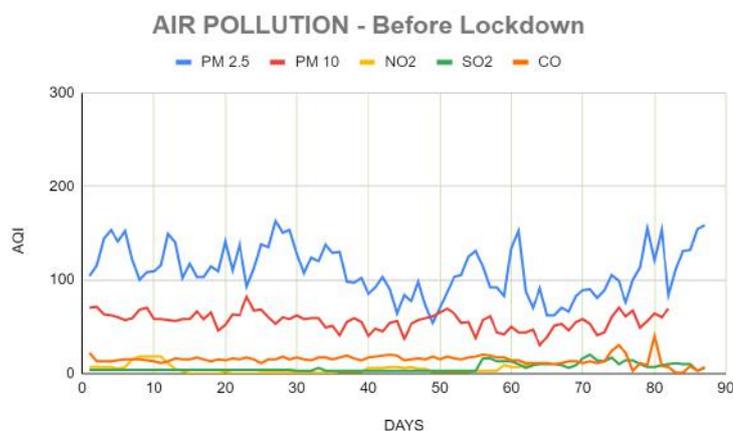
Variation of carbon monoxide is shown in figure 5. CO is mostly emitted from vehicular sources. However, other sources include forest fires agricultural waste burning, bio fuel burning, oxidation of hydrocarbons, and combustion of Fossil fuels. A higher concentration of CO is observed before lockdown. $(25-50) \text{ mg}/m^3$. The level of value of CO before lockdown is $(0-25) \text{ mg}/m^3$ and $(25-50) \text{ mg}/m^3$. And the level of CO during lockdown $(25-50) \text{ mg}/m^3$. Both before and during lockdown

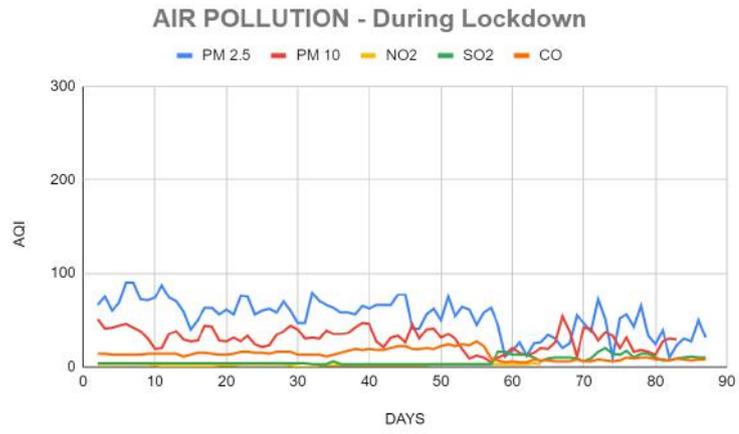
value of CO is poor. Hence the value of CO has been reduced by 5.72 %.



4.0.6 Overall Variations- Before and During lockdown

The variation of all pollutants is shown in figure 6,7. we took 87 days both before and during the lockdown. However, the value of the concentration of all pollutants is reduced during lockdown except SO_2 . SO_2 had an increase during the lockdown. The value of the concentration of all pollutants is greater than that during the lockdown. Hence air pollution was reduced during the lockdown.





Chapter 5

Conclusion

Data was collected from the Central Pollution Control Board's official website for before and during lockdown periods to estimate if there is variation in the concentrations of 5 major pollutants.

We arrived at conclusions based on the z test for two-sample mean and graphical representation of AQI values for each pollutant.

5.0.1 Z-Test

Based on the z test we concluded that the concentration of PM 2.5, PM 10, NO_2 , and CO has decreased during the lockdown. There has been no variation in the concentration of SO_2 during the lockdown.

5.0.2 AQI Graph

Based on the graphs we plotted we concluded that the concentration of PM 2.5, PM 10, NO_2 , and CO has decreased during the lockdown period. There has been a slight increase in the concentration of SO_2 during the lockdown.

Lockdown has resulted in improvements in air quality in Kochi to some

extend. The results obtained from this study gives an insight into the betterment of air quality.

The government of Kerala has introduced the e-mobility project to reduce air pollution. According to this scheme subsidies and incentives are provided for purchase and manufacture of electric vehicles to reduce pollution and switch to green transportation.

Chapter 6

Case-study Comparison

Diurnal and temporal changes in air pollution during COVID-19 strict lockdown over different regions of India” study looked at the temporal and diurnal changes of the six criteria air pollutants, including PM 2.5, PM 10, NO_2 , O_3 , CO, and SO_2 during lockdown (25th March - 3rd May 2020) over various regions of India using the observations from 134 real-time monitoring sites of Central Pollution Control Board (CPCB).

The study selected four regions namely, Indo Gangetic Plain, Central India, South India, northwest India representing a significant reduction has been found in PM 2.5, PM 10, NO_2 , and CO , all the regions during the lockdown.

The identification of commonalities across a range of AQI in the Southern region as Kochi is a part of South India was the purpose of this comparison. The AQI values of the study were similar to our study. We tabulated the results to clearly depict the similarities.

POLLUTANTS	CASE STUDY RESULTS	OUR RESULTS
PM 2.5	40-60% reduction in concentration	34 .75% reduction in concentration
PM 10	40-60 %reduction in concentration	30 .47 % reduction in concentration
NO_2	30-70% reduction in concentration	40% reduction in concentration
SO_2	mixed behavior with slight increase at some sites	0.027% increase in concentration
CO	Same levels during the lockdown	5.72 %reduction in concentration

From the table, we analyze that the reduction in Particulate Matter 2.5, 10 of

Kochi does not lie between the range of South India. Whereas, NO_2 lies in the range of South India. SO_2 has been increased as it has been mentioned. When the South India range of CO hasn't changed there was a minimum reduction in Kochi.

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CERTIFICATE

This is to certify that the dissertation entitled, **AIR POLLUTION VARIATION DUE TO LOCKDOWN IN KOCHI** is a bonafide record of the work done by Ms. **P.I ABNA MEHDI** under my guidance as partial fulfillment of the award of the degree of **Bachelor of Science in Mathematics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

Date: 4-03-2022
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PROJECT REPORT
YOUNG ADULTS ATTITUDE TOWARDS GENDER ROLES IN
NIGERIA AND SOUTH INDIA

Submitted By:

ABRAHAM FAVOUR ISRAEL

Register No:

SB19PSY001

Under the guidance of

MRS. BINDU JOHN

In partial fulfilment of the requirement for award of the degree of

B.SC PSYCHOLOGY



ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

Nationally Re-credited at 'A++' level (4th cycle)

Affiliated to: Mahatma Gandhi University

MARCH 2022

CERTIFICATE

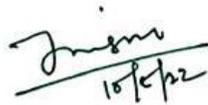
This is to certify that the project report entitled, “YOUNG ADULTS ATTITUDE TOWARDS GENDER ROLES IN NIGERIA AND SOUTH INDIA” is a bonafide record submitted by MS. ABRAHAM FAVOUR ISRAEL Reg.no: SB19PSY001 in partial fulfilment of the requirements for the award of the Degree of Bachelor of Psychology during the academic year 2019-2022.



Mrs. Bindu John
Head of the Department
Department of Psychology
St. Teresa's College, Ernakulam



External Examiner:

A handwritten signature in black ink, followed by the date "10/1/22" written below it.

DECLARATION

I, Abraham Favour Israel hereby declare that the study presented in this dissertation entitled, “Young adults attitudes towards gender roles in Nigeria and South India “A study on which is submitted to the Department of Psychology, St. Teresa’s College, Ernakulam is a bonafide record of the research work carried out by me, under the supervision and guidance of Mrs. Bindu John, Assistant Professor and Head of Department, Department of Psychology, St. Teresa’s College, Ernakulam, in partial fulfilment of the requirements for the degree of Bachelor of Science in Psychology and has not previously formed the basis for the award of any degree, diploma, fellowship, title or recognition before.

Place: Ernakulam

Abraham Favour Israel

Date:

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In successfully completing this project report, many people have helped me. I would like to thank all those who are related to this project.

Primarily, I would like to Thank God Almighty for the grace and blessings he has embedded in me which have helped me in completing this project successfully.

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Thanking You

Abraham Favour Israel

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CHAPTER ONE

INTRODUCTION

INTRODUCTION

Society (this was first coined in French as Societe, which means a company, later taken in Latin terms as societas, which means an interaction or bond between parties that are friendly.) refers to a part of a unit that is distinguishable by particular aims or standards of living or conduct (Merriam-Webster dictionary, 2021.) Society can also be seen as a group of people who live together in the same geographical area or share the same belief system. The term "society" has evolved in different ways and has been explained by different philosophers and sociologists, trying to explain how moral behaviour and social interaction emerge. Moral behaviour is those behaviours that are seen to be acceptable by society, and they work according to society's norms and rules. Society makes rules and norms that guide moral behaviour and also play a role in differentiating the two genders (male and female).

Gender roles originate from society. It is a set of societal norms that have been passed down from different generations. It consists of those norms that differentiate femininity and masculinity and the set of roles that they can act in. (Lumenlearning, 2022) Gender roles in the current scenario have changed from the traditional roles which were set by society such that women could not do men's work to a more egalitarian set role that grants rights to every human being.

Gender roles are practiced in families, institutions, societies, cultures, and religions, being that people are brought up in this manner, they tend to build their self-concept through these norms and rules which guide them on what to do and not do. Parents are key role players in gender role perception. They differentiate a male child from a female child through the type and colour of clothes and toys. Then they distinguish the children by giving them a set of tasks and responsibilities according to their gender. *In most cultures, male children are given fieldwork activities while the female child is given the kitchen work responsibilities. There are also stereotypes being told to male children that boys are not supposed to cry and it's only the female child who is supposed to do so.*

Perception refers to the way sensory information is processed and interpreted (lumenlearning, 2022). Perception of the social norms and roles develops in a child around their 2-5 years.

(healthychildren , 2018) They learn the difference between different genders and can classify themselves among those genders which could clearly be seen in Sigmund Freud's psychosexual stages.

1.1 BACKGROUND OF THE STUDY

The topic "Young adults attitudes towards gender roles in Nigeria and South India" was chosen for cross-cultural research in order to examine how young adults in different societies, rules, norms, cultures, and geographical locations perceive gender roles, and to measure how roles have evolved in different societies either toward egalitarian types or still in traditional roles. Gender role study brings empirical data and resources on how social norms are structured and practiced. The empirical data will act as a theoretical basis for how societal norms will be studied and how practices are followed.

1.2 NEED AND SIGNIFICANCE OF THE STUDY

There is evidence that gender role perception leads to stereotypes. These stereotypes result in overt negative activities toward the group of people the stereotype is against. Individuals' perceptions of gender roles matter in how they will act toward an individual that falls within these schemas. Schemas are those cognitive frameworks an individual forms by using cognitive processes such as perception and interpretation, schemas about gender roles are formed and developed via societal norms. Measuring how society has influenced society is one way of controlling gender stereotypes, which will reduce the glass ceiling effects and gender inequality.

1.3 STATEMENT OF THE PROBLEM

Gender refers to the characteristics of women, men, girls, and boys that are socially constructed. This includes norms, behaviours, and roles associated with being a woman, man, girl, or boy, as well as relationships with each other. As a social construct, gender varies from society to society and can change over time.(WHO 2002).

Traditionally, in the early days, the roles set for both men and women in terms of jobs or task setting were that women were given household tasks and shelter for the family, while men were granted tasks that involved outdoor performances.

In certain states in Nigeria, the traditional norms were that women were meant to work at home, taking care of the family. They were not allowed to own farmlands, but they were meant to work on them. They were trained to become housewives, and because the educational system in Nigeria did not favour women, they were made to stay at home while the male children attended schools and acquired formal education. The traditional norms and roles in Nigeria favour the patriarchal system and reduce the chance for women to establish themselves. The roles keep evolving slowly. Women were gradually allowed to become petty traders, and they started taking up the role to provide for their families when men found it difficult to make the necessary provision. After Nigeria's independence in 1960, a system of compulsory education for girls was formally established, which has helped in transforming gender roles from traditional to egalitarian.

In India, the traditional norms were that women were supposed to stay at home and take care of the family. They were not granted freedom of speech or freedom of movement. They were trained to perform tasks and activities in preparation for their marriage. The societal norm favoured the male child more than the female child. The fathers were the ones that controlled every activity in the family. During the 1950s, the roles gradually changed to be egalitarian. Female children were now allowed to work in offices and share the same job context as their male counterparts. Family roles are shared between the male and female, such as kitchen tasks.

The research topic was chosen in order to understand how young adults view gender roles in Nigeria and India with reference to the present gender roles in their society. The topic was chosen in order to identify the different attitudes young adults have toward their own gender roles in their society and in order to see and evaluate if the young adults are being influenced by the traditional or the egalitarian gender roles in their society.

1.4 OBJECTIVE OF THE STUDY

1. To find the gender difference in attitude of young adults towards gender roles
2. To explore the cultural differences in attitude of young adults towards gender roles

1.5SCOPE OF THE STUDY

The study is focused on the attitudes of young adults between the ages of 18 to 25 towards gender roles in society, specifically their perceptions, ideas, beliefs, and thoughts towards the roles of women in society. The comparative study investigates the cultural differences and similarities in the attitudes of the young adult population, in both Indian and Nigerian cultures.

1.6LIMITATIONS OF THE STUDY

The study is subjected to certain limitations, which will be explained here.

1. The data was collected through a digital questionnaire using Google Forms. Therefore, it is subjected to insincerity on the part of the participants due to their mood, personality, boredom, etc.
2. The process of data collection was restricted due to time constraints.
3. The sample of the study is limited to people with higher-level educational qualifications

CHAPTER TWO
REVIEW OF LITERATURE

LITERATURE REVIEW

Eccles, Jacobs & Harold (1990) analysed the role that parents play in influencing their children to engage in gender role stereotyped activities. This article puts forward that parents distort the perceptions of their own children, the parents make them perform only those activities which are attributed to gender role specific activities. This eventually affects the child's self perceptions and choices.

In a different study, Shameer (2021) closely examined the existence of potential correlation between parent's gender role attitude (GRA) and that of their children. The study found that the parent's gender role attitude played a significant role in the GRA of their children.

While examining how gender role attitudes emerged and how they are a cause of conflict, Marks, Bun & McHale (2009) found that particular gender role attitude is because of family pattern which is caused by socioeconomic status, the parents who were brought up in an environment with gendered household and tasks, in turn carried it on to their children. The gender role patterns identified were egalitarian parents and children, traditional parents and children, and divergent thinking. Most family conflicts happen in a traditional family.

Ram , Gaur & Strohschein (2014) conducted a study on gender socialization to examine the difference between male and female youth in India and its association with mental health. The result of this study revealed that females experienced more mental health issues than male when they were made to engage in household practices that favoured male. Family violence and restrictions to independence were associated with mental health problems for both male and female youth.

In another study focused on mental health of women in India on the basis of various aspects from the society like physiological, family, socio-economic, culture and media, Vajpayee and Makkar (2014) found that there is strong stigma on the gender role of women. They are expected to be in a particular way that society expects them to be. All of the above mentioned factors have a negative influence on a woman's mental well being.

In 2012, Hren conducted a study to determine how the career decisions of women get affected with perceived gender roles throughout their childhood and early adulthood, especially in science-related career fields. The study was based on the connection between gender roles and career decisions through the three areas which were support, opportunities, postmodern feminism. The result of the study shows that support is received from family and, near and dear ones as well as they do get opportunities but not always a positive experience is received.

Atli (2017) study focused on the gender role perception of high school students in various professions. The findings of the study demonstrated that students perceived certain genders for certain professions such as nurses for women, engineers and policemen for men, and doctors, lawyers, psychologists etc neutrally for both genders. It emphasizes the importance of giving awareness to students on gender role perception.

Kumari & Joshi (2015) conducted a study with the objective of finding out the perception of adolescents regarding the stereotyped portrayal of women in the media and its influence on real life experiences. The study shows that there is stereotypical representation of gender roles in media and it reinforces the traditional patriarchal notions of gender as perceived by the adolescents. Female students showed more agreement with typical stereotypical representation of women in the traditional role or as a sex object and they felt a need of regulation on the content of media as compared to males.

Kambouri and Evans (2019) analysed how patterns of gender behaviour can lead to gender stereotypes in which the study examines how certain roles are standardized for both genders, which further leads to those actions being conceptualized only for that particular gender. The gender stereotypes emphasize the difference in both sexes, especially in physical appearance, traits, behaviours and education. The findings of the study was that these fixed stereotypes of gender roles have a damaging effect on children and their future opportunities. From an adult perspective girls have limited opportunities in comparison with boys.

According to Ifechukwu (2013) research tries to explain how society influences gender identity, the study was made in order to develop a scale to measure the attitude of Nigerian college students toward gender roles. The tools were used by Nigerians studying in Ireland and in Nigeria, the results show that culture and society are factors in changing people's gender role attitudes.

Ogege et al.(2016) made a research to examine the gender differentiation and social mobility in Nigeria, putting more emphasis on how the roles males play are highly rewarded than the ones women do. As cited by Ogege stated that changing the institutional arrangement will reduce the social mobility for women.

Ejukonemu (2018) states that gender role and how societies perceive femininity has changed, explaining the traditional aspect in which women were taken as the weaker sex. The article emphasizes sex role as seen in the precolonial and the contemporary period in Nigeria, enhancing the concept that society still views women in a downgraded manner even when women have completely changed during the contemporary period.

Falola (2007) as cited in the article on the Role of Nigerian women states that gender roles in the society have evolved since the 20th century. The findings were that the roles have evolved to a more modern or egalitarian aspect rather than the traditional roles that involve the patriarchy system. Through formal education women have tried to overcome these systems and move toward a more modern role aspect.

Ifechukwu in his study 'Gender role attitudes among Nigerian students: Traditional or Egalitarian?' looks at how society influences the process of our gender identity and how it dictates the role we are expected to play according to our gender. Although a large number of students hold egalitarian gender role beliefs in all items, more traditional gender role attitudes are imbibed within ideologies that are related to core gender roles attached to norms and traditions of Nigerian students. The overall result of the quantitative research indicate that a bigger number of the entire participant still believe that women should come second place for opportunities outside the home; the division of labour has been naturally placed where they belong.

15. Odimegwu et al. (2017) examine the gender differences in the effect of family structures on educational outcomes of youths in Nigeria, focusing on how the family characteristic and gender differences affect educational purposes. Due to the large growth of youth being out of the institution, the result of the study shows that the number of males administered in an institution in Nigeria is more than females, and most females have never been in schools due to early marriage and traditional practices of the patriarchal system

CHAPTER THREE
THEORETICAL FRAMEWORK

THEORETICAL FRAMEWORK

3.1 CONCEPT OF CULTURE AND GENDER ROLES

The study is on Young adults attitudes towards gender roles in Nigeria and South India. Gender roles are “socially and culturally defined prescriptions and beliefs about the behaviour and emotions of men and women” (Anselmi and Law, 1998). The study emphasizes the difference in perception and attitude towards gender roles, focusing on South Indian and Nigerian societies, which are held by college students of both cultures. Men and women have different social worlds in which women express more equality but they have more gender restrictions (Ram, Strohschein, and Gaur, 2014). This occurs due to the perceived gender roles where each gender is defined by specific roles and practices. While examining the cultural aspect in Nigeria , it was observed that men were given more preference in terms of education while females were restricted to traditional practices of the patriarchal system. Changes have occurred to this condition with the gradual development of the Nigerian society from traditional to contemporary (Ejukonemu, 2018).

Indian society is more stereotypical than egalitarian. With time, changes did take place but it was still difficult for people to digest the fact that a woman can be the breadwinner of the family and the men can take care of children as well as the household.

When people are not given the right education and knowledge regarding such important affairs it results in them perceiving the gender roles differently and in a stereotypical manner. This study is important as it brings an understanding about the significant differences between the cultures and also the way in which the attitudes of the younger generation is influenced by society regarding gender roles. Choosing this topic can bring awareness about the cultural setting regarding gender roles in Nigeria and South India. It can also provide insight into the different attitudes that young adults may have due to the difference in perception of gender roles.

3.2 DEFINITIONS

3.2.1 GENDER ROLES

Gender roles are "socially and culturally defined prescriptions and beliefs about the behaviour and emotions of men and women" (Anselmi and Law 1998, p. 195). Many theorists believe that perceived gender roles form the bases for the development of gender identity. According to the world health organization, gender roles are socially constructed roles, behaviours, activities, and attributes that a given society considers appropriate for men and women (WHO 2015). The term 'gender role' was first coined by John Money in 1955 during the course of his study of intersex individuals to describe the manners in which these individuals express their status as a male or female (Lumen learning).

Different researchers and philosophers have tried to give a proper definition of gender roles and how individuals are differentiated, there are still ongoing debates on this matter, starting from Sigmund Freud who introduced the psychosexual stages in his attempt to explain how individuals develop and how they handle the libido, it can boldly be seen in the phallic stage where the differentiation occurs, gender role is something assigned to individuals based on their gender, there are norms set by the society which have been internalized and practiced by each family in the societal in the attempt to build moral behaviour and structure.

3.2.2 ATTITUDE

Attitudes can be defined as "behaviour based on conscious or unconscious mental views developed through cumulative experience" (Venes, 2001, p. 189). In their influential book *The Psychology of Attitudes*, Eagly and Chaiken (1993, p. 1) define an attitude as 'a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour'. Inherent in this definition is the idea that reporting an attitude involves the expression of an evaluative judgment about a stimulus object. In other words, reporting an attitude involves making a decision concerning liking vs. disliking, approving vs. disapproving or favouring vs. disfavouring a particular issue, object or person (Eagly and Chaiken, 1993).

3.2.3 CULTURE

According to the American Psychological Association (APA), culture is defined as the distinctive customs, values, beliefs, knowledge, art, and language of a society or a community. These values and concepts are passed on from generation to generation, and they are the basis for everyday

behaviours and practices. Virtually every definition of culture (e.g., Hofstede 1980, Mead 1955) suggests that it represents a coalescence of discrete behavioural norms and cognitions shared by individuals within some definable population that are distinct from those shared within other populations.

3.3 THEORIES OF GENDER ROLES

There are many theories that explain gender roles as well as gender stereotypes. Many theorists believed that a gender role is the base of developing one's gender identity. A few theories in relation to this are :

3.3.1 THEORY OF GENDER SCHEMA

Sandra Bem put forward the theory of Gender Schema which focuses on the function of cognitive organization along with socialization. The theory introduces the idea that children initially learn the way their culture and/or society define gender roles and further internalize this knowledge as gender schema. Thus the formed schema is then subjected to further reorganization due to successive experiences (Bem, 1993). The children's perception of gender is an interaction between their previously formed schema and experiences. In the course of time, they integrate their self-concepts to the schemas and accept the traits which they believe suitable for their gender.

3.3.2 SOCIAL ROLE THEORY

Alice Eagly put forward a theory of gender development based on socialization, which postulates that societal expectations and division of labour based on stereotypes results in gender roles. In an attempt to further elucidate this, Eagly (1987) defined the difference between communal and agentic factors in characteristics of gender stereotypes. The communal dimension is described by qualities, such as nurturance and emotional expressiveness, frequently associated with domestic activities and hence, with women. The agentic dimension is described in terms of assertiveness and independence, generally associated with public activities and hence, with men.

When cultures advocate gender stereotypes and develop expectations based on them, the behaviour becomes strongly influenced by gender roles (Eagly, 1987). Eagly proposes the theory

that gender roles are closely associated with gender stereotypes. There are four dimensions in which gender stereotypes vary; traits, role behaviours, physical characteristics, and occupations. For instance, women are more likely to be seen as caring and nurturing while men are more likely to be viewed as assertive and competent.

Social role theory proposes that gender stereotypes are acquired from the unequal distribution of men and women in social roles. Sexual division of labour has been prevalent for a long time in the society. This conflicting distribution of men and women in social roles, and the conclusion it brings about what men and women are like, gives rise to gender stereotypes.

3.3.3 EVOLUTIONARY THEORY

The evolutionary theory of gender development focuses on the genetic basis for difference between the genders. Functionalists (e.g., Shields 1975) put forward the theory that men and women have evolved in different ways in order to fulfil their functions that are necessary for survival. Sociobiologists (e.g., Buss 1995) propose that the difference in behaviour between the gender arises from the distinct sexual and reproductive strategies which has evolved to guarantee that men and women are capable to reproduce and pass on the genes.

CHAPTER IV
RESEARCH METHODOLOGY

RESEARCH METHODOLOGY

A research methodology is an outline of how a given piece of research is carried out. It defines the techniques or procedures that are used to identify and analyse information regarding a specific research topic. It is also referred to as a systemic gathering of data and information as well as its analysis for the advancement of knowledge in any subject or finding intellectual answers to practical questions through the application of systematic methods. Research methodology helps give a clear explanation of the finding of any research, it gives a clear analysis of the data.

This study follows a Quantitative research methodology, quantitative research methodology is descriptive and subjective irrespective of facts. It involves observation and description. The methodology can be used to evaluate the knowledge, attitudes, behaviours, and opinions of people.

4.1 OBJECTIVES

1. To find the gender difference in attitude of young adults towards gender roles
2. To explore the cultural differences in attitude of young adults towards gender roles

4.2 HYPOTHESIS

1. Ho: There is no significant difference in the attitude towards gender roles for both Nigerian and South Indian culture.

H1: There is significant difference in the attitude towards gender roles for both Nigerian and South Indian culture.

2. Ho: There is no significant difference in the attitude held by males and females towards gender roles

H1: There is significant difference in the attitude held by males and females towards gender roles.

4.3 RESEARCH DESIGN

The study was executed using a quantitative cross-cultural design in an attempt to determine if there exist cultural differences and similarities in the attitude of Nigerian and South Indian young adults, towards gender roles. The study was conducted among 147 young adults residing in South India and 118 residing in Nigeria. A sample of 265 was collected using a digital questionnaire which yielded 165 females and 100 males between the age group of 18 - 25 years. The Gender Role Attitude Scale was used as the tool which consisted of 38 items divided into five different gender roles. The scale was scored as per the standard scoring procedure that was provided. The completed Gender Role Attitude Scale data were analysed using SPSS and Google Excel. For testing the hypothesis Chi Square Test was resorted to from SPSS.

4.4 SOURCES OF DATA

The data for the study was obtained through primary sources, the Gender Role Attitude Scale questionnaire was circulated to the public by the researchers. The researchers distributed the questionnaires and got the responses from March to April 2022.

4.5 SAMPLE DESIGN

The sample focused on young adults 18 to 25 years of age and specifically those individuals who were of South Indian or Nigerian origin.

4.6 SAMPLE SIZE

The target sample of the study was young adults between 18 - 25 years of age including both genders and the total sample size of the study is 265.

4.7 SAMPLING METHOD

The study followed a Non-probability or Non-random sampling method, Non-probability sampling method is defined as a sampling technique in which the researcher selects samples

based on the subjective judgement of the researcher rather than random selection. Non-Probability sampling has four types: Convenient, consecutive, snowballing, and Quota. The Convenient Non-probability method was used in this study, Convenient sampling is a non-probability sampling technique where samples are selected from the population only because they are conveniently available to the researcher.

4.8 METHOD OF DATA COLLECTION

The data of the samples were collected through a digital platform where the scale was circulated as an online questionnaire through Google forms. The questionnaire began with a voluntary participation form which also included the confidentiality of the data that was entered followed by the demographic details such as age , gender etc of the participant. The Gender Role Attitude Scale was used which took the participants 15 minutes to complete it. All the data was acquired and the final results were achieved through SPSS.

4.9 DRAFTING QUESTIONNAIRE

The questionnaire consisted of three sections:

Informed Consent – this was developed by the researcher. It contains the voluntary consent of the participants to take part in the questionnaire provided their identity will be kept confidential.

Demographic Information - this part of the questionnaire collects the basic details of the participants such as name, age, gender, area of residence.

The Gender Role Attitude Scale (GRAS) was used as the questionnaire. These are a set of questions that are taken from the Social Role questionnaire(SRQ-R; Baber and Tucker, 2006)

The Gender Role Attitude Scale (GRAS) is an instrument developed to determine the attitude of university students towards gender roles. The scale consisted of 38 items and five subscales. There are 8 items in the egalitarian gender roles , female gender roles , marriage gender roles and traditional gender roles subscales, and total of 6 items in the male gender roles subscale. It is

necessary to remove items from scale that have a factor load less than 0.30 as a result of factor analysis according to Tezbaúaran (1997). The GRAS factor load value was between 0.35 and 0.79. The factor analysis results showed that the instrument has more than one dimension. These dimensions present the variety of factors that are influential in students attitudes about gender roles.

The GRAS is a 5-point Likert type scale. The egalitarian attitude sentences regarding gender roles were scored as 5 points for ‘completely agree,’ 4 points for ‘agree,’ 3 points for ‘undecided,’ 2 points for ‘disagree,’ and 1 point for ‘absolutely disagree.’ The traditional attitude sentences regarding gender roles were scored in the opposite way : 1 point for ‘completely agree,’ 2 points for ‘agree,’ 3 points for ‘undecided,’ 4 points for ‘disagree’, and 5 points for ‘absolutely disagree.’

4.10 DATA ANALYSIS TECHNIQUE

The responses of the subject were analysed using Statistical Package for Social Sciences (SPSS) and Excel sheet. SPSS is a statistical software developed by IBM for data management, analysis and investigation. The following statistical tool was applied for data analysis.

Chi-Square Test

Chi-square (χ^2) is used to test hypotheses about the distribution of observations into categories, with no inherent ranking.

The Chi square test looks at the pattern of observations, and will tell us if certain combinations of the categories occur more frequently than we would expect by chance, given the total number of times each category occurred. It looks for an association between the variables.

There are three types of chi tests:

- tests of goodness of fit
- the test of independence
- the test for homogeneity.

All three tests rely on the same formula to compute a test statistic. These tests function by deciphering relationships between observed sets of data and theoretical or “expected” sets of data that align with the null hypothesis.

The Chi-square goodness of fit test checks whether your sample data is likely to be from a specific theoretical distribution.

The Chi-square test of independence checks whether two variables are likely to be related or not

The chi-square test of homogeneity tests to see whether different columns (or rows) of data in a table come from the same population or not (i.e., whether the differences are consistent with being explained by sampling error alone).

The formula used in Chi Square Test is :

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

χ^2 = the test statistic

Σ = the sum of

O = Observed frequencies

E = Expected frequencies

The chi-square statistic tells you how much difference exists between the observed count in each table cell to the counts you would expect if there were no relationship at all in the population.

A very small chi square test statistic means there is a high correlation between the observed and expected values. Therefore, the sample data is a good fit for what would be expected in the general population. A very large chi square test statistic means that the sample data (observed values) does not fit the population data (expected values) very well. In other words, there isn't a relationship.

CHAPTER 5
DATA ANALYSIS

DATA ANALYSIS

The study was conducted on 265 young adults between the age group of 18 to 25 years and those who reside either in Nigeria or South India. The objectives of the study were 1) To find the gender difference in attitude of young adults towards gender roles and 2) To explore the cultural differences in attitude of young adults towards gender roles. To meet these objectives, two hypotheses were generated, which are: There is no significant difference in the attitude towards gender roles for both Nigerian and South Indian culture, there is no significant difference in the attitude held by males and females towards gender roles. A quantitative cross – cultural research design was used and the Chi-Square Test of Independence was used for data analysis.

Figure 1

Distribution of participants based on gender

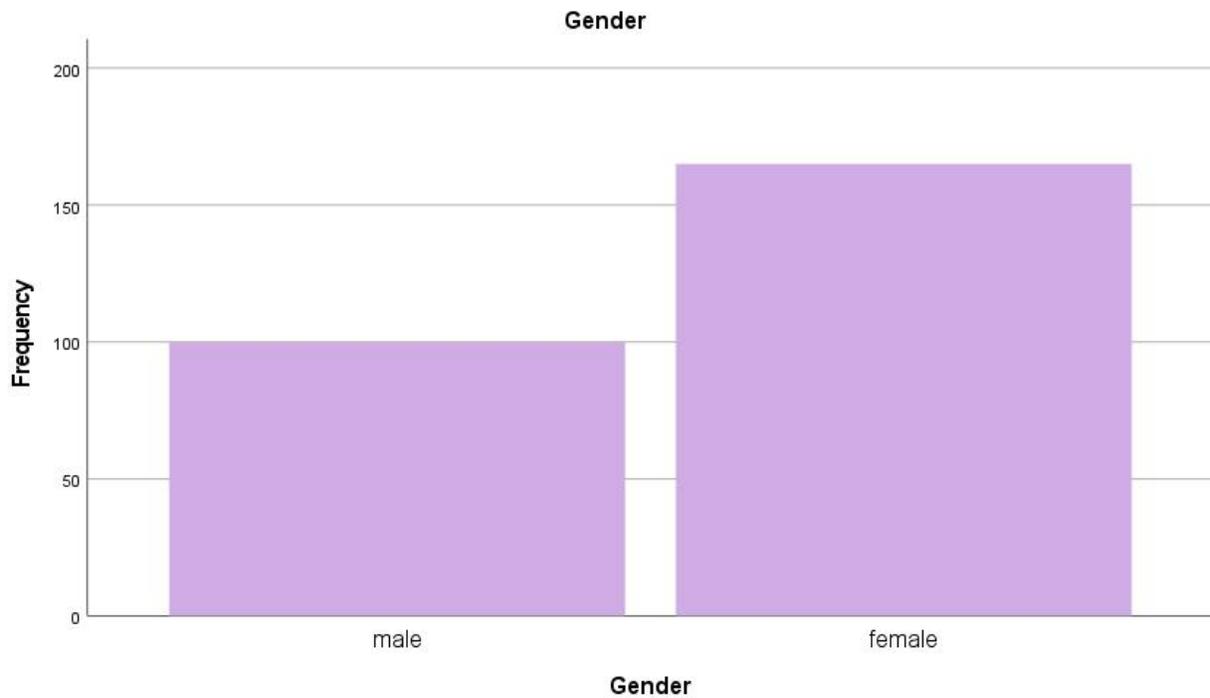


Figure 1 shows the distribution of participants based on gender in the study. There are 100 males and 165 females.

Figure 2

Distribution of participants based on culture

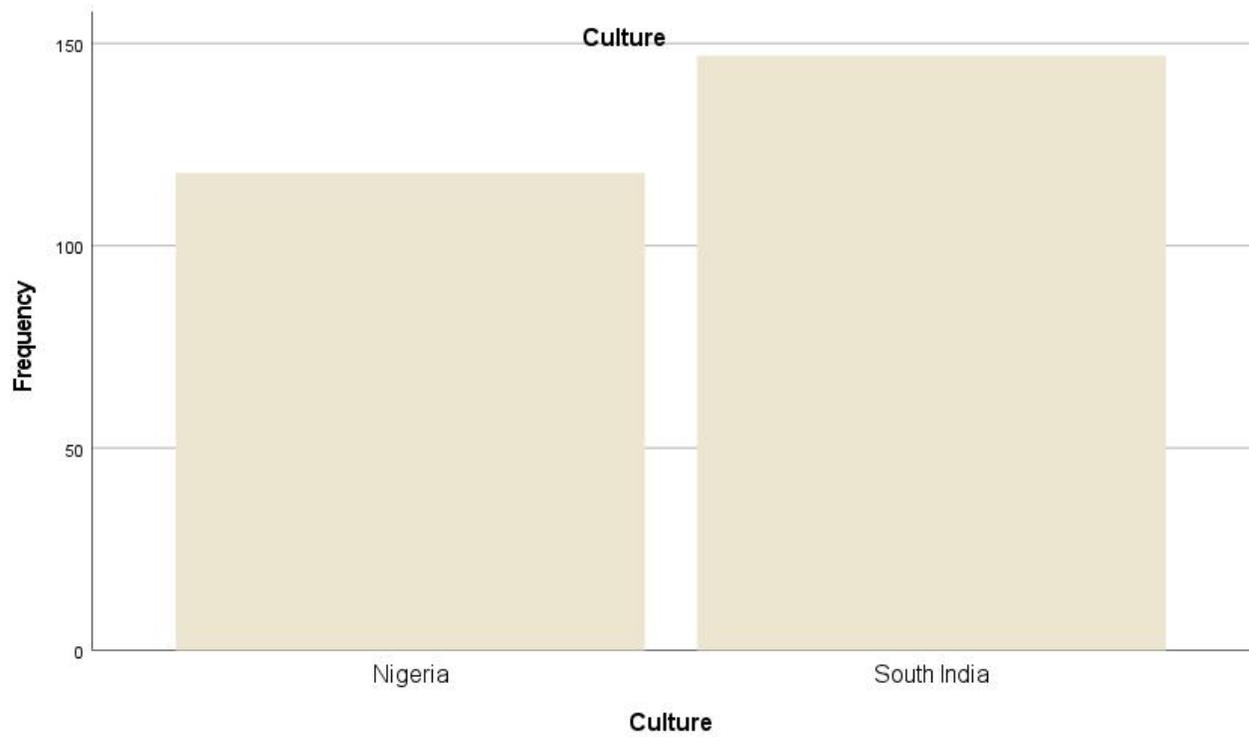


Figure 2 shows the distribution of participants based on culture in the study. There are 118 Nigerians and 147 South Indians.

HYPOTHESIS : 1

Table 1

	Completely Agree		Agree		Undecided		Disagree		Absolutely Disagree		$\chi^2 (4)$
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Nigeria	8	6.7	25	21.1	45	38	22	18.6	18	15.2	111.44
South India	0	0	1	0.6	10	6.8	35	23.8	101	68.7	

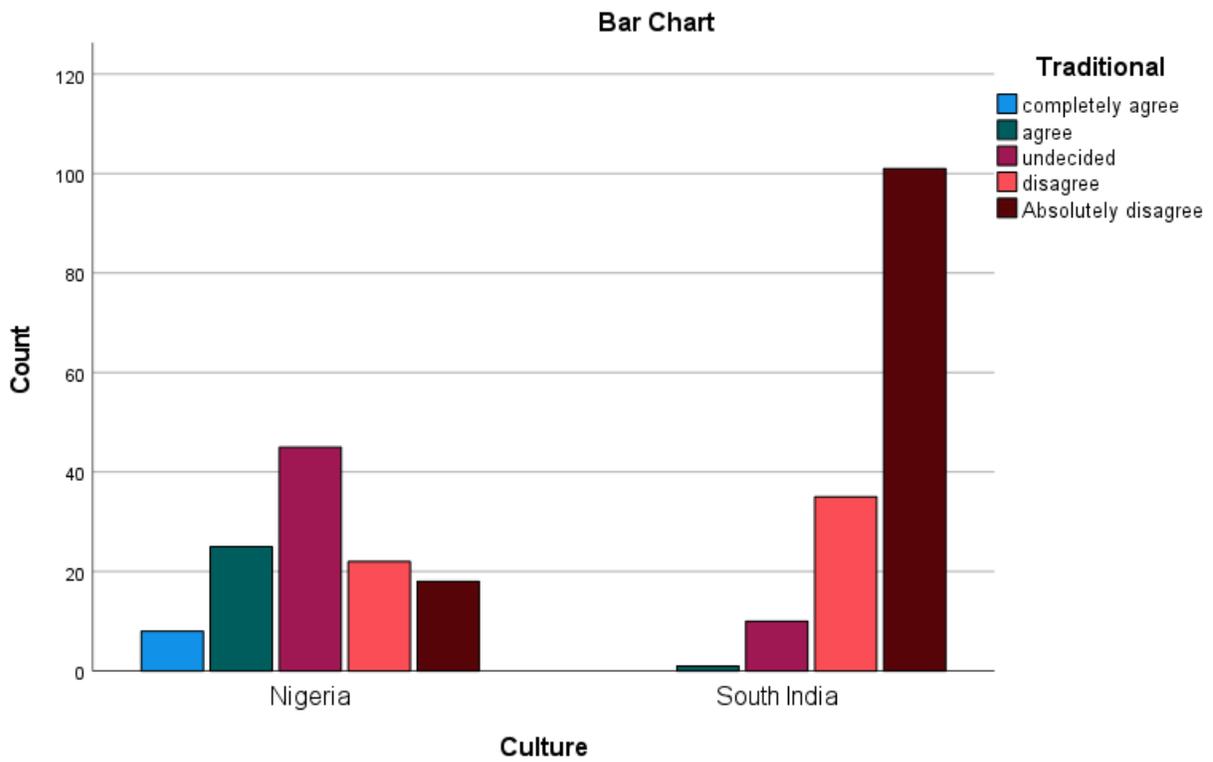


Table 1 and 2 shows the results of a chi-square test of independence that examined the relationship between the cultures (Nigeria and South India) and attitude towards gender roles (Egalitarian or Traditional Attitude).

The relationship between the variables are significantly different with $\chi^2 (2, N = 265) = 25.02, p < .001$ and $\chi^2 (4, N = 265) = 111.44, p < .001$ for egalitarian and traditional attitude held by both the cultures respectively.

Results show that South Indian culture has a more egalitarian attitude and the Nigerian culture has a more traditional attitude towards gender roles. Therefore, the null hypothesis is rejected as the significance level is less than .05.

HYPOTHESIS : 2

Table 3

Chi – Square Results for Egalitarian attitude based on both genders (N= 265)

Source		Undecided		Egalitarian Agree		Completely Agree		$\chi^2 (2)$
<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Male	6	6	24.24	70	70			15.29
Female		1	0.6	19	11.5	145	87.8	

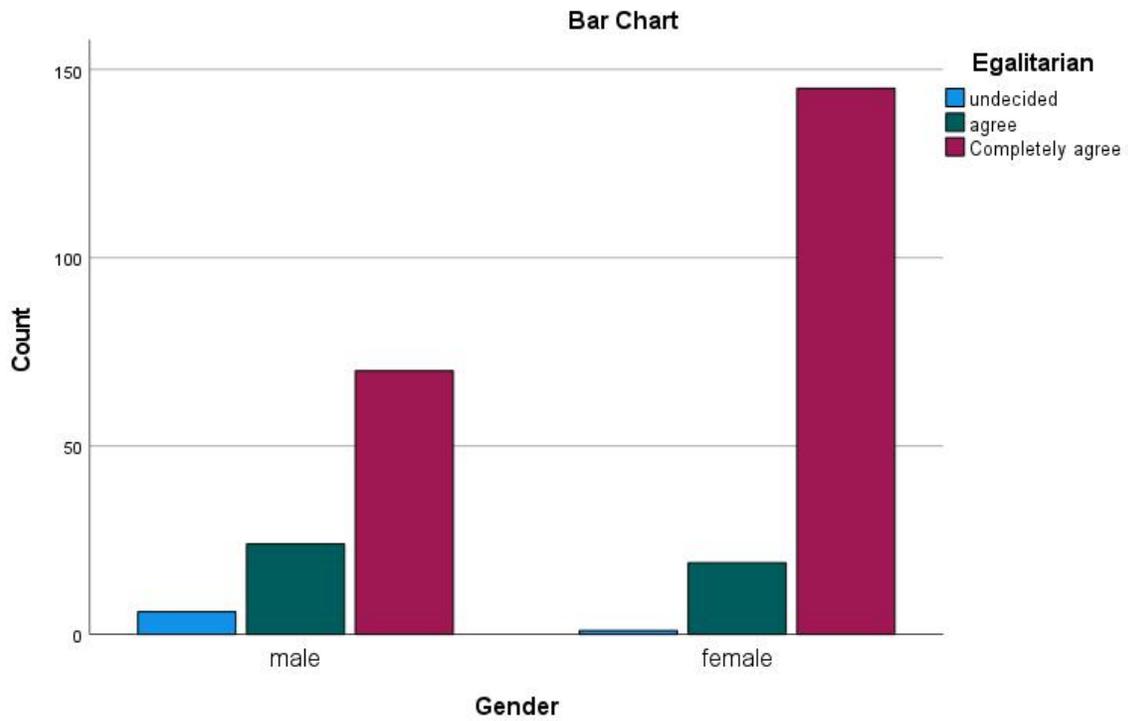


Table 4

Chi – Square Results for Traditional attitude based on both Genders (N= 265)

Source	Traditional										χ^2
	Completely Agree		Agree		Undecided		Disagree		Absolutely Disagree		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Male	8	8	12	12	27	27	22	22	31	31	23.93
Female	0	0	14	8.4	28	16.9	35	21.2	88	53.3	

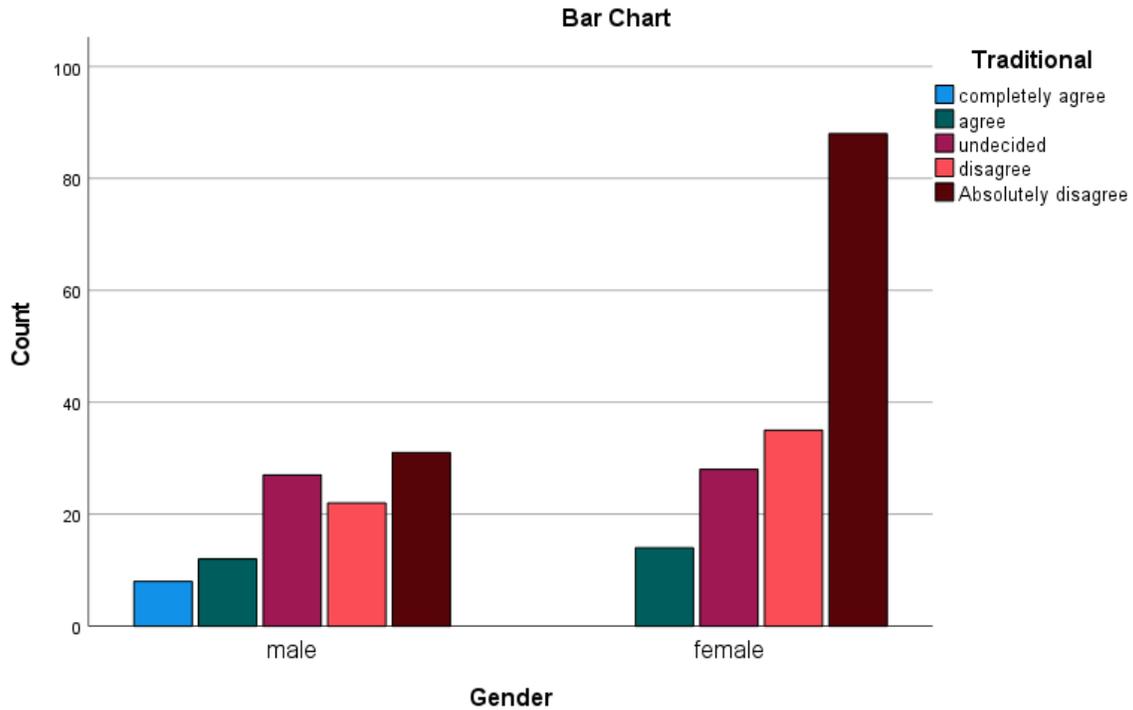


Table 3 and 4 shows the results of a chi-square test of independence that examined the relationship between the genders (Male and Female) and attitude towards gender roles (Egalitarian or Traditional Attitude).

The relationship between the variables are significantly different with $\chi^2 (2, N = 265) = 15.29, p < .001$ and $\chi^2 (4, N = 265) = 23.93, p < .001$ for egalitarian and traditional attitude held by both genders respectively.

Results show that Females have a more egalitarian attitude and the Males have a more traditional attitude towards gender roles. Therefore, the null hypothesis is rejected as the significance level is less than .05.

CHAPTER 6
FINDINGS

FINDINGS

The study exhibited that there is a difference in attitude towards gender roles between both the genders especially among young adults. Using the Chi – Square test of Independence , it was observed that women have a more egalitarian attitude in relation to gender roles than men who have a more traditional attitude. This shows that women have a view which revolves around equality and access to similar opportunities to everyone.

Another interesting finding is that both the cultures under study , Nigeria and South India , have differences regarding the attitude of young adults towards gender roles. The context of cultural differences was measured using Chi – Square Test of Independence where the residents of Nigeria were found to have a traditional attitude regarding gender roles while the young adults of South India have a egalitarian attitude in comparison.

Considering the entire study , a majority of the participants had an egalitarian attitude and only a minority of them had a traditional view. This shows that a good amount of people believe in treating all individuals with the same principles , norms and values regardless of their gender , origin , economical status etc.

CHAPTER 7
RECOMMENDATIONS

RECOMMENDATIONS

In light of the limitations encountered during the research process, below are a list of recommendations that could be taken into consideration for future research on gender role attitudes in a cross-cultural research study.

1. The sample size gathered should be enough to represent the total population in a particular geographical location.
2. The samples gotten were not of equal gender distribution.
3. The sample gotten should include all people of all ages and socioeconomic statuses and educational qualification
4. Since very little research has been done in this area, the statistical tools for it are limited, so it depends on the research statistics used in obtaining the output

CHAPTER 8
CONCLUSION

CONCLUSION

The purpose of the study was to examine the cultural and gender difference in the attitude of young adults towards gender roles. It has been concluded that there is a significant variation in both the context of gender and culture. The cultural context shows that the South Indians residents exhibit an egalitarian view while Nigerian residents express a traditional view in their attitudes. The gender difference indicate that women tend to have greater egalitarian views as compared to men with traditional views

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APPENDIX

This is a cross-cultural study on Young adults attitudes towards gender roles in Nigeria and South India. The objective of the study is to explore young adult's attitude towards gender roles in the society between two different cultures. The study is conducted on individuals who belong

to the age group 18 - 25 and is meant for South Indians and Nigerian residents. The information provided will solely be used for the purpose of research and will remain confidential.

I . Consent Form

II .Socio-demographic Details: Name , Age , Gender , Educational Qualifications , Level of Employment and Area of Residence.

GENDER ROLES ATTITUDE SCALE (GRAS)

Read each statement carefully and select the option that matches your response. There are 38 statements in the questionnaire which are divided into five subscales. Each can be answered using the five options that are given.

A. Egalitarian gender roles

- A1. Decision to have a child should be made by both spouses in a marriage.
- A2. Equal fee should be paid to the women and men in professional life.
- A3. Widowed woman should be able to live by herself.
- A4. Assets should be shared equally when spouses divorce.
- A5. Equal chances should be enabled to women and men for professional development.
- A6. Domestic work should be shared equally between spouses in the family.
- A7. Daughters and sons should be benefited equally from the family's economical means.
- A8. Spouses should decide together in the family.

B. Female gender roles

- B1. A woman should experience sexual encounter after they are married.
- B2. The future wife of a man should be a virgin.
- B3. Girls can be able to live by themselves when they gain their economical freedom.
- B4. A woman should be able to go out by herself at night.
- B5. A woman should consult a woman doctor in the hospital.
- B6. Families should allow girls to flirt.
- B7. The last decision regarding the choice of her husband should be made by her father.
- B8. A woman's basic task is motherhood.

C. Marriage gender roles

- C1. Husband's cheating on a wife should be regarded as normal.
- C2. Every wish of the man should be realized at home.
- C3. Man should marry again if the woman is not able to deliver a child.
- C4. A woman should reject sexual encounter in marriages if she does not desire it.
- C5. Husbands should make the decisions regarding woman's life.
- C6. Contraception in marriages should be responsibility of only woman.
- C7. A woman is considered more precious if she delivers a boy.
- C8. Woman should prefer to remain silent instead of arguing in case of a conflict with their husbands.

D. Traditional gender roles

- D1. The head of the household is man.
- D2. A man's main task in the house is breadwinning.
- D3. Woman should not work if the economical situation of the man is adequate.
- D4. Profession implemented by woman and man should be different.
- D5. Men should be preferred in employment applications because of women's fertility.
- D6. A girl should obey his father's wishes until she is married.
- D7. Man should deal with tasks away from home such as shopping and paying the bills.
- D8. Girls should be dressed in pink while boys should be dressed in blue.

E. Male gender roles

- E1. Man should decide on how to use family income.
- E2. Men should be employed in high status professions.
- E3. Boy's education should be prioritized in the family.
- E4. A man should beat up his wife if necessary.
- E5. Education level of the man should be higher than woman in marriages.
- E6. Man should be older than woman in marriages.

PROJECT REPORT

**A STUDY ON THE RELATION BETWEEN NOVELTY SEEKING AND
BRAIN LATERALIZATION**

Submitted by:

ADHEENA MB

Register No:

SB19PSY002

Under the guidance of

MS. JISHA SEKHAR

In partial fulfillment of the requirement for award of the degree of

B.Sc. PSYCHOLOGY



ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

Nationally Re-accredited at 'A++' level (4th
cycle) Affiliated to: Mahatma Gandhi University

MARCH 2022

CERTIFICATE

This is to certify that the project report entitled, “THE RELATION BETWEEN NOVELTY-SEEKING BEHAVIOR AND BRAIN LATERALIZATION”, is a bonafide record submitted by MS. Adheena MB, Reg.no. SB19PSY002, in partial fulfillment of the requirements for the award of the Degree of Bachelor of Psychology during the academic year 2019-2022.



Ms. Bindu John

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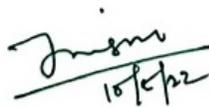
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External Examiner:



DECLARATION

I, Adheena M.B, hereby declare that the study presented in the dissertation entitled, “The Novelty Seeking and Brain lateralization”, which is submitted to the Department of Psychology, St. Teresa’s College, Ernakulam is a bonafide record of the research work carried out by me, under the supervision and guidance of Ms. Jisha Sekhar, Assistant Professor, Department of Psychology, St. Teresa’s College, Ernakulam, in partial fulfillment of the requirements for the degree of Bachelor of Science in Psychology and has not previously formed the basis for the award of any degree, diploma, fellowship, title or recognition before.

Place: Ernakulam

Adheena M.B

Date:

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Thanking You

Adheena M.B

ABSTRACT

Project Title: A STUDY ON THE RELATION BETWEEN NOVELTY SEEKING AND BRAIN LATERALIZATION

Research focus: Emerging adulthood (18-25) of Kerala.

Although several separate studies have been done on brain lateralization and novelty seeking, there is very little literature on the relation between brain lateralization and novelty seeking. The present study aims to examine the existence of a relationship between novelty seeking and brain lateralization while also considering the possible association of right-brain dominance with novelty-seeking behavior. Novelty-seeking is one of the traits that keeps you healthy and happy and fosters personality growth as you age (Robert Cloninger). On the other hand, lateralization of the brain is linked to many functions that are distinct to each region. To measure brain lateralization, we used the polarity questionnaire by Bruce Eldine Morton, an 11-item true-false scale that measures hemispheric dominance. The Zuckermann's Sensation Seeking Scale – V (SSS – V) 40 questions that are designed to assess individual differences in the optimal level of stimulation. The SSS -V Scale can be scored as a general measure of sensation-seeking by summing all items. Data collection was performed through a questionnaire combining both the measurements on 100 people of Kerala between the ages of 18-26 years. The Spearman Correlation method and Chi-Square test were used for statistical analysis. Results revealed a significant strong positive correlation between brain lateralization and novelty-seeking, and right-brain individuals were found to score high in novelty-seeking than left-brain people.

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CHAPTER I
INTRODUCTION

INTRODUCTION

1.1 THE BACKGROUND STUDY

Lateralization appears throughout the human body, even in the brain, and is often associated with diverse behavioral and cognitive functions. Lateralization is associated with creativity, visuospatial arrangement, language, and sexual orientation. Novelty seeking or sensation seeking is a personality trait referring to the tendency to pursue new experiences with intense emotional sensations. People with higher novelty-seeking are more impulsive, adventure-seeking, disorderly, and more inclined to engage in drug abuse, alcoholism, sexual activities, and dangerous sports. But at the same time, it is one of the traits that keeps you healthy and happy and fosters personality growth as you age (C. Robert Cloninger). It is a quintessential human survival skill that promotes better adaptability to changes. Researchers have found that dopamine modulates individuals' tendency for novelty-seeking, and externally depends on their upbringing, local culture, and their stage of life. It is often associated with creativity, Parkinson's disease, and drug abuse, found to have an association with the activation or dominance of the right hemisphere. However, very little previous research exists linking handedness and novelty-seeking behavior in human beings apart Sonja Kuderer and Sylvia Kirchengast (2016), study on 'The association of hand preference and sensation-seeking behavior.'

1.2 PROBLEM STATEMENT

Since brain lateralization affects many functioning, behavioral traits, and disorders, does it have an influence on the way people feel excitement over novel stimuli, or otherwise known as the the novelty-seeking behavior?

1.3 NEED AND SIGNIFICANCE OF THE STUDY

Since novelty seeking trait is associated with many risky activities, drug abuse, addiction, creativity, and some disorders like antisocial, Parkinson's disease, its connection to hemispheric dominance can be an indicator. The future studies could use more developed tools to measure the variables. It can also extend to other behaviors associated with novelty seeking. The outcome of this study will be an academic gain in brain specialization and it can help to understand people to be more conscious of the vulnerabilities related to high/ low novelty-

seeking behavior. They can also manipulate their tendency to the intensity of novelty to lead a well-balanced life and mental health.

1.4 SCOPE OF THE STUDY

The current study's pre-eminence is to increase knowledge on the relationship between novelty seeking and brain lateralization. The study critically examines the novelty-seeking trait and hemispheric lateralization. A particular focus is on demonstrating the association between increased novelty-seeking scores and the right brain.

1.5 OBJECTIVES

- To examine the relation between novelty seeking and brain lateralization.
- To examine whether novelty seeking traits are relatively higher among right hemispheric dominant individuals.

1.6 LIMITATIONS OF THE STUDY

The current study has its limitations.

- The present sample is not homogenous in age as the study mainly focuses on emerging adulthood and is confined only to the state Kerala.
- The accuracy of brain lateralization could be improved if fMRI is employed.
- The cultural effect of Kerala had an impact on certain items of the Zuckerman Sensation-Seeking Scale-V (SSS-V).
- Sample of left brained people are comparatively low compared to right brained people. Hence a small sample size.

CHAPTER II
REVIEW OF LITERATURE

LITERATURE REVIEW

The brain lateralization or functional dominance of one hemisphere over the other, in which one is more responsible or entirely responsible for the control of function in comparison to the other, is reflected by diverse behavioral and cognitive functions and is strongly evident in handedness or the employment of one hand over the other (Corballis 2009). Recent research clarified that handedness and cerebral asymmetry are not unique to humans. Nevertheless, uniquely human activities, such as language, or that are more highly developed in humans than in other species, such as manual skill (dexterity), may well have exploited asymmetry in ways not evident in non-human species (Corballis 1997). The present study aims to re-establish the findings of "The association of hand preference and sensation-seeking behavior" by Sonja Kuderer and Sylvia Kirchengast, published in 2016 on 300 participants. Kuderer and Kirchengast (2016) tested the hypothesis that left-handedness is associated with higher sensation-seeking levels. The collection of data on sensation-seeking and handedness by 55 homogenous sample populations computed the investigation. The result revealed that sensation-seeking behavior showed significant negative correlations with age and the Handedness Index. Higher scores of left-handers in Experience Seeking (ES), sensation seeking (SS) as well in Thrill and Adventure Seeking (TAS) indicated a larger risk investment in this handedness group. This result contradicted the findings of Christman (2013); there exists no difference between left-handers and right-handers on novelty seeking. The result found that strong right-handers may be less open to new experiences, also suggested, in the future, a possible three-way connection between strong right-handedness, conservative views, and a lack of open-mindedness. His later study found that consistent-handers are less sensation-seeking, more authoritarian, and more sensitive to disgust, and consistent-handedness seems to underlie all of these associations (2013). Research by Cameron & Rogers (1999) on common marmosets (*Callithrix jacchus*) problem-solving and responses in a novel setting found that left-handed marmosets displayed a delay while entering a novel room containing novel structures and objects and touching them. The results highlighted the specialization of the right hemisphere (left hand) for fear and negative emotional states and the left hemisphere (right hand) for approach and positive emotional states. Wright and Hardie (2012) substantiated a similar finding in their study and found left-handers scored higher scores, supporting the right hemisphere's role in negative affect and inhibition. The result fits the prediction of the behavioral inhibition system's role in the revised reinforcement sensitivity theory (rRST). There were no trait differences found, yet there was a significant relationship between trait and

state anxiety. However, Oltedal & Rundmo (2006) proved otherwise; the anxiety of drivers remarkably correlated to excitement-seeking. The aim was to investigate the effects of personality traits and gender on risk driving behavior and accident involvement; found that anxiety was closely correlated to excitement-seeking and risk-driving behavior; excitement-seeking also correlated to risky driving behavior and collisions. Wright, Hardie, and Wilson (2008) research study investigated the relationship between handedness, gender, behavioral approach, and inhibition using Carver and White's (1994) BIS/BAS Scale on 112 participants found left-handers and females exhibited the most inhibition. Babaei K, Issazadegan A, Pirnabikhah N, Tajoddini E.(2016) investigated the Role of the Brain-Behavioral System (BAS/BIS), Novelty-Seeking, Reward Dependence, and Predicting Addiction Potential found that the behavioral activating system and novelty-seeking dimensions of personality traits positively correlated with addiction potential. The future implication of the study is to prevent the tendency to addiction by detecting high behavioral activating systems (BAS) and high novelty-seeking characteristics. Tomer and Aharon-Peretz (2015) concluded that approach and; avoidance reflected different patterns of dopaminergic asymmetry. The reduced novelty seeking reflected in the left hemisphere and increased harm avoidance is associated with greater dopamine loss in the right striatum. According to Harris, McNamara, and Durso (2015), the patients with right-onset disease exhibited higher novelty-seeking than patients with the left-onset disease. Hence it implies that patients with right-onset Parkinson's disease who are taking dopamine agonists and who exhibit high novelty-seeking are at greater risk for developing impulse control disorders than are patients with left onset patients. It's well known that hippocampal plasticity can be enhanced by novelty exploration in animals through dopaminergic neuromodulation in the substantia nigra/ventral tegmental area (SN/VTA). Bunzeck and Duzel (2006) confirmed the idea that novelty engages brain systems involved in appetitive reinforcement learning supports that novel stimuli excite dopaminergic neurons in animals and also activate dopaminergic areas in humans. Harburg, Roeper, Ozgoren, and Feldstien (1981) investigated the relationship between handedness and temperament among younger persons; found that left-handers rated themselves more emotional than right-handers younger sinistral males appeared less extroverted than dextral and rated themselves more extraverted than dextral while older left-handed females rated themselves more extraverted than dextral. A research study by Christman, Jasper, Sontam, and Cooil (2007) suggested that the right hemisphere is in charge of rating risks and perception of obvious threats. The findings of 'Sensation Seeking in England and America: Cross-cultural, Age, and Sex Comparisons' corroborated that risk-taking or sensation-seeking describes the need to make manifold, novel,

and complex experiences (Zuckerman et al. 1978). It also showed a negative correlation between age and sensation-seeking; the older the age, the lesser the sensation-seeking tendency. In his book *Behavioral Expressions and Biosocial Bases of Sensation Seeking*, he further explained that in gender disparity, the male showed a higher sensation-seeking tendency. Roth, Schumacher, and Brahler (2005) study determined the demographic effect on novelty seeking. The paper on 'Sensation seeking in the community: Sex, age, and sociodemographic comparisons on a representative German population sample' highlighted the positive correlation between novelty seeking and education as well as income. High novelty-seeking may be associated with less aversion to risk, and the r-PI plays an important role in relating risk prediction to novelty-seeking. Converging shreds of evidence found a greater correlation among some traits like Hyper sexuality, social dominance, sociability, aggression, exploration of novel situations, play, and general activity. Furthermore, sensation seeking, the averaged evoked potential (AEP), and monoamine oxidase (MAO) show convergence in hypomania or bipolar manic-depression. They are also commonly correlated with sociopathy and drug abuse (Zuckerman, Marvin; Buchsbaum, Monte S.; Murphy, Dennis L. (1980). Franken, Gibson, and Rowland found that "*Sensation seeking and its biological correlates, Psychological Bulletin (1992)*" supported the idea that high sensation seekers perceive the world as less threatening. They are less likely to lead to negative outcomes than low sensation seekers. Denny's study on "Handedness and depression (2009)" predicted that left-handers are significantly more susceptible to depressive symptoms than right-handers. Much research implied a relationship between handedness and drug use. Harburg et al. (1978) recognized that left-handers have a greater tendency to smoke concomitantly and tend to smoke more than right-handed smokers.

There is sufficient literature associating handedness and behavioral and cognitive properties as well novelty-seeking to other behaviors and mental disorders like depression and anxiety, yet, very few have a direct association between brain lateralization and novelty seeking (or sensation seeking). The existing ones are either contradictory or focused more on left-right handers/ consistent - inconsistent, scarcely on mixed handers.

CHAPTER III
THEORETICAL FRAMEWORK

THEORETICAL FRAMEWORK

Brain Lateralization is the tendency for some neural functions or cognitive processes to be concentrated more on one side of the brain or another. The human brain is a paired organ that consists of 3 major parts; the cerebrum, the cerebellum, and the brain stem. The largest part, the cerebrum is divided into two hemispheres: the right hemisphere and the left hemisphere along the longitudinal fissure, a deep groove down the middle. The cerebrum covers about 85% of the total brain weight, and it is the region that controls a wide range of bodily functions. It is responsible for integrating impulses, directing motor activity, and controlling higher intellectual functions. The quest to identify parts of the brain involved in language began by nineteenth century. Paul Broca, a French neurosurgeon, examined the brain of a deceased patient who was suffering from an unusual disorder. The patient was able to understand spoken language, and he did not have any motor impairments of the mouth or tongue that might have affected his ability to speak, yet he could neither speak a complete sentence nor express his thoughts in writing. The only articulate sound he could make was the syllable “tan”, which accomsted as his name. When Broca autopsied Tan’s brain, he discovered a sizable lesion in the left inferior frontal cortex. Broca then studied eight other patients, all of whom had similar language deficits having lesions in their left frontal hemisphere, which led him to make his famous statement that 'We speak with the left hemisphere.' He identified for the first time the existence of a “language center” in the posterior portion of the frontal lobe of this hemisphere, which is now famously known as the “Broca’s area”, the first area of the brain to be associated with a specific function. Ten years later, Carl Wernicke, a German neurologist, discovered another part of the brain, the Wernicke’s area, involved in understanding language, in the posterior portion of the left temporal lobe. People who had a lesion at this location could speak, but their speech was often incoherent and made no sense. Several studies proved that brain functions specialize in each hemisphere of the brain. The two most lateralized functions in the human brain are motor control and language. When a function is lateralized it means that one side of the brain exerts more control over this function than the other does. The side that exerts more control is often called the “dominant hemisphere” for this function. Lateralization of motor control is what determines whether someone is right-handed or left-handed. When someone is ambidextrous, they can use either hand as easily as the other, it means that their brain is only partly lateralized or not at all lateralized for motor control. In right-handed people, the “dominant” hemisphere for motor control is left, while in left-handed people, it is the right. The reason for this inversion is that the motor pathways of the nervous system cross over to

the other side of the body as they go down the spinal cord. Thus the movements of one side of the body are controlled by the hemisphere on the opposite side. The left side of the brain controls the right side of the body. If the left side of the brain is dominant, the person is logical and more academically inclined. The left hemisphere is referred to as the digital brain. It is responsible for verbal communication, analysis, order, reading, writing, sequences, logic, and many more functions. Left hemisphere people usually excel in the fields of business analysis, programming, reporter, scientist, and network administrator. A right hemisphere dominant person excels in arts. It is visual and intuitive. It is also called the analog brain. It is responsible for creativity, imagination, intuition, holistic thinking, arts, non-verbal cues, emotions, and many other functions. Right hemisphere dominant people usually excel in the field of Graphic designing, psychology, interior designing, counseling, managing, etc. The dominance in the hemisphere varies from one person to another. The hemisphere of the brain used in every activity is not always the same for every person.

Novelty Seeking

The American Psychological Association defines novelty as “the quality of being new and unusual”. The attraction to novelty has been shown to begin as early as 1 year of age; for example, when infants are shown pictures of visual patterns, they will stare longer at a new pattern than at a pattern they have already seen. In consumer behavior, the attraction to novelty is manifested as a desire for a change, even in the absence of dissatisfaction with the present situation. For example, despite satisfaction with a particular product, many consumers will switch to a different brand just because it is new. In Cloninger's model of psychobiology, novelty seeking (NS) is an inherited, unlearned, temperamental bias toward novel signals from the environment. It can be measured along a spectrum from low to high (as with 3 other temperamental domains) and when towards the upper end of the spectrum, it is associated with higher exploratory activity, need for higher levels of baseline stimulation, impulsive decision making, extravagance in approach to reward cues, quick temperedness, low tolerance for frustration, impulsivity, and proneness to addiction. Novelty seeking is positively associated with the five-factor model trait of extraversion and to a lesser extent openness to experience and is inversely associated with conscientiousness. Novelty seeking is positively related to Impulsive sensation seeking from Zuckerman's Alternative five models of personality and psychoticism in Eysenck's model. When novelty seeking is defined as a decision process (i.e. in terms of the trade-off between foregoing a familiar choice option in favor of deciding to explore a novel choice option), dopamine is directly shown to increase novelty-seeking

behavior. Although the exact causes for novelty-seeking behaviors are unknown, there may be a link to genetics. Studies have found an area on the Dopamine receptor D4 gene on chromosome 11 that is characterized by several repeats in a particular base sequence. Multiple studies have identified a link to genetics, in particular one conducted by Dr. Benjamin and colleagues, where individuals who had longer alleles of this gene had higher novelty-seeking scores than individuals with the shorter allele. In another study relating to the gene and financial risk, Dr. Dreber and colleagues found a correlation between increased risk-taking and the DRD4 gene in young males. Although there are studies that support the link between NS and dopaminergic activity via DRD4, there are also studies that do not exhibit a strong correlation. The importance of DRD4 in novelty-seeking is yet to be confirmed conclusively. In addition to potential heredity, novelty-seeking behaviors are seen with the modulation of dopamine. The overall effect of dopamine, when exposed to novel stimuli, is a mass release of the neurotransmitter in reward systems of the brain including the mesolimbic pathway. The mesolimbic pathway is active in every type of addiction and is involved with reinforcement. Because of this activation in the brain, NS has been linked to personality disorders as well as substance abuse and other addictive behaviors. DRD4 receptors are highly expressed in areas of the limbic system associated with emotion and cognition. SNPs such as rs4680 have also been examined within this realm of study. It is important to note the individual's age with novelty seeking. This behavior will decrease with time, especially as the brains of adolescents and young adults finalize in development. Possible factors of variation include gender, ethnicity, temperament, and environment.

CHAPTER IV
RESEARCH AND METHODOLOGY

RESEARCH METHODOLOGY

A research methodology involves specific techniques that are adopted in the research process to collect, assemble and evaluate data. It's adopted to check a certain theory and its application along a specific set of academic standards. It also defines those tools that are used to gather relevant information in a specific research study.

This chapter provides a complete description of the study plan, the sample, the sampling procedure, the measure and the procedure used for data collection.

STATEMENT

Since brain lateralization affects many functioning, behavioral traits, and disorders, does it have an influence on the way people feel excitement over novel stimuli, the novelty-seeking behavior?

OBJECTIVES

- To examine the relation between novelty seeking and brain lateralization.
- To examine whether novelty seeking traits are relatively higher among right hemispheric dominant individuals.

HYPOTHESIS

- There exists a relation between brain lateralization and novelty seeking.
- Right brain individuals are high in novelty seeking.

RESEARCH DESIGN

The study is a quantitative research that uses correlation design to identify the relationship between novelty-seeking behavior and brain lateralization. The correlational research can demonstrate the relationship between variables though it cannot prove that changing one variable will change another. The primary objective of the study is to examine whether there exists a relation between brain lateralization and novelty-seeking. The correlational studies only give an understanding of whether there is a relationship between two groups and do not establish causation. Since both variables are categorical in nature, the relation between right brain and novelty seeking was measured using chi- square test. It tests whether distributions of categorical variables differ from each another

SOURCES OF DATA

The primary data collection was by sending out questionnaires in the google form through snowball sampling. The information on the variables, theories, and their significance in other areas, were collected from research journals published in Springer, Elsevier, and websites like google scholar, pubMed. General information on the variables, functions, characteristics, and significance, was collected from blogs and Google websites.

SAMPLE DESIGN

The data collection employed a non-probability sampling design. The questionnaires were sent out to the people of Kerala. The sampling technique was based on the subjective judgment of the researcher rather than random selection. An equal number of right and left brain people was selected and was focused more on a particular age group (18-26). The emerging age group was chosen as it was found that the novelty seeking tendency reach an optimal level around this time period. The sample is selected on the basis of inclusion – exclusion criteria.

Inclusion Criteria for the sample obtained were :-

- I. Individuals within the age range 18 – 26.
- II. Individuals from different parts of Kerala.

Exclusion Criteria for the sample obtained were: -

- I. Individuals above age 26 and belw the age of 18.
- II. Individuals from outside Kerala.

SAMPLING SIZE

The sample consisted of 100 individuals including both male and female between the emerging adults of age 18-26 years in Kerala. The sample consist of 50 right brain dominant and 50 left brain dominant individuals were selected from a population.

SAMPLING METHOD

Snowball sampling was used to gather information for the study. Snowball sampling or chain-referral sampling is a non-probability sampling technique in which the samples have traits that are rare to find. This is a sampling method in which existing subjects provide referrals to recruit samples required for a research study. Snowball sampling or chain-referral sampling is a nonprobability sampling technique in which the samples have traits that are rare to find. This is a sampling method in which existing subjects provide referrals to recruit samples required for a research study. The data collection was through a google form. The form was shared with friend and family circles and from there to other referrals.

METHOD OF DATA COLLECTION

The data collected through the online Google form was found to be more convenient, as to reach out to more people. The questionnaire in Google form was sent through social media communities, such as WhatsApp, Facebook, and Instagram, to friends and then to others

DRAFTING QUESTIONNAIRE

The data was collected through Google form. It had four parts, a consent seeking part, a socio-demographic profile, a brain lateralization questionnaire, and a novelty-seeking measuring questionnaire. In the consent seeking part, their consent to participate in the study was asked. The participants were assured that the information will not be used for any other purpose. All research data were obtained on a voluntary basis, the right to withdraw at any time was assured and strict confidentiality and anonymity was ensured. The study was conducted in compliance with Ethical principles of APA. The socio-demographic profile gathered data such as initials or names, age, and gender. Questionnaires measuring brain lateralization and novelty-seeking were arranged one after the other along with instructions.

1. Zuckermann's Sensation Seeking Scale for Novelty seeking

The Zuckermann's Sensation Seeking Scale – V (SSS – V) consists of 40 questions that are designed to assess individual differences in optimal level of stimulation. The SSS -V Scale can be scored as a general measure of sensation seeking by summing all items, but can also be split into four 10 items factors that are 1) Thrill and Adventure seeking 2) Experience seeking 3) Disinhibition 4) Boredom Susceptibility.

2. Polarity questionnaire

The polarity questionnaire by Bruce Eldine Morton, an 11 item -false scale measures the hemispheric dominance/ lateralization. Recognizing that everyone has access to both sides of their brain yet one part of it dominates the functioning within the individual. The polarity questionnaire aims to assess which side of their brain dominates.

DATA ANALYSIS TECHNIQUE

The collected data was analysed using IBM -SPSS ver. 25.0. Since brain lateralization variable was not normally distributed, non-parametric tests were employed Spearman correlation was used to examine the association between novelty seeking and brain lateralization. Comparison of mean values of novelty seeking on brain lateralization was carried out using Chi- squared test. The chi-square test was employed to examine whether right brain individuals have high novelty- seeking behavior.

Spearman's correlation coefficient is a statistical measure of the strength of a monotonic relationship between paired data. It is denoted by the Greek letter ' ρ ' (rho) is used for data analysis. It measures the strength and direction of the association between two ranked variables. Thus, it provides information about the magnitude of the association, or correlation as well as the direction of the relationship. The Spearman correlation is a number indicating -1 to 1 indicating the extent to which two variables are linearly related. Towards 0, the degree of relation of the variable reduces, but 0 means no correlation. The direction of the relationship between the two variables is correlated positively, and both the values decrease or increase together. On the other hand, if the value is in the negative range, then it shows that the relationship between variables is correlated negatively, and both of the values will go in the opposite direction and 0 value indicates that no relationship exists between the variables considered

Chi-squared test

In statistics, there are two types of variables: numerical variables (countable) and categorical variables. A chi-square test for independence compares two variables in a contingency table to see if they are related. In a more general sense, it tests whether distributions of categorical variables differ from each another. A chi-squared statistic is a single number that tells t how much difference exists between observed counts and the expected counts if there exists no

relationship in the population. A chi-square test will give you a p-value. The p-value will tell if the test results are significant or not. Hence lower value for chi-square means there is a high correlation between two sets of data.

CHAPTER V
DATA ANALYSIS

DATA ANALYSIS

The collected data were analyzed using IBM SPSS ver.25.0.

A normality test was performed to confirm whether the sample data was drawn from a normally distributed population. Under the normality test, the dependent variable, i.e novelty seeking was shown to be normally distributed. The independent variable, Brain lateralization was shown to be scattered and distributed. Hence, nonparametric tests have been used to assess the relationship between the variables.

- Correlation between brain lateralization and Novelty-seeking

Table 5.1: Spearman Correlation Coefficient between Brain Lateralisation and Novelty Seeking (N=100)

Correlation between Brain lateralization and Novelty-seeking

			Brain Lateralization	Total SS
Spearman's rho	Brain Lateralization	Correlation Coefficient	1.000	.657**
		Sig. (2-tailed)	.	.001
		N	100	100

** . Correlation is significant at the 0.01 level (2-tailed).

Spearman correlation test was administered to examine the association between the variables. Spearman rank correlation is a non-parametric test that is used to measure the degree of association between two variables. The data obtained from the participants (N=100) were scored appropriately and analyzed.

From the results obtained in Table 5.1, it is inferred that brain lateralization has a significance strong positive correlation with novelty seeking at 0.01 level of significance ($r=0.657$) which contradicts the Null Hypothesis (H_0) that there is no significant relationship between brain lateralization and novelty seeking. Hence hypothesis H_0 is rejected. And therefore, we are accepting hypothesis H_1 , that is there is a significant relationship between brain lateralization and novelty seeking. The findings show that Brain lateralization plays an important role in Novelty seeking.

- Relation between right brain and novelty seeking behavior

Table 5.2: Pearson's Chi Square test between Brain Lateralisation and Novelty Seeking in the participants.

(N=100)

Brain lateralization and Novelty seeking

		Interpretation of NS			
			average	low	Total
Brain Lateralization	Left	Count	25	25	50
		Expected Count	37.5	12.5	50.0
	Right	Count	50	0	50
		Expected Count	37.5	12.5	50.0
	Total	Count	75	25	100
		Expected Count	75.0	25.0	100.0

Table 5.3: Distribution between left brain dominance, right brain dominance and novelty seeking.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	33.333 ^a	1	.001		
Continuity Correction ^b	30.720	1	.001		
Likelihood Ratio	43.152	1	.001		
Fisher's Exact Test				.001	.001
N of Valid Cases	100				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.50.

b. Computed only for a 2x2 table

Table 5.4 =: Symmetric Measures- It shows the strength of the relation between Brain lateralization and Novelty- seeking.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	-.577	<.001
	Cramer's V	.577	<.001

Pearson's Chi-Square Test was computed to check whether right-brain dominant individuals show more novelty-seeking behavior than left-brain dominant individuals. From Table 5.2 below we can see that there is a dependent relationship between the variables; brain lateralization and novelty seeking (>0.001). There is a significant relationship between the two variables,

$$X^2(1,100) = 33.333, p < 0.001.$$

Table 5.3 makes it evident that the right brain dominance seems to have the highest association with novelty seeking. The right brain dominance count of novelty seeking is high, 50 on average with an expected count of 37.5. The low score count was shown to be 0 with an expected count of 12.5. The left brain dominance count was 25 for average and 25 for low with an expected count of 37.5 and 12.5 respectively. From this data, we can infer that the count for novelty-seeking in right-brain dominant individuals is average rather than low. The count for novelty-seeking in left-brain dominant individuals is shown to be equal in both categories for average and low. The association between right-brain dominance and average levels of novelty seeking is high compared to the association between left-brain dominance and novelty seeking. Table 5.4 shows that the Phi value is .577 which implies that the strength is closer to 1, hence validating the conclusions inferred from the test.

CHAPTER VI
FINDINGS

FINDINGS

The study tried to illuminate the relationship between brain lateralization and novelty seeking and concluded the existence of a relation between novelty-seeking and brain lateralization.

The primary objective was to examine the existence of a relationship between brain lateralization and novelty-seeking behavior. Hence this study tested the hypothesis that there existed an association between the two variables. The correlation between brain lateralization and novelty-seeking was tested using the Spearman correlation test. The result found that significantly strong positive relationships exist between brain lateralization and novelty-seeking. It implies the strong influence of lateralization of the brain on how people react to novel stimuli, thrill, and excitement seeking, and their tendency to seek out new experiences.

The secondary objective was to investigate whether right-brain individuals showed a higher tendency to engage in novelty-seeking behavior. The testing of the hypothesis that right brain individuals have high novelty-seeking established this association. Hence insinuated that the right hemispheric dominant individuals tend to exhibit high novelty-seeking behavior. The novelty-seeking tendency was found more in the right brain individuals than left-brain individuals. According to Robert Cloninger, novelty-seeking in the right combination with other traits is a crucial predictor of well-being. It is one of the traits that keeps you healthy and happy and fosters personality growth as you age. So it could be said that with the right combination of traits right-brain individuals have a higher chance to be happy.

Additionally, it was seen that there exists an impact of culture on novelty seeking on some items of the Zuckerman sensation seeking scale as the sensation-seeking scores of all were in the average range of scale of interpretation. It was observed that most of both brain-laterality preferred sexual relations after marriage. A higher degree of people preferred a reliable and trusting friend to an exciting friend. We also believe that participants might not be forthcoming when admitting the intake of marijuana. The study illuminated the Keralites' tendency towards novelty seeking and their mental schema regarding marriage and friendship.

This paper is a modest contribution to the ongoing research on brain laterality. To our knowledge, this is the first approach trying to investigate the brain laterality and novelty-seeking behavior among Keralites. This serves as an introduction to the impact of a collective community on novelty seeking.

The present study thus confirms the positive relationship between brain lateralization and novelty-seeking behavior, especially in right hemispheric dominant individuals.

CHAPTER VII
RECOMMENDATIONS

RECOMMENATIONS

The study establishes a positive correlation exists between brain lateralization and novelty-seeking behavior. The current research needs replicating with a bigger sample size across different cultures and geographical distribution to understand their impact on novelty seeking and brain lateralization. A more homogenous population in terms of age may help understand their effect on brain lateralization and novelty-seeking behavior pair. Though the present study provides evidence for novelty-seeking differences related to brain lateralization. Replicating the study with fMRI to measure brain laterality can bring promising empirical evidence on brain lateralization. Future studies can focus on new research concerning laterality phenomena and correlating novelty-seeking personality characteristics. Future research in this field will be required to extend knowledge on lateralization and novelty-seeking associated psychological disorders.

CHAPTER VIII

CONCLUSION

CONCLUSION

The human brain is split into two hemispheres, right and left, joined together by the corpus callosum, a bundle of nerve fibers located in the middle of the brain. Each hemisphere is responsible for different functions, the left brain, for instance, is associated with language functions (Broca's and Wernicke's area). Similarly, lateralization has a strong effect on handedness also. Novelty seeking (NS) is a personality trait reflecting excitement in response to novel stimuli. It is one of the traits that keeps you healthy and happy and fosters personality growth as you age (Robert Cloninger). A novel stimulus sets off a cascade of brain responses, activating several neuromodulatory systems. Thus it has a wide range of effects on our cognition; improving perception and action, attention, increasing motivation, eliciting exploratory behavior, and promoting learning. But it is also linked to a high tendency to smoke, drug use, and engage in risky behaviors. The present study aimed to examine whether there exists a relation between novelty seeking and brain lateralization. The secondary objective was to check whether right-brain dominant individuals showed a more novelty-seeking tendency. The study was conducted on a sample of 100 individuals between the 18-26 age group. It is found that there exists a positive correlation between brain lateralization and novelty seeking. The novelty-seeking tendency was found to be higher among right-brain individuals. Thus, the study established the relation between the right hemisphere and novelty-seeking behavior. The outcome of this study will be an academic gain in the brain specialization field of research and this relation can be a predictor of disorders associated with novelty-seeking to the right brain people

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APPENDIX

CONSENT FORM

By clicking "I Agree" below, you are indicating that you have freely consented to participate in this research study. The data obtained would be kept strictly confidential and used solely for research purposes.

SOCIO-DEMOGRAPHIC FORM

(E-MAIL ID)

NAME:

AGE:

EDUCATION:

PLACE:

QUESTIONNAIRES

1 ZUCKERMAN'S SENSATION SEEKING SCALE V

Each of the items below contains two choices, A and B. Please circle the letter of the choice which most describes your likes or the way you feel. In some cases, you may find items in which both choices describe your likes or feelings. Please choose the one which better describes your likes or feelings. In some cases, you may find items in which you do not like either choice. In these cases, mark the choice you dislike least. Do not leave any items blank.

It is important you respond to all items with only one choice, A or B. We are interested only in your likes or feelings, not in how others feel about these things or how one is supposed to feel. There are not right or wrong answers as in other kinds of tests. Be frank and give your honest appraisal of yourself.

1. A I like "wild" uninhibited parties.
B I prefer quiet parties with good conversation.

2. A There are some movies I enjoy seeing a second or even a third time.
B I can't stand watching a movie I've seen before.

3. A I often wish I could be a mountain climber.
B I can't understand people who risk their necks climbing mountains.

4. A I dislike all body odors.
B I like some of the earthy body smells.

5. A I get bored seeing the same old faces.
B I like the comfortable familiarity of everyday friends.

6. A I like to explore a strange city or section of town by myself, even if it means getting lost.

- B I prefer a guide when I am in a place I don't know well.
7. A I dislike people who do or say things just to shock or upset other people.
B When you can predict almost everything a person will do and say he or she must be a bore.
8. A I usually don't enjoy a movie or a play where I can predict what will happen in advance.
B I don't mind watching a movie or play where I can predict what will happen in advance.
9. A I have tried marijuana or would like to.
B I would never smoke marijuana.
10. A I would not like to try any drug which might produce strange and dangerous effects on me.
B I would like to try some of the new drugs that produce hallucinations.
11. A A sensible person avoids activities that are dangerous.
B I sometimes like to do things that are a little frightening.
12. A I dislike "swingers" (people who are uninhibited and free about sex).
B I enjoy the company of real "swingers."
13. A I find that stimulants make me uncomfortable.
B I often like to get high (drinking liquor or smoking marijuana).
14. A I like to try new foods that I have never tasted before.
B I order the dishes with which I am familiar, so as to avoid disappointment and unpleasantness.
15. A I enjoy looking at home movies, travel slides, or home videos.
B Looking at someone's home movies, travel slides, or home videos bores me tremendously.

16. A I would like to take up the sport of water-skiing.
B I would not like to take up water-skiing.
17. A I would like to try surf-board riding.
B I would not like to try surf-board riding.
18. A I would like to take off on a trip with no pre-planned or definite routes,
or timetable.
B When I go on a trip I like to plan my route and timetable fairly carefully.
19. A I prefer the “down-to-earth” kinds of people as friends.
B I would like to make friends in some of the “far-out” groups like artists or “punks.”
20. A I would not like to learn to fly an airplane.
B I would like to learn to fly an airplane.
21. A I prefer the surface of the water to the depths.
B I would like to go scuba diving.
22. A I would like to meet some persons who are homosexual (men or
women).
B I stay away from anyone I suspect of being “gay” or “lesbian.”
23. A I would like to try parachute jumping.
B I would never want to try jumping out of a plane with or without a
parachute.
24. A I prefer friends who are excitingly unpredictable.
B I prefer friends who are reliable and predictable.
25. A I am not interested in experience for its own sake.
B I like to have new and exciting experiences and sensations even if they are a little
frightening, unconventional, or illegal.

26. A The essence of good art is in its clarity, symmetry of form and harmony of colors.
B I often find beauty in the “clashing” colors and irregular forms of modern paintings.
27. A I enjoy spending time in the familiar surroundings of home.
B I get very restless if I have to stay around home for any length of time.
28. A I like to dive off the high board.
B I don’t like the feeling I get standing on the high board (or I don’t go near it at all).
29. A I like to date members of the opposite sex who are physically exciting.
B I like to date members of the opposite sex who share my values.
30. A Heavy drinking usually ruins a party because some people get loud and boisterous.
B Keeping the drinks full is the key to a good party.
31. A The worst social sin is to be rude.
B The worst social sin is to be a bore.
32. A A person should have considerable sexual experience before marriage.
B It’s better if two married persons begin their sexual experience with each other.
33. A Even if I had the money I would not care to associate with flighty rich persons in the 'jet set.'
B I could conceive of myself seeking pleasures around the world with the “jet set.”
34. A I like people whoa are sharp and witty even if they do sometimes insult others.
B I dislike people who have their fun at the expense of hurting the feelings of others.
35. A There is altogether too much portrayal of sex in movies.
B I enjoy watching many of the “sexy” scenes in the movies.

36. A I feel best after taking a couple of drinks.
 B Something is wrong with people who need liquor to feel good.
37. A People should dress according to some standards of taste, neatness, and style.
 B People should dress in individual ways even if the effects are sometimes strange.
38. A Sailing long distances in small sailing crafts is foolhardy.
 B I would like to sail a long distance in a small but seaworthy sailing craft.
39. A I have no patience with dull or boring persons.
 B I find something interesting in almost every person I talk with.
40. A Skiing fast down a high mountain slope is a good way to end up on crutches.
 B I think I would enjoy the sensations of skiing very fast down a high mountain slope.

The table below summarizes and exemplifies the four subscales of the SSS (each with 10 items):

SSS subscale	Description	SSS allocated items	Positive answer choices
Boredom Susceptibility (BS)	aversion to repetition, routine, and dull people	2, 5, 7, 8, 15, 24, 27, 31, 34, 39	I get bored seeing the same old faces. I prefer friends who are excitingly unpredictable.
Disinhibition (Dis)	desire for social and sexual disinhibition	1, 12, 13, 25, 29, 30, 32, 33, 35, 36	I like "wild" uninhibited parties. I like to have new and exciting experiences and sensations even if they are a little frightening, unconventional, or illegal.
Experience Seeking (ES)	pursuit of an unconventional lifestyle via unplanned activities and/or hallucinatory drugs	4, 6, 9, 10, 14, 18, 19, 22, 26, 37	I like to try new foods that I have never tasted before. I would like to try

			some of the new drugs that produce hallucinations.
Thrill and Adventure Seeking (TAS)	desire to engage in sports or activities involving speed and danger	3, 11, 16, 17, 20, 21, 23, 28, 38, 40	I would like to learn to fly an airplane. I would like to sail a long distance in a small but seaworthy sailing craft.

2 MORTON'S POLARITY QUESTIONNAIRE

Recognizing that everyone has access to both sides of his or her brain and that there are no incorrect answers here, mark the following statements True or False (T or F), depending on how well you feel the statement fits you personally.

1. When I become upset, after cooling down I don't need to talk, I need to be alone.
2. I tend to be introspective, self-conscious, thin-skinned, and psychological.
3. I would rather maintain and use good old solutions than find new better ones.
4. I talk about thoughts, things, or acquaintances more than entertainment, sports, or politics.
5. I am comfortable and productive in the presence of disorder and disorganization.
6. I find it very difficult to tolerate when my mate (or "important other") becomes defiant to me in private.
7. I don't need a lot of physical contact from my mate.
8. I like daily small reassurances of my mate's love more than monthly large rewards.
9. I tend not to be very romantic or sentimental.
10. I am strict than lenient with our children (or I would be if I had children).
11. Given the opportunity, I am more of an early morning person than a late night person.

**GREEN MARKETING – A STUDY ON CONSUMER
PERCEPTION AND PREFERENCES WITH A SPECIAL
REFERENCE TO RESIDENTS OF ERNAKULAM**

Project Report

Submitted by

STEFFI DE ALMEIDA (REG.NO.AB19COM037)

ADITHYA S RAJ (REG.NO.ABI9COM038)

AMLA SILPHA (REG.NO.AB19COM039)

Under the guidance of

Ms. SHANA XAVY

In partial fulfillment of requirements for the award of the degree of

Bachelor of Commerce



ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

COLLEGE WITH POTENTIAL FOR EXCELLENCE

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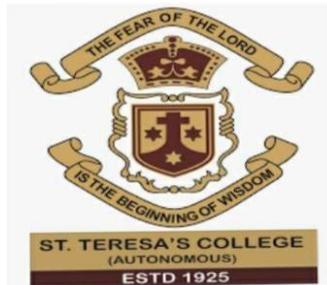
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CERTIFICATE

This is to certify that the project report titled **“GREEN MARKETING – A STUDY ON CONSUMER PERCEPTION AND PREFERENCES WITH A SPECIAL REFERENCE TO RESIDENTS OF ERNAKULAM”** submitted by **STEFFI DE ALMEIDA, ADITHYA S RAJ, AMLA SILPHA** towards partial fulfillment of the requirements for the award of the degree of **Bachelor of Commerce** is a record of bonafide work carried out by them in the academic year 2021-2022.

Supervising Guide

Ms. Shana Xavy

Assistant Professor

Department of Commerce

Head of the Department

Ms. Ann Thomas Kiriyanthan

Assistant Professor

Department of Commerce

Place: Ernakulam

Date: 31.03.2022



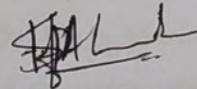
DECLARATION

We, **STEFFI DE ALMEIDA, ADITHYA S RAJ, AMLA SILPHA**, do hereby declare that this dissertation entitled, "**GREEN MARKETING – A STUDY ON CONSUMER PERCEPTION AND PREFERENCES WITH A SPECIAL REFERENCE TO RESIDENTS OF ERNAKULAM**" has been prepared by us under the guidance of **MS. SHANA XAVY**, Assistant Professor, Department of Commerce, St Teresa's College, Ernakulam.

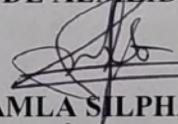
We also declare that this dissertation has not been submitted by us fully or partly for the award of any Degree, Diploma, Title or Recognition before.

Place: **ERNAKULAM**

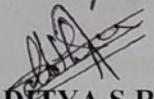
Date: **31.03.2022**



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STEFFI DE ALMEIDA

AMLA SILPHA

ADITYA S RAJ

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Climate change was first mentioned as early as the 19th century. Now, decades later, this change is becoming very apparent. Environmental degradation and over-exploitation of resources are going up at an alarming rate. As Evo Morales said, it's high time we realize that "The Earth has rights too, to live without pollution. What mankind must know is that human beings cannot live without mother earth, but the planet can live without humans."

Fortunately, there is a growing concern among citizens regarding these issues. From celebrities to common people, everyone is becoming increasingly interested in protecting the environment. There is a growing trend towards green products.

In response to this, businesses have started to adjust their behavior. The marketer is expected to sustain a clean and healthy environment voluntarily, as a part of corporate social responsibility. This can also be used effectively in marketing strategies. Eco marks on products attract more consumers and are an effective promotion tool.

Green Marketing refers to all activities that facilitate any exchange intended to satisfy human needs and wants in such a way that the satisfaction of the said needs and wants occurs with the minimum detrimental impact on the natural environment.

In this era where consumers determine the fate of a company, green marketing imparts a proactive strategy for these companies to cater to the market by imparting nature-friendly products and services. A green-marketing approach promotes the integration of environmental issues into all aspects of corporate activities.

1.2 SIGNIFICANCE OF THE STUDY

With the ever-increasing environmental issues, it is high time green marketing is normalized. Green products are much more than just an aesthetic; it is a matter of environmental and social morality. Green marketing shouldn't be reduced to just

another method of marketing, instead, it should be promoted with great significance. Marketers hold the responsibility of making consumers aware of the availability and advantages of green products. The Government has also started to encourage green initiatives.

Green marketing is becoming popular as more people become disturbed with environmental issues and resolve to spend their money in a way that is non-detrimental to the planet. Additionally, it offers a wide spectrum of promotion strategies and helps firms in positioning themselves in the market.

A drastic transformation would take place if every business adopted green marketing practices since it is a vital factor in sustaining the planet. However, not much research concerning green marketing has been done in India and there is a question about the awareness of green products among consumers.

This study focuses on identifying the advantages and limitations of green marketing and the manner in which green marketing practices are perceived by the ultimate consumers.

1.3 SCOPE OF THE STUDY

Consumer Demand Studies have revealed that Indian consumers are emotional buyers. The growing population of green-oriented gives a lot of scope for green marketing to expand. Environmentally aware consumers prefer organizations that deliver safe green products.

Competition Practicing green marketing offers leverage in the industry. Organizations that have not adopted green marketing strategies are under pressure to adopt them to face competition in the industry.

Corporate Social Responsibility Organizations like the TATA group practice green marketing as an obligation towards the environment and society. This also contributes towards the company's corporate social responsibility.

Government Initiatives The government has laid down various policies and guidelines for companies to adopt practices that are environmentally safe.

Now is the right time to select “Green Marketing” globally. A drastic change will take place in the world of business if all nations make strict roles because green marketing is essential to save the world from pollution. Green marketing assumes even more importance and relevance in developing countries like India.

The responses for this study were collected from Ernakulam, a district in Kerala, India. The survey was conducted during the months of January 2022 to February 2022.

1.4 STATEMENT OF THE PROBLEM

Mass production is inevitable to satisfy the expanding population. The limited natural resources of the planet have to be used judiciously to satisfy human needs and environmental damage should be kept to the minimum. If not, mankind will face the consequences of environmental deterioration.

Green marketing refers to the practice of developing and promoting based on their real or perceived environmental sustainability. This study is conducted on the topic “Green marketing – A study on consumer perception and preferences”.

The focus of this study is to understand the attitude of consumers towards green products and green marketing and to identify the factors that influence green consumer purchase decisions.

1.5 OBJECTIVES OF THE STUDY

The main objective of the study is to understand the perception and attitudes of consumers towards green products and green marketing and to analyze their behavior towards the same.

- To understand the awareness level of the consumers towards green marketing.
- To study the influence of various demographic factors on green marketing.
- To examine the factors that influence the consumer to buy green products.
- To analyze the level of satisfaction towards the usage of green products.

1.6 RESEARCH METHODOLOGY

Research Design: The study is both descriptive and analytical. The analytical part analyses consumer perception and preferences regarding green marketing.

Collection of data: Data collected consists of both primary and secondary data.

Primary Data: This was collected by circulating google forms among consumers residing in the district of Ernakulam.

Secondary Data: This was collected from published sources like journals, articles, websites, etc.

Sampling Design: The convenient sampling technique has been adopted to analyze consumer perception regarding green marketing.

Population: The population under study is limited to consumers residing in Ernakulam.

Sample Size: A sample of 120 consumers is considered under study.

Tools of analysis: Percentage analysis, ranking method, etc have been used to analyze the primary data collected.

1.7 LIMITATIONS OF THE STUDY

Some limitations of the study are:

- Period of study is restricted due to time constraints.
- The study is based on information collected from randomly selected respondents and hence, there might be sampling errors.
- There are also significant place constraints.

1.8 KEYWORDS

- **Environmental Degradation:** It is a process in which the environment is endangered in some way, reducing biological diversity and the general health of the environment.

- **Social Responsibility:** Businesses, in addition to increasing the shareholders' value, must act in a way that benefits the community.
- **Green products:** These can be described as products that contain recycled materials, reduce waste, save energy or water, use less packaging, and reduce the amount of toxic or waste products used or disposed of.
- **Green consumer:** Someone who is aware of his or her obligation to protect the environment by selectively purchasing green products or services.
- **Purchasing behavior:** It is the decision processes and acts of people involved in buying and using products.
- **Marketing mix:** The set of actions, or tactics, that a company uses to promote its brand or product in the market. The 4Ps make up a typical marketing mix - Price, Product, Promotion, and Place.
- **Sustainable Growth:** Development that meets the needs of the current generation without compromising the ability of the next generation to meet its needs.

CHAPTER 2
REVIEW OF LITERATURE

2.1 INTRODUCTION

Green Marketing is becoming a popular research area both locally and around the world. Several studies have been conducted on green marketing and a good majority of those are about green strategies adopted by companies and consumer perception of green marketing. In our research, we desire to analyze consumer preferences and perceptions of the same.

We have attempted to provide a review of different literature based on the area of green marketing. These research papers and journals have helped us to obtain a better understanding of the theoretical and practical aspects of green marketing. We could also learn about many terms related to this area such as green loyalty, green branding, eco-labeling, etc. Many journals provide different definitions of green marketing.

The term Green Marketing became notable in the late 1980s and early 1990s. **The American Marketing Association** hosted the very first discussion group on "Ecological Marketing" in the year **1975**. This workshop led to the publishing of one of the first books on green marketing named "Ecological Marketing.

Polonsky (1994) defines green marketing as all activities envisioned to create and help any exchanges intended to satisfy human needs or wants, such that the fulfillment of these needs and wants occur, with a minimal negative impact on the natural environment.

Peattie (1995) describes green marketing as a management process of identifying, anticipating, and satisfying the consumers' needs and wants, with profitability as well as sustainability.

The definition of green marketing has evolved greatly since its start in the 1970s. According to **Peattie (2001)**, the development of green marketing has three phases. The first phase was termed "Ecological" green marketing, and during this phase, all marketing activities were done to provide remedies for environmental issues. The second phase was "Environmental" green marketing and the attention shifted to clean technology that included designing advanced new products, to

take care of pollution and waste problems. The third phase was "Sustainable" green marketing. It emerged in the late 1990s and early 2000.

It is noticed by **Polonsky (1994)** that, a big part of society believes that, green marketing refers solely to the promotion or advertising of products with environmental attributes. The let-down of some green marketing strategies is that companies have used the environment as an additional promotional tool without taking any effort to analyze or alter the original product itself and its environmental impact (**King, 1985**).

Polonsky (1994) also states that green marketing integrates an extensive range of activities, like product alteration, changes to production, variations in packaging, as well as modifying advertising. Green marketing has developed and changed over a period of time.

2.2 LITERATURE REVIEW

Several studies have been conducted in this area. A brief review of some papers has been included below.

- 1. Suma S. R. (Oct. 2013, University of Kerala, Trivandrum) in her thesis on "Green Marketing with Special Reference to Fast Moving Consumers Goods"**

The study proposes to identify and inspect the strategies employed by the FMCGs to achieve their goal and how the consumer shifts their interest from conventional products to green products. Through this study, the researcher tried to examine the factors affecting the green purchasing behavior of the customers.

From the research report, we understand that product quality is the most significant motivational factor. Knowledge and concern about the environment and the seriousness of environmental problems are also responsible for consumer behavior towards green products.

Marketing factors like product quality, price, promotion, and distribution also affect purchasing behavior. Customers expressed a desire for green products to be less expensive, easy to use, to be made of natural ingredients. Some reasons why customers have not purchased green products are mainly because of unavailability, restricted choices, high prices, etc.

2. Ms. Artee Aggrawal (August, 2010 D.Y. Patil University) in her thesis on “Factors affecting Green Marketing in India: A study of Metro consumers”

The research was conducted with the objective to understand the factors affecting green purchasing behavior among Indian consumers. The researcher tried to establish a relationship between the 11 factors with other demographic aspects.

The 11 factors under the study were:

1. Concern for health and environment, 2. Eco buying attitude, 3. Social responsibility, 4. Eco-certification, 5. Social awareness and value, 6. Lifestyle, 7. Absence of marketing, 8. Promotion, 9. Brand consciousness, 10. Indifferent attitude, 11. Packaging.

Analysis of the above factors disclosed that "Concern for health and environment" was considered the most important determining. Eco-certification and social awareness also proved to be important factors. Indifferent attitude came out as the least important factor. Gender and qualification had a significant connection with green purchasing behavior. Age didn't have a noteworthy relationship with green purchasing behavior.

3. Mr. Suresh Chandra Padhy (January, 2014 D.Y. Patil University) in his thesis on “A Study of Green Marketing Practices in Selected Automobile Companies and its Effect on the Consumers in Pune and Aurangabad”

The researcher classified consumers into four categories. These were “serious green”, “just green”, “fashionable green” and “not green”. Mr. Suresh Padhy found that a majority of the consumers were aware and concerned about environmental issues. A lot of consumers felt that companies are not implementing proper green practices. Eco-friendly products are quite expensive.

Consumers are aware that “green” has something to do with the environment but they don’t fully understand the term green marketing. Consumers gave more importance to the features and quality of the products instead of their effects on the environment. The researcher advised that companies should take an initiative to educate consumers about green marketing and its practices.

4. Ms. Jamindar Deepa Shivaji Kunda (October, 2019 University Of Mumbai) in her thesis “A Study on Consumer Perception Towards Green Marketing in Fast Moving Consumer Goods with Special Reference to Mumbai, Thane, and Ratnagiri Districts”

The study was conducted to find out consumers' perceptions of FMCG green products. The main objectives were to understand the awareness level of the consumers regarding green marketing and to determine the factors motivating consumers to purchase green products.

We can see that a huge majority of the respondents are concerned about the environment and a good portion of them are aware of the green marketing concept and have purchased green products. The respondents belonging to the 18-25 age group are the ones who mainly use eco-friendly products. We can also see that there are more female consumers of green products. The main quality they expect from green products is for them to be made of natural ingredients and to be available at a reasonable price. A large number of consumers are ready to pay more for green products. If eco-friendly products are produced, priced, distributed, and promoted effectively, consumers will definitely make good use of them.

5. Dinuk Arseculeratne, Rashad Yazdanifard (November, 2013, Centre of Southern New Hampshire University (SNHU) in their thesis on “How Green Marketing Can Create a Sustainable Competitive Advantage for a Business”

The thesis paper discusses the importance of competitive profit for business companies and how green marketing relies on business firms to gain a competitive advantage. The thesis paper focuses on the use of green marketing strategy to provide an overview of how various businesses incorporate marketing combinations into the green market.

A business plan is made by responding to changes in market demand and green marketing has received significant momentum with the revitalization of environmental awareness among consumers. Requirements for an effective green marketing strategy are identified. The strategy relies heavily on the contribution, collaboration, and cooperation of various business stakeholders. Green marketing actually represents a paradigm change strategy in many business firms as they have changed the way the business moves towards accessing customers.

6. Magali Morel, Francis Kwakye (Spring Semester, 2012, Umea School of Business) in their thesis on “Green Marketing: Consumers Attitude towards Eco-Friendly Products and Purchase Intention in the FMCG Sector”

The research study is about green marketing but especially on consumer attitudes and the purpose of purchasing eco-friendly products. It has been a worldwide concern for this purpose for the conservation of pollution and environmental degradation. The purpose of this study was to identify and evaluate the impact of the four traditional elements of marketing, satisfaction, and word of mouth (WOM) on attitude as well as purchasing intentions in eco-friendly products, especially mobile consumer goods (FMCG) or non-permanent consumer goods.

Their discovery revealed that consumers are already buying eco-friendly products and those who were satisfied with previous purchases were willing to resume using the products. In addition, the importance of WOM advertising on green products, and the fact that consumers believe in green demand explains the variation of the purpose of purchase.

7. Dr. Shruti P Maheshwari (2014, Shri Vaishnav Institute of Management, Indore) in her thesis on “Awareness of Green Marketing and its Influence on the Buying Behaviour of Consumers: Special Reference to Madhya Pradesh, India”

This paper examines consumers' beliefs and attitudes about environmental protection and their eco-friendly shopping behavior. This paper indicates that

consumers are not adequately exposed to green material advertising communications and hence the researcher suggests greater use of marketing to promote and sell existing products that are environmentally friendly and effective.

It also reviews consumer behavior and the impact of communication and marketing to identify consumer behavior on how they are encouraged to choose green products. This study confirms the existence of an environmental action gap, a gap between consumer beliefs and behavior over being green. Overall, it is clear that the Indian market for green products is not being exploited by advertisers within consumer groups with environmentally friendly values.

8. Olivia Hagman, Ida Segerqvist, Sofie Wahlstrom (May, 2017, Jonkoping University) in their thesis on “Credibility of Green Marketing in the Fast Fashion Industry”

This thesis aims to investigate to what extent consumers see green marketing as a parallel, in the context of the fast-growing fashion industry. It also assesses which green marketing claims, expressed by fast-growing fashion companies, consumers see as trustworthy and why.

This thesis suggests that fast-moving fashion companies should understand what affects the consistency of their green marketing. There are six factors to consider: green marketing vision; past view of companies as well brands; industry limitations; the effect of price reliability; short term v/s long-term solutions; and showing results.

The research suggests that fast fashion companies should focus on green marketing the product and process as these are considered the most reliable. The results suggest that if the company can create a credible image about sustainability, its green marketing will be considered credible. If fast-growing fashion companies are working to survive with a long-term vision, they should have honest and sincere motives for their green effort.

9. Hahhighatdoust, Gholamreza (2020) in their thesis of "Green marketing a study of consumer perception and preferences in India"

Respondents displayed considerable knowledge levels of green marketing and environmental deterioration. It was found that there was no significant relationship between gender and awareness of green products. It was found that the respondents strongly felt that green marketing influenced their purchasing behavior.

It emerged that green products were not reasonably priced, were not easily accessible, and were not adequately promoted. Respondents were influenced by the promotion of green products and felt that packaging, labeling, and product information strongly influenced their purchase decisions.

Green marketers should identify such segments of consumers and accordingly, design and market products at suitable price levels. Advertisements campaigns may be used to promote the use of eco-friendly products. Society should make it clear that green products are for environmental benefits as well as for their value satisfaction.

10. Singh, Trilok Pratap (2018) in their thesis on " Impact of Green Marketing on Consumer Attitudes and Behavioural Intentions "

Green marketing plays a vital role in the environmental management of any country. From this study, the researcher has found that all the stakeholders show awareness of green marketing practices at a satisfactory level. However, the level of awareness is not up to the mark. Moreover, the stakeholders face difficulties in implementing green marketing practices in their position.

Green awareness positively influences and affects the customers' imagery and enhances brand recall and recognition. Green trust positively contributes by making them aware of the value or utility of extra money being given to them. Green brand image enhances the credibility of information disseminated by related brands and positively builds the buying intentions of the Customers. Green

concern enhances the probability of potential product purchase as compared to conventional products.

Customers are going for conspicuous green product purchases, and are also prepared to invest additional time and are willing to pay an additional price for the purchase of green products.

11. Singh Rajendra (2018) in their thesis "Green Marketing Strategies for consumer durables in India"

The above study reveals that females are more interested in buying green products as compared to men. As the age increases, starting from 48 years until 60 years, respondents' buying behavior towards green products also increases. As the people get more educated their responsibilities towards family, society, etc grow. They are more aware of products and their uses. Respondents whose earning capacity is more than 20,000 per month are able to spend more on green purchases, as green products are expensive. Generally, the middle and rich family class can afford to buy these products.

The study also revealed that consumers' buying habit toward green purchasing is positive. If product quality in relation to the company's green strategies is matched with the expectation of consumers, the company will definitely achieve a competitive advantage in the long run both in the local and international markets. Green marketing itself has a broader scope.

12. Haytko, D. L. & Matulich. E. (2008) in their thesis "Green Advertising and Environmentally Responsible Consumer Behaviours: Linkages Examined"

They evaluated that some aspects like the ever-increasing global warming and other related made changes or as they stated "transformations" to the perceptions of consumers towards green or environmental advertising.

Factor analysis on environmentally responsible consumer behavior extracted 5 factors namely: "environmental activism", "everyday environmental thoughts and

behaviors”, “respondents’ “environmental responsibility” and “understanding of environmental issues”.

To link between the two, respondents were coded into 2 groups: environmentally responsible and environmentally apathetic. Environmentally responsible respondents had a more positive attitude towards green advertising than those who were environmentally apathetic.

CHAPTER 3
THEORETICAL FRAMEWORK

3.1 INTRODUCTION

Concern for the environment is now a phenomenon of sorts. For a developing country like India, the future is bright from an industrialization point of view but at the cost of deteriorating the environment. The impact hits harder considering how it's the most densely populated country on the planet.

This has raised concerns among consumers and has started affecting their purchase decisions. Companies now incorporate these concerns to function in a way that satisfies the public. Green marketing is an inclusive term. A green company may manufacture green products and market them in an environment-friendly manner. They may also participate in activities like large-scale afforestation, organizing ocean cleaning campaigns, etc. In addition, they may also operate using renewable energy sources. They function in a way that is not as detrimental to the environment as conventional manufacturing practices.

Green companies pay a lot of attention to the product packaging and product promotion as these are key points that attract and are most noticed by potential customers.

3.2 GREEN MARKETING

Green Marketing is also known as ecological marketing and environmental marketing. Green marketing is not just about making green claims or packaging or promotion. It involves more than mere image building. It is a much broader concept and covers the different marketing activities which the firms undertake to either create a positive impression or lessen the detrimental impact of their product or services on the environment (Jain & Kaur, 2003a).

Green Marketing includes market research to identify the target market and target segment for the product, studying marketers' awareness, attitude, and behavior toward the green products. It also involves positioning and creating the brand image of the products and developing a green marketing mix program (Jain & Kaur, 2003b). It promotes environmental core values into the corporate culture of

many organizations and enterprises forcing the organizations to produce environmentally safe products and practice green marketing philosophy.

Green Marketing may be viewed as a marketing activity as well as a marketing philosophy (Jain and Kaur, 2003a). Marketing green products such as hospitality efficient hotels, and energy-efficient electric bulbs are examples of marketing activity. “Save conventional energy” and “conserve natural habitat” programs are examples of marketing philosophy.

Green marketing involves the whole range of marketing activities for products and services that satisfy the customers’ wants and needs for quality, performance, affordable pricing, and convenience without leaving or leaving a less detrimental impact on the environment.

Some successful green products are energy star-rated appliances, energy-efficient electronic devices, environment-friendly household products, and alternative hotels, restaurants, and spas.

Studies have shown that marketers are gaining awareness regarding the importance of environment-friendly products, and the impact of the environment on human life, and they prefer green products to conventional goods that harm the environment. Consumers and marketers are also becoming more outspoken regarding their needs for environmentally safe products, even if they have to pay a higher premium for this. This demand has forced organizations to practice green marketing to serve the needs of customers although it is in its inception stage.

The main motive of Green Marketing is to focus on renewable resources and provide support to the natural environment with minimum harm to society and try and use the product for a longer duration. All this is progress towards a future of sustainable development.

3.3 SIGNIFICANCE OF GREEN MARKETING

Increasing population and overproduction of goods have led to the pollution of natural surroundings for the past few decades. Hence, there's a growing interest among people concerning the protection of the environment and many are changing their buying behavior for the same.

A new culture of buying organic and eco-friendly products has shifted the focus to a new marketing platform - green marketing. A completely new market for consumers to buy green products rather than non-green products. Green marketing is not only environmentally friendly but benefits the company in the long run.

Going green reduces waste by lowering operating costs and also creates additional savings, both naturally and economically. Business equipment and environmentally friendly processes such as dimmer lights or LED lights, water conservation policies, compulsory recycling, and hybrid vehicles save money on consumables, fuel, etc. This creates a positive cash flow.

With the "Go Green" campaign, companies can create an impression of having a responsible attitude towards natural resources. This in turn encourages the customers to adopt more eco-friendly and clean practices. All of this creates a positive image of the product in the eyes of existing and potential customers.

Being green always adds to the consumer base. This feature also gives a competitive advantage over other companies in the same marketing line. In addition, it sets an example for the public, of how environmental marketing can transform society.

A green and eco-friendly lifestyle will help us progress towards sustainability. As there is no limit to individual needs and resource requirements, and the current availability of resources is not sufficient to satisfy these needs, green marketers need to help consumers use resources efficiently.

Green marketing is a new way to compete. A customer accepts products with an eco-label heartily. Today both individual and industrial consumers are deeply concerned about eco-friendly products. Although there are advances in technology, customers vote for an organization that produces environmentally friendly products. This has led to competition in the field of marketing.

Business organizations are a very important part of the nation and its economy. They help the government in many ways. They create jobs in the community. They are a source of income and contribute to the development of the country. Business organizations can support the government through green advertising. They help reinforce the government policies regarding environmental protection.

In eco-friendly advertising, natural materials with minimal damage to the earth are used. It is easily available and inexpensive. Green products save costs in the long run and are efficient when the whole life of the product is considered. It does not pollute the environment. Therefore, business organizations do not need to invest a lot of money in cleaning and public health.

Business organizations can improve customer engagement through green marketing. Relationship marketing does not focus on quick sales, instead, it is aimed at building a large group of satisfied and loyal customers representing the business and its product. Reasonable and sensible customers highly value the efforts of business firms in environmental protection.

Green marketing is an effort made by business organizations to save the world by producing eco-friendly goods and performing green activities. Green marketing thus helps in the survival of the planet.

3.4 CHARACTERISTICS OF GREEN MARKETING

Green marketing is a marketing philosophy that promotes the production and sale of clean eco-friendly products with environmental protection. Green marketing emphasizes the long-term protection of consumers and the public by producing

and using pure, useful, and high-quality products without any negative impact on the environment.

Green marketing involves many activities. Green marketing promotes the production of pure products through pure technology, energy conservation, environmental conservation, minimal use of natural resources, etc.

The efforts of individuals, social organizations, firms, and governments in this regard can be described as green marketing efforts. The media has begun its campaign to protect the planet from further deterioration. Efforts are being made worldwide to conserve natural resources.

3.5 EVOLUTION OF GREEN MARKETING

At the start of the industrial revolution in early 1920, the philosophies of the companies were to produce low-cost products. The demand for the products was so high and hence, there was no need to market them. Firms were able to sell whatsoever they produced. During the early 1930s, competition among firms started. There was more choice between firms. To win over this competition, firms started what was known as the “Selling Concept” by which firms tried to persuade customers through personal selling and advertising.

Decades passed and in 1960, yet another philosophy emerged. Here, the customer is king and they purchase the satisfaction of a want. Firms started spending all their energy to try and identify the needs of customers and produce goods and services according to their requirements. However, they were only focused on satisfying customers without paying heed to social morality.

The 1970s era was known as the social marketing era. Along with profit maximization and customer satisfaction, social interest was also considered a part of marketing. But even though social interests were brought to attention, the prospect of earning quick money won over and overpowered everything. This resulted in serious problems like pollution, acid rain, ozone layer depletion,

deforestation, increased greenhouse gas emission, etc. Global warming has also become a serious issue.

Now, the government has ratified a good number of guidelines to control this perilous situation. In addition to this, customers are increasingly concerned and have started demanding products that do not harm the environment. The Supreme Court of India has come forward to implement the rules and regulations on companies to produce environment-friendly products. As a result, companies have come a long way from being “business-friendly” to becoming “marketer friendly” to “environment friendly”.

Since the beginning of the 21st century, companies have started to comprehend the benefits of practicing green marketing and manufacturing green products. They have realized that resources are limited and human wants are unlimited. Growing concern for the environment is seen among Marketers. Environmental regulations and judicial pronouncements to protect the environment are already in place. Green marketing practices have been embraced by companies to employ resources efficiently by minimizing waste, accomplishing the organization’s objectives, and confirming the environmental legislation.

3.6 ADVANTAGES OF GREEN MARKETING

Green Marketing has been accepted and implemented by many firms worldwide. Many studies have suggested several reasons for the companies trying to become green and follow green practices. Green Marketing has several positive influences on the different stakeholders of the economy.

1. Enter new markets.

When a company emphasizes the positive effects that its product or service has, it has the potential to reach new target consumers. Residents who have never considered adopting solar electricity, for example, may change their minds if the information is clear, simple, and tailored to their requirements.

Highlighting sustainable manufacturing processes, the usage of eco-friendly and organic items in the workplace, composting and recycling at work, and carpooling to work are all examples of green marketing benefits.

The list goes on and on. Packaging that is less or better, paperless policy, recycling printer cartridges, planting trees, and lowering your carbon footprint are all examples of ways to reduce your carbon footprint. Every business has the opportunity to publicize its efforts, which is why green marketing provides so many advantages in terms of reaching and educating new consumers.

2. Improved earnings for the green company

For the millennial generation, sustainability is a major priority. They are prepared to pay more for items and services that they believe are environmentally friendly or have a favorable social impact. Customers feel comforted when their items are chemical-free and produced from recyclable, environmentally friendly materials.

Customers may make educated decisions that assist the environment by using green marketing and awareness efforts. This is a valuable asset since conscientious customers pay attention to the things they buy and use, and will become more active in speaking their opinions about your product, resulting in increased sales.

3. Competitive advantage

Firms that perform green marketing, establish themselves as an aware or responsible industry leader. This is true even for clients who do not place a high value on environmental concerns. It also gives you a broader range of marketing elements to promote and discuss with your clients, going beyond standard techniques like cheap prices, durability, and style.

Instead of just selling the price and value of the product, green marketers focus on its environmental and social advantages.

4. Bring major concerns to the attention of the public.

Partnering with fellow environmental leaders might be part of a company's green marketing strategy if it supports any causes. This may give a campaign, an event, or a training class a lot of traction.

Patagonia, for example, contributes a part of its profits to environmental charity and is widely regarded as one of the most ethical outdoor apparel brands in the world. Their website has an entire section dedicated to environmental and social responsibility. Whole Foods works with its suppliers to promote sustainable agriculture and has even developed its Eco-Scale for cleaning goods.

These are major corporations, but even the tiniest businesses may benefit from green marketing strategies.

5. Corporate Social Responsibility

The environment has become both an element of a company's responsible approach to commercial activity and a possibility for entrepreneurial growth at the same time.

These concepts integrate the notion of corporate social responsibility, which has been and continues to be a hot subject at multiple World Economic Forum annual meetings.

The European Union defines CSR as the voluntary integration of social and environmental issues into day-to-day business operations and contacts with stakeholders. Companies freely choose to contribute to a better community and a cleaner environment under this philosophy.

3.7 DISADVANTAGES OF GREEN MARKETING

Like everything, green marketing also comes with certain disadvantages. This is what hinders consumers and marketers from adopting this practice despite the many benefits provided.

1. Green marketing can be expensive.

Not everyone will be on the board with the green marketing efforts, inside or out. This is because everyone has their ideas about what green is and what it is not. If the firm's marketing efforts are not in line with the personal beliefs and ideologies of consumers, then they will not go out of their way to try and learn about these products.

2. Scepticism

There is a prevailing skepticism many firms claim to market "green" products. Many products promote how "green" they are, when in reality, it may not be true. This is known as greenwashing. When consumers are exposed to such fake products, they will naturally be suspicious of even genuine products.

3. Development and research can prove to be very difficult.

Identifying how the existing product creates a negative impact on the environment can be very complex. It may take a lot of examination to find out what that impact is and how it can be remedied.

And once sufficient data is available, the project will require full commitment to changing the direction to solve the main issue. Because there is no guarantee that these efforts will generate revenue, the costs involved may be difficult to accept.

4. Green marketing can create resistance.

Not everyone likes change. People are accustomed to their ways, are familiar with their habits and practices, and do not like it when this flow is interrupted. An innovative product may even be labeled as disruptive, and consumers will be quick to avoid it without giving it much thought.

5. Perception can affect how people approach your product.

There could be other conventional alternatives to green products that are more expensive than the latter, and some consumers may believe that green products lack quality. The cost of obtaining targeted statistics may incur a lot of time and money.

6. It is still a relatively new concept.

It may not always be successful from a profit perspective, but positive social and environmental impacts can leave a lasting impression. Those ideas, however, may not matter much if the firm's objectives are profit-driven.

3.8 SUSTAINABLE DEVELOPMENT

Sustainable development is one of the major objectives of green marketing. It can be referred to as "satisfying the needs of the present without compromising the capacity of the future generations to meet their own needs". The capacity of our environment is not endless. It means that upcoming generations may not be capable to meet their wants in the manner that we are now. The requirements today are sincere and direct, yet, it's crucial to figure out new ways to meet these needs while not overlooking future requirements.

Human needs are unlimited but the means to satisfy them are limited. Companies should hence meet their objectives while optimizing the use of their resources. The common theme throughout a sustainable development strategy is the need to incorporate economic and ecological considerations in decision-making by creating policies that preserve the value of agricultural advancement and environmental protection.

Implementing sustainable business practices can make the products more attractive while reducing expenses. It also increases brand loyalty. Organizations that practice green marketing are committed to sustainable development and social responsibility. Being sustainable combines many elements such as energy efficiency, utilizing renewable energy, water preservation, waste management and recycling, eco-friendly attire, organic products, sustainable farming, and so on. These are also part of green marketing. Communicating authentic facts about a company's dedication to environmental causes is the key to a successful green marketing strategy. The end product of green marketing is, therefore, environmental protection for the present and the future generation.

Soon, the Government will be adopting more stringent policies to enable sustainable development. Large and small organizations should realize this and progress toward Green Marketing. Immense environmental deterioration has been caused by industrialization and economic development. The Government will have no choice but to impose stricter policies to save the planet. This will be especially severe towards development projects which specifically pose a threat to the environment.

The Government of India has sanctioned the Kyoto Protocol in August 2002 and will hold companies accountable for the environmental damage caused due to corporate operations and take stringent action against them. The G20 leaders are trying to restrain harmful emissions to protect the planet and accomplish sustainable progress.

3.9 FMCG

The Fast Moving Consumer Goods (FMCG) sector is a key participant in the Indian economy. These are everyday products used by every community group regardless of social class, gender, or age. FMCG sector is highly profitable due to low entry rates, embedded distribution network, low operating costs, low per capita use, large consumer base, and simple manufacturing processes. They also have comparatively low investments.

FMCGs are inexpensive products and require minimal purchasing efforts. These are endless products sold in packaged forms. These products are purchased by the end-user regularly in small quantities. The main components of the FMCG can be categorized as Personal Care, Home Care, and Packed Food and Tobacco.

The FMCG product affects all aspects of human life. These products are commonly used by all sections of the community and much of their income is spent on them. Apart from this, this field is one of the most important contributors to the Indian economy. The sector has shown incredible growth over the past few years, even during the recession. The future of the FMCG sector is very promising due to its natural capacity and positive changes in the environment.

Today, FMCGs have become an integral part of human life. This sector created great job opportunities in India even during the recession period, which is why it is one of the most important pillars of the Indian economy.

3.10 GREEN PRODUCTS

A green product is a product that is designed to have little to no negative impact on the environment. It is a sustainable product that is harmless even after its useful life. It has reduced or zero plastic and carbon footprint. Customers may even buy these products not necessarily for environmental reasons. For example, biodegradable paper products like napkins, towels, etc.

Green products usually have two objectives. Reducing wastage and maximizing resource efficiency. They are manufactured using non-toxic ingredients and eco-friendly procedures and are certified by recognized organizations. Brands producing green products often communicate their benefits to the target market using green marketing.

Green products reduce the threat of exhaustion of natural resources since they are made from organic materials and renewable sources of energy. This reduces the emission of greenhouse gases like methane, carbon monoxide, etc.

Green products also last longer and green sources of energy like solar energy reduce the electricity bills of the user. These products also have low maintenance costs. And since these products are free from harmful chemicals and toxins, they improve the physical and mental well-being of their users.

However, green products involve innovation and a good investment. This increases the overall cost of manufacturing the products, which in turn makes them more expensive compared to the available alternatives. This factor usually discourages consumers from purchasing them. In addition to this, a good proportion of the public is still either unaware or ignorant about the benefits of going green.

3.11 GREEN MARKETING PRACTICES

Green marketing practices include all the functions of marketing which talk about customer satisfaction with environmental protection. If the marketer satisfies the need and wants of the customer and take care of the society and stakeholder then we can say that the concept of green marketing practices is properly applied and implemented.

Marketers focus on all components of the marketing mix and each concept is developed and communicated in a very eco-friendly manner. Small companies usually find performing green marketing practices quite difficult due to their lack of resources and increased expenses.

Financially sound companies, however, can perform these practices much more comfortably compared to the former. Companies use this opportunity to enhance their market share and goodwill from the different forms of green marketing practices. It also helps in increasing their sales turnover.

Green marketing practices involve the use of green brands, green advertisements, and green labels in a variety of ways to enhance and develop products to increase their market demand through customer satisfaction. Companies use long-term and short-term strategies at different market levels to try and satisfy every single type of market requirement. This includes innovation supported by new forms of technology to increase the overall effectiveness of green practices.

Green marketing practices can be applied in every sphere, like industrial, consumer durables, FMCGs, etc. Every sector accepts environmental responsibility since they are the cause of environmental pollution at all levels. The Government is also taking an initiative to promote public attention toward green marketing practices. This provides confidence to the marketer and hence they perform more resolutely in the future.

3.12 GREEN MARKETING MIX

The 4 Ps of green marketing are the same as that of traditional marketing. The only difference is the combination of eco-friendly green factors and is known as “green product”, “green price”, “green place”, and “green promotion”.

1. Product

The products are manufactured and developed according to the demands of the customer. It is usually made from organic materials or recycled goods. Green Products save water and energy and minimize environmental harm. Entrepreneurs exploit emerging green markets in two different ways. They either identify customers’ environmental requirements and develop products to fulfill these needs or develop environmentally responsible products to have a more lasting impression than their competitors. Products that support sustainable developments are usually:

- Products that are made from recycled goods
- Products that can be recycled or reused.
- Products that save water, energy, or gasoline, and reduce environmental degradation.
- Products with environmentally responsible packaging.
- Products with green labels.
- Certified products which meet environmentally responsible criteria.
- Organic products.
- Services that rent or loan products.

It is important to confirm that products meet the quality expectations of customers and are thoroughly tested before public use.

2. Price

Organic products are a little expensive compared to conventional ones. Pricing is the most critical element of the marketing mix. Green pricing takes into consideration the people, profit, and the planet. Customers will pay a premium only if they are sure of any additional product value. This may be improved

performance, aesthetic, design, or taste. Environmental benefits are also often the deciding factor between products of similar value or quality.

However, in the long run, when we consider the entire life of durable products, environmentally responsible products, are often less expensive than their counterparts. For example, electric vehicles, solar panels, water-efficient printing, etc.

3. Place

Only a handful of customers will go out of their way to purchase green products out of concern. And therefore, the choice of place to make products available will have a substantial influence on the number of customers enticed.

Activities relating to managing the firm's supply chain by monitoring and refining environmental performance are also included in "green place". Companies have started working together with their channel partners to acquire either reusable or disposable raw materials to practice green marketing

Marketers trying to effectively introduce fairly unfamiliar green products should strongly position them in the broader marketplace so that they don't appeal just to a small green niche market. The location must also be consistent with the image the marketers want to project rather than being compromised by the image of the place. The location must also differentiate green marketers from their competitors.

4. Promotion

Promotion includes advertising, sales promotions, direct marketing, and field promotions. This is a paid form of communication and is specially curated for the target audience.

Smart green marketers will strengthen their environmental integrity by employing more sustainable marketing and communication practices. For example, providing promotional letters and electronic statements by email. E-marketing is rapidly replacing more conventional marketing practices.

Printed materials are rarely used and if necessary, can be produced using recycled materials and energy-efficient procedures like waterless printing. Retailers are recognizing the value of coalitions with other green companies, environmental support groups, and research organizations. To promote their environmental commitment, many retailers no longer use plastic bags and instead sell paper ones.

3.13 GREEN LOGISTICS

Green Logistics is defined as “efforts to measure and reduce the environmental impact of transport activities, using an effective disintegration design”. Companies choose to "Go green" because consumers are concerned about the environment and are basing their purchasing decisions on this. Green companies have a competitive advantage due to the same reasons stated above. Green companies adopt a green transport system to reduce traffic congestion, lessen pollution, promote community compatibility, and save on travel costs. The green system transport infrastructure lays the foundation for the whole system of green logistics.

Logistics is the integrated management of all operations essential to delivering products through the supply chain. For a typical product, this supply chain starts from the raw material source through the production and distribution system up to that point of usage and associated reverse logistics. Planning activities include freight forwarding, storage, asset management, logistics, and related information processing. The main purpose of logistics is to integrate these services in a way that meets the needs of the customer at a minimal cost. In the past, this was defined in monetary terms only.

As concern for the environment increase, companies should take into account the external costs of logistics particularly related to climate change, air pollution, noise, and accidents. Logistics is an important function of modern transportation systems. Although traditional logistics seeks to plan forward distribution, i.e., transport, warehouse, packaging, and handling of goods from manufacturer to

buyer, environmental considerations opened up markets for recycling and disposal and led to a whole new sub-sector called green logistics.

Green Logistics is a type of logistics that gives importance to social and environment-friendly activities instead of just economic activities. It takes effort in measuring and minimizing the environmental impact of planning activities. This covers every operation to streamline and deploy products, information, and services between the point of origin and place of use. It is to build the value of a sustainable company.

3.14 APPROPRIATE USE OF A GREEN MARKETING STRATEGY

Green marketing goals must be included in corporate planning as part of a holistic approach. Both green and traditional marketing has two major themes: marketing mix and marketing strategy.

The individual STP process sequences are demand measurement, segmentation, target market selection, and positioning. An organization approaches the design and selection of a suitable strategy using the STP process.

According to Ginsberg and Bloom, a corporation can choose from the four tactics listed and apply them to ecologies, goods, and the whole economy of green market sectors. The vertical axis depicts the green market segments' potential to absorb, while the horizontal axis depicts an enterprise's ability to differentiate its product by going green.

1. Lean green

A company that attempts to be socially responsible but does not focus on alerting the public about its efforts. It focuses on lowering costs and enhancing efficiency through environmental initiatives, resulting in a low-cost competitive advantage.

2. Defensive green marketing

A company utilizes green marketing to avoid a catastrophe or to defend itself from the competition. Although environmental activities are promising and long-term, efforts to promote them are intermittent and transient, since the goal is not to differentiate oneself from the competitors by engaging in green activities.

3. Shared green

A business invests over time in ecologically friendly operations, involving considerable financial and non-financial resources. Green marketing, according to the corporation, is a chance to develop unique goods and solutions that satisfy client demands, giving it a competitive edge. First and foremost, it promotes the consumer's immediate and concrete advantages; second, it stimulates environmental engagement.

4. Extremely environmentally friendly

Environmental concerns are completely incorporated into company operations and the product life cycle. Dedicated outlets and distribution channels are frequently used to service niche markets (market gaps).

3.15 GREEN CONSUMERISM

Green consumerism refers to a situation in which consumers want products and services that have undergone an eco-friendly production process and that can be recycled or deposited without causing environmental harm. Green consumerism includes the production, promotion, development, and utilization of goods and services based on their environmental benefits.

Green consumerism is a comprehensive and responsible management system that satisfies, identifies, fulfills, and anticipates the needs of stakeholders in maintaining a natural and environmentally friendly environment.

Economic, social, and cultural forces have set the stage for green consumerism. It is a social attitude and social movement in modern times, especially aimed at encouraging people to be more aware of the manufacturing processes and to only

buy or use environmentally friendly products and services. For this reason, green investing has created a balance between consumer behavior and organizational profit objectives as it is largely based on sustainable and environmentally friendly consumer behavior.

Green consumerism promotes economical packaging options. It has a social attitude such as preferring to buy loose products like vegetables and fruits instead of pre-packaged products. It also promotes the reuse of paper and plastic packaging bags and cans.

As a result of green consumerism, greenhouse gas emissions from the transport and industrial sectors have declined sharply. Also, strict standards have been set against emissions from engines and motors and the development of fossil fuel selection.

Green consumerism attitudes promote energy efficiency, which in turn helps to save money, reduce utility bills, reduce greenhouse gas emissions, and enable the economy to meet growing energy needs. Through green consumerism, the economic benefits of resource systems, as well as the risk management associated with inefficient production processes, have also been achieved.

With the advent of green consumerism, there has been a growing demand for environmentally friendly food production. As a result, people are slowly developing a culture of buying more natural and local foods, which are healthier due to the absence of synthetic chemicals, antibiotics, hormones, pesticides, etc.

Although the decline of green cover and its impact on the natural environment may seem normal and insignificant now, in the years to come, people will realize the significance of sustainable development.

3.16 GREEN LOYALTY

Green loyalty refers to the degree of purchase decisions driven by a commitment toward sustainable development. Although firms have a responsibility to produce

products that have little or no detrimental impact on the environment, in the end, it is the customer who is obliged to use these eco-friendly products.

Education of consumers results in their empowerment. Empowered consumers prefer environmentally safe products when all other features are equal. Ultimately green marketing entails that the consumer must “Think Green, Think clean”. The need for customer trust, confidence, commitment, and loyalty as a result of gratification is vital in green marketing as well as customer relationship. Competitive advantage can be attained by environment-related activities and this serves as an incentive for companies to go green to promote ecologically sustainable business practices.

3.17 KINDS OF GREEN

The green gauge report divides consumers into five different segments. These are True Blues, Greenbacks, Sprouts, Grouzers, and Apathetics.

1. True Blues

This group is committed to environmental causes and lives by them. They are the most ardent environmentalists, believing that they can make a significant impact in rescuing the environment on their own. They have a big effect on others since they are politically and socially engaged. True Blues are six times more likely to donate to environmental organizations and four times more inclined to avoid items manufactured by firms that are not environmentally conscious. They are the most educated group, and they are more likely to hold executive or professional positions.

2. Greenbacks

Greenbacks are those who are ready to pay more for things that are better for the environment. They are among the tiny number of customers who indicate they are willing to spend up to 22% extra on green products. They are concerned about the environment and support environmental activism, but they are too busy to make lifestyle changes. They are not politically engaged in general, but they are willing to express their views on environmental issues. This group has a high level of

green purchasing. They will frequently search for recyclable materials and environmentally friendly items. They avoid purchasing goods from firms that they believe are ecologically unfriendly. Greenbacks are more likely to be married, educated, and young, and to work in white-collar occupations.

3. Sprouts

Sprouts are willing to participate in environmental activities on occasion, but only when they are low-effort. As a result, recycling is their primary environmentally friendly practice. They look at labels to see if they were green. Their environmental stewardship ends at the grocery cash register. If a green product is more expensive than others in the store, sprouts are less likely to pick it. They have a good education. They make up the swing group, which may vote in either direction on any environmental issue. They are frequently the source of new Greenbacks and True-Blues due to their increased education.

4. Grouzers

Individuals, according to Grouzers, do not play a substantial role in environmental protection. Instead, they believe the government and huge companies bear responsibility. They are frequently perplexed and misinformed about environmental issues. Only a small percentage of Grouzers recycle bottles and cans regularly, and they do so reluctantly. They, more than any other group, including the Basic Browns, are considerably more inclined to make excuses for their poor environmental behavior.

Grouzers grumble that they are too busy, that it is difficult to become engaged, that green goods are too expensive and ineffective, and, lastly, that all they do will be insignificant in the grand scheme of things. They have the mindset that it is someone else's issue, so why bother?

5. Apathetics

They are also known as Basic Browns. They aren't tuned in to or aware of their surroundings. They just do not believe that environmental issues are as terrible as

they claim. Browns don't make excuses for their lack of action; they simply don't give a damn. There are simply too many other things to worry about for the Basic Browns.

The way people react to their surroundings varies by section. Companies should keep in mind that consumers' environmental concerns influence not all product categories or single brands equally. True blues show a stronger dedication to the environment. They may be able to influence a broader range of customers in the future since they have a stronger societal impact.

3.18 GREEN CONSUMER PROFILES

The green consumer is only a generic term, there are a variety of profiles that make up this term. The “American Genius” addresses the consumer profiles of three shades of green consumers: eco-chic, economizer, and idealist.

1. The Eco-Chic

The eco-chic customer isn't concerned with the environmental benefits of turning green, rather they are concerned with their image and the coolness element of being green. This customer wants people to know they're hip and fashionable, so if green is "cool," that's what they'll wear.

This customer uses social media extensively and informs their friends and followers that they are environmentally conscious.

These customers are younger than the general population and consider themselves trendsetters and early adopters of technologies and trends. They drive a Prius not because it saves them money or because it is the proper thing to do, but because other people will think they are environmentally conscious if they do.

It's about establishing an identity based on the car you drive (a hybrid) and the clothing you wear (organic cotton clothes). If you want to appeal to this market, your items must be fashionable while still being environmentally sustainable. If you're targeting the eco-chic market, the focus should be on the product's cool

element. The key motivations for this group's consumers to purchase green items are the trendiness and prestige connected with it.

2. The Economizer

The shopper wishes to become green to save money. This type of customer examines items and pricing to see how much money they can make. This individual is more like an eco-chic shopper who doesn't care about the environment and isn't concerned with doing the right thing. It's all about saving money, though.

The economizer will spend more money upfront to save money in the future. This is the individual who considers his purchases to be valuable. For example, upgrading his heating system to a more efficient type today, despite the higher initial cost, will save him money in the long run due to lower fuel expenditures.

Many facts and data are used in marketing tactics to appeal to this demographic. The advertising message should focus on how the product will save them money now and, in the future, as well as how smart they will be if they choose this option.

3. The idealist

The truly green customers are idealists. They choose to become green because it is the proper thing to do for the environment, future generations, and the entire world. They are committed to the green movement, and their activities reflect this belief. They are willing to pay a higher price for green items because they see the benefit that goes beyond money.

For many customers, becoming green is a way of life. They recycle and will go to great lengths to reduce their carbon footprint. They will do everything they can to improve the world's living conditions. They are typically active volunteers who are connected to the community, primarily via professions. They are passionate about sharing ideas and want to make a difference in the world. They are well-versed on the internet.

It's rather easy to market to them. Simple statements stating that doing the right thing is the right thing to do are adequate. There's no need to add anything trendy or cost-effective. The potential environmental impact of such a product must be well stated.

3.19 ROLE OF BRANDING IN GREEN MARKETING

Branding is a distinct marketing technique as well as a critical product characteristic. It is the product's sign and identity that sets it apart from the competitors. Eco-labeling, for example, is the practice of labeling items and services that are more ecologically friendly than their alternatives. In the context of green marketing, however, we must distinguish between a company's brand and its green image, as well as an internationally approved product classification.

Environmental labels are labels that are given to customers to assist them to distinguish between environmentally friendly and conventional products. They assist in overcoming a lack of knowledge. Environmental labeling would be superfluous if all important data about the product and the conditions of its manufacture were known.

The brand value of a company increases when green marketing principles are implemented. It increases the value of its products, gains a competitive advantage, improves the company's image, gains new markets, and is prepared to deal with stakeholder environmental pressures. The image of the green mark, the fulfillment of the expectation of green promises, and trustworthiness are all tied to the notion of creating a brand value related to environmental and social performance. As a result, the green label fits the "3E" criteria: it is ecological (minimizes negative environmental consequences), transparent (does not encourage unfair practices and social injustice), and economically beneficial (supports long-term economic sustainable development).

As previously said, global economic advancements are aimed toward integrated environmental protection, which means that we are assessing not only the product but also the overproduction and post-production processes from an environmental

standpoint. The 2016 State of Green Business Index, which looked at 1600 of the world's top companies, employs three major factors to assess their environmental sustainability efforts: greenhouse gas emissions, water usage, and waste created. The research also looks at overall investments in practical solutions and lists several companies that have an impact on the supply chain, using a selection criterion based on eligible procurement.

All of these indicators are intertwined with green marketing's aims and concepts. According to research, the firms polled established measurable objectives for lowering greenhouse gas emissions, water usage, and waste. Furthermore, data reveals that in all three categories, there is a growth in the number of businesses seeking third-party confirmation of their activities, as well as unique clean technology innovations.

3.20 GREENWASHING

Greenwashing is the process of conveying a false idea or providing misleading information about how a company's products fit into the environment. It is an unsubstantiated claim used to mislead purchasers into believing that an organization's products are environmentally pleasant.

Greenwashing is a play on the word "whitewashing," which means to use misleading information to patch up bad behavior. For example, companies involved in greenwashing may claim that their products come from recycled materials or have energy-saving benefits. While some environmental claims may be partially true, companies that engage in greenwashing often exaggerate their claims or profits to mislead consumers.

Also known as the "green sheen," greenwashing is an effort to benefit from the growing demand for environmentally friendly products, whether that means natural, healthy, chemical-free, recyclable, or slightly wasteful of natural resources.

The term originated in the 1960s when the hotel industry was designing one of the most obvious examples of greenwashing. They posted notices in the hotel rooms asking guests to re-use towels to save space. Hotels enjoy the benefits of lower laundry costs.

Recently, some of the world's largest carbon emitters, such as conventional energy companies, have tried to present themselves as environmental champions. Products are greenwashed through a process of renaming, recycling, or repacking. Green washed products may convey the idea that they are more natural, healthier, or less chemical than competing products.

Companies are engaged in greenwashing through media releases and advertisements that highlight their clean energy or efforts to reduce pollution. But in reality, the company may not be making a significant commitment to green programs. In short, companies that make unsubstantiated claims that their products are environmentally friendly or provide a certain green profit are involved in greenwashing.

3.21 BARRIERS TO GREEN BUYING BEHAVIOUR

Several factors stand in the way of practicing green marketing. This is what makes consumers and marketers hesitant about the idea of green marketing.

1. Lack of Awareness

Marketers are the general public is aware that the present situation of the environment is bad and that their routines are responsible for this degradation. However, they are disorganized and do not know how to act upon it. Companies should educate marketers regarding environmental degeneration, green products the product mix which will satisfy the customers and lead to sustainable growth.

2. Negative Perceptions

Many green companies and green products have a bad reputation. Marketers often believe that green products are expensive but poor in performance and lack the necessary features. This negative perception can be removed only by developing

genuine green products and spreading awareness and communicating solid facts about them to the market.

3. Distrust

Marketers and consumers today are uncertain regarding the quality linked with green products. They often hesitate because they aren't sure if the products are green as claimed by the manufacturers.

To remove this barrier of distrust, firms should be honest in their communication and should be able to prove the genuineness of their products and procedures.

4. High Prices

Price is the largest barrier to Green Marketing. It is seen that marketers observe and conclude benefit of green goods is trivial compared to the premium they pay for them as compared to conventional products.

Marketers also likely find it hard to determine the environmental performance or green claims of a product due to a lack of standards. Claims such as "organic produce", "bio-degradable", and "recycled material", are not always verifiable. Hence, the legitimacy of green products is always a cause of uncertainty in the mind of marketers.

5. Low Availability

Very often, customers and marketers desire green products but they are not easily available. There are many examples, especially in a country like India, like clean energy, green hospitalization, plastic-free packaging, etc. It is not possible to support green products because the local infrastructure does not provide them.

3.22 STEPS TO REMOVE BARRIERS

Knowing what stops marketers from buying green products isn't enough. It is necessary to know how to break down these barriers. Some steps have been suggested to break down these barriers (Sheila Bonini and Jeremy Oppenheim, Fall 2008).

1. Educate Marketers

Firms need to educate their marketers regarding green products because most of them are not aware of green products, their benefits, or their availability relative to conventional products.

2. Build Better Products

There is a misconception that green products are not as efficient as conventional products. Therefore, firms need to ensure that green products are the better alternative. This is because marketers prefer reliability, durability, and performance to environmental friendliness. In this way, marketers will prefer it due to the double benefits.

3. Be Honest

Companies must be honest about their green claims and not make any exaggerated statements. They should communicate only facts about the impact of their products on the environment. They should be able to prove the claims if the situation arises. Otherwise, marketers will not believe the companies.

4. Offer More

Customers will be willing to pay more for green products only if they can confirm that the value received exceeds the costs. They should be provided with both financial and environmental benefits. Marketers should be convinced that their product helps to save the environment in addition to the conventional benefits.

CHAPTER 4
DATA ANALYSIS AND INTERPRETATION

DEMOGRAPHIC VARIABLES

Demographic variables of the respondents surveyed and analyzed include gender, age, and annual income. The following tables and graphs represent the same.

TABLE 4.1 DEMOGRAPHIC DATA: GENDER

SL.NO.	GENDER	NO. OF RESPONDENTS	PERCENTAGE
1	Male	40	33%
2	Female	80	67%
	TOTAL	120	100%

Source: Primary Data

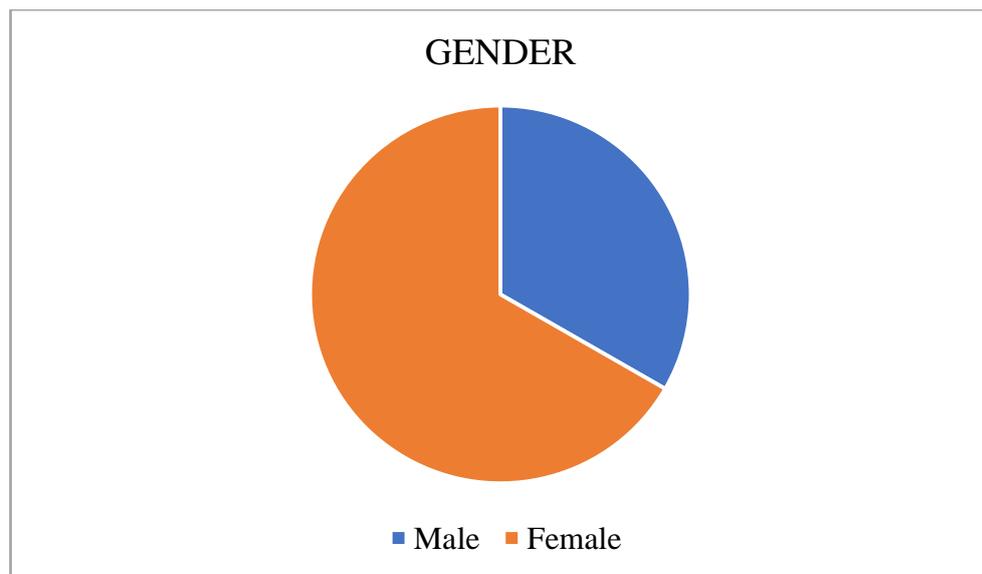


Fig. 4.1: GENDER

INFERENCE

The diagram above shows the demographic data of respondents. 67% of the respondents are female while 33% are male. This indicates that the majority are female.

TABLE 4.2 DEMOGRAPHIC DATA: AGE

SL. NO.	AGE	NO. OF RESPONDENTS	PERCENTAGE
1	18-25	106	88.33%
2	26-32	7	5.83%
3	33-40	1	0.83%
4	Above 40	6	5%
	TOTAL	120	100%

Source: Primary Data

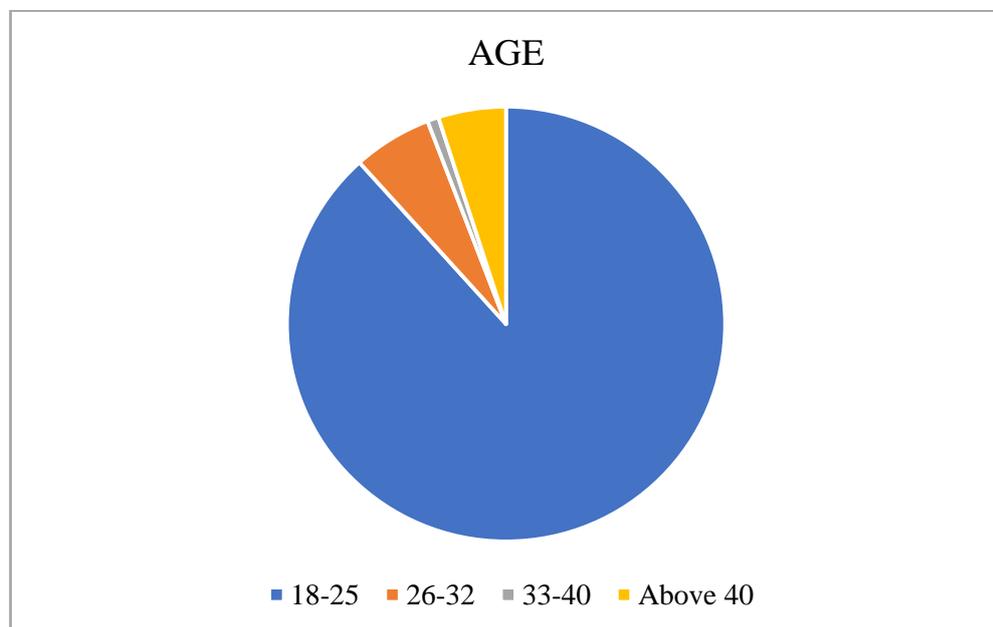


Fig. 4.2: AGE

INFERENCE

The majority of respondents (88.33%) belong to the 18-25 age range. 5.83% belong to the 26-32 age group. The minority (0.83%) belongs to the 33-40 age group while the rest are above 40 (5%).

TABLE 4.3 DEMOGRAPHIC DATA: INCOME

SL. NO.	INCOME	NO. OF RESPONDENTS	PERCENTAGE
1	Below 1 lac	79	65.83%
2	1-5 lacs	27	22.5%
3	6-10 lacs	9	7.5%
4	11-25 lacs	4	3.33%
5	Above 25 lacs	1	0.83%
	TOTAL	120	100%

Source: Primary Data

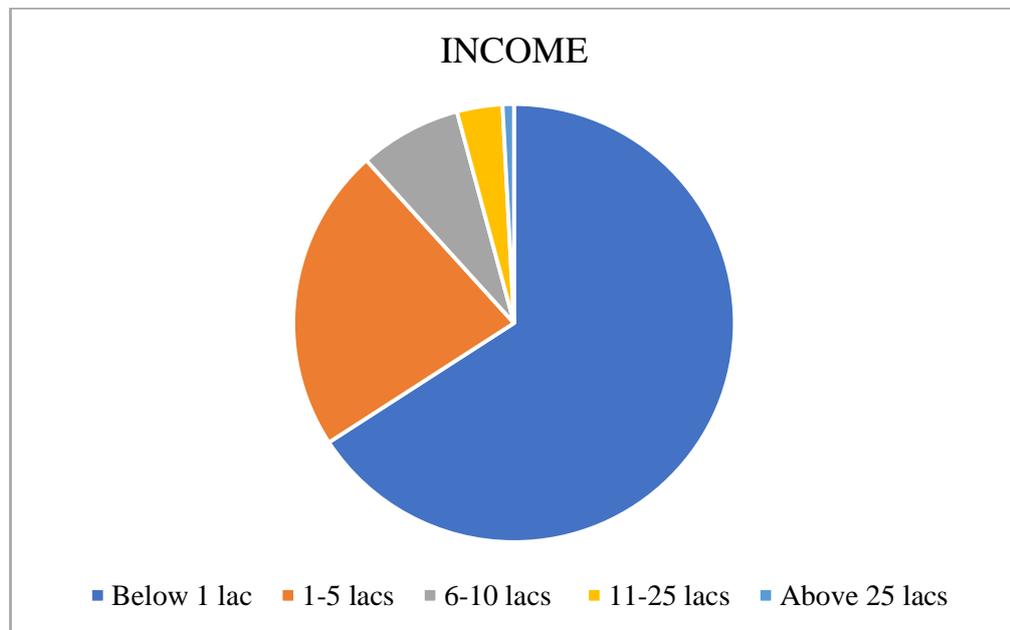


Fig. 4.3: INCOME

INFERENCE

The diagram shows the data regarding the income of the respondents. The majority (65.83%) earn less than 1 lac per annum. This could be respondents in the 18-25 age category as they might be studying currently and hence might not have a regular income. 22.5% of the respondents have an income of 1-5 lacs per annum. This may include some students. 7.5% belong to the 6-10 lacs range while 3.33% have an income between 11 and 25 lacs. The others (0.83%) have an income above 25 lacs.

TABLE 4.4: I am aware of green products.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	55	45.83%
2	Somewhat Agree	49	40.83%
3	Neutral	15	12.5%
4	Somewhat Disagree	0	0%
5	Strongly Disagree	1	0.83%
	TOTAL	120	100%

Source: Primary Data

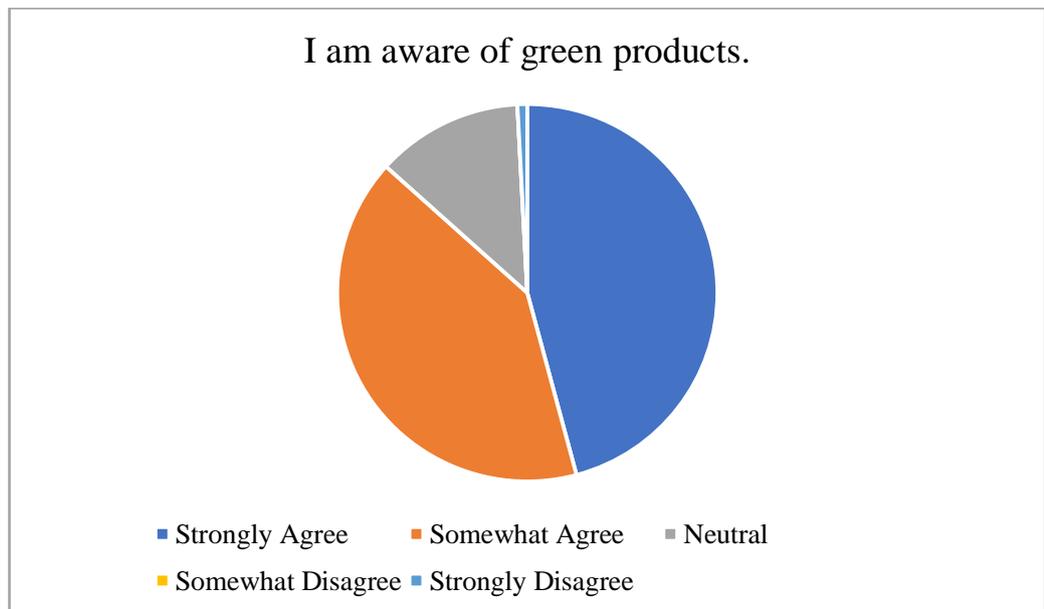


Fig. 4.4: Frequency of awareness of green products.

INFERENCE

The above chart shows the awareness of green products among the respondents. We can see that the majority of them are aware of green products. Among them, 45.83% are aware and 40.83% are somewhat aware of the existence and use of green products. Only 0.83% of the respondents are not at all aware of these products and 12.5% belong to the neutral stage. This shows more than 85% of the focus group is aware of green products to an extent. Nevertheless, measures may be taken for increasing the awareness of green products among consumers.

TABLE 4.5: The environment is severely damaged.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Yes	112	93.33%
2	No	2	1.66%
3	Maybe	6	5%
	TOTAL	120	100%

Source: Primary Data

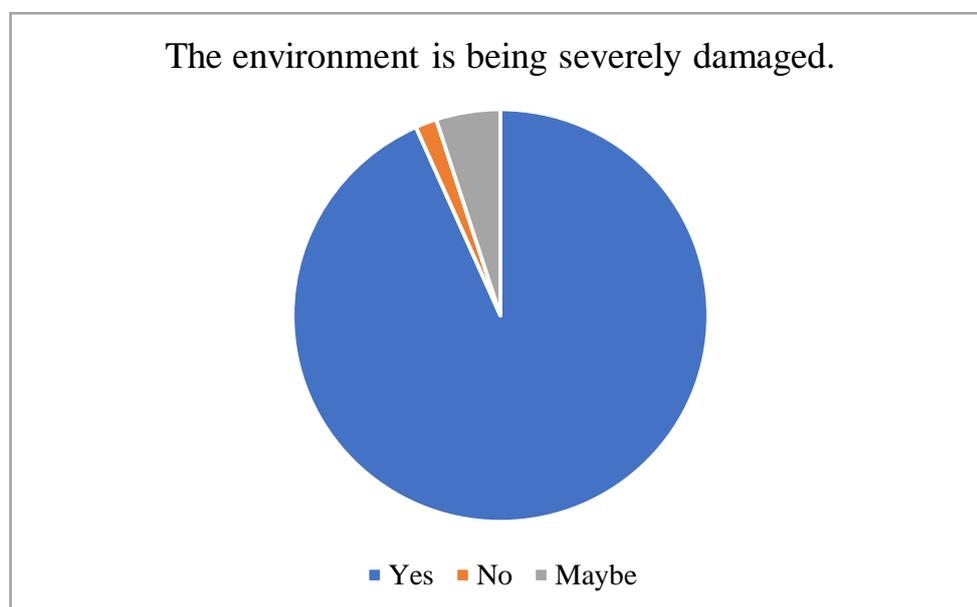


Fig. 4.5: The environment is severely damaged.

INFERENCE

The above diagram shows the respondents' acknowledgment of environmental degradation. Out of the total respondents, 93.33% agree that the environment is in fact, being severely damaged. 1.66% of the focus group are yet to acknowledge the severity of damages to the environment and the rest 5% are unsure of the statement and have answered "maybe" to the said question. Hence, the majority of the respondents agree that the environment is being damaged.

TABLE 4.6: I would describe myself as environmentally responsible.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	59	49.16%
2	Somewhat Agree	42	35%
3	Neutral	17	14.16%
4	Somewhat Disagree	2	1.66%
5	Strongly Disagree	0	0%
	TOTAL	120	100%

Source: Primary Data

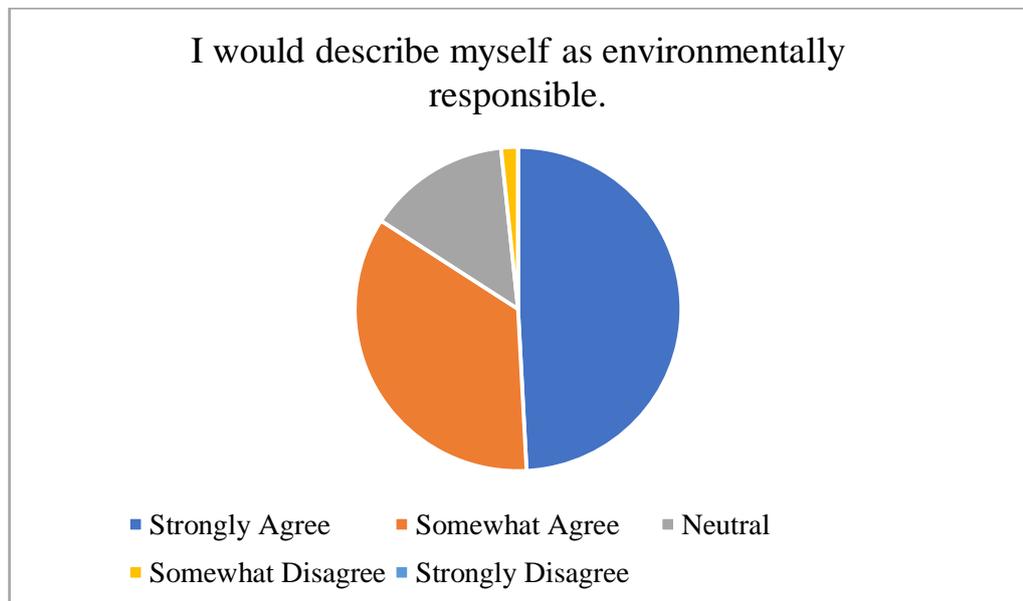


Fig. 4.6: I would describe myself as environmentally responsible.

INFERENCE

The chart shows that majority of the focus group is environmentally responsible. Among them, half of the respondents, i.e.; 49.16% of them strongly agree with this and 35% of them agree only to some degree. 1.66% of respondents somewhat disagree with them being environmentally and 14.16% belong to the neutral stage. There is still a significant shortage of environmentally responsible citizens. Awareness regarding environmental degradation must be spread so that more people recognize the seriousness of the situation.

TABLE 4.7: Green products are the better option for future sustainability.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	89	74.16%
2	Somewhat Agree	25	20.83%
3	Neutral	6	5%
4	Somewhat Disagree	0	0%
5	Strongly Disagree	0	0%
	TOTAL	120	100%

Source: Primary Data

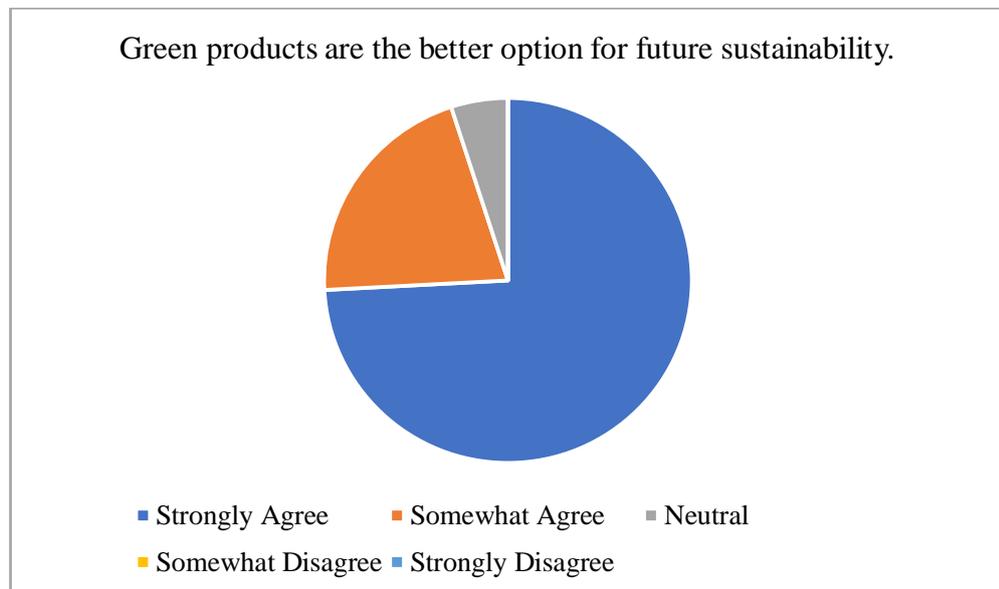


Fig. 4.7: Green products are the better option for future sustainability.

INFERENCE

This chart shows whether the respondents agree or disagree with green products being better products for future sustainability. Almost 95% of them agree with it. Among them, 74.16% strongly agree and 20.83% only agree to an extent on green products are the better option for future sustainability. 5% of the respondents remain neutral. None of them are against the fact that green products are indeed the superior alternative.

TABLE 4.8: Green products are better than non-green products.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	73	60.83%
2	Somewhat Agree	35	29.16%
3	Neutral	8	6.66%
4	Somewhat Disagree	3	2.5%
5	Strongly Disagree	1	0.83%
	TOTAL	120	100%

Source: Primary Data

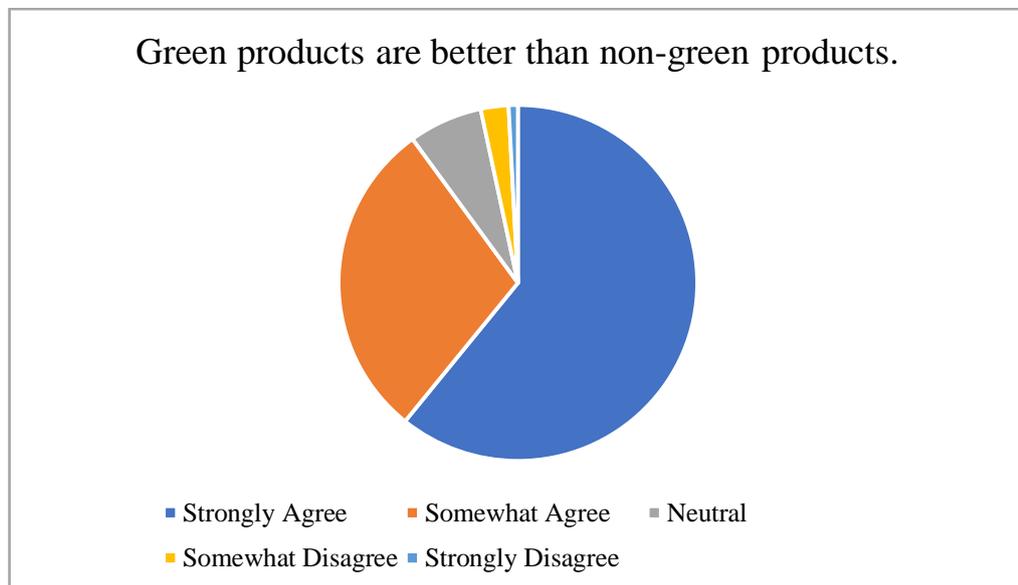


Fig. 4.8: Green products are better than non-green products.

INFERENCE

This diagram shows the preference of respondents for green products over non-green products. More than half of the respondents agree that green products are better than non-green products. 60.83% strongly agree and 29.16% somewhat agree. But 2.5% somewhat disagree and 0.83% strongly disagree and state that non-green products are superior. This could be because of other utilities. 6.66% of the respondents' preferences remain neutral. It may be suggested that brands should put in more effort to manufacture superior products that are environmentally safe.

TABLE 4.9: How often do you purchase/ use green products?

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Very Often	16	13.33%
2	Often	40	33.33%
3	Sometimes	62	51.66%
4	Seldom	2	1.66%
5	Never	0	0%
	TOTAL	120	100%

Source: Primary Data

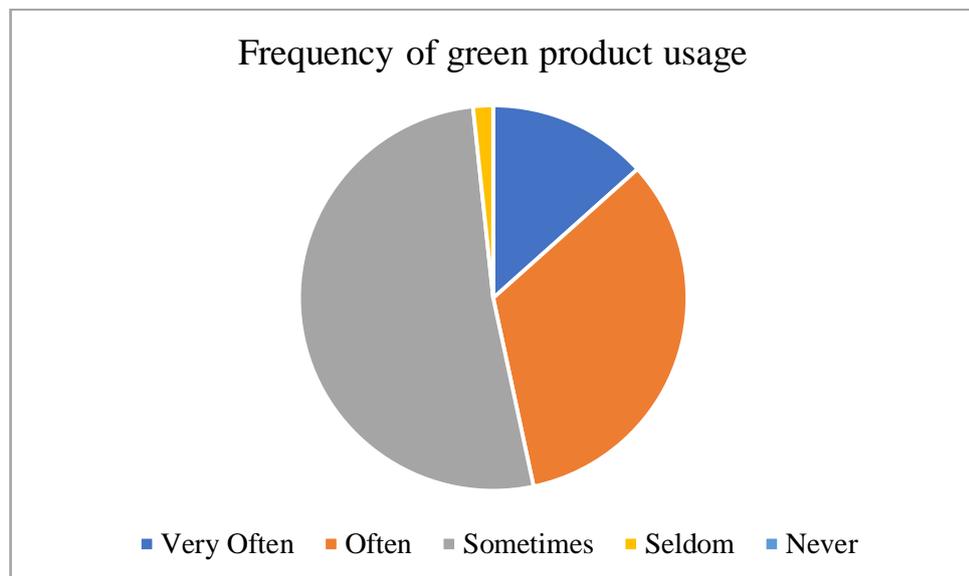


Fig. 4.9: Frequency of green product usage

INFERENCE

This chart shows the frequency of green product usage by the respondents. It is seen that the majority of the respondents (51.66%) use green products only occasionally. A smaller percentage (13.33%) purchase or use green products very often. 1.66% seldom use these products. 33.33% of the respondents use these products often. This chart suggests that measures must be taken to appeal to the consumers about the benefits of using green products in order to increase their demand.

TABLE 4.10: On a scale of 0-5, rate your green product experience.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	1	1	0.83%
2	2	9	7.5%
3	3	35	29.17%
4	4	50	41.67%
5	5	25	20.83%
	TOTAL	120	100%

Source: Primary Data

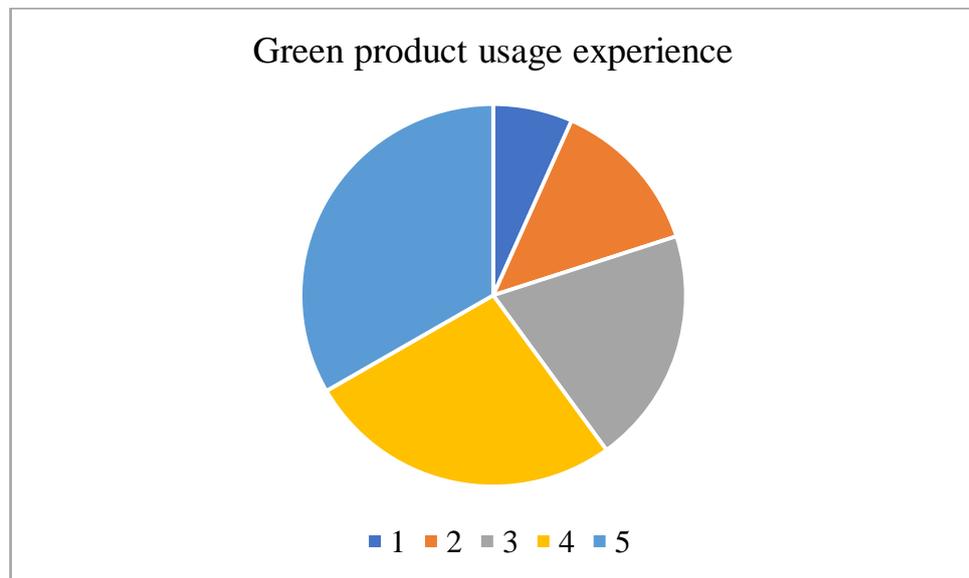


Fig. 4.10: Green product usage experience

INFERENCE

We asked the respondents to rate their experience with green products on a scale of 0-5 and found that 41.67% of them gave a rating of 4 out of 5, showing the majority are fairly satisfied with their experience. 20.83% are strongly satisfied as they've rated 5 on their experience with green products. 29.17% have marked 3 and 7.5% have marked 2. Only 0.83% are highly dissatisfied with their experience and have marked 1. Even though the majority are satisfied with their experience, companies must modify green products and include more attractive and efficient features in them.

TABLE 4.11: Green labels are easy to recognize.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	33	27.5%
2	Somewhat Agree	59	49.16%
3	Neutral	26	21.66%
4	Somewhat Disagree	2	1.66%
5	Strongly Disagree	0	0%
	TOTAL	120	100%

Source: Primary Data

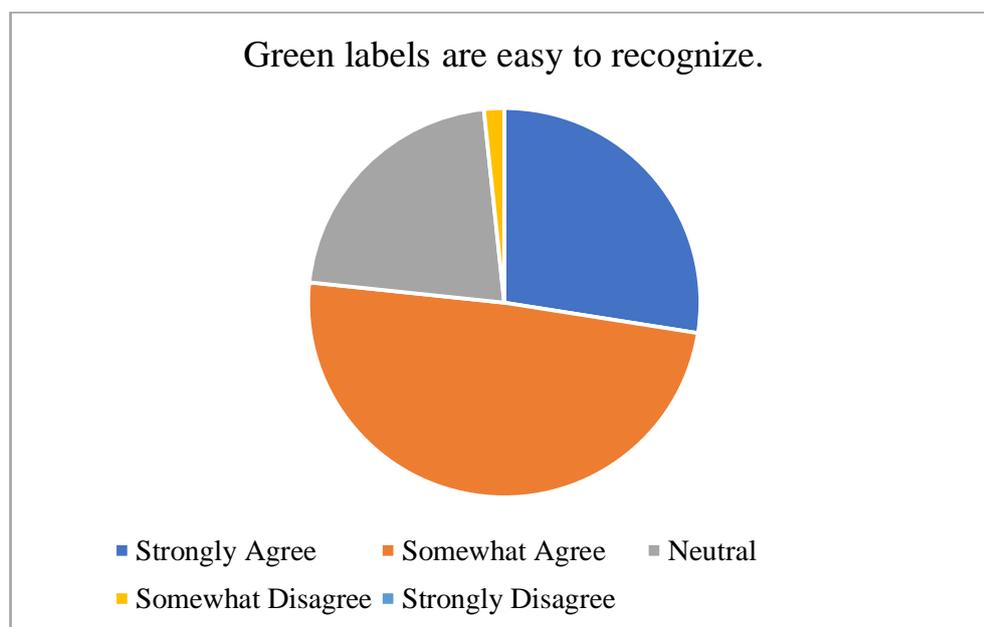


Fig. 4.11: Green labels are easy to recognize.

INFERENCE

The above diagram shows the percentage of people who agree or disagree with the fact that green labels are easy to recognize. The majority of the respondents, i.e.; 49.16% only agree with this to some extent while 27.5% of them strongly agree with this. 1.66% of the respondents somewhat disagree and 21.66% of respondents' answer stays neutral. Even though the majority agrees that green labels are easy to recognize, some measures can be taken to help people familiarize themselves with green labels.

TABLE 4.12: Green labels make the product appealing.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	40	33.33
2	Somewhat Agree	56	44.66
3	Neutral	22	18.33
4	Somewhat Disagree	2	1.66
5	Strongly Disagree	0	0
	TOTAL	120	100

Source: Primary Data

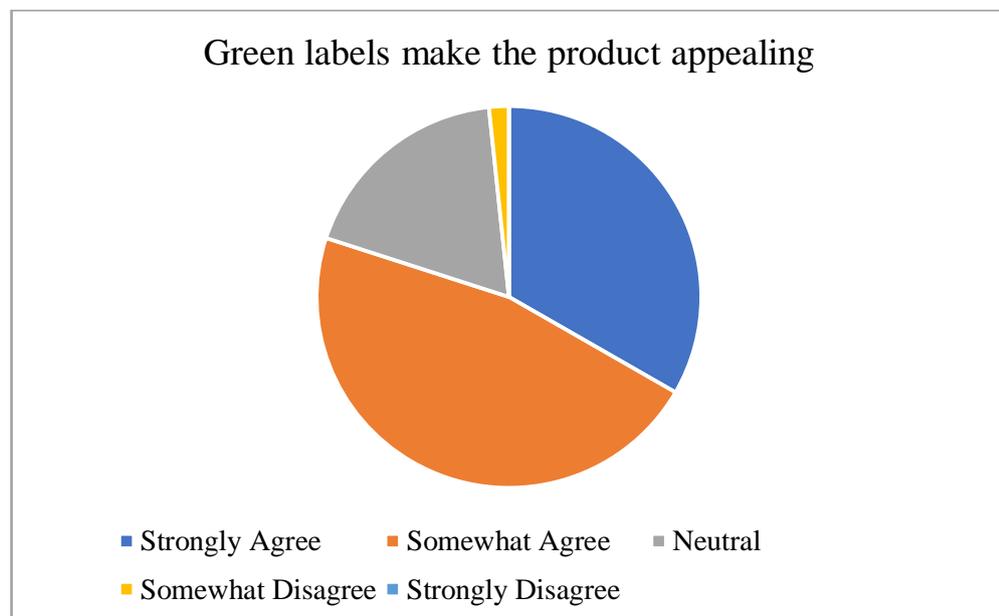


Fig. 4.12: Green labels make the product appealing.

INFERENCE

The above chart is of the percentage of people who agree that green labels make the product appealing. 46.66% of respondents agree with this to some extent and 33.33% strongly agree with the fact that green labels make the product appealing. 18.33% of them seem to have a neutral thought on this while 1.66% of them claim that green labels do not add to the product appeal. Therefore, it may be suggested that measures can be taken to educate consumers about the importance of these labels.

TABLE 4.13: Attractive environmental advertising encourages me to buy green products.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	53	44.16
2	Somewhat Agree	43	35.83
3	Neutral	21	17.5
4	Somewhat Disagree	2	1.66
5	Strongly Disagree	1	0.83
	TOTAL	120	100

Source: Primary Data

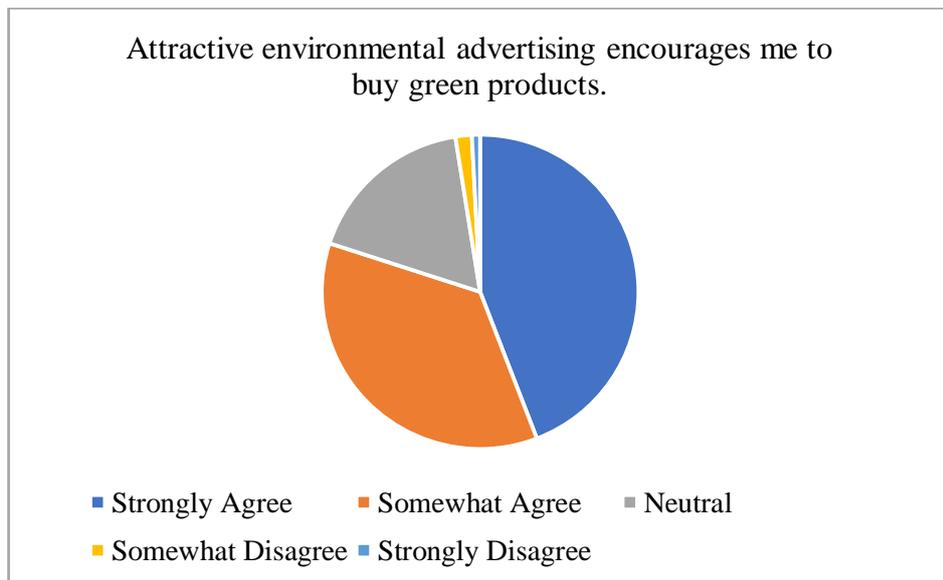


Fig. 4.13: Attractive environmental advertising encourages me to buy green products.

INFERENCE

The chart shows that the majority agrees with this. 44.16% of the respondents strongly agree and 35.83% of them somewhat agree. 0.83% strongly disagree and 1.66% somewhat disagree with environmental advertising being a catalyst for them to purchase green products. 17.5% of respondents have chosen neutral. If better appealing environmental advertisements can be introduced it will create an encouragement among the rest to buy these products.

TABLE 4.14: Do you think there is enough information about green features?

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Yes	39	32.5
2	No	38	31.66
3	Maybe	43	35.83
	TOTAL	120	100

Source: Primary Data

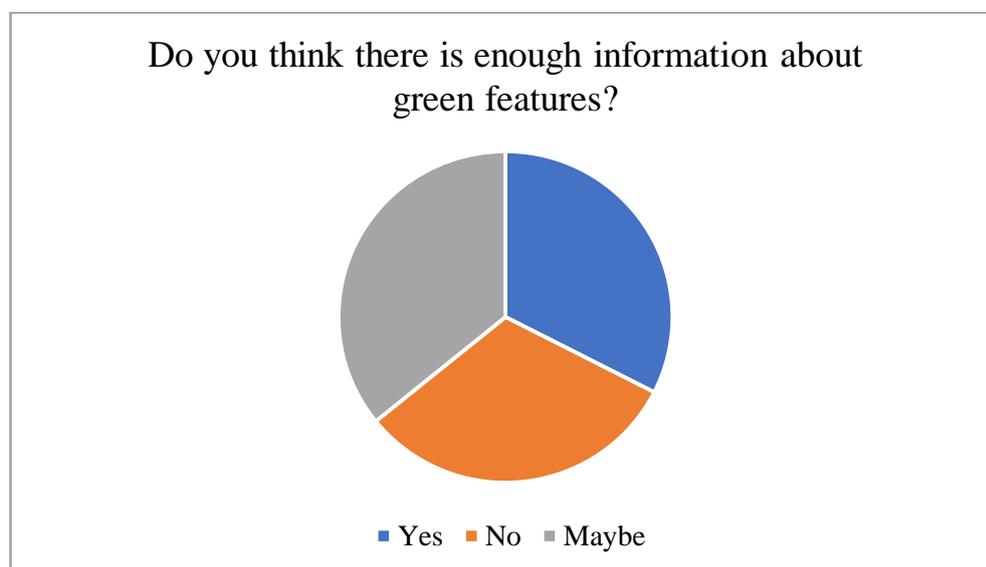


Fig. 4.14: Do you think there is enough information about green features?

INFERENCE

The above diagram shows the percentage of respondents who agree or disagree on whether there is adequate information about green features when purchasing a product. The majority of respondents (35.83%) are not so sure of it. An almost equal percentage of them (32.5%) claim that there is enough information while the others (31.5%) don't agree with this. Hence, we can see that the responses are almost divided equally and measures must be taken to provide enough information regarding green products so that consumers can make well-informed purchasing decisions.

TABLE 4.15: I prefer to buy products with eco-friendly packaging.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	73	60.83
2	Somewhat Agree	37	30.83
3	Neutral	9	7.5
4	Somewhat Disagree	1	0.83
5	Strongly Disagree	0	0
	TOTAL	120	100

Source: Primary Data

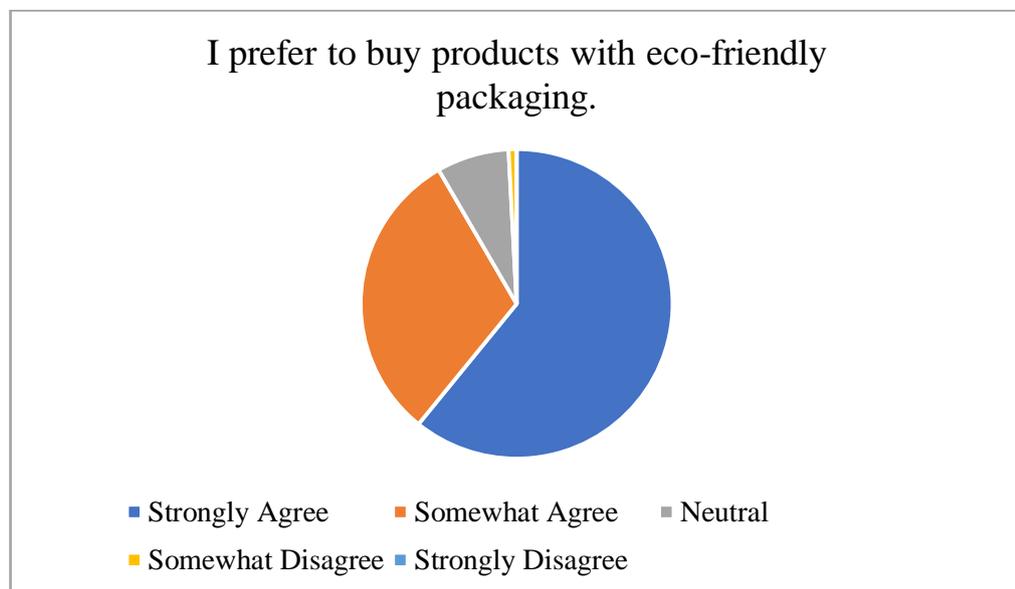


Fig. 4.15: I prefer to buy products with eco-friendly packaging.

INFERENCE

The above diagram shows the percentage of consumer preference for products with eco-friendly packaging. 60.82% of the respondents strongly agreed that they preferred eco-friendly packaging. 30.83% only agree to an extent and nearly 7.5 % have a natural opinion. Only a minute percentage (0.83%) are somewhat disagreeing. None of the respondents strongly disagree. Therefore, we can understand that a good majority of the consumers prefer eco-friendly packaging and companies must satisfy this need while also encouraging the rest of the consumers to make use of it.

TABLE 4.16: I am willing to pay more for green products.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	31	25.83
2	Somewhat Agree	48	40
3	Neutral	33	27.5
4	Somewhat Disagree	5	4.16
5	Strongly Disagree	3	2.5
	TOTAL	120	100

Source: Primary Data

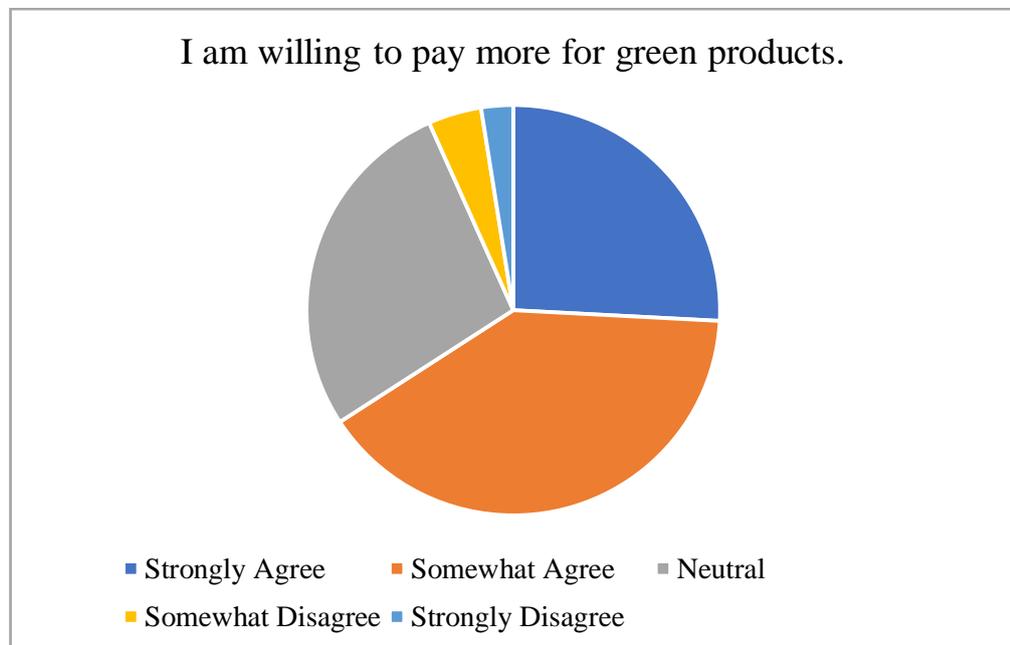


Fig. 4.16: I am willing to pay more for green products.

INFERENCE

The diagram above shows the willingness of the respondents to pay a premium for green products. Only 25.83% of them strongly agree with this and the majority (40 %) agree to some extent. 27.5 % of the respondents maintain a neutral stance. 4.16 % somewhat disagree and 2.5% of the respondents are strongly against this. We can see that a good portion of the consumers is willing to pay more for green features and companies must make these products available to them. Companies can also benefit from the premium received as it enhances their profits.

TABLE 4.17: My purchase habits are influenced by my concern for the environment.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	34	28.33
2	Somewhat Agree	45	37.5
3	Neutral	35	29.16
4	Somewhat Disagree	6	5
5	Strongly Disagree	0	0
	TOTAL	120	100

Source: Primary Data

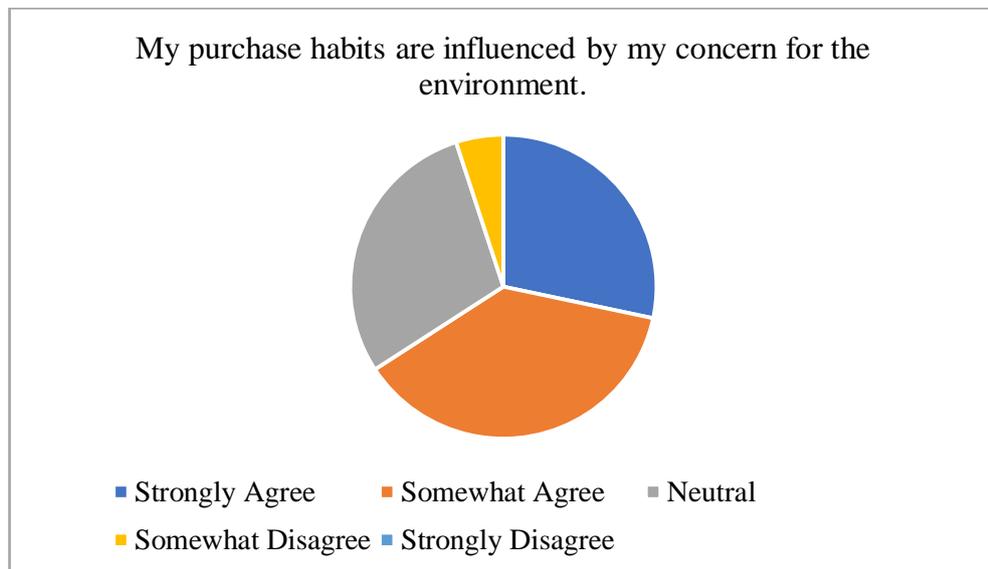


Fig. 4.17: My purchase habits are influenced by my concern for the environment.

INFERENCE

The above diagram visually represents the purchasing behavior of consumers and whether it is influenced by their concern for the environment. Only 37.5 % agreed with this statement to some extent while 29.16% of them gave a neutral response. Close behind, 28.35% of the respondents strongly disagreed. This shows that even though people are environmentally aware, their concern is not adequate enough to alter their purchasing decisions. A majority of them can hence be categorized into “sprouts”.

TABLE 4.18: I find green branded products reliable.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	40	33.33
2	Somewhat Agree	46	38.33
3	Neutral	30	25
4	Somewhat Disagree	4	3.33
5	Strongly Disagree	0	0
	TOTAL	120	100

Source: Primary Data

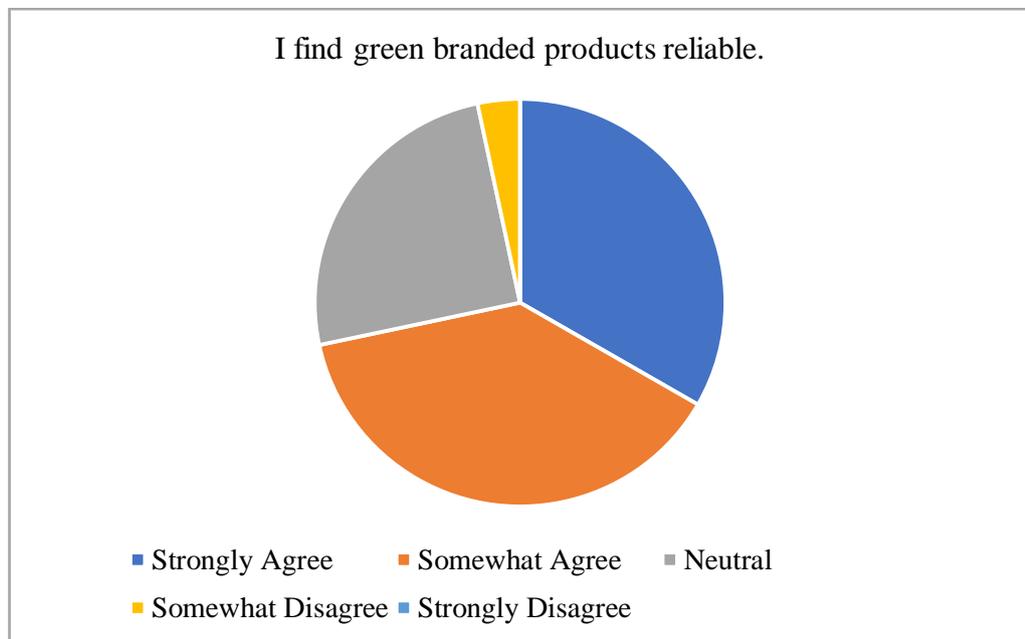


Fig. 4.18: I find green branded products reliable.

INFERENCE

The above diagram represents the percentage of the respondents who find green branded products reliable. 33.33% of people strongly believe that green branded products are reliable and 38.33% agree to some extent. 25% of the respondents remain neutral and only a small portion (3.33%) find green products unreliable. Hence, we can say that a good majority are satisfied with the efficiency of green products.

TABLE 4.19: I have adequate knowledge about green marketing.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Strongly Agree	27	22.5%
2	Somewhat Agree	60	50%
3	Neutral	30	25%
4	Somewhat Disagree	3	2.5%
5	Strongly Disagree	0	0%
	TOTAL	120	100%

Source: Primary Data

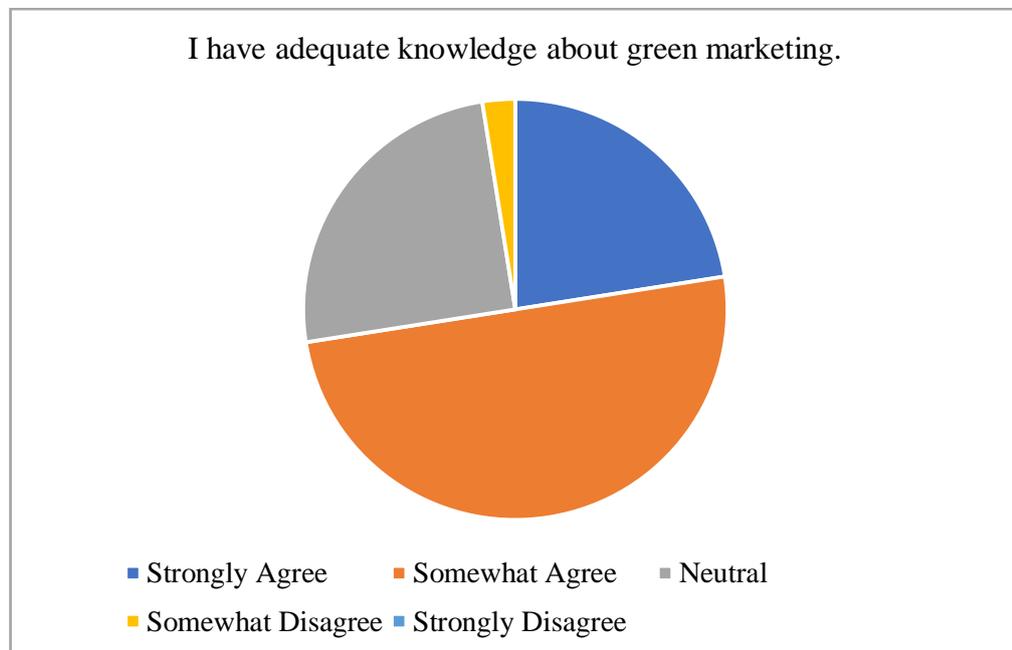


Fig. 4.19: I have adequate knowledge about green marketing.

INFERENCE

The diagram shows the number of respondents who claim to have adequate knowledge about green marketing. 22.5% strongly believe that they are well informed about green marketing while a majority of 50% agree to a certain extent. 25% of the respondents gave a neutral response while a minority of 2.5% claimed to have not much knowledge in this area. Measures must be taken to normalize green marketing practices so that consumers can be well informed.

TABLE 4.20: Which marketing element strongly influences your buying behavior towards green products?

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Product	75	62.5%
2	Price	12	10%
3	Place	2	1.66%
4	Promotion	15	12.5%
5	Packaging	16	13.33%
	TOTAL	120	100%

Source: Primary Data

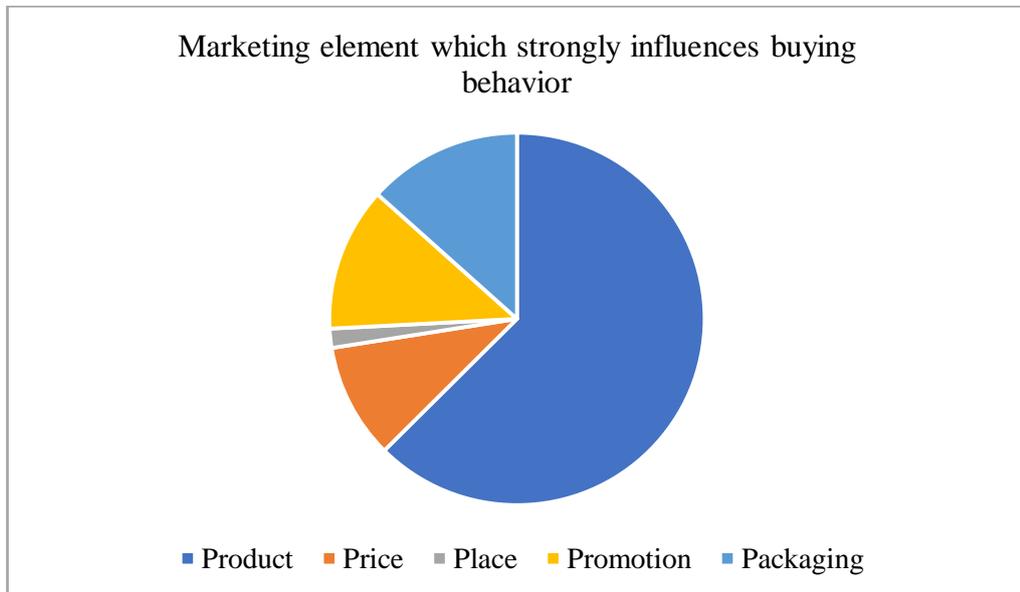


Fig. 4.20: Marketing element which strongly influences buying behavior

INFERENCE

The above diagram shows which marketing elements strongly influence the respondents’ green buying behavior. The marketing mix element which very strongly influenced (62.5%) their purchasing behavior is “product”. Right behind we have “packaging”, “promotion”, and “price” which influenced the purchase decision to some extent (10-13%). “Place” did not seem to have much of an influence (1.66%). Hence, marketers should make the products more efficient to take advantage of their impact on buying decisions.

TABLE 4.21: I feel brands do not truly satisfy the greening process.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	Yes	48	40
2	No	6	5
3	Maybe	49	40.83
4	Cannot say	17	14.16
	TOTAL	120	100

Source: Primary Data

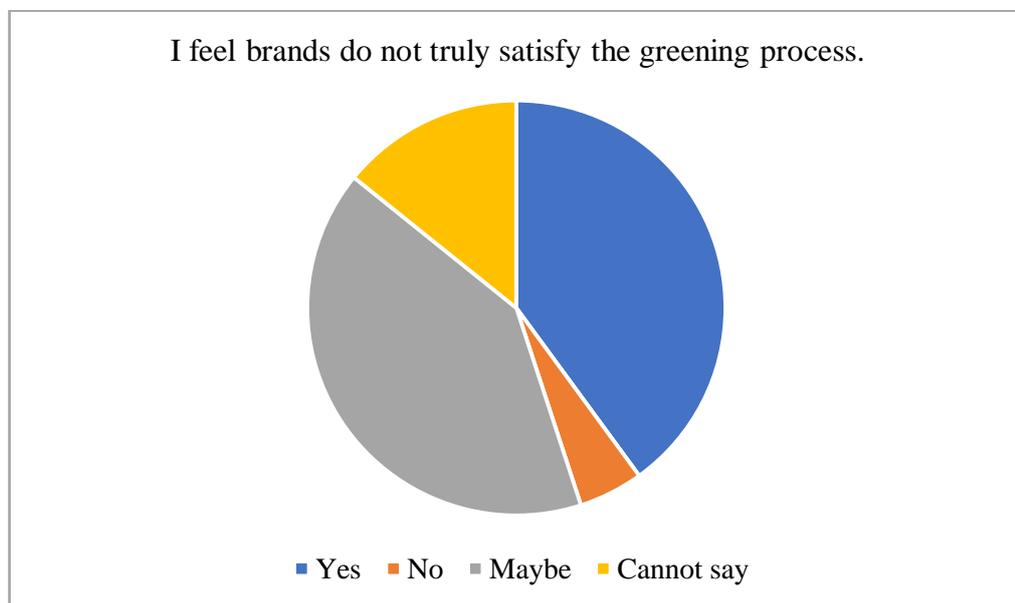


Fig. 4.21: I feel brands do not truly satisfy the greening process.

INFERENCE

The diagram represents the respondents who feel that brands do not truly satisfy the greening process. A majority of the consumers (40% and 40.83%) responded yes and maybe respectively. 14.16% are unsure and 5% think that brands do satisfy the greening process. Hence, it may be interpreted that a lot of consumers are skeptical about the green brands' genuineness and are therefore a little reluctant to buy their products. If companies can communicate honestly to customers with factual evidence, any misconception can be removed.

TABLE 4.22: The main reason as to why I prefer green products.

SL. NO.	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE
1	It is my duty as a socially responsible person.	1	0.83
2	I find it more useful	1	0.83
3	For aesthetic purposes	2	1.66
4	I am concerned about the over-exploitation of resources	32	26.66
5	It is important to me that the product I use do not harm the environment	61	50.83
6	It makes me socially attractive	4	3.33
7	Supporting environmental protection makes me feel special	19	15.83
	TOTAL	120	100

Source: Primary Data

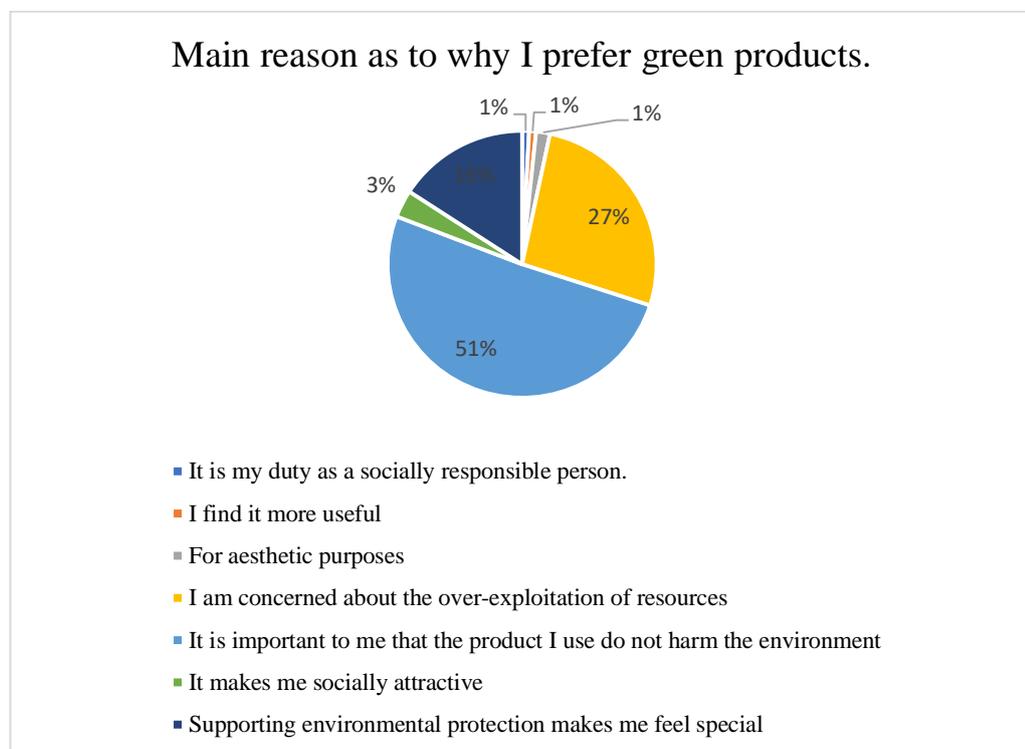


Fig. 4.22: Main reason as to why I prefer green products.

INFERENCE

The diagram shows the major reasons for purchasing green products. 50.83% claimed that it is because they do not want the products which they use to harm the environment. 26.66% stated their concern about the over-exploitation of resources. 15.83% of them claimed that the reason is that it makes them feel special. 3.33% do it because it makes them socially attractive. 0.83% find green products more useful while the rest consider it their duty as socially responsible citizens.

CHAPTER 5
SUMMARY, FINDINGS,
RECOMMENDATIONS, AND
CONCLUSION

5.1 SUMMARY

For a developing country like India, the future is bright from an industrialization point of view but at the cost of deteriorating the environment. This has raised concerns among consumers and has started affecting their purchase decisions. Companies now incorporate these concerns in order to function in a way that satisfies the public.

This study on green marketing attempts to analyze the attitudes, perceptions, and preferences of consumers towards green products and marketing with a special reference to consumers residing in Ernakulam.

Green marketing was studied in detail. The evolution, characteristics, significance, benefits, and limitations were some areas covered. Theories about green products, green logistics, green marketing strategies, green marketing mix, greenwashing, etc. were also studied in brief. We looked into green consumerism and the ways in which green consumers are classified. Barriers to green marketing and ways to remove these barriers were also detailed.

Analysis of the responses has helped us in reaching several conclusions. It is seen that most consumers are well aware of green marketing but are a bit reluctant to act on it due to some constraints like price and distrust in the genuineness of these products. Nevertheless, it can be said that there is still a long way to go and marketers must focus on the promotion of these products while educating consumers about their benefits and achieving their environmental objectives.

5.2 FINDINGS

1. We can see that majority of the respondents are female (67%).
2. It is clear that the majority of the respondents belong to the 18-25 year category. Most of them are university students or graduates.

3. The majority of the respondents have an income below 1 lac. This can be linked to most of them being university students. They may not have a regular income yet.
4. According to this survey, the majority of the respondents are familiar with green products.
5. The study shows that 112 of the respondents out of 120 are aware of environmental degradation and agree that the environment is being severely damaged.
6. Most of the respondents claim they're environmentally responsible. But the depth of this awareness is unclear. Even though a handful of them held a neutral stance, none of them were against this.
7. The majority of respondents agree that green products are the better alternative for future sustainability.
8. It's clear from the study that green products are better than non-green products and more than half of the respondents agree with the same.
9. As per the study, it's found that respondents use green products only occasionally which proves that the demand for green products is comparatively low. Stronger advertisement and sales promotion is needed to bring this demand up.
10. Even though the majority of the respondents gave a high user experience, 45 of them rated below 3. This shows there is still room for improvement.
11. Most of the respondents claim they are able to recognize the green labels easily. But there is still a good percentage who remain neutral or don't agree. Therefore, measures must be taken to make consumers more familiar with these labels.

12. The majority of respondents agree that green labels add to the product appeal.
13. It's found from the survey that alluring and attractive environmental advertising creates an encouragement among people to buy green products. Marketers must use this strategy to their advantage.
14. An almost equal number of respondents said yes, no, and maybe when asked if there is enough information about green features. Measures must be taken to communicate such information to consumers so that they can make educated purchase decisions.
15. A good majority of respondents claimed that they prefer products with eco-friendly packaging. Marketers must satisfy this need.
16. Though the majority of respondents claimed that they are willing to pay a premium for green products, many remain tentative. Companies must be able to prove that the products are worth the premium.
17. A good percentage of respondents claim that their purchase decisions are influenced by their concern for the environment. Others remain neutral.
18. Majority of the respondents agreed that they find green products reliable. Others gave a neutral response. Companies must communicate true information about the products in order to remove distrust and increase reliance on green products.
19. Many claimed to have adequate knowledge of green marketing. However, the majority only agreed to an extent and many others remained neutral. Hence, we can say that there is a need for consumer education regarding this.
20. A huge majority of respondents claimed that the product factor strongly influences their buying behavior. Companies and marketers should hence

focus on ensuring the products are manufactured using good ingredients and efficient energy-saving processes. The products should be of superior quality.

21. Majority of the respondents claimed that they feel brands did not truly satisfy the greening process. Companies should not practice greenwashing and instead should be able to prove the greenness of their products and communicate only facts about the benefits of their products.
22. The majority of respondents claimed that the main reason why they prefer green products is that it is important to them that the products they use do not harm the environment.

5.3 RECOMMENDATIONS

Based on the information obtained from the respondents, some recommendations have been put forward to help achieve the environmental objectives of green marketing.

1. Majority of the respondents claimed that they are environmentally aware, but this awareness seems to be vague from their other responses. The majority claimed to purchase green products but only occasionally. Companies should therefore focus on advertising their eco-friendly branding. Promotional campaigns and advertising in-store and using pamphlets and electronic media may be used.
2. Companies and marketers should be able to convince consumers that the products are of good quality and are superior to their non-green counterparts. The quality aspect should not be lightly in the name of eco-friendliness.
3. Customers must feel that the product is worth the premium. Proper price discrimination should be in place. Customers belonging to the target market should find the premium reasonable. From the responses, we can

see that the product factor is the most important to consumers in the marketing mix. Quality ingredients and efficient energy-saving processes must be used in the manufacture and this should be communicated to the consumers.

4. Companies and marketers must be genuine. They should refrain from making false exaggerated claims for the sake of advertising and instead communicate solid facts about the benefits and advantages of their products to the consumers. Companies should look for opportunities to prove the green-ness of their product to add more credibility and demonstrate how their product's effectiveness and quality compare to a non-green product. Customers have grown increasingly alert to greenwashing. One way to overcome this issue is to utilize eco-labeling to provide the customers with information while at the same time addressing environmental issues.
5. Availability of green alternatives is still an issue in many places. Even if consumers have a desire to purchase green products, they simply cannot do so due to a lack of convenience. Marketers must therefore ensure that a good distribution channel must be in place and that the consumers have easy access to green products.
6. Ultimately, it is up to the producers to switch to more eco-friendly methods of manufacture. They might have to incorporate profitability and environmental responsibility into their methods of production and marketing. Consumers should be given a choice of purchase. And for that, green products must be manufactured more and made available in the market.

5.4 CONCLUSION

This study examines the consumer's perception and attitudes towards green marketing.

Green marketing is a relatively recent phenomenon and it is growing due to the awareness amongst consumers and businesses about minimizing the adverse impact

on the environment. Green marketing is catching on in a big way. Marketers, as well as consumers, are slowly but strongly recognizing it.

Awareness is being created about the use of eco-friendly materials, which help conserve the environment. Green marketing is gaining prominence across the world and in India too. However, green marketing has not reached its full potential yet.

The Environmental problems in India are growing rapidly due to the growing population thus leading to the need for an initiative that benefits both marketers and customers, so it's the right time to implement green marketing. Businesses are realizing the problem and coming forward with many solutions.

Consumers are concerned about the present and future environment. They have shown a positive attitude towards green products but expressed concern about the availability and price of such products. Marketers must make green products available to consumers as they have shown a willingness to buy them if available.

Effective green marketing requires the use of good marketing principles to make green products desirable to consumers. It's found that the marketing element 'product' highly influences the consumer's purchasing behavior. Efficient products should be manufactured to take advantage of their impact on buying decisions.

Until green marketing becomes normalized, largescale promotion of such goods must be encouraged to influence more people and achieve environmental objectives.

This research provides a good understanding of consumer behavior towards green products and green marketing. More research can be done on a large scale to find out more about consumer behavior and to understand more about the green phenomenon.

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APPENDIX

QUESTIONNAIRE

A STUDY ON GREEN MARKETING - CONSUMER PERCEPTION AND PREFERENCES IN THE DISTRICT OF ERNAKULAM

1. GENDER

- Male
- Female
- Other

2. AGE

- 18-25
- 26-32
- 33-40
- Above 40

3. INCOME p.a.

- Below 1 lac
- 1-5 lacs
- 6-10 lacs
- 11-25 lacs
- Above 25 lacs

4. I am aware of green products.

- Strongly Agree
- Somewhat Agree
- Neutral
- Somewhat Disagree
- Strongly Disagree

5. The environment is severely damaged.

- Yes
- No
- Maybe

6. I would describe myself as environmentally responsible.

- Strongly Agree
- Somewhat Agree
- Neutral
- Somewhat Disagree
- Strongly Disagree

7. Green products are the better option for future sustainability.

- Strongly Agree
- Somewhat Agree
- Neutral
- Somewhat Disagree
- Strongly Disagree

8. Green products are better than non-green products.

- Strongly Agree
- Somewhat Agree
- Neutral
- Somewhat Disagree
- Strongly Disagree

9. How often do you purchase/ use green products?

- Very Often
- Often
- Sometimes
- Seldom
- Never

10. On a scale of 0-5, rate your experience in using green products.

- 0
- 1
- 2
- 3

- 4
- 5

11. Green labels are easy to recognize.

- Strongly Agree
- Somewhat Agree
- Neutral
- Somewhat Disagree
- Strongly Disagree

12. Green labels make the product more appealing.

- Strongly Agree
- Somewhat Agree
- Neutral
- Somewhat Disagree
- Strongly Disagree

13. Attractive environmental advertisements will encourage me to buy green products.

- Strongly Agree
- Somewhat Agree
- Neutral
- Somewhat Disagree
- Strongly Disagree

14. Do you think there is enough information about green features when you buy the product?

- Yes
- No
- Maybe

15. I prefer to buy products that use eco-friendly packaging.

- Strongly Agree
- Somewhat Agree

- Neutral
- Somewhat Disagree
- Strongly Disagree

16. I am willing to pay more for green products.

- Strongly Agree
- Somewhat Agree
- Neutral
- Somewhat Disagree
- Strongly Disagree

17. My purchase habits are influenced by my concern for the environment.

- Strongly Agree
- Somewhat Agree
- Neutral
- Somewhat Disagree
- Strongly Disagree

18. I find green branded products reliable.

- Strongly Agree
- Somewhat Agree
- Neutral
- Somewhat Disagree
- Strongly Disagree

19. I know about green marketing.

- Strongly Agree
- Somewhat Agree
- Neutral
- Somewhat Disagree
- Strongly Disagree

20. Which marketing element strongly influences your buying behavior toward green products?

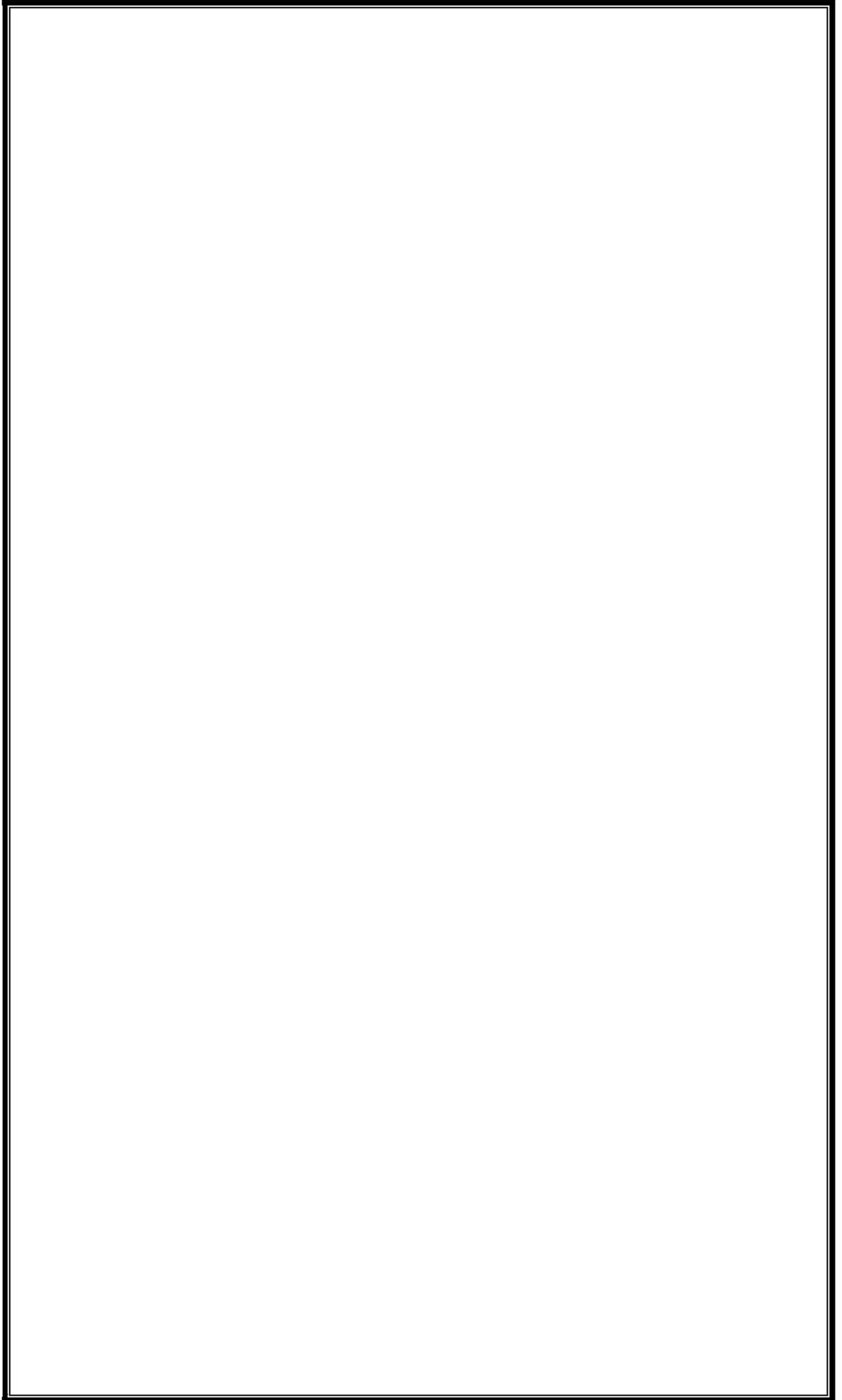
- Product
- Packaging
- Place
- Promotion
- Price

21. I feel brands do not truly satisfy the greening process.

- Yes
- No
- Maybe
- Cannot say

22. The main reason as to why I prefer green products

- I am concerned about the overexploitation of resources
- It is important to me that the product I use do not harm the environment
- Supporting environmental protection makes me feel special
- It makes me socially attractive
- For aesthetic purposes
- Other...



Project Report

On

DIGITAL IMAGE PROCESSING

Submitted

in partial fulfilment of the requirements for the degree of

BACHELOR OF SCIENCE

in

MATHEMATICS

by

ASHNA C S

(Register No. AB19AMAT044)

Under the Supervision of

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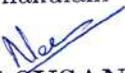
ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

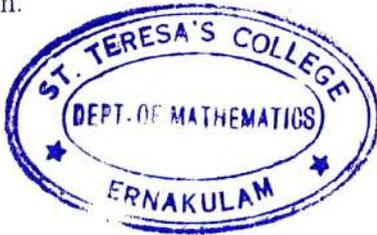


CERTIFICATE

This is to certify that the dissertation entitled, **DIGITAL IMAGE PROCESSING** is a bonafide record of the work done by Ms. **ASHNA C S** under my guidance as partial fulfillment of the award of the degree of **Bachelor of Science in Mathematics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

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DECLARATION

I hereby declare that the work presented in this project is based on the original work done by me under the guidance of NEENU SUSAN PAUL, Assistant Professor, Department of Mathematics, St. Teresa's College(Autonomous), Ernakulam and has not been included in any other project submitted previously for the award of any degree.

Ernakulam.

Date:14/03/2022



ASHNA C S

AB19AMAT044

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Ernakulam.

ASHNA C S

Date:14/03/2022

AB19AMAT044

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Chapter 1

DIGITAL IMAGE PROCESSING

1.1 INTRODUCTION

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is the type of signal processing in which input is an image and output is another image associated with that image . At present, image processing is among the most rapidly growing technologies. It forms core research area within the important science branches such as engineering and computer science disciplines.

There are two types of methods used for image processing:

-Analogue image processing

-Digital image processing

1. Analogue image processing

Analogue image processing can be used for hard copies like printouts and photographs. The images are manipulated by varying the electrical signal. Analog image processing is done on analog signals. It includes the processing on two dimensional analog signals. The most well known example is the television image

2. Digital image processing

Digital image processing uses computers to manipulate images. The image will be converted to digital form using a scanner-digitizer and

then process it.

1.2 DIGITAL IMAGE PROCESSING

In this method, an image is defined as a two-dimensional function $f(x, y)$ where x and y are plane (spatial) coordinates. The amplitude of f at any pair of co-ordinates (x, y) is called the intensity or gray level of the image at that particular point.

An image with x, y and the intensity values of f as finite, discrete quantities is called a digital image. The field of digital image processing refers to processing digital images by means of a digital computer. A digital image consists of finite number of elements, each of which features a particular location and value. Pixel is the smallest component of an image that could be manipulated.

Imaging machines cover almost the whole EM spectrum, ranging from gamma to radio waves. They can work on images created from sources that humans are not accustomed to associating, ie, images which incorporates ultrasound, electron microscopy, and computer-generated images. Thus, digital image processing encompasses a wide variety of applications.

Digital image processing has two main tasks:

- Improvement of pictorial information.
- Processing of the image data for storage, transmission and representation for the autonomous machine perception.

1.3 HISTORY OF DIGITAL IMAGE PROCESSING

The early signs of image processing are often dated back to the 1920s. A news company (The Bartlane Cable Picture Transmission Service) transferred images by the submarine cable between the London and the New York.

The pictures were send via codes and reconstructed on the telegraph printer. Later during the space era, the image processing was used to understand the outerspace and the satellite operations. Today, Nasa



A digital picture produced in 1921 from a coded tape by a telegraph printer with special type faces.

Figure 1.1:

leads the field of image processing. The image processing made one among its earliest contributions to space by capturing the Ranger 7 probe, also as the Apollo landing mission. NASA became one of the biggest developer of image processing.



Figure 1.2: (The first picture of the moon by a U.S. spacecraft. Ranger 7 took this image on July 31, 1964 at 9:09 A.M. EDT, about 17 minutes before impacting the lunar surface.)

Image processing is also useful for the medical imaging, videophones, character recognition, law enforcement, photographic enhancements, and artistic effects. The conception of a computer dates back to the invention of the abacus in Asia Minor, further than 5000 years ago. More lately, there have been developments in the past two centuries that are the foundation of what we call a computer today.

Medical doctors can use image processing to spot possible operations and procedures that could be done to patients. MRI and CAT scan are other applications of image processing. The CAT scan focuses on a digital image through x-rays of the body to spot unusual things.

Video chat has recently emerged on the scene as a preferred topic for families, friends and firms. Now, with our cellphones, we are able to

create and edit photos. This is often called mobile image processing. Mobile processing is growing rapidly. Other applications of image processing including crimes fighting by law enforcement through camera surveillance and the face recognition . The creation of image processing has allowed the law to guard and serve the country in a major way through stopping crime.

1.4 TYPES OF DIGITAL IMAGES

1.4.1 BINARY IMAGES

Binary images are the simplest type of images which can take only two values, generally black and white, or 0 and 1. A binary image is also referred to as a 1-bit image because it takes only 1 binary digit to represent each pixel. These types of images are constantly used in operations where the only information required is general shape or outline. Binary images are created from the gray-scale images via a threshold operation, where every pixel above the edge value is turned white ('1'), and those below it are turned black ('0').

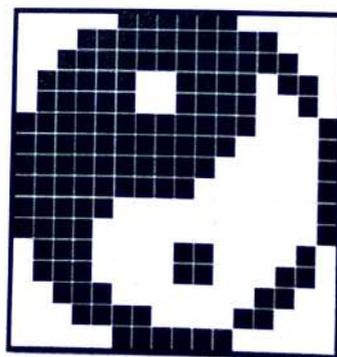


Figure 1.3: Binary images

1.4.2 GRAYSCALE IMAGES

Gray-scale images are known as monochrome (one-color) images. It contain gray-level information, no color information. The number of

bits used for each pixel determines the measure of various gray levels available. The typical gray-scale image contains 8 bits data, which allows us to have 256 different gray levels. Grayscale is a range of gray tones from white to black, as used in a snap display or print-out. Therefore, a grayscale image contains only tones of gray and no color



Figure 1.4: Grayscale images

THRESHOLDING

A binary image is attained from a grey-scale image by following a process of information abstraction. Thresholding is the main ways used at this stage for converting binary images. The main thing of the thresholding is to extract the foreground from the background. Thresholding is the simplest technique of image segmentation and the most common way to convert a grayscale image into a binary image.

In thresholding we choose a threshold value. Also all the grey position value which is below the named threshold value is classified as 0 (black i.e background) and all the gray position which is greater than or equal to the threshold value are classified as 1 (white i.e foreground).

$$g(x,y) = 1 \text{ if } f(x,y) \geq T \text{ or } 0 \text{ otherwise}$$

Then $g(x, y)$ represents threshold image pixel at (x, y) and $f(x, y)$ represents grayscale image pixel at (x, y) .

1.4.3 COLOR IMAGES

Color images are three band monochrome images in which, each band contains a different color and the true information is stored in the digital

image. The color images contain gray position data in each spectral. The images are represented as red, green and blue (RGB images) and each color image has 24 bits/ pixel (8 bits for every of the three color band RGB).



Figure 1.5: Color images

8-BIT COLOR FORMAT

8- bit color is used for storing image data in a computer's memory or in a range of an image. In this arrangement, each pixel represents one 8 bit byte. It has 0-255 range of colours , during which 0 is employed for black, 255 for white and 127 for gray color. The 8- bit color format is also comprehended as a grayscale image.



Figure 1.6: 8-bit-color-format

16- BIT COLOR FORMAT

The 16- bit color format is also appertained to as high color format. It has different colour tones. It's used in the network developed by Microsoft. The 16- bit color format is further divided into three formats which are Red, Green, and Blue also known as RGB format . In RGB format, there are 5 bits for Red, 6 bits for Green, and 5 bits for Blue. One fresh bit is added in green because altogether the three colors green color is soothing to eyes.

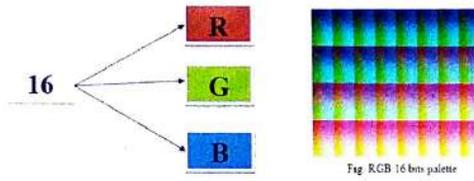


Figure 1.7: 16-bit-color-format

24- BIT COLOR FORMAT

The 24-bit color format is also appertained to as verity color format. The 24-bit color format is also distributed in Red, Green, and Blue. As 24 can be equally divided on 8, so it's distributed equally between 3 distinctive colors like 8 bits for Red, 8 bits for Green and eight bits for Blue

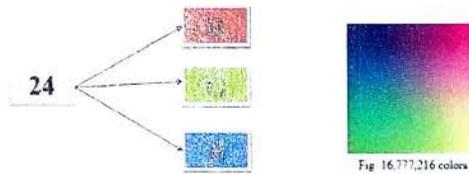


Figure 1.8: 24-bit-color-format

1.4.4 MULTISPECTRAL IMAGES

Multispectral images generally contain information outside the normal human perceptual range. This may include infrared, ultraviolet, X-ray, or radar data. These aren't images in the usual sense because the information represented isn't directly visible by the human system. Still the information is often represented in visual form by mapping the different spectral bands to RGB elements.



Figure 1.9: Multispectral image

Chapter 2

IMAGE PROCESSING AND MATRICES

2.1 THE NOTION OF PIXEL ELEMENTS

In a digital image, the smallest controllable element is called a pixel. A pixel is known as the atom of the picture. The number of pixels in a picture depends on the quality of camera used to take that picture. Numerous computer systems contain between a 24-bit system to a 32-bit system. The greater the number of pixels, the better is that the quality of the image. Numerous images that cameras produce are expressed in megapixels, which are the number of million pixels that are displayed. The greater the number of megapixels in an image allows for much better quality in a photo .

The pixel coloration is a product of color blending. The colors are generated with three base colors. The three base colors are red, blue, and green. Each of these three base colors has 256 gradations. The color of a pixel is determined by the value of the red, green, blue element. This means that we can generate $256 \times 256 \times 256 = 16777216$ different types of pixel in RGB system . There are also other color systems beside the RGB color system. For example, the CMYK (cyan-magenta-yellow-key) which is used mainly for the printed color illustrations (hard copy). The RGB system is used mainly for the computer displays.

Consider the following image. When we zoom in continuously, we ob-



Figure 2.1:

serve little squares. Those squares are pixels and their number depend on the type of device use to realize the picture.

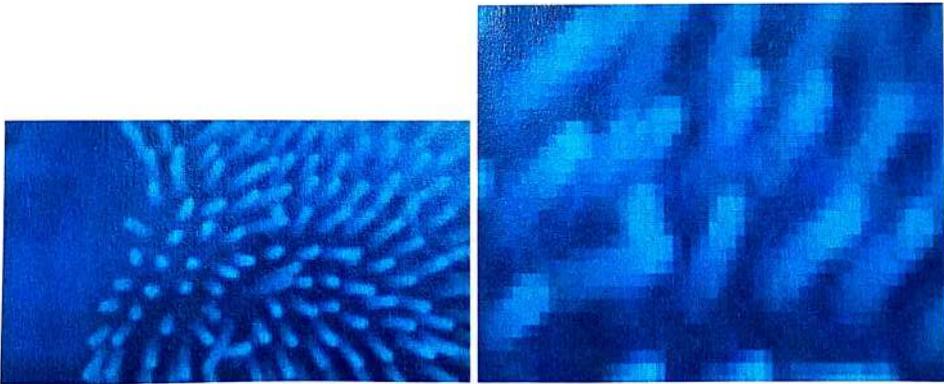


Figure 2.2:

2.2 IMAGE AS A MATRIX

The digital images can be manipulated using matrices, since when broken into the smallest bits of information (pixels) they are matrices. The given figure demonstrates binary pixel art, in which each box is being represented in the correlating matrix with either “1” or “0”. A zero means the box contains nothing (white), while a one indicates that the box is filled (black).

Generally in digital images, the number that each spot of the matrix contains is much more complex and has information for the amount of

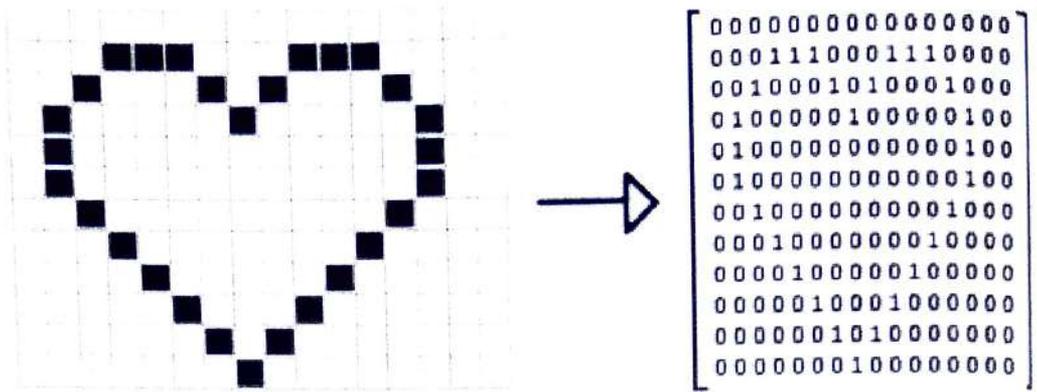


Figure 2.3: Binary pixel art.

red, green, and blue that the pixel should display. So each pixel stores the information about what color it should be displaying in the digital image, putting the output within a small 1x1 square. When viewed far away and together, they produce the illusion of lines, curves, and blended colors rather of the individual squares.



Figure 2.4: A portion of a digital image zoomed in. Each square represents an individual color.

2.3 MATHEMATICAL TOOL FOR IMAGE PROCESSING

2.3.1 ARRAY VERSUS MATRIX OPERATIONS

Images are viewed as the matrix. There is a difference in Matrix and Array Operation. In Array operation, it is carried out by pixel by pixel in image. Let these be two images:

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \text{ and } \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}$$

Then the Matrix Operation is :

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} = \begin{bmatrix} a_{11}b_{11} + a_{12}b_{21} & a_{11}b_{12} + a_{12}b_{22} \\ a_{21}b_{11} + a_{22}b_{21} & a_{21}b_{12} + a_{22}b_{22} \end{bmatrix}$$

And Array Operation is :

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} = \begin{bmatrix} a_{11}b_{11} & a_{12}b_{12} \\ a_{21}b_{21} & a_{22}b_{22} \end{bmatrix}$$

2.3.2 ARITHMETIC OPERATIONS

ADDITION OPERATION

Let $h(x,y)$ is the new corrupted image as we are adding noise $g(x,y)$ to original image $f(x,y)$ to hide the noise in the original image

$$h(x,y) = f(x,y) + g(x,y).$$

Adding constant to the image makes the image brighter i.e, $h(x,y) = f(x,y) + \text{constant}$

SUBTRACTION OPERATION

The subtraction between two images is $h(x,y) = f(x,y) - g(x,y)$, where $f(x,y)$ is image 1 and $g(x,y)$ is image 2. The practical application of image subtraction is in medical imaging called mask mode radiography. Subtracting the constant from the original image makes it darker.

MULTIPLICATION OPERATION

In this equation $h(x,y)=f(x,y) \times g(x,y)$, $h(x,y)$ is the new image formed, $f(x,y)$ is image1 and $g(x,y)$ is image2. We can also multiple a constant to an image like $h(x,y)=f(x,y) \times \text{constant}$. Multiplication Operation is used in shading correction.

DIVISION OPERATION

In division operation $h(x,y) = f(x,y)/g(x,y)$, where $f(x,y)$ and $g(x,y)$ are two images and $h(x,y)$ is the new image formed. We can also divided it by constant i.e. $h(x,y) = f(x,y)/\text{constant}$.

Chapter 3

DIGITAL IMAGE REPRESENTATION

3.1 IMAGE REPRESENTATION

The monochrome digital image $f(x, y)$ resulted from sampling and quantization has finite discrete coordinates (x, y) and intensities (gray levels). We shall use integer values for these separate coordinates and gray levels. Thus, a monochrome digital image can be represented as a 2-dimensional array (matrix) that has M rows and N columns.

$$f(x, y) = \begin{pmatrix} f(1,1) & f(1,2) & \dots & f(1,N) \\ f(2,1) & f(2,2) & \dots & f(2,N) \\ \vdots & \vdots & & \vdots \\ \vdots & \vdots & & \vdots \\ f(M,1) & f(M,2) & \dots & f(M,N) \end{pmatrix}$$

Figure 3.1:

Each element of this matrix array is called pixel. The spatial resolution (number of pixels) of the digital image is $M \times N$. The gray level resolution (number of gray levels) L is

$$L = 2^k$$

where k is the number of bits used to represent the gray levels of the

digital image. When an image can have

$$2^k$$

gray levels, we can refer to the image as a “k-bit image”.

For example, an image with 256 possible gray-level values is called an 8-bit image. The gray levels are integers in the interval $(0, L-1)$. This interval is called the gray scale.

The number b of bits required to store a digitized image is $b = M \times N \times k$

EXAMPLE

For an 8-bit image of size 512×512 , determine its gray-scale and storage size. Solution

$$k = 8, M = N = 512$$

Number of gray levels

$$L = 2^k = 2^8 = 256$$

The gray scale is $(0, 255)$

$$\text{Storage size (b)} = M \times N \times k = 512 \times 512 \times 8 = 2,097,152 \text{ bits}$$

3.1.1 SPATIAL DOMAIN METHOD

The term spatial domain refers to the aggregate of pixels composing an image. Spatial domain methods are procedures that operate directly on these pixels.

Spatial domain is denoted by $g(x, y) = T(f(x, y))$

where g is the input image, f is the output image, T is the operator applied on the image f .

3.2 RELATIONSHIPS BETWEEN PIXELS

A digital image consists of a finite number of elements, each of which features a particular position and value. These elements are mentioned as picture elements, image elements and pixels. Pixel is the term most extensively used to denote the elements of a digital image

3.2.1 NEIGHBOURHOOD OF PIXEL

An image is denoted by $f(x, y)$ and p, q depict individual pixels of the image.

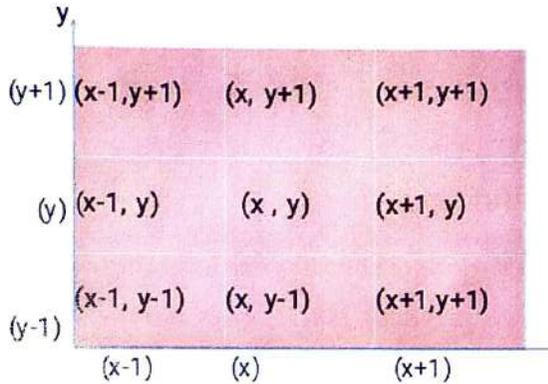


Figure 3.2: Neighbourhood of a pixel

N4(P) - 4 NEIGHBOURS

A pixel p at (x, y) has 4-horizontal or vertical neighbours at $(x + 1, y)$, $(x-1, y)$, $(x, y+1)$ and $(x, y-1)$. These are called the 4-neighbours of p and denoted by $N4(p)$.

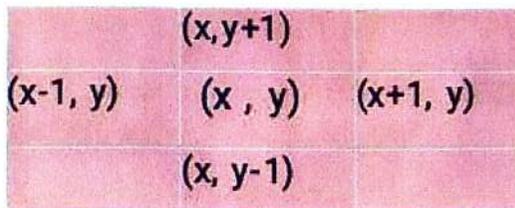


Figure 3.3: 4 Neighbours

ND(P)- DIAGONAL NEIGHBOURS

A pixel p at (x, y) has 4 diagonal neighbours at $(x+1, y+1)$, $(x+1, y-1)$, $(x-1, y+1)$ and $(x-1, y-1)$. These neighbours are called the diagonal-neighbours of p $ND(p)$.

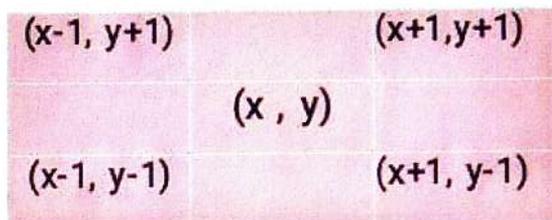


Figure 3.4: Diagonal Neighbours

N8(P)- 8 NEIGHBOURS

The 4-neighbours and the diagonal neighbours of p are together called 8-neighbours of p $N8(p)$ $N8(P) = N4(P) + ND(P)$

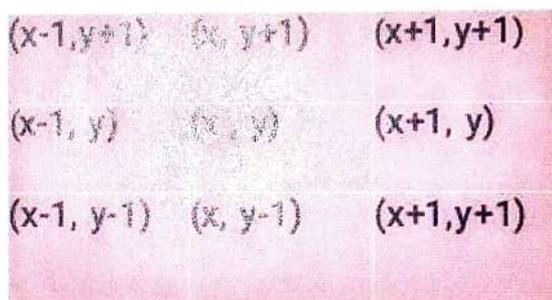


Figure 3.5: 8 Neighbours

3.2.2 ADJACENCY OF PIXELS

Two pixels that are neighbours and have the same gray level are adjacent. Let V denote the set of intensity values

4 ADJACENCY

Two pixels p and q with values from V are said to be 4-adjacent, if q is in the set $N4(p)$.

8 ADJACENCY

Two pixels p and q with values from V are said to be 8-adjacent, if q is in the set $N8(p)$.

m ADJACENCY

Two pixels p and q with values from V are said to be m -adjacent, if q is in $N_4(p)$ or q is in $N_D(p)$

3.2.3 CONNECTIVITY BETWEEN PIXELS

Two pixels are said to be connected if they are adjacent in some sense.

4-CONNECTIVITY

Two or more pixels are 4-connected if they are 4-adjacent with each others.

8-CONNECTIVITY

Two or more pixels are 8-connected if they are 8-adjacent with each others.

m-CONNECTIVITY

Two or more pixels are m -connected if they are m -adjacent with each others.

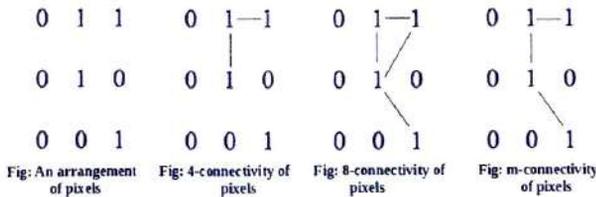


Figure 3.6: Connectivity of $V=1$

3.3 FUNDAMENTAL STEPS IN DIGITAL IMAGE PROCESSING

Fundamental steps in digital image processing are:

- Image acquisition
- Image enhancement
- Image restoration
- Wavelets and multiresolution processing
- Color image processing

- Morphological processing
- Compression
- Segmentation
- Description and representation

IMAGE ACQUISITION

It is the fundamental steps of digital image processing. The image acquisition can be simple as being given an image already in digital form. It includes the image that is acquired by the system is usually completely unprocessed. This usually involves retrieving images from a source that is automatically capturing images.

IMAGE ENHANCEMENT

It is the most straightforward and most appearing area of image processing. It is process of manipulating an image so that the result is more suitable than the original for the specific application. Image enhancement can be done by Spatial domain method and Frequency domain method

WAVELETS AND MULTIREOLUTION PROCESSING

Wavelets are the basis for representing the images in several degrees of resolution. At the same time, the images can divide into lower regions for pyramidal representation and data compression

COLOR IMAGE PROCESSING

The colour image processing is an area which has been gaining its importance due of its significant increase in the use of digital images through the internet. It includes colour modelling and processing in a digital sphere etc.

MORPHOLOGICAL PROCESSING

As a matter of fact, it deals with extracting image components that are useful in description and representation of the shape. On the opposite

hand, it involves basic morphological operations such as dilation and erosion.

COMPRESSION

In fact, the compression deals with techniques that are useful for reducing the storage required to save lots of a picture or the bandwidth from transmitting it

SEGMENTATION

Segmentation is the process of partitioning an image into its constituent parts or an object. The segmentation is the primary tasks in digital image processing . In fact, a segmentation procedure provides the process with a long way towards a successful solution of imaging problems which helps to require objects to determined individually.

DESCRIPTION AND REPRESENTATION

Description and representation follow the output of a segmentation stage, that is usually is raw pixel data. At the same time, choosing an observation is the only part of the answer for converting raw data into the form that is useful for subsequent digital signal processing systems. It deals with extracting the attributes which result in some quantitative details of interest or is fundamental for distinguishing one class of the objects from another

Chapter 4

SOME OPERATIONS ON IMAGE

4.1 SOME OPERATIONS ON IMAGE

MATLAB is a programming platform developed by the LINPACK and EISPACK projects for engineers and scientists to analyse and design systems that transform our world. MATLAB stands for Matrix laboratory. MATLAB reads each image as a matrix and therefore any matrix operation has an analogue for images. Consider the following images.



Figure 4.1:

After extracting the matrices associated to the above images, we can perform the following operations.

- Image addition/ addition of 2 images
- Image subtraction/ difference of 2 images
- Multiplication of an image by a constant/ scalar multiplication

- Absolute value of an image/ modulus value

4.1.1 IMAGE ADDITION

In image addition, the operator takes two identically sized images as input and produces a third image as output of the same size as the first two, in which each pixel value is the sum of the values of the corresponding pixel from each of the two input images. The addition of two images is performed in a single pass. The output pixel values are given by:

$$Q(i, j) = P_1(i, j) + P_2(i, j)$$

If it is simply desired to add a constant value C to a single image then:

$$Q(i, j) = P_1(i, j) + C$$

Example:

MATLAB CODE:

```
I=imread('rice.png'); % Read first image
J=imread('cameraman.tif'); % Read second image
imshow(I) % Display first image
imshow(J) % Display second image
A=imadd(I,J); % Add the two images
imshow(A) % Display the result
```

OUTPUT:



Figure 4.2:

4.1.2 IMAGE SUBTRACTION

In image subtraction, the operator takes two images as input and produces as output a third image whose pixel values are simply those of the first image minus the corresponding pixel values from the second image. The output pixel values are given by:

$$Q(i, j) = P_1(i, j) - P_2(i, j)$$

If it is simply desired to subtract a constant value C from a single image then:

$$Q(i, j) = P_1(i, j) - C$$

Example:

MATLAB CODE:

```
I=imread('rice.png'); % Read first image
J=imread('cameraman.tif'); % Read second image
imshow(I) % Display first image
imshow(J) % Display second image
S=imsubtract(I,J); % Subtract images
imshow(S) % Display the result
```

OUTPUT:



Figure 4.3:

4.1.3 MULTIPLICATION OF AN IMAGE BY A CONSTANT

In multiplication of an image by a constant, the operator takes a single input image and produces output in which each pixel value is multiplied by a specified constant. Scaling by a constant is performed using:

$$Q(i, j) = P_1(i, j).C$$

Example:

MATLAB CODE:

FIRST IMAGE:

```
I=imread('rice.png'); % Read first image
imshow(I) % Display first image
M=immultiply(I,1.5); % Multiply first image by the constant 1.5
imshow(M) % Display the result
```



Figure 4.4:

```
N=immultiply(I,0.5); % Multiply first image by the constant 0.5
imshow(N) % Display the result
```

SECOND IMAGE:

```
J=imread('cameraman.tif'); % Read second image
imshow(J) % Display second image
M=immultiply(J,1.5); % Multiply second image by the constant 1.5
imshow(M) % Display the result
```



Figure 4.5:



Figure 4.6:

```

N=immultiply(J,0.5); % Multiply second image by the constant 0.5
imshow(N) % Display the result

```



Figure 4.7:

From the above examples, it is clear that multiplication by a constant is used to change the contrast of an image. When the images were multiplied by 1.5, we got an image lighter than the original image but when they were multiplied by 0.5, we got a darker one. This indicates that

as the number increases we will get lighter image.

4.1.4 ABSOLUTE VALUE OF AN IMAGE

Example:

MATLAB CODE:

```
I=imread('rice.png'); % Read first image
J=imread('cameraman.tif'); % Read second image
imshow(I) % Display first image
imshow(J) % Display second image
S=imabsdiff(I,J); % Modulus operation on images
imshow(S) % Display the result
```



Figure 4.8:

Now, we have the freedom to crop,resize and alter picture at your fingertips. Instagram is one of the commonly used social media app. As we know, it allows you to snap a photo and add or subtract anything in the photo that you like and we can apply effects with the help of filters. This all are possible because ,the Instagram system operates similarly to our MATLAB code reading of jpeg images.

4.2 APPLICATIONS OF DIGITAL IMAGE PROCESSING

4.2.1 IMAGE SHARPENING AND RESTORATION

Image sharpening and restoration refers to reprocess the images that have been captured in the modern camera in order to make them a better image or to change the images to get a clear image. It usually does the work of a photoshop. It includes sharpening, blurring, zooming, detecting edges and vice versa, grayscale to colour conversion, image retrieval and image recognition. Some common examples are shown in the fig 4.9 ,4.10 ,4.11 ,4.12



Figure 4.9: Original image

Figure 4.10: Zoomed image

Figure 4.11: Sharpened image

Figure 4.12: Blurred image

4.2.2 MEDICAL FIELD

Some common applications of Digital Image Processing in the field of medicine are Medical CT, PET Scan ,UV Imaging, X-Ray Imaging, Gamma Ray Imaging

4.2.3 REMOTE SENSING

In remote sensing, the Earth's area is scanned by a satellite or from a very high ground and then it is observed and analysed to obtain information about it. One of the particular applications of Digital Image Processing in the field of remote sensing is to detect infrastructure damages caused by an Earthquake. As it takes more time to identify



Figure 4.13:

the damage, even if serious damages are focussed on. Sometimes the area affected by the Earthquake is so wide, so that it is not possible to estimate the damages with the human eye. Even if it is possible, it is a very hectic and time consuming procedure. An image of the effected area is taken from the above ground and then it is analysed to get more information about the various damages done by the Earthquake.

The key steps included in the analysis are:

- Analysis and enhancement of various types of edges
- The extraction of edges

4.2.4 TRANSMISSION AND ENCODING

The first image that was transmitted through the wire is from London to New York using the submarine cables. The picture that was sent through the wire is shown below. The picture took three hours to reach



Figure 4.14:

from place to another. Just imagine, today we are able to see live video, live CCTV footage from one continent to another within seconds. This shows that a lot of work has been done in this field. This field not only focuses on transmission but also on encoding. Many different formats have been developed for high and low bandwidth for different purposes.

4.2.5 MACHINE / ROBOT VISION

Apart from many challenges, one of the biggest challenge that a robot face today is to increase the vision of the robot. Make a robot able to see things, identify them, identify the hurdles etc. So much work has been contributed by this field and a complete computer vision has been introduced to work on it.

HURDLE DETECTION

One of the common task that has been done through image processing is Hurdle Detection, by identifying different types of objects in the image and then calculating the distance between the robot and the hurdles.

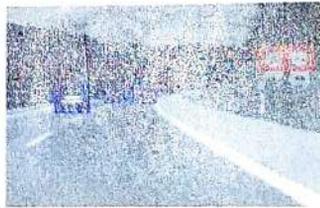


Figure 4.15:

4.2.6 COLOUR PROCESSING

Colour processing mainly includes the processing of coloured images and the different colour spaces in it. For example, RGB color model. It also involves storage, studying transmission and encoding of these colour images.

4.2.7 VIDEO PROCESSING

A video is nothing but it is just the very fast movement of pictures. The quality of the video mainly depends on the number of pictures per minute and the quality of each picture being used. Video processing involves motion detection, noise reduction, frame rate conversion, colour space conversion, detail enhancement, aspect ratio conversion etc.

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Project Report

On

MATHEMATICS BEHIND RUBIK'S CUBE

Submitted

in partial fulfilment of the requirements for the degree of

BACHELOR OF SCIENCE

in

MATHEMATICS

by

AFROZA AFSAL

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Under the Supervision of

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MARCH 2022



CERTIFICATE

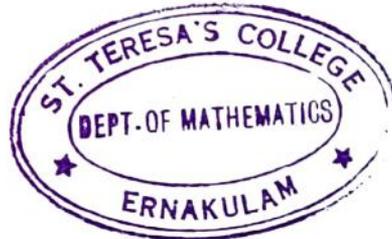
This is to certify that the dissertation entitled, **MATHEMATICS BEHIND RUBIK'S CUBE** is a bonafide record of the work done by Ms. **AFROZA AFSAL** under my guidance as partial fulfillment of the award of the degree of **Bachelor of Science in Mathematics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

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DECLARATION

I hereby declare that the work presented in this project is based on the original work done by me under the guidance of Dr. Susan Mathew Panakkal, Assistant Professor, Department of Mathematics, St. Teresa's College(Autonomous), Ernakulam and has not been included in any other project submitted previously for the award of any degree.

Ernakulam.

Date: 07-03-2022



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AB19BMAT016

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Ernakulam.

Date: 07-03-2022

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AB19BMAT016

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Chapter 1

INTRODUCTION

Rubik's cube is a 3D combination puzzle. It is widely considered to be the world best selling toy. First it was invented by Hungarian sculptor. The concept of Rubik's Cube is derived from China Luo book. That can be converted into jiucong map. In 1974 Erno Rubik was developed into modern Rubik's Cube. And it is also called magic Cube. It won a special award for German game and awards for best toy in US, France and UK. There are several features in Rubik's Cube structure such as permutations and combinations, rotation, cycle and its mechanism can be used in various science field such as mechanics field in physics, math's. The Rubik's cube structure has a few elements for example turn, change and blends and cycle and balance, which were treated as actual models or instruments to study specific scientific issues or were considered by utilizing scientific hypothesis or strategies in certain spaces. All things consider the standards of Rubik's cube are contained in various scientific frameworks that include stages and combo- countries, balances and cyclicity.

1.1 LITERATURE REVIEW

Lach and Sakshaug (2004) performed a take a look at the usage of those methods, which supplied quite a few thrilling results. They noted 'Games are clearly motivating and amusing, video games facilitate individualization of evaluation and instruction, and video games make the summary greater concrete.' They additionally concluded that gambling arithmetic video games ought to enhance college students' spatial abilities and algebraic reasoning. This take a look at had each a manage institution and an experimental institution. Both businesses consisted of

higher middle-magnificence college students who scored above the thirtieth percentile in math at the Stanford Achievement Test. At the start and of entirety of the take a look at each the manage and experimental businesses have been given a pre-take a look at and a post-take a look at. Both businesses scored further withinside the pre-take a look at. The researchers located a fine statistically big distinction of their experimental institution's pre-take a look at and post-take a look at ratings. There became no statistically big distinction among the pre-take a look at and post-take a look at ratings of the manage institution. Instructional sport gambling in lecture rooms is strongly supported via way of means of Blum and Yocom (1996). They declare that video games can boom motivation and permit college students a amusing manner to Practice talents they have got already learned. Klein and Freitag (1991) and Olsen and Platt (1992) located that video games helped college students' trouble fixing talents due to the fact the video games gave them a risk to clear up issues in a non-threatening environment.

1.2 PRELIMINARY

1.2.1 GROUP

Group G is a set of points with an operation, $*$, that relates every pair of elements x and y such that the following properties are satisfied:

1. **Closure:** $\forall x, y \in G, x * y = z, z \in G$.
2. **Associativity:** $\forall x, y, z \in G$, we have $x *(y * z) = (x * y) * z$.
3. **Identity:** \exists an element ' a ' $\in G$, such that $\forall x \in G, x*1 = 1*x = x$.
4. **Inverse:** $\forall x \in G, \exists x^{-1}$, such that $x * x^{-1} = 1$.

1.2.2 ABELIAN GROUP

A group is said to be Abelian, if it is commutative.

i.e. $x * y = y * x$

1.2.3 PERMUTATION

A Permutation is an invertible mapping of a finite set N onto itself.

1.2.4 CYCLE

A Cycle is a subset of a permutation in which the affected elements, E , can ordered, and every element of E is sent to another element of E .

1.2.5 TRANSPOSITION

A cycle of length two is known as Transposition.

1.2.6 PARITY

Parity is the property of an integer of whether it is even or odd.

1.2.7 ORDER

Order of the group is the number of elements.

1.3 ORIGIN AND DEVELOPMENT

The concept of Rubik's Cube is derived from China Luo-book that can be converted into jiucong map. Ten-order magic square is a certain configuration Combination of numbers $1, 2, 3, \dots, (n^2)$ in a n -th order square, which makes the sum of the numbers in Each row, each column and two diagonals $n((n^2) + 1)/2$. It is called the magic square constant. Rubik's Cube The constant of the third-order cube is 15. The rearrangement of the nine places is one-dimensional and three-order The cube and the game have eight movable chess pieces placed in nine places Create another pattern by moving the pieces in order to complete Rearrange's mode change nine Places. It is a game developed from Jiucong around the Yuan Dynasty in China. From that point forward, the improvement of the block moved from the request to the aspect. In the Qing Dynasty, Chinese researchers set forward the possibility of utilizing computerized pieces of three-layered wizardry

squares. Indeed, this was a three-layered second-request block model. Different further developed solid shapes are planned into Grow the Rubik's Cube family after the Rubik's Cube was created. As a rule, Rubik's Cube can be isolated into two kinds of Classification: 3D squares and molded blocks. One 3D shape alludes to the block in the container structure, not has changed, yet the request for the solid shapes has been expanded. There are unique Various variations of the Rubik's Cube with up to 33 layers. With $2 \times 2 \times 2$ (pocket size/smaller than normal shape), standard $3 \times 3 \times 3$ Solid shape, $4 \times 4 \times 4$ (Rubik's Revenge/Rubik's Cube), and $5 \times 5 \times 5$ (Teacher's Cube) is the most renown exceptional.

$17 \times 17 \times 17$ "Preposterous" block (recorded toward the finish of 2011) Until December 2017, the biggest scale (and the most costly) save, cost in excess of 2,000 US dollars) business deals 3D square. There is a functioning plan of $22 \times 22 \times 22$ 3D square.

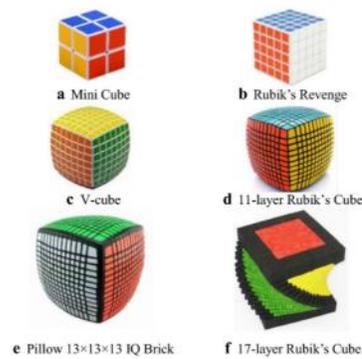
Also exhibited in January 2016, and The $33 \times 33 \times 33$ 3D shape was sent off in December 2017. Chinese manufacturer ShengShou has been producing cubes in all sizes from $2 \times 2 \times 2$ to $10 \times 10 \times 10$ (as of late 2013), and also produced an $11 \times 11 \times 11$ model. The uncommonly molded 3D shape alludes to the block family other than the cubic 3D square. The primary state of uniquely molded shape is different, including polyhedron cubes, sphere block, tetrahedron 3D square, reflect solid shape, gear cube, cake 3D square, etc.

1.4 TYPES OF RUBIK'S CUBE

The Magic Cubes are divided into two broad categories: Cubic Cube and Specially Shaped Cube.

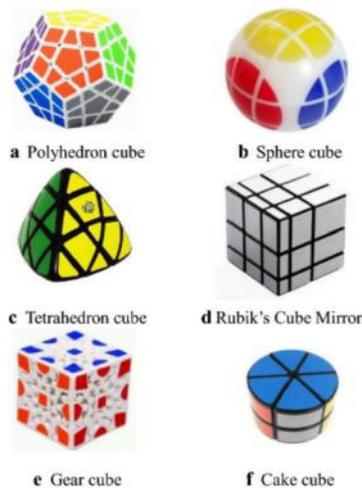
1.4.1 CUBIC CUBE

A Cubic cube refers to a cube in a box structure that is not changed but the order of the cube increases. There are different variation of Rubik's cube to $33 \times 33 \times 33$. Different types of cubic cube involves $2 \times 2 \times 2$ (Pocket/mini cube), $3 \times 3 \times 3$ (Standard cube), $4 \times 4 \times 4$ (Revenge/Master cube), $5 \times 5 \times 5$ (Professor's cube), and so on.



1.4.2 SPECIALLY SHAPED CUBE

The specially shaped cube refers to the cube family besides the cubic cube. The structural shape of the cube is diverse including polyhedron cube, sphere cube, tetrahedron cube, mirror cube, cake cube, gear cube and so on.



Chapter 2

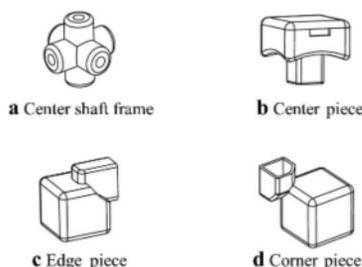
BASIC CHARACTERISTICS

The three main characteristics of a Rubik's cube are:

2.1 STRUCTURAL AND ROTATIONAL

The structure of the Rubik's Cube mechanism is the most exciting thing of the Rubik's Cube. At first, the cube seemed completely impossible to work. Few people have proposed possible mechanisms, and few people have proposed realities. Later, many of the Rubik's Cube mechanisms were based on mortise connections between components. The cubes are fixed together and there are no key components in any respect. This connection is difficult to make with sufficient accuracy, so the face can be turned over without difficulty. A Cube ($3 \times 3 \times 3$) consists of 26 scaled down cubes, also called 'pieces' or 'cube lets' as well as a center shaft frame, 6 center pieces, 8 corner pieces, and 12 edge pieces. Each consists of a hidden internal extension that interlocks with the others while permitting them to circulate to unique locations. The central component can be divided into two components. The middle piece and the middle shaft frame are related through spring-loaded screws the system of assembling different pieces separately. The constraints on the edges are formed by way of structural restrictions and the pressure locking of two adjoining centers. The restrictions on the corner pieces are shaped by the use of structural constraints and force locking of three adjoining edges. They all contact each other via planes and curved surfaces. The internal extensions of the corner piece and the brink piece are firmly hooked together. When force is applied, these collets-forming layers can flexibly rotate around the axis. The feature of Rubik's Cube, where small pieces are connected by mutual

mosaics.



2.2 PERMUTATION AND COMBINATION

The concept of permutation and combination was put forward to meet the needs of the number of people, that is, the idea of permutation and combination. It can describe the spatial coordinate system of the Rubik's Cube, which has a one-to-one correspondence with the Cartesian coordinate system. These suggest that the rotation transformation of the Rubik's cube incorporates the idea of permutation and combination. The Rubik's Cube achieves the desired state and various color combinations by rotating the blocks. The Rubik's Cube has six sides. First, every face has the same color, and each face has nine small outer surfaces. They may usually be fifty-four outer surfaces. Each side of the Rubik's Cube is composed of shadows with different shapes after each side is randomly rotated several times. The transformation among different configurations of the Rubik's cube may be used as a model the use of the concept of permutation and combination to pursue the variety of solutions. The characteristics of combination transformation have inspired many product design thinking, especially the actual realization and structural design of industrial product modularization.

2.3 CYCLIC CHARACTERISTICS

Loop is one of the easy traits of Rubik's cube. The range of instances the Rubik's cube rotates is referred to as the cycle period. The Rubik's Cube is returned to its original state from its original state through a certain number of operations and specified operations. Periodic characteristics can be divided into two types: periodic and non-periodic. If the cycle period is consistent, the cycle is periodic. If the movement cycle is variable, the cycle is non-periodic.

Chapter 3

GROUP THEORY

3.1 GROUPS

The different transformations and configurations of the cubes form subgroups of permutation groups produced by different horizontal and vertical rotations of the puzzle. Front (F) means to rotate the front 90 degrees clockwise. Counterclockwise rotation is indicated by lowercase letters (f) or addition (F'). Indicates a 180-degree turn by adding a superscript 2 (F²) or just moving followed by a 2 (F2).

THEOREM: A group of operations on the cube can be moved from the unresolved state to the resolved state by moving in various combinations in the group under the series operation. Then we call this group a cube group.

Proof

Group G is composed of a group of objects and binary operator's * on objects satisfying the following four conditions.

Operation * is closed, so for any group elements h and g in G, h * g is also in G. The operation * is associative, so for any element f, g, and h, (f * g) * h = f * (g * h). There is a unit element e ∈ G such that e * g = g * e = g. Each element in G has an inverse g⁻¹ Relative to the operation such that g * g⁻¹ = g⁻¹ * g = e. Rubik's cube is not Abelian, the sequence of moves acting on cube is not commutative. For example (RU) is not equal to (UR).

3.2 PERMUTATION

The different movement sequences of the cube elements can be regarded as the arrangement or rearrangement of the cube. Note that different movement sequences of moving the cube elements can be seen as an arrangement or rearrangement of the cube. The number of possible permutations of squares on the Rubik's Cube seems daunting. There are 8 corner pieces, which can be 8 rows! Each method can be arranged in 3 directions, providing 3^8 possibilities for each arrangement of corner blocks. There are 12 side pieces, which can be arranged into $12!$ Method. Each edge block has 2 possible directions, so each arrangement of edge blocks has 2^{12} arrangements. But in the Rubik's Cube, only $1/3$ of the arrangement makes the corner cube rotate correctly. The arrangement of has the same edge flip direction as the original cube is only $1/2$. Only $1/2$ among them has the correct cube rearrangement parity.

The number of Rubik's cube configuration species is about,

$$(8! \cdot 3^8 \cdot 12! \cdot 2^{12}) \div (3 \cdot 2 \cdot 2 \cdot 2) = 43,252,003,274,489,856,000 \text{ ,43 quintillion.}$$

3.3 PARITY

THEOREM: The cube always has even parity, or an even number of cubbies exchanged from the starting position.

Proof

Let $P(n)$: after n rotations, there is an even number of cubbies exchanged. We assume $P(n)$ to show $P(n) \rightarrow P(n+1)$.

After n moves the cube has an even number of cubbies exchanged. Since the $n+1$ move will be a face turn, there will be an even number of cubbies flipped. There was already an even number exchanged, and so an even parity of cubbies exchanges is preserved overall. Since any permutation of the Rubik's cube has even parity, there is no move that will exchange a single pair of cubbies. This means that when two cubbies are exchanged, we know there must be other cubbies exchanged as well.

THEOREM: If the cube starts at the solved state, and one move sequence P is performed successively, then eventually the cube will return to its solved state.

Proof

Let P be any cube move sequence. Then at some number of times m that P is applied, it recycles to the same arrangement k , where $k < m$ and m is the soonest an arrangement appears for the second time. So $P^k = P^m$. Thus if we show that k must be 0, we have proved that the cube cycles back to P^0 , the solved state. If $k = 0$, then we are done, since $P^0 = 1 = P^m$. Now we prove by contradiction that k must be 0. If $k > 0$: if we apply P^{-1} to both P^k and P^m . We get the same thing, since both arrangements P^k and P^m are the same. Then $P^k \cdot P^{-1} = P^m \cdot P^{-1} \rightarrow P^{k-1} = P^{m-1}$. But this is contradictory, since we said that m is the first time that arrangements repeat, so therefore k must equal 0 and every move sequence eventually cycles through the initial state again first before repeating other arrangements.

3.4 LAGRANGE'S THEOREM

Lagrange's theorem states that for finite groups, the size of any subgroup divides the order of the group.

Lagrange says that if you repeat a sequence of moves, i.e., take successive powers, you will evidently get back where you started.

A simple example is to look at the power of F . You will notice that the power of F gives you a set of 4 elements $\{F, F^2, F^3, F^4\}$, where $F^4=I$. Here I use to mean "move" without doing anything. In addition, Lagrange stated that the Rubik's Cube must be divisible by 4. Because the subgroup generated by F , namely $\{F, F^2, F^3, I\}$, has 4 different elements.

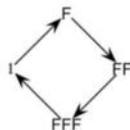
3.5 CAYLEY'S GRAPH

We can in-depth understand the structure of groups and subgroups is a Cayley's diagram. It would be ridiculous to draw a Cayley's diagram for R . If there are 43

trillion vertices, we will look at the Cayley's graphs of some small subgroups of R .

If the two groups have the same Cayley's diagram, they have essentially the same structure, which is called isomorphism. The two isomorphic groups will have the same order and the same effect on the cube. For example, performing FFRR has the same effect as rotating a cube, so that L is now facing forward, and then performing RRBB.

The following is the Cayley graph for the subgroup generated by F :



The moves $\phi = FF$ and $\rho = RR$ generate the following graph (note that $\phi^2 = \rho^2 = 1$):



Chapter 4

CRYPTOGRAPHY

4.1 MITCHELL'S CRYPTOGRAPHY

West Virginia University Economics Professor Douglas W. Mitchell (Douglas W. Mitchell) submitted Propose a suggested cryptographic system using Rubik's Cube toys to the Math's Magazine, Cryptologia, 1992. Replacement and transposition encryption are the two most basic forms of encoding and decoding messages. Generally, the use of transposed cipher text creation mechanisms is not efficient in generating letters in the way required for encoding and decoding. This type of system is designed to apply multiple alphabet substitutions, that is, the arrangement of alphabets, rather than not multi-picture replacement, or position arrangement.

4.2 MECHANISM OF MITCHELL'S CRYPTO-SYSTEM

The original Rubik's Cube, a 3×3 arrangement of 27 mini cube faces, had six faces, nine cubes each. The rotation of the cube allows movement around three axes rotating the face by a multiple of 2 will restore the cube to its original shape, but as the cube changes. Mitchell's password system involves some sneaky steps to repair the plain text. The first step of the process requires writing number "1" in the upper left corner of the cube face. The number "2" can be on a square chosen arbitrarily on the other side, and so on, until all six sides have a characteristic number as its representative identifier. Take the top line, and then you can write the plain text on the rest of the cube surface, starting from the top line and writing from left to right. Below is the first cube written in quotation marks

of the exchange. Rotating the key will imply the order of reading the cipher text. Mitchell described a six-letter extension, such as "AFDEBC", which tells the recipient to read First is the text on the top surface of the cube, then the surface represents "F", etc., until it is copied To the paper.

In addition, Mitchell proposed that the order of reading letters be determined by Additional letters in the key extension: "Suppose X stands for reading from left to right, top to bottom Rank first, middle row second, bottom row last, and Y stands for reading from top to bottom, First, the left column, then the center column, then the right column, and so on." This is after it's easy to create and decipher. The decoder will copy the cipher text onto the cube Follow the order of key expansion. The rotated key will read backwards, this will involve replacing right with left and down with up. Plain text can Read from the face marked "1", then "2" and so on. Mitchell points out the direction the face after the first one will be one of four possibilities, the correct one to read Understandable plain text. For rotary keys, we can use the following criteria: R = row, C = column, L = level. 1, 2, 3 will represent a clockwise rotation of a face in multiples of 2.

Chapter 5

APPLICATION AND CURRENT RESEARCH STATUS

5.1 APPLICATION

Rubik's Cube, 'Huarongdao' as constructed by Chinese, and 'Independent diamond' constructed by the French are known as three major intellectual toys of the world. Although the Rubik's Cube was constructed just over 40 times ago, it has been popular with people around the world, and an adding number of cube suckers and scholars have come hooked on Rubik's Cube's charm. The main reason is that Rubik's Cube contains the esoteric fine principles and an each- encompassing metamorphosis, which attracts curious people to explore the mystifications of Rubik's Cube. These experimenters studied the description of gyration of the Rubik's Cube, explored recovery algorithms and the fine principles of the Rubik's Cube, and used the Rubik's Cube as a model to study the scientific problems in multidisciplines.

As seen from the below studies, with the exploration and operation of Rubik's Cube, it isn't only an intellectual toy. It has changed from a exploration object to an object of significance in multidisciplinary exploration. These studies and operations are substantially grounded on the abstract characteristics of the Rubik's Cube structure. The exploration to explore the internal medium law of Rubik's

Cube has just begun. The medium principle of Rubik's Cube structure has yet to have an in- depth study.

With the nonstop enhancement in the demand of mechanical products, classical mechanisms are moving forward to ultra modern complex mechanisms, which changed from fixed topology to variable topology and from weak coupling to strong coupling. Variable topology and strong coupling of the cell body gradationally attracted attention. Compared with a resembling medium and simple multi loop coupled medium, the structure of Rubik's Cube has a advanced complex degree of freedom, the rack of Rubik's Cube structure is connected to a number of end-effectors, and the connection between rod and rod is non-continuous. Still, Rubik's Cube has great operation eventuality in the artificial field for its features, including high space application, a large number of combinations, sophisticated sports form, and multi module structure. The operation of Rubik's Cube in the ministry assiduity has the following three ideas.

The multi-end effectors of Rubik's Cube and the ability of permutation and combination can be applied to mechanical design. The Rubik's Cube medium can be used as the main structure of multifunctional mechanical products. The use of the gyration of the cube medium can achieve the asked position or form of movement, so that different ends of the selector can complete a task in order in a certain position, or make different ends of the selector work together to complete a job with orderly cooperation.

According to the kinetic brace characteristics of the Rubik's Cube structure that are different from the common structure, the cube kinetic dyads can be integrated into the current artificial medium. If such a clever design operation can replace the robot globular joint, the problem of a small gyration angle of the globular joint being limited by the mechanical structure will be answered, therefore expanding the robot's work space, especially that of the resembling mechanism. If this design

can be applied to a machine tool holder or the manipulator of a mechanical arm, the flexibility of setting and operation will be greatly bettered. The Rubik's Cube structure has high space application.

If this specified can be applied to other mechanical products, I'll promote the miniaturization process of mechanical products.

In addition, with the development of the world's aero-space assiduity, there will be more and more deep- space disquisition systems. Some features of the Rubik's Cube structure including modular, rotating, multifunctional, multipurpose, and recyclable functions can be applied to the design of deep- space disquisition spacecraft or vehicles.

According to the below operation ideas, the application of the cell structure also requires introductory theoretical exploration. The movement of the product to achieve a certain direction involves the exploration of degrees of freedom order to achieve the needed form of movement and specific state related to the structural mathematical expression and the metamorphic parcels. There are some problems with the Rubik's Cube medium, including a certain degree of flexibility, a large number of face connections, a number of movement directions of special locales, and numerous further. Posterior exploration on specific static, disunion, control, and other motifs will be involved.

With farther disquisition, implicit operations of the Rubik's Cube bear the study of medium problems of the cube structure. This can lay a theoretical foundation for operations of the cell medium and promote special cube mechanisms from educational toys to Ministry (similar as robots, aerospace, etc.).

5.2 CONCLUSION

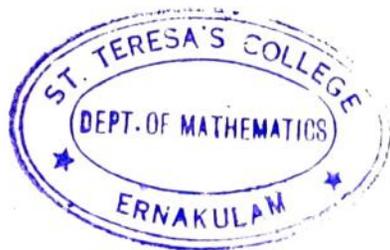
There are numerous types of Rubik's cubes. Some reach minds in theoretical exploration and operation have been done. This document has totally introduced the origin and development of the Rubik's Cube, anatomized the characteristics Rubik's cube structure and performance characteristics, assaying Rubik's cube as a group, Rubik's cube encryption, Rubik's Cube Operations and reviewed the state of Rubik's Cube exploration, including scientific conceits, restoration algorithms and Characteristic operations. The external characteristics of the Rubik's Cube have it has been studied and applied in multidisciplinary fields, thus the principles of the internal structure of the Rubik's cube they must be explored at the same time. Exploration on the Rubik's cube in the field of mechanics is still in its immaturity. The new problems of the Rubik's cube medium should be studied, and a methodical proposition of the Rubik's Cube the medium must be formed. Some consummations of the exploration have a guiding significance in development of the Rubik's Cube Medium in Mechanical Engineering- operations. The topological proposition of the cube medium has not yet been studied further.

5.3 CURRENT RESEARCH STATUS

The Rubik's Cube was rated as the stylish toy of the public fair in Nuremberg in Germany in 1978, and his innovator Rubik was awarded "Stylish game in the world", Invention Award 'Since also, Rubik's fissionability Cube has spread each over the world. At the same time, a transnational conference of representatives of mathematicians it happen in Helsinki. The Rubik's cube has attracted great attention with experts and experimenters. After that, the papers and have been published written on the Rubik's cube continuously, and the door to explore the mystifications of Rubik's cube has been opened. Latterly, the current examinations of the Rubik's cube are reviewed in colorful disciplines at home and abroad, including examinations of the scientific conceits of the Rubik's Cube, reduction algorithms, characteristic operations and problems of mechanisms. Eventually, the operations and perspectives of the Rubik's Cube in the field of mechanisms are banded.

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**To study the impact of service quality and restaurant
ambiance on customer loyalty**

Project Report

Submitted by

AFSINA A . A (Reg. No . SB19BMS001)

Under the guidance of

Smt. NAMITHA PETER

In partial fulfilment of the requirements for award of the degree of

Bachelor of Management Studies- International Business



ST.TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

COLLEGE WITH POTENTIAL FOR EXCELLENCE

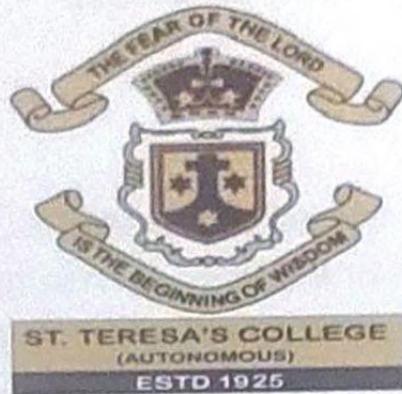
Nationally Re-Accredited At 'A++' Level (NAAC Fourth Cycle)

March 2022

Valued by : *[Signature]*
09/05/22

Dr. Sr. Usha. A. A

ST.TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM, KOCHI – 682011



CERTIFICATE

This is to certify that the project entitled "Impact of service quality and restaurant ambiance on customer loyalty: measuring the mediating effect of customer satisfaction", has been successfully completed by Afsina.A.A, Reg.No.SB19BMS001, in partial fulfillment of the requirements for the award of degree of Bachelor of Management Studies in International Business, under my guidance during the academic years 2019-2022.

Date : 09/05/2022

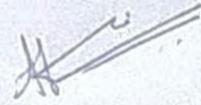


**Mrs .NAMITHA PETER
INTERNAL FACULTY GUIDE**

DECLARATION

I, Afsina. A.A ,Reg. No.SB19BMS001, hereby declare that this project work entitled "Impact of service quality and restaurant ambiance on customer loyalty: measuring the mediating effect of customer satisfaction" is my original work. I further declare that this report is based on the information collected by me and has not previously been submitted to any other university or academic body.

Date: 09/05/22



AFSINA A.A
Reg.No.SB19BMS001

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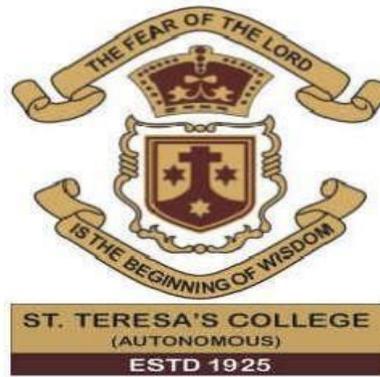
CERTIFICATE

This is to certify that the project report entitled, “Impact of service quality and restaurant ambiance on customer loyalty: measuring the mediating effect of customer satisfaction”, is a bonafide record submitted by Afsina.A.A ,Reg.No.SB19BMS001, in partial fulfillment of the requirements for the award of the Degree of Bachelor of Management Studies in International Business during the academic years 2019-2022.

Date :

**Dr.LIZZY MATHEW
PRINCIPAL**

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CERTIFICATE

This is to certify that the project entitled “Impact of service quality and restaurant ambiance on customer loyalty: measuring the mediating effect of customer satisfaction”, has been successfully completed by.Afsina.A.A,Reg.No.SB19BMS001,in partial fulfillment of the requirements for the award of degree of Bachelor of Management Studies in International Business, under my guidance during the academic years 2019-2022.

Date :

**Mrs.NAMITHA PETE
INTERNAL FACULTY GUID**

DECLARATION

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I further declare that this report is based on the information collected by me and has not previously been submitted to any other university or academic body.

Date:

AFSINA A.A
Reg.No.SB19BMS001

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AFSINA.

Exicutive summary

Customer loyalty is positively related to customer satisfaction as happy customer consistently favor the brands that meet their needs. Loyal customers are purchasing a firm's products or services exclusively, and they are not willing to switch their preferences over a competitive firm.

The study deals with the impact of service quality and restaurant ambience on customer satisfaction and loyalty at Ali baba and 41 dishes .This study will be helpful to get an overall idea about customer preference and customer satisfaction towards Ali baba restaurant. This is mainly focused on the customer satisfaction with reference to Ali Baba and 41 dishes, Panampilly Nagar.

The primary objective of this study is to work on finding the impact of service quality and restaurant ambience on customer loyalty with reference to Ali baba restaurant, Panampilly Nagar. This study put light on various factors that affect customer loyalty in customers such as ambience, food quality and service quality. Some of the objectives of this study used for finding conclusions are to study the role of service quality and ambience on customer satisfaction towards Ali baba restaurant, to understand the demographic differences between customers for service quality and ambience, to study the influence of restaurant ambience on customer satisfaction and to study the influence of customer satisfaction on customer loyalty

The study can help Ali baba management segment the customer base and frame appropriate strategies to target them. It helps to ascertain the satisfaction level of the customers regarding ambience, food quality and service quality. It identifies the factors that determine a customer's preference of dining experience. It will help the management to improve on their restaurant quality and ambience that would help increase customer satisfaction. And the restaurant management can calculate the average loyal customers of the rest and help cater to their needs and retain them for the long term.

By analyzing the values and graph findings, suggestions and conclusions of the topic are prepared.

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CHAPTER 1
INTRODUCTION

(1.1) OVERVIEW

(1.1.1) Customer loyalty

Customer loyalty is positively related to customer satisfaction as happy customers consistently favor the brands that meet their needs. Loyal customers are purchasing a firm's products or services exclusively, and they are not willing to switch their preferences over a competitive firm.

Brand loyalty stems out of a firm's consistent effort to deliver the same product, every time, at the same rate of success. Organizations give special attention to customer service, seeking to retain their existing current base by increasing customer loyalty. Often, they offer loyalty programs and customer rewards to the most loyal customers as an expression of appreciation for doing

(1.1.2) Customer satisfaction

Customer satisfaction indicates the fulfillment that customers derive from doing business with a firm. In other words, it's how happy the customers are with their transaction and overall experience with the company. Repeat business with them.

Customers derive satisfaction from a product or a service based on whether their need is met effortlessly, in a convenient way that makes them loyal to the firm. Hence, customer satisfaction is an important step to gain customer loyalty.

(1.1.3) Service quality

Service quality is one of the most important factors in determining the customer satisfaction and customer loyalty which has a direct impact on organization's success. That is the reason many organizations are focusing on service quality in order to enhance customer satisfaction and get a high level of purchase intention towards the customer. When perceived value of performance meets from the customer expectations then customer get satisfied, and when perceived value of performance doesn't meet from the customer expectations then customer get dissatisfied which is not in the favor of business. *(1.1.4) Importance of Customer*

Loyalty

Customer acquisition is top of mind for most businesses – most of their marketing budget is spent on advertising materials meant to drum up new visitors. Not to mention, new technologies

such as group buying sites and consumer reviewing apps are emerging to help businesses expand their reach. However, many fail to put as much focus on customer loyalty programs.

Building and growing a restaurant or retail business is much more than just accumulating new customers – it's retaining recurring ones, too. Many businesses overlook the importance of customer retention and loyalty programs. They are able to bring increased sales, brand awareness and a sense of security during tough times. In fact, the Gartner Group reports that 20 percent of a business' existing customers generate 80 percent of its profits.

In order to bolster profitability, businesses must cultivate and care for their recurring customers, engaging them in customer loyalty programs and providing them with frequent incentives.

(1.1.5) five reasons why loyal customers are essential to a business:

- **Loyal customers are easier to sell to**

Because loyal customers are more familiar with their preferred businesses, they are usually more inclined to try new menu items, new products and recommendations. In fact, according to Marketing Metrics, the probability of selling to new prospects is about 5 to 20 percent, but for an existing customer is 60 to 70 percent. In other words, it's extremely worthwhile – businesses can put forth the same amount of effort, but expect much higher success.

- **Loyal customers can act as brand ambassadors**

As brand ambassadors, your loyal customers can reinforce your values to other consumers. Because they frequent your store or restaurant and are satisfied with your product, they are also more likely to share their positive experiences with others – in the form of recommendations, reviews or social media praise. They are also more inclined to speak about your brand in everyday conversation with their peers, or “word-of-mouth marketing.

- **Acquiring new customers is more expensive**

Research has shown that it is six to seven times more expensive to acquire new customers than to continue serving loyal customers. To acquire new customers, restaurants and retail stores have to catch their eye with advertisements, provide introductory information about their brand, draw them in with discounts and deals and encourage them to try new items or products. Each

of these tasks can be costly. On the flip side, focusing on customer loyalty is much less laborintensive.

- **Loyal customers protect a business from competition.**

loyal customers are the foundation for a restaurant or store. If competition gets stiff or budgets get tight, they will be there to give you some padding – an “economic moat” as Warren Buffett puts it. Newer customers will be more likely to switch to a competitor, hurting your sales. Loyal customers reduce the risk of price sensitivity; they aren’t likely to abandon your brand after a small price adjustment. In tough times, your business’ ability to retain customers could be its saving grace.

- **Loyal customers offer constructive feedback**

How can a brand grow if it is unsure which areas of the business need improvement? loyal customers know the brand inside and out and can tell , honestly and constructively, what is doing right and what needs some work. Newer customers could shy away or develop biases after one or two unpleasant experiences, giving way to negative reviews that might not be an accurate representation of an average visit. Feedback is essential to maintaining quality products and service.

(1.1.6) Six Stages of Customer Loyalty

Customer loyalty can also be measured by the level of commitment each customer shows to the company. There are six stages in customer loyalty, and each stage increases in the amount of loyalty the customer shows. For example, a customer who is a repeat purchaser is more loyal than the customer who buys for the first time. A customer who refers to a friend is more loyal than the customer who simply buys once and uses the product.

The six stages of customer loyalty are:

1. Awareness – customer is aware of company and what it offers
2. Research – customers are considering purchasing, and have visited websites, downloaded resources, etc.
3. Buy – customer has bought product or service
4. Use – customer uses the service that they purchased

5. Repeat – customer purchases from company again
6. Refer – customer refers friends or family members to company

The goal of any company is to move the customer from stage one (awareness) all the way through to stage six (repeat buyer and referrer).

(1.1.7) The Future of Customer Loyalty

Rely on proximity to keep customers coming back. Most people would shop at the local corner store, get a savings account at the local bank and book their annual holiday at the travel agent next door. Customers were loyal to local businesses because they knew the owner from soccer practice.

Today, 85% of shoppers start their search on Google, instead of at the local shopping center. Simply by typing in a description of what they want to buy, customers can compare prices across every online business. One click, and they can get it delivered the next day. Customer loyalty is decreasing as competition is increasing.

In order to attract customers, and keep them coming back, companies need to invest in building company loyalty. By meeting and exceeding expectations consistently, companies can start to build a relationship with customers.

Competing simply on price is a race to the bottom. Companies with zero customer loyalty are forced to play this game, offering deeper and deeper discounts to attract new customers. But companies who have loyal customers don't need to compete on price. Instead, they can leverage their strong relationship with customers to keep them coming back.

(1.2) STATEMENT OF THE PROBLEM

The importance of customer loyalty impacts almost every metric important to running a business. Without happy customers that continue to buy from you, the business won't survive. New customers tend to cost more to acquire, and don't spend as much money as loyal, repeat customers. Keeping customers coming back for more is critical to business success. And it's why short term profit grabs don't work. Loyal customers are just better for business: they help business grow and they keep profits high.

The study deals with the role of service quality and restaurant ambience on customer satisfaction and loyalty at Ali baba restaurant and what are the factors that influence the customer satisfaction.

(1.3) LITERATURE REVIEW

In twenty-first century one of the leading marketing strategies is to provide value to the customer. Providing such products or services to your customer that is providing superior value to the customer as a competitor does (Chen & Hu, 2010). A satisfy customer can play a very positive role in especially service industry like fast food or restaurant because one satisfy customer can bring more ten customers only by spreading positive word of mouth, while a dissatisfied customer is very dangerous for business because it can away more than ten customers from your business only by spreading negative word of mouth until or unless determine that customer and take away his complaint (Ryu, Han, & Jang, 2010). Retention of customers has become a prime concern of a business, different drivers of customer loyalty has been studied for a long time by researchers like quality, price, physical environment etc. only to retain customer, because if a business is continuously acquiring new customers every day but it losses the old one customer every then the ultimate result would be zero, that's why this is very important to hold old customer while you are acquiring new one. customer satisfaction and customer loyalty are strongly correlated with each other, customer satisfaction have a significant impact on customer loyalty, both of the variables are very important to any business, to assure the customer loyalty a firm must have to assure the customer satisfaction. If a restaurant gets success to achieve customer loyalty through customer satisfaction then it can enjoy long-term benefits, and that is the only reason due to which restaurants are giving special attention to customer satisfaction and customer loyalty nowadays. A restaurant has to consider not only customer satisfaction and customer loyalty but all the factors that are related to them like product attributes and service attributes. Customer loyalty is essential in the restaurant industry, but customer loyalty can only be achieved by customer satisfaction in the restaurant industry, research work has also explored the factors like customer preference, customer trust, service quality with customer and customer satisfaction with customer loyalty. The trend of going out is becoming a part of our life, taking lunch and dinner outside is normal now so the need of restaurants is also increasing and there are many restaurant openings in the city, they are trying to satisfy their customers by providing better service quality and better quality food in order to achieve customer loyalty. Due to the globalization and high speed of economic

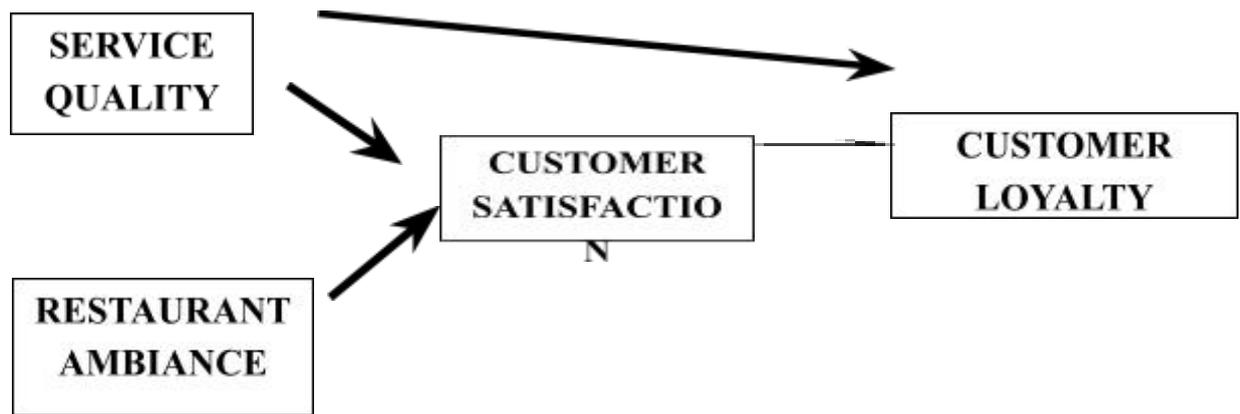
development competition in fast food restaurant industry has become very intensive, where you have to must satisfy your customer by providing them a better quality of services, because a competitor can beat you or capture your customer by providing better services than you. there is a significant impact on service quality and customer satisfaction especially in restaurant and fast food industry not only impact but there is also found a positive relationship between service quality and customer satisfaction, because as much better services provide by service provider the customer will be most satisfactory, the poor the service provided will make customer dissatisfy, so that can be said service quality has a great impact on customer satisfaction and as well on fast food restaurant industry.customer loyalty is very important and plays a vital role in the restaurant industry, but customer loyalty can only be achieved by customer satisfaction in the restaurant industry, research work has also explored the factors like customer preference, customer trust, service quality with customer satisfaction and customer satisfaction with customer loyalty. The trend of going out is becoming a part of our life, taking lunch and dinner outside is normal now so the need for restaurants is also increasing and there are many restaurant openings in the city, they are trying to satisfy their customers by providing better service quality and better quality food in order to achieve customer loyalty . Service quality has a signi cantly positive relationship with customer satisfaction, and ultimately impact on customer loyalty, so through improvement in service quality you can improve customer loyalty, positive comments by customers also play a vital role in restaurant industry, because comments shows satisfaction or dissatisfaction or the degree and level of satisfaction that a customer gets from services. services cannot resemble like physical goods because physical goods are tangible while services are intangible heterogeneous and inseparable from its supplier that's why it is difficult to measure the concepts of service quality, unlike quality concepts of production sector quality concepts developed by using consumer behavior models. Voice of the customer is considered very important in service quality because the service quality is the difference between the expectations and performance. Now service quality has become a great success factor for restaurant and fast food sectors.Restaurants managers are focusing on improving the service quality in their restaurants. Along with the service quality the context of the service quality is also important. Many studies show that service quality is positively correlated with customer satisfaction and customer loyalty but instead of that companies do not focus on service quality sometimes

(1.3.1) Service quality

Service quality is one of the most important factors in determining the customer satisfaction and customer loyalty which has a direct impact on organization's success. That is the reason many organizations are focusing on service quality in order to enhance customer satisfaction and get a high level of purchase intention towards the customer. When perceived value of performance meets from the customer expectations then customer get satisfied, and when perceived value of performance doesn't meet from the customer expectations then customer get dissatisfied which is not in the favor of business. Customer loyalty is essential in the restaurant industry, but customer loyalty can only be achieved by customer satisfaction in the restaurant industry, research work has also explored the factors like customer preference, customer trust, service quality with customer satisfaction and customer satisfaction with customer loyalty. The trend of outing is becoming the part of our life, taking lunch and dinner outside is normal now so the need of restaurant is also increasing and there are many restaurant opening in city, they are trying to satisfy their customers by providing better services quality and better quality food in order to achieve customer loyalty. Retention of customers has become a prime concern of a business, different drivers of customer loyalty has been studied for a long time by researchers like quality, price, physical environment etc. only to retain customer, because if a business is continuously acquiring new customers every day but it losses the old one customer every then the ultimate result would be zero, that's why this is very important to hold old customer while you are acquiring new one.

(1.3.2) Conceptual Framework and Hypothesis Development

There has been seen a strong and positive relationship between restaurant ambiance and customer satisfaction, the Physical environment of a restaurant has a positive impact on consumer behavior. By improving the physical environment of a restaurant not only customer satisfaction can be enhanced but a restaurant can increase its profit as well. The ambiance of a restaurant can be a tool for satisfying the customer and maximizing the profit that has been seen that there is a strong influence of service quality on customer satisfaction and customer loyalty, even each dimension of service quality like assurance, tangibility, empathy, reliability, and responsiveness has a significant impact on customer loyalty, better services provided by a restaurant can make a customer satisfaction and loyalty.



i. Service quality and Customer satisfaction

In fast food industry to get customer loyalty there is no other way but only through customer satisfaction, and customer satisfaction only can be achieved by providing better services quality, restaurant can get edge only by providing superior service quality and can compete for their competition and can get competitive advantage by providing better quality of service. Some authors have studied the impact of service quality on customer satisfaction alone but they measure the impact of three elements of customer satisfaction and customer perceived value, and these three elements are service quality, food, and physical environment, customer satisfaction customer perceived value can be driven by service quality, food, and physical environment. (Ryu, Lee, & Gon Kim, 2012) Customer satisfaction can drive by service quality as well as the dimensions of service quality and these dimensions are assurance, tangibility, reliability, empathy, and responsiveness, these service quality dimensions along with the image of restaurant has a great impact on customer satisfaction and also has a strong relationship between them (Wu, 2013). In the era

of intense competition among fast food restaurant and beverage industry, these industries are getting privilege by providing remarkable services to their valuable customers and getting customer loyalty in order to obtain more and more customer satisfaction, if a restaurant is not able to differentiate itself by food it is providing then it differentiate itself by providing better and remarkable service quality. (Mee, Ariffin, & Rahman, 2014)

Hence the following hypothesis is proposed

H1- Perceived service quality is positively associated with customer satisfaction.

ii. Restaurant Ambiance and Customer Satisfaction

Along with the service quality and food quality, physical environment of a restaurant is also plays an important role in building restaurant image and enhance the satisfaction of a customer, these elements are also called food service quality dimension that can impact on customer perceived value, restaurant image and customer satisfaction as well as. It is also seen that there is an impact of restaurant environment on customer's consumption, if the environment of a restaurant is not good and healthy then it can impact on customer's consumption and customer satisfaction, to reduce this risk a restaurant has to provide a better physical environment in order to remain his customer satisfied. The physical environment of a restaurant can even impact on the emotions of a customer, the environment can affect the behavioral intention of the customer, the physical environment of a restaurant can emotionally satisfy a customer, and the physical environment can bring change in the behavioral intention of the customer. If a customer gets emotionally disturbed with the physical environment then a restaurant cannot satisfy it only by food and service quality this research is a concern with the relationship between physical environment quality, personal interaction quality, and behavior intention on the customer satisfaction that will be the ultimate reason to get customer loyalty, this research also explores the impact of store ambiance on customer satisfaction and retaining and attracting customers.

Hence the following hypothesis is proposed

H2- Restaurant ambiance is positively associated with customer satisfaction.

iii. Service Quality and Customer Loyalty

There is a huge impact of service quality, customer satisfaction and customer loyalty on restaurant industry, there is a conceptual model between service quality, customer satisfaction, and customer loyalty and the analyst has confirmed that there is a positive relationship between service quality and customer loyalty, the mediating role of customer satisfaction also confirm the effect of service quality on customer loyalty Service quality could be the reason for returning a customer again in the same restaurant and not only returning to the same restaurant but recommend to the other persons to go into the same restaurant. A customer who satisfies with the services of a restaurant can be the reason of bringing four other customers but a customer who dissatisfies with the restaurant services can be the reason of taking away ten customers from the restaurant. To identify the attributes that can influence customer satisfaction and can determine the between service quality and

customer loyalty are including service quality, food quality, price and the physical environment of a restaurant, customer satisfaction plays a mediating role between service quality, food quality, price, physical environment and customer loyalty.

Hence the following hypothesis is proposed

H3- Perceived service quality is positively associated with customer loyalty.

iv. Customer Satisfaction and Customer Loyalty

There has been strongly observed a relationship between customer satisfaction and customer loyalty, in case of restaurant to satisfy your customer is very essential and necessary because if you don't satisfy your customer then your customer will not come back so retaining your customer and to make them loyal with restaurant, a restaurant has to satisfy its customer by service and food. Customer satisfaction is a mediator between service quality and customer loyalty researchers found a significant relationship between service quality, customer satisfaction, and customer loyalty, basically first of all service quality exerts an impact on customer satisfaction and customer satisfaction creates customer loyalty. It is also observed that higher the customer satisfaction will lead to the higher customer loyalty, while lower the customer satisfaction will lead to the lower customer loyalty, that mean the level of customer satisfaction determines the level of customer loyalty, Chinese restaurants are trying to create higher level of customer loyalty through higher customer satisfaction (Lim, Ahn, & Lim,). Results show that there are a strong relationship and correlation between customer satisfaction and customer loyalty, customer satisfaction has a positive impact on customer loyalty and this correlation has a great implication in restaurant industry that's why restaurants are continuously trying to improve their product quality as well as service quality to satisfy their customers and retain them loyal. (Pham Thi, 2013) Hence the following hypothesis is proposed.

(1.4) SIGNIFICANCE OF STUDY

Following are the benefits of the study:

- i. The study can help Ali baba management segment the customer base and frame appropriate strategies to target them.
- ii. It helps to ascertain the satisfaction level of the customers regarding ambiance, food quality and service quality.
- iii. It identifies the factors that determine a customer's preference of dining experience.
- iv. It will help the management to improve on their restaurant quality and ambiance that would help increase customer satisfaction.

- v. It would also help to calculate the average loyal customers of the rest and help cater to their needs and retain them for the long term.

(1.5) SCOPE OF THE STUDY

This study will be helpful to get an overall idea about customer preference and customer satisfaction towards Ali baba restaurant. This is mainly focused on the customer satisfaction with reference to Ali Baba and 41 dishes, Panampally Nagar.

(1.6) OBJECTIVES OF THE RESEARCH

One of the research objectives is to work on finding the impact of service quality and restaurant ambience on customer loyalty with reference to Ali baba restaurant, Panampilly Nagar. I have decided to study various factors that affect customer loyalty in restaurant customers such as ambience, food quality and service quality. Objectives

(1.6.1) To study the role of service quality and ambience on customer satisfaction towards Ali baba restaurant.

(1.6.2) To understand the demographic differences between customers for service quality and ambience

(1.6.3) To study the influence of restaurant ambience on customer satisfaction (1.6.4)
To study the influence of customer satisfaction on customer loyalty

(1.7) RESEARCH HYPOTHESIS

H₁: perception about restaurant ambience varies based on customer loyalty levels

H₂: perception about service quality varies based on customer loyalty levels

H₃: customer's likeliness to recommend the restaurant to other people is dependent on the comfortness of restaurant ambience

(1.8) RESEARCH METHODOLOGY

(1.8.1) Data collection

Data collection used through questionnaire methods to study the impact of service quality and ambience on customer satisfaction. Secondary data in research includes an introduction to the

industry profile that is the restaurant industry, a brief write up on Ali baba, introduction to my topic and literature review. All information for the given secondary data has been collected from previously done research papers, internet sites, Wikipedia etc.

(1.8.2)Research design

Descriptive research design has been followed by collection through questionnaire to the customers

(1.8.3)Sampling method (1.8.4)Sample size

The sample for the research is confined to Ali baba, panampally nagar keeping in view the limitation of time and resources .the sample size taken in 107 respondents ,questionnaire were distributed through social media platforms like whatsapp and email to the responses.

(1.8.5)Tools of data collection

The questionnaire is carefully designed to meet requirements of the research. The questionnaire consists of two parts. First part is normally focused on studying the consumer preference and the level of customer satisfaction and the second part covers the demographic aspects of the respondent.

Most of the questions in the first part are constructed with 4point Likert scale from 1(highly satisfied), 2(satisfied), 3(not satisfied) and 4(highly dissatisfied). Ranking questions are also used to identify preference of the customers while selecting a restaurant, ranking is based on 8 factors (1-highly important 8- least important) . MCQ questions were also used to determine the customer's preferences.

(1.8.6)Data analysis techniques

All the data has been analyzed in the SPSS software package. The tools used for analysis in SPSS for this research are

- i. One way ANOVA

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1.8 LIMITATIONS

- i. One of the limitations of this study is time ii.
Cost is another limitation

<p style="text-align: center;">CHAPTER 2</p> <p style="text-align: center;">INDUSTRY, COMPANY</p> <p style="text-align: center;">AND PRODUCT PROFILE</p>

(2.1)INDUSTRY PROFILE

(2.1.1)Overview

Restaurant companies are essentially retailers of prepared foods, and their operating performance is influenced by many of the same factors that affect traditional retail stores. For the most part, restaurants have business models that are relatively easy to understand. Nonetheless, there are a number of unique factors to consider when making investment decisions regarding this large and segmented industry.

Competition between restaurants is intense, since dining options abound. And, while there are certainly dominant players in this industry (especially among fast-food purveyors), no one company has the market cornered. Indeed, virtually every restaurant location must compete not only against other publicly traded chains, but also a wide array of small, local establishments. Competitors include everything from delis and pizzerias to fine-dining restaurants. And, of course, it is relatively easy to forgo prepared foods, altogether, in favor of home cooking, which

is usually a less expensive option. Thus, restaurant meals are discretionary purchases, and the industry tends to be highly cyclic

(2.1.4)Fast Food vs. Casual Dining

Restaurants can be loosely broken down into two broad categories: fast food and casual sitdown establishments. The same general factors discussed above dictate the performance of each group, but sit-down restaurants tend to be more expensive, making them even more sensitive to consumer budgets and the health of the economy. Fast-food restaurants, being less dependent on macroeconomic conditions, are better defensive investment plays. In a recessionary environment, their convenience and value make them attractive options for diners seeking inexpensive meals or for those trading down from casual-dining establishments.

Convenience is a major part of the fast-food business model, so a vast network of stores is essential to success. In addition to expansive hamburger chains, there are a number of large players that focus on niches, such as sandwiches and pizza.

Fast food is responsible for most of the industry's international sales. Foreign markets offer vast growth potential for companies willing to take on the challenge of finding a successful formula that appeals to a wide array of customs and tastes. A well-known brand name provides a huge leg up when expanding overseas, which is one reason why fast-food makers dominate the international arena. The convenience of these restaurants and their typically inoffensive menus, which appeal to most diners, are other pluses.

(2.1.5)Investment Considerations

Restaurant stocks have a number of attractive attributes. Their business models are easy to understand, as are the factors that affect their performance. Most are cyclical, so broad economic conditions often play an outsized roll in the group's overall performance. However, fast-food retailers can sometimes provide more shelter in a down economy. Conservative investors might find the stocks of mature operators appealing as growth-and-income holdings. Conversely, fledgling companies, with new or unique formats, use most of their cash flow for expansion, and their stocks may offer attractive 3- to 5-year appreciation potential to the more venturesome

(2.1.8)Challenges in Running a Restaurant Business in India

i. Staff Training and Recruitment

A restaurant is primarily known for its food and services. You need to have an expert chef whose cooking would lure customers to the restaurant. And you need a well-trained staff whose efficiency and hospitality charms the customers even more.

ii. Designing the Right Menu

A mouthwatering menu with delicacies is a sure way to attract customers. However, delivering the delicacies is a feat that many restaurants fail to master. The simple menu seems like just a piece of paper with all your food items listed on it, but it is so much more than that. The customer looking at a menu decides what he wants in 107 seconds before defaulting to the easiest option. The colors, the order in which dishes are listed, and even the font of the price matters. Often restaurateurs fail to price the menu the right way or make mistakes in the placement of the items. Also, if the menu is too long and complicated, the customer might get confused.

iii. Internal Thefts

From inventory thefts to on-counter thefts, thefts at restaurants take many forms and is quite challenging. No matter how many strict rules you implement, and how many CCTV cameras you install, pilferage is something that seems virtually impossible to avoid. Unless you're willing to sit behind the counter yourself and monitor all activities, it is challenging to avoid on counter thefts.

iv. Performance Consistency in Restaurant

Most restaurants find it difficult to maintain consistency in their service. When the restaurant opens, the food is excellent, and so is the service. With time and difficulties (read dwindling funds), the standard goes down, eventually driving the customers away. This mainly happens because of the lack of standardization in the restaurant in terms of operations. Everything, right from your restaurant's Vendor Management to the Recipe Management, should be standardized to maintain consistency.

v. Replicating the Success

This is perhaps the most common challenge in running a restaurant and especially while expanding. The first outlet may become a huge success, but more than often, even the management doesn't know how it happened. It seems like a combination of hard work and luck that leads a restaurant to flourish. Most restaurants don't know how to replicate their success while branching out.

(2.1.4) Scope and opportunities for Indian restaurant industry

Even though there's a growing eating out trend in India, Indians still lag far behind the West and even some Asian countries when it comes to dining at restaurants. According to the National Restaurant Association of India (NRAI), Chinese eat out 60 times a month; Thai people eat out 45 times a month; and Indonesians eat out 15 times in a month. Indians, on the other hand, eat out about 2-4 times in a month on an average.

Indians have a lot of catching up to do with other countries in Asia and the West so far as eating out is concerned. But the restaurant industry has nothing to worry about as there are many drivers of growth for this business in India. These growth engines are both consumer as well as enterprise driven. Some of the key engines of growth, as listed by NRAI in its report, include:

i. Changing demographics:

There's a vast pool of working population in India, which includes women. There's an upwardly mobile middle class, which is liberal and progressive. In addition to that, there's a rapid increase in nuclear families and all of these factors contribute to the growth of the restaurant industry. ii. Greater spending power:

India's per capita income has been increasing steadily and this has led to an increase in the disposable income of Indians. Added to that is the concept of double-income households which is the result of more women joining the workforce. All this has led to an increase in the purchasing power of Indians, which is driving the growth of the food service industry. iii.

Increased exposure:

More and more Indians are traveling abroad, which has increased their awareness about global cuisines. Popular food and cooking shows on television such as MasterChef have also led to greater exposure to gourmet food. iv. India as a travel destination:

With India projecting itself as a major tourist destination to the world abroad, restaurants in the country have all the incentive to expand their repertoire and up the level of their services to cater to a growing international market.

v. **Infrastructure and IT development:**

For the customers, this has meant an enhanced dining experience due to factors like lower waiting time and improved ordering, which keeps them coming back for more and drives the growth of the industry. For restaurants, infrastructure and IT development helps them control costs, minimize waste, maintain quality, etc. and helps them improve their bottom-line. IT-driven business intelligence and data analysis helps them streamline their business and improve results.

(2.2) COMPANY PROFILE

Ali baba & 41 dishes

Ali Baba & 41 Dishes is a multi-cuisine restaurant offering Arabic, Chinese, Indian, South Indian, Tandoori cuisines. It is an ideal place for having a lavish dine-in with family and friends. Alibaba & 41 Dishes, tempted by an unrivaled range of authentic & imaginative traditional Indian foods. Our food is cooked to the highest standards by using the best quality & freshest ingredients. Alibaba & 41 dishes are the one of the popular leading tasty and yummy food restaurants in Kerala. Our Food not only attractive but also tasty for every aging customer. We pick our ingredients with the utmost care and use only the freshest and natural constituents which are then cooked according to our Healthy and Clean Policy so as to provide you with the most nutritious food. Hence you remain Healthy without ever having to make a compromise on Taste. With the rich experience of more than 5 years, we offer the cleanest and best quality delicious food products produced using the most modern technology to suit the contemporary taste. quick service, freshly cooked food, the best in quality and tasty food is our mantra. With an extensive menu of breakfast, lunch, and dinner favorites, we have something for everyone.

Keeping in mind the health of our consumers, we prepare food items in a clean environment. This has enabled us to gain maximum customer satisfaction. With an efficient and hardworking workforce, we provide our customers with the supreme quality food products.

CHAPTER 3

DATA ANALYSIS

DATA ANALYSIS AND INTERPRETATION

The data collected from the respondents is analyzed and tabulated below to explore the objectives of the study.

The data has been analyzed in SPSS software. Most of the questions in first part are constructed with 4point Likert scale from 1(highly satisfied), 2(satisfied), 3(not satisfied) and 4(highly dissatisfied). Ranking questions are also used to identify that the customers feel important while selecting a restaurant, ranking is based on 8 factors (1-highly important 8least important). The tools for analysis are percentage and analysis, correlation and regression. Each question is analyzed and is presented with a table and graphs with interpretation and inference.

First part is focused on studying the consumer preference and the level of customer satisfaction and the second part covers the demographic aspects of the respondent.

3.1 DEMOGRAPHIC DETAILS OF RESPONDENTS

The demographic detail of the respondents is shown in Table 3.1. It is shown that out of 203 respondents, 52.7% constitutes male and 47.3% constitutes female. Respondents are categorized into five segments based on their age , 21.2% belong to 10-20 years age group, 49.8% to 20-30 years group, 26.1% to 30-40years group, 2% in 40-50 age group and 1% above 50 years of age. Based on place of the respondents it is segmented, 7.9% in urban areas, 43.8% and 48.3% in rural areas. Married respondents consist of 40.4% and unmarried respondents consist of 59.6%. the study also segments respondents based on their monthly income into five classes, respondents with monthly income below 10,000rs constitutes 15.3%, between 10,00030,000rs constitutes 35.5%, 30,000-50,000rs constitutes 17.2% and monthly income above 50,000rs constitutes 11.3% . 20.7% of the respondents were students.

(Table 3.1) Demographic variables of respondent

Demographic Characteristic		Number of respondents	Percentage
Gender	Male	62	54.2
	Female	45	44.9
		107	100%
Age	10-20	41	21.2
	20-30	43	49.8
	30-40	19	26.1
	40-50	2	1
	>50	2	1
		107	100%
place	rural	11	7.9
	Semi-urban	45	43.8
	urban	51	48.3
		107	100%

3.2 DIFFERENCE IN PERCEPTION OF FOOD QUALITY WITH RESPECT TO CUSTOMER LOYALTY LEVELS

Researchers may be interested in determining whether the means from more than two groups are equal or not. To test whether the difference in means from more than two groups is statistically significant, Analysis of Variance (ANOVA) is performed.

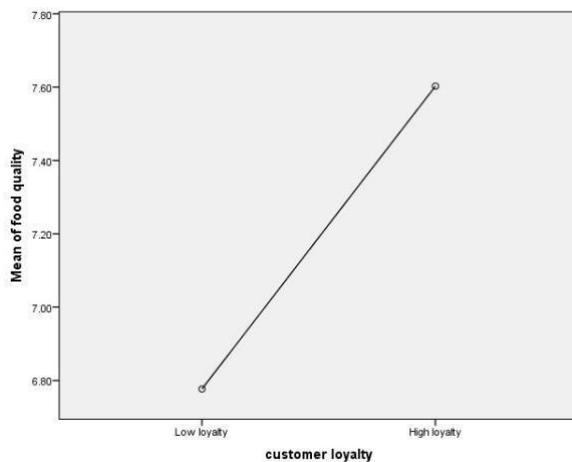
Here, one-way ANOVA is performed to test if there is a difference in the perception about food quality based on customer loyalty levels.

H₀: perception about food quality varies based on customer loyalty levels

(Table3.3) showing difference in the perception of food quality based on customer loyalty

	N	Mean	Std. Deviation	F	df	sig
Low loyalty	67	6.7769	1.69480	3.349	8	0.011
High loyalty	40	7.6027	1.68934		99	
Total	107	7.0739	1.73475		107	

it can be seen that there is a statistically significant effect of loyalty of customers to the restaurant on the perception of food quality $F(4) = 0.011$, $p < 0.05$. Thus, the null hypothesis of this case stands rejected. It can be concluded that there is a significant impact of loyalty of customers to the restaurant on the perception of food quality at Ali baba restaurant. **(fig 3.3)**



From fig3.3, we can infer that there is a difference in the perception about food quality based on customer loyalty levels. Customers who are highly loyal have better perception about food quality than the ones who are less loyal or not loyal to the restaurant.

3.4 DIFFERENCE IN PERCEPTION OF RESTAURANT AMBIENCE WITH RESPECT TO CUSTOMER LOYALTY LEVELS

Researchers may be interested in determining whether the means from more than two groups are equal or not. To test whether the difference in means from more than two groups is statistically significant, Analysis of Variance (ANOVA) is performed.

Here, one-way ANOVA is performed to test if there is a difference in the perception about restaurant ambience based on customer loyalty levels .

H₀: perception about restaurant ambience varies based on customer loyalty levels

Table 3.5 showing difference in the perception of restaurant ambience based on customer loyalty

	N	Mean	Std. Deviation	F	df	sig
Low loyalty	78	14.2308	2.68945	4.688	1	.032
High loyalty	29	15.1644	3.36243		106	
Total	107	7.0739	1.73475		107	

it can be seen that there is a statistically significant effect of loyalty of customers to the restaurant on the perception of restaurant ambience $F(4.688) = 0.032, p < 0.05$. Thus, the null hypothesis of this case stands rejected. It can be concluded that there is a significant impact of loyalty of customers to the restaurant on the perception of restaurant ambience at Ali baba and 41 dishes restaurant.

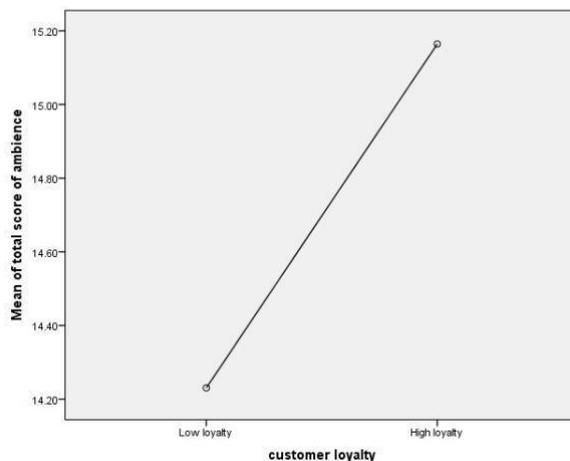


Fig3.4

From fig3.4, we can infer that there is a difference in the perception about restaurant ambience based on customer loyalty levels. Customers who are highly loyal have better perception about restaurant ambience than the ones who are less loyal or not loyal to the restaurant.

3.5 DIFFERENCE IN PERCEPTION OF SERVICE QUALITY WITH RESPECT TO CUSTOMER LOYALTY LEVELS

Researchers may be interested in determining whether the means from more than two groups are equal or not. To test whether the difference in means from more than two groups is statistically significant, Analysis of Variance (ANOVA) is performed.

Here, one-way ANOVA is performed to test if there is a difference in the perception about service quality based on customer loyalty levels. To this effect, the following hypotheses are proposed and the results shown in Table 4.19 and 4.20.

H: perception about service quality varies based on customer loyalty levels

Table 3.8 showing difference in the perception of service quality based on customer loyalty

	N	Mean	Std. Deviation	F	df	sig
Low loyalty	59	10.2923	2.66603	2.555	4	.040
High loyalty	48	11.7397	6.74543		103	
Total	107	10.8128	4.60891		107	

From table 3.8 it can be seen that there is a statistically significant effect of loyalty of customers to the restaurant on the perception of service quality $F(2.555) = 0.040, p < 0.05$. Thus, the null hypothesis of this case stands rejected. It can be concluded that there is a significant impact of loyalty of customers to the restaurant on the perception of service quality at Ali baba and 41 dishes restaurant.

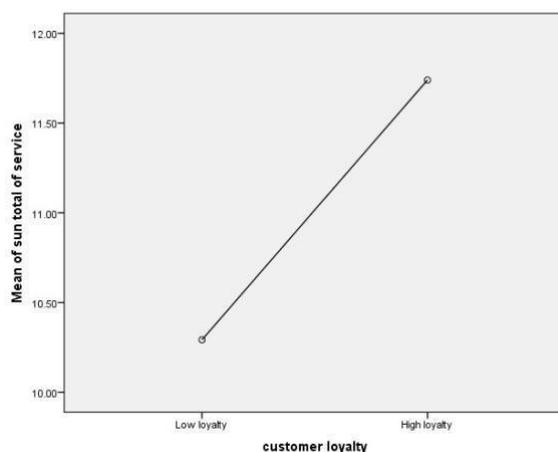


Fig3.5

From fig3.5, we can infer that there is a difference in the perception about service quality based on customer loyalty levels. Customers who are highly loyal have better perception about service quality than the ones who are less loyal or not loyal to the restaurant

4.1) LIST OF FINDINGS

- i. From table (3.1)Ali baba restaurant has more young customers who belong to the age group of 20years to 30 years of age.
- ii. The restaurant is preferred by both men and women to dine
- iii. From the study it is found that the majority of the people i.e 57% people prefer outside for tastiness of food. So it is very important to concentrate on the tastiness of food. Then comes ambience, 33.6% ,that is preferred by people for dining out. iv. People visit Ali baba restaurant usually with their friends (71%) and family (18.7%)
- v. Majority of the customers (50.5%) prefer both types of dine experience, dine in and take away. Only a few people like to take away the type of dine experience (9.3%).
- vi. Table(3.3)b shows the One way anova for finding perception about food quality varies based on customer loyalty levels
- vii. Table (3.3) shows that there is a significant impact pf loyalty of customers to the restaurant on the perception of food quality.
- viii. Table(3.4)b shows that there is a relationship between the customership of the respondent with Ali baba restaurant and their place of living at the 5% level. People in the urban areas have been the customers of the restaurant for more than 3 years
- ix. From we can infer that there is a difference in the perception about food quality based on customer loyalty levels. Customers who are highly loyal have better perception about food quality than the ones who are less loyal or not loyal to the restaurant.
- x. From table (3.5) we can infer that there is a difference in the perception about restaurant ambience based on customer loyalty levels. Customers who are highly loyal

have better perception about restaurant ambience than the ones who are less loyal or not loyal to the restaurant.

- xi. From fig(3.8) Customers who are highly loyal have better perception about service quality than the ones who are less loyal or not loyal to the restaurant.
- xii. that customer's likeliness to recommend the restaurant to other people is dependent on the comfortness of restaurant ambience

(4.2) SUGGESTIONS

- i. Since Ali baba's majority customers are youth, the restaurant management should focus on catering to them. The restaurant must update their food and related technologies with changing time and trends without affecting the restaurant's tradition.. Varieties in both food and services should be brought in.
- ii. Most of the Customers of this restaurant are first timers so the restaurant must focus on making them satisfied and converting them into loyal customers.
- iii. Since the study showed that most of the people preferred outside food because of the taste factor, so the restaurant must work on making their food tastier . also ambience of the restaurant is another factored that need attention so that people keep coming back to your restaurant.
- iv. It's evident from the findings that most of the customers come to dine with their friends and family. This information can be used by the management to take various marketing decisions .
- v. More than half of the respondents preferred both dine in and take away type of dine experience. .
- vi. Quality of food should be improved since most of the people find it as an important factor when selecting a restaurant to dine. To survive in this tough competitive industry one has to improve what they lacks

(4.3) CONCLUSION

Customer loyalty refers to a situation where a customer develops a long standing preference or loyalty towards a particular product or service. Customer loyalty is reflected in the repeated purchases the customer makes of a particular product and his favorable nature towards a product or service. Customer loyalty also helps to market the product positively in the customer's close friend and family circle. The importance of customer loyalty impacts almost every metric important to running a business. Without happy customers that continue to buy from the store, the business won't survive. New customers tend to cost more to acquire, and don't spend as much money as loyal, repeat customers. Keeping customers coming back for more is critical to business success. And it's why short term profit grabs don't work. Loyal customers are just better for business: they help businesses grow and they keep profits high.

This study is to work on finding the impact of service quality and restaurant ambience on customer loyalty with reference to Ali baba and 41 dishes restaurant. Majority of the customers prefer dine from Ali baba restaurant . The study infers that there is a difference in the perception about restaurant ambience and service quality based on customer loyalty levels. Customers who are highly loyal have better perception about restaurant ambience and service quality than the ones who are less loyal or not loyal to the restaurant. The study also shows that customer's likeliness to recommend the restaurant to other people is dependent on the comfortness of restaurant ambience. The Quality of food should be improved since most of the people find it as an important factor when selecting a restaurant to dine..

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ANNEXURE

QUESTIONNAIRE

Respected madam/sir, as a part of my project I would like to gather some information from you which will help me in an in depth study of project. The information provided by you will be kept confidential and will be used for academic purpose only. I would be obliged if you co-operate with me in filling the questionnaire.

1. How long have you been the customer of alibaba restuarant once

in a week

Twice in a week

Once in 2 week

Once in a month

2. How did you hear about alibaba restuarant • family • friends

• Advertisement • Other specify

3. Why do you prefer outside food:

• Tasty Food • ambience • reluctant to cook • others specify.....

4. which type of dine experience do you prefer?

• Take away • Dine in restaurants • both

5. How did you find the ambience in restaurant?

highly satisfied, satisfied, dissatisfied, highly dissatisfied

6. How would you rate the quality of food?

1 2 3 4 5

7. How would you rate the range of optuons in menu?

Too few options,just right,too many options

8.was the staff welcoming and friendly?

yes , no

9.On a scale 1-5 how would you rate the cleanliness of restaurant?

1 2 3 4 5

10.How would you rate the wait time for your food?

1 2 3 4 5

11.How did you rate the accesibility of alibaba restaurant?

1 2 3 4 5

12.Was the employee attentive and availble when you needed him or her?

yes no

13.How comfartable did you find the seating?

highly satisfied, satisfied, dissatisfied, highly dissastified

14.How would you find the service throughout your meal?

strongly agree,agree,disagree,strongly disagree

15.How would you rate the presentation of your meal?

highly satisfied, satisfied, dissatisfied,highly dissatisfied

16.on a scale 1-5 how likely is it that you would recommended alibaba restaurant to you friends or family?

1 , 2, 3, 4, 5

**MEDICAL DATA TRANSFER USING IMAGE STEGANOGRAPHY &
BLOCKCHAIN**

ST. TERESA'S COLLEGE (AUTONOMOUS)

AFFILIATED TO MAHATMA GANDHI UNIVERSITY



PROJECT REPORT

In partial fulfilment of the requirements for the award of the degree of

**BCA (CLOUD TECHNOLOGY AND INFORMATION
SECURITY MANAGEMENT)**

By

Agnel Josy - SB19BCA001

&

Shannon Simon - SB19BCA019

**III DC BCA (CLOUD TECHNOLOGY AND INFORMATION SECURITY
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Under the guidance of

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DEPARTMENT OF COMPUTER APPLICATIONS

MARCH 2022

DECLARATION

We, undersigned hereby declare that the project report, **Medical Data Transfer Using Image Steganography & Blockchain**, submitted for partial fulfilment of the requirements for the award of degree of BCA St. Teresa's College (Autonomous), Ernakulam (Affiliated to MahatmaGandhi University), Kerala is a bonafide work done by us under supervision of **Ms. Rija Jose**. This submission represents our ideas in our own words and where ideas or words of others have been included. We have adequately and accurately cited and referenced the original sources. We also declare that we have adhered to the ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not previously formed the basis for the award of any degree, diploma or similar title of any other University.

Ernakulam

March 2022

Agnel Josy - SB19BCA001

Shannon Simon - SB19BCA019

ST. TERESAS COLLEGE (AUTONOMOUS), ERNAKULAM

**BCA (CLOUD TECHNOLOGY & INFORMATION SECURITY
MANAGEMENT)**

DEPARTMENT OF COMPUTER APPLICATIONS



CERTIFICATE

This is to certify that the report entitled **Medical Data Transfer Using Image Steganography & Blockchain** submitted by **Agnel Josy** and **Shannon Simon** to St. Teresa's College, Cochin in partial fulfilment of the requirements for the award of the Degree of BCA in CT & ISM is a bonafide record of the project work carried out by him/her under my/our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Rija Jose
04/04/22
RIJA JOSE



Shannon Simon
4/4/22

Internal Supervisor

For Head of the Department

External Supervisor

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ABSTRACT

Secure updating and sharing for large amounts of healthcare information in efficient and secure transmission are important but challenging in communication channels amongst hospitals. In particular, in addressing the above challenges, two issues are faced, namely, those related to confidentiality and integrity of their health data and to network failure that may cause concerns about data availability. To the authors' knowledge, no study provides secure updating and sharing solution for large amounts of healthcare information in communication channels amongst hospitals. Therefore, this study proposes and discusses a novel steganography based blockchain method in the spatial domain as a solution. The novelty of the proposed method is based on the Advanced Encryption Standard (AES) & Least Significant Bit (LSB) algorithm. In addition, hash function can hide secret medical data in hospital databases whilst providing confidentiality with high embedding capacity and high image quality. Moreover, stego images with hash data and blockchain technology are used in updating and sharing medical data between hospitals in the network to improve the level of confidentiality and protect the integrity of medical data in grey-scale images, achieve data availability if any connection failure occurs in a single point of the network and eliminate the central point (third party) in the network during transmission.

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LIST OF ABBREVIATIONS

SL NO.	ABBREVIATIONS	EXPANSION
1	LSB	Least Significant Bit
2	AES	Advanced Encryption Standard
3	BT	Blockchain Technology
4	OTP	One Time Password
5	CO	Covid 19
6	CPU	Central Processing Unit
7	API	Application Program Interface
8	RAM	Random Access Memory
9	QR	Quick Response
10	AWS	Amazon Web Services

CHAPTER - 1

INTRODUCTION

The World Health Organization first reported a novel coronavirus on December 31, 2019. The coronavirus disease 2019 pandemic is the largest shock to the world in recent decades and has caused an extraordinary impact on human lives. Different countries have contributed varying technologies that can help medical and healthcare providers stop this pandemic. These contributions describe several of the major threats to individual and collective human health, as well as the values and recommendations that need consideration to counteract such threats in the future. Sustainable health systems and social care need improvements to satisfy the current needs. Considerable healthcare data are generated daily from medical institutions, hospitals and individuals to enhance the understanding of the disease whilst considering environment and lifestyle when conducting disease treatment. Moreover, integration between hospitals is necessary to help doctors in the rapid delivery of treatment. This integration should ensure secure full-field communication channels amongst hospitals. For a clear view of how to support the security of health system in integrating hospitals with considerable healthcare data for communication

What is the main challenge and issues in this study?

Secure updating and sharing such large amounts of healthcare data in efficient and secure transmission are important but challenging. Potential contributors state that these issues have not been thoroughly investigated. In addition, challenges arise because more private health data of people are collected and exchanged amongst hospitals and clinical laboratories. In particular, to settle the secure updating and sharing challenges, two issues are faced.

Firstly, patients and hospitals are becoming increasingly concerned about the integrity and confidentiality of their health data. Many state-of the-art approaches focus on improving data providers' responsibilities to detect data disclosure activities. However, protecting the access to patient data and providing immediate notifications of data disclosure risks are urgently needed.

Secondly, hundreds of health systems are in use today, but most of these systems adopt a centralised architecture that suffers from a single point of failure that may cause concerns for data availability. Systems have little or even no communication and cooperation in securing data of patients.

What are the recommended technologies for such challenges and their issues?

Two technologies are recommended for the updating and sharing challenges and their issues.

Firstly; steganography technology can be used to improve the confidentiality payload and robustness integrity of stenographic transactions in distributed hospitals. This technique can provide the confidentiality that represents high image quality, high embedding capacity and attack resistance. However, no study has yet focused on the integrity of secret data after retrieval from stego images and discovered tampering during data storage in the database. Therefore, essential improvements are needed for data protection regarding the data hiding method. The channels used in conventional stenographic techniques are not secure and often result in privacy leakage on the part of the sender. Therefore, hashes can be used to develop a new steganography method to achieve confidentiality and integrity during the transmissions between the communication channels.

Secondly, blockchain technology can be used to maintain a continuous updating and sharing of all transactions across distributed hospital network for data-based decentralise communication, and to improve the level of confidentiality and maintain data availability despite network failure. That is, data availability is ensured regardless whether any single point of the network has a failure connection. Moreover, the central point (third party) in the network is eliminated during the transmission. In conclusion, the combination between the steganography and blockchain technology can ensure the updating and sharing of medical CO data with high level of security.

What are the current scenarios for academic literature that attempt to use steganography based blockchain?

Literature has limited attempts to use steganography based on blockchain but not on medical data. For instance, a security system to secure digital documents, such as smart contracts, is proposed by relying on steganographic encoder and decoder for hidden messages and use the quick response (QR) code for user document validation. Initially, the user document is inserted and subjected to a validation using the QR code. Subsequently, nodes are formed and finally stored in the blockchain before the normalization phase. Another study proposed a blockchain-based technique for data hiding to ensure the protection of digital video data privacy. Group encoding and multi-field embedding are also proposed to improve the payload and robustness of the steganography transaction. A patient verification framework based on steganography and blockchain technique

using finger vein biometrics [66] is also proposed. However, data hiding was only used in the database and not during data transmission. Thus, a steganography-based blockchain technique and covert communication that ensure secure updating and sharing of the communication channel with high confidentiality payload, integrity and availability of data during network failure remains a requirement.

1.1 INFORMATION HIDING

In computer science, information hiding is the principle of segregation of the design decisions in a computer program that are most likely to change, thus protecting other parts of the program from extensive modification if the design decision is changed. The protection involves providing a stable interface which protects the remainder of the program from the implementation (whose details are likely to change). Written in another way, information hiding is the ability to prevent certain aspects of a class or software component from being accessible to its clients, using either programming language features (like private variables) or an explicit exporting policy.

Information hiding aims to protect the integrity of the data during transmission or while in storage. Steganography is a branch of information hiding which conceals the existence of the secret data hidden in a cover medium.

1.1.1 TECHNIQUES FOR INFORMATION HIDING

There are three major data hiding techniques popular: watermarking, cryptography and steganography.

- Watermarking – A watermark is a recognizable image or pattern that is impressed onto paper, which provides evidence of its authenticity. Watermark appears as various shades of lightness/darkness when viewed in transmitted light. Watermarks are often seen as security features to banknotes, passports, postage stamps and other security papers. Digital watermarking is an extension of this concept in the digital world. A watermarking system's primary goal is to ensure robustness, i.e, it should be impossible to remove the watermark without tampering the original data
- Cryptography – Cryptography is an art of transforming data into an unreadable format called cipher text. The receiver at other side, decipheres or decrypt the message into plain text. Cryptography provides data confidentiality, data integrity, authentication and non-

repudiation. Confidentiality is limiting access or placing restriction on certain types of information. Integrity is maintaining and assuring the accuracy of data being delivered, i.e, information contains no modification, deletion etc. Authentication ensures the identity of sender and receiver of the information. Non-repudiation is the ability to ensure that the sender or receiver cannot deny the authenticity of their signature on the sending information that they originated.

- Steganography – Steganography is a practice of hiding/concealing the message, file, image within other message, file or image. The word steganography is of Greek origin and means "covered writing" or "concealed writing". In other words, it is the art and science of communicating in a way which hides the existence of the communication. The goal is to hide messages inside other harmless messages in a way that does not allow enemy to even detect that there is a second message present. Steganography focuses more on high security and capacity. Even small changes to stego medium can change its meaning. Steganography masks the sensitive data in any cover media like images, audio, video over the internet.

1.2 STEGANOGRAPHY

Steganography is the practice of hiding a secret message inside of (or even on top of) something that is not secret. That something can be just about anything you want. These days, many examples of steganography involve embedding a secret piece of text inside of a picture. Or hiding a secret message or script inside of a Word or Excel document.

The purpose of steganography is to conceal and deceive. It is a form of covert communication and can involve the use of any medium to hide messages. It's not a form of cryptography, because it doesn't involve scrambling data or using a key. Instead, it is a form of data hiding and can be executed in clever ways. Where cryptography is a science that largely enables privacy, steganography is a practice that enables secrecy – and deceit.

1.2.1 USES OF STEGANOGRAPHY

Steganography means of storing data in a way that it hides the existence of them. Steganography used to carry out hidden exchanges. For example, Governments are interested in two types of communication of hidden data: first, which supports national security and second, which does not. Steganography support both types, also business have similar concerns, about trade secrets for new technologies or products information. Of course, using steganography to communicate greatly

reduces the risk of information leakage. Businesses takes advantage of another form of steganography, called watermarking. Watermarking is mainly used to identify and entails hidden unique part of information within a medium without touching the medium. Also, steganography enhances the privacy individually, although it is not a substitute for encryption, of course this is effective only if the hidden embedded information is not detected. If the communication is almost never exists, this will becomes so private to be caught.

Steganography can be a way which makes it possible to send news and information without being censored and without the fear of the messages being intercepted and traced back to us.

1.2.2 STEGANOGRAPHIC METHODS

The formula below describes the process of steganography as discussed above:

$$\text{cover_medium} + \text{hidden_data} + \text{stego_key} = \text{stego_medium}$$

The explanation of this formula is, The cover medium refers to the file that we are going to put our information on it. Hidden data obviously is the data we want to keep secret. An encryption advanced which is a choice for us. The result shall be a stego medium, which is the same file as the cover medium. The easiest way to hide the data in an image , is called LSB (least significant bit) insertion.

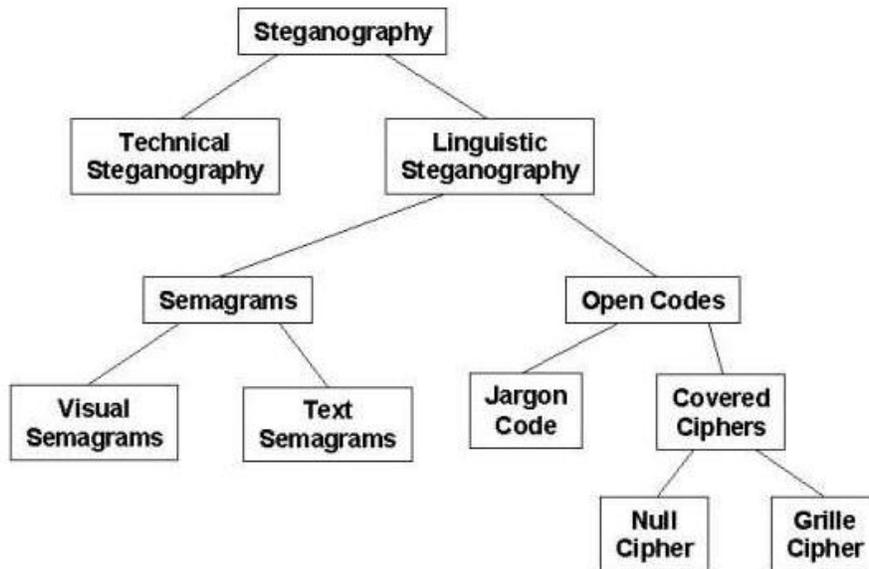


Fig 1: Shows a common taxonomy of steganographic techniques

1.2.3 STEGANOGRAPHY TOOLS

A steganography software tools allow a user to attach hidden data in a carrier file, such as an image or video, and sometimes it could be an audio, and later take off that data. It is not necessary to hide the message in the original file at all. Thus, it is not necessary to edit the original file and thus, it is hard to detect nothing. If a given part of the message is subjected to successive bitwise manipulation to generate the cypher text, then there is no evidence in the original file to show that it is being used by a third party. to encrypt a file. An example of this method is described in a self-published science fiction novel. In that example a file is encrypted using a 1949 photo from a digital archive of National Geographic magazine.

1.2.4 STEGANOGRAPHY AND SECURITY

Steganography is an effective and efficient way of hiding data, it is just protecting the data from the unauthorized or unwanted interception. But stego is merely one of many methods to defend the confidentiality of data. It is probably the best used in integration with another data-hiding method. When used in collection, these ways can all be a part of a layered security mechanism. Some good complementary methods include:

- Encryption- Encryption is the operation of crossing data or plaintext through a series of mathematical processes that generate an alternate form of the original text known as ciphertext. The encrypted text can only be read by one who have been given the proper key to decrypt the ciphertext back into its original plaintext form. Encryption doesn't hide data, but it does make it difficult to read!
- Hidden directories (Windows)- Windows provides this feature, which allows users to hide files. Using this mechanism is as easy as changing the characteristics of a directory to "hidden", and hoping that no one can view all types of files in their explorer.
- Hiding directories (Unix)- in current directories that have a lot of files, such as in the /dev directory on a Unix implementation, or making a directory that starts with three dots (...) versus the normal single or double dot.
- Covert channels- Some tools can be used to transfer important data in seemingly normal network traffic. One such tool that does that is Loki. Loki is a tool that hides data in ICMP traffic (like ping).

1.2.5 METHOD OF STEGANOGRAPHY

A lot of methods are available for digital Steganography. But exploiting the lenient constraints of a file formats is the most famous one. There are a lot of software that uses this technique.

a- Image as carriers:

One of the ways to hide data is using images, which is a good method. The difficulty to reveal the data hidden increases with the detailed in an image, and that makes it harder to guess or to suspect that image. JPHIDE/JPSeek is a package that uses the coefficients to hide the information. (<http://linux01.gwdg.de/~alatham/stego.html>).

There was a new method of that, that embeds data in visually insignificant parts of an image. These both methods modify the image. The user however can explore image degradation with different messages and images of different length. Another way is for GIF images, is to modify an image's palette for hiding its data. Gifshuffle, which is a tool, that doesn't modify the image itself, in any visible way. It permutes a GIF image's color map, that will leave the original image completely intact.

b- Audio File Carriers:

A lot of packages also available for embedding and hiding data in the audio files. One of the tools for audio file hiding stego is the MP3Stego, which does not only hide information effectively, of course arbitrary, rather also claims to be partly strong method of watermarking the targeted MP3 audio files. The WAV format, which stands for Wavafom Audio File Format, is a Microsoft audio format which mainly windows depends on, however, this format lets users hide data using StegoWave or Steghide. Using an audio file as a medium is less popular than using an image as a steganography medium.

c- Data Ordering:

The data ordering which does not have ordering constrains, is usually a very good method of steganography. Each change of a group of objects could be pointed to a positive integer. pointing can then be used to encode the hidden data by modifying the sequence of objects that are not considered in ordered by the carrier medium. While this technique mainly, does not change the information quality, the data which are hidden can of course easily get lost if the medium is

encoded again. For example, if we have a GIF which its color map consist of hidden data, we could then open the GIF in our favorite graphics-editing tool package that will be used , and save it again. Visually, the result will be both identical , from the original file to the second file, but the ordering of the color map may have been lost.

1.3 ADVANCED ENCRYPTION STANDARD (AES) ALGORITHM

The Advanced Encryption Standard (AES) is an encryption algorithm that was selected by the National Institute of Standards and Technology (NIST) for the United States government, commercial, and private organizations to use for securing sensitive unclassified information.

AES encrypts 128-bit blocks of data at a time using cryptographic keys. There are three options for encryption key lengths: 128-, 192-, or 256-bits.

Since the AES algorithm is considered secure, it is in the worldwide standard.

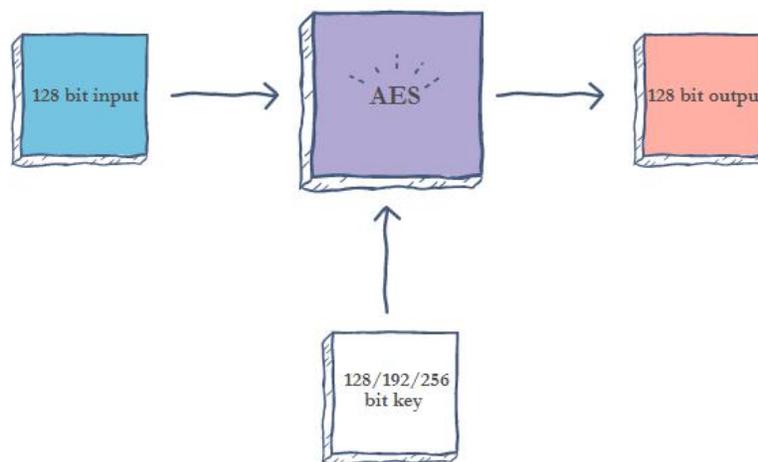


Fig 2: AES working logic

1.3.1 Features of AES

- **SP Network:** It works on an SP network structure rather than a Feistel cipher structure, as seen in the case of the DES algorithm.
- **Key Expansion:** It takes a single key up during the first stage, which is later expanded to multiple keys used in individual rounds.
- **Byte Data:** The AES encryption algorithm does operations on byte data instead of bit data. So it treats the 128-bit block size as 16 bytes during the encryption procedure.

- **Key Length:** The number of rounds to be carried out depends on the length of the key being used to encrypt data. The 128-bit key size has ten rounds, the 192-bit key size has 12 rounds, and the 256-bit key size has 14 rounds.

1.3.2 AES WORKING

The AES algorithm uses a substitution-permutation, or SP network, with multiple rounds to produce cipher text. The number of rounds depends on the key size being used. A 128-bit key size dictates ten rounds, a 192-bit key size dictates 12 rounds, and a 256-bit key size has 14 rounds. Each of these rounds requires a round key, but since only one key is inputted into the algorithm, this key needs to be expanded to get keys for each round, including round 0.

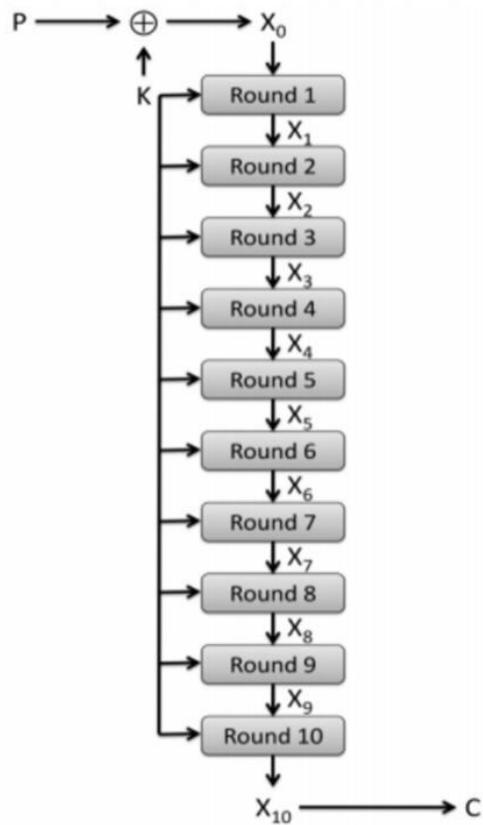


Fig 3: AES working based on rounds

1.3.3. STEPS INVOLVED IN EACH ROUND

Each round in the algorithm consists of four steps.

1. Substitution of the bytes

In the first step, the bytes of the block text are substituted based on rules dictated by predefined S-boxes (short for substitution boxes).

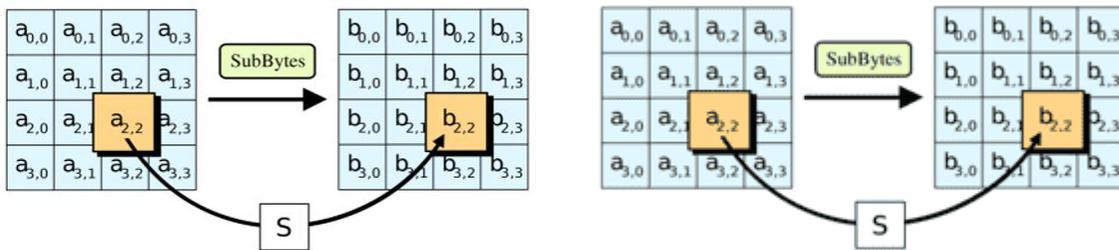


Fig 4: Substitution of the bytes

2. Shifting the rows

Next comes the permutation step. In this step, all rows except the first are shifted by one, as shown below.



Fig 5: Shifting the rows

3. Mixing the columns

In the third step, the Hill cipher is used to jumble up the message more by mixing the block's columns.

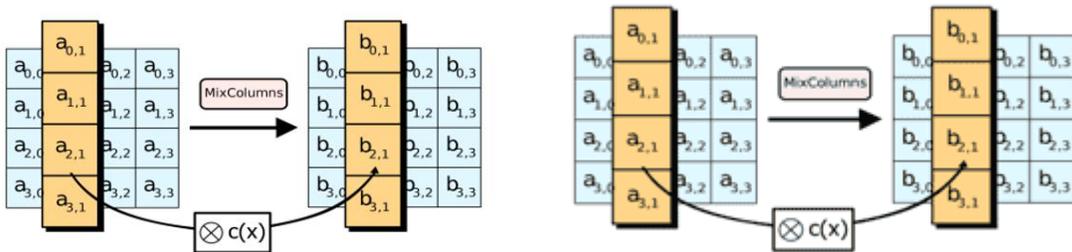


Fig 6: Mixing the columns

4. Adding the round key

In the final step, the message is XORed with the respective round key.

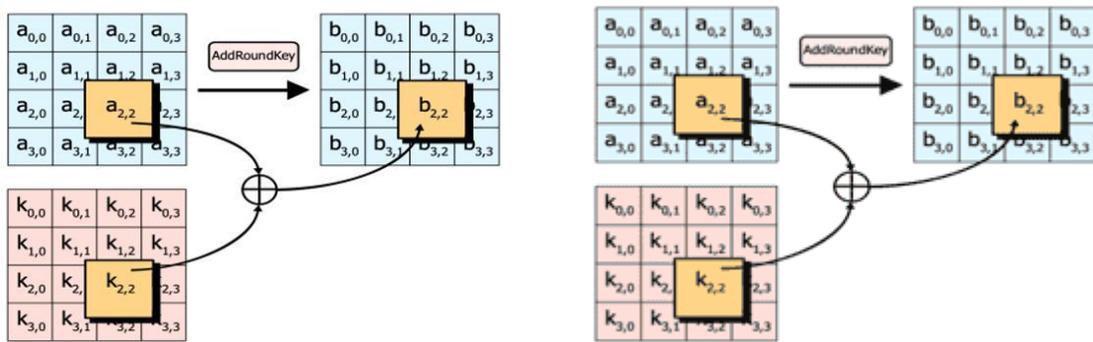


Fig 7: Adding the round key

When done repeatedly, these steps ensure that the final cipher text is secure.

1.3.4 APPLICATIONS OF AES:



Fig 8: Applications of AES

The applications of the AES Encryption algorithm are as follows:

- **Wireless Security:** Wireless networks are secured using the Advanced Encryption Standard to authenticate routers and clients. WiFi networks have firmware software and complete security systems based on this algorithm and are now in everyday use.
- **Encrypted Browsing:** AES plays a huge role in securing website server authentication from both client and server end. With both symmetric and asymmetric encryption being used, this algorithm helps in SSL/TLS encryption protocols to always browse with the utmost security and privacy.
- **General File Encryption:** Apart from corporate necessities, AES is also used to transfer files between associates in an encrypted format. The encrypted information can extend to chat messages, family pictures, legal documents, etc.
- **Processor Security:** Many processor manufacturers enable hardware-level encryption using the likes of AES encryption to bolster security and prevent meltdown failures, among other low-profile risks.

1.4 LEAST SIGNIFICANT BIT (LSB) ALGORITHM

LSB-Steganography is a steganography technique in which we hide messages inside an image by replacing Least significant bit of image with the bits of message to be hidden. By modifying only the first most right bit of an image we can insert our secret message and it also make the picture unnoticeable, but if our message is too large it will start modifying the second right most bit and so on and an attacker can notice the changes in picture. Least Significant Bit steganography is one such technique in which least significant bit of pixels of the image is replaced with data bits. This approach has the advantage that it is simplest one to understand, easy to implement and results in stego-images that contain embedded data as hidden.

1.4.1 STEPS FOR LSB:

The encoding is done using the following steps:

1. Convert the image to grayscale
2. Resize the image if needed
3. Convert the message to its binary format
4. Initialize output image same as input image
5. Traverse through each pixel of the image and do the following:
6. Convert the pixel value to binary
7. Get the next bit of the message to be embedded
8. Create a variable **temp**
9. If the message bit and the LSB of the pixel are same, set temp = 0
10. If the message bit and the LSB of the pixel are different, set temp = 1
11. This setting of temp can be done by taking XOR of message bit and the LSB of the pixel
12. Update the pixel of output image to input image pixel value + **temp**
13. Keep updating the output image till all the bits in the message are embedded
14. Finally, write the input as well as the output image to local system.

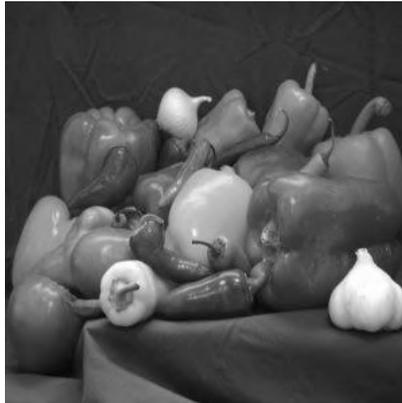
Example:**Input :** message='geeksforgeeks'

Fig 9: Input Image

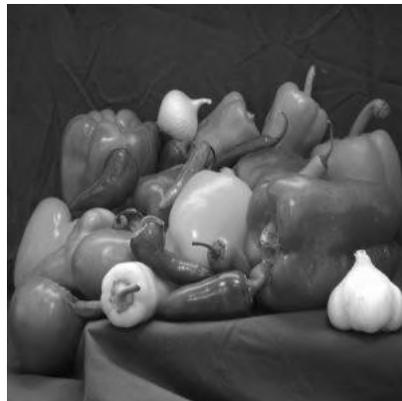
Output : Image with the given message embedded:

Fig 10: Output Image

1.4.2 ADVANTAGES OF LSB

- This method is very fast and easy to implement in comparison to other methods of image Steganography.
- The output image has very slight difference to the input image.
- Instead of embedding the message in only the LSB, we can embed the message in last two LSBs, thus embedding even large messages.
- This method forms the basics of many other complex algorithms

- Instead of embedding the message in only the LSB, we can embed the message in last two LSBs, thus embedding even large messages.

1.4.3 DISADVANTAGES OF LSB

- This type of encoding the data is weak since it can be easily decoded by taking the LSBs of the image and getting the message in binary format.
- This is method is too old because it was used long ago when other encoding methods were not yet developed.
- When embedding the message in more than one LSB, the image quality may reduce depending on how many pixels are changed.

1.5 BLOCKCHAIN

Blockchain technology is a structure that stores transactional records, also known as the block, of the public in several databases, known as the “chain,” in a network connected through peer-to-peer nodes. Typically, this storage is referred to as a „digital ledger.”

Every transaction in this ledger is authorized by the digital signature of the owner, which authenticates the transaction and safeguards it from tampering. Hence, the information the digital ledger contains is highly secure.

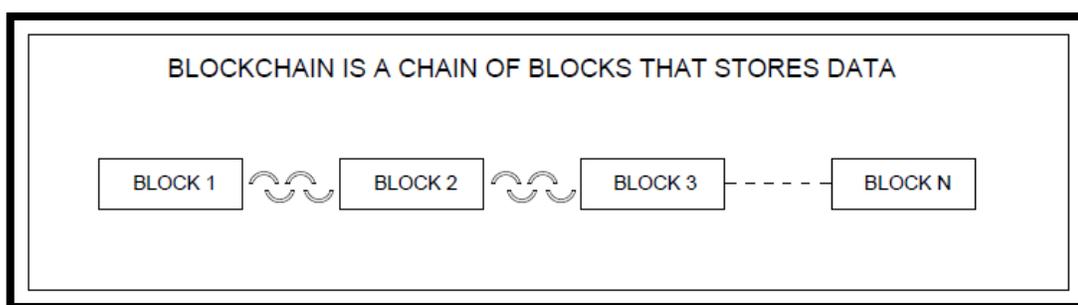


Fig 11 : Blockchain

In simpler words, the digital ledger is like a Google spreadsheet shared among numerous computers in a network, in which the transactional records are stored based on actual purchases.

The fascinating angle is that anybody can see the data, but they can't corrupt it .

1.5.1 WHY IS BLOCKCHAIN POPULAR

Suppose you are transferring money to your family or friends from your bank account, you would log in to online banking and transfer the amount to the other person using their account number. When the transaction is done, your bank updates the transaction records. It seems simple enough, right? There is a potential issue which most of us neglect.

These types of transactions can be tampered with very quickly. People who are familiar with this truth are often wary of using these types of transactions, hence the evolution of third-party payment applications in recent years. But this vulnerability is essentially why Blockchain technology was created. Technologically, Blockchain is a digital ledger that is gaining a lot of attention and traction recently. But why has it become so popular? Well, let's dig into it to fathom the whole concept.

Record keeping of data and transactions are a crucial part of the business. Often, this information is handled in house or passed through a third party like brokers, bankers, or lawyers increasing time, cost, or both on the business. Fortunately, Blockchain avoids this long process and facilitates the faster movement of the transaction, thereby saving both time and money [3].

Most people assume Blockchain and Bitcoin can be used interchangeably, but in reality, that's not the case. Blockchain is the technology capable of supporting various applications related to multiple industries like finance, supply chain, manufacturing, etc., but Bitcoin is a currency that relies on Blockchain technology to be secure.

Blockchain is an emerging technology with many advantages in an increasingly digital world:

- **Highly Secure** - It uses a digital signature feature to conduct fraud-free transactions making it impossible to corrupt or change the data of an individual by the other users without a specific digital signature.
- **Decentralized System** - Conventionally, you need the approval of regulatory authorities like a government or bank for transactions; however, with Blockchain, transactions are done with the mutual consensus of users resulting in smoother, safer, and faster transactions.
- **Automation Capability** - It is programmable and can generate systematic actions, events,

and payments automatically when the criteria of the trigger are met.

1.5.2 HOW DOES BLOCKCHAIN TECHNOLOGY WORK

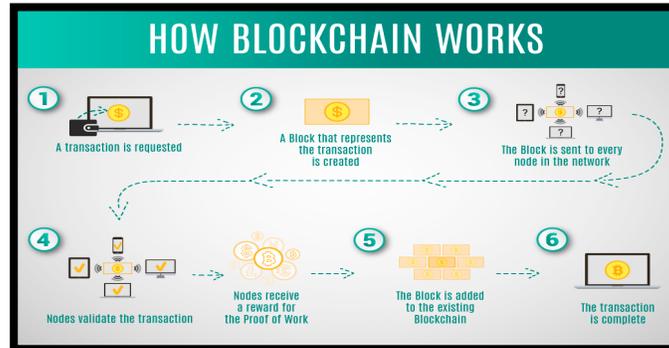


Fig 12: How Blockchain Works

In recent years, you may have noticed many businesses around the world integrating Blockchain technology. But how exactly does Blockchain technology work? Is this a significant change or a simple addition? The advancements of Blockchain are still young and have the potential to be revolutionary in the future; so, let's begin demystifying this technology.

Blockchain is a combination of three leading technologies:

- Cryptographic keys
- A peer-to-peer network containing a shared ledger
- A means of computing, to store the transactions and records of the network
Cryptography keys consist of two keys – Private key and Public key.

These keys help in performing successful transactions between two parties. Each individual has these two keys, which they use to produce a secure digital identity reference. This secured identity is the most important aspect of Blockchain technology. In the world of cryptocurrency, this identity is referred to as „digital signature“ and is used for authorizing and controlling transactions.

The digital signature is merged with the peer-to-peer network; a large number of individuals who act as authorities use the digital signature in order to reach a consensus on transactions, among other issues. Blockchain users employ cryptography keys to perform different types of digital

interactions over the peer-to-peer network.

1.5.3 PROCESS OF TRANSACTION

One of Blockchain technology's cardinal features is the way it confirms and authorizes transactions. For example, if two individuals wish to perform a transaction with a private and public key, respectively, the first person party would attach the transaction information to the public key of the second party. This total information is gathered together into a block.

The block contains a digital signature, a timestamp, and other important, relevant information. It should be noted that the block doesn't include the identities of the individuals involved in the transaction. This block is then transmitted across all of the network's nodes, and when the right individual uses his private key and matches it with the block, the transaction gets completed successfully.

In addition to conducting financial transactions, the Blockchain can also hold transactional details of properties, vehicles, etc.

Hash Encryptions –

Blockchain technology uses hash encryption to secure the data, relying mainly on the SHA256 algorithm to secure the information. The address of the sender (public key), the receiver's address, the transaction, and his/her private key details are transmitted via the SHA256 algorithm. The encrypted information, called hash encryption, is transmitted across the world and added to the Blockchain after verification. The SHA256 algorithm makes it almost impossible to hack the hash encryption, which in turn simplifies the sender and receiver's authentication.

Proof of Work -

In a Blockchain, each block consists of 4 main headers.

- Previous Hash: This hash address locates the previous block.
- Transaction Details: Details of all the transactions that need to occur.
- Nonce: An arbitrary number given in cryptography to differentiate the block's hash address.

- **Hash Address of the Block:** All of the above (i.e., preceding hash, transaction details, and nonce) are transmitted through a hashing algorithm. This gives an output containing a 256-bit, 64 character length value, which is called the unique „hash address.“ Consequently, it is referred to as the hash of the block.

Numerous people around the world try to figure out the right hash value to meet a predetermined condition using computational algorithms. The transaction completes when the predetermined condition is met. To put it more plainly, Blockchain miners attempt to solve a mathematical puzzle, which is referred to as a proof of work problem. Whoever solves it first gets a reward.

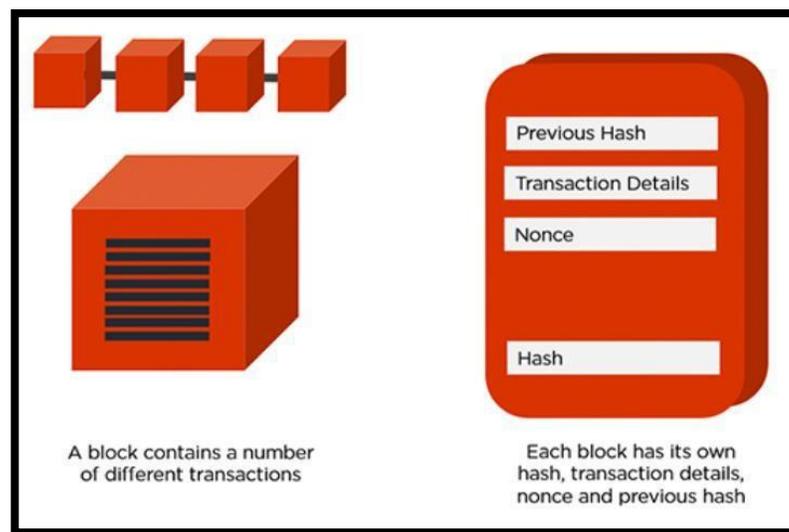


Fig 13: Process of Transaction

Mining -

In Blockchain technology, the process of adding transactional details to the present digital/public ledger is called „mining.“ Though the term is associated with Bitcoin, it is used to refer to other Blockchain technologies as well. Mining involves generating the hash of a block transaction, which is tough to forge, thereby ensuring the safety of the entire Blockchain without needing a central system.

1.5.4 STRUCTURE OF BLOCKCHAIN

The structure of blockchain technology is represented by a list of blocks with transactions in a particular order. These lists can be stored as a flat file (txt. format) or in the form of a simple database. Two vital data structures used in blockchain include [7]:

- **Pointers** - variables that keep information about the location of another variable. Specifically, this is pointing to the position of another variable.
- **Linked lists** - a sequence of blocks where each block has specific data and links to the following block with the help of a pointer.

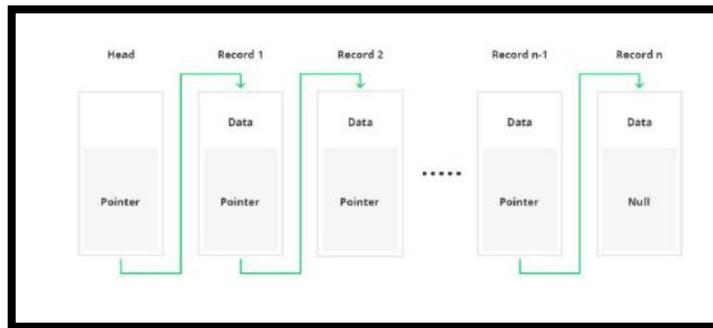


Fig 14: Structure of Blockchain

Logically, the first block does not contain the pointer since this one is the first in a chain. At the same time, there is potentially going to be a final block within the blockchain database that has a pointer with no value.

Blockchain architecture can serve the following purposes for organizations and enterprises:

- **Cost reduction** - lots of money is spent on sustaining centrally held databases (e.g. banks, governmental institutions) by keeping data current secure from cyber crimes and other corrupt intentions.
- **History of data** - within a blockchain structure, it is possible to check the history of any transaction at any moment in time. This is an ever-growing archive, while a centralized database is more of a snapshot of information at a specific point.
- **Data validity & security** - once entered, the data is hard to tamper with due to the blockchain's nature. It takes time to proceed with record validation, since the process occurs in each independent network rather than via compound processing power. This means that the system sacrifices performance speed, but instead guarantees high data security and validity.

1.5.5 CORE COMPONENTS OF BLOCKCHAIN ARCHITECTURE

These are the core blockchain architecture components [5]:

- **Node** - user or computer within the blockchain architecture (each has an independent copy of the whole blockchain ledger)
- **Transaction** - smallest building block of a blockchain system (records, information, etc.) that serves as the purpose of blockchain
- **Block** - a data structure used for keeping a set of transactions which is distributed to all nodes in the network
- **Chain** - a sequence of blocks in a specific order
- **Miners** - specific nodes which perform the block verification process before adding anything to the blockchain structure
- **Consensus (consensus protocol)** - a set of rules and arrangements to carry out blockchain operations.

1.5.6 TYPES OF BLOCKCHAIN ARCHITECTURE

All blockchain structures fall into three categories:

- **Public blockchain architecture:** Public blockchain architecture means that the data and access to the system is available to anyone who is willing to participate (e.g. Bitcoin, Ethereum, and Litecoin blockchain systems are public).
- **Private blockchain architecture:** As opposed to public blockchain architecture, the private system is controlled only by users from a specific organization or authorized users who have an invitation for participation.
- **Consortium blockchain architecture:** This blockchain structure can consist of a few organizations. In a consortium, procedures are set up and controlled by the preliminary assigned users.

A private blockchain is considered more centralized since it is controlled by a particular group

with increased privacy. On the contrary, a public blockchain is open-ended and thus decentralized. In a public blockchain, all records are visible to the public and anyone could take part in the agreement process. On the other hand, this is less efficient since it takes a considerable amount of time to accept each new record into the blockchain architecture.

In terms of efficiency, the time for each transaction in a public blockchain is less eco- friendly since it requires a huge amount of computation power compared to private blockchain architecture.

1.5.7 BENEFITS OF BLOCKCHAIN TECHNOLOGY

Blockchain solutions are not only limited to the exchange of cryptocurrencies. There are numerous benefits that this technology can present to businesses in many different industries, through its distributed and decentralized nature :

- **Greater Transparency:** Blockchain's greatest characteristic stems from the fact that its transaction ledger for public addresses is open to viewing. In financial systems and businesses, this adds an unprecedented layer of accountability, holding each sector of the business responsible to act with integrity towards the company's growth, its community and customers.
- **Increased Efficiency:** Due to its decentralized nature, Blockchain removes the need for middlemen in many processes for fields such as payments and real estate. In comparison to traditional financial services, blockchain facilitates faster transactions by allowing P2P cross-border transfers with a digital currency. Property management processes are made more efficient with a unified system of ownership records, and smart contracts that would automate tenant-landlord agreements.
- **Better Security:** Blockchain is far more secure than other record keeping systems because each new transaction is encrypted and linked to the previous transaction. Blockchain, as the name suggests, is formed by a network of computers coming together to confirm a „block“, this block is then added to a ledger, which forms a „chain“. Blockchain is formed by a complicated string of mathematical numbers and is impossible to be altered once formed. This immutable and incorruptible nature of blockchain makes it safe from falsified information and hacks. Its decentralized nature also gives it a unique quality of being „trustless“ – meaning that parties do not need trust to transact safely.
- **Improved Traceability:** With the blockchain ledger, each time an exchange of goods is

recorded on a Blockchain, an audit trail is present to trace where the goods came from. This can not only help improve security and prevent fraud in exchange-related businesses, but it can also help verify the authenticity of the traded assets. In industries such as medicine, it can be used to track the supply chain from manufacturer to distributor, or in the art industry to provide an irrefutable proof of ownership.

1.5.8 KEY CHARACTERISTICS OF BLOCKCHAIN ARCHITECTURE

Blockchain architecture possesses a lot of benefits for businesses. Here are several embedded characteristics:

- **Cryptography** - blockchain transactions are validated and trustworthy due to the complex computations and cryptographic proof among involved parties
- **Immutability** - any records made in a blockchain cannot be changed or deleted
- **Provenance** - refers to the fact that it is possible to track the origin of every transaction inside the blockchain ledger
- **Decentralization** - each member of the blockchain structure has access to the whole distributed database. As opposed to the central-based system, consensus algorithm allows for control of the network
- **Anonymity**- each blockchain network participant has a generated address, not user identity. This keeps users' anonymity, especially in a public blockchain structure
- **Transparency** - the blockchain system cannot be corrupted. This is very unlikely to happen, as it requires huge computing power to overwrite the blockchain network completely.

CHAPTER - 2

LITERATURE SURVEY

There are some papers regarding the implementation of image steganography for securing the information hiding and also using blockchain for the secure transfer of data. These papers helped us to learn and understand the thing more deeply. They gave clear ideas about various types of techniques and methods they followed and advantages and disadvantages of those models. Here we are discussing some papers which are related to our work.

- PSO-Blockchain based Image Steganography for securing Health Data

(Mohsin, A.H.)

In this paper we deal with updating and sharing large amounts of healthcare information (such as medical data on coronavirus disease 2019 [COVID-19]) in efficient and secure transmission that are important but challenging in communication channels amongst hospitals. Here two issues are faced, namely, those related to confidentiality and integrity of their health data and to network failure that may cause concerns about data availability. The author came up with the steganography-based blockchain method in the spatial domain as a solution. The novelty of the proposed method is the removal and addition of new particles in the particle swarm optimisation (PSO) algorithm. In addition, hash functions can hide secret medical COVID-19 data in hospital databases whilst providing confidentiality with high embedding capacity and high image quality.

- Particle Swarm Optimization: A powerful technique for solving Problem

(Bruno Seixas)

PSO variants will be summarized and hybrid methods representing a combination of heuristic and deterministic optimization methods are going to be presented as well. Before the presentation of these algorithms, the reader will be introduced to the main challenges when approaching the PSO algorithm. Two study cases of diverse nature, one regarding the PSO in its classical version and another one regarding the hybrid version, are provided in this chapter showing how handful and versatile it is to work with PSO. The former case is the optimization of a mechanical structure in the nuclear fuel bundle and the last case is the optimization of the cost function of a cogeneration system using PSO in a hybrid optimization.

- Research on Embedding Capacity and Efficiency of Information Hiding Based on Digital Images

Generally speaking, being an efficient information hiding scheme, what we want to achieve is high embedding capacity of the cover image and high visual quality of the stego image, high visual quality is also called embedding efficiency. This paper mainly studies on the information hiding technology based on gray-scale digital images and especially considers the improvement of embedding capacity and embedding efficiency. For the purpose of that, two algorithms for information hiding were proposed, one is called high capacity of information hiding algorithm (HCIH for short), which achieves high embedding rate, and the other is called high quality of information hiding algorithm (HQIH for short), which realizes high embedding efficiency. The simulation experiments show that our proposed algorithms achieve better performance.

- Assessment of the Image Distortion in Using Various Bit Lengths of Steganographic LSB (Yucel Inan)

Steganographic techniques are used to transmit the information in the image to the receiver in a secure manner. There are two main principles: hide the message in the image and the second one is to reduce the distortion on the image caused by information hiding. By making changes on digital images, a lot of information can be placed in the image. Nevertheless, changes in the image should not be noticed. In this paper, the effect of using various bit length of the steganographic LSB method on the image distortion is studied. The PSNR, SNR and MSE were used to assess the distortion rates of the images

- Steganography in Images Using LSB Technique (Arun Kumar Singh, Juhi Singh)

This paper, a data-hiding technique based on the LSB technique of digital images is presented. A lossless data hiding technique using LSB in images is presented in this paper. LSB data hiding technique does not affect the visible properties of the image. Secrets can be hidden in all types of medium: text, audio, video and images. It is the science of embedding information into the cover image viz., text, video, and image (payload) without causing statistically significant modification to the cover image. The modern secure image steganography presents a challenging task of

transferring the embedded information to the destination without being detected. This paper deals with hiding text in an image file using Least Significant Bit (LSB) technique. The LSB algorithm is implemented in the spatial domain in which the payload bits are embedded into the least significant bits of cover image to derive the stego-image.

- Raster Scan Technique for Secure Communication in Steganography

(Yogita Birdi , Harjinder Singh)

Data is encrypted and a Raster Scan technique is proposed. This technique is similar to the Raster Scan principle of displaying an image on a CRT display. In this work Mean Square Error and Peak Signal Noise Ratio is calculated for the proposed technique and the results are compared with existing techniques

- A High-Capacity Image Steganography Method Using Chaotic Particle Swarm Optimization

(Aya Jaradat)

Image steganography has been widely adopted to protect confidential data. Researchers have been seeking to improve the steganographic techniques in order to increase the embedding capacity while preserving the stego-image quality. In this paper, we propose a steganography method using particle swarm optimization and chaos theory aiming at finding the best pixel locations in the cover image to hide the secret data while maintaining the quality of the resultant stego-image. To enhance the embedding capacity, the host and secret images are divided into blocks and each block stores an appropriate amount of secret bits.

- New Method of Image Steganography Based on Particle Swarm Optimization Algorithm in Spatial Domain for High Embedding Capacity

(De Rosal Ignatius)

The development of the internet and the web makes human activities more practical, comfortable, and inexpensive. Public networks make the security of websites vulnerable to attack. This research proposes a Honeypot for server security against attackers who want to steal data by carrying out a brute force attack. In this research, Honeypot is integrated on the server to protect the server by

creating a shadow server. This server is responsible for tricking the attacker into not being able to enter the original server. Brute force attacks tested using Medusa tools. With the application of Honeypot on the server, it is proven that the server can be secured from the attacker.

- **Image Steganography: A Review of the Recent Advances**

(Nandhini Subramanian)

Image Steganography is the process of hiding information that is not visible to the human eye. The main goal of this paper is to explore and discuss various deep learning methods available in the image steganography field. Deep learning techniques used for image steganography can be broadly divided into three categories - traditional methods, Convolutional Neural Network-based and General Adversarial Network-based methods. Along with the methodology, an elaborate summary on the datasets used, experimental set-ups considered and the evaluation metrics commonly used are described in this paper.

CHAPTER – 3

EXISTING SYSTEM

3.1 OVERVIEW

Secure updating and sharing for large amounts of healthcare information in efficient and secure transmission are important but challenging in communication channels amongst hospitals. In particular, in addressing the above challenges, two issues are faced, namely, those related to confidentiality and integrity of their health data and to network failure that may cause concerns about data availability. To the authors' knowledge, no study provides secure updating and sharing solution for large amounts of healthcare information in communication channels amongst hospitals.

Therefore, this study proposes and discusses a novel steganography based blockchain method in the spatial domain as a solution. The novelty of the proposed method is the removal and addition of new particles in the particle swarm optimisation (PSO) algorithm. In addition, hash function can hide secret medical data in hospital databases whilst providing confidentiality with high embedding capacity and high image quality. Moreover, stego images with hash data and blockchain technology are used in updating and sharing medical data between hospitals in the network to improve the level of confidentiality and protect the integrity of medical data in grey-scale images, achieve data availability if any connection failure occurs in a single point of the network and eliminate the central point (third party) in the network during transmission.

The proposed method is discussed in three stages. Firstly, the pre-hiding stage estimates the embedding capacity of each host image. Secondly, the secret data hiding stage uses PSO algorithm and hash function. Thirdly, the transmission stage transfers the stego images based on blockchain technology and updates all nodes (hospitals) in the network. As proof of concept for the case study, the authors adopted the latest research published in the *Computer Methods and Programs in Biomedicine* journal, which presents a rescue framework within hospitals for the storage and transfusion of the best convalescent plasma to the most critical patients with on the basis of biological requirements.

3.2 STAGES IN THE EXISTING SYSTEM

Existing steganography method based on blockchain and PSO algorithm consists of 4 stages.

- Stage 1: Pre-Hiding
- Stage 2: Secret medical data hiding
- Stage 3: Secret medical data Transmission
- Stage 4: Secret data retrieval

3.2.1 Stage 1 : Pre-Hiding

This stage will be discussed before starting the steganography process to:

- Allow each node (server in hospital) to estimate the capacity of host images for hiding secret COVID-19 data
- Reduce the time consumed by the PSO algorithm in selecting the best bit locations in the host images for hiding secret data.

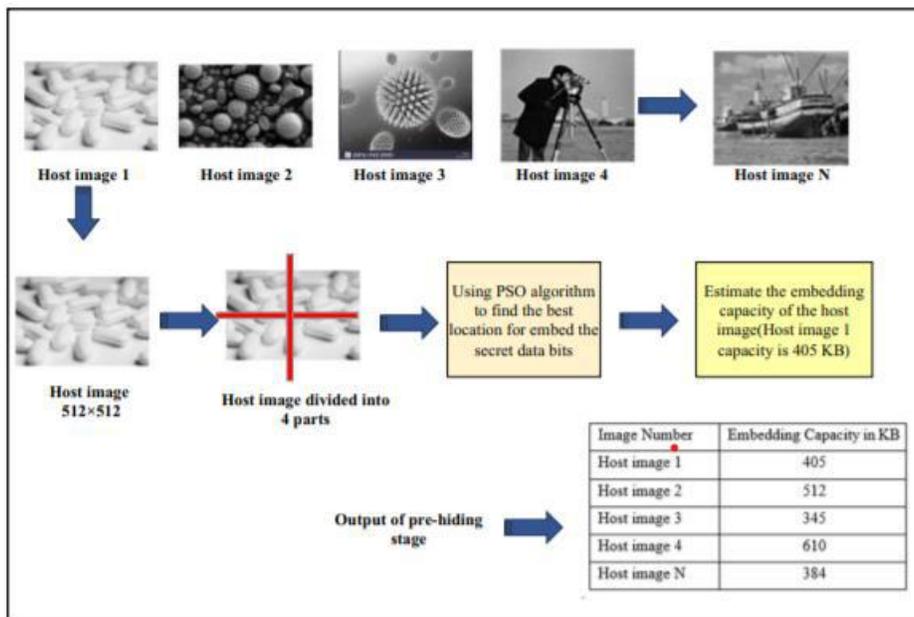


Fig 15: Stage 1 - Pre-Hiding

Most of the recent technologies can utilise various forms of carrier messages, such as image, text and video. However, image file remains the most common form of carrier message because it can be easily sent during active communication between two parties. Images can exist in three different forms: binary (black and white), grey scale and red–green–blue (RGB) images. The study [65] that

served as the benchmark of the current study used grey-scale images; therefore, the current study will adopt grey-scale images.

3.2.1.1 Finding the best bit location in the host image for hiding

The best bit location is the location where message bits could be embedded with the least chance of distortion. The start pixel, the number of LSB used in each pixel and the pixel sequence of the scanning image are determined using this method to conceal the message bits. The raster order of pixels in the LSB substitution method refers to the pixels’ order in the cover image. These pixels are scanned from left to right and from the first row to the last row of the cover image. The major aim of this concept is to transform the steganography problem into a search and optimization problem. As a result, various positions and orders in the carrier image could serve as the ideal position for secret data embedment as they produce various peak signal-to-noise ratios (PSNRs). Hence, the problem of pixel scanning direction has 16 possible solutions. If a new method is designed to check all the possible orders and identify the best order for a given carrier image, then basic LSB steganography may be used to improve the result. The host image is divided into four equal parts [11]; therefore, row-wise image pixel scanning is done from top to bottom or reverse, whereas column-wise scanning is done from right to left or reverse.

<p>Algorithm 1: Finding the best bit location in the host image for hiding medical COVID-19 data Input: Grey-scale host images. Output: Embedding capacity of each host image.</p>
<p>Begin Divide the host image into four equal parts. Check the size of the host image and the size of secret COVID-19 data that can be embedded in the image. Start subiteration 1: <ul style="list-style-type: none"> • Implement the PSO algorithm using Particle = [Direction X-offset, Y-offset, bit-planes, X-side length, Y-side length]. • Scan each part of the host image according to the raster order. End subiteration 1. Set the embedding capacity of the image.</p>
<p>End</p>

Table 1: Finding the best bit location in the host image for hiding medical COVID-19 data

3.2.2 Stage 2: Secret medical data hiding

This stage can be divided into two steps:

- Dividing the secret medical data into blocks and calculating the Hash value
- Hiding the block of secret medical COVID-19 data in host images

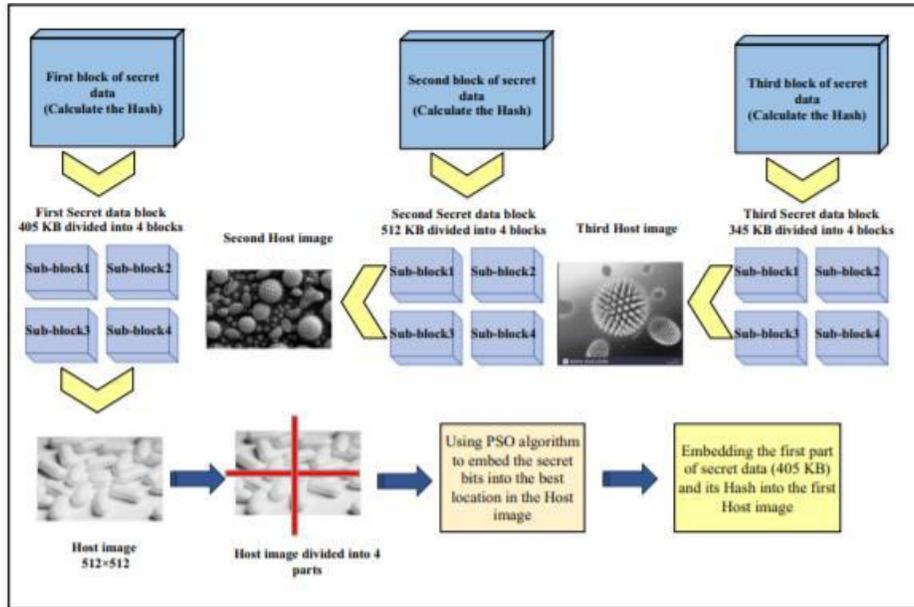


Fig 16: Stage 2- Secret medical data hiding

3.2.2.1 Calculating the size of secret medical data

In this step, the secret data is reduced to blocks according to the host images’ size, which is the output of the previous stage (pre-hiding), and then the blocks of secret data are converted into binary data to prepare for embedding into the host image as explained in the next step.

The advantages of this step are as follows:

- The secret data is hidden according to the embedding capacity of each host image.
- The secret data embeded in specific host images will be incomplete (distributed in many host images); therefore, the security level of steganography is enhanced compared with other steganography methods that embed secret data completely in one image.

This complete embedment will increase the vulnerability of the image to attack. Moreover, the quality of the stego image will be high because the embedding will be done according to the capacity of host images.

3.2.2.2 Hiding the block of secret medical COVID-19 data in host images

In this step, the blocks of secret data are hidden in the host images. The particles of the PSO algorithm used in this stage are: Direction X-offset, Y-offset, bit-planes, X-side length, Y-side length, data block number, host image number, Genesis image number, HC-SD. HN-SD, HL-SD.

The secret bit pole (SB-Pole) was determined by using the direction of secret bits (SB-Dire) to define the message bits' direction, whereas the last particle is determined by the bit plane's direction (BP-Dire) to show the direction of the LSB planes.

3.2.3 Stage 3: Secret medical data (stego images) transmission stage

The benefits of using blockchain technology in stego image transmission are to: Enhance the level of security when hiding secret data during steganography by distributing the secret data in multi-host images and using hashes as pointers during the retrieval of the secret data.

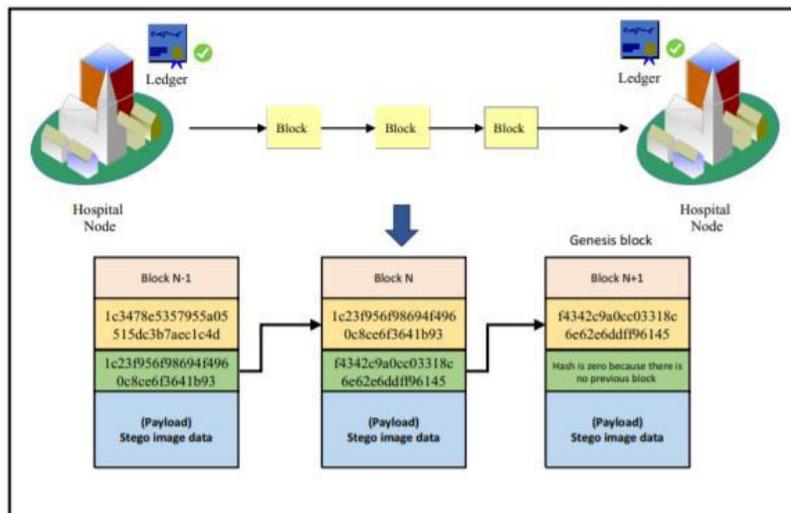


Fig 17: Stage 3- Secret medical data (stego images) transmission stage

Blockchain was used in stego image transmission in the decentralised architecture as explained in the following procedures:

1. The decentralised architecture based on blockchain technology has no central point (third party) that verifies the transaction between any nodes (hospitals) in the network as the connection will be by pair.
2. Based on blockchain technology, all nodes (hospitals) in the network will receive the data immediately without the need to verify the transaction from any third party when any node transfers any secret data to any node in the network. The validity of the transaction needs to be verified by at least 50% of the nodes in the network; this procedure will make tampering the transaction hard for any attacker.
3. The transmission will proceed as a chain of data blocks that contain the secret medical data when any node (hospital) sends the medical secret data (stego image) to all nodes (hospitals) in the network based on blockchain technology. Each block contains the payload (stego image of

data), the hash of this image (current stego image) and the hash of the previous stego image except the first block called the Genesis block, which contains only the payload (stego image of data) and the hash of the first stego image.

4. The hash of the Genesis block will be stored in the ledger of the nodes (each node in the network) that received the block of data.

5. The node will check the value of the hash of the Genesis block, which has been stored in the ledger with the hash of the Genesis block coming with this block, when the second block of data reaches the node (each node in the network), which contains the hash of the second block, the previous block (Genesis block) and payload.

6. If the hashes are similar, then the data content is not tampered.

7. The same process will be implemented with each block of data to check the integrity of the stego images.

8. After finishing all the transactions, the ledger in each node will contain all the hashes of the stego image to ensure the integrity of the transmitted data and will use this hash during the retrieval of the secret data from the stego images.

3.2.4 Stage 4: Secret COVID-19 data retrieval

The embedded secret data can be extracted by the reverse process. The information is extracted from the last row of the stego image. The procedure of retrieving the secret data can be summarise as follows:

1. Extract the information from the last row in the last stego image.

2. Check the hash of the last stego image extracted with the last stego image in the ledger. If the result matches, then no tampering happened in the stego image content during its storage in the database.

3. Implement stenography method based on PSO algorithm in reverse to obtain the secret data from the stego image.

4. Check the hash of the next stego image ($N-1$) extracted in 1 to know the next stego image that contains the second block of secret data.

5. Repeat 2, 3 and 4 until the next stego image has no Hash.

6. Aggregate all the parts of the secret data blocks to obtain the final secret data.

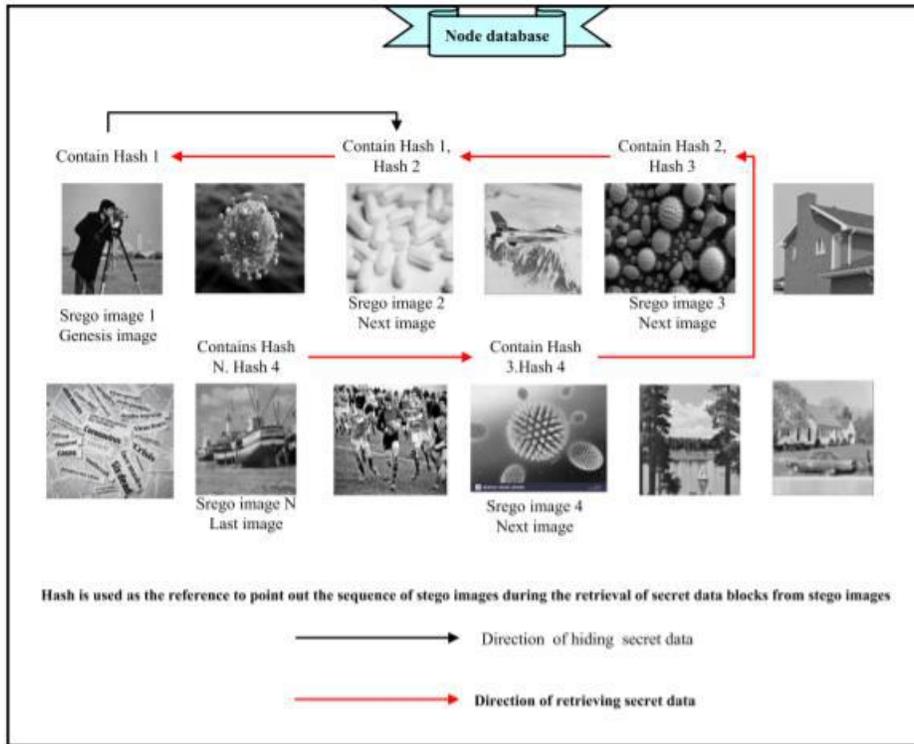
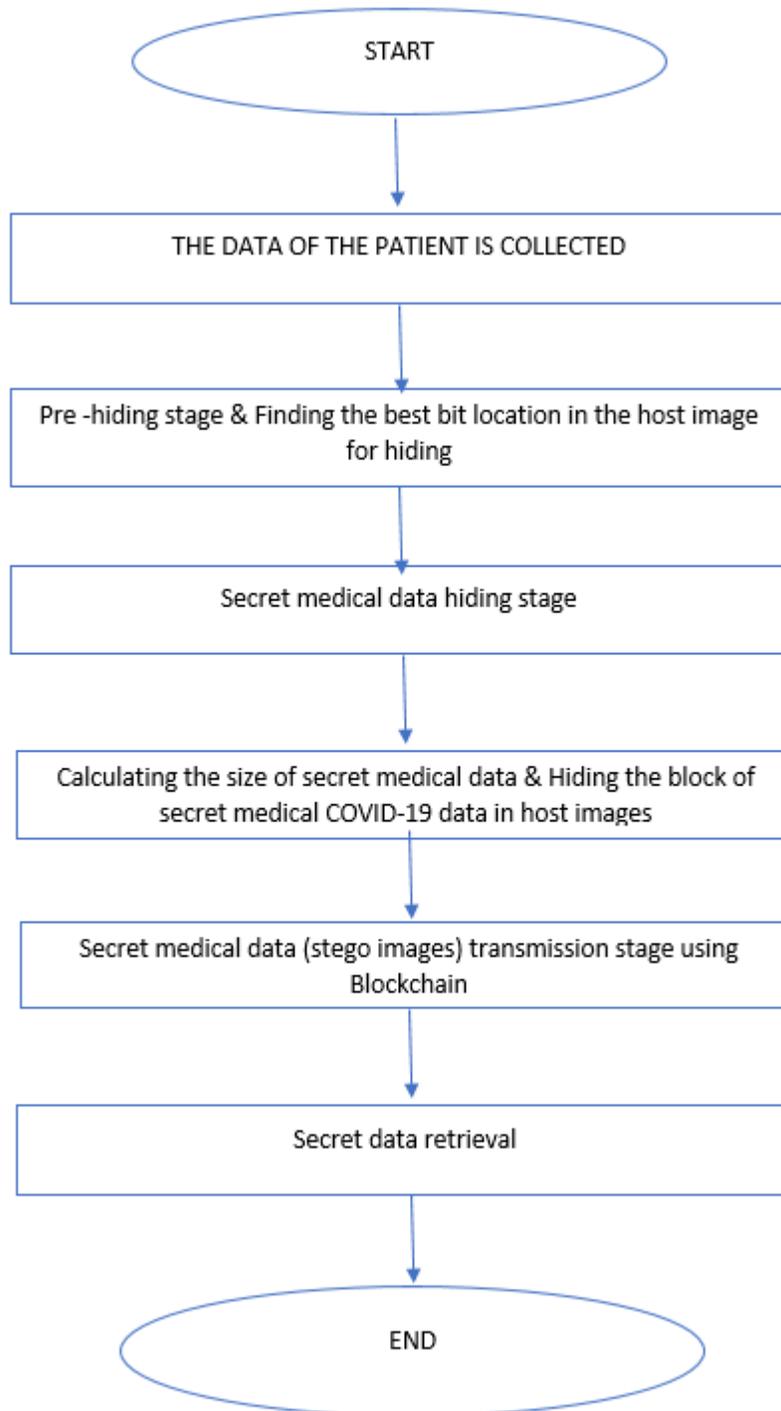


Fig 18: Stage 4- Secret COVID-19 data retrieval

3.3 FLOWCHART



3.4 DEMERITS OF EXISTING SYSTEM

- Collecting real datasets of patients and recovered donors is difficult.
- Time consuming to find the embedding capacity of the image.
- PSO algorithm consists finding the best bit location - increases the complexity of the algorithm.
- Storing the Hash value of data - more complex.
- Transferring the Stego image as data in the blocks may not allow successful retrieval.
- System is not secured using authentication process
- The existing method is not implemented and has many limitations based on the complexity of the PSO algorithm.

CHAPTER – 4

PROPOSED SYSTEM

4.1 OVERVIEW

Efficient and secure transmission are important but challenging in communication channels amongst hospitals. In particular, in addressing the above challenges, two issues are faced, namely, those related to confidentiality and integrity of their health data and to network failure that may cause concerns about data availability. No study provides secure updating and sharing solution for large amounts of healthcare information in communication channels amongst hospitals. Therefore, this study proposes and discusses a novel steganography based blockchain method in the spatial domain as a solution. A new steganography method for concealing secret messages inside a host image based on Advanced Encryption Standard (AES) & Least Significant Bit (LSB) algorithm is proposed. AES algorithm is used to encrypt the medical data and performing image steganography using the LSB technique.

The stego image generated is stored in a cloud platform and blockchain technology are used in updating and sharing medical data between hospitals in the network to improve the level of confidentiality and protect the integrity of medical data in grey-scale images, achieve data availability if any connection failure occurs in a single point of the network and eliminate the central point (third party) in the network during transmission.

Benefits of using blockchain technology in stego image transmission are to:

- Enhance the level of security when hiding secret data during steganography by distributing the secret data in multi-host images and using hashes as pointers during the retrieval of the secret data (see secret data hiding stage);
- Ensure the integrity of data during the transmission and retrieval of secret data from stego images;
- Ensure the availability of the secret data in all the nodes in the network.

4.2 STAGES IN THE PROPOSED SYSTEM

The proposed system consists of five stages.

- Stage 1 - User Authentication.
- Stage 2 - Apply AES algorithm to encrypt the medical data
- Stage 3 - Perform image steganography using the LSB algorithm
- Stage 4 - Store the stego image on a cloud platform (AWS)
- Stage 5 - Use blockchain for transferring the data

4.3 ALGORITHM

STEP 1: The user logs into the system using their respective credentials for username and password.

STEP 2: The user uploads the image of the medical records.

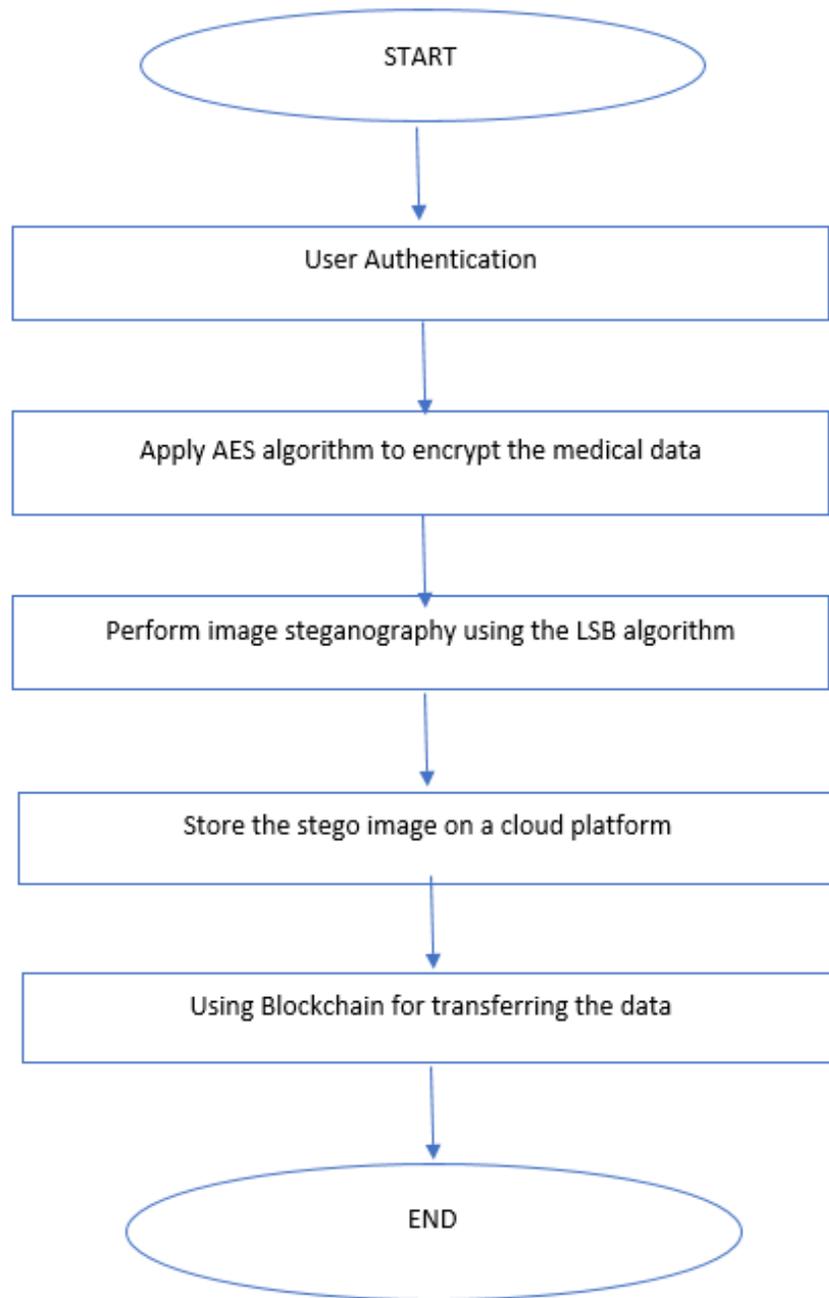
STEP 3: The medical records are encrypted using the AES algorithm and the LSB algorithm which performs the image steganography.

STEP 4: The Stego image is stored on the cloud platform, Amazon Web Services(AWS).

STEP 5: The link to the cloud platform is transferred using the blockchain method to the other users.

STEP 6: By performing the reverse algorithm, the medical records could be accessed by the other users.

4.4 FLOWCHART



4.5 MERITS OF THE PROPOSED SYSTEM

- Manages the user interface by allowing the doctors to communicate with each other.
- OTP (One Time Password) is sent via mail to ensure the secure authorization.
- Steganography technology can be used to improve the confidentiality payload and robustness integrity of stenographic transactions in distributed hospitals.
- Advanced Encryption Standard (AES) algorithm is easy to implement, it consumes less memory.
- The proposed method divides secret data into several parts and hides them in multi-host images.
- Blockchain is used for stego image link transmission in distributed hospitals to increase the security of transmission of secret data and to eliminate the third party.

CHAPTER - 5

SYSTEM REQUIREMENT SPECIFICATIONS

➤ SOFTWARE REQUIREMENTS

- Coding Platform (Python language)
- Operating System-Windows
- MYSQL Database

➤ HARDWARE REQUIREMENTS

- 8 GB RAM
- Hard disk
- i5 Processor
- Monitor
- Keyboard
- Mouse

CHAPTER 6

SYSTEM DESIGN ARCHITECTURE

Level 0:

The Proposed system consists of three modules:

Module 1: ADMIN

Module 2: PATIENT

Module 3: DOCTOR

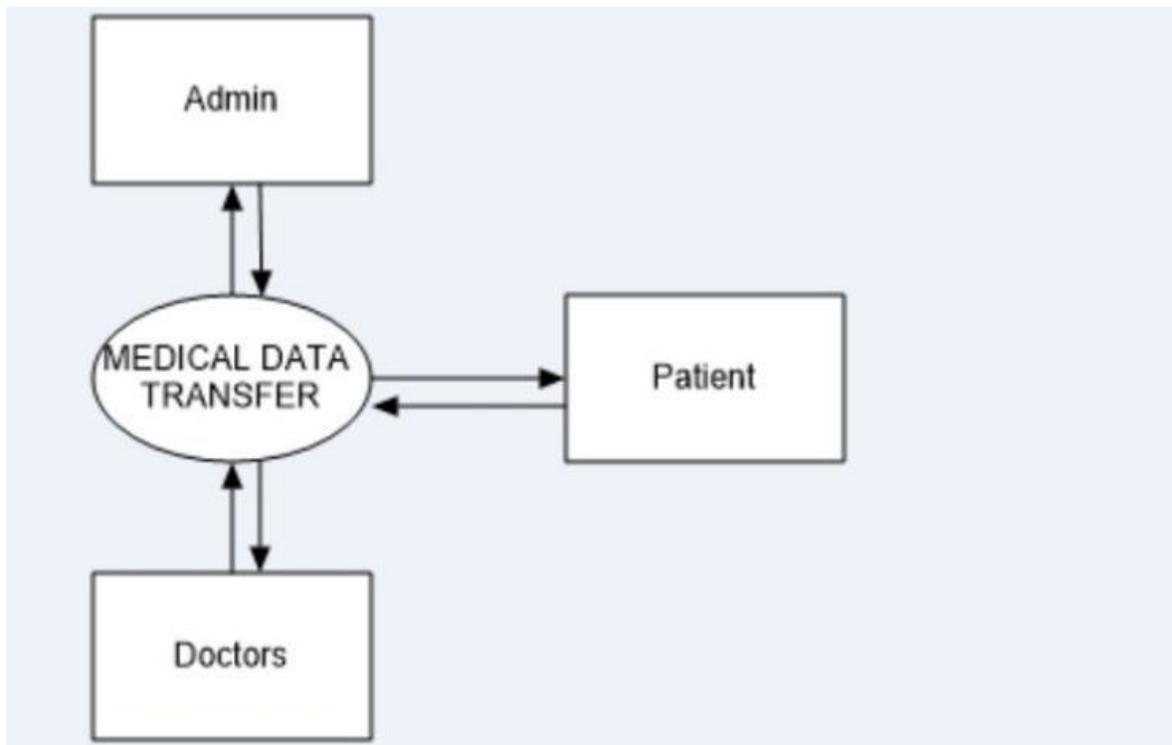


Fig 19: Basic abstract of system

Level 1.1

MODULE 1 : ADMIN

The module ‘ADMIN’ consists of the following features:

- Login
- Manage doctors
- View Patients
- View Request
- View Complaints and send reply

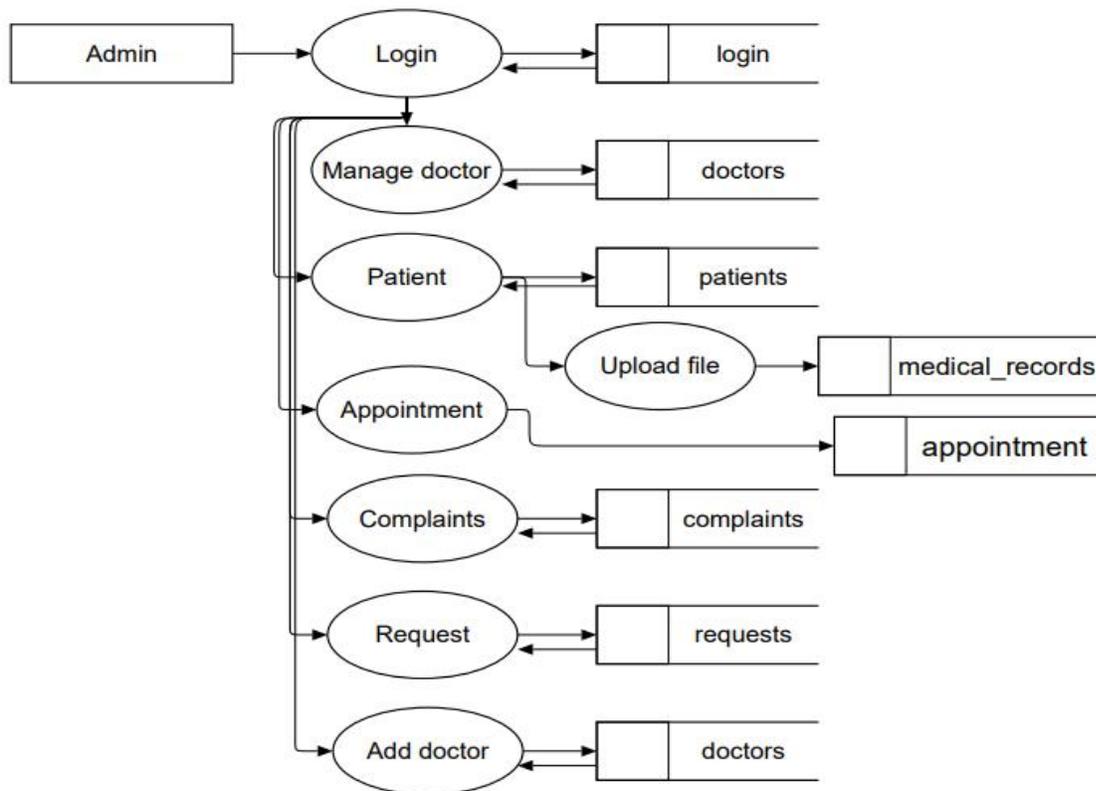


Fig 20: Abstract of ADMIN module

Level 1.2

MODULE 2 : PATIENT

The module ‘PATIENT’ consists of the following features:

- Login
- View doctors
- Make an appointment
- Check appointment status
- Send complaint and view reply

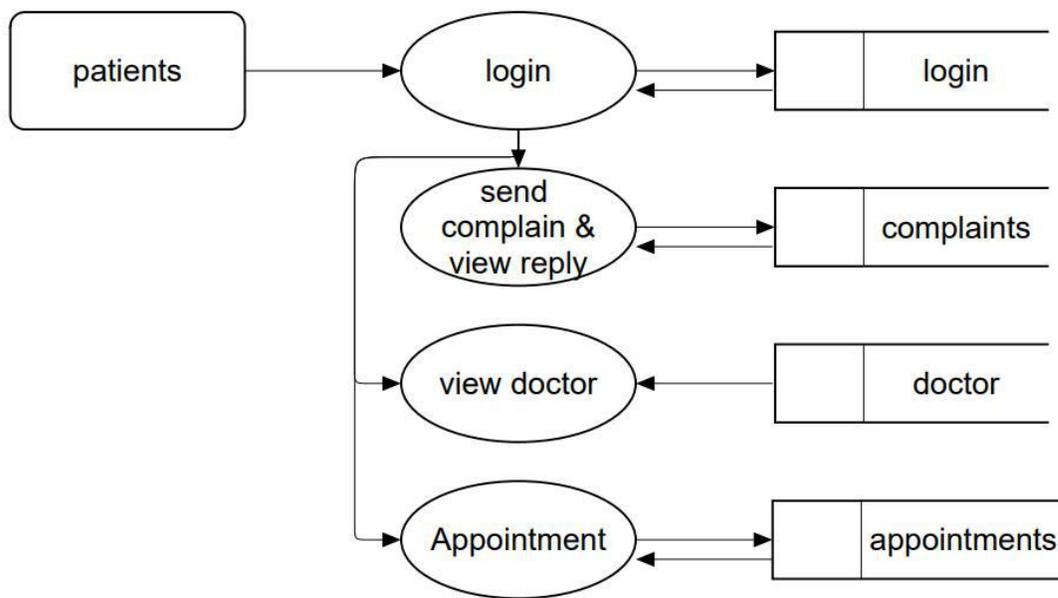


Fig 21: Abstract of PATIENT module

Level 1.3

MODULE 3 : DOCTOR

The module ‘DOCTOR’ consists of the following features:

- Login
- View appointments
- View patient details
- Update status
- Upload patient medical reports
- Request to access patient medical records
- View Patient details
- Request for a file
- Download if accepted
- View Request
- Approve/Reject
- Chat with doctors

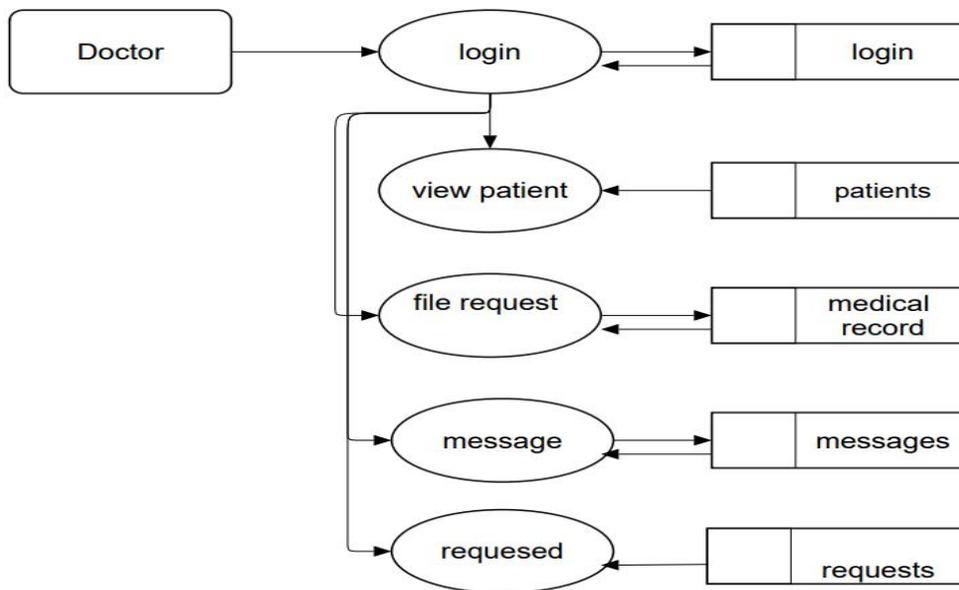


Fig 22: Abstract of DOCTOR module

CHAPTER 7

MODULE DESCRIPTION

The system consists of three modules:

- **Module 1: ADMIN**
- **Module 2: PATIENT**
- **Module 3: DOCTOR**

MODULE 1 : ADMIN

The module 'ADMIN' consists of the following features:

- Login
- Manage doctors
- View appointments
 - View patient details
 - Update status
 - Upload patient medical reports
- View Patients
- View Request
- View Complaints and send reply

Login:

The admin is requested to login to the website with the respective admin credentials in the Username & Password field.

Once the login is successful, the admin will be redirected to the admin page where he could:

- View & Manage Doctor's Details

- View Patients's Details
- View Requests
- View Complaints & Send Reply

Manage Doctors:

The admin registers the doctors after verifying their authenticity. After adding the doctors, the admin could:

- View the doctor's details
- Update the doctor's details
- Delete the doctor's details

View Appointments:

The admin could view the appointments that are made by their respective patients for consulting them. By viewing the appointments, they could view the date of when the patient wants to consult them and the time at which they want to consult the doctor

View patient details:

The admin could view the details of the respective patients who have made an appointment to consult with them.

Update Status:

Once the admin has viewed the details of the respective patients, he could decide whether to approve or reject the appointment that is made by the patient. This depends on the date and time of the appointment that is made by the patient. Once the appointment has been confirmed by the admin, the appointment status would appear as confirmed. Or else if the appointment has been rejected by the admin, then the appointment status would appear as rejected to the patient.

View Patient Details:

The admin could view the details of the patients who have registered and upload the respective medical records based on the doctor they are consulting.

Upload Patient Medical Reports:

The admin could upload the medical reports of the patients so that these reports could be viewed by the other doctors by sending a request to the admin who uploaded the medical reports. The medical reports contains the various medical details of the patients. The medical data is uploaded in the form of images by the admin.

View Requests:

The admin could view the requests made by a doctor for referring a particular medical record which was uploaded for another doctor and could accept/ reject the request to download the medical records.

View complaints & send reply:

Admin could view the complaints that have been received from the patients and send the appropriate responses.

MODULE 2 : PATIENT

The module 'PATIENT' consists of the following features:

- Login
- View doctors
- Make an appointment
- Check appointment status
- Send complaint and view reply

The Patient first registers with their details to be able to log into the website with the Username and Password that they entered during registration.

Login:

The patient is requested to login to the website with the respective patient credentials in the Username & Password field.

Once the login is successful, the patient will be redirected to the patient page where he could:

- View Doctors
- Make an appointment
- Check appointment status
- Send complaint and view reply

View Doctors:

Patient could view the Doctors who are available or whom they want to consult. After finding the required Doctor, the patient could make an appointment with the doctor for consulting them.

Make an appointment:

The patient makes an appointment with the doctor after viewing the doctor's details. While making the appointment, the patient is requested to specify the date on which he wants to consult the doctor along with the time. After making the appointment, he could wait for the response from the admin who confirms the appointment.

Check appointment status:

Once the appointment has been confirmed by the admin, the appointment status would appear as confirmed. Or else if the appointment has been rejected by the admin, then the appointment status would appear as rejected.

Send complaint and view reply:

The patient could send a complaint to the admin. If they haven't received any response from the doctor or if they are facing any difficulties while using the website.

The patient could also send the complaint if the patient is not able to view the details of the doctors or if he's not able to make the appointment. Based on the complaint sent, the patient would be receiving the reply from the admin.

MODULE 3 : DOCTOR

The module 'DOCTOR' consists of the following features:

- Login
- View Patient Details
- View Doctor Details
- View Patient Details
- Request for a file
- Download if accepted
- Requested
- Approve/Reject
- Chat with doctors

The details of the doctors are entered by the admin and they are registered by the admin after

verifying their authenticity. After the doctor's details are registered in the website, they are provided with the respective credentials for the username and password:

Login:

The doctor is requested to login to the website with the respective doctor credentials in the username and password field. Once the login is successful, the doctor will be redirected to the doctor page where he could:

- View Patient details
- Request for a file
- Download if accepted
- Requested
- Approve/Reject
- Chat with doctors

View Patient Details:

The doctor could view the details of the patient who belongs to them and download the respective medical records.

View Doctor Details:

The doctor could view the details of the other doctors in the hospital.

View patient details:

The doctor could view the details of the respective patients who belongs to another doctor.

Request to access patient medical records:

If the doctor finds medical details of his respective patient uploaded under another doctor, then the request is sent by the former to the admin to access the details of their respective patient. Once the request has been approved by the admin who uploaded the reports, the doctor who is trying to access the medical reports could download it.

Download if accepted:

If the request made by the doctor is accepted by the admin who has uploaded the reports, then the former would be able to download the medical records of the patient or else he won't be able to and will have to request again.

Requested:

If the admin approves the request that is made by another doctor to download the patient's medical records, then the status would appear as approved and the doctor would be able to download the report. If the admin rejects the request that is made by another doctor to download the patient's medical records, then the status would appear as rejected and the doctor will have to request again.

Chat with Doctors:

The doctors could chat with the other doctors who have been registered in the website regarding the details of the patients. They could also confirm the details of the respective patient's medical reports which are needed by them.

CHAPTER 8

IMPLEMENTATION

USER INTERFACE PART:

1. ADMIN:

The user accesses the website and is directed to the HOME page.



Fig 23: Home Page

Upon clicking the LOGIN, the user is directed to the Login page where he enters the default USERNAME and PASSWORD for the admin.



Fig 24: Admin Login

If the Login is successful, the user is requested to enter the OTP which they would receive through their mail.

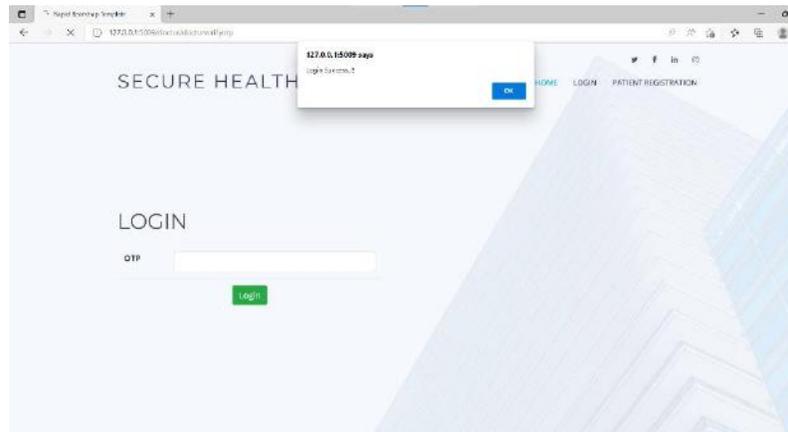


Fig 25: Successful Login

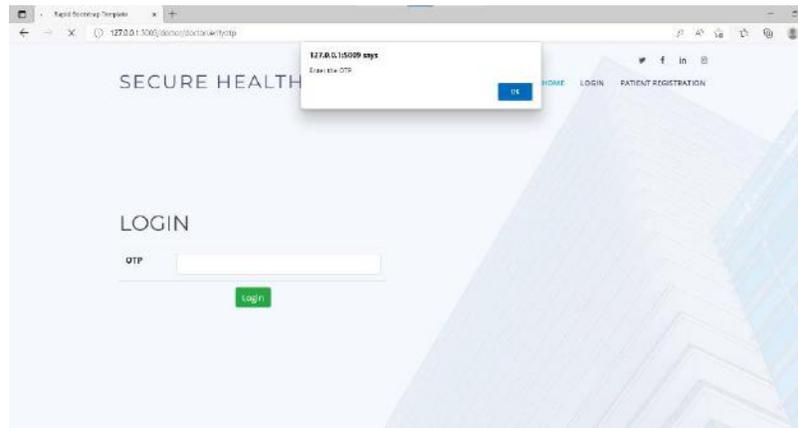


Fig 26: Enter OTP

After the correct OTP is entered, the user is directed to the ADMIN home page.



Fig 27: Admin Home Page

The admin could register the details of the new Doctor.



Fig 28: Doctor Registration

The admin could also update and delete the details of the doctor.

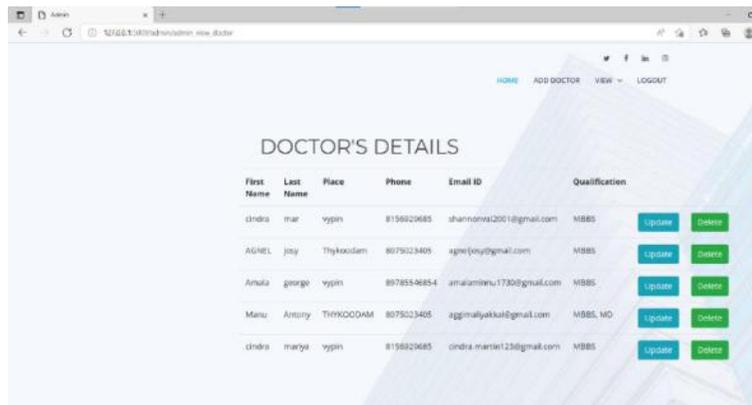


Fig 29: Doctor details updating

The admin could view the details of the patients who have registered and upload their medical records.



Fig 30: View Patient Details

The admin could download the details of the already registered patients.

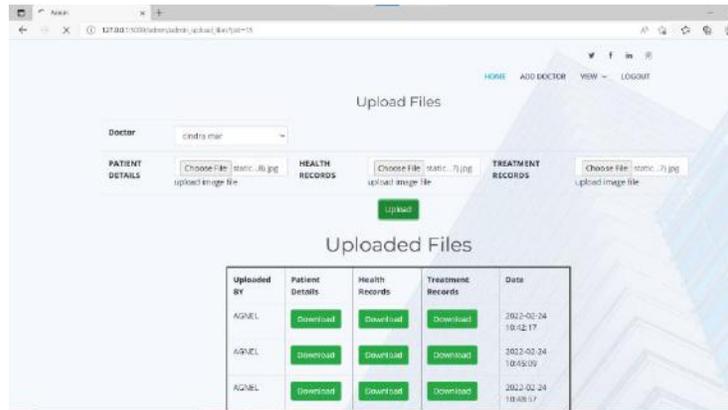


Fig 31: Upload & Download Medical Records

Admin approves / rejects the request send by the other doctors to access the medical records of the patients.

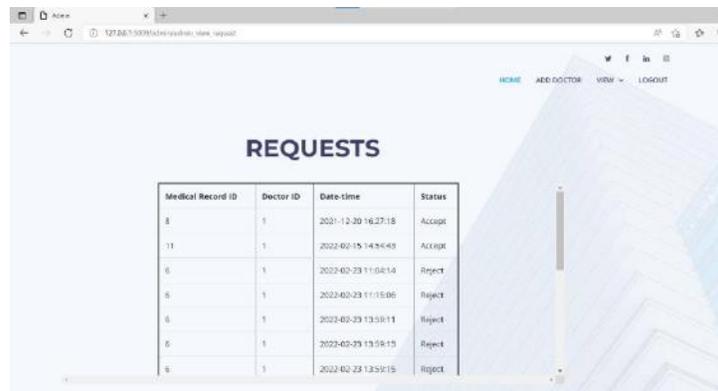


Fig 32: Accept/reject Requests

The admin confirms / rejects the appointment requests made by the patients to the other doctors.

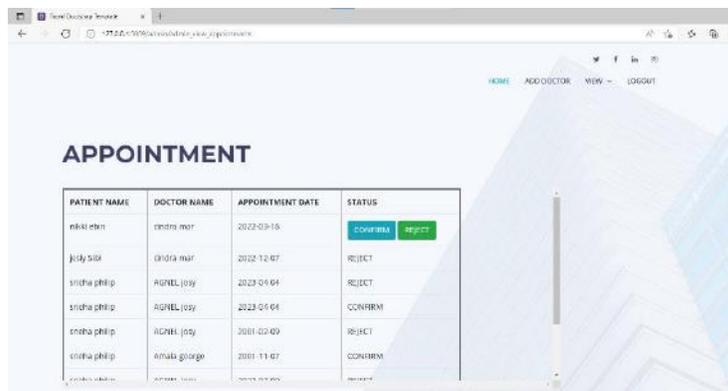


Fig 33: Accept/Reject Patient Appointment

The admin could view the complaints send by the patients and send them the reply.

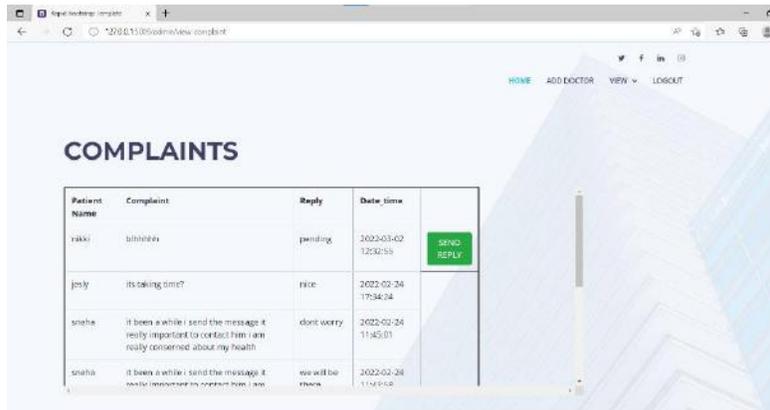


Fig 34: View and Reply to Complaints

2. PATIENT:

The patient could self-register their details in the HOME page and the SUCCESSFUL REGISTRATION message pops up.

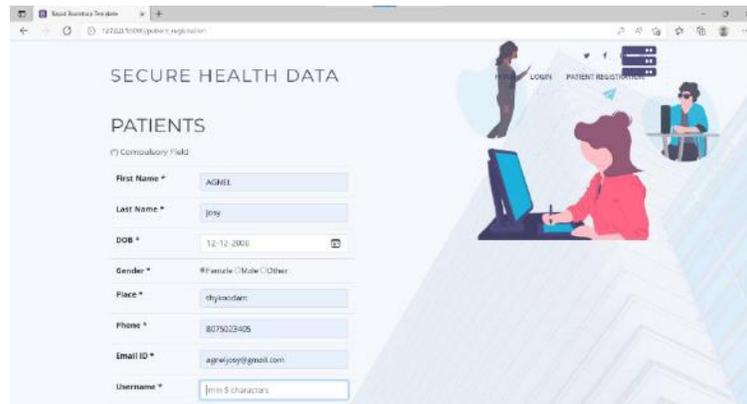


Fig 35: Patient Registration

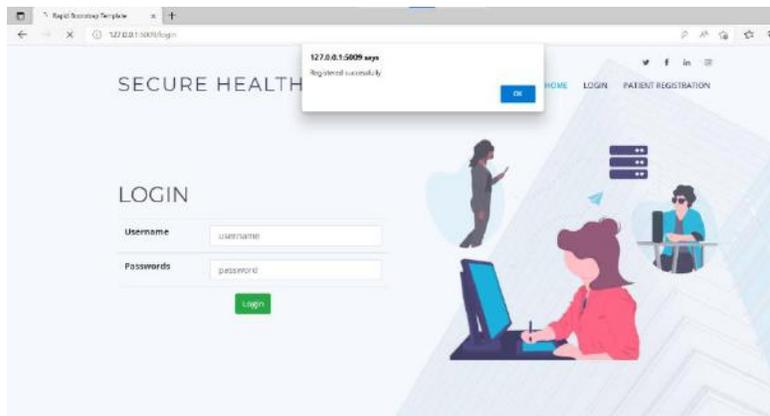


Fig 36: Registered Successfully

Upon clicking the LOGIN , the user is directed to the Login page where he enters the registered USERNAME and PASSWORD for the patient.

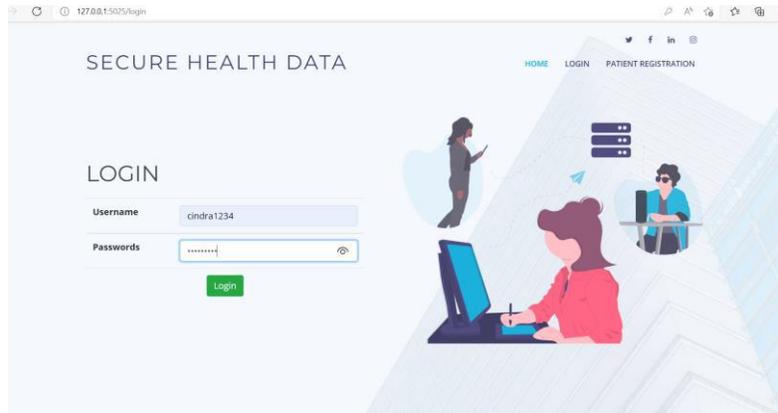


Fig 37: Patient Login

If the Login is successful, the user is requested to enter the OTP which they would receive through their mail.

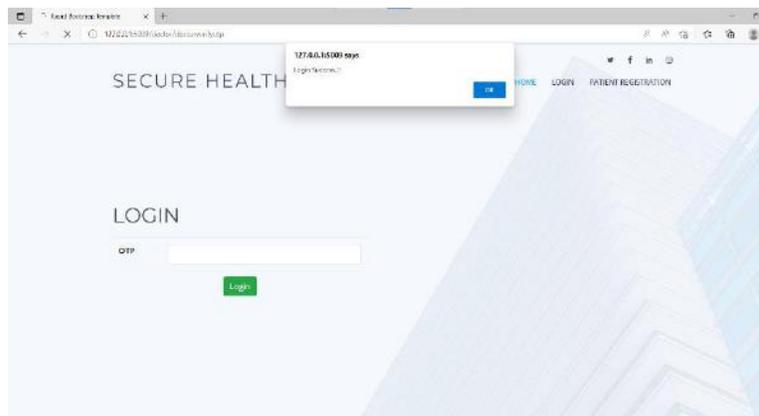


Fig 38: Login Success

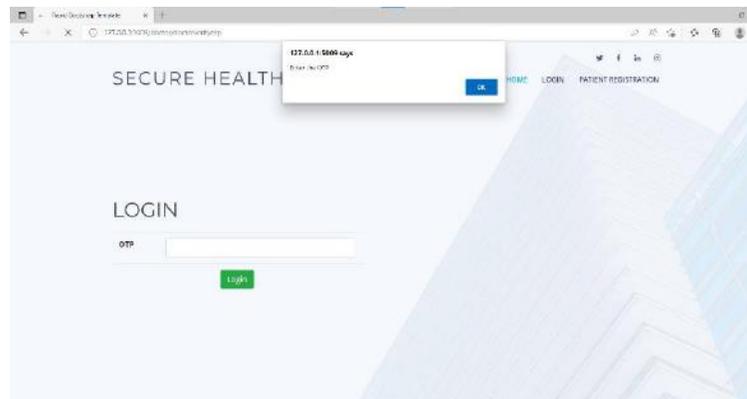


Fig 39: Enter OTP

After the correct OTP is entered, the user is directed to the PATIENT home page.



Fig 40: Patient Home Page

The patient could view the details of the doctor and make an appointment with them at the convenient time.



Fig 41: Make Appointment

The patient could send complaints to the admin and view the reply send by them.

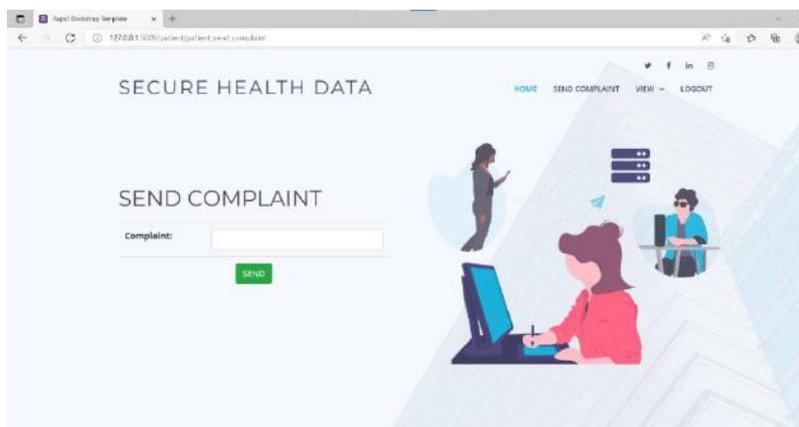


Fig 42: Send complaint to admin



Fig 43: View Complain Reply

3. DOCTOR:

Upon clicking the LOGIN , the user is directed to the Login page where he enters the registered USERNAME and PASSWORD for the doctor.



Fig 44: Doctor Login

If the Login is successful, the user is requested the enter the OTP which they would receive through their mail.

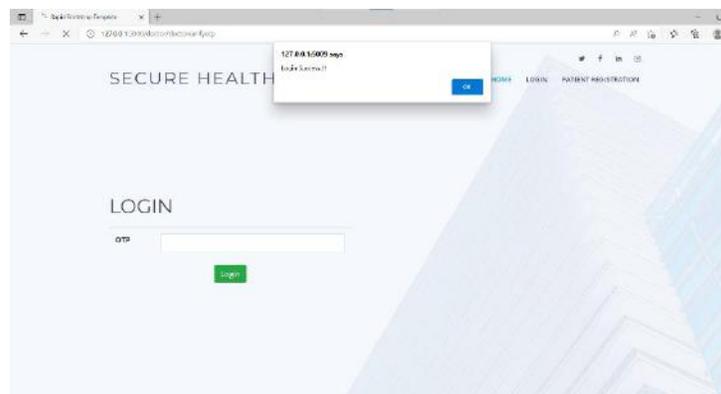


Fig 45: Login Success

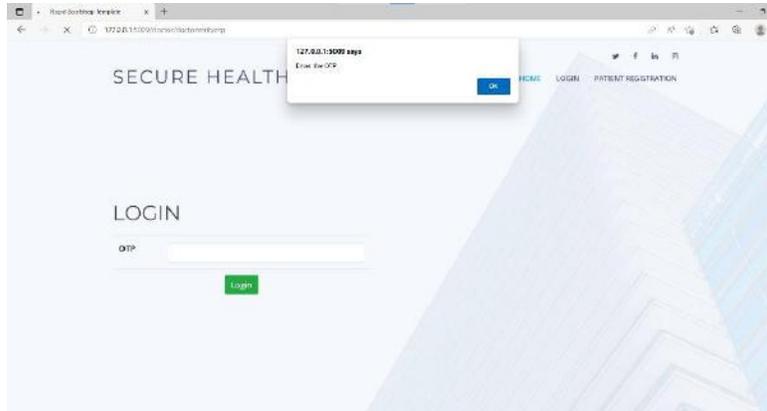


Fig 46: Enter OTP

After the correct OTP is entered, the user is directed to the DOCTOR home page.



Fig 47: Doctor Home Page

The doctor could view and download the files of the patients that belongs to him.



Fig 48: View Patient Medical records

The doctor could view the details of the other doctors and select the required doctor’s patients.



Fig 49: Send Request To view Records

The doctors could view the details of the request send by them to view the medical records.

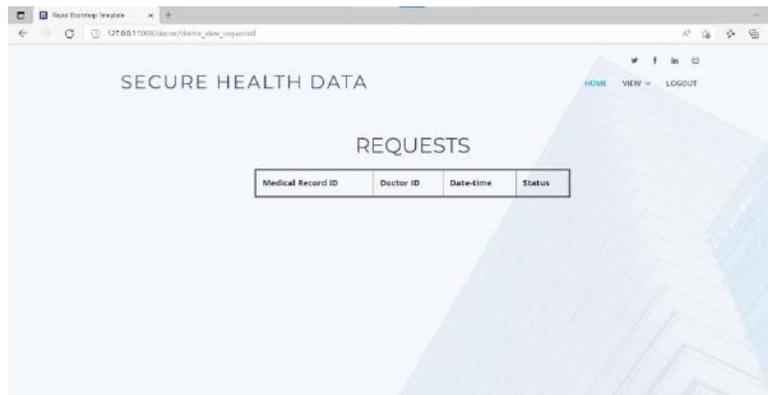


Fig 50: View Requests

The doctors could send messages to the other doctors for confirming the details of the patients or for any clarification.



Fig 51: Message doctors

CHAPTER 9

RESULT AND ANALYSIS

The findings of the proposed method in this study should be validated to check whether the proposed method is appropriate for the purpose of securing the hiding and transmission of data, as well as overcoming the identified limitations and producing the expected performance.

Moreover, the validation process will determine whether the proposed

method has achieved all the requirements in relation to the goals of this study. The validation stage for the proposed steganography method can be achieved by discussing security analysis using two types of attack; most biometric systems are prone to two types of attack, namely, spoofing and brute-force attacks.

For spoofing, we consider that an attacker spoofs the user via phishing or a similar method to access the node and then analyse the resistance of the proposed steganography method against this type of attack. For brute-force attacks, we assume that an attacker is attempting to guess the hash via brute-force attack. The general claims of this study is proposed and a novel steganography-based block chain method in spatial domain for secure updating and sharing the data of donors and patients during the transmission channels is discussed. The main claims of this study are briefly stated as follows:

1. The use of hashes when hiding secret data can secure the integrity of the data after retrieval from stego images. This steganography method is state-of-the-art given that no other has focused on the integrity of secret information within distributed hospitals after retrieval.
2. According to literature, all the previous steganography methods hide secret data in one host image (complete secret data); the proposed method divides secret data into several parts, then uses the hash as a pointer between stego images amongst hospitals. This manner of hiding makes the proposed method very difficult to break by any attacker. Moreover, the expected stego image has a high level of quality because the host image's embedding capacity is estimated before hiding the secret data (not more or less than the embedding capacity). This step provides a high level of confidentiality.
3. According to literature, stego image transmission is challenging; therefore, blockchain is used data and to eliminate the third party. Moreover, the secret data has a high level of confidentiality.

4. The proposed method has the ability to avoid network failure during disasters on the basis of used the blockchain technology. This ability ensures data availability regardless whether any single point of network has failure connection. This feature is important in terms of providing medical care services.

CHAPTER - 10

CONCLUSION

This study presents a novel method of secret medical data hiding, which can be adopted as a new framework and covert communication between hospitals with decentralised architecture when transmitting healthcare information of patients. This method can classify plasma donors and determine priority patients according to the highest emergency and plasma data to be matched with the data of tested donor CPs based on the decision matrix. In terms of secure updating and sharing, the proposed steganography method based on AES & LSB algorithm and hash function can hide secret medical data in hospital databases whilst providing confidentiality with high embedding capacity and high image quality.

FUTURE SCOPE :

Moreover, stego images with hash data and blockchain technology are used in updating and sharing medical data between hospitals in the network, to improve the level of confidentiality and ensure the protection of the integrity medical data in grey-scale images, ensure data availability regardless whether any single point of the network has a failure connection and eliminate the central point (third party) in the network during the transmission.

Overall, blockchain technology can be used to develop future electronic voting systems, which can be deployed to fulfil the principles of democratic elections. However, the privacy of public blockchains remains a critical issue because of long-term privacy concerns. The proposed method to secure the recently published framework within a hospital for the storage and transfusion of the best CP to the most critical patients on the basis of biological requirements can be simulated and implemented in the future to serve as a guide for providing healthcare services with secret data during the above-mentioned challenges and issues.

CHAPTER - 11

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CHAPTER 12

APPENDIX

Source Code

admin

```
from flask import Blueprint,render_template,request,redirect,url_for,session
from database import *
import uuid,base64
from core_blockchain import *
admin=Blueprint('admin',__name__)

@admin.route('/admin_view_doctor',methods=['get','post'])
def admin_view_doctor():
    data={ }
    q="select * from doctors"
    res=select(q)
    data['doctor']=res
    if 'action' in request.args:
        action=request.args['action']
        doctor_id=request.args['doctor_id']
    else:
        action=None
    if action=="admin_update":
        doctor_id=request.args['doctor_id']
        q="select * from doctors where doctor_id='%s'"%(doctor_id)
```

```

res=select(q)

data['doctor_update']=res

if 'submit' in request.form:

    firstname=request.form['firstname']

    lastname=request.form['lastname']

    place=request.form['place']

    phone=request.form['phone']

    email=request.form['email']

    qualification=request.form['qualification']

    q="update doctors set

first_name='%s',last_name='%s',place='%s',phone='%s',email='%s',qualification='%s' where
doctor_id='%s'"%(firstname,lastname,place,phone,email,qualification,doctor_id)

    update(q)

    return redirect(url_for('admin.admin_view_doctor'))

if action=="admin_delete":

    doctor_id=request.args['doctor_id']

    q="delete from doctors where doctor_id='%s'"%(doctor_id)

    delete(q)

    return redirect(url_for('admin.admin_view_doctor'))

return render_template('admin_view_doctor.html',data=data)

@admin.route('/admin_view_patient')

def admin_view_patient():

    data={ }

    a="select * from patients"

    res=select(a)

    data['patient']=res

    return render_template("admin_view_patient.html",data=data)

```

```
@admin.route('/view_complaint')
```

```
def view_complaint():
```

```
    data={ }
```

```
    a="select * from complaints inner join patients using(patient_id)"
```

```
    res=select(a)
```

```
    data['complaint']=res
```

```
    return render_template("view_complaint.html",data=data)
```

```
@admin.route('/view_request')
```

```
def view_request():
```

```
    data={ }
```

```
    a="SELECT *,`patients`.`first_name` AS fn,`patients`.`last_name` AS lm,`doctors`.`first_name` AS  
fname,`doctors`.`last_name` AS lname FROM requests INNER JOIN doctors USING(doctor_id) INNER  
JOIN `medical_records` USING(`medical_record_id`) INNER JOIN `patients` USING(`patient_id`)"
```

```
    res=select(a)
```

```
    data['request']=res
```

```
    return render_template("view_request.html",data=data)
```

```
@admin.route ('/admin_send_reply',methods=['get','post'])
```

```
def admin_send_reply():
```

```
    cid=request.args['cid']
```

```
    if 'submit' in request.form:
```

```
        reply=request.form['reply']
```

```
        q="update complaints set reply='%s' where complaint_id='%s'" %(reply,cid)
```

```
        update(q)
```

```
        return redirect(url_for('admin.view_complaint'))
```

```
    return render_template("admin_send_reply.html")
```

```

@admin.route('/admin_view_appointments')

def admin_view_appointments():

    data={ }

    a="SELECT *,`patients`.`first_name` AS pfirstname,`patients`.`last_name` AS
plastname,`doctors`.`first_name` AS dfirstname,`doctors`.`last_name` AS dlastname FROM `appointments`
INNER JOIN `patients` USING(patient_id) INNER JOIN `doctors` USING(doctor_id)"

    res=select(a)

    data['appointment']=res

    if 'action' in request.args:

        action=request.args['action']

        id=request.args['id']

    else:

        action=None

    if action=="CONFIRM":

        q="update appointments set status='CONFIRM' where appointment_id='%s'"%(id)

        update(q)

    if action=="REJECT":

        q="update appointments set status='REJECT' where appointment_id='%s'"%(id)

        update(q)

    return render_template("admin_view_appointments.html",data=data)

@admin.route('/admin_upload_files',methods=['get','post'])

def admin_upload_files():

    data={ }

    # doctor_id=session['did']

```

```
# print(doctor_id)

pid=request.args['pid']

q="SELECT * FROM `doctors`"
res=select(q)
data['doctor']=res

if 'submit' in request.form:
    doctor_id=request.form['doctor_id']
    patientdetails=request.files['patientdetails']
    path1="static/uploads/"+str(uuid.uuid4()+patientdetails.filename
    patientdetails.save(path1)

    healthrecords=request.files['healthrecords']
    path2="static/uploads/"+str(uuid.uuid4()+healthrecords.filename
    print("hello")
    healthrecords.save(path2)

    treatmentdetails=request.files['treatrecords']
    path3="static/uploads/"+str(uuid.uuid4()+treatmentdetails.filename
    treatmentdetails.save(path3)

    with open(path1, "rb") as imageFile1:
        data1 = base64.b64encode(imageFile1.read()).decode('utf-8')
    with open(path2, "rb") as imageFile2:
        data2 = base64.b64encode(imageFile2.read()).decode('utf-8')
    with open(path3, "rb") as imageFile3:
```

```
        data3 = base64.b64encode(imageFile3.read()).decode('utf-8')

        flash("Successfully uploaded")

        create_block(data1,data2,data3,path1,path2,path3,pid,doctor_id)

        return redirect(url_for('admin.admin_view_patient'))

q="select * from medical_records where patient_id='%s'" %(pid)
res=select(q)
print(res)
data['records']=res
return render_template("admin_upload_files.html",data=data)

@admin.route('/download')
def download():
    if "pd" in request.args:
        mid = request.args['mid']
        data = download1(mid)
        filename="static/uploads/reportedimage.jpg"
        fh1 = open(filename, "wb")
        fh1.write(base64.b64decode(data))
        fh1.close()
        file = open(filename, "rb")
        data = file.read()
        # pritrn(data)
        return Response(data,
            mimetype="text/plain",
            headers={"Content-Disposition":
                "attachment;filename=%s" % filename})
```

```
if "hr" in request.args:

    mid = request.args['mid']

    data = download2(mid)

    filename="static/uploads/reportedimage.jpg"

    fh1 = open(filename, "wb")

    fh1.write(base64.b64decode(data))

    fh1.close()

    file = open(filename, "rb")

    data = file.read()

    # pritrn(data)

    return Response(data,

                    mimetype="text/plain",

                    headers={"Content-Disposition":

                            "attachment;filename=%s" % filename})

if "tr" in request.args:

    mid = request.args['mid']

    data = download3(mid)

    filename="static/uploads/reportedimage.jpg"

    fh1 = open(filename, "wb")

    fh1.write(base64.b64decode(data))

    fh1.close()

    file = open(filename, "rb")

    data = file.read()

    # pritrn(data)

    return Response(data,

                    mimetype="text/plain",

                    headers={"Content-Disposition":
```

```
"attachment;filename=%s" % filename}))
```

```
@admin.route('/admin_view_request')
```

```
def admin_view_request():
```

```
    data={}
```

```
    # did=session['did']
```

```
    a="select * from requests where medical_record_id in (select medical_record_id from  
medical_records)"
```

```
    res=select(a)
```

```
    data['request']=res
```

```
    if 'action' in request.args:
```

```
        action=request.args['action']
```

```
        rid=request.args['rid']
```

```
    else:
```

```
        action=None
```

```
    if action=="accept":
```

```
        q="update requests set status='Accept' where request_id='%s'"%(rid)
```

```
        update(q)
```

```
    if action=="reject":
```

```
        q="update requests set status='Reject' where request_id='%s'"%(rid)
```

```
        update(q)
```

```
    return render_template("admin_view_request.html",data=data)
```

```
@admin.route('/admin_logout')
```

```
def admin_logout():
```

```
    if not session['lid'] is None:
```

```
return redirect(url_for('public.firstpage'))
```

```
else:
```

```
return redirect(url_for('admin.admin_home'))
```

core blockchain

```
from flask import *
```

```
import uuid
```

```
import smtplib
```

```
import hashlib
```

```
from database import *
```

```
import datetime
```

```
import codecs
```

```
import base64
```

```
import Crypto
```

```
from Crypto.Cipher import AES
```

```
from Crypto import Random
```

```
from sample import *
```

```
BLOCK_SIZE = 16
```

```
pad = lambda s: s + (BLOCK_SIZE - len(s) % BLOCK_SIZE) * chr(BLOCK_SIZE - len(s) %  
BLOCK_SIZE)
```

```
unpad = lambda s: s[:-ord(s[len(s) - 1:])] 
```

```
def get_hashed_value(previous_hash, data):
```

```
    header_bin = (str(previous_hash) + "" + str(data))
```

```
inner_hash = hashlib.sha256(header_bin.encode()).hexdigest().encode()

outer_hash = hashlib.sha256(inner_hash).hexdigest()

return outer_hash
```

```
def create_block(data1,data2,data3,path1,path2,path3,pid,did)

    q = "SELECT * FROM block_chain ORDER BY block_id DESC LIMIT 1"

    print(q)

    res = select(q)

    new_hash = 0

    previous_hash = 0

    time_stamp = datetime.datetime.now()

    if res:

        previous_hash = res[0]['block_hash']

    new_hash = get_hashed_value(previous_hash, time_stamp)

    password = "9874RRMFM"

    datas1 = encrypt(data1, password).decode('utf-8')

    datas2 = encrypt(data2, password).decode('utf-8')

    datas3 = encrypt(data3, password).decode('utf-8')

    # //////////////////////////////////////

    unique = str(uuid.uuid4())

    details1=secure_filename(unique + "." + path1.split(".")[-1])

    filename1 = "static/encrypted/" + details1

    print(details1)

    fh = open(filename1, "wb")

    fh.write(base64.b64decode(datas1))

    fh.close()
```

```

cloud_upload(r""+filename1)

# //////////////////////////////////////

# //////////////////////////////////////

unique = str(uuid.uuid4())

details2=secure_filename(unique + "." + path2.split(".")[1])

filename2 = "static/encrypted/" + details2

print(details2)

fh = open(filename2, "wb")

fh.write(base64.b64decode(datas2))

fh.close()

cloud_upload(r""+filename2)

# //////////////////////////////////////

# //////////////////////////////////////

unique = str(uuid.uuid4())

details3=secure_filename(unique + "." + path3.split(".")[1])

filename3 = "static/encrypted/" + details3

print(details3)

fh = open(filename3, "wb")

fh.write(base64.b64decode(datas3))

fh.close()

cloud_upload(r""+filename3)

# //////////////////////////////////////

z="insert into medical_records values(null,'%s','%s',(select first_name from doctors where
doctor_id='%s'),'%s','%s','%s','%s',now())"%(pid,did,did,filename1,filename2,filename3,password)

insert(z)

q='INSERT into block_chain values(null, "%s", "%s", "%s", "%s", "%s", "%s", "%s",
"%s")'%(new_hash, details1,details2,details3, previous_hash, did,pid, time_stamp)

print(q)

```

```
insert(q)
```

```
return "success"
```

```
def download1(mid):
```

```
q = "select * from medical_records where medical_record_id = '%s'" %(mid)
```

```
print(q)
```

```
res = select(q)
```

```
key = res[0]['key']
```

```
print(res[0]['patient_details'])
```

```
with open(res[0]['patient_details'], "rb") as imageFile:
```

```
data = base64.b64encode(imageFile.read()).decode('utf-8')
```

```
data = decrypt(data,key)
```

```
return data
```

```
def download2(mid):
```

```
q = "select * from medical_records where medical_record_id = '%s'" %(mid)
```

```
print(q)
```

```
res = select(q)
```

```
key = res[0]['key']
```

```
print(res[0]['health_records'])
```

```
with open(res[0]['health_records'], "rb") as imageFile:
```

```
data = base64.b64encode(imageFile.read()).decode('utf-8')
```

```
# data= file.read()
```

```
data = decrypt(data,key)
```

```
return data
```

```
def download3(mid):
```

```
q = "select * from medical_records where medical_record_id = '%s'" %(mid)
```

```
print(q)
```

```
res = select(q)
key = res[0]['key']
print(res[0]['treatment_records'])
with open(res[0]['treatment_records'], "rb") as imageFile:
    data = base64.b64encode(imageFile.read()).decode('utf-8')
data = decrypt(data,key)
return data
```

```
def temp_function():
```

```
    data = "sreejesh"
    password = "9874RRMFM"
    enc = encrypt(data, password)
    print(enc)
    enc = enc.decode('utf-8')
    print(enc)
```

```
def encrypt(data, password):
```

```
    private_key = hashlib.sha256(password.encode("utf-8")).digest()
    raw = pad(data)
    iv = Random.new().read(AES.block_size)
    cipher = AES.new(private_key, AES.MODE_CBC, iv)
    return base64.b64encode(iv + cipher.encrypt(raw))
```

```
def decrypt(enc, password):
```

```
    private_key = hashlib.sha256(password.encode("utf-8")).digest()
    enc = base64.b64decode(enc)
    iv = enc[:16]
```

```
cipher = AES.new(private_key, AES.MODE_CBC, iv)
return unpad(cipher.decrypt(enc[16:]))
```

cloud(sample)

```
import sys
from boto.s3.key import Key
import boto
import boto.s3
import ast
import os

from flask.globals import request

from werkzeug.utils import secure_filename
from flask import Flask, jsonify

AWS_ACCESS_KEY_ID = 'AKIAVTA624LZNEGZPSAQ'
AWS_SECRET_ACCESS_KEY = 'nRF9IOBROOhBQmAmkFc+xq9e6oR1BPiBeXgKteRV'

def cloud_down( fname,sname):
    bucket_name = 'samplebucket1riit'
    conn = boto.connect_s3(AWS_ACCESS_KEY_ID, AWS_SECRET_ACCESS_KEY)

    bucket = conn.create_bucket(bucket_name, location=boto.s3.connection.Location.DEFAULT)
    key = bucket.get_key(fname)
    key.get_contents_to_filename(sname)
```


Data duplication

```
import os

from CustomHash import encrypt,decrypt,create_key

from flask import current_app as app

from werkzeug.utils import secure_filename

from database import *

import hashlib

import base64

import uuid

from shutil import copyfile

from datetime import datetime,timedelta

def create_tag(data):

    tag = hashlib.sha512(hashlib.sha512(data.encode("ascii")).hexdigest().encode("ascii")).hexdigest()

    return tag

def upload(data,name,pid,did,title,uby):

    # print(data)

    unique = str(uuid.uuid4())

    details=secure_filename(unique + "." + name.split(".")[1])

    filename = "static/medical_reports/" + details

    print(filename)

    filenameess = "static/duplicates/" + details

    print(filenameess)

    key = None

    key = str(create_key())
```

```
print(key)

enc_text = encrypt(data, key)

fh = open(filename, "wb")

fh.write(base64.b64decode(enc_text))

fh.close()

fh = open(filename, "wb")

fh.write(base64.b64decode(enc_text))

fh.close()

# q="update filedownload set status='downloaded' where file_id='%s'" %(fid)

# print("dgdghdgh",q)

# update(q)

q="INSERT INTO
`medical_records`(`patient_id`,`doctor_id`,`uploaded_by`,`file`,`date_time`,`key`,`title`)VALUES('%s','%s','
%s','%s',NOW(),'%s','%s')"%(pid,did,uby,filename,key,title)

id=insert(q)

with open("static/check."+name.split(".")[-1], "rb") as imageFile:

    datas = base64.b64encode(imageFile.read()).decode('utf-8')

filenames="static/duplicates/"+str(uuid.uuid4())+"."+name.split(".")[-1]

fh1 = open(filenames, "wb")

fh1.write(base64.b64decode(datas))

fh1.close()

q="insert into duplicates values(null,'%s','%s','%s')" %(id,filenames,filenamess)

insert(q)

q="insert into shared values(null,'%s','%s')" %(id,did)

insert(q)
```

```
created = True
```

```
return True
```

```
def restore(file_id):
```

```
    q = "select * from duplicates where file_id='%s'" % (file_id)
```

```
    result = db.select(q)
```

```
    # filename = result[0]['dup_filename']
```

```
    with open(filename, "rb") as imageFile:
```

```
        data = base64.b64encode(imageFile.read()).decode('utf-8')
```

```
    delete_file(filename)
```

```
    q = "delete from duplicates where dup_filename='%s' and emp_id='%s'" % (filename,emp_id)
```

```
    db.delete(q)
```

```
    q = "select * from file where file_id='%s'" % file_id
```

```
    result = db.select(q)
```

```
    key = result[0]['key']
```

```
    # data = decrypt(data,key)
```

```
    filename = result[0]['filename']
```

```
    return upload(data,filename,emp_id)
```

```
def download(mid):
```

```
    q = "select * from medical_records where medical_record_id = '%s'" % (mid)
```

```
    print(q)
```

```
    res = select(q)
```

```
    key = res[0]['key']
```

```
# file = open(res[0]['file'], "rb")
print(res[0]['file'])
with open(res[0]['file'], "rb") as imageFile:
    data = base64.b64encode(imageFile.read()).decode('utf-8')
# data= file.read()
data = decrypt(data,key)
return data
```

```
def del_all_exp_files():
```

```
    date = (datetime.today() - timedelta(days=7)).strftime('%Y-%m-%d')
    q = "select * from file inner join duplicates using(file_id) where date < '%s'" % date
    res = db.select(q)
    ids = []
    for row in res:
        ids.append(str(row['dup_id']))
        delete_file(row['dup_filename'])

    q = "delete from duplicates where dup_id in %s" % ("+", ".join(ids)+")"
    return db.update(q)
```

```
def get_all_exp_files():
```

```
    date = (datetime.today() - timedelta(days=7)).strftime('%Y-%m-%d')
    q = "select * from file inner join duplicates using(file_id) where date < '%s'" % date
    return db.select(q)
```

```
def delete(file_id):
```

```
    q = "select * from file where file_id='%s'" % file_id
```

```
res = db.select(q)
file_path = res[0]['file_path']
delete_file(file_path)
q = "delete from file where file_id='%s'" % file_id
db.delete(q)
```

```
def delete_file(filename):
    if os.path.exists(filename):
        os.remove(filename)
```


Project Report

On

STUDY ON ALGEBRAIC GRAPH THEORY

Submitted

in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE

in

MATHEMATICS

by

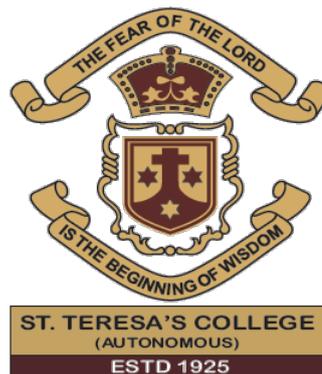
AGNES P VARGHESE

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(2020-2022)

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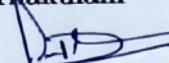


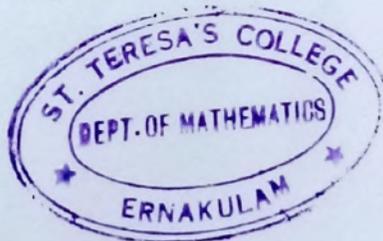
CERTIFICATE

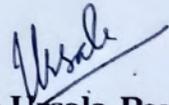
This is to certify that the dissertation entitled, **STUDY ON ALGEBRAIC GRAPH THEORY** is a bonafide record of the work done by Ms. **AGNES P VARGHESE** under my guidance as partial fulfillment of the award of the degree of **Master of Science in Mathematics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

Date : 26.5.2022

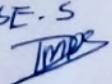
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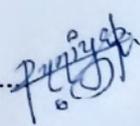

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DECLARATION

I hereby declare that the work presented in this project is based on the original work done by me under the guidance of **MRS. DHANALAKSHMI O.M.**, Assistant Professor, Department of Mathematics, St. Teresa's College(Autonomous), Ernakulam and has not been included in any other project submitted previously for the award of any degree.

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SM20MAT001

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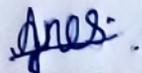
I am extremely thankful to the head of our department, DR.URSALA PAUL for her valuable suggestions, critical examination of my work during the progress.

I am grateful to the teaching and non-teaching staff of Mathematics department, my parents and friends and all those who has given me the moral support and helped me to complete my project and made this venture a success.

I would like to express my sincere thanks to GOD ALMIGHTY, for his constant love and grace that he has showered upon me .I extend my pleasure to him for providing me with all the convenience and strength to undertake and complete this project.

Place : Ernakulam

Date: 26.5.2022


AGNES P VARGHESE
SM20MAT001

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Chapter 1

INTRODUCTION AND HISTORICAL OUTLINE

1.1 INTRODUCTION

Graph theory is one of the newly emerging field in mathematics that has a notable application. Algebraic graph theory is one of the multidimensional branches of Mathematics enriched with many interesting problems. It is one of the most explored and fastest emerging fields in mathematics, with numerous opportunities for research. In the last several decades, in investigating complex graph structures algebraic techniques are being increasingly used. It is an interesting subject concerned with the interplay between algebra and graph theory. Here algebraic techniques are used in the study and explaining problems about graphs. The main aim is to translate the properties of graphs into algebraic properties and then using the results and methods of algebra, deduce the theorems about graphs. There are many interesting algebraic objects associated with graphs, also one can give interesting and elegant proofs of graph theoretic facts using algebraic tools. The literature of algebraic graph theory itself has developed enormously. The problems about graphs is in contrast to geometric, combinatoric, or algorithmic approaches. There are three main branches of algebraic graph theory.

(i) USING LINEAR ALGEBRA:

This is the first branch of algebraic graph theory that involves the study of graphs in connection with linear algebra. It mainly deals with the study of the spectrum

of the adjacency matrix, or the Laplacian matrix of a graph. This part of algebraic graph theory is also called spectral graph theory.

(ii) USE OF GROUP THEORY:

This is the second branch of algebraic graph theory. It involves the study of graphs in connection to group theory, particularly automorphism groups and geometric group theory. The main focus is placed on the various families of graphs based on its symmetry such as symmetric graphs, vertex transitive graphs, edge transitive graphs, etc.

(iii) STUDY OF GRAPH INVARIANTS:

This is the third branch of algebraic graph theory that concerns with the algebraic properties of invariants of graphs especially the knot invariants and chromatic polynomial.

There are two main connections between Algebra and Graph Theory. These arise from two algebraic objects associated with a graph; its Adjacency matrix and Automorphism group they are related. The automorphism group can be regarded as a collection of all permutation matrices that commute with the adjacency matrix. However the two connections involve different algebraic techniques - Linear algebra and group theory.

Linear algebra is a branch of mathematics concerning linear equations and linear functions and their representations through matrices and vector spaces. Linear algebra fundamental in modern presentations of geometry.

In mathematics, group theory learns the algebraic structures known as groups. The method of group theory have influenced many parts of algebra. Linear algebraic groups and lie groups are two branches of group theory that have experienced advances.

Graph theory is the study of graph which are mathematical structures used to model pair wise relations between objects. A graph in this context is made up of vertices, nodes or points which are connected by edges, arcs or lines. Graphs are one of the prime objects. This project is divided into five chapters:

CHAPTER 1

This chapter introduces us with a brief note on what is algebraic graph theory and history of graph theory.

CHAPTER 2

This chapter includes the basic definitions, terminology and notations of graph theory and linear algebra which are needed for the subsequent chapters. Also some pre-requisite about Protein structure and Thalassemia as they are needed.

CHAPTER 3

In this chapter we discuss the use of linear algebra in graph theory for the sake of convenience and standardization. This is the first branch of algebraic graph theory that concerns with the study of graphs in connection with linear algebra. Especially it studies the spectrum of adjacency matrix or Laplacian matrix of a graph.

CHAPTER 4

This chapter deals with the Laplacian matrix of a graph and its properties. Also an alternative approach is explored.

CHAPTER 5

In this chapter we discuss about the applications of algebraic graph theory. And some of the applications of algebraic graph theory are briefly described and highlighted.

1.2 HISTORY

The story begins in the 18th century in the city of Konigsberg which was located on the Pregal River in Prussia. The river divided the city into four land masses including the island of Kneiphopf. And these four regions were linked by seven bridges. These seven bridges are termed as Blacksmith's bridge, Connecting bridge, Green bridge, Merchant's bridge, Wooden bridge, High bridge and Honey bridge. During Sunday afternoons, the citizens of Konigsberg used to walk around their beautiful city. While walking around their beautiful city, they decided to create a game for

themselves. The goal was starting from one land mass they have to cross each of the seven bridges exactly once and come back to starting place. None of the citizens of Königsberg were able to find out a route that would allow them to cross each of the seven bridges exactly once.

Several mathematical studies were done on this problem. Then a Swiss mathematician Leonhard Euler thought about this problem. And on 26th August 1735, Euler presented a paper containing the solution to the Königsberg bridge problem. He addressed this specific problem, as well as a general solution was given i.e. with any number of land masses and any number of bridges a solution is possible and concluded that there is no solution to Königsberg Bridge Problem. But we could only solve it if either all the vertices in the graph were even, or if only two of the vertices were odd. This paper was later published in 1741. The method he used to solve this problem is considered to be the birth of graph theory.

Then for a few years no further studies were carried out. Later a study of electrical networks was done. The theory of graphs and their associated matrices shared a long rich synergy and joint development. Starting from the foundational classical work by G. Kirchhoff's modelling and analysis of electric circuits, motivated the birth and the further development of a wide range of graph-theoretical concepts and a certain classes of matrices.

And in 1857, Cayley discovered in the very natural setting of organic chemistry an important class of graphs called trees. He was engaged in enumerating the isomers of the saturated hydrocarbons C_nH_{2n+2} , with a given number n of carbon atoms.

Then the Four Colour Theorem. This is the most famous problem in graph theory and perhaps in all of mathematics is the celebrated four color conjecture. The problem is any map on a plane or the surface of a sphere can be colored with only four colors so that no two adjacent countries have the same color. Each country must consist of a single connected region and adjacent countries are those having a boundary line common. This is a remarkable problem that can be explained by any mathematician to the so called man in the street in five minutes. But at the end of the explanation, both will understand the problem, but neither will be able to solve it.

Chapter 2

PRELIMINARIES

2.1 PRE-REQUISITE ABOUT GRAPH THEORY

2.1.1 Basic Definitions

GRAPH

A Graph is an ordered triple $G = (V(G), E(G), I_G)$, where $V(G)$ is a non empty set , $E(G)$ is a set disjoint from $V(G)$ and I_G is an incidence relation that associates with each element of $E(G)$ an unordered pair of elements of $V(G)$.

Elements of $V(G)$ are called the vertices (or nodes or points) of G and elements of $E(G)$ are called the edges (or lines) of G . $V(G)$ and $E(G)$ are the vertex set and edge set of G respectively. $n(G)$ and $m(G)$ are the number of vertices and edges of the graph G respectively. The number $n(G)$ is called the order of G and $m(G)$ is the size of G .

LOOP

An edge having same end points is called a loop.

MULTIPLE OR PARALLEL EDGES

A set of two or more edges of a graph G is called a set if multiple or parallel edges if they have the same pair of distinct ends.

ADJACENT EDGE

The vertices u and v are adjacent to each other in G if and only if there is an edge of G with u and v as its ends.

ADJACENT VERTEX

Two distinct edges e and f are said to be adjacent if and only if they have a common end vertex.

SIMPLE GRAPH

A graph G is called simple if it has no loops and no multiple edges.

FINTITE GRAPH

A graph is called finite if both $V(G)$ and $E(G)$ are finite.

INFINITE GRAPH

A graph that is not finite is called an infinite graph.

DEGREE OF VERTEX (also called Valency)

Let G be a graph and $v \in V$. The number of edges incident at v in G is called the degree (or valency) of the vertex v in G and is denoted by $d_G(v)$ or simply $d(v)$.

ISOMORPHISM OF GRAPHS

Let $G = (V(G), E(G), I_G)$ and $H = (V(H), E(H), I_H)$ be two graphs.

A graph isomorphism from G to H is a pair (ϕ, θ) where $\phi: V(G) \rightarrow V(H)$ and $\theta: E(G) \rightarrow E(H)$ are bijections with the property that $I_G(e) = \{u, v\}$ if and only if $I_H(\theta(e)) = \{\phi(u), \phi(v)\}$.

If (ϕ, θ) is a graph isomorphism, the pair of inverse mappings (ϕ^{-1}, θ^{-1}) is also a graph isomorphism.

BIPARTITE GRAPH

If the vertex set of a graph G can be partitioned into two non-empty subsets X and Y such that each edge has one end in X and other end in Y . The pair (X, Y) is called a bipartition of the bipartite graph.

The most important property of bipartite graphs is that they are the graphs that contain no cycles of odd length. The complete bipartite graph $K_{p,q}$ is the $p \times q$ bipartite graph in which each vertex is adjacent to all those in the other partite set.

COMPLETE GRAPH

A graph G is called complete if every pair of distinct vertices of G are adjacent in G and the complete graph on n vertices is denoted by K_n .

A complete bipartite graph of the form $K_{1,q}$ is called a star.

DEGREE SEQUENCE

A sequence formed by the degrees of the vertices of G is called a degree sequence of G .

DIRECTED GRAPH

A directed graph is a graph in which the edges are directed by arrows.

DEGREE SEQUENCE

A sequence of non-negative integers $d = (d_1, d_2, \dots, d_n)$ is called graphical if there exists a simple graph whose degree sequence is d .

WALK

A walk in a graph G is an alternating sequence of vertices and edges beginning and ending with vertices in which v_{i-1} and v_i are the ends of e_i .

PATH

A walk is called a path if all the vertices in the walk are distinct.

CYCLE

A cycle is a closed trail in which the vertices are all distinct.

TREE

A tree is a connected graph that has no cycles. They have been characterized in many ways, a few of which are listed below. For a graph G of order n :

- G is connected and has no cycles.
- G is connected and has $n-1$ edges.
- G has no cycles and has $n-1$ edges.
- Any graph without cycles is a forest

NOTES:

- If G is a graph with maximum degree Δ that is neither an odd cycle nor a complete graph, then $\chi(G) \leq \Delta(G)$.
- A graph G is bipartite if and only if it contains no odd cycles.
- The sum of the degrees of the vertices of a graph is equal to twice the number of its edges.

2.2 PRE-REQUISITE ABOUT LINEAR ALGEBRA

SQUARE MATRIX

An $m \times n$ matrix consist of mn real numbers arranged in m rows and n columns. An $m \times n$ matrix is called a square matrix if $m = n$. Let A be a square matrix of order n . The entries $a_{11}, a_{22}, \dots, a_{nn}$ are said to constitute the diagonal of A . The trace of A is defined as, $\text{Trace } A = a_{11} + a_{22} + \dots + a_{nn}$

\implies A zero matrix 0 is a matrix in which each entry is 0 .

\implies A square matrix A is symmetric if $A^T = A$

MINOR OF A MATRIX

A minor of a matrix A is the determinant of some smaller square matrix, cut down from A by removing one or more of its rows or columns.

A minor of A of order k is principal if it is obtained by deleting $n-k$ rows and $n-k$ columns with the same numbers.

DEFINITION 2.2.1

If A is a square matrix then the determinant $\det (A - \lambda I)$ is a polynomial in the variable λ of degree n and is called the characteristic polynomial of A . The equation $\det (A - \lambda I) = 0$ is called the characteristic equation of A . By the fundamental theorem of algebra the equation has n complex roots and these roots are called the eigenvalues of A .

The set of eigenvalues is the spectrum of A . The eigenvalues might not all be distinct. The number of times an eigenvalue occurs as a root of the characteristic equation is called the algebraic multiplicity of the eigenvalue.

If $\lambda_1, \lambda_2, \dots, \lambda_n$ are the eigenvalues of A , then $\det A = \lambda_1 \lambda_2 \dots \lambda_n$ while $\text{trace } A = \lambda_1 + \lambda_2 + \dots + \lambda_n$

A principal submatrix of a square matrix is a submatrix formed by a set of rows and the corresponding set of columns.

A principal minor of A is the determinant of a principal submatrix. The sum of the products of the eigenvalues of A , taken k at a time, equals the sum of the $k \times k$ principal minors of A . When $k = I$ this reduces to the familiar fact that the sum of the eigenvalues equals the trace. The Cayley Hamilton theorem states that every matrix satisfies its characteristic equation.

DEFINITION 2.2.2

An $n \times n$ matrix A is said to be positive definite if it is symmetric and if for any nonzero vector x , $x^T Ax \geq 0$. The identity matrix is clearly positive definite, then the following conditions is equivalent to A being positive definite :

- 1) The eigenvalues of A are positive.
- 2) All principal minors of A are positive.

2.3 PRE-REQUISITE OF PROTEIN STRUCTURE

Proteins are macro molecules found in the cells that play many critical roles in the body. They do most of the work in cells and are required for all metabolic activities in an organism. Proteins are made up of smaller sub units called amino acids, which are attached to one another by peptide bond to form long polypeptide chains. There are about 20 types of amino acids that can be combined to make a protein. The sequence of amino acids determines the structure of proteins. Protein exist in four different structures such as primary, secondary, tertiary and quaternary.

2.4 PRE-REQUISITE ABOUT THALASSEMIA

Thalassemia is an inherited blood disorder in which the body makes an abnormal form of haemoglobin and have less haemoglobin than normal. Haemoglobin is the protein molecule in red blood cells that carries oxygen. A person with Thalassemia can become anaemic and fatigued due to the excessive destruction of red blood cells. Anemia is a condition in which your body doesn't have enough normal, healthy red blood cells.

Thalassemia is inherited, in the sense that at least one of your parents must

be a carrier of the disorder. It's caused by either a genetic mutation or a deletion of certain key gene fragments. A person with mild Thalassemia might not need treatment since it is a less serious form of the disorder.

There are two main forms of Thalassemia that are more serious. They are:

(i) Alpha Thalassemia:

In Alpha Thalassemia, at least one of the alpha globin genes has a mutation or abnormality.

(ii) Beta Thalassemia:

In Beta Thalassemia, the beta globin genes are affected. Each of these forms of Thalassemia has different subtypes.

But the severe forms might require bone marrow transplant or regular blood transfusions or continuous medications and supplements. But this is not a permanent cure. These are only just precautions to suppress the disease.

Chapter 3

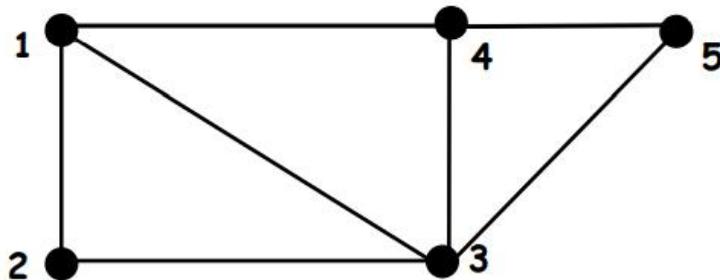
LINEAR ALGEBRA IN GRAPH THEORY

DEFINITION 3.1 : ADJACENCY MATRIX

An adjacency matrix is a means of representing which vertices (nodes) of a graph are adjacent to which other vertices.

Let G be a graph with $V(G) = \{v_1, v_2, \dots, v_n\}$ and $E(G) = \{e_1, e_2, \dots, e_n\}$. The adjacency matrix of G , denoted by $A(G)$, is the $n \times n$ matrix, whose entries a_{ij} are given by,

$$a_{ij} = \begin{cases} 1, & \text{if } v_i \text{ and } v_j \text{ are adjacent} \\ 0, & \text{otherwise} \end{cases}$$



$$A(G) = \begin{pmatrix} 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 \end{pmatrix}$$

Here we can see that the diagonal of an adjacency matrix of the graph G contains only zeros because there are no self-loops. Remember that our graphs have no multiple edges or loops. This causes the trace of the adjacency matrix, denoted by $\text{tr}(A)$, the sum of its main diagonal, to be zero. Also, when $A(G)$ represents a graph, it is symmetric matrix and all of the elements are non-negative. In other words, $a_{ij} = a_{ji}$.

Thus we can say A is a symmetric matrix with zeros on the diagonal and that the trace of A is zero.

LEMMA 3.2:

Let G be a connected graph with vertices $1, 2, \dots, n$ and let A be the adjacency matrix of G . If i, j are the vertices of G with $d(i, j) = m$, then the matrices I, A, \dots, A^m are linearly independent.

DEFINITION 3.3 : SPECTRUM OF A GRAPH

The spectrum of a graph G is the set of numbers which are eigenvalues of $A(G)$, together with their multiplicities of $A(G)$. If the distinct eigenvalues of $A(G)$ are $\lambda_0 \geq \lambda_1 \dots \geq \lambda_{s-1}$ and their multiplicities are $m(\lambda_0), m(\lambda_1), \dots, m(\lambda_{s-1})$, then we shall write

$$\text{Spec } G = \left(\begin{array}{ccc} \lambda_0, \lambda_1 \dots & & \lambda_{s-1} \\ m(\lambda_0), m(\lambda_1) \dots & & m(\lambda_{s-1}) \end{array} \right)$$

DEFINITION 3.4 : ADJACENCY ALGEBRA

The adjacency algebra of a graph G is the algebra of polynomials in the adjacency matrix $A(G)$. We shall denote the adjacency algebra of G by $A(G)$. Since every element of the adjacency algebra is a linear combination of powers of A , we can obtain results about $A(G)$ from a study of these powers. We already a walk of length l in G , joining v_1 to v_p to be a finite sequence of vertices of G . $v_i = u_0, u_1, \dots, u_l = v_p$ such that u_{i-1} and u_i are adjacent for $1 \leq i \leq l$

DEFINITION 3.5 : CHARACTERISTIC POLYNOMIAL

If A is a square matrix then the $\det(A - \lambda I)$ is a polynomial in the variable of

degree n and is called the characteristic polynomial of A . The equation $\det(A - \lambda I) = 0$ is called the characteristic equation of A . By the fundamental theorem of algebra the equation has n complex roots and these roots are called the eigenvalues of A . The set of eigenvalues is the spectrum of A . The eigenvalues might not all be distinct. The number of times an eigenvalue occurs as a root of the characteristic equation is called the algebraic multiplicity of the eigenvalue.

DEFINITION 3.6 : EIGEN VALUES AND WALKS

The oldest, and perhaps the most fundamental, relationship between the eigenvalues of a graph and its geometric properties concerns walks – particularly, closed walks. Suppose that A is the adjacency matrix of a graph. Then the powers of A enumerate the walks in that graph.

DEFINITION 3.7 : EIGEN VALUES AND LABELLINGS OF GRAPHS

The columns of the adjacency matrix A correspond to the vertices of the graph. If A acts on a vector x , then the entries of that vector can have the same correspondence, so a vector may be used to label the vertices. When we use an eigenvector, the eigenvalues will reflect the geometric structure of the graph.

DEFINITION 3.8 : COSPECTRAL

Two non isomorphic graphs are said to be cospectral if they have the same eigenvalues with the same multiplicities. Two methods are used for the construction of cospectral graphs. One uses operations on graphs (Complements, Product etc) to produce new cospectral ones, while the other logically pastes different graphs together.

One easy way to construct cospectral graph is due to Hoffman. Take two non isomorphic graphs G_1 and G_2 , and consider the graph formed by taking k copies of G_1 and $s-k$ copies of G_2 . Let H_k be the complement of this graph. The graphs H_k ($k = 0, 1, \dots, s$) are cospectral. Thus we can have arbitrarily large sets of non isomorphic cospectral graphs.

A second method of constructing cospectral graphs is by pasting smaller graphs together. One way is to take two graphs, G and H , designate a special vertex in each of them and let it be u and w . We denote this new graph by G, H . Then find

the characteristics polynomials of G and H . If the characteristic polynomials are equal the two graphs G and H are cospectral.

DEFINITION 3.9 : *ALGEBRAIC MULTIPLICITY*

The algebraic multiplicity of an eigenvalue is the number of times that the value occurs as a root of the characteristic polynomial.

DEFINITION 3.10 : *GEOMETRIC MULTIPLICITY*

The geometric multiplicity is the dimension of the eigenspace, or the subspace spanned by all of the eigenvectors.

THEOREM 3.11: *MATRIX TREE THEOREM*

Let H is a subgraph of G if $V(H) \subset V(G)$ and $E(H) \subset E(G)$. A subgraph H of G is a spanning subgraph of G if $V(H) = V(G)$. Hence, a spanning subgraph of G is obtained by deleting some of the edges of G but keeping all vertices. If H is a spanning subgraph of G and H is a tree then we say that H is a spanning tree of G .

Chapter 4

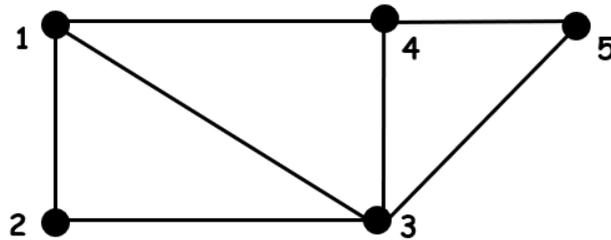
LAPLACIAN MATRIX OF A GRAPH

4.1 DEFINITIONS

The Laplacian is an alternative to the adjacency matrix for describing the adjacent vertices of a graph. Let G be a graph with $V(G) = \{v_1, v_2, \dots, v_n\}$ and $E(G) = \{e_1, e_2, \dots, e_m\}$. The Laplacian matrix $L(G)$ of a graph G is the square matrix ($n \times n$) that corresponds to the vertices of a graph. The main diagonal of the matrix represents the degree of the vertex while the other entries are as follows:

$$A_{ij} = \begin{cases} -1, & \text{if } v_i \text{ and } v_j \text{ are adjacent} \\ 0, & \text{otherwise} \end{cases}$$

Example : Consider a graph G



$$L(G) = \begin{pmatrix} 3 & -1 & -1 & -1 & 0 \\ -1 & 2 & -1 & 0 & 0 \\ -1 & -1 & 4 & -1 & -1 \\ -1 & 0 & -1 & 3 & -1 \\ 0 & 0 & -1 & -1 & 2 \end{pmatrix}$$

The Laplacian matrix can also be derived from $L(G) = D(G) - A(G)$, where $D(G)$ is the diagonal matrix whose entries represent the degrees of the vertices, and $A(G)$ is the adjacency matrix.

DEFINITION : ALGEBRAIC CONNECTIVITY

The Laplacian of a connected graph has eigenvalues $\lambda_1 \leq \lambda_2 \leq \dots \leq \lambda_n$. Then the algebraic connectivity of a graph is defined to be λ_2 , the second smallest eigenvalue. The name is a result of its connection to the vertex connectivity and the edge connectivity of a graph. It is the most important information contained within the spectrum of a graph.

REMARK 1: The oldest result about the Laplacian matrix concerns about the number of spanning trees of a graph. The Matrix Tree Theorem is one of the most significant applications of the Laplacian and is usually contributed to Kirchhoff.

DEFINITION : POSITIVE SEMI-DEFINITE MATRIX

A positive semidefinite matrix is one that is Hermitian, and whose eigenvalues are all non-negative. A Hermitian matrix is one which equals its conjugate transpose. This is usually written:

$$\overline{A^H} = A^T = A$$

DEFINITION : CHARACTERISTIC FUNCTION

The characteristic function is the function for which every subset N of X , has a value of 1 at points of N , and 0 at points of $X - N$. In other words, it takes the value of 1 for numbers in the set, and 0 for numbers not in the set.

PROPERTY 1:

The smallest eigenvalue of L is 0.

PROPERTY 2:

The multiplicity of 0 as an eigenvalue of L is the number of connected components in the graph.

PROPERTY 3:

The algebraic connectivity is positive if and only if the graph is connected.

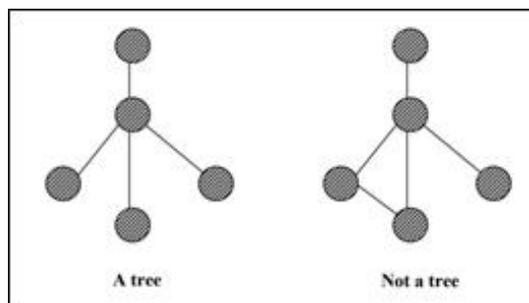
NOTE:

Eigenvalues of Laplace matrices of graphs are related to various combinatorial properties of graphs. They can be used to extract information about some parameters that are hard to compute or estimate, most notably those related to expansion and vertex partitions. The smallest and largest eigenvalue can be expressed as solutions to a quadratic optimization problem. It turns out that the right generalized setting for this is semi-definite programming, where duality theory leads to powerful applications. A more general setting of weighted graphs is presented, which brings us also to the study of simple random walks whose transition matrix can be expressed via the related Laplacian

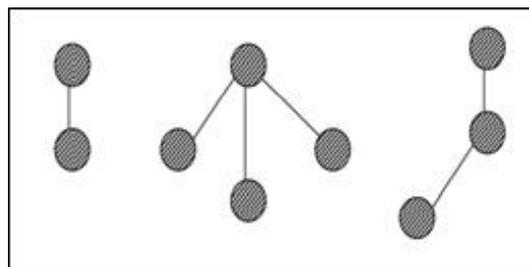
4.2 SPANNING TREES

In order to discuss spanning trees, we must first cover a few definitions. A tree is a connected graph that has no cycles.

Example:

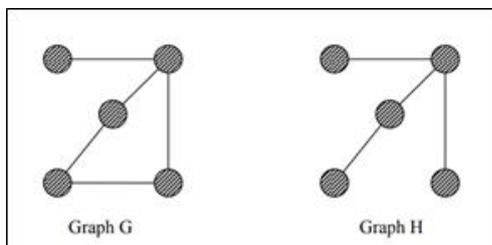


A subgraph H of a graph G is a graph whose vertex and edge sets are subset of $V(G)$ and $E(G)$ in that order. A few subgraphs of the tree above are:



A subgraph H is said to span a graph G if $V(H) = V(G)$. A spanning tree of a

graph is a spanning subgraph that is a tree. Given graph G below, graph H is a spanning tree of G.



Before we go into the next few properties, we need to understand a co-factor of a matrix, which begins with the minor of a matrix. A minor M_{ij} of a matrix B is determined by removing row i and column j from B, and then calculating the determinant of the resulting matrix. The co-factor of a matrix is $(-1)^{i+j}M_{ij}$.

LEMMA:

Let G be a graph with $V(G) = \{v_1, v_2, \dots, v_n\}$ and $E(G) = \{e_1, e_2, \dots, e_m\}$.

Then the following assertions hold:

- (i) $L(G)$ is a symmetric, positive semi definite matrix.
- (ii) The row and the column sums of $L(G)$ are zero.
- (iii) The smallest non-zero eigenvalue of L is called the spectral gap.
- (iv) The second smallest eigenvalue of L is the algebraic connectivity of G

PROPERTY 4:

The Matrix Tree Theorem

Given a graph G, its adjacency matrix A, and its degree matrix C, the number of non identical spanning trees of G is equal to the value of any co-factor of the matrix $C - A$.

COROLLARY - Cayley's Tree Formula:

The number of different trees on n labeled vertices is n^{n-2} .

4.3 AN ALTERNATIVE APPROACH

There is an alternative way of defining eigenvalues. We can define them in their “normalized” form. One advantage to this definition is that it is consistent with eigenvalues in spectral geometry and in stochastic processes. It also allows results which were only known for regular graphs to be generalized to all graphs. We will use NL to represent the Laplacian calculated using this definition.

In a graph where d_v represents the degree of vertex v , the Laplacian would be defined to be the matrix,

$$NL(u, v) \begin{cases} 1 & \text{if } u = v \text{ and } d_v \neq 0 \\ \frac{-1}{\sqrt{d_u d_v}} & \text{if } u \text{ and } v \text{ and adjacent} \\ 0 & \text{otherwise} \end{cases}$$

Chapter 5

APPLICATIONS OF

ALGEBRAIC GRAPH THEORY

Algebraic graph theory is the branch of mathematics in which algebraic methods are used to solve problems about graphs. It is an interesting subject concerned with the interplay between algebra and graph theory. In the last several decades, in investigating complex graph structures algebraic techniques are being increasingly used. Algebraic tools help to give surprising and elegant proofs of graph theoretic facts, and there are many interesting algebraic objects associated with graphs. Graph theory is rapidly moving into the mainstream of mathematics mainly because of its application in diverse fields which include:

- (i) Biochemistry (genomics)
- (ii) Electrical engineering (Communications, network and Coding theory) -Identifying clusters is an important aspect in the field of electrical network connections.
- (iii) Computer Science (Algorithms and computations) -In computer science graphs are used to represent networks of communication, data organization, the flow of computation etc. Also Computer scientists use it in load balancing algorithms.
- (iv) Operation Research (Scheduling).

There are numerous applications of algebraic graph theory, specifically spectral graph theory, within the sciences and many other fields. It is an important sub-branch of algebraic graph theory. Spectral graph theory is used in the study of chemical compounds, DNA, Brain network analysis etc. Laplacian eigenvalues determine the kinematic behavior of a liquid flowing through a system of communicating pipes. The graphs are useful in geometry and certain parts of topology

such as knot theory. Graph spectral method is extremely helpful in finding the needed results with minimal computations. Algebraic graph theory has close relation with group theory. Algebraic graph theory has many application and potential applications to problems in quantum computing, although the connection has become apparent very recently. Work in quantum information theory is leading to a wide range of questions which can be successfully studied using ideas and tools from algebraic graph theory. Contemporary scientific literature offers ample evidence that the algebraic methods which have revolutionized pure mathematics are now in process of having a similar impact in the physical sciences. The algebraic approach to statistical mechanics and quantum theory is an example of this new orientation. Another significant application of algebraic graph theory is the design and analysis of topologies of interconnection networks. The topologies that are used to connect processors in a supercomputer have a high degree of symmetry and are usually Cayley graphs. Some of the applications of algebraic graph theory are briefly described as viz:

5.1 GOOGLE PAGE RANK

Page Rank is a way of measuring the importance of a particular web pages. It was invented by Larry Page and Sergey Brin while they were graduate students at Stanford, and it became a Google trademark in 1998. This was named after Larry Page, one of the founders of Google. Page Rank (PR) is an algorithm used by Google Search to rank web pages in their search engine results. A Page Rank results from a mathematical algorithm based on the web graph, created by all World Wide Web pages as nodes and hyperlinks as edges.

According to Google, Page Rank works by counting the number and quality of links to a page to determine a rough estimate of how important the website is. The usefulness of a search engine depends on the relevance of the result set it gives back. There may of course be millions of web pages that include a particular word or phrase. However some of them will be more relevant, popular, or authoritative than others. A user may not have the ability or patience to scan through all pages that contain the given query words. One expects the relevant pages to be displayed within the top 10-20 pages returned by the search engine.

Page Rank algorithm is one of the most known and influential algorithms for

computing the relevance of web pages that is used by the Google search engine. The idea behind the Page Rank is that, the importance of any web page can be judged by looking at the pages that link to it. If we create a web page a and include a hyperlink to the web page b , this means that we consider b important and relevant for our topic. If there are a lot of pages that link to b , this means that the common belief is that page b is important. If on the other hand, b has only one backlink, but that comes from an authoritative site c , (like www.google.com, www.cnn.com, www.cornell.edu) we say that c transfers its authority to b , in other words, c asserts that b is important. Whether we talk about popularity or authority, we can iteratively assign a rank to each web page, based on the ranks of the pages that point to it.

Page Rank is a link analysis algorithm and it assigns a numerical weighting to each element of a hyperlinked set of documents, with the purpose of "measuring" its relative importance within the set. The algorithm may be applied to any collection of entities with reciprocal quotations and references. The numerical weight that it assigns to any given element E is referred to as the PageRank of E and denoted by $PR(E)$.

The rank value indicates an importance of a particular page. A hyperlink to a page counts as a vote of support. The Page Rank of a page is defined recursively and depends on the number and Page Rank metric of all pages that link to it ("incoming links"). A page that is linked to by many pages with high Page Rank receives a high rank itself.

Page Rank works by counting the number and quality of links to a page and determine a rough evaluation of how important the website is. The underlying assumption is that more important websites are likely to receive more links from other websites. Numerous academic papers concerning Page Rank have been published. In practice, the Page Rank concept may be vulnerable to manipulation. But knowing about the advantages and disadvantages of Google page rank, one can try to avoid the possible errors that may reduce the rank value of an existing website or while creating new website.

5.2 SPECTRAL CLUSTREING

Spectral clustering is a technique with roots in graph theory. Here the approach is used to identify communities of nodes in a graph based on the edges connecting them. The method is flexible and allows us to cluster non graph data as well. Clustering algorithms have their application in many areas including detection, image segmentation, search result grouping, market segmentation and social network analysis. Clustering is one of the initial steps done in exploratory data analysis to visualize the similarity and to identify the pattern lying hidden in data points. The aim of clustering is to find the similarity within a cluster and the difference between two clusters. There are two major approaches in clustering. They are Compactness and Connectivity.

Spectral clustering helps us overcome two major problems in clustering. First being the shape of the cluster and the other is determining the cluster centroid. K-means algorithm generally assumes that the clusters are spherical or round i.e. within k-radius from the cluster centroid. In K means, many iterations are required to determine the cluster centroid. In spectral, the clusters do not follow a fixed shape or pattern. Points that are far away but connected belong to the same cluster and the points which are less distant from each other could belong to different clusters if they are not connected. This implies that the algorithm could be effective for data of different shapes and sizes. When compared with other algorithms, it is computationally fast for sparse data sets of several thousand data points. You don't need the actual data set to work with. Distance or though it might be costly to compute for large data sets as eigen values and eigen vectors need to be computed and then clustering is to be done. But the algorithms try to cut the cost.

In spectral clustering there are three major steps involved: Constructing a similarity graph, projecting data onto a lower-dimensional space, and clustering the data. Given a set of points S in a higher-dimensional space, it can be elaborated as follows:

1. Form a distance matrix
2. Transform the distance matrix into an affinity matrix A
3. Compute the degree matrix D and the Laplacian matrix $L = D - A$.

4. Find the eigenvalues and eigenvectors of L .
5. With the eigenvectors of k largest eigenvalues computed from the previous step form a matrix.
6. Normalize the vectors.
7. Cluster the data points in k -dimensional space.

Spectral clustering has its application in many areas which includes: image segmentation, educational data mining, entity resolution, speech separation, spectral clustering of protein sequences, text image segmentation. Though spectral clustering is a technique based on graph theory, the approach is used to identify communities of vertices in a graph based on the edges connecting them. This method is flexible and allows us to cluster non-graph data as well either with or without the original data.

5.3 PROTEIN STRUCTURE ANALYSIS

There are an enormous number of proteins present in our body cells. The three dimensional structure of proteins is the key to understanding their function and evolution. A protein is formed by the binding of amino acids by peptide bond to form a long chain-like molecules called poly-peptides. There are four major protein classes, shown below in Figure 5.1. The cylinders represent helix and the arrows represent the strands. A helix is a spiral molecule formed from the benzene rings.

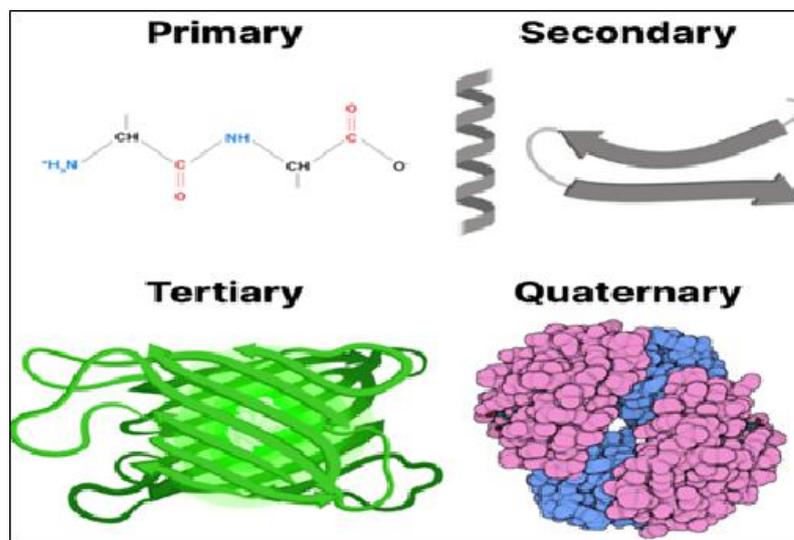


Figure 5.1: DIFFERENT STRUCTURES OF PROTEINS

The analysis of stable folded three-dimensional structures provide an insight into the protein structures for amino acid sequences and drug design studies. The composition of the protein backbone and side-chains makes the geometry of a protein structure. The Protein structure can have the same gross shape but have different geometric structure. Graphs help us to represent the topology of protein structures, regardless of their complexity. The main problem is to identify and define the vertices and edges. Fig 5.2 are a few simple examples of proteins with their graphs below them.

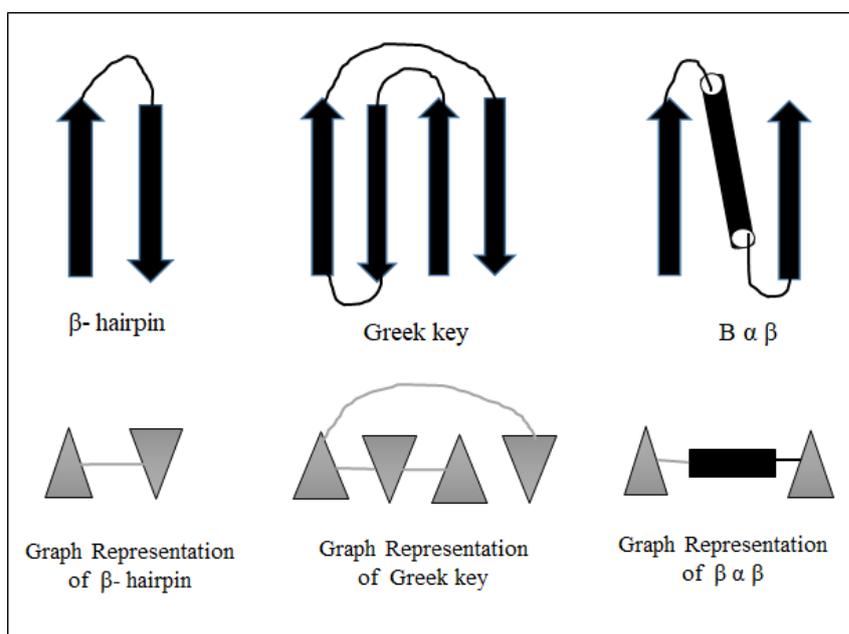


Figure 5.2: CONVERSION OF PROTEIN STRUCTURES TO GRAPH

Properties of graphs and their spectral graph give information about protein structure, depending on how the vertices and edges are defined. The basic unit of a protein is its amino acid sub units. To study cluster identification, the amino acids represent the vertices and the three-dimensional connectivity between them is represented by the edges. To study fold and pattern identification and the folding rules of proteins, α -helices and β -strands are used for vertices and spatially closed structures are used for edges. To identify proteins with similar folds, the poly-peptide chain are the vertices and the side chains within a certain radius are the edges.

Mathematical graphs are used to represent β structures, which is much more advantageous than drawing three-dimensional figures. The vertices represent the

single β -strands and the two edge sets represent the sequential and hydrogen bond between them. Connected graphs are used to represent α -helical structures. The vertices represent secondary structures and the edges represent contacts between helices. The main reason for setting the structures up this way is to gain information about the folding process of protein structures and understand better organization and patterns within these structures. Since the comparison of protein structures is important for revealing the evolutionary relationship among proteins, predicting protein structures and function.

The protein connectivity is determined by identifying the main chain atoms within a prescribed distance. This comes from identifying clusters. Two protein graphs can be compared to check whether they have some common features, and thus provide insight into structural overlaps of proteins. One way of finding this is by tree searching algorithm, which is a series of matrix permutations. Through it, sub-graph isomorphism are detected to determine the largest sub-graph that is common in a pair of graphs. This can highlight the areas of structural overlap and therefore show structural and functional similarities not found through other methods. But this method requires a very high number of computations. Now a few heuristic methods have been discovered to reduce the time and cost of the computations. Structural biologists are finding promising applications of graph theory with optimism that this field of mathematics will continually contribute to the understanding of protein structure, folding stability, function and dynamics.

Many methods have been developed in the past to support two or multiple protein structures. In spite of the importance of this problem, many mathematical or statistical frameworks have rarely been pursued for general protein structure comparison. One of the major issue in this field is that with many different distances used to measure the similarity between protein structures, none of them are in proper distances when protein structures of different sequences are compared.

Using an elastic Riemannian metric on spaces of curves, geodesic distance, a proper distance on spaces of curves, can be calculated for any two protein structures. In this protein structures can be treated as random variables on the shape manifold, and means and covariance can be computed for populations of protein structures. It can be used to build Gaussian-type probability distributions of protein structures for use in hypothesis testing. The covariance of a population of

protein structures can be used to reveal the population-specific variations in it and it can be helpful in improving structure classification. With curves demonstrating protein structures, the matching is performed using elastic shape analysis of curves, which can effectively model the conformational variations and insertions/deletions.

The protein structure arrangement problem addresses the problem of measuring the degree of resemblance in three-dimensional structure of two proteins. The representation of each protein using a simple contact map permits the correspondence graph for the protein pair to be produced and the maximum clique within this graph provides a measure of the structural similarity among the two proteins. This study uses a recently developed method called maximum clique algorithm.

Having a protein structure helps us to provide a greater level of understanding of how a protein works, which can allow us to create hypotheses about how we can control it, or modify it. For example, knowing a protein's structure could allow you to design site-directed mutations with the intent of changing function that causes abnormality. And this abnormality may result in certain diseases like Thalassemia, Sickle cell anemia, Cystic Fibrosis etc.

For Example - In the case of Thalassemia

To diagnose Thalassemia, the usual procedure is likely taking a blood sample. They'll send this sample to a lab to be tested for anaemia and abnormal haemoglobin. A lab technician will also look at the blood under a microscope to see if the red blood cells are oddly shaped.

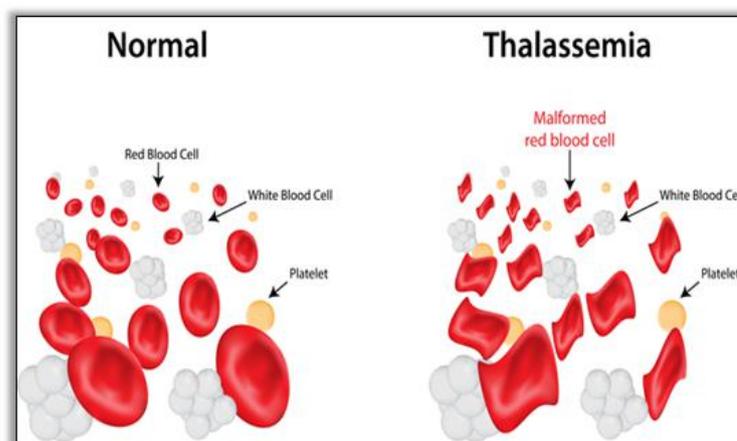


Figure 5.3: NORMAL BLOOD CELL AND THALSSEMIC BLOOD CELL

Abnormally shaped red blood cells are a sign of Thalassemia as shown in the Figure 5.3. The lab technician may also perform a test known as haemoglobin electrophoresis. This test separates out the different molecules in the red blood cells, allowing them to identify the abnormal type.

If we are observing the Figure 5.3, we can just identify that one is normal and other is abnormal. And we conclude that the person is Thalassemic. We won't be able to explain the defect in detail, since the structure is complex and vague.

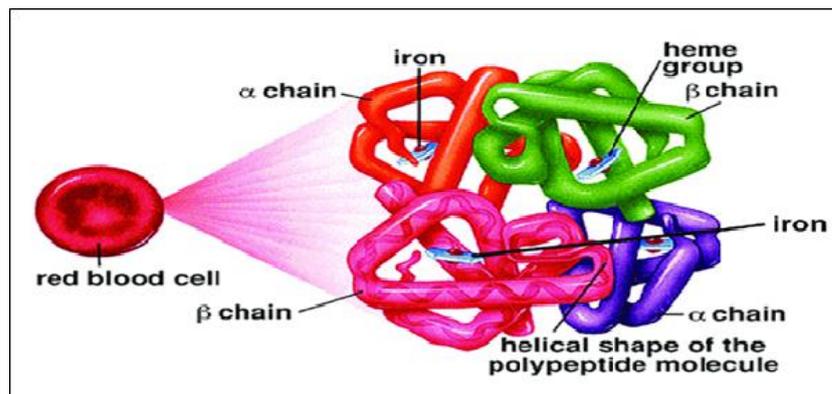


Figure 5.4: PROTEIN STRUCTURE OF HAEMOGLOBIN

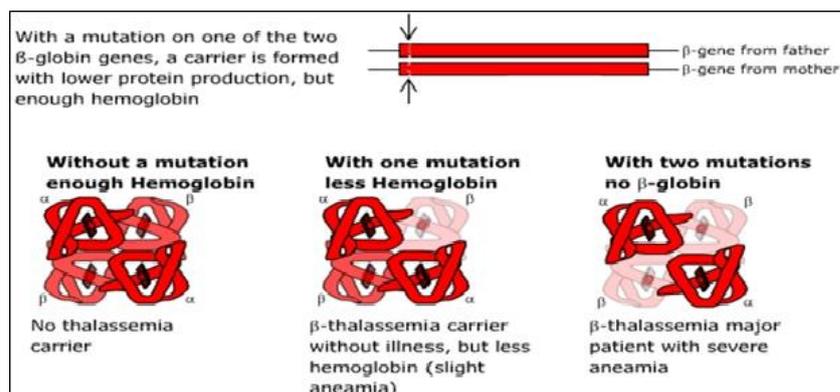


Figure 5.5: PROTEIN STRUCTURE OF ABNORMAL HAEMOGLOBIN

The Figure 5.4 is the protein structure of normal haemoglobin and Figure 5.5 is the protein structure of abnormal haemoglobin of Thalassemic patient. From the Figure 5.4, we can construct the graph of protein structure of normal haemoglobin as we discussed above in the protein structure (refer Figure 5.6).

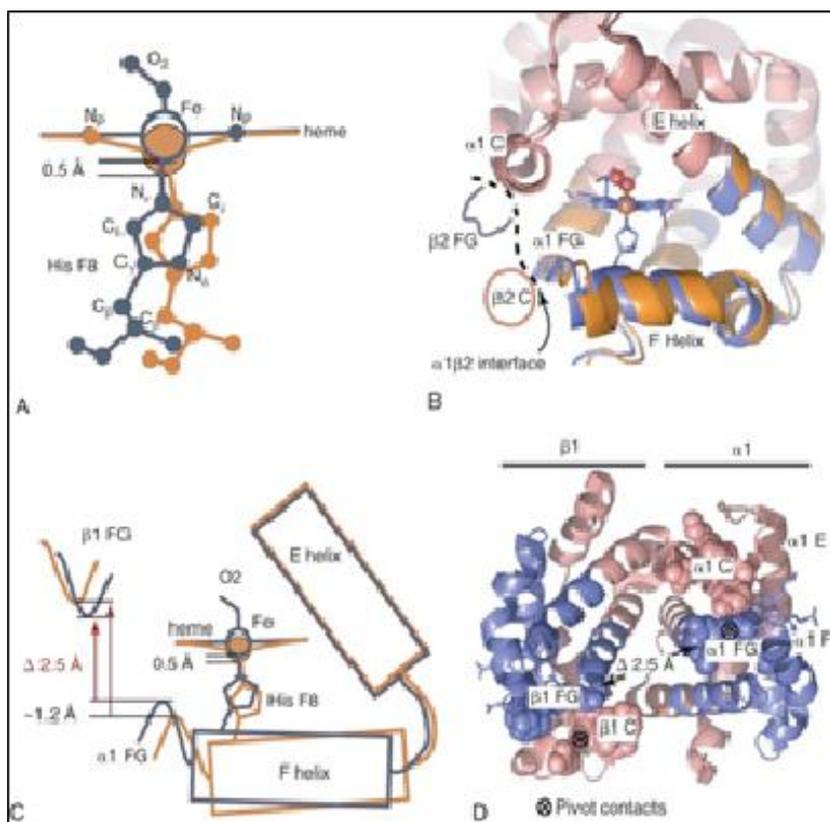


Figure 5.6: GRAPH OF NORMAL HAEMOGLOBIN

Similarly we can construct the graph of protein structure of abnormal haemoglobin of a Thalassaemic patient. Then by comparing the graph structure of both haemoglobin we can identify and analyze the defectiveness in the structure. And we will be able to give a detailed explanation of the defective structure of the haemoglobin. The successful implementation of this approach could allow more sophisticated and novel clinical applications that may lead to a permanent cure for Thalassaemia.

Chapter 6

CONCLUSION

Algebraic graph theory is concerned with the use of algebraic techniques in the study of graphs. Algebraic graph theory is a fascinating subject concerned with the interplay between algebra and graph theory. Algebraic tools can be used to give surprising and elegant proofs of graph theoretic facts and there are many interesting algebraic objects associated with graphs. Algebraic graph theory can be viewed as an extension to graph theory. The first part of algebraic graph theory involves the applications of linear algebra and matrix theory to the study of graphs. The adjacency matrix completely determines the graphs, and its spectral properties are shown to be related to the properties of the graph. For example, if a graph is regular then the eigenvalues of its adjacency matrix are bounded in absolute value by the valency of the graph.

The applications of linear algebra, graph theory, and the spectral of a graph remains forever through the various sciences and other fields. We know, mathematics is found everywhere, and is required in many situations in order to evaluate, process, and for the better understanding of the world around us.

Algebraic graph theory, particularly spectral graph theory, studies the algebraic connectivity via characteristic polynomial, eigenvalues, and eigenvectors of matrices associated with graphs, such as adjacency matrix or Laplacian matrix. Topological graph theory concerns the embedding and immersions of graphs, and the association of graphs with topological spaces, such as abstract simplicial complexes. Mathematically, graphs are useful tools in geometry and certain parts of

topology such as knot theory and algebraic topology.

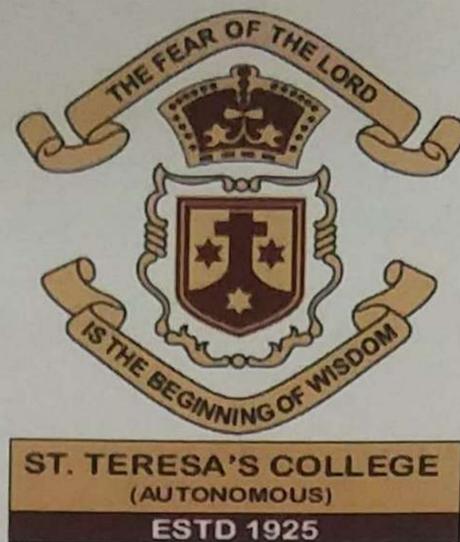
Several discovery systems in graph theory have been very successful in helping mathematicians to formulate and explore speculations, or to suggest interesting speculations in an entirely automated way. Moreover, new systems sometimes based on new principles are being developed. The underlying paradigms, i.e., enumeration, interactive computing, formula manipulation, generation and selection, heuristic optimization are varied. They appear to be largely complementary. So one may expect much activity and the arrival of more comprehensive systems in the near future.

Finally, knowing about different application of algebraic graph theory one will be able to understand how simpler it is to use algebraic method in illustrating complicated problems. Application of algebraic method will help us to minimize the time consumption when compared with other methods. Also we will be able to give a clear cut result with concrete explanation for a particular problem.

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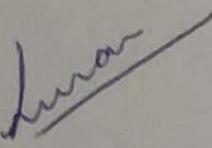
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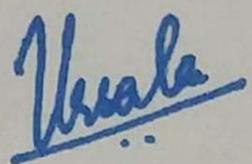


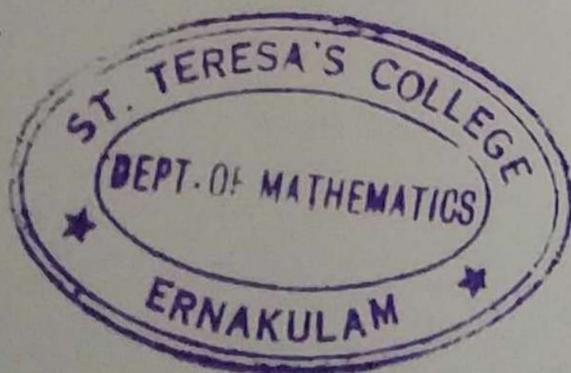
CERTIFICATE

This is to certify that the dissertation entitled, **AN INTRODUCTION TO FRACTALS** is a bonafide record of the work done by Ms. **AISHWARYA PRAJITH** under my guidance as partial fulfilment of the award of the degree of **Bachelor of Science in Mathematics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

Date:06/04/2022
Place: Ernakulam

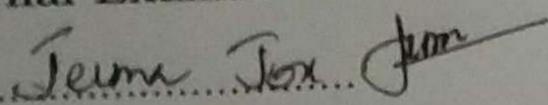
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**A study on
CONSUMER PERCEPTION TOWARDS
FOOD DELIVERY APPS IN ERNAKULAM DURING COVID-19**

**Project Report
Submitted by**

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**Under the guidance of
SMT. MERIN ELIZABATH HARRY**

**In partial fulfillment of the requirement for the Degree of
BACHELOR OF COMMERCE**



**ST. TERESA'S COLLEGE ESTD 1925
ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM
COLLEGE WITH POTENTIAL FOR EXCELLENCE
Nationally Re-Accredited with A++ Grade
Affiliated to
Mahatma Gandhi University
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March-2022**

ST. TERESA'S COLLEGE, ERNAKULAM (AUTONOMOUS)
COLLEGE WITH POTENTIAL FOR EXCELLENCE
Nationally Re-Accredited at A++ Grade



CERTIFICATE

This is to certify that the project titled "A STUDY ON CONSUMER PERCEPTION TOWARDS FOOD DELIVERY DURING COVID-19 (with reference to Ernakulam district)" submitted to Mahatma Gandhi University in partial fulfillment of the requirement for the award of Degree of Bachelor in Commerce is a record of the original work done by Ms. Aishwarya Pradeep, Ms. Teresa Varghese, Ms. Kajal, under my supervision and guidance during the academic year 2019-22.

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DECLARATION

We, by Ms.Aishwarya Pradeep, Ms Teresa Varghese, Ms. Kajal, final year B.Com students, Department of Commerce (SF), St Teresa's College Autonomous do hereby declare that the project report entitled A STUDY ON CONSUMER PERCEPTION TOWARDS FOOD DELIVERY APPS IN ERNAKULAM DURING COVID-19 submitted to Mahatma Gandhi University is a bonafide record of the work done under the supervision and guidance of Smt. Maria Elizabeth Harry, Assistant Professor of Department of Commerce (SF), St. Teresa's College Autonomous) and this work has not previously formed the basis for the award of any academic qualification, fellowship, or other similar title of any other university or board.

PLACE: ERNAKULAM

DATE: 29/04/2022

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First of all, we are grateful to God Almighty for his blessings showered upon us for the successful completion of our project.

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Aishwarya Pradeep

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**A STUDY ON CONSUMER PERCEPTION TOWARDS
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DURING COVID-19**

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Online food delivery is a service in which a store or restaurant delivers food to a customer through the restaurant's website. Due to internet and allied technologies, customers can easily avail all the information that are required to select, evaluate and purchase the product. The online food delivery market in India is growing significantly with evolving lifestyle patterns and changing eating habits of Indians. Revolution in the online retail market made a strong impact on the Indian food industry (2020). Dynamic work schedules and escalation in disposable incomes have promoted online food delivery, especially in the urban areas.

The number of working women has increased in the Indian workforce, particularly in the organized sectors. Due to this there is a rise in double income families. With both the partners working and sustaining hectic working schedules, it becomes tough for people to get sufficient time and energy to daily enjoy homemade food. Further overall spending capacity of the families have also increased. In addition to this, the key players in the market like Swiggy and Zomato keep on announcing lucrative offers for the existing and new customers in order to keep up the intense competition in the online food ordering market.

This results in people's increasing preference towards ordering food online and relishing their favorite cuisine at home at a reasonable price, thereby increasing the value and user base of the online food ordering market in India. Online food delivery apps are acting as an agent between the restaurant and end-user.

Online food delivery works on two delivery types i.e., Aggregator & Cloud Kitchen. The Food Aggregators allow consumers to compare and order their meals from different restaurants through a single app. It is more prevalent in India than Cloud kitchens.

Furthermore, COVID- 19 lockdowns have also positively impacted India's online food delivery industry by the full-filling urge of eating outside. Many leading players like Zomato, Swiggy, Eat.fit, McDonald's Corporation, and Domino's Pizza Inc, etc. have introduced contactless delivery service through food delivery applications, which are used

in India.

How to use a food delivery app generally:

1. You need to download a given app from the Play Store or App Store (For Apple phones).
2. Register yourself, provide your details, and there are several menus from various restaurants on the screen with attractive discounts.
3. Browse them and then compare the rates on other food delivery apps, and there you have it! Best of food delivered to you at the most competitive pricing.

1.2 OBJECTIVES

- To study the consumers perception towards food delivery apps during covid 19 pandemic in India.
- To study the factors that influence consumer's choice in the adoption of food delivery apps.
- To study the positive and negative factors associated with the utilization of food delivery apps.
- To study the strategies implemented by Online Food ordering apps.

1.3 STATEMENT OF PROBLEM

Food delivery app is an online food ordering system whose software allows restaurant businesses to accept and manage orders placed via a website or mobile app. Zomato is the first food delivery app to sweep the whole country by its then exclusive services. Online ordering system mainly consists of two components, first, is the app website or the mobile app for customers to view the restaurant's menu and place their online order. Second, is an admin management interface, for the restaurant to receive and manage orders.

Food delivery apps, although a success, gained increasing demand upon the surge of the Covid 19 pandemic. This service offered employment opportunities as well as convenience of ordering to its users. Thus, the study focuses on the consumer attitude and perception towards food delivery apps.

1.4 SIGNIFICANCE OF STUDY

Food delivery apps offer the convenience of ordering food from any place at any time. This study undertakes to give an insight about various food delivery apps and its services. This study helps in understanding the consumer attitude and perception towards food delivery apps especially during the ongoing pandemic. The study also aims to find the problems, risks and benefits associated with the use of food delivery apps for consumers, employees as well as restaurants.

1.5 RESEARCH METHODOLOGY

Research can be defined as a systematic investigation to establish facts. Research methodology is defined as a highly intellectual human activity used in the investigation of nature and matter and deals specifically with the manner in which data is collected, analyzed and interpreted.

The study is conducted to obtain data on consumer perception towards Various food delivery apps in India. A sample size of 100 people is selected and their responses are collected by ways of convenient sampling. Primary data was collected on the basis of a questionnaire method which was designed to collect information required for the study. Secondary data was obtained and used for developing literature review for the study. The data collected was analyzed using both statistical tools and percentage analysis.

1.5.1 TYPE OF RESEARCH: A descriptive research design is used under this project.

1.5.2 SOURCE OF INFORMATION: Information required for this project is acquired by collecting primary data as well as evaluating secondary data. Primary data will be collected from the sample using online questionnaire from 100 respondents. Secondary data includes articles from magazines, journals, reviews, etc. related to the subject and

project documents.

1.5.3 SAMPLING TECHNIQUE: Convenient sampling techniques have been adopted for this purpose of carrying out this project.

1.5.4 SAMPLE SIZE: 100 consumers are randomly selected to collect data for the analyses.

1.5.6 TOOLS USED: Tables, graphs and charts are used to present the analyzed data.

1.6 LIMITATIONS OF THE STUDY

- A sample size of 100 from across the country cannot be considered as a complete representation of the population of the entire country.
- Reluctance in disclosing personal experiences related to usage of food delivery service.
- Data collected may not be accurate.
- Consumer perceptions change from time to time with advancement in technology and ongoing competition

CHAPTER 2
THEORETICAL FRAMEWORK AND
LITERATURE REVIEW

2.1 LITERATURE REVIEW

1. Hafiz U R Rahman, Mahmood Ashraf, Muhammad Abra, Abid Mehmood (2019), In their research paper, to study the useable food delivery applications, presents the overall background of food delivery applications and procedure of ordering of food through food delivery applications. Today the world of information technology rules the world and nowadays people are familiar with the use of computers, mobiles and mobile applications. In this paper the author proposed a new system for food ordering which is based on k-means and apriori algorithm. By using the proposed system, the customers place orders for the food, by using an android touch pad. This system covers the main three areas which are, serving area, cashier table and the kitchen. From the study it can be seen that food delivery apps have brought about a positive impact. Findings of the study concluded that the use of digital applications in the food ordering systems are increasing and have become more popular among customers. However, there are still some usability issues in the current available food delivery applications. There is a need to develop mobile applications further that purely apply the usability rules and guidelines.

2. Dr. Mitali Gupta (2019), in her project to study the usage of food delivery apps stated that, the format of home delivery or the takeaways have gained plenty of additional customers in locations like malls, offices and big-party orders for residential complexes. Individuals missing breakfast on the thanks to work, order-in. People, United Nations agency want a higher selection of company lunch or party orders too. Everybody appears to be in awe of the net food order and delivery possibility for the convenience and immediate supply of food reception. Besides, the convenience of ordering groceries from your mobile app or application program has definitely alienated some market share from the trusty 'kirana' or the mom-n-pop stores. Without feeling pressure to wrap up their order, customers are more inclined to explore all of their menu options, and even end up spending more than they would when ordering over the phone or in person. With no line behind them, the pressure for your guests to make speedy orders is gone, and they'll be more inclined to get that extra item. Most of the people know about Swiggy, Zomato etc, they are growing online food ordering apps nowadays. They provide good servicing for the customers from different areas, places and clients along with fabulous taste.

3. Mr. Jack Collison, Department of Economics, Stanford University (2020), in his paper regarding The Impact of Online Food Delivery Services on Restaurant Sales stated that The meteoric growth of e-commerce makes it an ever-important area to study. Even in traditional industries, well-established offline firms have adopted new online sales channels that aim to increase their revenue. This has led to the hybridization of strictly brick-and-mortar stores, which now operate both online and offline. In fact, by 2012, more than 80 percent of U.S. retailers sold merchandise through both online and offline channel. Online food delivery is a prime example of e-commerce disrupting a traditional market. A flood of new food delivery firms has caused rapid growth in the total number of transactions and revenue for the nascent industry. Although online food delivery services provide extra channels for potential revenue, they also create the risk of cannibalization in which brick-and-mortar sales actually suffer because consumers who purchase in-store have transitioned to mostly online purchasing behavior. The COVID-19 pandemic may further accelerate this trend because in-person dining has essentially been shut down.

4. Jasna Mary Joseph (2019), Guest Faculty, Department of Commerce, St. Peter's College, Kolenchery, Kerala to identify the level of customer satisfaction on Online Food Delivery Apps in Kochi and to identify the most influencing factor of customer satisfaction towards Online Food Delivery Apps. No business can exist without customers. Customer value is an asset to the organization. The factors which influence ordering food online were convenience and time saving, promotions and discounts. Consumers are satisfied with respect to quality of food, timely delivery and packaging. The study reveals that Swiggy is the most preferred online food delivery app (mean score 1.66) followed by Uber eats (mean score 1.72). Zomato is the least preferred App (mean score 2.62). Majority of the respondents (68%) prefer dinner, 20 % of the respondent's order lunch through the app. 41 percent of the respondents order food online on a random basis while 34 percent orders food on special occasions, 23 percent order online once in a week. Only 2 percent of the respondents make orders daily. Majority of the respondents spend less than ` 500 per order while ordering food. 38 percent spend in between ` 500 and ` 1000. Convenience is the most influencing factor of the respondents to use online food delivery app (mean score 2.48). The next factor is time saving (mean score 2.90) followed by offers and discounts (mean score 4.33). Doorstep delivery (mean score 4.73) is another factor considered for the

usage. Respondents also use an online food delivery app based on the recommendation of friends/ relatives (mean score 4.90). The factors which influence the order food online are convenience, time saving and the discounts and offers given by the operators. Majority are satisfied with the discounts, cashbacks/ rewards, pricing, packaging, quantity of food, quality of food, payment system and ease in using the app. Thus, the advent of online food delivery apps has created a locus for searching, comparing and conveniently accessing the services.

5. Varsha Chavan (2015), According to her, the use of smart device-based interfaces for customers to view, order and navigate has helped the restaurants in managing orders from customers immediately. The capabilities of wireless communication and smartphone technology in fulfilling and improving business management and service delivery. Their analysis states that this method is convenient, effective and easy to use, which is expected to improve the overall restaurant business in coming times

6. Leong Wai Hong (2016), According to him, technological advancement in many industries have changed the business model to grow. Efficient systems will facilitate the productivity and profitability of an edifice. The use of an online food delivery system is believed that it will lead the restaurant's business growth from time to time and provides the restaurants to facilitate major business online.

7. H.S.Sethu & Bhavya Saini (2016), their aim was to investigate the students perception, behavior and satisfaction of online food ordering and delivery services. Their study reveals that online food delivery services facilitate the scholars in managing their time higher. It is additionally found that simple accessibility of their desired food at any time was the prime reason for using the services.

8. Sonali Jadhav (2018), in the study titled Food ordering mobile applications-A new wave in food entrepreneurship, has analyzed the benefits and challenges of food delivery apps for customers and the restaurants and has established the gaining popularity of the apps among the customers.

9. Karishma Sharma (2018), The services of each app are very attractive with offers to

influence the viewers. Dinner was the most opted meal time of meals by the people using this app, and preferred only for users less than 3. If they have three or more, they tend to dine out. Here is evidence that the food ordering app has reduced the walking customers.

10. Karthika et.al (2018), in their study titled A study on the various food ordering apps based on consumer preference, opined that the online food ordering apps need to improve their restaurants sites and menus to satisfy the customers in a better way.

11. J. Das (2018), has studied, analyzed and compared the top 4 food delivery apps namely, Zomato, Swiggy, Foodpanda and Ubereats. Providing better discounts” and “better choices of restaurants”, Zomato is positioned at the top by the customers. Zomato is also positioned at the top by the customers while considering on delivery on time and good customer service. In both situations, customers ranked Ubereats at the last position.

12. Sethu and Saini (2016), The online food ordering apps were analyzed by the researcher on the basis of certain characteristics. Majority of the consumers were aware about purchasing on the internet and found that it is very convenient to use the internet.

13. Dr.Neha Parashar (2013),Customer’s attitude towards online food purchase also showed the convenience, no hassle and ease of use as the major factor, also the preference among the mobile food app is choice based on the perceptions of consumer’s reviews or feedback.

14. Kimes (2011), said that the amount of increase in online food ordering is because of , convenience and control. Almost half of the population has ordered food online. Personal interaction with restaurant employees, satisfaction level of consumers after ordering food online and changed behavior of the consumers regarding food mobile ordering Apps shows the perception of consumers for mobile food ordering apps.

15. Donkoh and Quainoo (2012), stated that the Customers perceptions about food and services are very important for the food and service industry because it helps them to identify the needs and preferences of the customers and satisfy them.

2.2 THEORETICAL FRAMEWORK

Economic growth and increasing broadband penetration are driving the global expansion of e-commerce. Consumers are increasingly using online services as their disposable income increases, electronic payments become more trustworthy, and the range of suppliers and the size of their delivery networks expand. The e-commerce market has experienced strong growth over the past decade, as customers have increasingly moved online.

Ordering food from food delivering applications is the process in which order for the food is placed through the app and is delivered to the customer to the specified place. Food delivery apps are basically designed for those people who don't have the time to go to restaurants. As the say, money is not money but time is money

Basically, mobile apps consist of a set of instructions that run on smartphones and perform a specific task. Mobile applications are easy to use, user friendly, inexpensive, convenient to carry, powerful development framework, simply downloadable and run on most of the smart devices. There are a number of apps which are pre-installed in smart phones and whereas the others, users can easily download.

Food delivery providers can be categorized as being either restaurant-to-consumer delivery or platform-to-consumer delivery operations. In restaurant-to-consumer delivery, food providers make the food and deliver it, such as KFC, McDonald's, and Domino's. The order can be made directly through the restaurant's online app. Third-party platforms also provide online delivery services from partner restaurants which do not necessarily offer delivery services themselves, a process which is defined as platform-to-consumer delivery. Third-party platforms vary from country to country, and include examples, such as Uber eats in the U.S., Eleme in China, Just Eat in UK, and Swiggy or Zomato in India. These application companies can either be responsible for recruiting and training professional delivery people, or they may also resort to crowdsourcing logistics. Professional delivery people are usually trained, and at least part of their salary is guaranteed, while a portion is commission-based. In contrast, the independent delivery people who are frequently known as "riders" are paid on a commission (per order) basis.

Various apps in the Indian market are: Zomato, Swiggy, Fasoos, Eat Fit, Domino's Pizza, UberEats etc. Zomato and Swiggy are one of the well-known applications that provide the online service of delivering food to consumer homes.

Swiggy is an online food delivery service that offers a lot of variety. They're the largest in India and operate in more than 500 cities throughout the country, such as Delhi, Mumbai, Hyderabad, and Bangalore, among other cities. The company also has features such as Swiggy Genie, which allows customers to order anything from groceries to shampoo while they enjoy their meal; Swiggy Money, which allows customers to load their Swiggy Wallet and pay instantly with ease; and Swiggy Super, where you can free delivery and amazing discount on top restaurants of your city. Swiggy has been rated as the best Online Food Delivery Service in India by several firms since its inception in 2014

Zomato is a restaurant discovery and food delivery service that operates in more than 500 cities across India. They list restaurants with detailed descriptions, photos of the dishes on offer, reviews from customers, as well as contact information- making it easy to find any cuisine you crave for your meal. Zomato has an extensive and interactive menu, which is why they are a favorite among Indian foodies. It has a wide variety of restaurants you can choose from, and it also offers the option to order ahead for pickup or delivery. Zomato boasts more than 95% of all online restaurant reviews and has been rated as one of Forbes' Top 100 Startups 2017.

Eat Fit or Cult.fit is an online food ordering service that helps you to maintain a healthy diet with three simple pillars: Deliver healthy, tasty Indian meals, Aid the wider adoption of physical exercise as a part of daily life and offer education through Yoga, Ayurveda, etc. Eat Fit has its own kitchen to prepare fresh, healthy meals. Then comes EatSure, which now serves ten cities across India and delivers over 95% of orders within 30 minutes! EatSure is running on a cloud kitchen-based business model wherein the parent company Rebel Foods is offering 10 in-house brands on its platform.

The revenue change of food ordering apps like Zomato has seen a constant uptick, and the growth rates for 2021 have been over 23%, making food delivery an exceedingly fast-growing segment.

2.3 ADVANTAGES:

Advantages for the customer:

- No more waiting in long queues to place an order.
- Increased transparency in pricing
- The convenience of ordering from any place at anytime
- Multiple ways to pay for the order
- Loyalty points which can mean better savings when they frequent a particular place
- Easy access to food for those who generally eat out but cannot due to safety concerns as well as restrictions made regarding the COVID-19 pandemic.

Advantages for the restaurant:

- Customers spend more when they order through an app as they have more time to make a decision.
- Restaurants can handle orders with more accuracy and increase their productivity
- Loyalty programs help restaurant to retain customers and do more repeat business
- It is easier to check the cash flow in the restaurant without having to open the registers and ordering notebooks
- Improved efficiency and lesser running costs
- During COVID-19, food delivery apps made up for the loss of reduced foot traffic due to safety issues and restrictions.
- Restaurants see an increase in bill sizes from online and delivery orders versus dine-in orders.

2.4 DISADVANTAGES:

Disadvantages to the customer:

- Minimal control over the customer experience
- Expensive fees for each order
- Problems with the customer retention
- Possible negative impact on dine-in guests
- Chances of technical problems
- Risk of data security
- May lead to increase in health concerns due to the constant ordering of unhealthy food available at an easy access during the COVID-19 pandemic.

Disadvantages to the restaurant:

- When working with a food delivery service, there will be more points of contact between the order being prepared and the food ending up in the hands of the customer. Thus, making it difficult to ensure the driver is meeting the standards you've set for your restaurant.
- Most food delivery app companies will take deep cuts of each meal delivered, which means you have to have a high volume of orders to see any real profit.
- Customers could have a bad impression of your restaurant due to traffic or road conditions or a wrong turn – delays that have nothing to do with the restaurant or its food.

2.5 CHALLENGES

- **UNABLE PRICING MODEL:**

The food delivery industry is becoming extremely competitive with several new players joining in especially during the pandemic. And this, in turn, has made it difficult for competing businesses to identify the right pricing strategy.

- **MANAGING LOGISTICS:**

This is one of the greatest challenges faced by many food delivery start-ups. Often, the huge influx of orders makes it difficult for the delivery partner to provide on-time deliveries. This usually happens in the beginning, when the restaurants do not have the capacity to manage big logistic orders without disrupting the walk-in orders.

- **BUILDING A STABLE CUSTOMER BASE:**

In today's age of E-Commerce, the number of food delivery platforms are constantly rising. Thus, the customers are overwhelmed by the choices available to them. In such cases, engaging new users and making them stick to your platform is not easy. A restaurant or delivery service that offers better deals, incentives, and perks earns the loyalty of the moment.

- **PARTNERING WITH THE RIGHT EXPERTS IN THE MARKET:**

For entrepreneurs developing an aggregate food delivery platform, identifying and partnering with the right restaurant partners requires loads of effort. Joining forces with the best and quality partners and listing them on the platform helps to establish a good brand image. However, with a plethora of food outlets out there, filtering the best ones may become a challenge.

- **TO COPE WITH CUSTOMER EXPECTATIONS:**

They have huge expectations when it comes to online services, especially food delivery. And to cope up with these expectations, you must provide them with high-quality food service. The customers are looking for convenience and simplicity. They want the process of food searching and ordering to be straightforward. Also, they expect timely food deliveries at their fingertips.

- **IDENTIFYING THE MOST SUITABLE MARKET STRATEGY:**

Even if you have developed a full-fledged food delivery software integrated with the best features, finding new users can get challenging. This is especially because you are not channelizing the most suitable marketing platforms. Many times, the rapidly shifting customer preferences may make it hard to define a proper marketing strategy.

- Prioritizing order requests.
- Allocating the right number of vehicles, delivery valets.
- Selecting specific areas for food delivery also hampers several start-ups.

CHAPTER 3
DATA ANALYSIS AND INTERPRETATION

The e-commerce market has experienced strong growth over the past decade, as customers have increasingly moved online. Food delivery apps have made life so easy for the busy, stressed-out urban Indian who'd instead order food on the phone than cook. Affordable, with various choices, free home delivery, and other features, food delivery apps gain popularity like never before. All around the world, the rising use of food delivery applications have changed the ways many consumers and food suppliers interact, and the sustainability impacts, defined by the three pillars of economic, social and environmental changes of this, has yet to be comprehensively assessed.

The study is conducted to obtain data on consumer perception towards Food delivery apps in India during Covid-19. The objective of our project is to study the consumer perception towards food delivery apps, the factors that influence consumers in the adoption of food delivery applications and the positive and negative impact of these applications. A sample size of 100 people is selected by ways of convenient sampling.

Data analysis and interpretation is the process of assigning meaning to the collected information and determining the conclusion, significance and implication of the findings. Analysis involves estimating the values of unknown parameters of the population and testing hypotheses for drawing inferences.

Primary data was collected on the basis of a questionnaire method which was designed to collect information required for the study. Interaction with some of the customers was also useful in the study. Secondary data was used for developing literature review for the study. The data collected was analyzed using both statistical tools and percentage analysis. The data collected was analyzed using both statistical tools and percentage analysis. Percentage analysis is the method in which the opinion of the respondents, percentage is calculated for respective scales of each factor. Pie charts and Bar graphs were used as the statistical tools for visual presentation of the categorical data and are also very useful for recording discrete data.

Gender

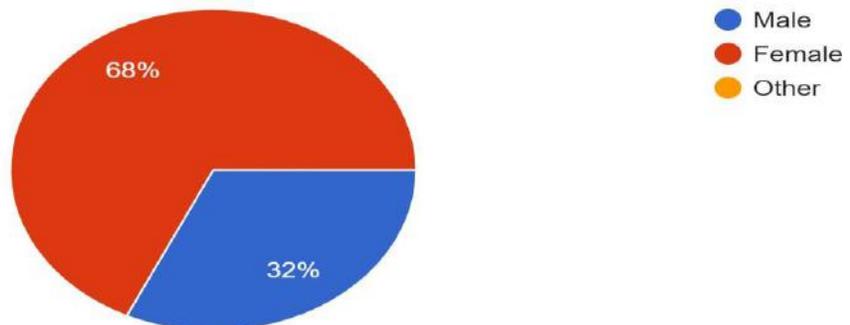
Table No: 3.1 Mentioning Gender of respondents

Determinant	Number	Percentage
Female	68	68
Male	32	32
Others	0	0
Total	100	100

Source: primary data

Figure No. 3.1 Showing gender of respondents

2. Gender
100 responses



Interpretation

From the above figure and chart, we can infer that 68% of the respondents are male, 32% of the respondents are female and no respondents belong to the category of others. This does not mean that more women use food delivery apps.

Age of respondents

Table No: 3.2 Showing age of respondents.

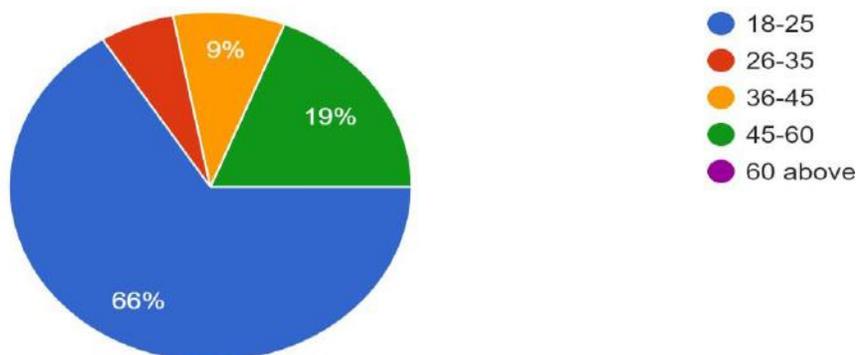
Determinant	Number	Percentage
18-25	68	68
26-35	6	6
36-45	9	9
46-60	19	19
60 Above	0	0
Total	100	100

Source: primary data

Figure No: 3.2 Showing age of respondents

3. Age

100 responses



Interpretation

From the above figure and chart, we can understand that 66% of the respondents are between the ages of 18-25. 6% of the respondents are between the ages of 26-30, 9% of the respondents are between the ages of 36-45, 19% of the respondents between the ages of 45-60 and 0% (none) are of the age above 6

Occupation

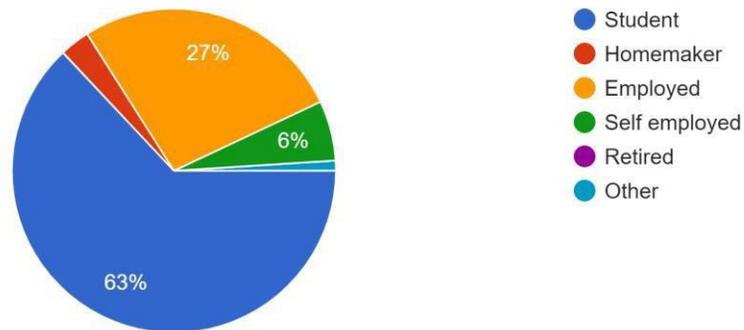
Table No: 3.3 Mentioning occupation of respondents

Determinant	Number	Percentage
Student	63	63
Homemaker	3	3
Employed	27	27
Self employed	6	6
Retired	0	0
Other	1	1
Total	100	100

Source: primary data

Figure No: 3.3 Showing the occupation of respondents

4. Occupation
100 responses



Interpretation

From the above figure and chart we can understand that 63% of the respondents using food delivery apps are students, 6% of the respondents using them are homemakers, 27% using them are employed, 6% of the respondents using them are Self employed and 0%(none) of the respondents using food delivery apps are retired.

Food Preference

Table No: 3.4 Mentioning Food preference of the respondents

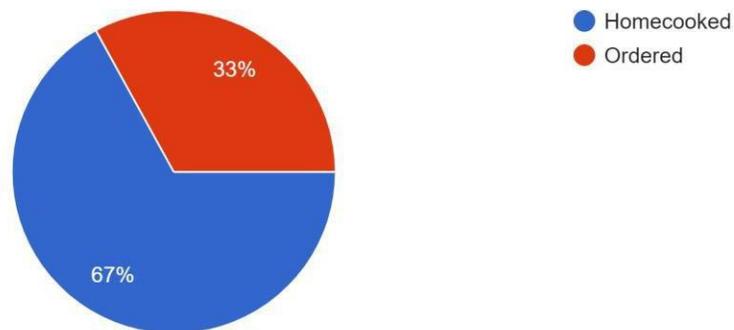
Determinant	Number	Percentage
Homecooked	67	67
Ordered	33	33
Total	100	100

Source: primary data

Figure No: 3.4 Showing food preference by the respondents

5. What type of food do you prefer?

100 responses



Interpretation

From the above figure and chart, we can understand that 67% of the respondents prefer to eat home cooked food while 33% of the respondents prefer ordering their food from restaurants.

Ordering of food

Table No: 3.5 Mentioning the frequency of ordering.

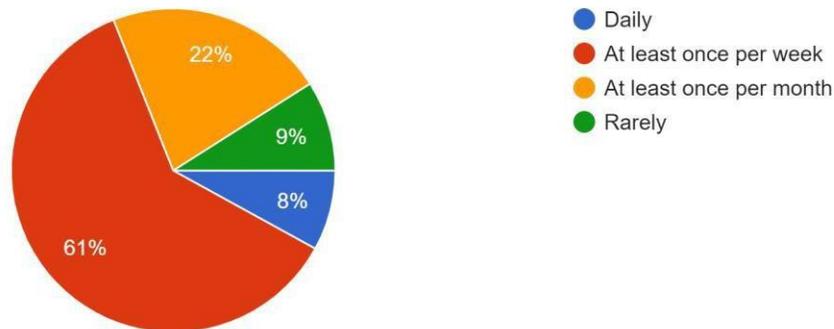
Determinant	Number	Percentage
Daily	8	8
Once per week	61	61
Once per month	22	22
Rarely	8	8
Total	100	100

Source: primary data

Figure No: 3.5 Showing preferred frequency to order

6. How often do you order food?

100 responses



Interpretation

From the above figure and chart, we can understand that 61% of the respondents prefer to order food from a restaurant at least once per week, 22% of the respondents prefer to order food from a restaurant at least once per month, 9% of the respondents rarely order from food from a restaurant and 8% of the respondent's order food daily from restaurants.

Frequency of ordering

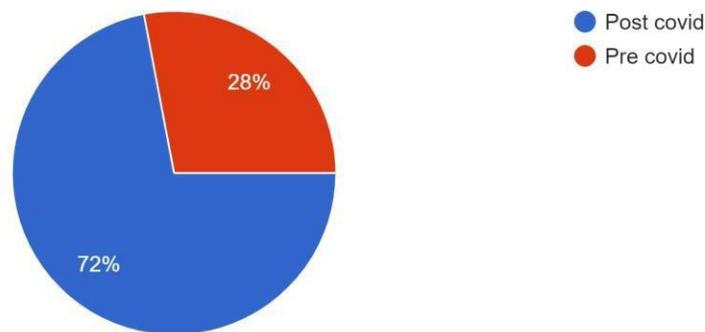
Table No: 3.6 Mentioning the frequency pre covid and post covid

Determinant	Frequency	Percentage
Pre Covid	28	28%
Post Covid	72	72%
Total	100	100

Source: primary data

Figure No: 3.6 Showing the frequency pre covid and post covid

7. Your frequency of ordering food was higher _____.
100 responses



Interpretation

From the above chart we can infer that 72% of the respondents started ordering food from restaurants post covid while 28% of the respondents had already started ordering from restaurants pre covid.

Medium used for ordering

Table No: 3.7 Mentioning the medium used for ordering food

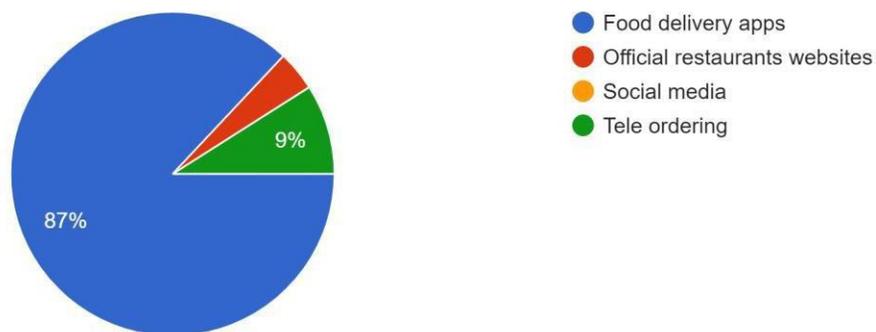
Determinant	Number	Percentage
Food delivery apps	87	87
Official restaurant websites	4	4
social media	0	0
Tele ordering	9	9
Total	100	100

Source: primary data

Figure No: 3.7 Showing the medium used for ordering food

8. Which medium do you prefer for ordering food?

100 responses



Interpretation

From the above figure and chart, we can understand that 87% of the respondents use Food delivery apps to order food, 9% use Tele ordering facility to order food, 4% of the respondents use the restaurants official website to order food and 0% (none) of the respondents use social media facilities to order food from restaurants.

Preferred food Delivery App

Table No: 3.8. Mentioning the delivery app used by respondents.

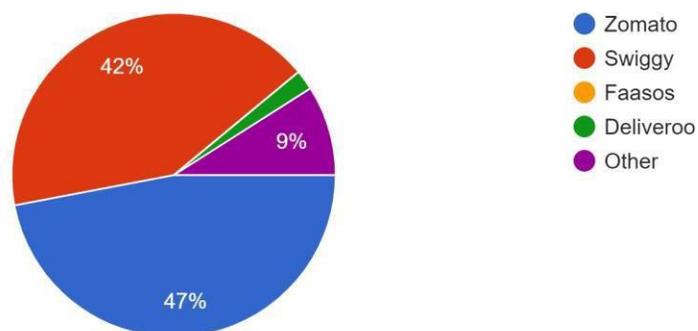
Determinant	Number	Percentage
Zomato	47	47
Swiggy	42	42
Faasos	0	0
Deliveroo	2	2
Other	9	9
Total	100	100

Source: primary data

Figure No: 3.8 Showing the delivery app used by respondents

9. Which food app do you prefer?

100 responses



Interpretation

From the above figure and chart, we can understand that 47% of the respondents use the Zomato app to order, 42% of the respondents use the Swiggy app to order food, 9% of respondents use other unspecified apps to order food, 2% of the respondents use the Deliveroo app to order food and 0% (none) of the respondents use the Faasos app to order food from restaurants.

Reasons for not using Delivery apps

Table No: 3.9 Mentioning reason for not using delivery apps

Determinant	Number	Percentage
High charges & Tax	14	14
Restaurants unable to delivery to desired location	12	12
Does not meet standards of restaurants	1	1
Lack of knowledge to app operation	2	2
Not applicable	54	54
Other	17	17
Total	100	100

Source: primary data

Figure No: 3.9 Showing reasons for not using delivery apps

10. If not, what is the reason for not using food delivery app?

100 responses



Interpretation

According to the above figure and chart we can infer that 54% of the respondents do use food delivery apps and hence the above question is not applicable to them. 17% of the respondents do not use food delivery apps because of other unspecified reasons, 14% of the respondents do not use it because of the high delivery charges and taxes applied, 12% of the respondents do not use food delivery apps to order food as the restaurants do not deliver to their desired location, 2% of the respondents do not use food delivery apps because of lack of knowledge regarding them and 1% of the respondents do not use the food delivery apps as they feel the food which has been delivered through apps do not match the regular standards of the restaurant.

Knowledge of delivery apps

Table No: 3.10 Mentioning how respondents came to know of food delivery app services

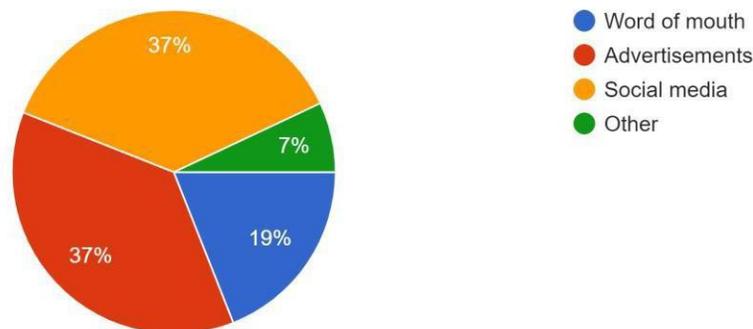
Determinant	Number	Percentage
Advertisements	37	37
Social Media	37	37
Word of mouth	19	19
Other	7	7
Total	100	100

Source: primary data

Figure No: 3.10 Showing how respondents came to know of food delivery app services

11. How did you come to know about the service of food delivery apps?

100 responses



Interpretation

According to the above figure and chart we can understand that 37% of the respondents know about food delivery apps through advertisements or by viewing about them on various forms of social media, 19% of the respondents know about the service of food delivery apps due to word of mouth of its already existing users and 7% of the respondents are aware of food delivery apps due to other unspecified mediums.

Food delivery app order timing

Table No: 3.11 Mentioning the preferred timing of ordering food from delivery apps

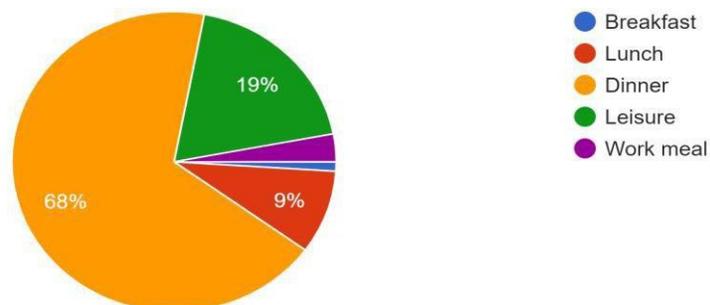
Determinant	Number	Percentage
Breakfast	1	1
Lunch	9	9
Dinner	68	68
Work Meal	2	2
Leisure	19	19
Total	100	100

Source: primary data

Figure No: 3.11 showing showing the preferred timing of ordering food from delivery apps

12. You usually prefer using food delivery apps for ordering _____.

100 responses



Interpretation

From the above figure and chart, we can understand that 68% of the respondents prefer ordering food using delivery apps for dinner, 19% of the respondents prefer to order food from delivery apps during their own desired leisure time. 9% of the respondents prefer ordering food using delivery apps for ordering lunch and 3% of the respondents use food delivery apps for ordering their work meal.

Satisfaction of dietary requirements

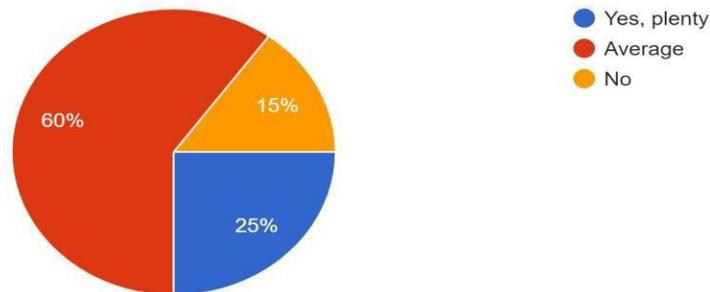
Table No: 3.12 Mentioning satisfaction of fulfilling dietary requirements of users

Determinant	Number	Percentage
Yes, plenty	25	25
Average	60	60
No	15	15
Total	100	100

Source: primary data

Figure No: 3.12 Showing satisfaction of fulfilling dietary requirements of users

13. Do you think there are sufficient options curated for people with specific dietary requirements?
100 responses



Interpretation

From the above figure and chart, we can understand that 60% feel that there is sufficient level of options for people with specific dietary requirements while ordering food from delivery apps but not plenty, 25% of the respondents feel that there are plenty of options for customers with specific dietary requirements that use food delivery apps and 15% of the respondents do not feel that there are enough options curated by food delivery apps for users with specific dietary requirements.

Influence of choice of order

Table No: 4.13 Mentioning what influences choice of order

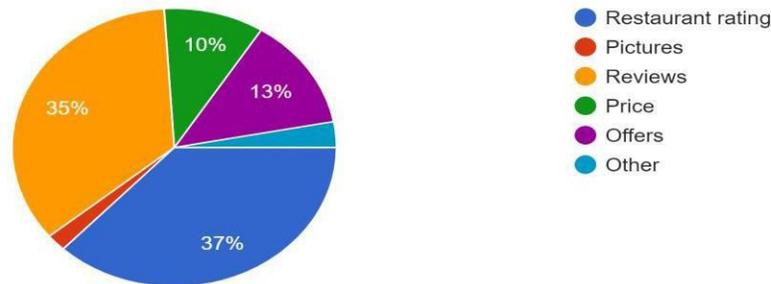
Reason	Number	Frequency
Restaurant rating	37	37
Pictures	2	2
Reviews	35	35
Price	10	10
Offers	13	13
Other	3	3
Total	100	100

source:primary data

Figure No: 3.13 Showing what influences choice of order

14. What influences your choice of order?

100 responses



Interpretation

From the above figure we can understand that 37% of the respondents are influenced by ratings of the restaurant while ordering food, 35% of the respondents are influenced by reviews, 13% of the respondents are influenced by offers, 10% by price, 3% by other unspecified factors and 2% by pictures.

Promotional offers and discounts

Table No: 3.14 Mentioning if respondents are satisfied with discounts and offers provided

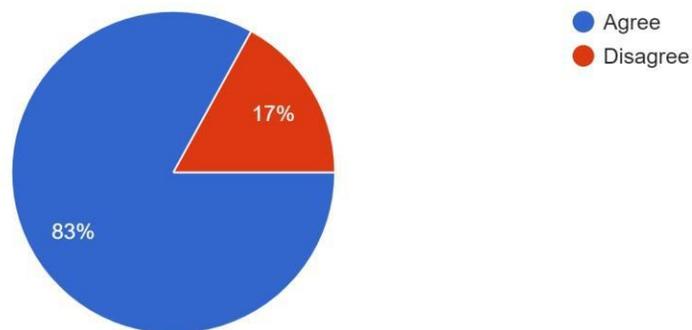
Opinion	Number	Percentage
Agree	83	83
Disagree	17	17
Total	100	100

Source: primary data

Figure No: 3.14 Showing if respondents are satisfied with discounts and offers provided

15. Do you think food delivery apps provide better promotional offers and discounts than restaurants?

100 responses



Interpretation

From the above information we infer that 83% of the respondents are satisfied with the promotional offers and discounts provided by online food delivery apps and 17% of the respondents are not satisfied by them.

Preferred Promotional offer in food delivery apps

Table No: 3.15 showing which is the most preferred promotional offer provided by food delivery apps.

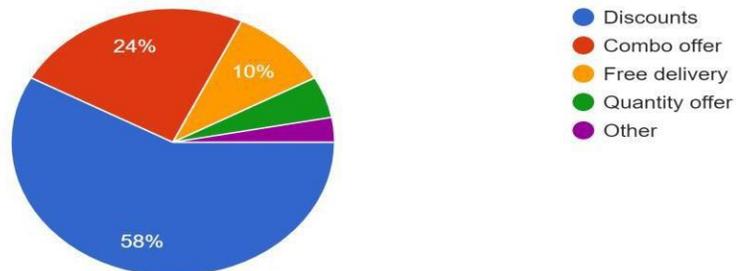
Determinant	Number	percentage
Discounts	58	58
Combo offer	24	24
Free Delivery	10	10
Quantity offer	5	5
Others	3	3
Total	100	100

Source: primary data

Figure No: 3.15 showing preferred promotional offers

16. Which Promotional offer do you prefer while ordering?

100 responses



Interpretation

From the above chart we can infer that 58% of the respondents feel that availing discounts on order is the most effective promotional offer, while 24% of the respondents prefer combo offers, 10% of the respondents prefer free delivery on order, 5% respondents prefer quantity offer, ie buy one get one free meanwhile 3% prefer other promotional offers available

Updates and Announcements from the apps

Table No: 3.16 showing whether the respondents receive updates and announcements from food delivery apps

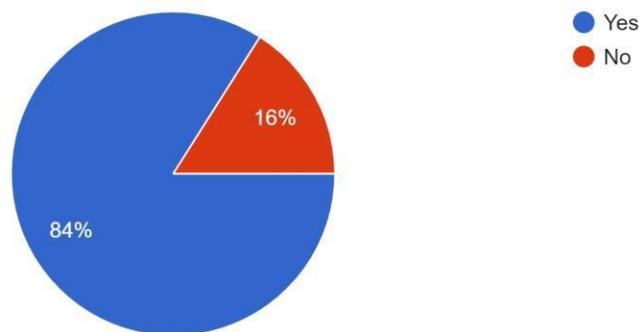
Determinant	Number	Percentage
Yes	84	84
No	16	16
Total	100	100

Source: Primary data

Figure No: 3.16 showing updates and announcements received regarding the apps

17. Do you receive updates and announcements regarding the app?

100 responses



Interpretation

From the above table and figure we can infer that 84% of respondents receive regular updates and announcements from food delivery apps about offers, special occasions etc where 16% of respondents do not receive any updates and announcements. This means most of the respondents disagreeing with receiving announcements and updates have unsubscribed for it.

Premium Membership in a Food delivery app

Table No: 3.17 showing whether the respondents own premium membership to any food delivery app

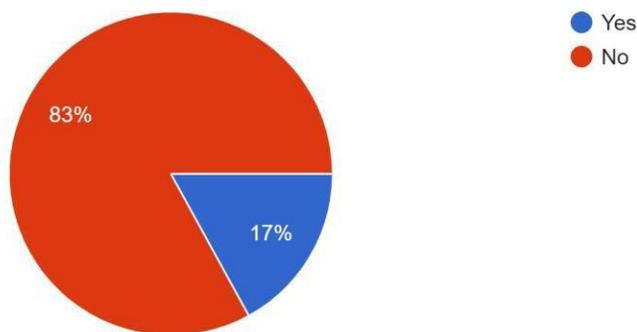
Determinant	Number	Percentage
Yes	83	17
No	83	17
Total	100	100

Source: Primary data

Figure No: 3.17 showing ownership of premium membership

18. Do you have premium membership for any food delivery app?

100 responses



Interpretation

According to the above table and figure, we can infer that 83% of the respondents own premium membership of at least one food delivery app and 17% of the respondents do not own premium membership to any food delivery app. This means 83% respondents avail extra benefits and offers tagging along with premium membership.

Delivery Time

Table No: 3.18 showing whether the usual time taken for food to be delivered to the respondents by food delivery apps.

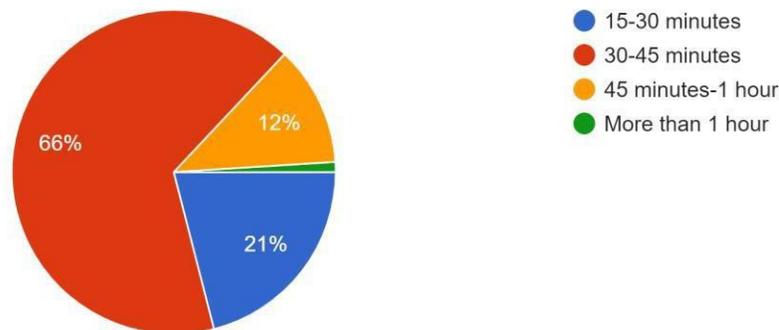
Determinant	Number	Percentage
15-30 minutes	21	21
30-45 minutes	66	66
45 minutes to 1 hour	12	12
More than 1 hour	1	1
Total	100	100

Source: Primary data

Figure No: 3.18 showing the usual delivery time.

19. How long does it usually take for your order to get delivered?

100 responses



Interpretation

According to the table and chart we can infer that for 21% of the respondent's food usually has been delivered within 15-30 minutes of ordering, for 66% of respondents food usually been delivered within 30-45 minutes of order, for 12% respondents food usually has been delivered by 45 minutes to 1 hour and for the remaining 1% respondent food delivery usually has taken more than an hour.

Difference in Quantity of food

Table No: 3.19 showing whether the quantity of food has changed while ordering the same order from different food delivery apps.

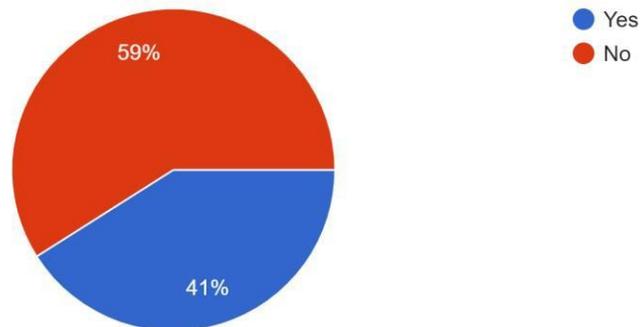
Determinant	Number	Percentage
Yes	41	41
No	59	59
Total	100	100

Source: Primary data

Figure No: 3.19 showing the quantity of food has changed while ordering the same order from different food delivery apps.

20. Have you noticed a difference in the quantity of food while ordering the same order from different food delivery apps?

100 responses



Interpretation

From the above table and chart, we can infer that 59% of the respondents have not experienced any change in the quantity of food when ordering the same item from different food delivery apps where 41% of the respondents have experienced a change in quantity when ordering the same item from different food delivery apps. This means at some occasions the food delivery app can be a factor in the quantity of food consumers receive.

Technical or Other order related issues

Table No: 3.20 showing whether the respondents have faced technical or other order related issues in food delivery apps.

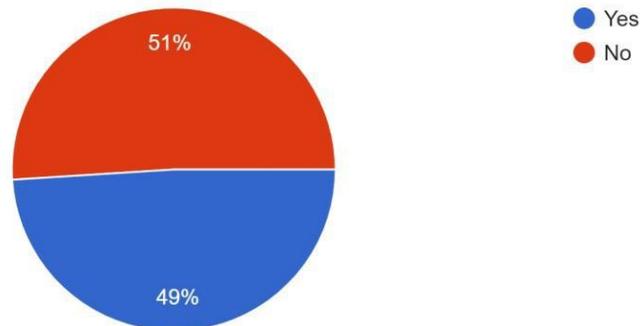
Determinant	Number	Percentage
Yes	49	49
No	51	51
Total	100	100

Source: primary data

Figure No: 3.20 showing technical or other order related issues in food delivery apps

21. Have you faced any technical or other order related issues while using the app?

100 responses



Interpretation

According to the above chart and figure we can infer that 51% of the respondent have unfortunately faced technical or other order related issues while ordering food from apps where 49% of the respondents have not faced any such difficulties yet by ordering from food delivery apps.

Customer Service

Table No: 3.21 showing how the customer service has attended to issues faced by respondents.

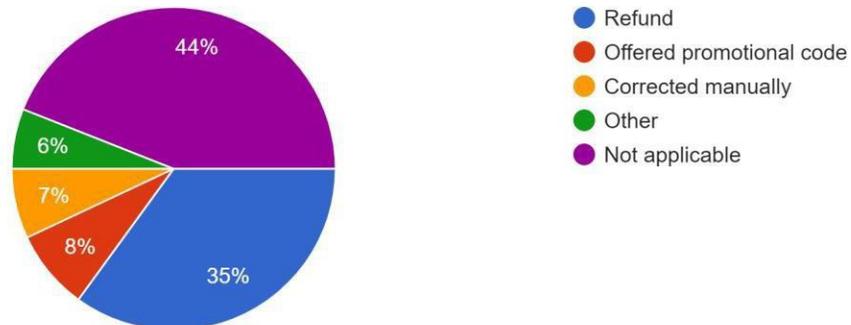
Determinant	Number	Percentage
Refund	35	35
Offered Promotional code	8	8
Corrected manually	7	7
Other	6	6
Not applicable	44	44
Total	100	100

Source: primary data

Figure No: 3.21 Solutions to issues faced by consumers

22. If yes, how was your issue addressed by the customer service?

100 responses



Interpretation

According to the above table and chart, we can infer that as solutions to issues faced by respondents, 35% of the respondents have been provided with refund, 8% of the respondents have been offered with promotional code for next order, 7% of respondents had their issues corrected manually, 6% respondents had their issues solved by other means and 44% have not faced any issues yet, for it to be solved.

Reliability and Effectiveness of Customer service

Table No: 3.22 showing whether the customer service of food delivery apps are reliable and effective.

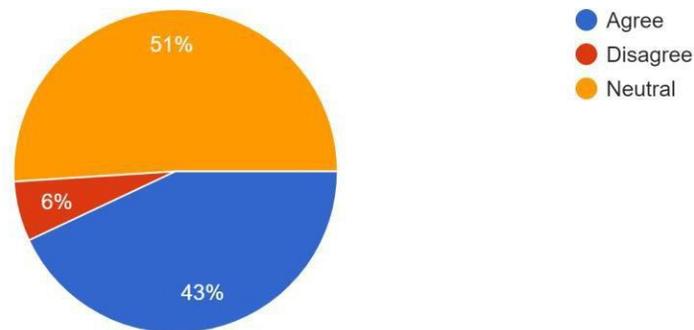
Determinant	Number	Percentage
Agree	43	43
Disagree	6	6
Neutral	51	51
Total	100	100

Source: Primary data

Figure No: 3.22 Customer perception of reliability and effective of customer service

23. Do you think customer service is reliable and effective?

100 responses



Interpretation

From the above table and chart, we can infer that, out of 100 respondents, 43% of the respondents agree with the fact that customer service is reliable and effective, 6% of the respondents feel customer service is not reliable and effective whereas majority of the respondents, that is 51%, do not have an opinion about the customer service of food delivery apps.

Customer feedback taken into Consideration

Table No: 3.23 showing customer feedback taken into consideration.

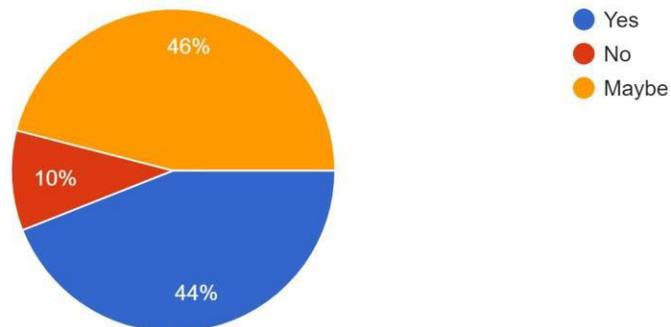
Consideration	Number	Percentage
Yes	44	44
No	10	10
Maybe	46	46
Total	100	100

Source: Primary data

Figure No: 3.23 showing the customer feedback relevance

24. Do you think delivery apps take customer feedback into consideration?

100 responses



Interpretation

According to the above chart and figure, we can infer that 44% of the respondents feel that the customer care takes their feedback into consideration, 10% do not feel that their feedback is not taken into consideration and 46% of the respondents are not sure if their feedback is valued.

Other services used most in food delivery apps

Table No: 3.24 Showing other services used mostly in food delivery apps.

Services	Number	Percentage
Table booking	3	3
Pick up or drop of items	30	30
Buy anything from any store	26	26
Meat and seafood store	15	15
Other	26	26
Total	100	100

Source: primary data

Figure No: 3.24 showing what kind of other services respondents use.

25. What are the other service have you used the most in food delivery apps?

100 responses



Interpretation

According to the above table and chart, 30% of the respondents use food delivery apps the most for picking and dropping any items, 26% of the respondents use it to buy anything from any shop, 15% of respondents use the food delivery app for buying meat and seafood, 3% of the respondents use it for booking tables while dine in and 26% of respondents use it for other additional services.

Real time order tracking service

Table No: 3.25 showing whether the respondents feel accurate and trustworthy.

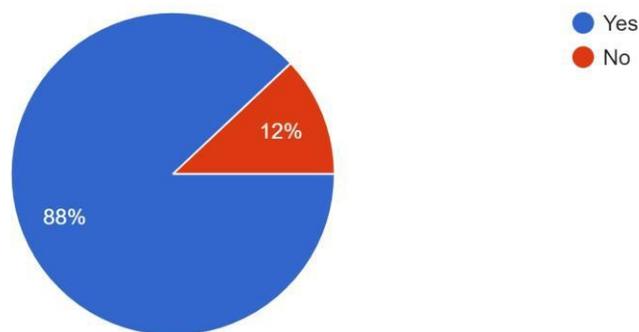
Determinant	Number	Percentage
Yes	88	88
No	12	12
Total	100	100

Source: primary data

Figure No: 3.25 showing whether the respondents feel trustworthy and accurate.

26. Do you think the real time order tracking service on food delivery apps is accurate and trustworthy?

100 responses



Interpretation

From the above table and chart, we can infer that 88% of the respondents feel that the real time tracking service is accurate and trustworthy whereas, the remaining 12% feel that the real time tracking service is not accurate and trustworthy.

Philanthropic activity participation

Table No: 3.26 showing whether food delivery apps involve philanthropic activities according to respondents

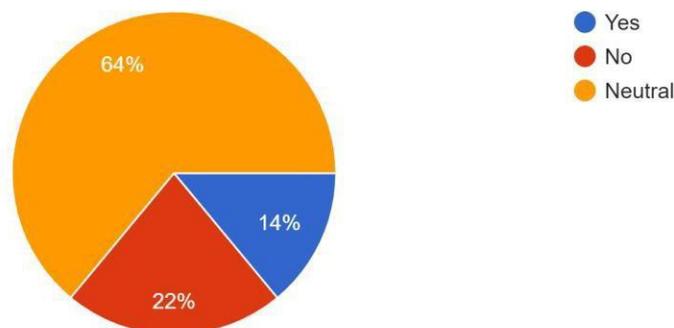
Determinant	Number	Percentage
Yes	14	14
No	22	22
Neutral	64	64
Total	100	100

Source: primary data

Figure No: 3.26 participation in philanthropic activities

27. Do you think food delivery apps are involved in sufficient philanthropic activities?

100 responses



Interpretation

From the above chart and table, we can infer that, 14% of the respondents feel that food delivery apps have active involvement in philanthropic activities, whereas 22% of the respondents feel that they are not involved in philanthropic activities and the rest 64% of the respondents do not have an opinion on this subject.

Packing of food

Table No: 3.27 showing where packaging is safe and effective in food delivery apps

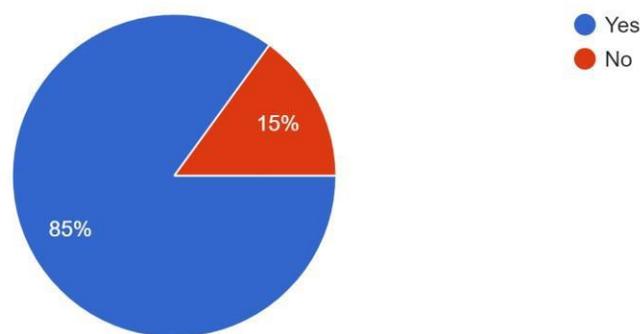
Determinant	Number	Percentage
Yes	85	85
No	15	15
Total	100	100

Source: primary data

Figure No: 3.27 safety in packaging

28. Do you find the packing of food ordered from food delivery apps effective and safe?

100 responses



Interpretation

According to the above chart and table, we can infer that 85% of the respondents find the packaging of food ordered from the food delivery apps effective and safe, but the remaining 15% of the respondents feel that food ordered from food delivery apps are not packed safely and hygienically.

Safety during Covid 19 pandemic

Table No: 3.28 showing whether the customers are satisfied by the safety measures adopted during the pandemic.

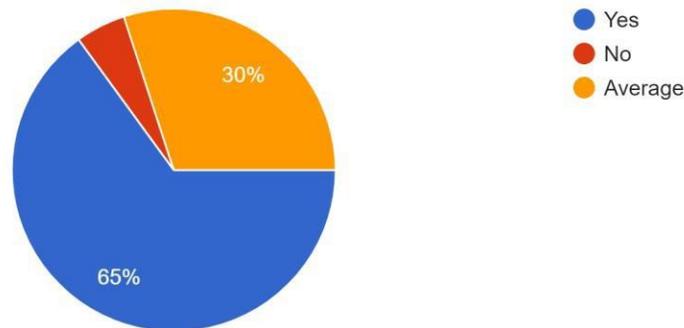
Determinant	Number	Percentage
Yes	65	65
No	5	5
Average	30	30
Total	100	100

Source: primary data

Figure No: 3.28 showing whether the customers are satisfied by the safety measures.

29. Are you satisfied with the safety measures adopted by food delivery apps during Covid 19 pandemic?

100 responses



Interpretation

From the above chart and table, we can infer that 65% of the respondents feel that the food delivery apps take necessary measures amidst the Covid-19 pandemic, 30% of the respondent feel that the safety measures taken are only average and 5% of the respondents feel that ordering food from food delivery apps is unsafe during Covid-19.

Order frequency variation

Table No: 3.29 showing the change in frequency of ordering by respondents during restricted times of the pandemic

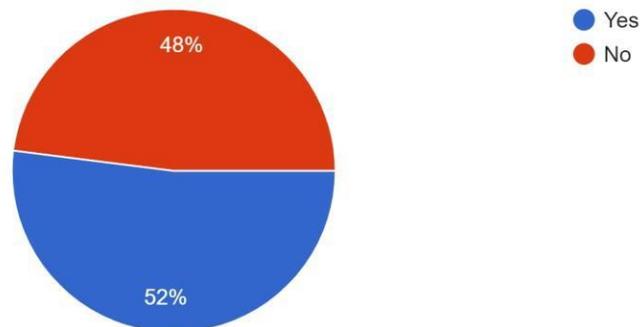
Determinant	Number	Percentage
Yes	52	52
No	48	48
Total	100	100

Source: primary data

Figure No: 3.29. showing variation in frequency of orders

30. Has your order frequency been affected due to government restrictions like curfew, during Covid 19?

100 responses



Interpretation

According to the above table and chart, we can infer that 52% of the respondents feel that their ordering frequency has been affected due to curfew or other additional restrictions during Covid-19 and the remaining 48% do not feel that their ordering frequency has been affected amidst Covid-19 curfew or other additional restrictions .

Mode of Payment

Table No: 3.30 showing the commonly used mode of payments for ordering by respondents.

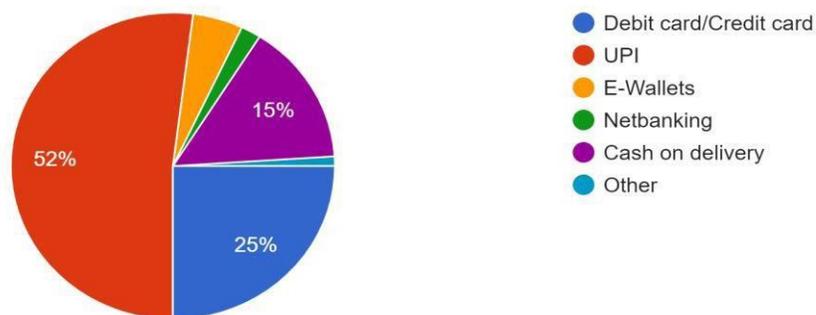
Determinant	Number	Percentage
Debit card/Credit card	25	25
UPI	52	52
E-Wallet	5	5
Netbanking	2	2
Cash On Delivery	15	15
Other	1	1
Total	100	100

Source: primary data

Figure No: 3.30 showing the mode of payments

31. Preferred mode of payment while using food delivery apps?

100 responses

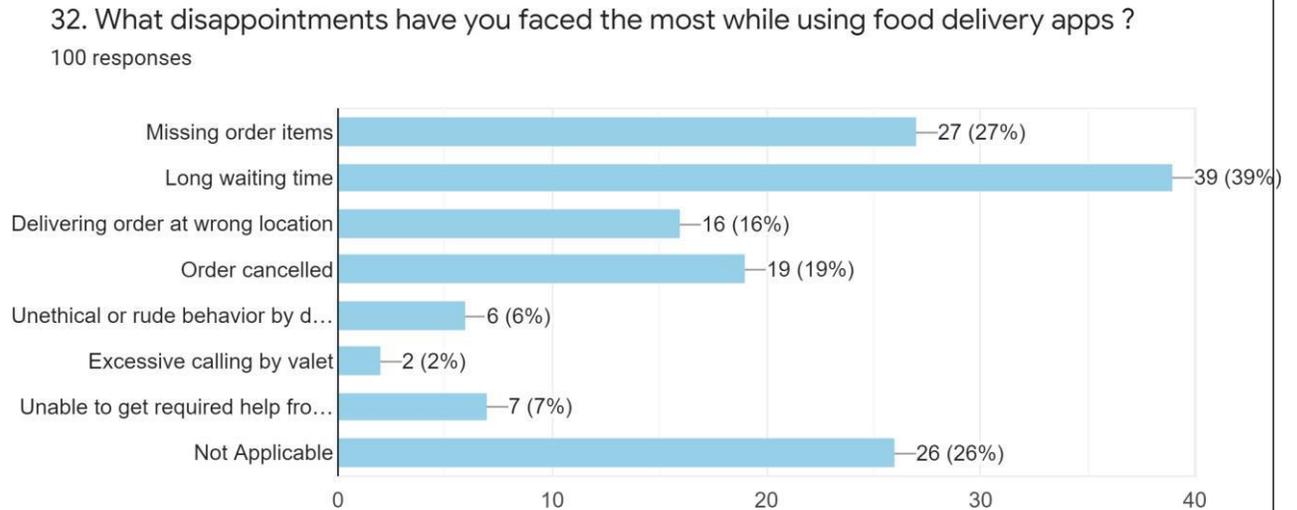


Interpretation

From the above data we can infer that 52% of the respondents use UPI for payment, 25% of the respondents use Debit or Credit card, 15% of the respondents opt for cash on delivery, 5% of the respondents use E-wallets and 2% use other modes of payment. None of the respondents use net banking usually for payment procedure while ordering from food delivery apps.

Difficulties faced by food delivery apps

Figure No: 3.31 showing the commonly caused difficulties by respondents



Source: primary data

Interpretation

From the above data we can infer that 39% of the respondents are troubled by long waiting time for delivering food, 27% of the respondents have faced missing order items, 16% of the respondents have had their orders delivered at wrong locations, 19% of the respondents have had their orders canceled, 6% of respondents have faced rude or unethical behavior by delivery valets, 2% of the respondents have faced excessive calling by delivery valet, 7% of the respondents have not acquired desired help from customer care whereas 26% of the respondents have not faced any difficulties while using food delivery apps.

Grocery and Medicine in food delivery apps

Figure No: 3.32 showing the response on buying groceries and medicines from food delivery apps

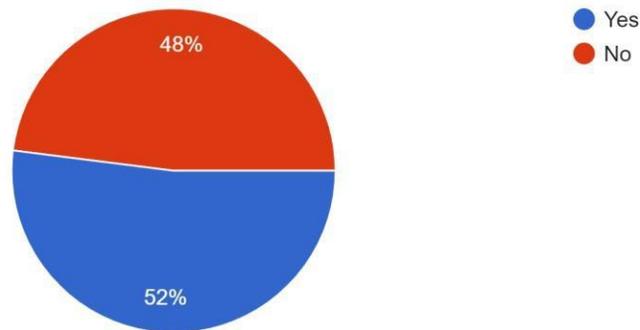
Determinant	Number	Percentage
Yes	52	52
No	48	48
Total	100	100

Source: primary data

Figure No: 3.32 showing purchase of groceries and medicines from food delivery apps

33. Have you tried ordering grocery or medicines from food delivery app?

100 responses



Interpretation

From the above chart and table we can infer that 52% of the respondents have used the grocery and medicine ordering facility in food delivery apps and the remaining 48% of the respondents have not used the grocery and medicine ordering facility in food delivery apps.

Experience of ordering grocery and medicine in food delivery apps

Figure No: 3.33 Showing the experience of buying grocery and medicine from food delivery apps by respondents

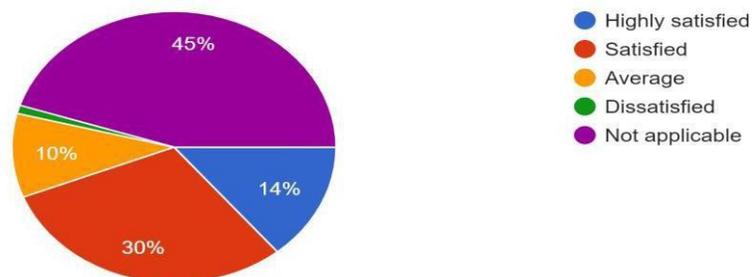
Determinant	Number	Percentage
Highly satisfied	14	14
Satisfied	30	30
Average	10	10
Dissatisfied	1	1
Not applicable	45	45
Total	100	100

Source: primary data

Figure No: 3.33 Showing experience of buying grocery and medicine from food delivery apps

34. If yes, how was the experience

100 responses



Interpretation

From the above data we can infer that 30% of the respondents are satisfied with the use of food delivery apps for acquiring groceries or medicine, whereas 10% of the respondents find it only average, meanwhile 14% of the respondents are highly satisfied, and 1% of the respondents are dissatisfied. 45% of the respondents have not used this feature, hence are not applicable.

Employment Opportunities

Figure No: 3.34 Showing respondent feedback on higher employment opportunities in food delivery app secretary during the pandemic.

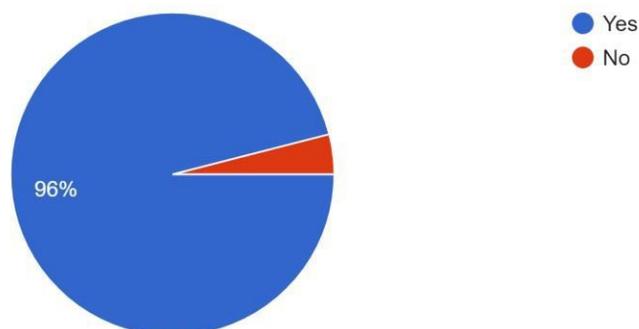
Determinants	Number	Percentage
Yes	96	96
No	4	4
Total	100	100

Source: primary data

Figure No: 3.34 Showing rise of employment opportunities provided by food delivery apps.

35. Do you think there has been a rise in employment opportunities by food delivery apps, especially during Covid 19?

100 responses



Interpretation

From the above chart and table we can infer that 96% of the respondents agree that food delivery apps have provided high employment opportunities to the population during the Covid 19 pandemic and the remaining 4% of the respondents do not feel that they have provided sufficient employment opportunities during Covid-19.

CHAPTER 4
FINDINGS, SUGGESTIONS AND CONCLUSION

Findings

The survey sample of people selected was 100 out of which, the most as 66% of the total respondents belonged to the age group of 18-25 years; compared to the age group 26-35 years as we have 6% of respondents, 9% of respondents who are between the ages of 36-45 and 19% respondents who are between the ages 45-60. Thus people of mostly all age groups are likely to accept and adopt usage of online food delivery apps

We infer that gender is an irrelevant factor when it comes to consumer attitude towards using online food delivery apps as we have 68% female respondents and 32% male respondents.

From the survey we can infer that, out of 100 respondent's student respondents were the highest followed by employees, self-employed, homemakers and the lowest number of respondents belong to the category of others.

Most of the people who responded to our survey preferred home cooked food compared to the minority 33% of the respondents who preferred food ordered from restaurants.

61% of the total respondents use food delivery apps at least once a week, whereas 22% of the respondents use it at least once a month. 8% of the respondents use the facility of food delivery daily but in contrast 9% of the respondents rarely use the facility.

From the survey, we were able to find out that 72% of the respondents increased usage of food delivery apps after the COVID-19 pandemic, probably due to lack of access or fear towards dine in facilities offered by restaurants. Whereas 28% of the respondents preferred using the app prior to the pandemic as they might have been concerned regarding the safety measures taken while preparing the food or delivering it, as there are chances of contracting the virus via the delivery valet.

Majority of the respondents, that is 87%, prefer ordering food via food delivery apps as it is a single destination with a curated list of restaurants and cuisines for consumers to choose from and they are also user friendly. Meanwhile 9% of the respondents prefer tele ordering as they are probably not aware or well versed regarding the practical usage of food delivery apps and the minority of 4% prefer ordering food from the official website of the restaurant, as most of the food chains occasionally provide better offers there.

While the majority of the respondents, that is 54% use food delivery apps, 14% of the respondents do not use them due to high delivery charges and taxes. Delivery charges usually vary due to distance, weather, rush hours etc. 12% of the respondents do not use food delivery apps because their restaurant of choice does not deliver to their desired location, 2% of the respondents lack knowledge regarding the practical use of the app, meanwhile 1% of the respondents feel that the apps do not meet restaurant delivery standards. 17% of the respondents do not use food delivery apps due to other unknown reasons such as lack of connectivity, remote location, etc.

From the study we can conclude that an equal number of respondents i.e 37% came to know about food delivery apps via traditional advertisements and advertising through social media. Traditional methods of advertising include advertising through print media, radio, television, etc. Leading food delivery apps have an active social media profile (Instagram, Twitter, Facebook etc.) through which they promote the use of their apps by sharing creative content in the form of posts, stories, tweets etc. They collaborate with various artists or celebrities to attract their fan base too. 19% of the respondents came to know about food delivery app services by word of mouth whereas the 7% of the respondents came to know through other mediums.

The app Zomato is preferred for ordering food over Swiggy, the second most preferred, by a slight margin. The app was launched in 2008 by Deepinder Goyal and Pankaj Chaddah. Zomato has brought together big and small restaurants filtered by your GPS location on a single platform for the consumer's benefit. The menus are scanned and uploaded, and you can also get reviews from people who have had previous experience with the place. They provide a wider variety of options in food as well as extra services provided, table bookings, better offers and exclusive privileges to Zomato pro members.

Installs: 100,000,000+

Rating: 4.0

Reviews: 4,631,802

Whereas Swiggy, based in Bangalore and operated by Bundl Technologies Private Limited, Swiggy

was founded in 2014 by Nandan Reddy, Rahul Jaimini, and Sriharsha Majety. This hyperlocal food delivery app currently operates in 25 cities in India. Swiggy has curated an array of unique services such as the Genie platform which enables the consumers to deliver anything you need to their desired location. They have also recently launched the Instamart feature which provides the facility of ordering groceries from Swiggy's very own centralized shop. They also have a specialized feature for meat and seafood lovers. Swiggy has established a reputation for itself in the online food delivery space in a short span.

Installs: 50,000,000+

Rating: 4.3

Reviews: 2,389,440

25% of the respondents feel that there are plenty of options curated for specific dietary requirements such as vegan, dairy free, gluten free, calorie deficit, organic, etc. Whereas 60% of the respondents feel there are sufficient number of options and 15% of the the respondents do not feel that food delivery apps offer services for people with specific diets.

37% of the respondents took restaurant ratings into consideration while ordering food from the apps. Restaurant ratings are fixed by the aggregate of individual ratings given by previous customer orders. 35% of the respondents cross check reviews in the form of customer feedback prior to ordering. 13% of the respondents are influenced by the available promotional offers such as discounts, combo offers, quantity offers, etc. 10% of the respondents take into consideration the price of items while ordering while 2% of the respondents cross check with pictures available in the app and 3% of the respondents have other factors such as faster delivery time, etc

Majority of respondents, 58%, regard discounts as the best type of promotional offer. Discounts are provided either by restaurants or by the app on special occasions (Diwali, New Year etc). Few examples are, cashback offer, first food order, selected orders or for use of particular credit cards, debit cards, or digital wallet for making payments. Then comes the combo offer, with 24% of the respondents, in which 'combo' is a word which is used instead of 'combination'. So, when an offer comes in combination with some other thing it is called a combo offer, eg, Fried Rice + Chilly Gobi combo or Biryani + Mint lime combo.

10% of the respondents look out for free delivery options as usually high delivery charges create a huge margin between gross bill payable and total bill payable. 5% of the respondents prefer quantity offers, example of which is Buy 1 get 1 free etc., whereas 5% of the respondents prefer other promotional offers.

Majority users, that is, 84% of the respondents receive regular updates and announcements from their respective food delivery apps via email, text messages or app notifications. These updates and announcements are usually about exclusive offers, limited time period discounts etc. These updates and announcements can be unsubscribed for if the user does not want to receive it.

83% of the respondents do not own any premium membership for any food delivery app probably due to lack of knowledge regarding the benefits, affordability or not finding it effective. 17% of the respondents have subscribed for premium membership. For example, Zomato has the feature of Zomato Pro, which is an all-encompassing membership that unlocks amazing privileges and discounts at the best restaurants across dining out and delivery. Each member will get access to all the extra perks at no additional cost in addition to some never-seen-before exclusive privileges on the Zomato app and a unique money-back guarantee for all Pro members.

Similarly, Swiggy has a feature called Swiggy One. The Swiggy One membership offers unlimited free deliveries from all restaurants along with free Instamart grocery deliveries, something that was missing from Swiggy's Bite and Binge subscription plans. Instamart orders only above ₹99 will be eligible for free delivery

59% of the respondents do not feel that there is a difference in the quantity of food when ordered from food delivery apps. Meanwhile, 41% of the respondents have a contrasting opinion. This might

be due to the assumption that restaurants try to vary with the quantity of food they provide because they have to pay a hefty amount of commission per order to these third-party aggregators like food delivery apps.

Out of the 49% of the respondents who faced issues while using the app, 35% of them were compensated by providing refund, 8% of them were resolved by providing promotional offer code, 7% of them were corrected manually, probably by returning the order to the correct location etc, and 6% of them had their issues addressed by other means. Majority of respondents, 44%, felt that their issues were not rectified as desired by customer service.

Other than ordering food from restaurants, majority of the customers i.e 30% use online food delivery apps for their service in which pick up and drop of any item can be done by delivery valets assigned by the app. This service allows pick up and drop off of items such as lunch boxes, documents, laundry, items for repair, shoes, stationery and other materials from one location to another from anywhere in your city. The next 26% of the respondents use the additional facility of buying any item available from the curated list of shops mentioned in the app. They include a wide range of items such as Instant meals, snacks, fruits and vegetables, ice creams, etc. 15% of the respondents additionally use food delivery apps to get fresh poultry and seafood delivered at their doorstep. 3% of the respondents use the apps for saving time and booking tables at their favorite restaurants easily, while 26% of the respondents use the food delivery apps for other additional services provided.

14% of the respondents feel that food delivery apps are doing a good number of philanthropic activities such as the daily feeding program by Zomato that serves cooked meals to people in need daily across India or the Swiggy Hunger Saviour Covid Relief Fund initiative by Swiggy that aims at collecting funds towards safety and welfare of delivery partners as well as their families. Meanwhile 64% of the respondents feel there are just enough philanthropic initiatives undertaken by food delivery apps and 14% of the respondents feel not enough interest is being out in this feel and more initiatives are required.

The majority 65% of the respondents feel that food delivery apps are adopting effective safety measures such as temperature tracker on its apps to make the customers aware of the body temperature of all the stakeholders from the cook to the delivery boy, and safety badges for those who comply with the highest standards of hygiene. The badges will be given to restaurants

following best practices and that have features like temperature control, masks, sanitation after 4 hours and safe packaging. or the no-contact delivery feature which makes sure that you do not come in contact with the delivery partner. 30% of the respondents feel that moderate amounts of safety measures are being taken while 5% of the respondents feel that safety measures taken by online food delivery apps during the Covid 19 pandemic are inadequate.

52% of the respondents prefer making payments using UPI portals such as PhonePe, Paytm, BHIM app, Google Pay. Meanwhile 25% of the respondents prefer using Debit/Credit cards for making their payments and 15% of the respondents prefer to make the payment directly to the delivery valets in the form of cash. E- Wallets like ICICI Pockets., Airtel Money, Freecharge, etc are preferred by 5% of the respondents and 2% of the respondents make their payments through the Net Banking facility using the PIN provided to them by their bank.1% of the respondents use other mediums to make their payment.

Suggestions

Today more than ever, people are ordering their meals from a food delivery service. Hence it becomes more important for food delivery apps to enhance their operations.

The first thing you want to look into is how many new restaurants have started in a particular area. Are any of them local or non-franchise ownerships? Make a list of these and plan to reach out to see if they'd like to add your food delivery service.

The next thing to review is the size of your delivery radius. If the size is too big, the delivery valets will probably take a longer time to make deliveries. They need not reduce their delivery radius; however, they should consider adding another base of operations to handle extra deliveries, especially if a certain quadrant is getting a lot more requests than others.

The food delivering apps should gain the trust of the people through transparent payment methods.

Providing exceptional customer experience is not limited to serving them delicious food; it should also be extended to after sales service as well, that is, efficient customer care support for issues faced by customers regarding orders. Instead of providing scripted solutions, they should provide personalized solutions to customer hindrances.

Take precautions that food doesn't spill within the package as it is unappealing and less appetizing. They can try out different packaging techniques and take advantage of spill free containers for delivery orders. The delivery valets need to be advised to make sure that the food was packaged intact while taking the order from the restaurant.

For example, don't forget to add safety seal stickers to every bag to guarantee food freshness and integrity. Add small freebies like wet napkins personalized with your brand name and logo or funky stickers to make packaging seem much more interesting and aesthetic.

Packaging containers should be sanitized well from the exterior and delivery valets should handle these containers only using gloves.

The food delivery apps must consist of clear pictures of the food from food joints that people order from instead of just having a name. This gives people clarity on what exactly they are ordering and will also attract customers to use the app for the same.

All food delivery apps must contain a proper feature which allows the user to customize their food and give proper instructions for cooking or delivering.

All the customer feedback and review need to be addressed, so that no customer grievance goes unnoticed and every single customer feels important to the food delivery company. This ensures retainment of existing customers and increase in potential customers.

Food delivery apps can initiate an informative corner which showcases its customers, information on all important and relevant days connected to the food industry or food culture globally, with special focus on India.

Customers can be entertained or appreciated by holding online competitions such as quizzes, games or spin the wheel on the app. These competitions can be associated with offering free promotional codes, gift hampers or offers for winners. This will increase the interaction between customers and the application.

Conclusion

We are emerging in a world in which more people are choosing to order food at home than dine in and people order groceries from online rather than to go grocery shopping. Increasing number of people have downloaded food delivery apps and are willing to try restaurants that only exist online.

The pandemic accelerated food delivery app's success when millions were confined to their homes under lockdown and food delivery apps were the only tools for people to get what they wanted, when they wanted it, and how they wanted it.

From our study about consumer perception towards food delivery apps in India, we found out that the majority of the respondents have positive feedback about food delivery apps. It offers many benefits to the society like, it is consumer friendly, accelerates M-Commerce, easy to attract new customers, build a visible brand, a big boost to customer retention and creating a professional workforce.

"Food delivery apps are the future of food industry"

CHAPTER 5
BIBLIOGRAPHY

In this project report while finalizing and analyzing quality problems in detail the following websites have been referred to. All the materials detailed below provided effective help and a guiding layout.

WEBSITES:

<https://www.zomato.com/>

<https://www.swiggy.com/>

www.researchgate.net

www.scribd.com

<https://economictimes.indiatimes.com/defaultinterstitial.cms>

<https://tradebrains.in/>

<https://www.quora.com/>

ANNEXURE

QUESTIONNAIRE: CONSUMER PERCEPTION TOWARDS FOOD DELIVERY APPS IN ERNAKULAM DURING COVID-19

Dear respondents,

We are collecting the following information as a part of our B.com final year project on “A study on consumer perception towards Food delivery apps in India during Covid 19”. We assure you that the information provided will be confidential and will be utilized only for the aforesaid purposes.

1. Name _____
2. Gender
 - Male
 - Female
 - Others
3. Age
 - 18-25
 - 26-35
 - 36-45
 - 45-60
 - 60 above
4. Occupation
 - Student
 - Homemaker
 - Employed
 - Self employed
 - Retired
 - Other
5. What type of food do you prefer?
 - Homecooked
 - Ordered
6. How often do you order food ?

- Daily
 - At Least once per week
 - At Least once per month
 - Rarely
7. Your frequency of ordering food was higher_____.
- Post Covid
 - Pre Covid
8. Which medium do you prefer for ordering food?
- Food delivery apps
 - Official restaurant website
 - Social media
 - Tele ordering
9. Which food app do you prefer?
- Zomato
 - Swiggy
 - Faasos
 - Deliveroo
 - Other
10. If not, what is the reason for not using a food delivery app?
- High delivery charge and taxes
 - Certain restaurants unable to deliver to desired location
 - Does not meet standard of restaurant delivery
 - Lack of knowledge related to operation of the app
 - Not Applicable
 - Other
11. How did you come to know about the service of food delivery apps?
- Word of mouth
 - Advertisements
 - Social media
 - Other

12. You usually prefer using food delivery apps for ordering _____
- Breakfast
 - Lunch
 - Dinner
 - Leisure
 - Work meal
13. Do you think there are sufficient options curated for people with specific dietary requirements?
- Yes, Plenty
 - Average
 - No
14. What influences your choice of order?
- Restaurant rating
 - Pictures available by other customers
 - Reviews
 - Price
 - Offers
 - Time for delivery
 - Other
15. Do you think food delivery apps provide better promotional offers and discounts?
- Agree
 - Disagree
16. Which promotional offer do you prefer while ordering?
- Discounts
 - Combo offer
 - Free delivery
 - Quantity Offer
 - Other
17. Do you receive updates and announcements regarding the app?
- Yes
 - No
18. Do you have premium membership for any food delivery app?

- Yes
- No

19. How long does it usually take for your order to get delivered?

- 15-30 minutes
- 30-45 minutes
- 45 minutes-1 hour
- More than 1 hour

20. Have you noticed a difference in the quantity of food while ordering the same order from different food delivery apps?

- Yes
- No

21. Have you faced any technical or other order related issues while using the app?

- Yes
- No

22. If yes, how was your issue addressed by the customer service?

- Refund
- Offered promotional code
- Corrected manually
- Other

23. Do you think customer service is reliable and effective?

- Agree
- Disagree
- Neutral

24. Do you think delivery apps take customer feedback into consideration?

- Yes
- No
- Maybe

25. What are the other services you use in food delivery apps?

- Table Bookings
- Pick up or drop of any items (home food, care packages, documents, clothes, etc)
- Buy anything from any store

- Meat and seafood store
- Other

26. Do you think the real time order tracking service on food delivery apps is accurate and trustworthy?

- Yes
- No

27. Do you think food delivery apps are involved in sufficient philanthropic activities?

- Yes
- No

28. Do you find the packing of food ordered from food delivery apps effective and safe?

- Yes
- No

29. Are you satisfied with the safety measures adopted by food delivery apps during Covid 19 pandemic?

- Yes
- No
- Average

30. Has your order frequency been affected due to government restrictions like curfew, during Covid 19?

- Yes
- No

31. Preferred mode of payment while using food delivery apps?

- Debit card/ Credit card
- UPI
- E-Wallets
- Net banking
- Cash on delivery
- Other

32. What disappointments have you faced the most while using food delivery apps?

- Missing order items
- Long waiting time
- Delivering order at wrong location
- Order canceled
- Unethical or rude behavior by delivery valet
- Excessive calling by valet

- Unable to get required help from customer service
- Not Applicable

33. Have you tried ordering groceries or medicines from a food delivery app?

- Yes
- No

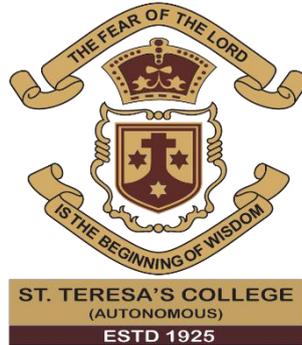
34. If yes, how was the experience?

- Highly satisfied
- Satisfied
- Average
- Dissatisfied
- Not applicable

35. Do you think there has been a rise in employment opportunities by food delivery apps, especially during Covid 19?

- Yes
- No

ST. TERESA'S COLLEGE
(AUTONOMOUS)
AFFILIATED TO MAHATMA GANDHI UNIVERSITY



E-VACCINATION SYSTEM
PROJECT REPORT

In partial fulfilment of the requirements for the award of the degree of
BACHELOR OF VOCATION IN
SOFTWARE DEVELOPMENT

By
AISWARYA BENNY
B.Voc Software Development
Register No: VB19SWD001

Under the guidance of
Smt. Sheeba Emmanuel

DEPARTMENT OF COMPUTER APPLICATIONS
2019-2022

CERTIFICATE



This is to certify that the project report entitled "E-VACCINATION SYSTEM", a bonafide record of the work done by AISWARYA BENNY during the year 2021-22 and submitted in partial fulfilment of the requirements for the degree of Bachelor of Vocational Software Development under Mahatma Gandhi University.

Rd.

Head of the Department

Shubal E
06/04/2022

Internal Examiner



Auth

External Examiner



An ISO 9001:2015 Certified Company



APRIL 5, 2022

TO WHOM SO EVER IT MAY
CONCERN

This is to certify that **AISWARYA BENNY**, 6th Semester, **BVOC – Software Development** student of **ST. TERESA’S COLLEGE, ERNAKULAM** has successfully completed a project titled **“E-VACCINATION SYSTEM”** from our organization.

The duration of the project was for 3 months. The Project was incorporated in **JAVA, ANDROID** and was implemented successfully.

Thanking you,

For **LCC Computer Education**

A handwritten signature in black ink, appearing to read 'T.S. Ramaswamy'.

T.S.
Ramaswamy
Director



DECLARATION

I, AISWARYA BENNY (Register no: VB19SWD001), BVoc. Software Development final year student of St. Teresa's College (Autonomous), Ernakulam, hereby declare that the project submitted named AISWARYA BENNY for the Bachelor's Degree in Software Development is my original work. I further declare that the said work has not previously been submitted to any other university or academic body.

Place : Ernakulam


AISWARYA BENNY

Date : 06 04 2022

ACKNOWLEDGEMENT

In this humble endeavour I have received a great deal of support and guidance from different quarters. First and foremost I thank the God almighty, for bestowing upon me abundance of grace, wisdom and power throughout the study and making it a success.

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I extend my gratitude to Mr VISHNU, faculty at LCC COMPUTER EDUCATION, Ernakulam under whose guidance and support this project work has been carried out.

Last but not the least, I would like to thank my parents and friends for motivating me and providing me the right environment for making this project work a great success.

AISWARYA BENNY

SYNOPSIS

The E-VACCINATION SYSTEM is a software application. E vaccination system aims to provide and encourage people about the vaccines. .The pandemic raised a wide range of demand for the vaccines globally. Therefore this app can be used for accessing all information and book vaccines.

This system will ease the process of vaccine registration and get informed. Those parents who couldn't get their children vaccinated (New born - 16 yrs) can now register for vaccination through this mobile application within minutes.

The graphical representation of the application is the main part of the system as it appeals to the user more and is easy to understand.

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1.INTRODUCTION

1.1 OVERVIEW OF THE SYSTEM

This is an interesting android project for computer science students. This system aims at providing and encouraging people about the vaccines that are important for infants and children. as we know, the infants are at higher risk of getting affected with infectious diseases as they have low immunity. Therefore, vaccination plays a vital role in their health and health immunity. This system will collect the information of the infants and children so that those parents who couldn't get their children vaccinated can get a chance to do so. This provides vaccine about new born state to 16 years. The requirements for this project are Android Studio for application development platform.java and Xml to add the functionalities and the interface for the user's best interaction.

2.SYSTEM ANALYSIS

2.1 INTRODUCCION

The first step in the system study includes analysis of the system. System analysis involves studying the way an organization currently receives and process data to produce information with the goal of determining how to make it work better. System analysis includes both a preliminary and a detailed stage. During preliminary analysis the analysis takes a quick look at what is needed and whether it benefits the perceived want. Detailed analysis includes an in depth look at what is wanted and contains more refined cost and benefits studies. The preliminary analysis begins when someone perceives a problem, modifications to existing, repairs to an existing system or demands an entirely new system. The analyst summarizes the gained modifications, including personal requirements and potential benefits of the new system in formal report called the preliminary report. Detailed analysis expands the preliminary efforts to include the complete analysis of all possible alternative solutions to the problem and complete expansion of what appears to be the most practical solution.

The system study is the process of gathering and interpreting facts, using this information for further studies on the system. It does various feasibility studies. In these studies, a rough figure of the system activities can be obtained, from which the decisions about the strategies to be followed for effective system study and analysis can be taken. The system study also identifies the method collection to be followed. The system study conducted an initial picture about the system working was got. From the information got form the study, the data collection methods are identified. Even in the first investigation itself drawbacks of the existing system could be identified.

Analysis involves the requirement determination and specifications. Basically, it involves establishing for all the system elements and then mapping these requirements to the software form. The analysis is intended to capture and describe all the requirements of the system and to make a model that defines a key domain classis in the system. The purpose is to provide an understanding and to enable a communication about the system between the developers and the people establishing the requirements.

2.2 EXISTING SYSTEM

in existing system, the process of vaccination, During the situation of covid 19 it is difficult to visit the health center and parent can visit the center, and register, spent more time. During this period vaccination time and date parent can remember and all the process of vaccination is responsible for the parent.

But the E-vaccination system provide to easier to find the vaccination time of children and parent can registered at the mobile or personal computer.in existing system is difficult and time consuming. Parent can visit the more time to health center. The health center provides the akasha workers. the akasha worker can visit the home of child and remember the time and date of the vaccination. Because the well-defined android app "E-vaccination system" avoid the visit of the role mediator such as akasha workers, it provides easy to health center not need anyone.

2.3 PROPOSED SYSTEM

In proposed system, in this app provide the admin can verify the health center, such as approve or reject. View the health center and locations. View vaccination by health centers repatriating can view and check the feedback. The admin can add vaccination details.

The health center using this preregister the system with join location.it provide the user can book the nearest health centers. health center views the vaccination bookings and to add the vaccination report. The user can easily register and login specified password with this Appvion the vaccination details. The user can easily find the nearby health center using google map, it is contained in this apogee vaccination schedule such as date and time by SMS. View vaccination history of this child.

2.4 FEASIBILITY STUDY

The main objective of the feasibility study is to test the technical, operational and economic feasibility of developing a computer system. The proposed system must be evaluated from a technical, operational and economic feasibility of developing of a computer. In any Project, feasibility analysis is a very important stage; here the project is checked for its feasibility. Any project may face scarcity in resources, time or work force. Hence all these are to be studied in detail and a conclusion should be drawn whether the project under consideration is feasible or not. This analysis is a test of the proposed project, regarding its work ability, impact on users and clients and resources management. Feasibility and risk involved are inversely related to each other. The main objective of feasibility is to test technical, operational and economic feasibility of a project.

2.5 SYSTEM SPECIFICATION

A software requirement specification (SRS), a requirements specification for a software system, is a complete description of the behavior of a system to be developed and may include a set of use cases that describe interactions the users will have with the software. In addition, it also contains non-functional requirements. Non-functional requirements impose constraints on the design or implementation (such as performance engineering requirements, quality standards, or design constraints) The software requirements specification document enlists all necessary requirements that are required for the project development.

2.6 SOFTWARE SPECIFICATION

The selection of hardware is very important in the existence and proper working of any software. When selecting hardware, the size and capacity requirements are also important. Below are some of the hardware that is required by the system.

2.7 HARDWARE SPECIFICATION

The most common set of requirements defined by any operating system or software application is the physical computer resources, also known as hardware. A hardware requirements list is often accompanied by a hardware compatibility list (HCL), especially in case of operating systems. An HCL lists tested, compatible, and sometimes incompatible hardware devices for a particular operating system or application.

We require much different software to make the application which is in making to work efficiently. It is very important to select the appropriate software so that the software works properly.

FRONT END: ANDROID

Android is a Linux based operating system designed primarily for touch screen mobile devices such as smart phones and tablet computers. Android is open source and Google releases the code under the Apache License. This open-source code and permissive licensing allows the software to be freely modified and distributed by device manufacturers, wireless carriers and enthusiast developers. Additionally, Android has a large community of developers writing applications that extend the functionality of devices, written primarily in a customized version of the Java programming language. Android is an open-source mobile operating system that combines and builds up on parts of many different open-source projects.

Android's kernel is based on the Linux kernel and has further architecture changes by Google outside the typical Linux kernel development cycle. Android does not have a native Window System nor does it support the full set of standard GNU libraries, and this makes it difficult to port existing Linux applications or libraries to Android. Android's user interface is based on direct manipulation using touch inputs that loosely correspond to real-world actions, like swiping, tapping, pinching and reverse pinching

to manipulate on-screen objects. Android devices boot to the home screen, the primary navigation and information point on the device, which is similar to the desktop found on PCs. Android home screens are typically made up of amplicons and widgets; amplicons launch the Assoc- acted app, where as widgets display live, auto updating content such as the weather forecast, the user's email inbox, or a news ticker directly on the home screen.

Graphical user interfaces

Web frameworks

Multimedia

Database

Networking

ABOUT JAVA

Java is a general-purpose computer-programming language that is concurrent, class- based, object-oriented, and specifically designed to have as few implementation dependencies as possible. It is intended to let application developers "write once, run anywhere" (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of computer architecture. As of 2016, Java is one of the most popular programming languages in use, particularly for client-server web applications, with a reported 9 million developers. Java was originally developed by James Gosling, a Canadian, at Sun Microsystems (which has since been acquired by Oracle Corporation) and released in 1995 as a core component of Sun Microsystems' Java platform. The language derives much of its original features from Smalltalk, with a syntax similar to C and C++, but it has fewer low-level facilities than either of them. The original and reference implementation Java compilers, virtual machines, and class libraries were originally released by Sun under proprietary licenses

ABOUT ANDROID

Android is a Linux-based operating system designed primarily for touch screen mobile devices such as Smartphone and tablet computers. Initially developed by Android, Inc., which Google backed financially and later bought in 2005. Android is open source and Google releases the code under the Apache License. This open-source code and permissive licensing allows the software to be freely modified and distributed by device manufacturers,

Wireless carriers and enthusiast developers. Additionally, Android has a large community of developers writing applications ("apps") that extend the functionality of devices, written primarily in a customized version of the Java programming language.

Android Studio is Android's official IDE. It is purpose-built for Android to accelerate your development and help you build the highest-quality apps for every Android device.

Android Studio's Instant Run feature pushes code and resource changes to your running app. It intelligently understands the changes and often delivers them without restarting your app or rebuilding your APK, so you can see the effects immediately.

The code editor helps you write better code, work faster, and be more productive by offering advanced code completion, refactoring, and code analysis. As you type, Android Studio provides suggestions in a dropdown list. Simply press Tab to insert the code.

The Android Emulator installs and starts your apps faster than a real device and allows you to prototype and tests your app on various Android device configurations: phones, tablets, Android Wear, and Android TV devices. You can also simulate a variety of hardware features such as GPS location, network latency, motion sensors, and multi- touch input.

Android Studio includes project and code templates that make it easy to add well-established patterns such as a navigation drawer and view pager. You can start with a code template or even right-click an API in the editor and select Find Sample Code to search for examples. Moreover, you can import fully functional apps from GitHub, right from the Create Project screen.

ABOUT MySQL

MySQL is a relational database management system (RDBMS) which is more than 11 million institutions. The program runs as a server providing multi-user access to a number of databases.

MySQL is owned and sponsored by a single for-profit firm, the Swedish company MySQL AB, now a subsidiary of Sun Microsystems, which holds the copyright to most of the code base. The project's source code is available under terms of the GNU General Public License, as well as under a variety of proprietary agreements.

SELECTION OF OPERATING SYSTEM

Windows10 an Overview

Windows 10 includes improved network, application and Web services. It provides increased reliability and scalability, lowers your cost of computing with powerful, flexible management services, and provides the best foundation for running business application.

Network Data Security

Network data can be protected on the wire or at the network interface. Securing data at the network requires a firewall to proxy services and mediate connections between the internal network, (LAN) and external network (Internet). This is the purpose of Proxy Server.

Internet Protocol Security

Internet Protocol Security (IPsec) is a framework of open standards for ensuring secure private communications over Internet Protocol networks, using cryptographic security services

3. SYSTEM DESIGN

3.1 INTRODUCTION

System design is an interactive process through which requirements are transmitted to a “blue print” for constructing the software initial; the blue print depicts a holistic view of software that is design is represented at a high-level abstraction a level that can be directly traced to specific data, functional and behavioral requirements. System design is the solution to the creation of a new system. This is the important aspect made up of several steps. System design is the process of developing specifications for a candidate system that meet the criteria established in the system analysis. Major step in system design is the preparation of the input forms and output reports in a form applicable to the users.

The main objective of system design is to use the package easily by a computer operator. System design is the creative act of invention, developing new inputs, a database, off-line files, method, procedures and output for processing business to meet an organization objective. System design-built information gathered during the system analysis. As design interaction occurs, subset-quant refinement leads to design representation at much lower level of abstraction. System design is a creative art of inventing and developing input, data bases, off line files, method and procedures, for processing data to get meaning full output that satisfy the organization objectives.

3.2 INPUT DESIGN

Input design is the process of converting user-oriented input to a based format. Inaccurate input data are the most common cause of errors in data processing. Errors entered by data entry operators can be controlled by input design. The goal of designing input data is to make data entry as easy, logical and free from errors. When we approach input data design; we design the data source documents that capture the data and then select the media used to enter them into computer.

User-friendly screen format can reduce the burden on end users, who are not highly proficient in computers. An important step in input design stage is a design of source document. Source document is the form in which the data can initially capture. The next step is the design of the document layout. In the layout organizes the document by placing information, where it will be noticed and establishes the appropriate sequence of items.

User interface design is very important for any application. The interface design describes how the software communicates within itself, to system that interpreted with it and with humans who use it. The input design is the process of converting the user-oriented inputs into the computer-based format. Input design is a part of overall system design, which requires very careful attention. If data going into the system is correct, then the processing and output will magnify these errors. Thus, the designer has a number of clear objectives in the different stages of input design

- To produce a cost-effective method of input.
- To achieve the highest possible level of accuracy.
- To ensure that input is acceptable to and understand by the user.

Inaccurate input data is most common cause of data processing errors. If poor input design-particularly where operators must enter data from source documents-permits bad data to enter a computer system, the outputs produced are of little value.

3.3 OUTPUT DESIGN

Computer output is the most important and direct source of information to the user. Efficient and intelligent output design improves the system's relationship and helps user decision-making.

In the output design it is determine how the implementation is to be played for immediate need and also the hardcopy output. A major form of input is a hardcopy from the printer. Print- outs should be designed around the output requirement of the user. Printers, CRT screen display are the examples for providing computer-based output. The output design associated with the system includes the various reports of the table generations and query executions.

A quality output is one, which meets the requirements of end user and presents the in- formation clearly. In any system result of processing are communicated to the user and to the other system through outputs. In the output design it is determined how the information is to be displayed for immediate need. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationships with the user and helps in decision –making. The objective of the output design is to convey the information of all the past activities, current status and to emphasis important events. The output generally refers to the results and information that is generated from the system. Outputs from computers are required primarily to communicate the results of processing to the users.

3.4 DATABASE DESIGN

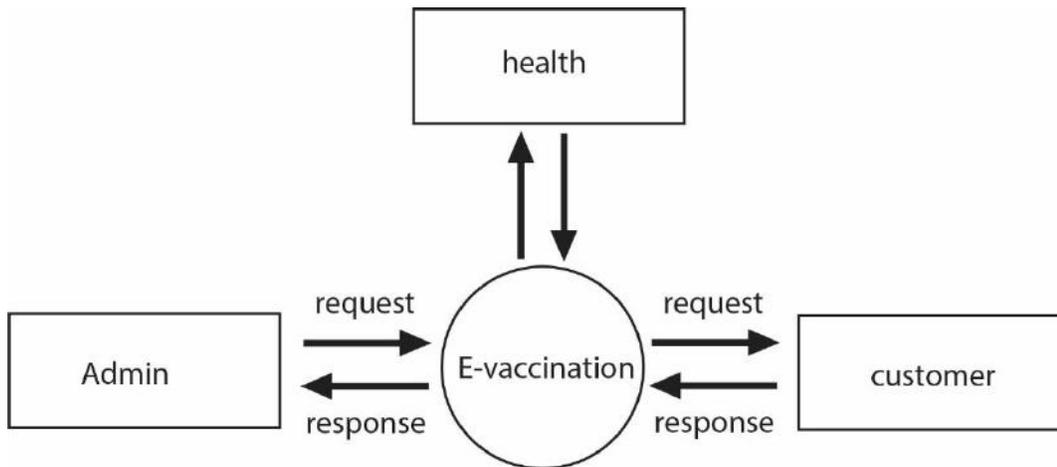
The Database design is the process of producing a detailed data model of a database. The logical data model contains all the needed logical and physical design choices and physical storage parameters needed to generate a design in a Data Definition Language, which can then be used to create a database. A fully attributes for each entry.

The term database design can be used to describe many different parts of the design of an overall database system. Principally, and most correctly, it can be thought of as the logical design of the base data structures used to store the data. In the relational model, these are the tables and views. In an object database, the entities and relationships map directly to object classes and named relationships. However, the term database design could also be used to apply to the overall process of designing, not just the base data structures, but also the forms and queries used as part of the overall data base applications within the database management system.

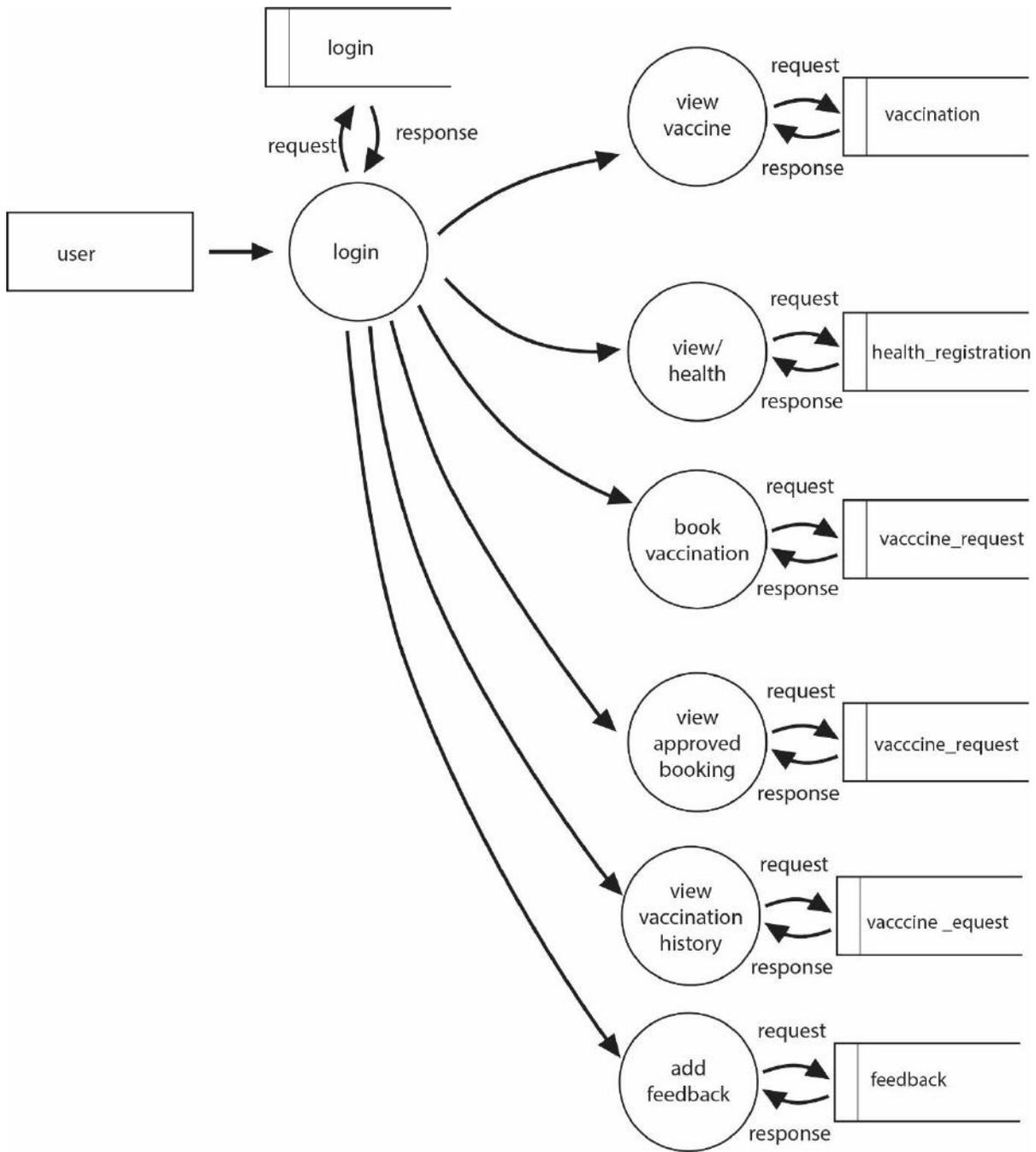
3.5 DATA FLOW DIAGRAM

A Data Flow Diagram (DFD) or a bubble chart is a graphical tool for structured analysis. It was De Macro in 1978 and Gene and Carson in 1979 who introduced DFD. DFD models a system transforms the data and creates, output data-flows which go by suing external entities from which data flows to a process which to other processes or external entities or files. Data in files many also flow to processes as inputs.

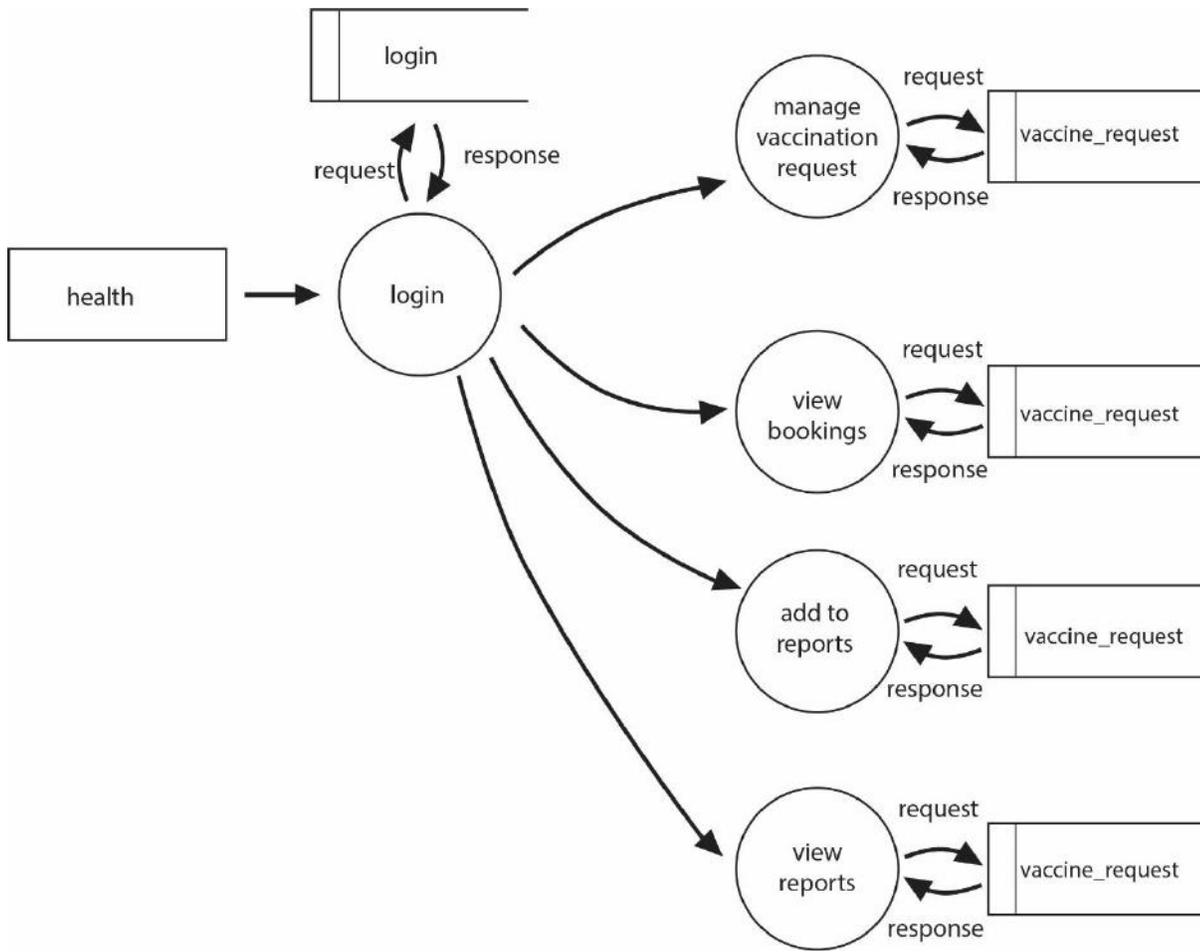
DATAFLOW DIAGRAMS



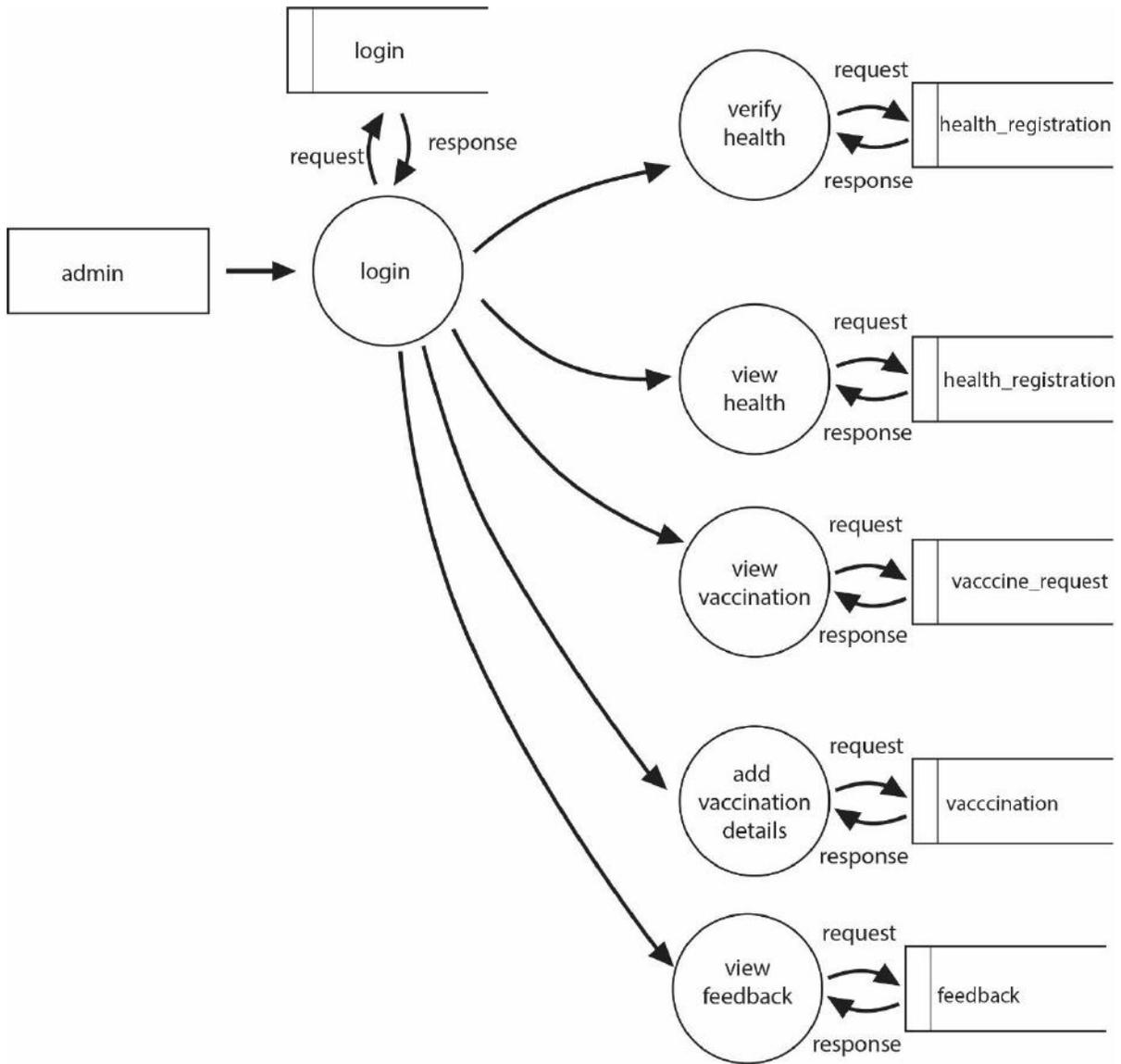
E-Vaccination



E-Vaccination



E-Vaccination



3.6 TABLE DESIGN

login

Field	Type	Null	Default	Comments
lid	int (20)	No		
rigid	varchar (100)	Yes	<i>NULL</i>	
email	varchar (100)	Yes	<i>NULL</i>	
password	varchar (100)	Yes	<i>NULL</i>	
type	varchar (100)	Yes	<i>NULL</i>	
status	varchar (100)	Yes	0	

Feedback

Field	Type	Null	Default	Comments
fid	int (11)	No		
aid	int (20)	Yes	<i>NULL</i>	
subject	varchar (100)	Yes	<i>NULL</i>	
description	varchar (500)	Yes	<i>NULL</i>	
do	varchar (100)	Yes	<i>NULL</i>	

Hearthrug

Field	Type	Null	Default	Comments
hid	int (20)	No		
name	varchar (100)	Yes	<i>NULL</i>	

E-Vaccination

Field	Type	Null	Default	Comments
address	varchar (200)	Yes	<i>NULL</i>	
phone	varchar (100)	Yes	<i>NULL</i>	
district	varchar (100)	Yes	<i>NULL</i>	
email	varchar (100)	Yes	<i>NULL</i>	
autojoin	varchar (100)	Yes	<i>NULL</i>	
status	varchar (100)	Yes	PENDING	
hula	varchar (100)	Yes	<i>NULL</i>	
holing	varchar (100)	Yes	<i>NULL</i>	

Customer reg

Field	Type	Null	Default	Comments
chide	int (20)	No		
name	varchar (100)	Yes	<i>NULL</i>	
address	varchar (100)	Yes	<i>NULL</i>	
phone	varchar (100)	Yes	<i>NULL</i>	
email	varchar (100)	Yes	<i>NULL</i>	
autojoin	varchar (100)	Yes	<i>NULL</i>	
status	varchar (100)	Yes	APPROVED	

E-Vaccination

Vaccine request

Field	Type	Null	Default	Comments
vied	int (11)	No		
aid	int (11)	Yes	<i>NULL</i>	
hid	int (11)	Yes	<i>NULL</i>	
name	varchar (100)	Yes	<i>NULL</i>	
description	varchar (400)	Yes	<i>NULL</i>	
Re5quested_date	varchar (50)	Yes	<i>NULL</i>	
status	varchar (30)	Yes	PENDING	
booking date	varchar (100)	Yes	NOT SCHEDULED	
booking time	varchar (100)	Yes	NOT SCHEDULED	

4.SYSTEM DEVELOPMENT

4.1 MODULE DESCRIPTION

MODULES

There are three modules for this project that are as follows-

1. Admin

- Verify Health center such as approve or reject.
- view health center.
- view vaccination (by health center) report.
- view feedback.
- add vaccination details.

2. Health center

- Register the system with join location.
- view vaccination request.
- view vaccination bookings.
- add to vaccination report.
- approve booking request (send notification)
- view report.

3. User

- Registration and login.
- view vaccination details.
- view health centers.
- view health centers (google map).
- book vaccination schedule.
- view bookings.
- get vaccination schedule (date and time) by SMS.
- view vaccination history.

5.SYSTEM IMPLEMENTATION

5.1 TESTING

Testing is an important stage in the software development life cycle. System testing is a critical element of a software quality assurance and represents the ultimate review of specification, design and coding.

Importance of software testing and its implication with software quality cannot be over me- phased. Testing is one-way developers can validate the quality of a software product and verify that it fully meets the specification. During testing, the system is tested with a set of cases and checked whether the input of the program is performing as it is expected. The system tested and reviewed to ensure that the entire user requirement has being satisfied. Testing was done throughout the system development at various stages since it is always a good practice to test the system at many different levels at various intervals that is sub systems, program modules as work progress and finally the system as a whole. If this is not done, then the poorly tested system can fail after installation. Testing is a very tedious and time-consuming job. For a test to be successful the tester should try and make the program file. Each test is designed with the intention of finding errors in the way system will process it. Though testing of a program doesn't guarantee the reliability of the system, it is done to assure that the system runs errors free.

Applications are not allowed to launch until all identified problem are fixed. Finally, a report is prepared at the end of testing to show exactly what was tested and to list the final outcomes. The software testing methodology is applied in four distinct phases:

- Unit Testing
- Integration Testing
- User Acceptance Testing
- Output Testing

Unit Testing

Developers typically do unit testing in order to trace out bugs in each module of the code. Unit testing is done in parallel with coding. It includes testing each function and procedures. Unit testing is also called as module testing. In module testing each module are tested for any possible logical error. They are also tested for specification to see if they are working as per the program should do and they are tested under various conditions. Each module is being tested thoroughly in order to discover pitfalls. Specification testing examines the specification what the program should do and how it should perform under various conditions. The testing will be done by entering data into different tables using forms. The data with less validation will be tested first. Whenever an error is encountered, an informative error message will be displayed which informs user about the type of error. After the completion of form testing the program will be tested.

Integration Testing

Integration testing is any type of software testing that seeks to verify the interfaces between components against a software design. Software components may be integrated in an iterative way or all together ("big bang"). Normally the former is considered a better practice since it allows interface issues to be located more quickly and fixed. Integration testing works to expose defects in the interfaces and interaction between integrated components (modules). The task of the integration test is to check that components or software applications, interacts without error. Therefore, testing the data flow between 2 modules is integration testing.

User Acceptance Testing

User acceptance testing is done by the user to check whether the project has met the requirement that has been mentioned at the beginning of the project. Flood alert is tested by the user by inputting values and the result generated is also validated.

Output Testing

After performing the validation testing, the next step is output testing of the proposed system since no system could be useful if it does not produce the required output in the specific format. The output generated or displayed by the system under consideration is tested asking the users about the format required by them. Here, the output is considered in two ways, one is on the screen and other is printed format. The output format on the screen is found to be correct as the format designed according to the user needs. For the hard copy also, the output comes out as specified by the user. Hence output testing does not result in any connection in the system.

5.2 VALIDATION CHECK

The validation phase reveals the failures and the bugs in the developed system. It will become known about the practical difficulties the system faces when operated in the true environment. Validation is the process of ensuring that user input is clean, correct, and useful

Typical validation tasks are:

- Has the user filled in all required fields?
- Has the user entered a valid email?
- Has the user entered text in a numeric field?

Form validation normally used to occur at the server, after the client had entered all the necessary data and then pressed the submit button. If the data entered by a client was incorrect or was simply missing, the server would have to send all the data back to the client and request that the form be resubmitted with correct information. This was really a lengthy process which used to put a lot of burden on the server. Most often, the purpose of validation is to ensure correct user input.

5.3 SYSTEM IMPLEMENTATION

The implementation phase of the software development is concerned with translating design specification into source code. The user tests the developed system and changes are made according to their needs. Our system has been successfully implemented. Before implementation several tests have been conducted to ensure that no errors are encountered during the operation. The implementation phase ends with an evaluation of the system after placing into the operation for a period of time.

The process of putting the developed system in actual use is called system implementation. This includes all those activities that take place to convert from old system to new system. The system can be implemented only after testing is done and is found to be working to specifications. The implementation stage is a systems project in its own right. The implementation stage involves following tasks:

- Careful planning.
- Investigation of system and constraints.
- Design of method to achieve change over.
- Evaluation of the changeover metho

6.SYSTEM MAINTENANCE

6.1 SYSTEM MAINTENANCE

System maintenance is a going activity, which covers a wide variety of activities including, removing program and design errors, updating documentation and test data and updating user support system maintenance is a catchall term used to describe various forms of computer or server maintenance required to keep a computer system running properly, it can describe network maintenance which could mean that servers are being physical repaired, replaced or mode. For the purpose of convenience, maintenance may be categorized into three classes they are:

CORRECTIVE MAINTENANCE

This type of maintenance implies removing errors in a program, which might have kept in the system due to faulty design or wrong assumption.

ADAPTIVE MAINTENANCE

In adaptive maintenance program functions are changed to enable the information system to satisfy the information needs of the user.

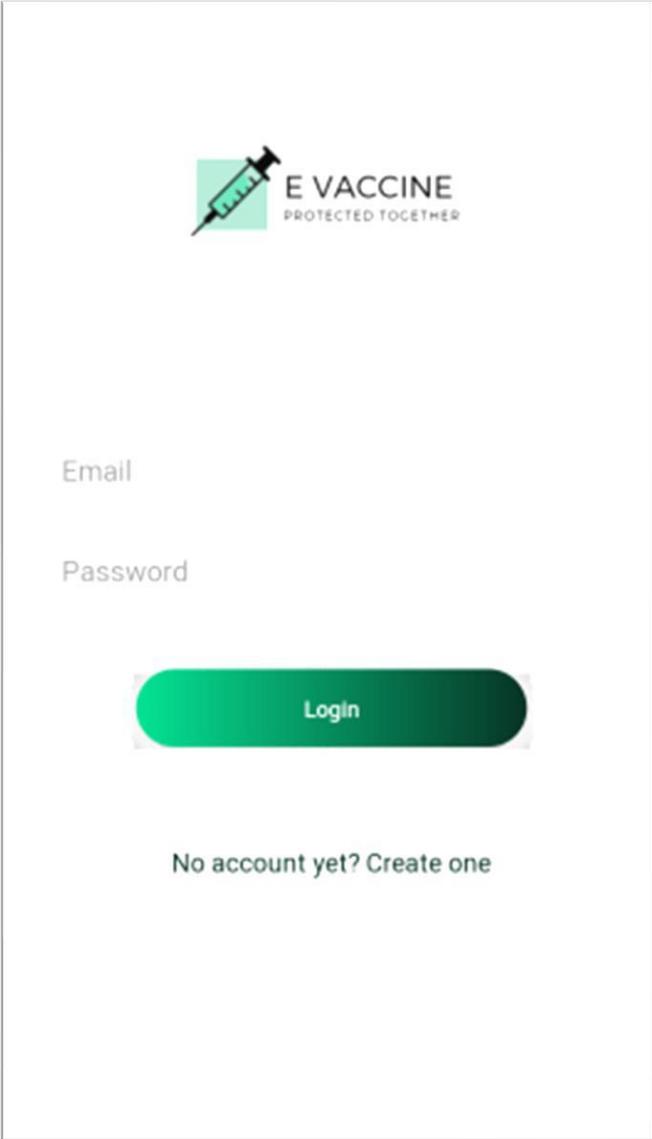
PERFECTIVE MAINTENANCE

In perfective maintenance means adding new programs or modifying the existing programs to enhance the performance of the information system. This type of maintenance under taken to respond to user addition needs which may be due to the changes within or outside of the organization.

7 APPENDICES

7.1 SAMPLE INPUT DESIGN OUTPUT DESIGN

Login



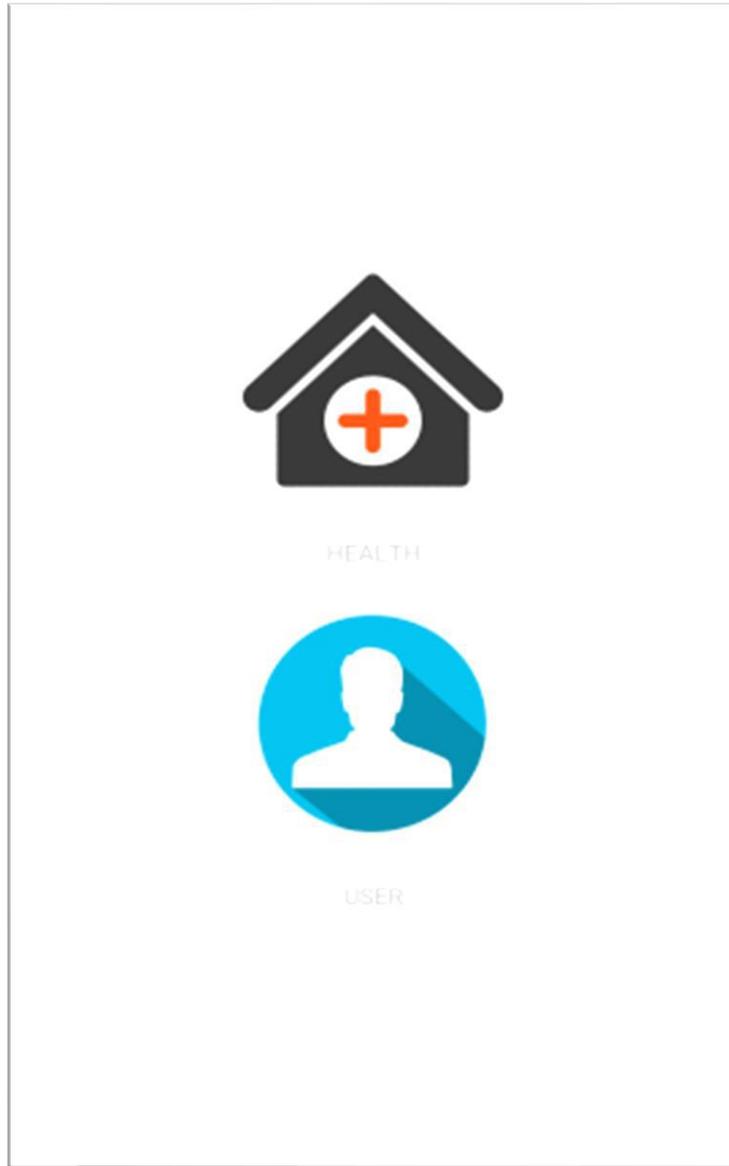


Email

Password

Login

No account yet? Create one



User register



Name

Address

Phone

Email

Password

Register Now

Already have an account? [Login](#)

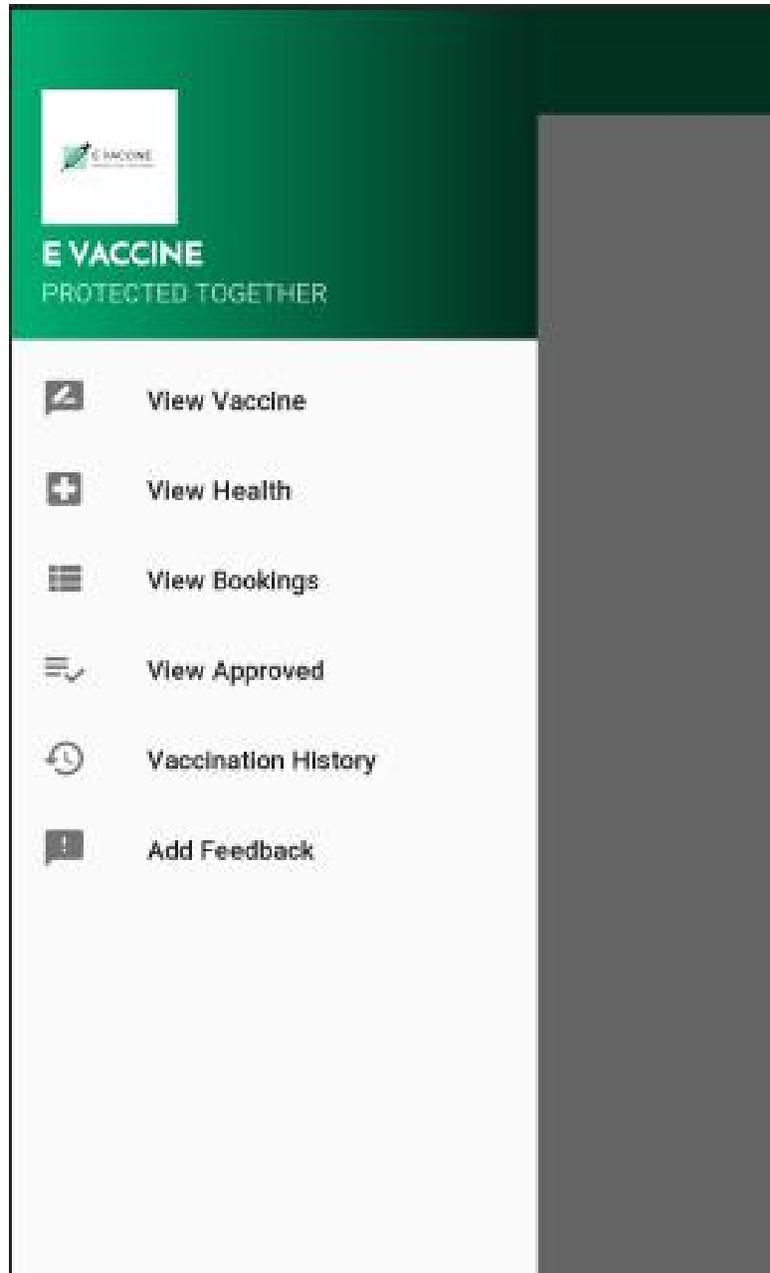
Add vaccination

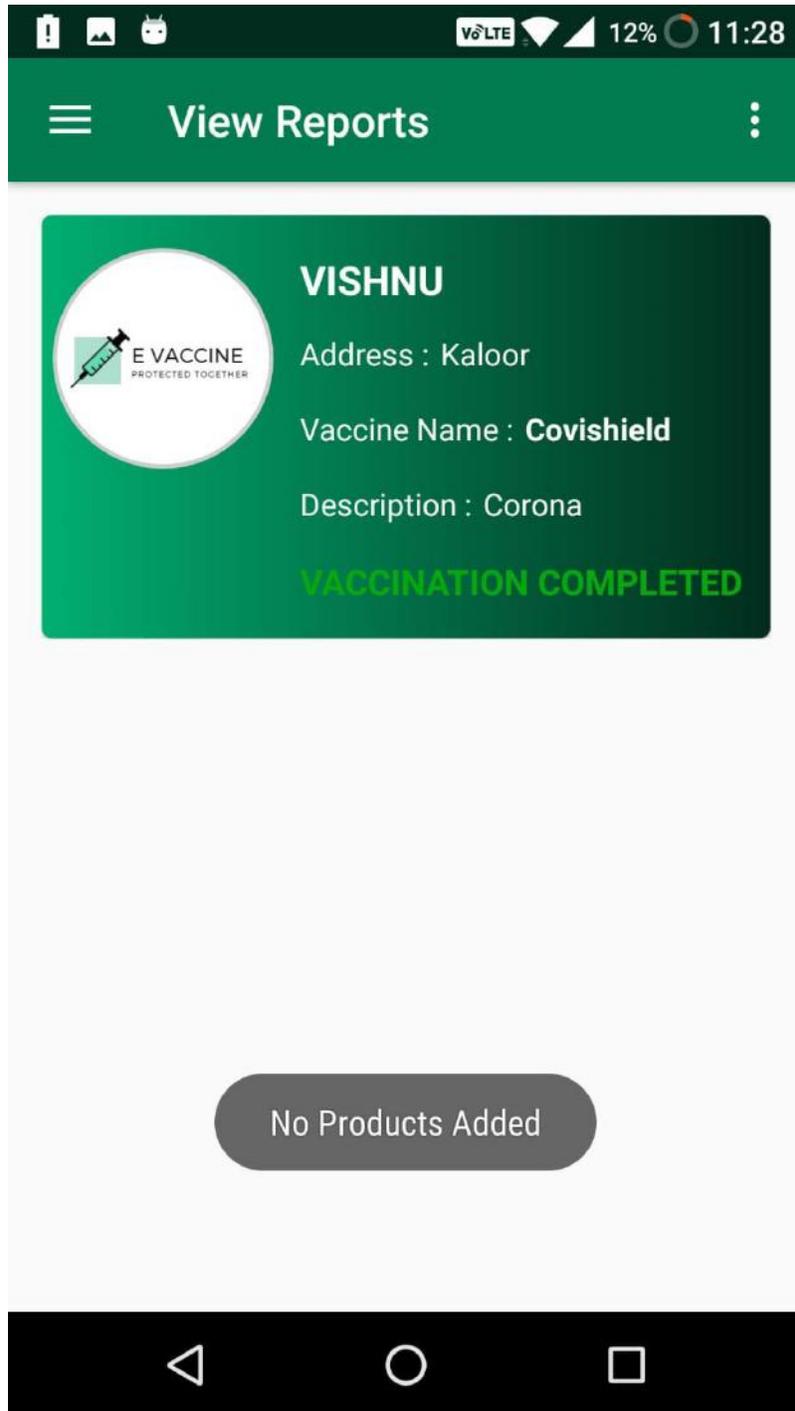
Add Vaccination

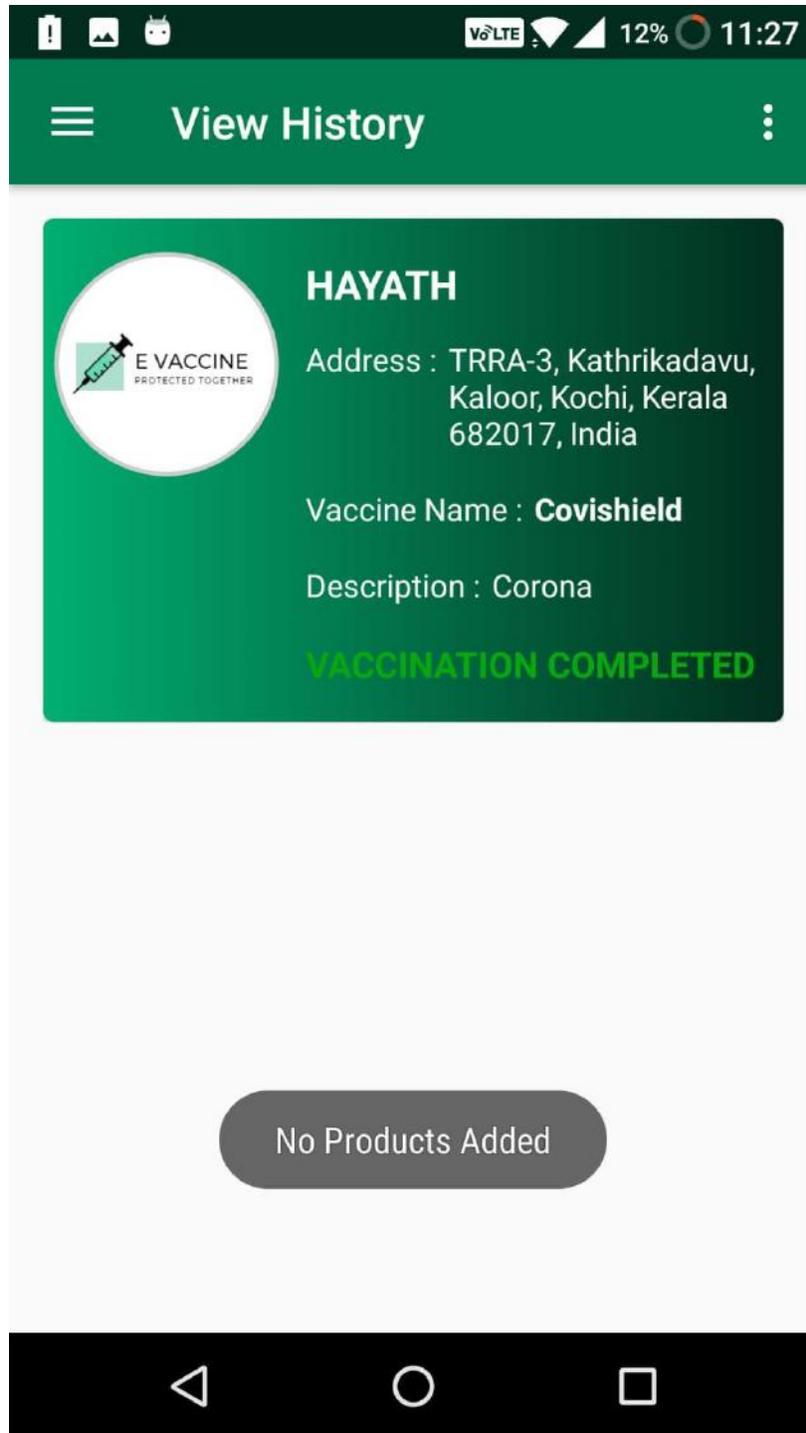
Add feedback

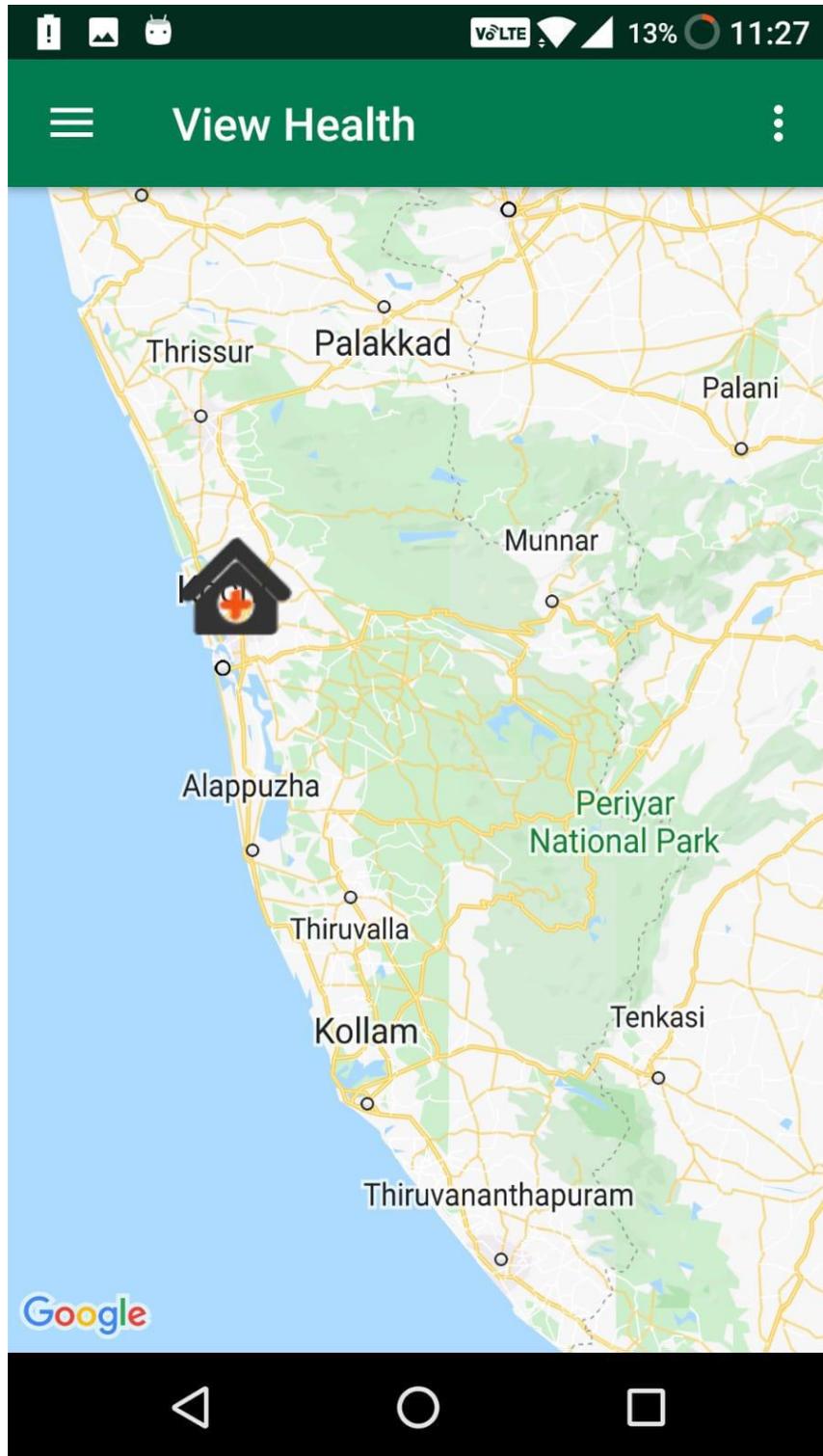
Add Feedback

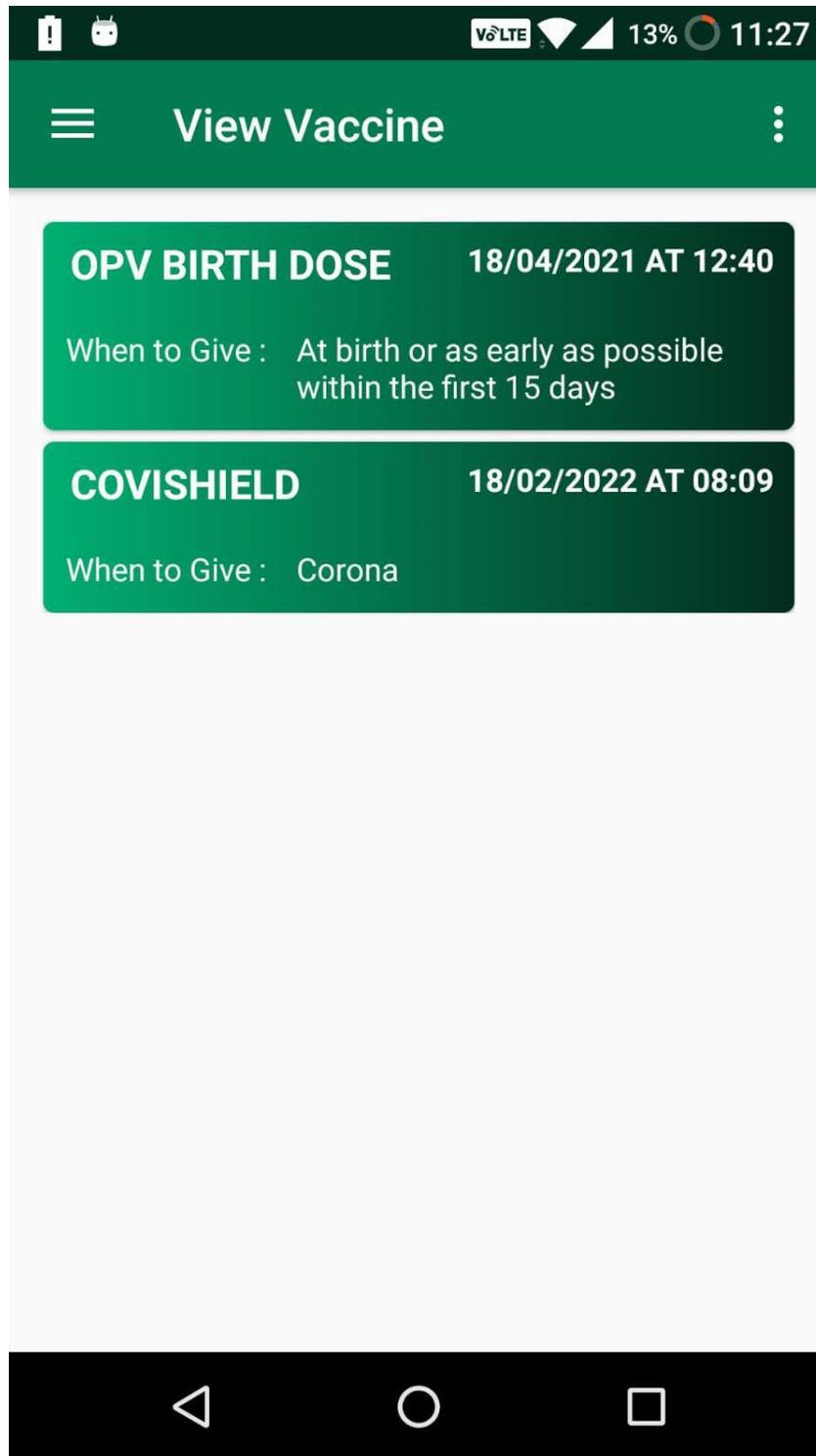
Content user











7.2 SOURCE CODE

```
Login.java
package com.syntax.evaccination;

import android.Manifest;
import android.app.AlertDialog;
import android.content.Context;
import android.content.DialogInterface;
import android.content.Intent;
import android.content.SharedPreferences;
import android.content.pm.PackageManager;
import android.graphics.Color;
import android.graphics.drawable.ColorDrawable;
import android.os.Build;
import android.os.Bundle;
import android.util.Log;
import android.view.View;
import android.widget.Button;
import android.widget.EditText;
import android.widget.TextView;
import android.widget.Toast;

import androidx.appcompat.app.ActionBar;
import androidx.appcompat.app.AppCompatActivity;
import androidx.core.app.ActivityCompat;

import com.android.volley.Request;
import com.android.volley.Response;
import com.android.volley.VolleyError;
import com.android.volley.toolbox.StringRequest;
import com.android.volley.toolbox.Volley;
import com.syntax.evaccination.ADMIN.Admin;
import com.syntax.evaccination.HEALTH.Health;
import com.syntax.evaccination.USER.User;

import java.util.HashMap;
import java.util.Map;

public class LoginActivity extends AppCompatActivity {
    EditText username, password;
    Button btnlog;
    TextView reg;
    String UNAME, PASS;
    AlertDialog.Builder builder;
    @Override
    protected void onCreate(Bundle savedInstanceState) {

//        requestWindowFeature(Window.FEATURE_NO_TITLE);
```

E-Vaccination

```
// getWindow().setFlags(WindowManager.LayoutParams.FLAG_FULLSCREEN,
//     WindowManager.LayoutParams.FLAG_FULLSCREEN);

super.onCreate(savedInstanceState);
setContentView(R.layout.activity_login);

ActionBar actionBar = getSupportActionBar();
actionBar.hide();

int PERMISSION_ALL = 1;
String[] PERMISSIONS = {
    Manifest.permission.WRITE_EXTERNAL_STORAGE,
    Manifest.permission.READ_EXTERNAL_STORAGE,
    Manifest.permission.ACCESS_FINE_LOCATION,
    Manifest.permission.ACCESS_COARSE_LOCATION,
    Manifest.permission.CAMERA,
    Manifest.permission.READ_SMS,
    Manifest.permission.SEND_SMS,
    Manifest.permission.READ_PHONE_STATE
};

if (!hasPermissions(this, PERMISSIONS)) {
    ActivityCompat.requestPermissions(this, PERMISSIONS, PERMISSION_ALL);
}

builder = new AlertDialog.Builder(this);

username = (EditText) findViewById(R.id.input_Lemail);
password = (EditText) findViewById(R.id.input_Lpassword);
btnlog = (Button) findViewById(R.id.user_loginButton);
reg = (TextView) findViewById(R.id.Userlink_register);

reg.setOnClickListener(new View.OnClickListener() {
    @Override
    public void onClick(View v) {
        startActivity(new Intent(getApplicationContext(),RegistrationActivity.class));
    }
});

btnlog.setOnClickListener(new View.OnClickListener() {
    @Override
    public void onClick(View v) {
        Validate();
    }
});
}

@Override
public void onBackPressed() {
```

E-Vaccination

```
builder.setMessage("Do you want to close this application ?")
    .setCancelable(false)
    .setPositiveButton("Yes", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface dialog, int id) {
            finish();
        }
    })
    .setNegativeButton("No", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface dialog, int id) {
            // Action for 'NO' Button
            dialog.cancel();
        }
    });
//Creating dialog box
AlertDialog alert = builder.create();
//Setting the title manually
alert.setTitle("E Vaccination");
alert.show();

alert.getWindow().setBackgroundDrawable(new ColorDrawable(Color.parseColor("#FFFFFF")));
}

private void Validate() {

    UNAME = username.getText().toString();
    PASS = password.getText().toString();

    if (UNAME.isEmpty()) {
        username.requestFocus();
        username.setError("enter your email ID");
    } else if (PASS.isEmpty()) {
        password.requestFocus();
        password.setError("enter password");
    } else {
        login();
    }
}

private void login() {

    com.android.volley.RequestQueue queue = Volley.newRequestQueue(getApplicationContext());

    StringRequest request = new StringRequest(Request.Method.POST, Utility.SERVERUrl, new
Response.Listener<String>() {
        @Override
        public void onResponse(String response) {
            Log.d("*****", response);

            if (!response.trim().equals("failed")) {
```

E-Vaccination

```
String data = response;
String respArr[] = data.trim().split("#");

SharedPreferences.Editor editor = getSharedPreferences("SharedData", MODE_PRIVATE).edit();
editor.putString("u_id", "" + respArr[0]);
editor.putString("type", "" + respArr[1]);
editor.commit();

if (respArr[1].trim().equals("ADMIN")) {
    startActivity(new Intent(getApplicationContext(), Admin.class));
    Toast.makeText(getApplicationContext(), "Login Successful", Toast.LENGTH_SHORT).show();
} else if (respArr[1].trim().equals("HEALTH")) {
    startActivity(new Intent(getApplicationContext(), Health.class));
    Toast.makeText(getApplicationContext(), "Login Successful", Toast.LENGTH_SHORT).show();
} else if (respArr[1].trim().equals("CUSTOMER")) {
    startActivity(new Intent(getApplicationContext(), User.class));
    Toast.makeText(getApplicationContext(), "Login Successful", Toast.LENGTH_SHORT).show();
} else {
    Toast.makeText(LoginActivity.this, "Something Went Wrong", Toast.LENGTH_SHORT).show();
}

} else {
    Toast.makeText(getApplicationContext(), "Login Failed", Toast.LENGTH_SHORT).show();
}
}
}, new Response.ErrorListener() {
    @Override
    public void onErrorResponse(VolleyError error) {

        Toast.makeText(getApplicationContext(), "my Error :" + error, Toast.LENGTH_LONG).show();
        Log.i("My Error", "" + error);
    }
}) {
    @Override
    protected Map<String, String> getParams() {

        Map<String, String> map = new HashMap<String, String>();
//        SharedPreferences sp=getSharedPreferences("booking_info", Context.MODE_PRIVATE);
        map.put("key", "login");
        map.put("U_name", UNAME);
        map.put("P_swd", PASS);

        return map;
    }
};
queue.add(request);
}

public static boolean hasPermissions(Context context, String... permissions) {
```

E-Vaccination

```
    if (android.os.Build.VERSION.SDK_INT >= Build.VERSION_CODES.M && context != null &&
permissions != null) {
        for (String permission : permissions) {
            if (ActivityCompat.checkSelfPermission(context, permission) !=
PackageManager.PERMISSION_GRANTED) {
                return false;
            }
        }
    }
    return true;
}
```

splash activity.java

```
package com.syntax.evaccination;
```

```
import androidx.appcompat.app.ActionBar;
import androidx.appcompat.app.AppCompatActivity;
```

```
import android.content.Intent;
import android.os.Bundle;
import android.os.Handler;
import android.view.Window;
import android.view.WindowManager;
```

```
public class SplashActivity extends AppCompatActivity {
    Handler handler;
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
```

```
        requestWindowFeature(Window.FEATURE_NO_TITLE);
        getWindow().setFlags(WindowManager.LayoutParams.FLAG_FULLSCREEN,
            WindowManager.LayoutParams.FLAG_FULLSCREEN);
```

```
        setContentView(R.layout.activity_main);
```

```
        ActionBar actionBar = getSupportActionBar();
        actionBar.hide();
```

```
        handler=new Handler();
        handler.postDelayed(new Runnable() {
            @Override
            public void run() {
                Intent intent=new Intent(getApplicationContext(), LoginActivity.class);
                startActivity(intent);
                finish();
            }
        }, 2000);
    }
```

E-Vaccination

```
    },3000);  
    }  
}
```

utility.java

```
package com.syntax.evaccination;
```

```
public class Utility {
```

```
    public static String ip = " 192.168.1.37";
```

```
    public static String SERVERUrl = "http://" + ip.trim() + ":8080/Evaccination/serverEV/evaccination_server.jsp";
```

```
}
```

8.CONCLUSION

Vaccines are among the greatest advances in global health and development. For over two centuries, vaccines have safely reduced the scourge of diseases like polio, measles and smallpox, helping children grow up healthy and happy. They save more than five lives every minute – preventing up to three million deaths a year, even before the arrival of Covid-19.

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**PHARMACOGNOSTIC AND PHYTOCHEMICAL
ANALYSIS OF SELECTED MEDICINAL PLANTS
USED IN AYURVEDA FOR THE TREATMENT OF
ARTHRITIS**

**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF
'MASTER OF SCIENCE' IN BOTANY**

By

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ERNAKULAM**

2022

CERTIFICATE

This is to certify that the dissertation titled: "PHARMACOGNOSTIC AND PHYTOCHEMICAL ANALYSIS OF SELECTED MEDICINAL PLANTS USED IN AYURVEDA FOR THE TREATMENT OF ARTHRITIS" is an authentic record of work carried out by **AISWARYA RAJU** under the supervision and guidance of **Dr. LIZA JACOB**, Associate Professor, Department of Botany & Centre for Research, St. Teresas's College (Autonomous), Ernakulam in partial fulfilment of the requirement for the Master's Degree of Science in Botany.



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Place: Ernakulam

Date:

AISWARYA RAJU

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INTRODUCTION

Plants are considered as one of the most important sources of medicines. Among the 2,50,000 higher plant species reported in the world, more than 80,000 species are being used as medicinal. The medicinal plants are extensively utilized throughout the world and are not only a major resource base for the traditional medicine and herbal industry but also provide livelihood and health security to a large segment of world population.

In India, approximately 3000 plant species are known to have medicinal properties and being used in our traditional systems of medicines, viz. Ayurveda, Yunani, Siddha, Homeopathy etc. The drugs are derived either from the whole plant or from different organs, like leaves, stem, bark, root, flower, seed, etc. (Jain *et. al.*,1968).

Plants are rich in a wide variety of secondary metabolites such as tannins, alkaloids, flavonoids etc. About 61% of new drugs developed between 1981 and 2002 were based on natural products and the have been very successful, especially in the areas of infectious diseases and cancer. The pre-historic period in India, works of Charaka and susruta namely charakasamhitha were additions of knowledge about medicine. Charakasamhitha deals with about 700 drugs, a few of which are indigenous to India. Today there are about 2000 drugs in use (Sharma,1995).

There is a promising future of medicinal plants as there are about half million plants around the world, and most of them are not investigated yet for their medical activities and their hidden potential of medical activities could be decisive in the treatment of present and future studies. In the development of human culture medicinal plants have played an essential role, for example religions and different ceremonies. Among the variety of modern medicines, many of them are produced indirectly from medicinal plants, for example aspirin. Many food crops have medicinal effects, for example garlic. Studying medicinal plants helps to understand plant toxicity and protect human and animals from natural poisons.

The medicinal effects of plants are due to secondary metabolite production of the plants. Keeping this consideration there have been increased waves of interest in the field of research in natural product chemistry. This interest can be due to several factors, including therapeutic needs, the remarkable diversity of both chemical structure and biological activities of naturally occurring secondary metabolites, the utility of novel bioactive natural compounds as biochemical probes, the development of novel and sensitive techniques to detect biologically

active natural products, improved techniques to isolate, purify, and structurally characterise these active constituents, and advances in solving the demand for supply of complex natural product. The importance of traditional medicine has also recognized by WHO and has created strategies, guidelines and standards for botanical medicines. For the cultivation, processing of medicinal plants and the manufacture of herbal medicines. For the cultivation, processing of medicinal plants and the manufacture of herbal medicines agro-industrial technologies need to be applied. Medicinal plants are resources of new drugs and many of the new drug and many of the modern medicines are produced indirectly from plants (Clark,1996).

PHARMACOGNOSY

Pharmacognosy (the science of biogenic or nature-derived pharmaceuticals and poisons) has been an established basic pharmaceutical science taught in institutions of pharmacy education for over two centuries. Over the past 20 years though it has become increasingly important given the explosion of new drugs, phytomedicines (plant medicines), nutraceuticals and dietary supplements – all of which need to be fully understood, tested and regulated

During the past 50 years there have been tremendous advances in chemical and biological techniques of analysis that have transformed research in pharmacognosy. The PSE has regularly held symposia of relevance to pharmacognosy and some of these are briefly reviewed in the area of natural products from higher plants. These symposia have charted the developments that link pharmacognosy with phytochemistry and illustrate the application of increasingly more sophisticated analytical techniques to the discovery of biologically active compounds. Plants have yielded clinical drugs, either as natural product molecules, or as synthetic modifications (Phillipson *et. al.*,2007).

The term pharmacognosy as a constituent scientific discipline of pharmacy has been in use for nearly 200 years, and it refers to studies on natural product drugs. During the last half of the 20th century, pharmacognosy evolved from being a descriptive botanical subject to one having a more chemical and biological focus. At the beginning of the 21st century, pharmacognosy teaching in academic pharmacy institutions has been given new relevance, as a result of the explosive growth in the use of herbal remedies (phytomedicines) in modern pharmacy practice, particularly in western Europe and North America.

In turn, pharmacognosy research areas are continuing to expand, and now include aspects of cell and molecular biology in relation to natural products, ethnobotany and phytotherapy, in addition to the more traditional analytical method development and phytochemistry.

Herbal medicines are complex compounds with multiple synergistic mechanisms of action that modulate (patho) physiological functions. Pharmacognosy is the study of medicine derived from natural sources that include plants, animals, and microorganisms, and the scope of the field depends on knowledge about the safety, purity, and efficacy of complex multi compound products. Herbal pharmacognosy is the application of this science specifically to traditional herbal medicine sources. Traditional medicines, particularly herbal medicine, remain the primary source of medicine in many countries and cultures globally. Although the root of this field is within traditional medicine, there is increased scientific focus on herbal pharmacognosy in recent years for novel therapeutic molecules.

Modern pharmacognosy includes the application of molecular, genomic, and metabolomic techniques, providing a significant increase in knowledge on the biological and clinical applications of herbal medicines. Secondary plant metabolites serve numerous roles in plant biology, including innate immunity, defence against herbivores and pathogens, antioxidant activity, and attraction of pollinators for cellular communication. These compounds have been used by humans throughout recorded and pre-recorded history as various commodities, including pigments, condiments, nutrition sources, and medicines.

The oldest form of traditional Asian medicine is Ayurveda, which is basically Hindu in origin and which is a sort of art-science-philosophy of life. In this respect it resembles traditional Chinese medicine, and like TCM has influenced development of more practical, less esoteric forms of medicine. In 20th century one of the most important events that influenced the use of medicinal plants in the Western world in last century was the serendipitous discovery of the antibacterial properties of fungal metabolites such as benzylpenicillin, by Florey and Fleming in 1928 at St. Mary's Hospital (London). These natural products changed forever the perception and use of plant – derived metabolites as medicines by both scientists and the lay public. Another important development came with the advent of synthetic chemistry in the field of pharmacy. Many of these studies involved compounds that were synthesized because of their potential as colouring material.

A large number of natural products or their derivatives were introduced as medicines, including many anti-cancer agents, the anti-malarial agent artemisinin and the anti-dementia medication

galantamin. Numerous examples of drugs which are natural products, their derivatives or a pharmacophore based on a natural product have given rise to such compounds, as well as the biochemical basis of many important illnesses. This has opened up new opportunities and avenues for drug development (Wallis,2002).

The systematic study of herbal remedies offers pharmacognosy groups an attractive new area of research, ranging from investigating the biologically active principles of phytomedicines and their mode of action and potential drug interactions, to quality control, and involvement in clinical trials (Kingham *et. al.*, 2001).

Arthritis is the swelling and tenderness of one or more joints. The main symptoms of arthritis are joint pain and stiffness, which typically worsen with age. The most common types of arthritis are Osteoarthritis and Rheumatoid arthritis.

It is a symptomatic disorder of chronic joint inflammation followed by swelling and pain. It occurs due to malfunctioning of the immune system or, from the family background or, from some injuries of joints in childhood. It can affect the cartilages and bones places around the affected joints and the internal organs like eyes, heart and lungs. Arthritis usually observed in the hand, feet or, wrist of the human body. Phytochemicals are most helpful in the treatment of arthritis, which are very much effective in inflammatory, autoimmune and infectious diseases.

Arthritis is especially of two types, rheumatoid arthritis (RA) and osteoarthritis (OA). RA is an autoimmune disease followed by chronic inflammation. This type of arthritis is happening due to hyperplasia of synovial membrane, which causes large-scale bone destruction around the joints. Some symptoms are there like pain, stiffness, restricted movement etc. with cardiovascular, skeletal and physiological disorders. There are some medications such as nonsteroidal anti-inflammatory drugs (NSAID's) and steroids, which can control RA. But these NSAID's have some side effects such as such as gastric ulceration and acute renal failure.

Women are more affected by RA rather than men. In another side OA is a disease of articular cartilage i.e., protective tissue presents at the end of the joints, which is wearing down day by day. It is causes joint pain and disability in movement followed by formation of osteophyte, joint space narrowing and chronic synovial inflammation. It also affects entire synovial joint like synovium, meniscus, ligaments etc (Bhattacharya *et.al.*, 2020)

Age is the most powerful risk factor for osteoarthritis (OA) in the United States. It is estimated that 68% of individuals older than 55 years have radiographic evidence of OA. The US is

growing older--the over-65 age group represented only 4% of the population in 1900, but accounted for 12.4% in 1988, and is projected to account for 22% by the year 2030. As the age of our population has increased, so has the prevalence of arthritis. About 43 million individuals (1 in 6) have arthritis, and most are older than 45 years. By the year 2020, 59.4 million persons in the US will be affected by arthritis, thus increasing chronic disability and costs by more than 25%. The annual cost to society in medical care and lost wages is currently estimated to be \$65 billion, and is projected to escalate to \$95 billion by the year 2000. Physicians who provide care for the increased number of patients with arthritis in the 21st century must be aware of improved therapeutic modalities to reduce arthritis related disabilities, hospitalizations, and complications related to therapy, to minimize the risk of adverse drug reactions, and to preserve function (Elders 2000).

PHYTOCHEMISTRY

Phytochemicals are biologically active, naturally occurring chemical compounds found in plants, which provide health benefits for humans as medicinal ingredients and nutrients. They protect plants from disease and damage, and also contribute to the plant's colour, aroma and flavour. In general, the plant chemicals that protect plants from environmental hazards such as pollution, stress, drought, UV exposure and pathogenic attack are called as phytochemicals (Gibson et al., 1998; Mathai, 2000).

Recently, it has been clearly shown that they also have roles in the protection of human health, when their dietary intake is significant (Samrot et al., 2009). Till date over 4,500 phytochemicals have been reported and are classified on the basis of their protective functions, and physical and chemical characteristics, amongst these about 350 phytochemicals have been studied in detail (Koche et al., 2010). Phytochemicals accumulate in different parts of the plants, such as in the root, stem, leaf, flower, fruit and seed. Many phytochemicals, particularly the pigment molecules like anthocyanins and flavonoids, are often concentrated in the outer layers of the various plant parts like leaves and fruits of vegetables. However, the levels of these phytochemicals vary from plant to plant depending upon the variety, climatic growing conditions. These compounds have biological properties such as antioxidant activity, anti-microbial effect, modulation of detoxification enzymes, stimulation of the immune system, decrease of platelet aggregation and modulation of hormone metabolism and anticancer property (Hamburger & Hostettman, 1991).

The exact classification of phytochemicals has not been given so far, because of their diverse forms and structures. Classically, the phytochemicals have been classified as primary or secondary metabolites, depending on their role in plant metabolism. Primary metabolites include the common sugars, amino acids, proteins, purines and pyrimidines of nucleic acids, chlorophylls etc. Secondary metabolites are the remaining plant chemicals such as alkaloids, terpenes, flavonoids, lignans, plant steroids, curcumins, saponins, phenolics and glucosides (Hahn, 1998; Ramawatet. al., 2009).

Phenolic Compounds

Phenolic compounds represent the largest category of phytochemicals and are most widely distributed in the plant kingdom. Phenolics are hydroxyl group (–OH) containing class of chemical compounds where the (–OH) group is bonded directly to an aromatic hydrocarbon group. Being a secondary metabolite, they have an important role as defence compounds. Phenolics exhibit several properties beneficial to humans and its antioxidant properties are important in determining their role as protecting agents against free radical-mediated disease processes. The three most important groups of dietary phenolics are flavonoids, phenolic acids and polyphenols (Schofield et al., 2001).

Flavonoids

Flavonoids are the largest group of plant phenols and also the most studied one. They are polyphenolic compounds that are ubiquitous in nature and occur as aglycones, glucosides and methylated derivatives. The flavonoids appear to have played a major role in successful medical treatments in ancient times, and their use has persisted up to now. Most flavonoids occur naturally associated with sugar in conjugated form and within any one class, may be characterized as monoglycosidic, diglycosidic etc. Flavonoids have gained recent attention because of their broad biological and pharmacological activities. The flavonoids have been reported to exert multiple biological properties including anti-microbial, cytotoxic, anti-inflammatory and anti-tumour activities (Dai & Mumper, 2010).

Tannins

Chemically, it is difficult to define tannins since the term encompasses some very diverse oligomers and polymers. It might be said that the tannins are a heterogeneous group of high molecular weight polyphenolic compounds with the capacity to form reversible and irreversible complexes with proteins (mainly), polysaccharides (cellulose, hemicellulose, pectin etc.),

alkaloids, nucleic acids and minerals. On the basis of their structural characteristics, it is therefore possible to divide the tannins into four major groups: Gallotannins, ellagitannins, complex tannins and condensed tannins. Recently the tannins have attracted scientific interest, especially due to the increased incidence of deadly diseases such as AIDS and cancers (Schofield et al., 2001).

Alkaloids

Alkaloids are natural products that contain heterocyclic nitrogen atoms and are always basic in character. The name of alkaloids derives from the 'alkaline' nature and it was used to describe any nitrogen-containing base. Almost all the alkaloids have a bitter taste. Alkaloids are significant for the survival of plant because they ensure their protection against micro-organisms (antibacterial and antifungal activities), insects and herbivores (feeding deterrents) and also against other plants by means of allelopathy (Molineux et al., 1996). The use of alkaloids containing plants as dyes, spices, drugs or poisons can be traced back almost to the beginning of civilization. Alkaloids have many pharmacological activities including anti-hypertensive effects (many indole alkaloids), antiarrhythmic effect, anti-malarial activity (quinine), and anti-cancer actions (dimeric indoles, vincristine, vinblastine).

Terpenoids

This class comprises natural products which have been derived from five-carbon isoprene units. Most of the terpenoids have multi cyclic structures that differ from one another by their functional groups and basic carbon skeletons. These types of natural lipids can be found in every class of living things and therefore considered as the largest group of naturally occurring secondary metabolites (Elbein et al., 1999). Many of these are commercially interesting because of their use as flavours and fragrances in foods and cosmetics.

Saponin

Most members of this group form stable foam in aqueous solutions such as soap, hence the name 'saponin'. Chemically, saponins, as a group, include compounds that are glycosylated steroids, triterpenoids and steroid alkaloids. Two main types of steroid aglycones are known, spirostan and furostan derivatives. The main triterpene aglycone is a derivative of oleanane (Bohlmann et al., 1998). Many saponins are known to be anti-microbial, to inhibit mould, and to protect plants from insect attack. Saponins may be considered a part of plants' defence

systems, and as such have been included in a large group of protective molecules found in plants named phytoanticipins or Phyto protectants.

Phytochemicals play an important role in the routine healthcare systems worldwide. The major classes of phytochemicals like alkaloids, phenolics, terpenoids and tannins have potential to prevent diseases and act as anti-microbial, anti-inflammatory, anti-oxidant, anti-cancerous, detoxifying agent, immunity potentiating agent and neuropharmacological agent. Each class of these functional agents consists of a wide range of chemicals with differing potency. Some of these phytochemicals are found to be multifunctional.

Phytochemicals play an important role in the routine healthcare systems worldwide. The major Classes of phytochemicals like alkaloids, phenolics, terpenoids and tannins have potential to prevent diseases and act as anti-microbial, anti-inflammatory, anti-oxidant, anti-cancerous, detoxifying agent, immunity-potentiating agent and neuropharmacological agent. Each class of these functional agents consists of a wide range of chemicals with differing potency. Some of these phytochemicals are found to be multifunctional. There is, however, much scope for further systematic research in screening Indian medicinal plants for their phytochemicals and assessing their potentiality as crude drug or drug components.

HISTOCHEMISTRY

Among ancient civilizations, India has been known to be rich repository of medicinal plants. The forest in India is the principal repository of large number of medicinal and aromatic plants, which are largely collected as raw materials for manufacture of drugs and perfumery products. The knowledge about the use of medicinal plants has been acquired through centuries and such plants are still valued even today. Medico scientist practicing allopathy and research minded Vaidya's, Hakims have contributed valuable knowledge regarding efficacy of reputed medicinal plants indigenous to India. Establishment of herbal forms in well selected localities will excise scientific control over the cultivation of medicinal herbs.

Histochemistry is the branch of histology dealing with the identification of chemical components of cells and tissues. Starch deposition occurs widely in the plant body, but the particularly common places of its accumulation are seeds, the parenchyma of the secondary vascular tissues in the stem and root, tubers, rhizomes and corn. Starch and proteins are the principal ergastic substances of the protoplast. Tannin is the heterogeneous group of phenol derivatives, usually related to glucosides. Tannins are particularly abundant in the leaves (xylem) of many plants (Kadam et.al., 1996). Saponins are the rare occurrence. Fats are widely

distributed in the plant body and they probably occur in small amount in every plant cell. Fats are common reserve material in seeds, spores and embryos in meristematic cells. Glucosides are the degradation product of the carbohydrates. Alkaloids are the degradation product of protein.

Histochemistry is a powerful technique for localization of trace quantities of trace quantities of substances present in biological tissues. Histochemical techniques have been employed to characterize structure and development, and to study time course of deposition and distribution of major storage compounds such as protein, lipid, starch, phytin and minerals such as calcium, potassium and iron in rice grains (Krishnan et al.2001; Krishnan and Dayanandan 2003).

SOURCE PLANT

Glycosmis pentaphylla Corr. is a genus within the tribe Clauseneae of the Citroideae subfamily of the Rutaceae. Its range of distribution is centred in south and southeast Asia and extends to south China and Taiwan as well as to New Guinea and north Australia. And there are still many taxonomic problems at the species level that remain to be solved.

The plant is often used in traditional medicine, both on its own and as an ingredient of various medicinal mixtures. Several alkaloids and amides that have been isolated from the plant are reported to have biological activities. Glycozolidol, a carbazole alkaloid isolated from the roots, is active against some gram-positive and gram-negative bacteria. Leaf and stem bark extracts have been shown to have a healing effect upon damaged liver tissue. Extracts of the root bark have been shown to exhibit significant activity in the treatment of diarrhoea. An ethanol extract was found to be more effective at lower dosages than an aqueous extract. A decoction of roots and leaves is taken for intestinal trouble. An infusion of leaves and roots is given after childbirth as a protective medicine. The leaves are considered appetitive, stomachic and an infusion of roasted leaves is prescribed for women after delivery as an appetizer. In traditional Indian medicine, the plant is used to treat diarrhoea, coughs, rheumatism, anaemia, and jaundice.

Vitex negundo Linn. (Verbenaceae) is a woody, aromatic shrub growing to a small tree. It commonly bears tri- or penta-foliolate leaves on quadrangular branches, which give rise to bluish-purple coloured flowers in branched tomentose cymes. It thrives in humid places or along water courses in wastelands and mixed open forests and has been reported to occur in Afghanistan, India, Pakistan, Sri Lanka, Thailand, Malaysia, eastern Africa and

Vitex negundo L. (Verbenaceae) is a hardy plant, flourishing mainly in the Indian subcontinent. All parts of the plant, from root to fruit, possess a multitude of phytochemical secondary metabolites which impart an unprecedented variety of medicinal uses to the plant. It is interesting to note that a single plant species finds use for treatment of a wide spectrum of health disorders in traditional and folk medicine; some of which have been experimentally validated. The plant is a component of a number of commercially available herbal formulations and has also shown potential as an effective bio-control agent. (Vishwanathan et.al.,2010).

Calotropis gigantea L. is a tall shrub with yellowish-white bark, and oblong thick leaves and purplish or white flowers in the family Asclepiadaceae. In ancient ayurvedic medicine the plant *Calotropis gigantea* is known as “Sweta Arka” and *Calotropis procera* as “Raktha Arka”. Both of them are often similar in their botanical aspects and also have similar pharmacological effects. *Calotropis gigantea* L. is drought resistant, salt tolerant to a relatively high degree, grows wild up to 900 meters (msl) throughout the country and prefers disturbed sandy soils with mean annual rainfall: 300-400 mm. Through its wind and animal dispersed seeds, it quickly becomes established as a weed along degraded roadsides, lagoon edges and in overgrazed native pastures. It has a preference for and is often dominant in areas of abandoned cultivation especially disturbed sandy soils and low rainfall. It is assumed to be an indicator of over cultivation.

Moringa oleifera Lam, is a natural as well as cultivated variety of the genus *Moringa* belonging to family Moringaceae. It is one of the richest plant sources of Vitamins A, B {1,2,3,6,7}, C, D, E and K. The vital minerals present in *Moringa oleifera* Lam include Calcium, Copper, Iron, Potassium, Magnesium, Manganese and Zinc. It has more than 40 natural anti-oxidants. The leaves, pods, seeds, gums, bark and flowers of *Moringa oleifera* Lam are used in more than 80 countries {including Pakistan} to relieve mineral and vitamin deficiencies, support a healthy cardiovascular system, promote normal blood-glucose levels, neutralize free radicals {thereby reducing malignancy}, provide excellent support of the body's anti-inflammatory mechanisms, enrich anaemic blood and support immune system. It also improves eyesight, mental alertness and bone strength. It has potential benefit in malnutrition, general weakness, lactating mothers, menopause, depression and benefits, nutritional value, therapeutic use osteoporosis. It is also used to make an efficient fuel, fertilizer and livestock feed. *Moringa oleifera* Lam is an edible extremely safe plant. Its tree could easily and cheaply

be cultivated and grown in Pakistan. We need to explore therapeutic, nutritional and benefit of this gift of nature reported to be one of the world's most useful trees.

OBJECTIVES OF THE PRESENT STUDY

- To study the pharmacognostic aspects of the plants *Glycosmis pentaphylla* Corr., *Vitex negundo* L., *Calotropis gigantea* L., *Moringa oleifera* Lam. used in the treatment of disease arthritis.
- To determine the important phytochemical constituent in *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam.
- To study the histochemical characters of *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam.
- To study the anatomical features of *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam.

REVIEW OF LITERATURE

Medicinal plants used against various inflammatory biomarkers for the management of rheumatoid arthritis were studied by (Shareen Singh 2020). This study highlights the properties of different plants which acts against arthritis. *Moringa oleifera* Lam was one among that. The various plant parts like seed and leaf possess antioxidant and anti-inflammatory property. The ethanolic extract of moringa leaves proved to be potent anti-arthritis at a dose of 250 mg/kg and tends to inhibit the inflammatory paw oedema in both acute and chronic phases of CFA-induced arthritic model. There was significant inhibition of production of nitric oxide (NO) by macrophage cells, reduction in the levels of cytokines (IL-1, IL-6 and TNF-alpha) and also the inhibition of autacoid (COX2 and PGE2) involvement in inflammation. Hence, the effective results of various studies concluded that the plant tends to possess potential beneficial medicinal effects for the treatment of arthritis.

Anti-inflammatory activity was studied on ethanolic extract of leaves of *Glycosmis pentaphylla* Corr by (Prawej Ansari 2015). The study was carried out with the ethanolic extract of leaves of *Glycosmis pentaphylla* Corr. This study investigated the blood corpuscular protective power of this plant as it used as blood tonic in Chinese traditional medicine. By the phytochemical screening, it showed both flavonoids and steroids. This study shows that *G. pentaphylla* Corr has property of pain or inflammation healing and from phytochemical analysis they found the presence of alkaloid and steroid, so it could also have anti-coagulation property as well and it seems as an ideal anti-inflammatory agent.

Pharmacological studies on *Glycosmis pentaphylla* Corr. whole plant was studied by (Kishore Sarkar 2013). In this study ethanolic extract of whole plant of *Glycosmis pentaphylla* Corr. was pharmacologically investigated to survey and assess the antioxidant, analgesic and antibacterial activities. In scavenging assay by DPPH, a stable radical, the extract showed a significant inhibition of scavenging activity of DPPH radical in concentration dependent manner, where IC50 value of the extract was 32µg/mL which was comparable to the IC50 value of the standard ascorbic acid, 16 µg/mL. In antibacterial activity test performed by disc diffusion method, the extract showed activity against the bacterial strains including *S. aureus*, *S. dysenteriae*, *S. paratyphi* and *S. Typhi* at the dose of 250 µg/disc and 500µg/disc. The results suggest that the ethanol extract of *G. pentaphylla* Corr could be a potential source of antioxidant, analgesic and antibacterial activity and demands for further pure compound isolation to identify the underlying mechanism.

A study was conducted on *Glycosmis pentaphylla* Corr. by (Natarajan et.al. 2020) to isolate Potential Bioactive Arborine and Skimmianine Compounds for Controlling Multidrug-Resistant *Staphylococcus aureus*. The isolation and structural characterization of bioactive compounds were carried out using various chromatographic techniques (TLC, column, HPLC, and LC-MS) and spectral studies such as FT-IR, CHNS analysis, ¹H-NMR, and ¹³C-NMR. The antimicrobial potential of isolated compounds was assessed according to the standard methods. The isolated compounds were identified as arborine and skimmianine, which exhibited a significant antibacterial effect with the lowest MIC and MBC values against MDR *S. aureus* and *in vitro* kinetic and protein leakage assays supported the antimicrobial activity. This study concludes that the isolated arborine and skimmianine compounds from *G. pentaphylla* Corr. harbor a strong antibacterial activity against MDR *S. aureus* and may be used as alternative natural drugs in the treatment of MDR *S. aureus*.

A study on 14 species of Thai *Glycosmis* in “Thai Plant Names, Tem Smitinand, Revised Edition”. Were conducted by (Stone, 1985). Thai *Glycosmis* species are still poorly known. The actual number of existing species of *Glycosmis* in Thailand was not previously enumerated. *G. pentaphylla* Corr. represents the most widespread and variable species within this genus. Morphological characteristic is various in pair and form of foliage, size and position of inflorescence (Stone, 1985).

In vitro mechanistic and in vivo anti-tumour studies of *Glycosmis pentaphylla* Corr (Retz.) DC against breast cancer was studied by (Shoja et.al. 2016). The present study is aimed at elucidating the effect of *Glycosmis pentaphylla* Corr (Retz.) DC on the key markers of apoptosis, metastasis and angiogenesis, in vitro. This study also evaluated the effect of fractions in vivo in DMBA-induced mammary tumour model. This study showed that the fractions induced apoptosis in breast cancer cells through the intrinsic/mitochondrial apoptotic pathway. The fractions were also able to inhibit the metastatic and angiogenic markers, MMP-9 and HIF-1 α . Anti-tumour studies in DMBA-induced mammary model in Sprague Dawley rats also showed favourable results.

Anti-inflammatory and analgesic activities of mature fresh leaves of *Vitex negundo* L. was studied by (Dharmasiri et.al. 2006). This study confirmed the oral anti-inflammatory, analgesic and antihistamine properties of mature fresh leaves (MFL) of *Vitex negundo* L. (Verbenaceae) claimed in the Ayurveda medicine by orally treating a water extract of the leaves to rats. This study concludes that the fresh leaves of *Vitex negundo* L. have anti-inflammatory

and pain suppressing activities possibly mediated via PG synthesis inhibition, antihistamine, membrane stabilising and antioxidant activities. The antihistamine activity can produce the anti-itching effect claimed in Ayurveda medicine.

Screening of antioxidant activity, total phenolics and GC-MS study of *Vitex negundo* L. was studied by (Praveen Kumar et.al. 2010). This study identified the phytochemicals present in the *vitex negundo* L. leaves and also evaluated the total phenols, total flavonoids and antioxidant activity of the leaf extract. Total phenol was carried out by Folin ciocalteu method. The antioxidant activity was evaluated by DPPH method and the leaves of *v. negundo* L. showed 23.21 mg/100 of ascorbic acid equivalent antioxidant capacity. The GC-MS study also carried out and it showed the presence of phytochemicals like 4H -Pyran-4-one, 2,3- dihydro-3,5-dihydroxy-6-methyl.

Phytochemical and Pharmacological Profile of *Vitex negundo* L. was studied by (Cheng-Jian Zheng et.al. 2015) This article reviewed all the chemical constituents and pharmacological properties of *Vitex negundo* L. (Verbenaceae) (VN). Total of 120 compounds isolated from VN can be divided mainly into four classes: flavonoids, lignans, terpenoids and steroids. The crude extracts and purified compounds of VN exhibited promising bioactivities, including anti-nociceptive, anti-inflammatory, anti-tumour, anti-oxidant, insecticidal, antimicrobial, anti-androgenic, anti-osteoporotic, anti-cataract, hepatoprotective and anti-hyperglycaemic activity. All the reported data lead to a conclusion that VN has convincing medicinal potential.

An In Vitro study of antibacterial activity on aqueous extract of *Calotropis gigantea* L. was conducted by (Gaurav Kumar et.al. 2010). In this study the leaves of *Calotropis gigantea* L. were screened for the antimicrobial activity against clinical isolates of bacteria. The aqueous extract of the *C. gigantea* L. was studied for its antagonistic activity against *Staphylococcus aureus*, *Escherichia coli*, *Bacillus cereus*, *Pseudomonas aeruginosa*, *Micrococcus luteus* and *Klebsiella pneumoniae*. In vitro antimicrobial activity was performed by well diffusion method in MH agar. The extract showed significant effect on the tested organisms. The extract showed maximum zone of inhibition against *E. coli* (17.6 ± 1.15), whereas, lowest against *K. pneumoniae* (12.6 ± 1.52). Crude extract showed maximum relative percentage inhibition

against *B. cereus* (188.52 %) and lowest relative percentage inhibition against *M. luteus* (24.92 %).

Gaurav Parihar & Neelam Balekar (2016) had studied the anti-inflammatory activity of latex of *Calotropis gigantea* L. Different parts of the plant showed the presence of various phytochemicals containing cardiogenic agents such as calotropin, calotropagenin, calotoxin, calotropagenin and voruscharine, steroids, di and triterpenes such as stigmasterol, β -sitosterol, flavonoids, polyphenolic compounds, and various newer reported hydrocarbons and proteins. This study concludes that it has the potential to be used as an antiarthritic agent. The latex (DL) of the plant *C. procera* has been reported to exhibit potent anti-inflammatory activity against carrageenan and formalin that are known to release inflammatory mediators.

Analgesic activity of *Calotropis gigantea* L. flower was studied by (Pathak 2011). In this study the alcoholic extract of the flowers of *Calotropis gigantea* L. was administered orally and explored for its analgesic activity in chemical and thermal models in mice. In acetic acid induced writhing test, an inhibition of 20.97% and 43.0% in the number of writhes was observed at the doses of 250 and 500 mg/kg, respectively. In the hot plate method, the paw licking time was delayed. The analgesic effect was observed after 30 min of dose administration which reached its maximum after 90 min.

A Study on Wound healing activity of *Calotropis gigantea* L. root bark in rats was conducted by (Pradeep et.al. 2009). This study investigated the effects of *Calotropis gigantea* L. root bark on wound healing activity in rats by excision, incision and dead space wound healing models in rats. Wistar albino rats of either sex weighing between 180 and 200 g were topically treated with extract formulated in ointment by using simple ointment BP as base. Rats of standard groups were treated with 5% Povidone iodine ointment topically. Topical application of *Calotropis gigantea* L. in excision wound model increased the percentage of wound contraction. Scar area and epithelization time were decreased. In incision wound and dead space wound breaking strength of wounds and hydroxyproline was increased.

Phytochemical and cytotoxic studies on the leaves of *Calotropis gigantea* was studied by (Khang Guyen et.al. 2017). A new lignan, 9'-methoxypinoresinol, and two new glycosylated 5-hydroxymethylfurfurals, calofurfuralside A, and calofurfuralside, together with nine known compounds have been isolated from the active fractions, CHCl_3 and EtOAc fractions of the

leaves of *Calotropis gigantea* L. Their structures were elucidated based on NMR and MS data. Among the isolated compounds, compounds **1** and **9** exhibited potent cytotoxicity against PANC-1 human pancreatic cancer cell line under the normoglycemic condition with IC₅₀ values of 3.7 and 3.3 μM, respectively. 9'-Methoxypinoresinol (**1**) significantly inhibited the colony formation of PANC-1 cells in a concentration-dependent manner.

Adak et.al. (2006) evaluated the anti-inflammatory activity of *Calotropis gigantea* L. (AKANDA) in various biological system. The anti-inflammatory activity was evaluated using carrageenin-induced kaolin -induced rat paw oedema for acute and cotton-pellet granuloma, adjuvant-induced arthritis model for chronic inflammation. Antipyretic activity was carried out using yeast induced pyresis method. Phenyl quinone induced writhing method in mice was used for analgesic activity. Test compounds exhibited variable anti-inflammatory activity and peak activity of the test compounds were reached at 2 h. Alkaloid fraction possesses comparatively high initial anti-inflammatory activity. The residual anti-inflammatory activity of alkaloid fraction of *Calotropis gigantea* L. suggests either a greater protein binding nature of the compound there by providing a slow released pool of active drug molecule in the system or non-available of possible bioactive metabolites to retain the activity profile relation.

Health benefits of *Moringa oleifera* Lam. was documented by (Abdull Razis et.al. 2014). This study revealed that *Moringa oleifera* Lam contains essential amino acids, carotenoids in leaves, and components with nutraceutical properties, supporting the idea of using this plant as a nutritional supplement or constituent in food preparation. An important factor that accounts for the medicinal uses of *Moringa oleifera* is its very wide range of vital antioxidants, antibiotics and nutrients including vitamins and minerals. This study concludes that almost all parts from *Moringa* can be used as a source for nutrition with other useful values.

Nutritional characterization of *Moringa (Moringa oleifera Lam.)* leaves was studied by (Moyo et.al. 2011). The objective of the study was to assess the nutritional value of *Moringa* leaves of the South African ecotype. Proximate and Van Soest methods were used to determine the nutritional value of *Moringa leaves*. The dried leaves had the following mineral contents: calcium, phosphorus, magnesium, potassium, sodium, sulphur, zinc, copper, manganese, iron and selenium. Vitamin E had the highest concentration of 77 mg/100 g than beta-carotene, which had 18.5 mg/100 g in the dried leaves. The fibre content was neutral detergent fibre (NDF) (11.4%), acid detergent fibre (ADF) (8.49%), acid detergent lignin (ADL) (1.8%) and (acid detergent cellulose (ADC) (4.01%).

Phytochemistry and Pharmacology of *Moringa oleifera* Lam was studied by (Birendra Kumar 2010). This study discusses the phytochemical composition, medicinal uses & its pharmacological activity. The present data suggest that the Methanolic and aqueous extract of root and bark, methanolic extract of leaves and flowers and ethanolic extract of seeds of *Moringa oleifera* Lam showed anti-inflammatory activity. In-vitro anti-inflammatory activity from the hot water infusions of flowers, leaves, roots, seeds and stalks or bark of *Moringa oleifera* Lam using carrageenan-induced and the extract was pharmacologically evaluated.

Determination of flavonoids by LC/MS and anti-inflammatory activity in *Moringa oleifera* Lam. was documented by (Coppin et.al. 2013). In this study twelve flavonoids were identified, including quercetin and kaempferol glucosides and glucoside malonates as major constituents and *Moringa oleifera* Lam was found to exhibit anti-inflammatory activity of constituents-rich varieties.

Manoj Kumbhare et.al. (2011) documented the Anti-Inflammatory and Analgesic Activity of Stem Bark of *Moringa Oleifera* Lam. The analgesic activity of stem bark of *Moringa oleifera* Lam. carried out using acetic acid-induced writhing in mice and tail flick test in rats. The anti-inflammatory activity was evaluated using carrageenan-induced rat paw edema and cotton pellet-granuloma formation in rats. Petroleum and methanolic extracts of *Moringa oleifera* Lam. was used. Treatment with Methanol extract showed significant inhibition of carrageenan induced rat paw edema. Maximum inhibition was observed at 400 mg/kg dose as compared to the control. So, the result obtained indicates that *Moringa oleifera* Lam. has analgesic and anti-inflammatory activities that supports the folk medicinal use of the plant.

MATERIALS AND METHODS

The present study was carried out using selected plants used for the treatment of arthritis.

Glycosmis pentaphylla Corr. is an evergreen shrub or small tree growing up to 5 metres tall which belongs to the family Rutaceae.

Vitex negundo L. is shrubs or trees rarely woody lianas. Stem and branches obtusely quadrangular. It belongs to the family Verbenaceae.

Calotropis gigantea L. is a large shrub growing to 4m tall. It has clusters of waxy flowers that are either white or lavender in colour. This belongs to the family Asclepiadaceae.

Moringa oleifera Lam is a fast-growing, drought -resistant tree of the family Moringaceae, native to the Indian subcontinent. Common names include moringa, drumstick tree.

The following were the parameters of the study:

1. PHARMACOGNOSTIC ANALYSIS

1.1 ORGANOLEPTIC EVALUATION

1.2 MICROSCOPIC STUDIES

1.2.1 STOMATAL TYPE AND STOMATAL INDEX

1.2.2 PALISADE RATIO

1.2.3 VEIN -ISLET NUMBER

1.2.4 VEIN- TERMINATION NUMBER

1.2.5 ANATOMY

2. HISTOCHEMICAL STUDIES

2.1 STARCH

2.2 POLYPHENOL

2.3 LIPIDS

3. PHYTOCHEMICAL ANALYSIS

1 PHARMACOGNOSTIC ANALYSIS

The main features studied are follows:

1.1 Organoleptic evaluation

organoleptic evaluation includes the study of the nature of the powdered leaf drug, for this, the colour, taste, and texture of the drug were noted.

1.2 Microscopic studies

1.1.1 Determination of stomatal type and stomatal index

The term stomatal index was first introduced by (Salisbury 1932). The percentage proportion of the ultimate divisions of the epidermis of a leaf which have been converted in to stomata is termed the stomatal index. For determining the stomatal index, the fresh leaves of the plant were taken. From the lower surface of the leaves, epidermal peels were taken. It was then stained with saffranine. The peel was placed in a glass slide and a drop of glycerine was put over it and covered with a cover glass without air bubbles. The slide was examined under the compound microscope. After this type of stomata, number of epidermal cells and stomata in the field were noted. The stomatal index was calculated using the formula:

$$\text{Stomatal index} = \frac{S \times 100}{E + S}$$

Where,

S = Number of stomata per unit

E = Number of epidermal cells in the same area

1.1.2 Palisade ratio

Palisade ratio is defined as the average number of palisade cells beneath each epidermal cell. Fresh leaves of the plant were taken. Then they were boiled with trichloroacetic acid solution. The sample was then mounted in glycerine, and focused under high magnification. Then the focal length of the microscope was adjusted to see the palisade cells were counted from each field below four adjacent epidermal cell and the ratio was

determined by dividing the total number of palisade cells by 4. The average palisade ratio was taken.

Palisade ratio furnishes an important data for leaf drug evaluation, which can be successfully applied for the studies of several dicot leaves of medicinal importance.

Palisade ratio = $\frac{\text{Number of palisade ratio}}{\text{Number of epidermal cells}}$

Number of epidermal cells

1.1.3 Determination of vein-islet number

The word vein – islet is found for the minute area of photosynthetic tissues encircled by the ultimate divisions of conducting strands. Vein-islet number is defined as the number of vein-islet per square millimetre of the leaf surface midway between the midrib and the margin.

The method of determination of vein-islet number was put forth by (Levin 1929). Leaf pieces were put in trichloroacetic acid. When the leaf become transparent, they are mounted in glycerine. A camera lucida was attached to the microscope. A paper was placed and the vein islet was traced by looking through

1.1.4 Determination of vein termination number

Vein termination number is defined as the number of veinlet termination per square millimetre of leaf surface between midrib and margin. The method of determination of vein termination number was put forth by (Hall & Melville 1954). Leaf pieces were placed in trichloroacetic acid. When the leaves become transparent and clean, one of the pieces was mounted in glycerine. Camera Lucida drawings were made and the number of vein termination process within the 4cm X 4cm square counted and average vein termination number was determined.

1.1.5 Anatomy

Transverse section of leaf was taken and stained, mounted in glycerine on to a micro slide, examined under the microscope and photograph was taken.

2. HISTOCHEMICAL STUDIES

2.1 Starch – iodine-potassium iodide reaction

The fresh leaf epidermal peelings and stem section were treated with iodine-potassium iodide solution and mounted in the same. Presence of starch can be confirmed by the appearance of black grains.

2.2 Polyphenols -Toludine blue O Method

The peelings were stained in Toludine blue O for 5 minutes, washed in running water, retained in distilled water for some time and then mounted in glycerine. The polyphenols when present stained turquoise blue.

2.3 Lipids – Sudan Dye Method

The fresh peelings were kept in 50% ethanol for 10 minutes, washed in 50% ethanol and mounted in glycerine. The fats, oils, waxes and free fatty acids stained blue-black.

3. PHYTOCHEMICAL ANALYSIS

(A) QUALITATIVE ANALYSIS

1.1 Detection of Alkaloids

For the preparation of plant extraction 1 gm of powdered sample of leaf was homogenized using 80% ethanol (10ml). The homogenate is centrifuged at 15000 rpm for 5 minutes and the supernatant was collected.

For the detection of alkaloids Mayer's, Wagner's, and Dragendroff's reagent was prepared.

(1) Mayer's reagent

It was prepared by dissolving 1.36g of HgCl₂ in 60 ml distilled water (Solution A) and 5g of KI dissolved in 10ml distilled water (Solution B). Both these solutions were mixed and diluted to 1000ml with distilled water. The extract was acidified with HCl before adding Mayer's reagent.

(2) Wagner's reagent

It was prepared by dissolving 1.27g of iodine and 2.9g of KI in 5ml distilled water and the solution were made up to 100ml.

(3) Dragendroff's reagent

It was prepared by dissolving 8g of bismuth sulphate in 20ml of Conc. HNO₃(solution A) and 27.2g in 50ml distilled water (solution B). The solution was mixed, supernatant solution was decanted and made up to 100ml with distilled water.

After the preparation of reagents small amount of plant extract (only aqueous extract) was taken and tested with all the 3 reagents and the formation of precipitate shows the presence of Alkaloids or Absence of alkaloids.

1.2 Detection of saponins – foam test

1gm of powdered plant material life was taken in 20ml distilled water. It was shaken for 10 minutes. Formation of frothy solution indicates the presence of saponins.

1.3 Detection of Flavonoids – Alkaline reagent test

To a little of the sample of leaf powder add 2ml of NaOH followed by 2ml of dilute H₂SO₄. The yellow colour in NaOH changes when dilute acid is added. This shows presence of flavonoids.

1.4 Detection of Tannin – Ferric chloride test

Little of sample were mixed with water and filtered. The filtrate was mixed with 2ml of 5% Ferric chloride solution in a test tube. Formation of green, blue or black colour indicates the presence of tannin.

2.5 Detection of steroid – Salkowski test

The aqueous extract was treated with few drops of concentrated sulphuric acid. A red colouration in lower layer of the solution indicates the presence of steroid.

2.6 Detection of Bitters

1 gm of powdered sample were shaken with ethyl alcohol and then with ethyl acetate formation of green colour shows the presence of Bitter.

2.7 Detection of Protein

(1) Biuret test

A few drops of CuSO_4 solution were added to 2ml of the test solution, aqueous extract of leaf powder followed the addition of 40% NaOH solution. It was mixed thoroughly and the colour was noted. Purple colour indicates the presence of Protein.

(2) Xanthoproteic test

Equal volume of test solution (aq. Extract) and Conc. HNO_3 (0.5ml) were mixed well and the solution was cooled to room temperature. The colour was noted. Yellow colour indicates the presence of protein. Again 40% NaOH was added to make the solution alkaline. The colour was noted again. Yellow colour changes to bright orange which indicates the presence of protein.

2.8 Detection of Resin

50% of HNO_3 was added to a little of the powdered sample. Brown colour obtained indicates the presence of resins.

2.9 Detection of Carbohydrate

(1) Molisch's test

2 Drop of Molisch's reagent was added to 2ml of the test solution and was mixed well. 1ml Conc. H_2SO_4 was added along the sides of the test tube without shaking.

(2) Benedict's test

5ml of Benedict's reagent was added to 1ml of test solution and the test tube was kept in boiling water for 5 minutes.

(3) Fehling's test

1ml of Fehling's reagent A was mixed with 1 ml of Fehling's reagent B to which a few drops of test solution are added and boiled.

2.10 Detection of Phenol

Two drops of 5% FeCl_3 of the extract in a test tube. Presence of greenish precipitate indicated the presence phenolics.

(B) QUANTITATIVE ANALYSIS

ESTIMATION OF FLAVONOID

Sample preparation

A ground freeze dried sample of 0.5 g was weighed and flavonoid compound was extracted with 50ml of 80% aqueous methanol on an ultrasonic bath for 20mts. An aliquot 2ml of the extract was ultracentrifuged for 5mts at 14000rpm.

Total Flavonoid assay

Total flavonoid content was measured by the aluminium chloride colorimetric assay. An aliquot (1ml) of extract or standard solution of catechin (20,40,60,80,100) was added to 10ml volumetric flask containing 4ml of distilled water. To the flask was added 0.3ml 5% NaNO₂. After 5 minutes 0.3ml of 10% of aluminium chloride was added. At the 6th minute, 2ml 1M NaOH was added and the total volume was made up to 10ml with distilled water. The solution was mixed and the absorbance was measured against prepared reagent blank at 510nm.

ESTIMATION OF TANNIN

For the estimation of tannins first indigo sulphonic acid was prepared. It was prepared by adding 1g indigo carmine in 25ml conc. Sulphuric acid in 100ml beaker. The indigo carmine was then dissolved completely in conc. Sulphuric acid. To this again 25ml of conc. Sulphuric acid was added and made up to 1L in volumetric flask using distilled water.

For titration, 0.1N potassium permanganate solution was taken in a burette and 25ml of the Indigo sulphonic acid was taken in 1L conical flask. It was then titrated and blank value was taken. Then 1g of the sample was taken in a conical flask with a rubber cork, 100ml distilled water was added to it and shaken well for 10 minutes. It was filtered, 10ml of the sample solution was taken in 1L conical flask and 25ml indigo sulphonic acid was added to the solution

The above solution was titrated with 0.1N Potassium permanganate solution. End point was the change of blue colour to golden yellow colour then the burette reading was taken, 1ml of 0.1N KMnO₄ is equal to 0.005647g of tannins.

Total tannin was calculated using the formula:

$$\text{Percentage of tannin} = \frac{\text{Burette reading} - \text{Blank reading} \times 0.005647 \times 10 \times 100}{\text{Weight of the sample}}$$

ESTIMATION OF PHENOLIC COMPOUNDS

1g of both leaf and bark (plant sample) were homogenized separately using 80% ethanol (25ml). the homogenate was centrifuged at 1000rpm for 20mts. The supernatant was collected and residue was again centrifuged and extract was collected. 0.2ml aliquot was taken from this extract in a test tube and 2.8ml distilled water was added. To this sample 0.5ml Folin cio calteau reagent was added and kept for 3 minutes. After that 2ml sodium bicarbonate was added. The test tube was placed in a boiling water bath for 1 mts. And optical density was measured against blank solution using colorimeter. Blank solution was prepared by taking 3ml distilled water. A standard graph was prepared using different concentration of sample and the concentration of phenol was obtained from the graph. It was expressed as mg phenol/100mg material. Phenol concentration of the plant was studied.

ESTIMATION OF CARBOHYDRATE

For the quantitative estimation of carbohydrate, the method adopted was that of Shirlaw and Gilchrist (1967). The method is based on colorimetric observations.

One gram each of Anthrone and Thyo urea was taken. 760ml of concentration H₂SO₄ was added to 240ml of distilled water. Anthrone and thiourea was dissolved in this. 200mg of oven dried and ground leaf sample was boiled for half hours with 20ml of distilled water in a 250ml conical flask. It was filtered and volume was made up to 50ml with distilled water. 1ml of the filtrate was pipetted in colorimetric tube and 10ml of anthrone reagent was added. After stoppering the tubes with rubber plugs then were kept in water bath and were cooled in running water. The coloured density developed was measured calorimetrically at 625nm.

The following equation was used for calculation:

$$\text{Mg. Carbohydrate/100gm of the sample} = \frac{X_a \times 20 \times 500}{\text{Reading the standard OD}}$$

Where X_a is the optical density of the sample

Preparation of standard carbohydrate solution

A Standard carbohydrate solution of 100.0ppm concentration was prepared by dissolving 100mg Glucose in distilled water and making it up to 1000ml.

OBSERVATIONS AND RESULTS

1. PHARMACOGNOSTIC ANALYSIS

1.2 ORGANOLEPTIC EVALUATION

Oven dried fine powder of these plants showed different colours. For *Glycosmis pentaphylla* Corr. & *Moringa oleifera* Lam leaf green colour, for *Vitex negundo* L. pale green, for *Calotropis gigantea* L. fainted green and for *Moringa oleifera* root white colour. The dried fine powder of *Glycosmis pentaphylla* Corr., *Vitex negundo* L., *Calotropis gigantea* L., and *Moringa oleifera* Lam leaf and root possess a characteristic odour, aromatic, odourless, aromatic and characteristic odour respectively. And fine powder of these plants tastes different. For *Glycosmis pentaphylla* Corr slightly bitter, for *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam leaf bitter and for *Moringa oleifera* Lam root pungent flavour.

1.3 MICROSCOPIC STUDIES

Glycosmis pentaphylla Corr, *Vitex negundo* L., *Moringa oleifera* Lam possess anomocytic stomata and *Calotropis gigantea* L. possess paracytic stomata. Stomatal index of *Glycosmis pentaphylla* Corr was found to be 10%. For *Vitex negundo* L. it was 6.06%. *Calotropis gigantea* L. shows 17.85% and for *Moringa oleifera* Lam 13.3%.

Palisade ratio of *Glycosmis pentaphylla* Corr was found to be 3.30. For *Vitex negundo* L. it was 2.7. *Calotropis gigantea* L. shows 1.25 and for *Moringa oleifera* Lam 2.3.

Vein islet number is defined as the number of vein islets per square mm of leaf surface midway between the midrib and margin and vein termination number is the number of veins per square mm of leaf surface midway between midrib and margin. Vein islet number and vein termination number for *Glycosmis pentaphylla* Corr was found to be 9 & 8. For *Vitex negundo* L. it was 23 & 7. *Calotropis gigantea* L. shows 10 & 18 and for *Moringa oleifera* Lam 10 & 15.

1.4 ANATOMY

Transverse section of leaf of *Glycosmis pentaphylla* Corr shows three major regions namely epidermis, mesophyll and vascular region. Epidermis is the outermost protective part and it covers the whole of its upper and lower surfaces. It has two divisions upper & lower epidermis. Numerous small openings called stomata are found in the epidermis. Lamina and mesophyll are diagnostic characters. Palisade tissue is double layered. Mid rib has non-lignified phloem and lignified xylem. Vascular bundles are amphicribal surrounded by endodermis. Endarch type of xylem.

Transverse section of leaf of *Vitex negundo* L. shows three major regions namely epidermis, mesophyll and vascular region. Epidermis is the outermost protective part and it covers the whole of its upper and lower surfaces. It has two divisions upper & lower epidermis. Numerous small openings called stomata are found in the epidermis. Epidermis is single

layered with unicellular hairs. Followed by One to three layers of hypodermis. 4-8 layer of palisade cells are present. Endarch type of xylem.

Transverse section of leaf of *Calotropis gigantea* L. shows three major regions namely epidermis, mesophyll and vascular region. Epidermis is the outermost protective part and it covers the whole of its upper and lower surfaces. It has two divisions upper & lower epidermis. Upper and lower epidermis is with one row of elongated cells with cuticle and stomata. Numerous small openings called stomata are found in the epidermis. It is followed by 2-3 rows of mesophyll. Xylem and phloem are surrounded by parenchyma cells. Endarch type of xylem.

Transverse section of leaf of *Moringa oleifera* Lam shows three major regions namely epidermis, mesophyll and vascular region. Epidermis is the outermost protective part and it covers the whole of its upper and lower surfaces. It has two divisions upper & lower epidermis. Palisade cells is with one row of elongated cells and it have dense stellate crystals of oxalate. Endarch type of xylem.

2. PHYTOCHEMICAL ANALYSIS

(A) QUALITATIVE ANALYSIS

2.1 Detection of Alkaloids

For detecting alkaloid, the sample were treated with Mayer's reagent, Dragendroff's and Wagner's reagent. *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam leaf showed the presence of precipitate formation whereas *Moringa oleifera* Lam root showed the absence of precipitate formation.

2.2 Detection of Saponins

Detection of saponin was done by shaking the powder vigorously with water. The formation of froth indicated the presence of saponins. *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam leaf & root showed the presence of saponin.

2.3 Detection of Flavonoids

For detecting flavonoid, the sample was treated with NaOH and dilute sulphuric acid. Yellow colour obtained showed discolouration on treatment with acid, indicated the presence of flavonoids. *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Calotropis gigantea* L., and *Moringa oleifera* Lam leaf & root showed the presence of flavonoids.

2.4 Detection of Tannins

For the detection of tannin, the filtered sample was treated with 5% ferric chloride solution in a test tube and the green colour indicated the presence of tannin in *Glycosmis pentaphylla* Corr, *Vitex negundo* L. and *Calotropis gigantea* L. and black colour indicated the presence of tannin in *Moringa oleifera* Lam leaf whereas *Moringa oleifera* Lam root showed the absence of tannin.

2.5 Detection of Steroid

For steroid the sample was treated with few drops of concentrated sulphuric acid and the red colouration in the lower layer indicated the presence of steroid in *Glycosmis pentaphylla* Corr, *Vitex negundo* L. and in *Moringa oleifera* Lam root whereas *Calotropis gigantea* L. and *Moringa oleifera* Lam leaf showed the absence of steroid.

2.6 Detection of Bitter

Detection of bitter was done by shaking the powder with ethyl alcohol followed by the ethyl acetate. The green colour indicated the presence of bitter. *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam leaf showed the presence of bitter whereas *Moringa oleifera* Lam root showed the absence of bitter.

2.7 Detection of Protein

The sample solution showed the absence of protein, when it was treated with specific reagent of

2.8 Detection of Resin

When the extract was treated with 50% HNO₃, brown colour was observed in *Glycosmis pentaphylla* Corr., *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam leaf & root which indicated the presence of resin.

2.9 Detection of Carbohydrate

Presence of carbohydrate in extract was tested using Molisch's reagent, Benedict's reagent and Fehling's reagent. *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Calotropis gigantea* Lam and *Moringa oleifera* Lam leaf & root showed reddish violet zone at the junction of two liquids when treated with Molisch's reagent.

Glycosmis pentaphylla Corr, *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam leaf & root showed orange red precipitate when treated with Benedict's reagent.

Glycosmis pentaphylla Corr, *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam leaf & root showed red precipitate when treated with Fehling's reagent. All the three tests indicate the presence of carbohydrate.

2.10 Detection of Phenol

For the detection phenol, two drops of 5% FeCl₃ was added to the extract in the test tube. Presence of greenish colour indicated the presence of Phenol. *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Calotropis gigantea* L., and *Moringa oleifera* Lam leaf showed the presence of phenol whereas *Moringa oleifera* Lam root showed the absence of phenol.

(B) QUANTITATIVE ANALYSIS

ESTIMATION OF TANNIN

The result of tannin content shows that the *Glycosmis pentaphylla* Corr was found to be 14%. For *Vitex negundo* L. it was 67%. *Calotropis gigantea* L. shows 33% and for *Moringa oleifera* Lam leaf 50%

ESTIMATION OF PHENOLIC COMPOUND

Phenolic content of the *Glycosmis pentaphylla* Corr was found to be 2.52 µg/l. For *Vitex negundo* L. it was 2.03 µg/l. *Calotropis gigantea* L. shows 1.25 µg/l and for *Moringa oleifera* Lam leaf 1.51 µg/l.

ESTIMATION OF CARBOHYDRATE

Carbohydrate content of the *Glycosmis pentaphylla* Corr was found to be 0.24 mg/g. For *Vitex negundo* L. it was 1.16 mg/g. *Calotropis gigantea* L. shows 0.22 mg/g. For *Moringa oleifera* Lam leaf and root is 0.22 mg/g & 0.24 mg/g.

ESTIMATION OF FLAVONOID

Flavonoid content of the *Glycosmis pentaphylla* Corr was found to be 5.01mg/l. For *Vitex negundo* L. it was 4.00 mg/l. *Calotropis gigantea* L. shows 3.2 mg/l. For *Moringa oleifera* Lam leaf and root is 2.53 mg/l and 1.5 mg/l.

ESTIMATION OF CHLOROPHYLL CONTENT

Carbohydrate content of the *Glycosmis pentaphylla* Corr was found to be 1.19 mg/g. For *Vitex negundo* L. it was 1.10 mg/g. *Calotropis gigantea* L. shows 1.34 mg/g. For *Moringa oleifera* Lam leaf 1.52 mg/g.

PHARMACOGNOSTIC ANALYSIS

TABLE 1

ORGANOLEPTIC EVALUATION OF THE POWDERED DRUG

Sl. No.	NAME OF THE PLANT	PARTS USED	COLOUR	ODOUR	TASTE
1.	<i>Glycosmis pentaphylla</i> Corr	Leaf	Green	Characteristic	Slightly bitter
2.	<i>Vitex negundo</i> L.	Leaf	Pale green	Aromatic	Bitter
3.	<i>Calotropis gigantea</i> L.	Leaf	Fainted green	Odourless	Bitter
4.	<i>Moringa oleifera</i> Lam (leaf)	Leaf	Green	Aromatic	Bitter
5.	<i>Moringa oleifera</i> Lam (root)	Leaf	White	Characteristic	Pungent flavour

MICROSCOPIC STUDIES TABLE 2

Sl.no.	Name of the plant	Stomatal type	Stomatal index	Palisade ratio	Vein-islet number	Vein-termination number
1.	<i>Glycosmis pentaphylla</i> Corr	Anomocytic	10	3.30	9	8
2.	<i>Vitex negundo</i> L.	Anomocytic	6.06	2.7	23	7
3.	<i>Calotropis gigantea</i> L.	Paracytic	17.85	1.25	10	18
4.	<i>Moringa oleifera</i> Lam	Anomocytic	13.3	2.3	10	15

HISTOCHEMICAL STUDY OF *GLYCOSMIS PENTAPHYLLA* Corr

TABLE 3

SL.NO.	PRINCIPLE	TEST	RESULT
1.	Starch	Iodine potassium iodide test	Present
2.	Polyphenol	Toludine blue O test	Present
3.	Lipid	Sudan dye test	Present

HISTOCHEMICAL STUDY OF *VITEX NEGUNDO* LINN.

TABLE 4

SL.NO.	PRINCIPLE	TEST	RESULT
1.	Starch	Iodine potassium iodide test	Present
2.	Polyphenol	Toludine blue O test	Present
3.	Lipid	Sudan dye test	Present

HISTOCHEMICAL STUDY ON *CALOTROPIS GIGANTEA* L.

TABLE 5

SL.NO.	PRINCIPLE	TEST	RESULT
1.	Starch	Iodine potassium iodide test	Present
2.	Polyphenol	Toludine blue O test	Present
3.	Lipid	Sudan dye test	Present

HISTOCHEMICAL STUDY ON *MORINGA OLEIFERA* Lam

TABLE 6

SL.NO.	PRINCIPLE	TEST	RESULT
1.	Starch	Iodine potassium iodide test	Present
2.	Polyphenol	Toludine blue O test	Absent
3.	Lipid	Sudan dye test	Present

PHYTOCHEMICAL ANALYSIS OF *GLYCOSMIS PENTAPHYLLA* Corr

TABLE 7

SL.NO.	CHEMICAL CONSTITUENTS	PHYTOCHEMICAL TEST	OBSERVATION	RESULT
1.	TEST FOR ALKALOID	MAYER'S TEST	Formation of brown colour precipitate	PRESENT
		DRAGENDROFF'S REAGENT		
		WAGNER'S REAGENT		
2.	TEST FOR SAPONINS	FOAM TEST	The formation of froth	PRESENT
3.	TEST FOR FLAVONOID	ALKALINE REAGENT TEST	yellow colour obtained showed decolouration on treatment with acid.	PRESENT
4.	TEST FOR TANNIN	FERRIC CHLORIDE TEST	Greenish black colour is formed	PRESENT
5.	TEST FOR STEROID	SALKOWSKI TEST	Red colouration in the lower layer of solution.	PRESENT
6.	TEST FOR BITTER	BITTER TEST	No Green colour is formed	ABSENT
7.	TEST FOR RESIN	NITRIC ACID TEST	Brown colour was observed	PRESENT
8.	TEST FOR PROTEIN	XANTHOPROTEIC TEST	No Yellow colour obtained changes to bright orange on addition of 40% NaOH	ABSENT
9.	TEST FOR CARBOHYDRATE	MOLISCH'S TEST	Reddish violet zone at the junction of liquids	PRESENT
		BENEDICT'S TEST	Orange red precipitate	
		FEHLING'S TEST	Red precipitate	
10.	TEST FOR PHENOL	FERRIC CHLORIDE TEST	Greenish precipitate	PRESENT

PHYTOCHEMICAL ANALYSIS OF *VITEX NEGUNDO* L.

TABLE 8

SL.NO.	CHEMICAL CONSTITUENTS	PHYTOCHEMICAL TEST	OBSERVATION	RESULT
1.	TEST FOR ALKALOID	MAYER'S TEST DRAGENDROFF'S REAGENT WAGNER'S REAGENT	Formation of brown colour precipitate	PRESENT
2.	TEST FOR SAPONINS	FOAM TEST	The formation of froth	PRESENT
3.	TEST FOR FLAVONOID	ALKALINE REAGENT TEST	yellow colour obtained showed decolouration on treatment with acid.	PRESENT
4.	TEST FOR TANNIN	FERRIC CHLORIDE TEST	Greenish black colour is formed	PRESENT
5.	TEST FOR STEROID	SALKOWSKI TEST	Red colouration in the lower layer of solution.	PRESENT
6.	TEST FOR BITTER	BITTER TEST	Green colour is formed	PRESENT
7.	TEST FOR RESIN	NITRIC ACID TEST	Brown colour was observed	PRESENT
8.	TEST FOR PROTEIN	XANTHOPROTEIC TEST	Yellow colour obtained changes to bright orange on addition of 40% NaOH	PRESENT
9.	TEST FOR CARBOHYDRATE	MOLISCH'S TEST	Reddish violet zone at the junction of liquids	PRESENT
		BENEDICT'S TEST	Orange red precipitate	
		FEHLING'S TEST	Red precipitate	
10.	TEST FOR PHENOL	FERRIC CHLORIDE TEST	Greenish precipitate	PRESENT

PHYTOCHEMICAL ANALYSIS OF *CALOTROPIS GIGANTEA* L.

TABLE 9

SL.NO.	CHEMICAL CONSTITUENTS	PHYTOCHEMICAL TEST	OBSERVATION	RESULT
1.	TEST FOR ALKALOID	MAYER'S TEST	Formation of brown colour precipitate	PRESENT
		DRAGENDROFF'S REAGENT		
		WAGNER'S REAGENT		
2.	TEST FOR SAPONINS	FOAM TEST	The formation of froth	PRESENT
3.	TEST FOR FLAVONOID	ALKALINE REAGENT TEST	yellow colour obtained showed decolouration on treatment with acid.	PRESENT
4.	TEST FOR TANNIN	FERRIC CHLORIDE TEST	Greenish black colour is formed	PRESENT
5.	TEST FOR STEROID	SALKOWSKI TEST	No Red colouration in the lower layer of solution.	ABSENT
6.	TEST FOR BITTER	BITTER TEST	Green colour is formed	PRESENT
7.	TEST FOR RESIN	NITRIC ACID TEST	Brown colour was observed	PRESENT
8.	TEST FOR PROTEIN	XANTHOPROTEIC TEST	No Yellow colour obtained changes to bright orange on addition of 40% NaOH	ABSENT
9.	TEST FOR CARBOHYDRATE	MOLISCH'S TEST	Reddish violet zone at the junction of liquids	PRESENT
		BENEDICT'S TEST	Orange red precipitate	
		FEHLING'S TEST	Red precipitate	
10.	TEST FOR PHENOL	FERRIC CHLORIDE TEST	Greenish precipitate	PRESENT

PHYTOCHEMICAL ANALYSIS OF *MORINGA OLEIFERA* Lam LEAF

TABLE 10

SL.NO.	CHEMICAL CONSTITUENTS	PHYTOCHEMICAL TEST	OBSERVATION	RESULT
1.	TEST FOR ALKALOID	MAYER'S TEST	Formation of brown colour precipitate	PRESENT
		DRAGENDROFF'S REAGENT		
		WAGNER'S REAGENT		
2.	TEST FOR SAPONINS	FOAM TEST	The formation of froth	PRESENT
3.	TEST FOR FLAVONOID	ALKALINE REAGENT TEST	yellow colour obtained showed decolouration on treatment with acid.	PRESENT
4.	TEST FOR TANNIN	FERRIC CHLORIDE TEST	Greenish black colour is formed	PRESENT
5.	TEST FOR STEROID	SALKOWSKI TEST	No Red colouration in the lower layer of solution.	ABSENT
6.	TEST FOR BITTER	BITTER TEST	Green colour is formed	PRESENT
7.	TEST FOR RESIN	NITRIC ACID TEST	Brown colour was observed	PRESENT
8.	TEST FOR PROTEIN	XANTHOPROTEIC TEST	No Yellow colour obtained changes to bright orange on addition of 40% NaOH	ABSENT
9.	TEST FOR CARBOHYDRATE	MOLISCH'S TEST	Reddish violet zone at the junction of liquids	PRESENT
		BENEDICT'S TEST	Orange red precipitate	
		FEHLING'S TEST	Red precipitate	
10.	TEST FOR PHENOL	FERRIC CHLORIDE TEST	Greenish precipitate	PRESENT

PHYTOCHEMICAL ANALYSIS OF *MORINGA OLEIFERA* Lam ROOT

TABLE 11

SL.NO.	CHEMICAL CONSTITUENTS	PHYTOCHEMICAL TEST	OBSERVATION	RESULT
1.	TEST FOR ALKALOID	MAYER'S TEST	No Formation of brown colour precipitate	ABSENT
		DRAGENDROFF'S REAGENT		
		WAGNER'S REAGENT		
2.	TEST FOR SAPONINS	FOAM TEST	The formation of froth	PRESENT
3.	TEST FOR FLAVONOID	ALKALINE REAGENT TEST	yellow colour obtained showed decolouration on treatment with acid.	PRESENT
4.	TEST FOR TANNIN	FERRIC CHLORIDE TEST	No Greenish black colour is formed	ABSENT
5.	TEST FOR STEROID	SALKOWSKI TEST	Red colouration in the lower layer of solution.	PRESENT
6.	TEST FOR BITTER	BITTER TEST	No Green colour is formed	ABSENT
7.	TEST FOR RESIN	NITRIC ACID TEST	Brown colour was observed	PRESENT
8.	TEST FOR PROTEIN	XANTHOPROTEIC TEST	Yellow colour obtained changes to bright orange on addition of 40% NaOH	PRESENT
9.	TEST FOR CARBOHYDRATE	MOLISCH'S TEST	Reddish violet zone at the junction of liquids	PRESENT
		BENEDICT'S TEST	Orange red precipitate	
		FEHLING'S TEST	Red precipitate	
10.	TEST FOR PHENOL	FERRIC CHLORIDE TEST	No Greenish precipitate	ABSENT

QUANTITATIVE ANALYSIS OF *GLYCOSMIS PENTAPHYLLA* Corr

TABLE 12

SL.NO.	PHYTOCHEMICAL	RESULT
1.	TANNIN	14%
2.	PHENOL	2.52µg/l
3.	CARBOHYDRATE	0.24mg/g
4.	FLAVANOID	5.01mg/l

QUANTITATIVE ANALYSIS OF *VITEX NEGUNDO* L.

TABLE 13

SL.NO.	PHYTOCHEMICAL	RESULT
1.	TANNIN	67%
2.	PHENOL	2.03µg/l
3.	CARBOHYDRATE	1.16 mg/g
4.	FLAVANOID	4.00 mg/l

QUANTITATIVE ANALYSIS OF *CALOTROPIS GIGANTEA* L.

TABLE 14

SL.NO.	PHYTOCHEMICAL	RESULT
1.	TANNIN	33%
2.	PHENOL	1.25µg/l
3.	CARBOHYDRATE	0.22mg/g
4.	FLAVANOID	3.2mg/l

QUANTITATIVE ANALYSIS OF *MORINGA OLEIFERA* Lam LEAF

TABLE 15

SL.NO.	PHYTOCHEMICAL	RESULT
1.	TANNIN	50%
2.	PHENOL	1.51µg/l
3.	CARBOHYDRATE	0.22mg/g
4.	FLAVANOID	2.53mg/l

QUANTITATIVE ANALYSIS OF *MORINGA OLEIFERA* Lam ROOT

TABLE 16

SL.NO.	PHYTOCHEMICAL	RESULT
1.	CARBOHYDRATE	0.24mg/g
2.	FLAVANOID	1.5mg/l

ESTIMATION OF CHLOROPHYLL CONTENT

TABLE 17

NAME OF THE PLANT	CHLOROPHYLL CONTENT
<i>GLYCOSMIS PENTAPHYLLA</i> Corr	1.19 mg/g
<i>VITEX NEGUNDO L.</i>	1.10 mg/g
<i>CALOTROPIS GIGANTEA L.</i>	1.34 mg/g
<i>MORINGA OLEIFERA</i> Lam	1.52 mg/g

PHYTOCHEMICAL ANALYSIS

QUALITATIVE ANALYSIS OF ALKALOID - FIG:1



Glycosmis pentaphylla Corr.



Vitex negundo L.



Moringa oleifera Lam. leaf



Calotropis gigantea L.

QUANTITATIVE ANALYSIS OF SAPONIN -FIG: 2



Glycosmis pentaphylla Corr.



Vitex negundo L.



Calotropis gigantea L.



Moringa oleifera
Lam. leaf



Moringa oleifera
Lam. root

QUANTITATIVE ANALYSIS OF FLAVONOID -FIG: 3



*Glycosmis
pentaphylla* Corr.



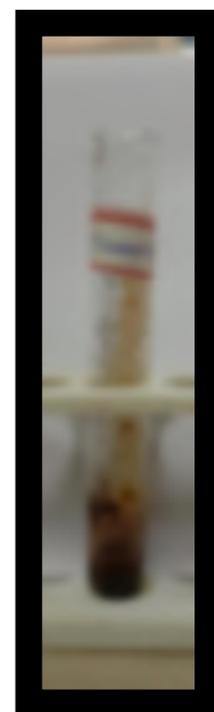
Vitex negundo L.



Calotropis gigantea L.



Moringa oleifera
Lam. leaf



Moringa oleifera
Lam. root

QUANTITATIVE ANALYSIS OF TANNIN – FIG: 4



*Glycosmis
pentaphylla* Corr.



Vitex negundo L.



Calotropis gigantea L.

QUANTITATIVE ANALYSIS OF STEROID -FIG: 5



*Glycosmis
pentaphylla* Corr.



Vitex negundo L.

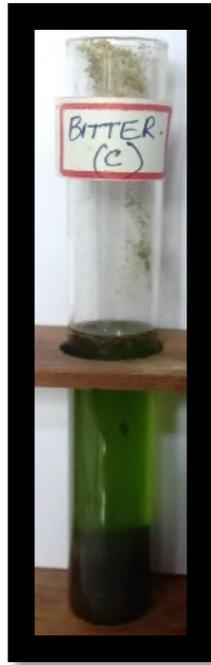


Moringa oleifera
Lam.root

QUANTITATIVE ANALYSIS OF BITTER -FIG: 6



Vitex negundo L.



Calotropis gigantea L.



Moringa oleifera
Lam. leaf

QUANTITATIVE ANALYSIS OF RESIN -FIG: 7



Glycosmis pentaphylla Corr.



Vitex negundo L.



Calotropis gigantea L.

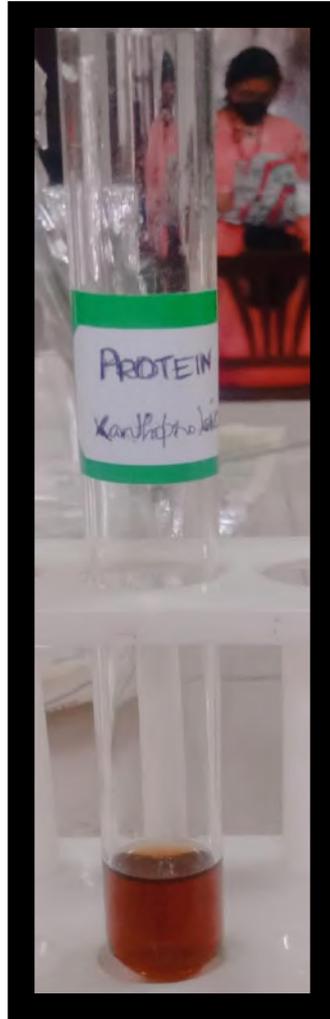


Moringa oleifera
Lam. leaf



Moringa oleifera
Lam. root

QUANTITATIVE ANALYSIS OF PROTEIN -FIG: 8

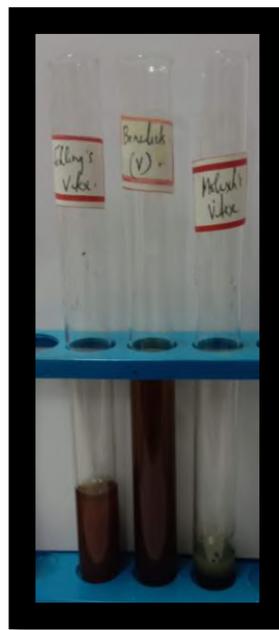


Vitex negundo L.

QUANTITATIVE ANALYSIS OF CARBOHYDRATE – FIG: 9



Glycosmis pentaphylla Corr.



Vitex negundo L.



Calotropis gigantea L.

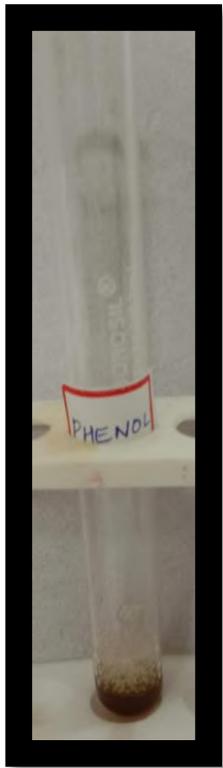


Moringa Lam.
oleifera leaf



Moringa Lam.
oleifera root

QUANTITATIVE ANALYSIS OF PHENOL FIG: 10



Glycosmis pentaphylla Corr.



Vitex negundo L.



Calotropis gigantea L.



Moringa oleifera
Lam. leaf

PHARMAGNOSTIC ANALYSIS

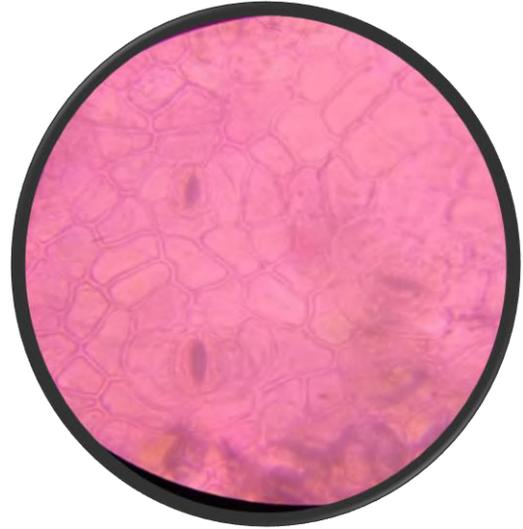
MICROSCOPIS STUDIES

STOMATAL TYPE

FIG: 11



*Glycosmis
pentaphylla* Corr.



Vitex negundo L.



Calotropis gigantea L.



Moringa oleifera
Lam.

VEIN – ISLET NUMBER AND VEIN TERMINATION NUMBER

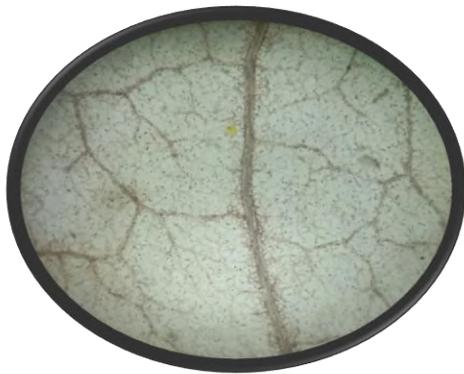
FIG: 12



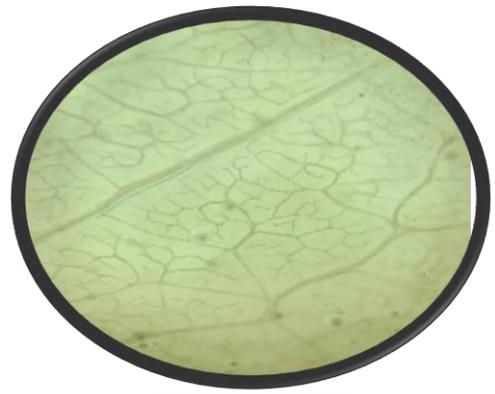
*Glycosmis
pentaphylla* Corr.



Vitex negundo L.



Calotropis gigantea L.

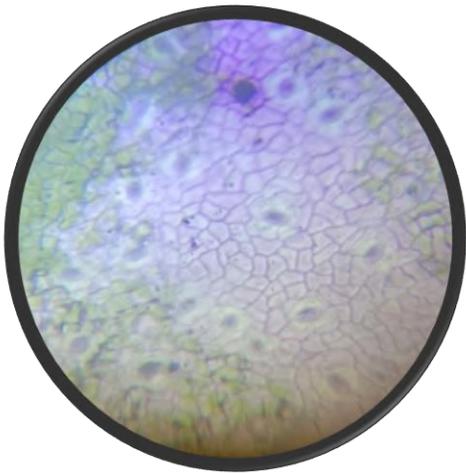


Moringa oleifera
Lam.

HISTOCHEMICAL STUDIES

FIG: 13

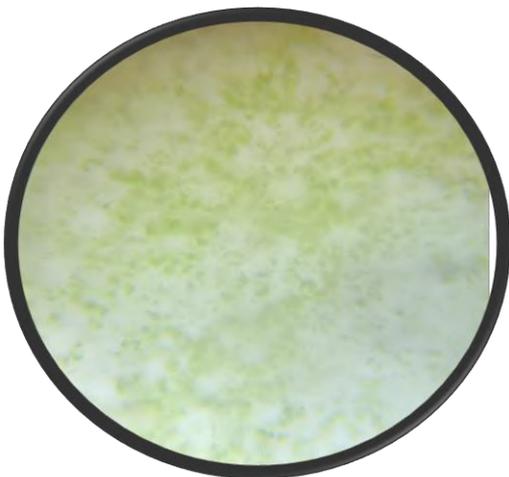
1. *GLYCOSMIS PENTAPHYLLA* Corr.



polyphenol



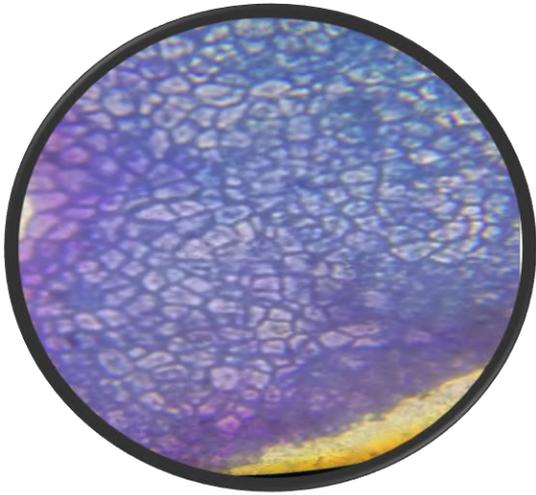
starch



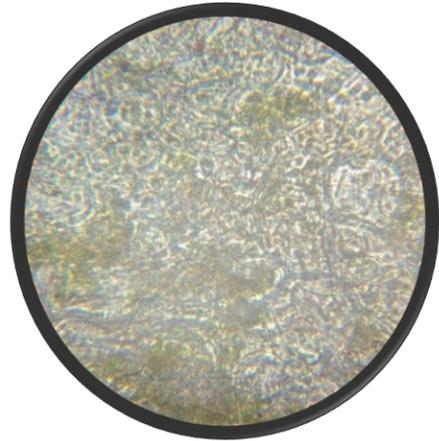
Lipids

FIG: 14

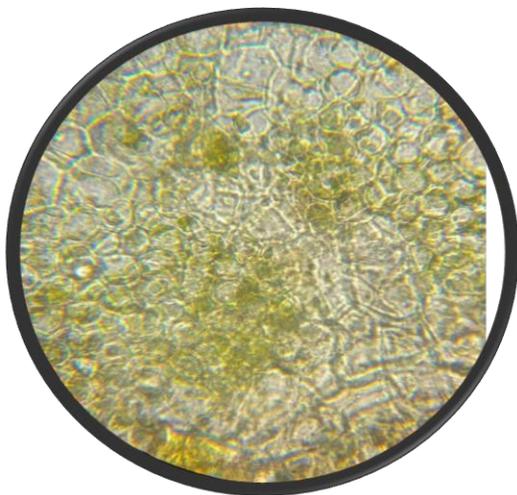
2. *VITEX NEGUNDO* L.



polyphenol



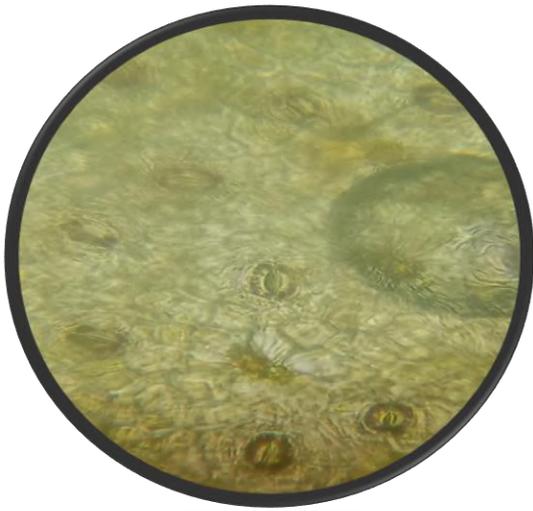
starch



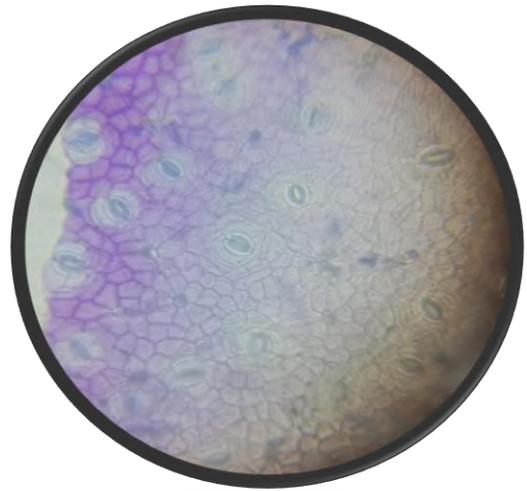
Lipids

FIG:15

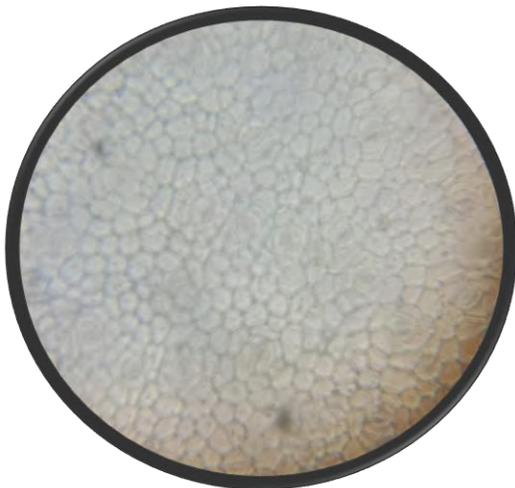
3. CALOTROPIS GIGANTEA L.



starch



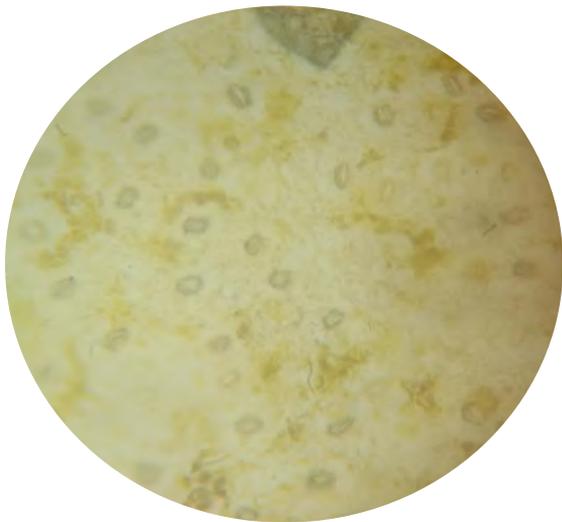
polyphenol



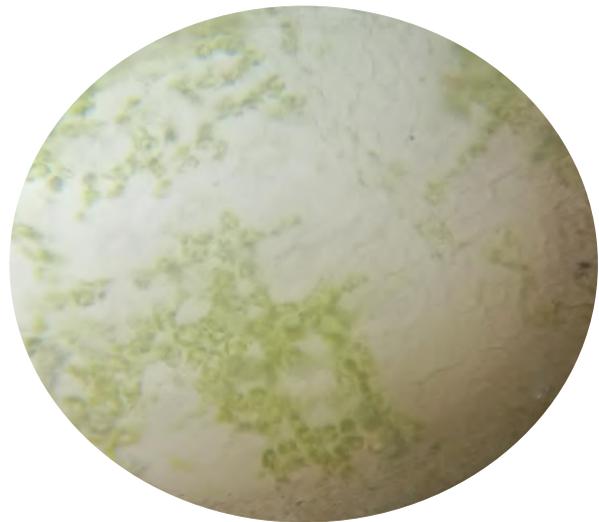
Lipids

FIG: 16

4. *MORINGA OLEIFERA* Lam



starch

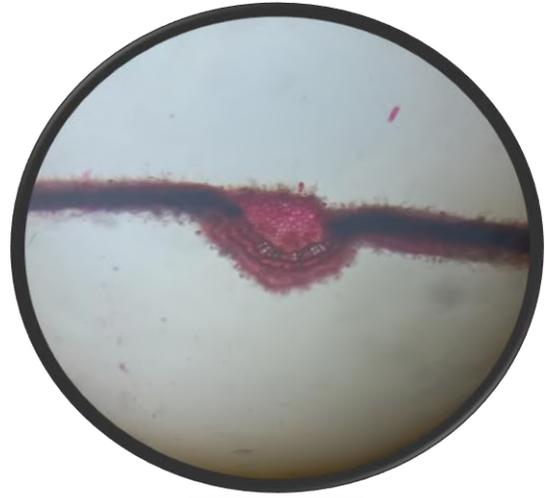


Lipids

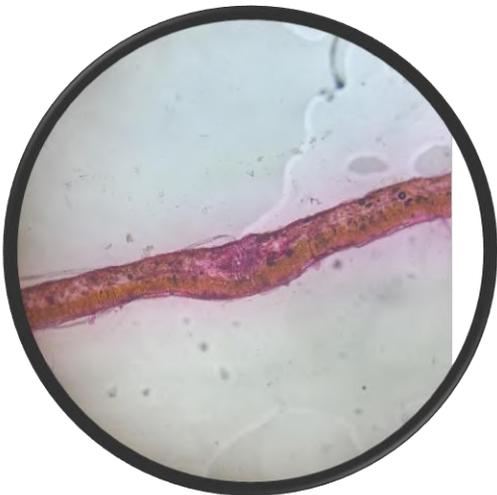
FIG: 17
ANATOMY



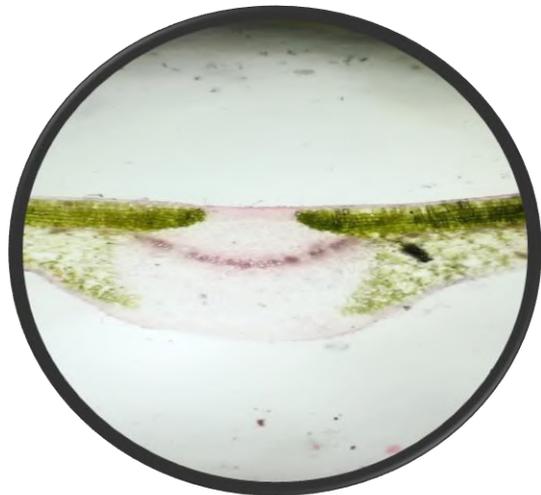
*Glycosmis
pentaphylla* Corr.



Vitex negundo L.



Moringa oleifera
Lam.



Calotropis gigantea L.

DISCUSSION

Medicinal plants constitute a group of industrially important crops which are great value for domestic use and for export. Plant based drugs are increasingly preferred in medical science. The forest areas have been the traditional source of medicinal plants and herbs and medicinal plants have curative properties due to the presence of various complex chemical substances of different composition.

The present study aimed to analyse the pharmacognostic, phytochemical and histochemical analysis of plants used for disease arthritis.

The pharmacognosy basically deals with standardization, authentication and study of natural drugs. It is closely involved with allied fields like phytochemical and toxicological screening of natural products. In pharmacognosy, organoleptic evaluation and microscopic studies are done. The organoleptic evaluation showed the dried finely powdered leaf of *Glycosmis pentaphylla* Corr & *Moringa oleifera* Lam leaf are green colour, for *Vitex negundo* L. pale green, for *Calotropis gigantea* L. fainted green and for *Moringa oleifera* Lam root white colour. The dried fine powder of *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam leaf and root possess a characteristic odour, aromatic, odourless, aromatic and characteristic odour respectively. *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Moringa oleifera* Lam possess anomocytic stomata and *Calotropis gigantea* L. possess paracytic stomata. Stomatal index of *Glycosmis pentaphylla* Corr was found to be 10%. For *Vitex negundo* L. it was 6.06%. *Calotropis gigantea* L. shows 17.85% and for *Moringa oleifera* Lam 13.3%.

Palisade ratio of *Glycosmis pentaphylla* Corr was found to be 3.30. For *Vitex negundo* L. it was 2.7. *Calotropis gigantea* L. shows 1.25 and for *Moringa oleifera* Lam 2.3.

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The phytochemical detection of secondary metabolites is done by following standard protocol. The secondary metabolites like alkaloids, saponins, flavonoid, steroid, tannin, resin, carbohydrate and phenol are found in *Glycosmis pentaphylla* Corr.

Alkaloids, saponins, flavonoid, steroid, tannin, resin, bitter, protein, carbohydrate and phenol are found in *Vitex negundo* L.

Alkaloids, saponins, flavonoid, tannin, resin, bitter, carbohydrate and phenol are found in *Calotropis gigantea* L.

Alkaloids, saponins, flavonoid, tannin, resin, bitter, carbohydrate and phenol are found in *Moringa oleifera* Lam leaf.

Saponins, flavonoid, steroid, resin, carbohydrate and are found in *Moringa oleifera* Lam root.

Medicinal plants used against various inflammatory biomarkers for the management of rheumatoid arthritis were studied by (Shareen Singh et al.,2020). The current review retrieved that, various medicinal plants possess an active phytoconstituents with anti-inflammatory and antioxidant properties, which tends to be effective alternative approach over the synthetic drugs concerned with high toxic effects. So, the current available literature provides an evident data concluding that the active constituents like fatty acids, flavonoids, terpenes and sesquiterpene lactones attenuate the RA symptoms by targeting the inflammatory biomarkers involved in the pathogenesis of RA. This study evaluated the results of *Moringa oleifera* Lam plant extract comprising phytoconstituents like flavonoids, terpenoids, alkaloids and sterols embracing antioxidant and anti-inflammatory activity.

Anti- arthritic activity of leaves of *Calotropis gigantea* L. were studied by (Kalpana S. Patil et al.,2007). Petroleum ether (40-60°), ethyl acetate, ethanol and aqueous extract of *Calotropis gigantea* L. leaves were tested for various preliminary phytoconstituents and were screened for anti-arthritic activities using Freund's adjuvant arthritis in albino rats. The extracts were administered orally for 21 days and the mean changes in diameter of paw were noted at regular intervals. The changes in body weight were recorded daily. On 22nd day at the end of study blood was collected and haemoglobin content, total WBC count, differential WBC count, ESR and RBC were also estimated. Steroids, triterpenoids, glycosides, flavonoids, carbohydrates, proteins were found to be present in *Calotropis gigantea* L. leaves extracts as observed by the qualitative tests. The migration of leucocytes into the inflamed area is significantly suppressed

by the extracts as seen from the significant decrease in total WBC count. Due to the presence of steroids, triterpenoids, glycosides, flavonoids, carbohydrates, proteins, found in *Calotropis gigantea* L. leaves extracts, it is potentially used in anti-arthritic activity.

Potential investigation of anti-inflammatory activity and phytochemical investigations of ethanolic extract of *Glycosmis pentaphylla* Corr leaves were studied by (Pravej Ansari et al.,2015). This study evaluated that *G. pentaphylla* Corr has property of pain or inflammation healing and from phytochemical analysis found the presence of alkaloid and steroid, so it could also have anti-coagulation property as well. A preliminary study on the phytochemical analysis that performed showed the presence of alkaloid, flavonoid, steroid, saponin etc. Alkaloid, a nitrogenous group of phytochemicals that has wide diversity in classification and distribution, has good evidence of pain killing activity. Flavonoids have the hepatoprotective reputation as anti-oxidant Phyto agent. This shows why the plant has anti-inflammatory effect. The presence of flavonoid enhances the scope to find out its anti-oxidant property, it seems this would be an ideal agent as anti-inflammatory agent if properly modified.

A review of the important chemical constituents and medicinal uses of *Vitex* genus were documented by (Ajay et al.,2011). Phytochemical studies of *Vitex negundo* L. showed the presence of several types of compounds, such as volatile oils, lignans, flavonoids, terpenes (triterpenes, diterpenes, sesquiterpenes) and steroids. This plant contains many polyphenolic compounds, terpenoids, glycosidic iridoids and alkaloids. Due to the presence of flavonoids, steroid and alkaloids, the Ayurvedic medicine and its various recent experimental models conclude that the oral administration of the plant leaves have been claimed to have anti-inflammatory activity. In the present work the presence of phytochemicals such a flavonoid, steroid, alkaloid is confirmed hence it can use as an anti-arthritic agent.

Traditional uses, phytochemistry and pharmacological properties of *Moringa oleifera* Lam plant were documented by (Garima Mishra et al.,2011). This article provides all necessary information regarding its phytochemical investigations, pharmacological actions and medicinal properties like anaemia, anxiety, asthma, blackheads, blood impurities, bronchitis, catarrh, chest congestion, cholera, conjunctivitis, cough, diarrhoea, eye and ear infections, fever, abnormal blood pressure, pain in joints, scurvy, semen deficiency, headaches and tuberculosis. It gives an account of all the data and reports which have been appeared to prove its medicinal and nutritional importance. A preliminary study on the phytochemical analysis that performed on leaves & roots showed the presence of flavonoid, sterol, glycosides which provide anti-

inflammatory activity. A Cáceres et al. (1992) reported anti-inflammatory activity from the hot water infusions of flowers, leaves, roots, seeds and stalks or bark of *Moringa oleifera* Lam using carrageenan-induced hind paw edema in rats. K.V. Sashidhara et al. (2009) from the roots of *Moringa oleifera* Lam isolated and characterized aurantiamide acetate 4 and 1,3-dibenzyl urea 5. Isolated compounds inhibited the production of TNF-alpha and IL-2.

A Review on Pharmacological and Phytochemical Profile of *Calotropis Gigantea* Linn were documented by (Gaurav et al.,2011). This study is a collective information concerning the ethnobotany, pharmacology, phytochemistry and biological activities of the *C. gigantea* L. Pharmacological screenings of *C. gigantea* revealed its medicinal potential and represents as a valuable medicinal plant with several medicinal properties such as antimicrobial activity, antimicrobial activity, Anti-inflammatory, Anti-pyretic activity Anti-diarrhoeal activity, Insecticidal activity and Wound healing activity. A preliminary study on the phytochemicals revealed the presence of alkaloids, cyanogenic, glycosides, phenolics, tannins 19, cardenolides 20, 21, flavonoids 22, terpenes 23, 24, sterols 25, Proteinases 26 and nonprotein amino acid 27 as major phytochemical groups. The present study also confirmed the presence of alkaloids, phenol, tannin and flavonoid.

Ethnomedicinal uses, phytochemistry, pharmacological activities and toxicological profile of *Glycosmis pentaphylla* Corr (Retz.) DC.: A review were documented by (Labony et al.,2021).

This review presented up-to-date information regarding the taxonomy, botany, distribution, ethnomedicinal uses, phytochemistry, pharmacology and toxicological profile of *G. pentaphylla* Corr.

Extensive phytochemical investigations of different parts of *G. pentaphylla* Corr have revealed the presence of at least 354 secondary metabolites belonging to structurally diverse classes including alkaloids, amides, phenolic compounds, flavonoids, glycosides, aromatic compounds, steroids, terpenoids, and fatty derivatives. A large number of *in vitro* and *in vivo* experiments have demonstrated that *G. pentaphylla* Corr had anticancer, antimutagenic, antibacterial, antifungal, anthelmintic, mosquitocidal, antidiabetic, antihyperlipidemic, anti-oxidant, anti-inflammatory, analgesic, antipyretic, anti-arsenicosis, and wound healing properties. So it can be suggested as a source of inspiration for the development of novel drugs, especially anticancer, antimicrobial, anthelmintic, and mosquitocidal agents. Moreover, bioassay-guided investigations into its diverse classes of secondary metabolites, especially the large pool of nitrogen-containing alkaloids and amides. The present study confirmed the

presence phytochemicals such as alkaloids, phenol, tannin, flavonoid, steroid, resin and carbohydrate. So, it can be suggested as a source for the development of novel drug of anti-inflammatory.

Phytochemical evaluation of *Vitex leucoxylon*, *vitex negundo* and *vitex trifolia* were studied by (K Aditya et al.,2020). This study was conducted to investigate phytochemical evaluation of *Vitex leucoxylon*, *Vitex negundo* L. and *Vitex trifolia*. The crude drug powder extracts of the leaves of the above plants were taken for the study. The Phytochemical Screening were done for the selected plants. Phenolic compounds, tannins, flavonoids, cardiac glycosides, and alkaloids were present in *Vitex leucoxylon*. Alkaloids, flavonoids, carbohydrates, glycosides and tannins were present in *Vitex negundo*. Alkaloids, saponins, flavonoids, carbohydrates and anthraquinone glycosides were present in *Vitex trifolia*. The extracts and crude dried powders of *Vitex leucoxylon*, *Vitex negundo* L. and *Vitex trifolia* were subjected to qualitative analysis for presence of chemical constituents. Alkaloids, flavonoids, carbohydrates, glycosides and tannins were present in *Vitex negundo* L. The present study also evaluated the presence of alkaloids, flavonoids, carbohydrates and tannin.

Presently investigation of the antiarthritic activity of the herbs leads to the development of many effective herbal therapies. Presence of Phytoconstituents like flavonoids, phenol, alkaloids, steroid indicates that it has potential anti-inflammatory activity. The information's about the plants or plant extracts which are discussed in the present study might be helpful for the further research on arthritis.

SUMMARY AND CONCLUSION

The world health organization (WHO) reveals that most percentage of the world's population relies on traditional remedies including plants as their primary health care aid. Medicinal plants are the oldest form of health care known to mankind. From the ancient times people are using different herbs or plants as the remedy for various diseases. Throughout the world several plants have been and are still used for medicinal properties. Plants are rich in a wide variety of secondary metabolites such as tannins, alkaloids, flavonoids, sterol, phenol, etc. about 61% of new drugs developed between 1981 and 2002 were based on natural products and they have been very successful, especially in the areas of infectious diseases and cancer. Various plant parts including root, leaf, flower, bark, fruit and trees.

The plants selected for the present study are *Glycosmis pentaphylla* Corr, *Vitex negundo* Linn., *Calotropis gigantea* Linn., *Moringa oleifera* Lam. These are medicinal plants used for arthritis disease which had paid serious attention to pharmacognostic, phytochemical and histochemical studies were conducted.

In pharmacognostic studies organoleptic evaluation and microscopical analysis were carried out. The organoleptic evaluation showed the dried finely powdered leaf of *Glycosmis pentaphylla* Corr & *Moringa oleifera* Lam leaf are green colour, for *Vitex negundo* L. pale green, for *Calotropis gigantea* fainted green and for *Moringa oleifera* Lam root white colour. The dried fine powder of *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Calotropis gigantea* L. and *Moringa oleifera* Lam leaf and root possess a characteristic odour, aromatic, odourless, aromatic and characteristic odour respectively. *Glycosmis pentaphylla* Corr, *Vitex negundo* L., *Moringa oleifera* Lam possess anomocytic stomata and *Calotropis gigantea* L. possess paracytic stomata. Stomatal index of *Glycosmis pentaphylla* Corr was found to be 10%. For *Vitex negundo* L. it was 6.06%. *Calotropis gigantea* L. shows 17.85% and for *Moringa oleifera* Lam 13.3%.

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Alkaloids, saponins, flavonoid, steroid, tannin, resin, bitter, protein, carbohydrate and phenol are found in *Vitex negundo* L.

Alkaloids, saponins, flavonoid, tannin, resin, bitter, carbohydrate and phenol are found in *Calotropis gigantea* L.

Alkaloids, saponins, flavonoid, tannin, resin, bitter, carbohydrate and phenol are found in *Moringa oleifera* Lam leaf.

Saponins, flavonoid, steroid, resin, carbohydrate and are found in *Moringa oleifera* Lam root.

In phytochemical study these plants showed the presence of secondary metabolites such as flavonoid, alkaloid, phenol, steroid which indicates that it has potential anti-inflammatory activity. Through screening of the literature available on these plants depicted the fact that these phytochemicals act as an anti-inflammatory agent. The information about the plants or plant extracts which are discussed here might be helpful for the further research on arthritis.

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**GREEN SYNTHESIS OF SILVER NANOPARTICLES
USING TULSI EXTRACT**

PROJECT REPORT

Submitted by

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Submitted to

Mahatma Gandhi University, Kottayam

In partial fulfilment of the requirement for the award of

BACHELOR'S DEGREE OF SCIENCE IN PHYSICS

MARCH 2022



ST. TERESA'S COLLEGE (AUTONOMOUS)

**ST. TERESA'S COLLEGE (AUTONOMOUS)
ERNAKULAM**



CERTIFICATE

This is to certify that the project report entitled “**GREEN SYNTHESIS OF SILVER NANOPARTICLES USING TULSI EXTRACT**” is a bonafide work by AKHILA GEORGE, St. Teresa's College Ernakulam, under my supervision at Department of Physics, St. Teresa's College, Ernakulam for the partial fulfilment of the award of Degree of Bachelor of Science in Physics during the academic year 2021-22. The work presented in this dissertation has not been submitted for any other degree in this or any other university.

Supervising Guide

Dr. KALA M.S.

Associate Professor

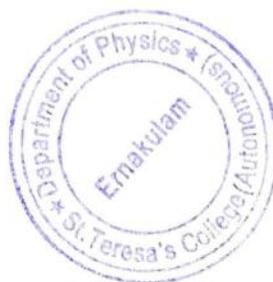
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PLACE: Ernakulam

DATE : 07/05/2022



**ST. TERESA'S COLLEGE (AUTONOMOUS)
ERNAKULAM**



**B.Sc. PHYSICS
PROJECT REPORT**

Name : AKHILA GEORGE
Register Number : AB19PHY026
Year of Work : 2021-2022

This is to certify that this project work entitled **“GREEN SYNTHESIS OF SILVER NANOPARTICLES USING TULSI EXTRACT”** is an authentic work done by AKHILA GEORGE.


Staff member in-charge

Dr. KALA M.S.

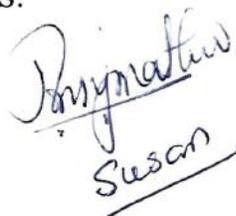

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Submitted for the University examination held at St. Teresa's College, Ernakulam.

DATE: 07/05/2022

EXAMINERS:


Pragnathu
Susan

DECLARATION

I, **AKHILA GEORGE** ,Register number: **AB19PHY026**, hereby declare that this project work entitled “**GREEN SYNTHESIS OF SILVER NANOPARTICLES USING TULSI EXTRACT**” is an original work done by me under the guidance and supervision of Dr. Kala M.S., Associate Professor, Department of Physics, St. Teresa’s College (Autonomous), Ernakulam in the partial fulfilment of the award of Degree of Bachelor of Physics under Mahatma Gandhi University. I further declare that this project is not partly or wholly submitted for any other purpose and the data included in this project is collected from various sources and are true to the best of our knowledge.

PLACE: Ernakulam

DATE : 07/05/2022

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ABSTRACT

Synthesis of metal nanoparticles using plant extracts is one of the most simple, convenient, economical and environmentally friendly methods that mitigate the involvement of toxic chemicals. Hence in recent years, several eco-friendly processes for the rapid synthesis of silver nanoparticles have been reported using aqueous extracts of plant parts such as the leaf, bark, roots, etc. Green synthesis of nanoparticles is an important area in the field of nanotechnology, which has cost effective and environment friendly benefit over physical and chemical methods. Though there are many chemical as well as physical methods, green synthesis of nanomaterials is the most emerging method of synthesis. In this project we had synthesized silver nanoparticles from silver nitrate through green synthesis method.

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- Absorption spectrum of silver nanoparticles
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- Conclusion

CHAPTER -1

NANOSCIENCE AND TECHNOLOGY

INTRODUCTION

Nanostructure science and technology is a broad and interdisciplinary area of research and development activity that has been growing explosively worldwide in the past few years. It has the potential for revolutionizing the ways in which materials and products are created and the range and nature of functionalities that can be accessed. It is already having a significant commercial impact, which will assuredly increase in the future.

Advances in Nanomaterials

- The history of nanomaterials began immediately after the big bang when Nanostructures were formed in the early meteorites.
- Nature later evolved many other Nanostructures like seashells, skeletons etc. Nano scaled smoke particles were formed during the use of fire by early humans. The scientific story of nanomaterials however began much later. One of the first scientific reports is the colloidal gold particles synthesised by Michael Faraday as early as 1857. Nanostructured catalysts have also been investigated for over 70 years.
- Nanosized amorphous silica particles have found large-scale applications in many every-day consumer products, ranging from non-diary coffee creamer to automobile tires, optical fibres and catalyst supports. In the 1960s and 1970's metallic nano powders for magnetic recording tapes were developed
- Today nanophase engineering expands in a rapidly growing number of structural and functional materials, both inorganic and organic, allowing to manipulate mechanical, catalytic, electric, magnetic, optical and electronic functions.
- The production of nanophase or cluster-assembled materials is usually based upon separated small clusters which then fused into a bulk-like material e.g., nanophase silicon, which differs from normal silicon in physical and electronic properties, could be applied

to macroscopic semiconductor processes to create new devices. For instance, when ordinary glass is doped with quantized semiconductor "colloids," it becomes a high-performance optical medium with potential applications in optical computing.

A nanoparticle is a small particle whose size ranges from 1 to 100 nanometres. Undetectable by the human eye, nanoparticles can exhibit significantly different physical and chemical properties to their larger material counterparts.

Importance of nanomaterials

These materials have created a high interest in recent years by virtue of their unusual mechanical, electrical, optical and magnetic properties. Some examples are given below:

- (i) Nanophase ceramics are of particular interest because they are more ductile at elevated temperatures as compared to the coarse-grained ceramics.
- (ii) Nanostructured semiconductors are known to show various non-linear optical properties. Semiconductor Q-particles also show quantum confinement effects which may lead to special properties, like the luminescence in silicon powders and silicon germanium quantum dots as infrared optoelectronic devices. Nanostructured semiconductors are used as window layers in solar cells.
- (iii) Nanosized metallic powders have been used for the production of gas tight materials, dense parts and porous coatings. Cold welding properties combined with ductility make them suitable for metal-metal bonding especially in the electronic industry.
- (iv) Single nanosized magnetic particles are mono-domains and very small particles have special atomic structures with discrete electronic states, which give rise to special properties in addition to the super-paramagnetism behaviour. Magnetic nanocomposites have been used for mechanical force transfer (ferrofluids), for high density information storage and magnetic refrigeration.
- (v) Nanostructured metal clusters and colloids of monometallic composition have a special impact in catalytic applications. They may serve as precursors for new type of heterogeneous catalysts and have been shown to offer substantial advantages

concerning activity, selectivity and lifetime in chemical transformations and electrocatalysis (fuel cells).

- (vi) Nanostructured metal-oxide thin films are receiving a growing attention for the realization of gas sensors (NO_x, CO, CO₂, CH₄ and aromatic hydrocarbons) with enhanced sensitivity and selectivity. Nanostructured metal-oxide (MnO₂) finds application for rechargeable batteries for cars or consumer goods.
- (vii) Polymer based composites with a high content of inorganic particles leading to a high dielectric constant are interesting materials for photonic band gap structure.
- (viii) The energy band structure and charge carrier density in the materials can be modified quite differently from their bulk and in turn will modify the electronic and optical properties of the materials. For example, lasers and light emitting diodes (LED) from both of the quantum dots and quantum wires are very promising in the future optoelectronics. High density information storage using quantum dot devices is also a fast-developing area.

Properties of Nanomaterials

Nanomaterials have the structural features in between of those of atoms and the bulk materials. While most micro structured materials have similar properties to the corresponding bulk materials, the properties of materials with nanometre dimensions are significantly different from those of atoms and bulks materials. This is mainly due to the nanometre size of the materials which render them: (i) large fraction of surface atoms; (ii) high surface energy; (iii) spatial confinement; (iv) reduced imperfections, which do not exist in the corresponding bulk materials.

Due to their small dimensions, nanomaterials have extremely large surface area to volume ratio, resulting in more “surface” dependent material properties. Especially when the sizes of nanomaterials are comparable to length, the entire material will be affected by the surface properties of nanomaterials. This in turn may enhance or modify the properties of the bulk materials. For example, metallic nanoparticles can be used as very active catalysts.

Chemical sensors from nanoparticles and nanowires enhance the sensitivity and sensor selectivity. The nanometre feature sizes of nanomaterials also have spatial confinement effect on the materials, which bring the quantum effects.

Reduced imperfections are also an important factor in determination of the properties of the nanomaterials. Nanostructures and Nanomaterials favours of a self- purification process in that the impurities and intrinsic material defects will move to near the surface upon thermal annealing. For example, the chemical stability for certain nanomaterials may be enhanced, the mechanical properties of nanomaterials will be better than the bulk materials. The superior mechanical properties of carbon nanotubes are well known. Due to their nanometre size, nanomaterials are already known to have many novel properties. Many novel applications of the nanomaterials rose from these novel properties like optical, electrical, mechanical and magnetic properties.

Optical properties

One of the most fascinating and useful aspects of nanomaterials is their optical properties. Applications based on optical properties of nanomaterials include optical detector, laser, sensor, imaging, phosphor, display, solar cell, photocatalysis, photo electrochemistry and biomedicine. The optical properties of nanomaterials depend on parameters such as feature size, shape, surface characteristics and other variables including doping and interaction with the surrounding environment or other nanostructures. Likewise, shape can have dramatic influence on optical properties of metal nanostructures. With the CdSe semiconductor nanoparticles, a simple change in size alters the optical properties of the nanoparticles. When metal nanoparticles are enlarged, their optical properties change only slightly as observed for the different samples of gold nanospheres. However, when an anisotropy is added to the nanoparticle, such as growth of nanorods, the optical properties of the nanoparticles change dramatically.

Optical properties of nanomaterials can be significantly different from bulk crystals. For example, the optical absorption peak of a semiconductor nanoparticle shifts to a short wavelength, due to an increased band gap. The colour of metallic nanoparticles may change with their sizes due to surface plasmon resonance.

Electrical properties

Electrical Properties of Nanoparticles discuss about fundamentals of electrical conductivity in nanotubes and nanorods, carbon nanotubes, photoconductivity of nanorods, electrical conductivity of nanocomposites etc. Conductivity of a bulk or large material does not depend upon dimensions like diameter or area of cross section and twist in the conducting wire etc. However, it is found that in case of carbon nanotubes conductivity changes with change in area of cross section. It is also observed that conductivity also changes when some shear force is given to nanotube. Conductivity of a multiwalled carbon nanotube is different than that of single nanotube of same dimensions. The carbon nanotubes can act as conductor or semiconductor in behaviour but we all know that large carbon (graphite) is good conductor of electricity. One interesting method which can be used to demonstrate the steps in conductance is the mechanical thinning of a nanowire and measurement of the electrical current at a constant applied voltage. With decreasing diameter of the wire, the number of electron wave modes contributing to the electrical conductivity is becoming increasingly smaller by well-defined quantized steps.

Mechanical properties

Mechanical Properties of Nanoparticles deal with bulk metallic and ceramic materials, influence of porosity, influence of grain size, super plasticity, filled polymer composites, particle-filled polymers, polymer-based nanocomposites filled with platelets, carbon nanotube-based composites etc. However, two materials, neither of which is produced by pressing and sintering, have attracted much greater interest as they will undoubtedly achieve industrial importance. These materials are polymers which contain nanoparticles or nanotubes to improve their mechanical behaviours, and severely plastic-deformed metals, which exhibit astonishing properties. However, because of their larger grain size, the latter are generally not accepted as nanomaterials. Experimental studies on the mechanical properties of bulk nanomaterials are generally impaired by major experimental problems in producing specimens with exactly defined grain sizes and porosities. Filling polymers with nanoparticles or nanorods and nanotubes, respectively, leads to significant improvements in their mechanical properties. Such improvements depend heavily on the type of the filler and the way in which the filling is conducted. The latter point is of special importance, as any

specific advantages of a nanoparticulate filler may be lost if the filler forms aggregates, thereby mimicking the large particles. The larger the particles of the filler or agglomerates, the poorer are the properties obtained. Although, potentially, the best composites are those filled with nanofibers or nanotubes, experience teaches that sometimes such composites have the least ductility. On the other hand, by using carbon nanotubes it is possible to produce composite fibres with extremely high strength and strain at rupture. Among the most exciting nanocomposites are the polymer-ceramic nanocomposites. Composites consisting of a polymer matrix and defoliated phyllosilicates exhibit excellent mechanical and thermal properties.

Application of nanomaterials

Nanomaterials find wide range of applications in the field of electronics, fuel cells, batteries, agriculture, food industry, and medicines.

(a) Fuel cells

A fuel cell is an electrochemical energy conversion device that converts the chemical energy from fuel (on the anode side) and oxidant (on the cathode side) directly into electricity. The performance of a fuel cell electrode can be optimized in two ways; by improving the physical structure and by using more active electro catalyst. A good structure of electrode must provide ample surface area, provide maximum contact of catalyst, reactant gas and electrolyte, facilitate gas transport and provide good electronic conductance. In this fashion the structure should be able to minimize losses.

Microbial fuel cell is a device in which bacteria consume water-soluble waste such as sugar, starch and alcohols and produces electricity plus clean water. This technology will make it possible to generate electricity while treating domestic or industrial wastewater. Different carbohydrates and complex substrates present in wastewaters can be turned into source of electricity with microbial fuel cell. Performance of the fuel cell mainly depends on the efficient electron transfer between the microorganism and the anode of the microbial fuel cell. When converting them into simpler molecules like CO_2 the organic molecules present in the wastewater release a certain amount of chemical energy. Thus, microbial fuel cell is a device that converts the chemical energy present in water-soluble waste into electrical energy by the catalytic reaction of microorganisms.

Carbon nanotubes (CNTs) have chemical stability, good mechanical properties and high surface area, making them ideal for the design of sensors and provide very high surface area due to its structural network. Since carbon nanotubes are also suitable supports for cell growth, electrodes of microbial fuel cells can be built using of CNT.

(b) Catalysis

Higher surface area available with the nanomaterial counterparts, nano-catalysts tend to have exceptional surface activity. For example, reaction rate at nano-aluminium can go so high, that it is utilized as a solid-fuel in rocket propulsion, whereas the bulk aluminium is widely used in utensils. Nano-aluminium becomes highly reactive and supplies the required thrust to send off pay loads in space. Similarly, catalysts assisting or retarding the reaction rates are dependent on the surface activity, and can very well be utilized in manipulating the rate-controlling step.

(c) Phosphors for High-Definition TV

The resolution of a television, or a monitor, depends greatly on the size of the pixel. These pixels are essentially made of materials called "phosphors," which glow when struck by a stream of electrons inside the cathode ray tube (CRT). The resolution improves with a reduction in the size of the pixel, or the phosphors. Nanocrystalline zinc selenide, zinc sulphide, cadmium sulphide, and lead telluride synthesized by the sol-gel techniques are used for improving the resolution of monitors. The use of nanophosphors is envisioned to reduce the cost of these displays so as to render high-definition televisions (HDTVs) and personal computers affordable to be purchase.

(d) Next-Generation Computer Chips

The microelectronics industry has been emphasizing miniaturization, whereby the circuits, such as transistors, resistors, and capacitors, are reduced in size. By achieving a significant reduction in their size, the microprocessors, which contain these components, can run much faster, thereby enabling computations at far greater speeds. However, there are several technological impediments to these advancements, including lack of ultrafine precursors to manufacture these components; poor dissipation of tremendous amount of heat generated by

these microprocessors due to faster speeds; short mean time to failures (poor reliability), etc. Nanomaterials help the industry break these barriers down by providing the manufacturers with nanocrystalline starting materials, ultra-high purity materials, materials with better thermal conductivity, and longer-lasting, durable interconnections (connections between various components in the microprocessors).

(e) Elimination of Pollutants

Nanomaterials possess extremely large grain boundaries relative to their grain size. Hence, they are very active in terms of their chemical, physical, and mechanical properties. Due to their enhanced chemical activity, nanomaterials can be used as catalysts to react with such noxious and toxic gases as carbon monoxide and nitrogen oxide in automobile catalytic converters and power generation equipment to prevent environmental pollution arising from burning gasoline and coal.

(f) Sun-screen lotion

Prolonged UV exposure causes skin-burns and cancer. Sun-screen lotions containing nano-TiO₂ provide enhanced sun protection factor (SPF) while eliminating stickiness. The added advantage of nano skin blocks (ZnO and TiO₂) arises as they protect the skin by sitting onto it rather than penetrating into the skin. Thus, they block UV radiation effectively for prolonged duration. Additionally, they are transparent, thus retain natural skin colour while working better than conventional skin-lotions.

(g) Sensors

Sensors rely on the highly active surface to initiate a response with minute change in the concentration of the species to be detected. Engineered monolayers (few Angstroms thick) on the sensor surface are exposed to the environment and the peculiar functionality is utilized in sensing.

CHAPTER 2
SYNTHESIS AND OPTICAL CHARACTERISATION OF
NANOMATERIALS

Nanotechnology is a branch of material science in which nanoparticles with specific intended properties are synthesized or produced by the application of physical or chemical processes. Synthesis of nanoparticles is carried out through various methods. The main classification for the production of nanoparticles is broadly divided into two methods:

Top Down

Bottom Up

The first approach of synthesis starts with a solid mass and making it into smaller nanosized particles by applying any mechanical method (i.e., mechanical grinding) and later stabilizing the particles to the required size. However, with this method it is difficult to achieve the expected narrow size. The second approach starts with atomic size material, which is fabricated to the required nanoscale by applying chemical methods, such as the hydrothermal method, sol-gel method, gas phase method, thermolysis, and hydrolysis. Although UV irradiation, aerosol technologies, laser ablation, and photochemical reduction processes lead to production of nanoparticles, these methods are costlier and also lead to the release of harmful by-products. Moreover, by these methods, it is difficult to have control over the surface chemistry, size, and structure of the nanoparticles. Nevertheless, a bottom-up approach is preferred to produce nanoparticles because it starts with simpler molecules to clusters and then to nanoparticles and will achieve greater control over the shape and size of the particles formed.

Most of these methods are extremely expensive and also involve the use of toxic, hazardous chemicals, which may pose potential environmental and biological risks. Since noble metal nanoparticles are widely applied to areas of human contact, there is a growing need to develop environmentally friendly processes for nanoparticle synthesis that do not use toxic chemicals. A quest for an environmentally sustainable synthesis process has led to a few biomimetic approaches. Biomimetics refers to applying biological principles in materials

formation. One of the fundamental processes in biomimetic synthesis involves bio reduction. Biological methods of nanoparticle synthesis using microorganisms, enzymes, fungus, and plants or plant extracts have been suggested as possible eco-friendly alternatives to chemical and physical methods. In the recent past, vast research has been carried out on biological systems, including bacteria, fungi, yeast, and plants and this has led to the transformation of inorganic metal ions to metal nanoparticles. The utilization of metal oxide nanoparticles has received much attention due to their unique properties, such as extremely small size, high surface-area-to-volume ratio, surface modifiability, excellent magnetic properties, and great biocompatibility. Hence, the production of nanoparticles should be economically viable, environmentally sustainable, and well accepted by society. Sometimes the synthesis of nanoparticles using plants or parts of plants can prove advantageous over other biological processes by eliminating the elaborate processes of maintaining microbial cultures

The degradation of any organic compounds by the green approach (plant extracts) is mainly due to the presence of polyphenols in the biodegradable material used for treatment purposes. A great deal of research is carried out on a wide range of plant extracts and their chemical constituents.

In materials science, “green” synthesis has gained extensive attention as a reliable, sustainable, and eco-friendly protocol for synthesizing a wide range of nanomaterials including metal/metal oxides nanomaterials, hybrid materials, and bioinspired materials.

Green synthesis methodologies based on biological precursors depend on various reaction parameters such as solvent, temperature, pressure, and pH conditions (acidic, basic, or neutral). For the synthesis of metal/metal oxide nanoparticles, plant biodiversity has been broadly considered due to the availability of effective phytochemicals in various plant extracts, especially in leaves such as ketones, aldehydes, flavones, amides, terpenoids, carboxylic acids, phenols, and ascorbic acids. These components are capable of reducing metal salts into metal nanoparticles. The basic features of such nanomaterials have been investigated for use in biomedical diagnostics, antimicrobials, catalysis, molecular sensing, optical imaging, and labelling of biological systems. Plants have biomolecules (like carbohydrates, proteins, and coenzyme) with exemplary potential to reduce metal salt into nanoparticles. Like other biosynthesis processes, gold and silver metal nanoparticles were first investigated in plant extract-assisted synthesis. Various plants including aloe vera (*Aloe barbadensis* Miller), Oat (*Avena sativa*), alfalfa (*Medicago sativa*), Tulsi (*Osimum sanctum*),

Lemon (*Citrus limon*), Neem (*Azadirachta indica*), Coriander (*Coriandrum sativum*), Mustard (*Brassica juncea*) and lemon grass (*Cymbopogon flexuosus*) have been utilized to synthesize silver nanoparticles and gold nanoparticles. Also, ZnO nanoparticles have been prepared with a great variety of plant leaf extracts such as coriander (*Coriandrum sativum*), crown flower (*Calotropis gigantea*), copper leaf (*Acalypha indica*), China rose (*Hibiscus rosa-sinensis*), Green Tea (*Camellia sinensis*), and aloe leaf broth extract (*Aloe barbadensis* Miller).

For nanoparticle synthesis mediated by plant leaf extract, the extract is mixed with metal precursor solutions at different reaction conditions. The parameters determining the conditions of the plant leaf extract are admitted to control the rate of nanoparticle formation as well as their yield and stability. The phytochemicals present in plant leaf extracts have uncanny potential to reduce metal ions in a much shorter time as compared to fungi and bacteria, which demands the longer incubation time. Therefore, plant leaf extracts are considered to be an excellent and benign source for metal as well as metal oxide nanoparticle synthesis. Additionally, plant leaf extract plays a dual role by acting as both reducing and stabilizing agents in nanoparticles synthesis process to facilitate nanoparticles synthesis. The composition of the plant leaf extract is also an important factor in nanoparticle synthesis, for example different plants comprise varying concentration levels of phytochemicals. The main phytochemicals present in plants are flavones, terpenoids, sugars, ketones, aldehydes, carboxylic acids, and amides, which are responsible for bioreduction of nanoparticles. Sugars such as glucose and fructose exist in plant extracts can also be responsible for the formation of metallic nanoparticles.



Optical Absorption

A spectrum of electromagnetic radiation transmitted through a substance, showing dark lines or bands due to absorption at specific wavelengths.

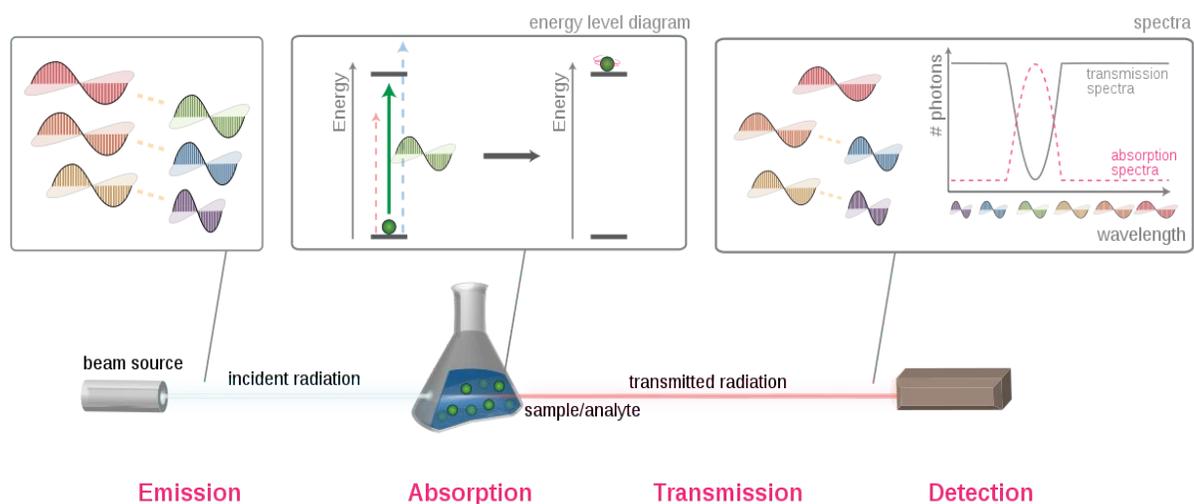
Absorption spectroscopy refers to spectroscopic techniques that measure the absorption of radiation, as a function of frequency or wavelength, due to its interaction with a sample. The sample absorbs energy, i.e., photons, from the radiating field. The intensity of the absorption varies as a function of frequency, and this variation is the absorption spectrum. Absorption spectroscopy is performed across the electromagnetic spectrum. A material's absorption spectrum is the fraction of incident radiation absorbed by the material over a range of frequencies of Electromagnetic Radiation. The absorption spectrum is primarily determined by the atomic and molecular composition of the material. Radiation is more likely to be absorbed at frequencies that match the energy difference between two quantum mechanical states of the molecules. The absorption that occurs due to a transition between two states is referred to as an absorption line and a spectrum is typically composed of many lines.

The frequencies will also depend on the interactions between molecules in the sample, the crystal structure in solids, and on several environmental factors (e.g., temperature, pressure, electromagnetic field). The lines will also have a width and shape that are primarily determined by the spectral density or the density of states of the system.

Absorption spectroscopy is employed as an analytical chemistry tool to determine the presence of a particular substance in a sample and, in many cases, to quantify the amount of

the substance present. Infrared and ultraviolet–visible spectroscopy are particularly common in analytical applications. Absorption spectroscopy is also employed in studies of molecular and atomic physics, astronomical spectroscopy and remote sensing.

There is a wide range of experimental approaches for measuring absorption spectra. The most common arrangement is to direct a generated beam of radiation at a sample and detect the intensity of the radiation that passes through it. The transmitted energy can be used to calculate the absorption. The source, sample arrangement and detection technique vary significantly depending on the frequency range and the purpose of the experiment.



An overview of electromagnetic radiation absorption is shown in the figure.

A white beam source – emitting light of multiple wavelengths – is focused on a sample (the complementary colour pairs are indicated by the yellow dotted lines). Upon striking the sample, photons that match the energy gap of the molecules present (green light in this example) are absorbed in order to excite the molecule. Other photons transmit unaffected and, if the radiation is in the visible region (400–700 nm), the sample colour is the complementary colour of the absorbed light. By comparing the attenuation of the transmitted light with the incident, an absorption spectrum can be obtained.

Theory

Absorption lines are typically classified by the nature of the quantum mechanical change induced in the molecule or atom. Rotational lines, for instance, occur when the rotational state of a molecule is changed. Rotational lines are typically found in the microwave spectral

region. Vibrational lines correspond to changes in the vibrational state of the molecule and are typically found in the infrared region. Electronic lines correspond to a change in the electronic state of an atom or molecule and are typically found in the visible and ultraviolet region. X-ray absorptions are associated with the excitation of inner shell electrons in atoms. These changes can also be combined (e.g., rotation-vibration transitions), leading to new absorption lines at the combined energy of the two changes.

The energy associated with the quantum mechanical change primarily determines the frequency of the absorption line but the frequency can be shifted by several types of interactions. Electric and magnetic fields can cause a shift. Interactions with neighbouring molecules can cause shifts. For instance, absorption lines of the gas phase molecule can shift significantly when that molecule is in a liquid or solid phase and interacting more strongly with neighbouring molecules.

The width and shape of absorption lines are determined by the instrument used for the observation, the material absorbing the radiation and the physical environment of that material. It is common for lines to have the shape of a Gaussian or Lorentzian distribution. It is also common for a line to be described solely by its intensity and width instead of the entire shape being characterized.

The integrated intensity—obtained by integrating the area under the absorption line—is proportional to the amount of the absorbing substance present. The intensity is also related to the temperature of the substance and the quantum mechanical interaction between the radiation and the absorber. This interaction is quantified by the transition moment and depends on the particular lower state the transition starts from, and the upper state it is connected to.

The width of absorption lines may be determined by the spectrometer used to record it. A spectrometer has an inherent limit on how narrow a line it can resolve and so the observed width may be at this limit. If the width is larger than the resolution limit, then it is primarily determined by the environment of the absorber. A liquid or solid absorber, in which neighbouring molecules strongly interact with one another, tends to have broader absorption lines than a gas. Increasing the temperature or pressure of the absorbing material will also tend to increase the line width. It is also common for several neighbouring transitions to be close enough to one another that their lines overlap and the resulting overall line is therefore broader yet.

Relation to transmission spectrum

Absorption and transmission spectra represent equivalent information and one can be calculated from the other through a mathematical transformation. A transmission spectrum will have its maximum intensities at wavelengths where the absorption is weakest because more light is transmitted through the sample. An absorption spectrum will have its maximum intensities at wavelengths where the absorption is strongest.

Relation to emission spectrum

Emission is a process by which a substance releases energy in the form of electromagnetic radiation. Emission can occur at any frequency at which absorption can occur, and this allows the absorption lines to be determined from an emission spectrum. The emission spectrum will typically have a quite different intensity pattern from the absorption spectrum, though, so the two are not equivalent. The absorption spectrum can be calculated from the emission spectrum using Einstein coefficients.

Relation to scattering and reflection spectra

The scattering and reflection spectra of a material are influenced by both its index of refraction and its absorption spectrum. In an optical context, the absorption spectrum is typically quantified by the extinction coefficient, and the extinction and index coefficients are quantitatively related through the Kramers-Kronig relation. Therefore, the absorption spectrum can be derived from a scattering or reflection spectrum. This typically requires simplifying assumptions or models, and so the derived absorption spectrum is an approximation.

Applications

Absorption spectroscopy is useful in chemical analysis because of its specificity and its quantitative nature. The specificity of absorption spectra allows compounds to be distinguished from one another in a mixture, making absorption spectroscopy useful in wide

variety of applications. For instance, Infrared gas analysers can be used to identify the presence of pollutants in the air, distinguishing the pollutant from nitrogen, oxygen, water and other expected constituents.

The specificity also allows unknown samples to be identified by comparing a measured spectrum with a library of reference spectra. In many cases, it is possible to determine qualitative information about a sample even if it is not in a library. Infrared spectra, for instance, have characteristic absorption bands that indicate if carbon-hydrogen or carbon-oxygen bonds are present.

An absorption spectrum can be quantitatively related to the amount of material present using the Beer–Lambert law. Determining the absolute concentration of a compound requires knowledge of the compound's absorption coefficient. The absorption coefficient for some compounds is available from reference sources, and it can also be determined by measuring the spectrum of a calibration standard with a known concentration of the target.

CHAPTER 3

EXPERIMENTAL

PREPARATION OF SILVER NANOPARTICLES USING GREEN SYNTHESIS METHOD

1. PREPARATION OF LEAF EXTRACT

- Healthy *Ocimum tenuiflorum*, commonly known as holy basil, tulsi or tulasi were collected in a beaker and washed several times with water to remove the dust and finally with distilled water.



- The samples were allowed to dry at room temperature.
- About 40g of leaves were weighed out with the help of weighing machine and were cut in to small pieces.





- Finally cut pieces are mixed with 200ml distilled water. The Mixture is then kept boiling for 30 minutes.



- After cooling it at room temperature, it is filtered using Whatman no-40 filter paper. 100 ml of the filtered extract was taken for the preparation of silver nanoparticles.

2. PREPARATION OF 50 ml OF 1 Molar SILVER NITRATE SOLUTION

- 50 ml of 1 molar silver nitrate solution is prepared by dissolving 8.4935 g of AgNO_3 in 50ml of distilled water.

3. SYNTHESIS OF SILVER NANOPARTICLES

- 100 ml of the plant extract solution was added to 50 ml of 1 molar silver nitrate solution
- The solution was allowed to settle at room temperature.
- Silver nanoparticles formed were allowed to settle down.



The formed silver nanoparticles are filtered from the solution using Whatman no-40 filter paper. It is then dried with the help of oven. Then it is crushed into powder form. Crushed powder is made dissolve in gellatin. The resulting solution is analysed using uv spectrophotometer.

4. PREPARATION 90 ml OF 1 ml Molar SILVER NITRATE SOLUTION

- 90 ml of 1 milli molar silver nitrate solution is prepared by dissolving 0.0152g of AgNO_3 in 90 ml of distilled water.

5.PREPARATION OF COLLOIDAL SOLUTION OF SILVER

A colloidal solution of silver is also prepared from 1ml molar silver nitrate using following procedure

- 90 ml of 1 milli molar silver nitrate solution was mixed with 10 ml of plant extract.
- The colour of the mixture changes gradually from colourless to brown.
- The mixture is kept undisturbed for 24 hours. The silver particles do not settle down in this time frame and remain suspended in the solution

The resulting colloidal solution of silver is analysed using UV spectrophotometer.

CHAPTER 4

ABSORPTION SPECTRUM OF SILVER NANOPARTICLES

UV – Visible spectroscopy is the most important technique and the simplest way to confirm the formation of nanoparticles. The absorbance spectrum of the colloidal sample was obtained in the range of 300–800 nm, using a UV – Visible spectrophotometer with distilled water as a reference.

Silver nanoparticles absorb and scatter light with extraordinary efficiency. Their strong interaction with light occurs because the conduction electrons on the metal surface undergo a collective oscillation when they are excited by light at specific wavelengths. This oscillation is known as a surface plasmon resonance (SPR), and it causes the absorption and scattering intensities of silver nanoparticles to be much higher than identically sized non-plasmonic nanoparticles. In metal nanoparticles such as in silver, the conduction band and valence band

lie very close to each other in which electron moves freely. These free electrons give rise to a SPR absorption band occurring due to the collective oscillation of electrons of metal nanoparticles in resonance with the light wave. This absorption strongly depends on the particle size, dielectric medium and chemical surroundings. For small metal particles, absorption spectra significantly depend only on the dipole oscillation. Theoretically and experimentally, it is found that when size decreases, the SPR peak shifts towards shorter wavelength side. It is also found that with the decrease in size, absorption spectra become weak and broad.

Silver nanoparticle absorption and scattering properties can be tuned by controlling the particle size, shape, and the local refractive index near the particle surface. The optical properties of spherical silver nanoparticles are highly dependent on the nanoparticle diameter. Smaller nanospheres primarily absorb light and have peaks near 400 nm, while larger spheres exhibit increased scattering and have peaks that broaden and shift towards longer wavelengths (known as red-shifting).

Silver nanoparticle optical properties also depend on the refractive index near the nanoparticle surface. As the refractive index near the nanoparticle surface increases, the nanoparticle extinction spectrum shifts to longer wavelengths (known as red-shifting). Practically, this means that the nanoparticle extinction peak location will shift to shorter wavelengths (blue-shift) if the particles are transferred from water ($n=1.33$) to air ($n=1.00$), or shift to longer wavelengths if the particles are transferred to oil ($n=1.5$). Increasing the refractive index from 1.00 to 1.60 results in an extinction peak shift of over 90 nm, moving the peak from the ultraviolet to the visible region of the spectrum. Similarly, the extinction peak can be tuned by coating aqueous nanoparticles with nonconducting shells including silica ($n=1.5$), biomolecules ($n=1.4-1.45$), or aluminum oxide ($n=1.58-1.68$). The optical properties of silver nanoparticles change when particles aggregate and the conduction electrons near each particle surface become delocalized and are shared amongst neighbouring particles. When this occurs, the surface plasmon resonance shifts to lower energies, causing the absorption and scattering peaks to red-shift to longer wavelengths. UV-Visible spectroscopy can be used as a simple and reliable method for monitoring the stability of nanoparticle solutions. As the particles destabilize, the original extinction peak will decrease in intensity (due to the depletion of stable nanoparticles), and often the peak will broaden or a secondary peak will form at longer wavelengths (due to the formation of aggregates). The rapid and irreversible change in the extinction spectrum clearly demonstrates that the

nanoparticles are agglomerating. UV/Visible spectroscopy can be used as a characterization technique that provides information on whether the nanoparticle solution has destabilized over time.

RESULT

The figure shows the UV- vis absorption spectra of the nanoparticle synthesized from AgNO_3 solution using green synthesis method.

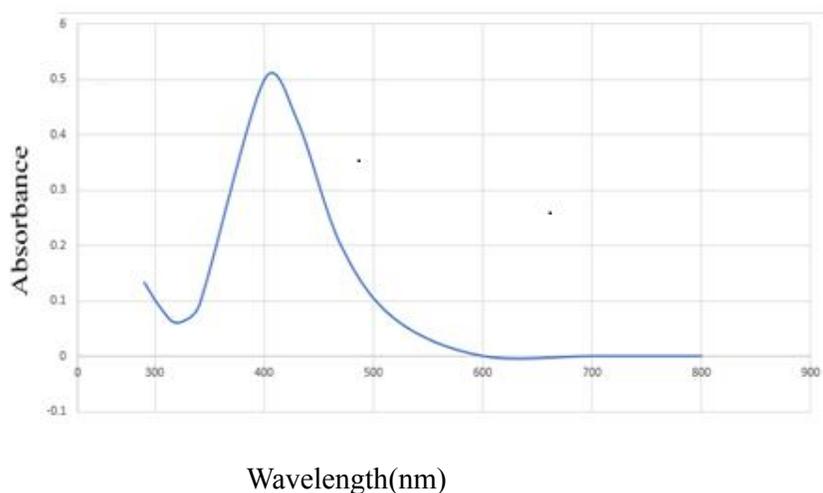


Fig: Absorption spectra of silver nanoparticles synthesized using tulsi extract. When we compare it with the UV-Vis absorption spectra of silver nanoparticles synthesized from different experiments, the peak observed around 420 nm coincides with other studies.

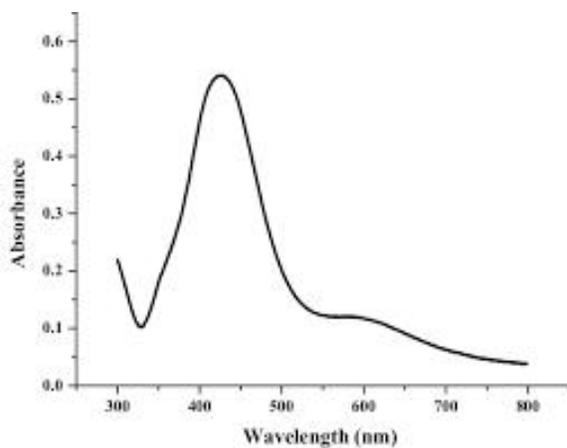


Fig: UV-visible absorption spectrum of Silver Nanoparticles Using a Biosurfactant from *Bacillus cereus* UCP 1615 as Stabilizing Agent

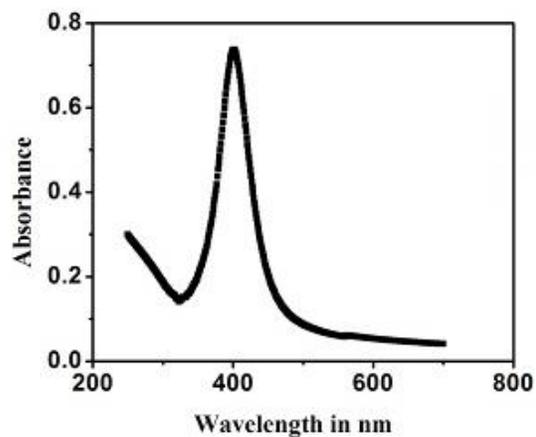
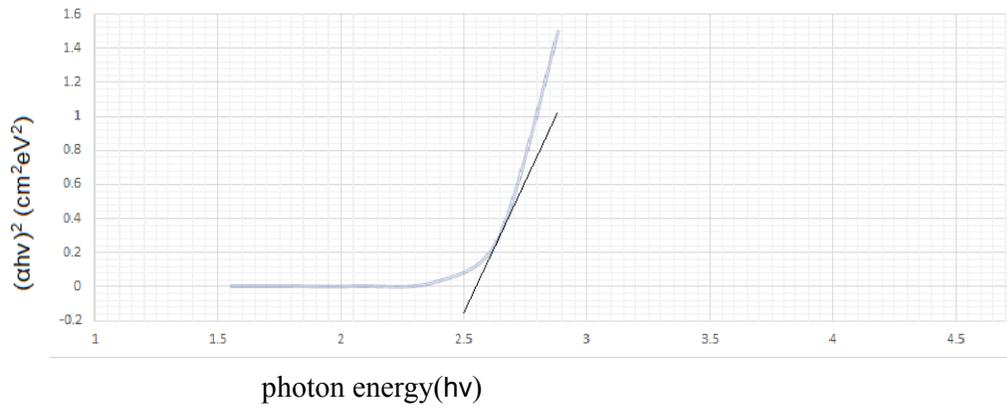


Fig: The UV-visible absorption spectrum of Ag nanoparticles synthesized from Reetha and Shikakai plant extract.

Hence it is evident that the nanoparticles formed were silver nanoparticles.

A Tauc plot is used to determine the optical bandgap in amorphous thin materials. Tauc plot of silver nanoparticle deduced from its absorption spectrum is shown below.



It is drawn by plotting photon energy $h\nu$ on x axis and $(\alpha h\nu)^2$ on y axis where h is the Planck's constant and α is the absorbance. We get a curve while plotting. To find the band gap energy we need to extrapolate the linear part of the curve to the energy axis as shown in the above figure. The point where the extrapolated line coincide at x axis gives the band gap energy of the silver nanoparticle and it is found to be 2.51 eV.

DISCUSSION

The experiment was performed by taking fresh and healthy Tulasi leaves and these were rinsed with tap water followed by distilled water to remove dust particles and were further dried. About 40g of leaves were transferred to a beaker containing 200ml of distilled water and was boiled for 30 minutes. Then the extracts were cooled to room temperature and filtered through Whatman filter paper No 40 to remove particulate matter. One molar silver nitrate solution is prepared by dissolving 8.4935g of AgNO_3 in 50ml of distilled water.

Then 100ml of plant extract solution was added to 500 ml of one molar silver nitrate solution. After the addition of the plant leaf extract to aqueous silver nitrate solution, the colour of the solution changed from light yellow to reddish-brown and finally to the colloidal brown indicating reduction of silver thus leading to nanoparticle synthesis. Silver nanoparticles appear yellowish-brown in colour in an aqueous medium as a result of surface plasmon vibrations.

The reduction of silver ions (Ag^+) was monitored by measuring the UV spectrum of the reaction medium after diluting the sample into distilled water. UV spectral analysis was done by using a UV spectrophotometer (SUV-S2100) at room temperature operated at a resolution of 1nm between 300-800nm ranges. The silver nanoparticles exhibited a maximum absorption spectrum at 420nm. The flat curves of the graph indicated the formation of polydisperse large nanoparticles due to the slow reduction rates.

Measuring the band gap is an important parameter in the nanomaterial industry. It is used to analyze the conductivity of the synthesized nanomaterial. The term band gap refers to the energy difference between the top of the valence band and bottom of the conduction band. For an electron to jump from a valence band to conduction band it requires a specific minimum amount of energy for the transition called as band energy. The band energy of silver nanoparticles was found out using its Tauc plot and it shown that silver nanoparticles exhibit a direct band gap of 2.51 eV.

Applications of silver nanoparticles

Silver nanoparticles are increasingly used in various fields, including medical, food, health care, consumer, and industrial purposes, due to their unique physical and chemical properties. These include optical, electrical, and thermal, high electrical conductivity, and biological properties. Due to their peculiar properties, they have been used for several applications, including as antibacterial agents, in industrial, household, and healthcare-related products, in consumer products, medical device coatings, optical sensors, and cosmetics, in the pharmaceutical industry, the food industry, in diagnostics, orthopedics, drug delivery, as anticancer agents, and have ultimately enhanced the tumor-killing effects of anticancer drugs. Recently, AgNPs have been frequently used in many textiles, keyboards, wound dressings, and biomedical devices. Nanosized metallic particles are unique and can considerably change physical, chemical, and biological properties due to their surface-to-volume ratio; therefore, these nanoparticles have been exploited for various purposes.

The biological activity of AgNPs depends on factors including surface chemistry, size, size distribution, shape, particle morphology, particle composition, coating/capping, agglomeration, and dissolution rate, particle reactivity in solution, efficiency of ion release, and cell type, and the type of reducing agents used for the synthesis of AgNPs are a crucial factor for the determination of cytotoxicity. The physicochemical properties of nanoparticles enhance the bioavailability of therapeutic agents after both systemic and local administration and other hand it can affect cellular uptake, biological distribution, penetration into biological barriers, and resultant therapeutic effects. Therefore, the development of AgNPs with controlled structures that are uniform in size, morphology, and functionality are essential for various biomedical applications.

Cancer is a complex, multifactorial disease which has the characteristic feature of the uncontrolled growth and spread of abnormal cells caused by several factors, including a combination of genetic, external, internal, and environmental factors, and it is treated by various treatments including chemotherapy, hormone therapy, surgery, radiation, immune therapy, and targeted therapy. Therefore, the challenge is to identify effective, cost-effective, and sensitive lead molecules that have cell-targeted specificity and increase the sensitivity.

Recently, AgNPs have been shown much interest because of their therapeutic applications in cancer as anticancer agents, in diagnostics, and in probing.

CHAPTER 5

CONCLUSION

This project was undertaken to present a simple and reproducible way for the synthesis of silver nanoparticles. The use of natural extracts, distilled water and non-toxic reagents allows the synthesis pathways presented to be considered as "green". The results of the experiment are used for the further study of the properties of the absorption spectrum such as finding the band gap energy of the synthesized silver nanoparticle from its tauc plot.

Based on the previous discussion the synthesis of nanoparticles may serve as a future direction in biomedical nanotechnology in developing antimicrobial compounds. The previously used metal antimicrobial may come with lots of possibilities with the advancement of green nanotechnology in combating multidrug resistance. Nanoparticles are seen to have the ability to cross and disrupt the membrane. Thus, loading drugs on the nanoparticle surface may increase the efficiency of biocidal motion by additional effect than disrupting the membrane. Thus, it can have the future option to decode bacterial lipopolysaccharide Achilles. The toxicity of silver nanoparticles is also a major issue. Although biomolecular capping in the green synthesis process reduces the toxicity, it is imperative to develop more efficient capping and reducing agents for particular uses.

The current trend of research is mainly carried out using whole plant extracts as reducing and capping agents. This serves as a drawback regarding not clearly understanding the role of isolated pure biomolecules in the synthesis and activity of nanoparticles. Synthesis using the

pure compound in an optimized condition may additionally give a solution regarding the poly disparity of green nanoparticle synthesis.

The biosynthesis of silver nanoparticles using leaf extract provides an eco-friendly, simple wound healing and other medical and electronic applications, making this method potentially exciting for the large-scale synthesis of other nanomaterials. Thus, we can conclude that this is an efficient method. These silver nanoparticles were rich sources of proteins and metabolites such as terpenoids, phenols etc. Applications of such eco-friendly nanoparticles in bactericidal, the plant extract could be used in various fields for the biosynthesis of nanoparticles as well as this method doesn't require sophisticated types of equipment and toxic chemicals.

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CERTIFICATE

This is to certify that the dissertation entitled, **EFFECTS OF COVID 19 ON VARIOUS FACTORS ON STUDENTS** is a bonafide record of the work done by Ms. **AKSHARA MARIA** under my guidance as partial fulfilment of the award of the degree of **Bachelor of Science in Mathematics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

Date: 04/03/2022

Place: Ernakulam

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External Examiners

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DECLARATION

I hereby declare that the work presented in this project is based on the original work done by me under the guidance of Smt. Shanty B P. Assistant Professor. Department of Mathematics, St. Teresa's College(Autonomous), Ernakulam and has not been included in any other project submitted previously for the award of any degree.



AKSHARA MARIA

AB19AMAT037

Ernakulam.

Date: 04/03/2022

19) Has corona time helped you financially (via online opportunities)

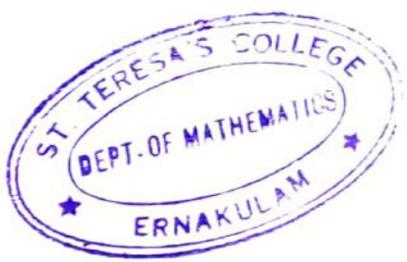
- Yes
- No

19) Do you welcome the continuation of online classes till the present pandemic situation become totally under control?

- Yes
- No

20) Do you really enjoy online learning?

- Yes
- No



Project Report

On

**EFFECTS OF COVID 19 ON VARIOUS
FACTORS ON STUDENTS**

Submitted

in partial fulfilment of the requirements for the degree of

BACHELOR OF SCIENCE

in

MATHEMATICS

by

AKSHARA MARIA

(REGISTER NO: AB19AMAT037)

Under the Supervision of

Smt. SHANTY B P



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APRIL 2022

ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM



CERTIFICATE

This is to certify that the dissertation entitled, **EFFECTS OF COVID 19 ON VARIOUS FACTORS ON STUDENTS** is a bonafide record of the work done by Ms. **AKSHARA MARIA** under my guidance as partial fulfilment of the award of the degree of **Bachelor of Science in Mathematics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

Date: 04/03/2022

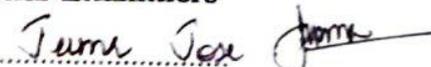
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1: 

2:

DECLARATION

I hereby declare that the work presented in this project is based on the original work done by me under the guidance of Smt. Shanty B P. Assistant Professor, Department of Mathematics, St. Teresa's College(Autonomous), Ernakulam and has not been included in any other project submitted previously for the award of any degree.

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Date: 04/03/2022



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AB19AMAT037

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Ernakulam.

Date: 04/03/2022

AKSHARA MARIA

AB19AMAT037

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Chapter 1

INTRODUCTION

1.1 ABSTRACT

The main purpose of the study was to identify and analyze the impacts of the pandemic on students . Through the study we were able to figure out how various factors like mental and physical health, academics etc has influenced the students. After analyzing the factors we were able to put up some suggestions.

1.2 STATISTICS

Statistics is a branch of science that deals with the collection, organisation, analysis of data and drawing of inferences from the samples to the whole population. This requires a proper design of the study, an appropriate selection of the study sample and choice of a suitable statistical test. An adequate knowledge of statistics is necessary for proper designing of a study or a clinical trial. Improper statistical methods may result in erroneous conclusions which may lead to unethical practice.

1.2.1 VARIABLES

Variable is a characteristic that varies from one individual member of population to another individual. Variables such as height and weight are measured by some type of scale, that conveys quantitative information and are called as quantitative variables. Sex and eye colour give qualitative information and are called as qualitative variables.

1.2.2 STATISTICS: DESCRIPTIVE AND INFERENCE

Descriptive statistics try to describe the relationship between variables in a sample or population. Descriptive statistics provide a summary of data in the form of mean, median and mode. Inferential statistics use a random sample of data taken from a population to describe and make inferences about the whole population. It is valuable when it is not possible to examine each member of an entire population.

1.2.3 INFERENCE STATISTICS

In inferential statistics, data are analysed from a sample to make inferences in the larger collection of the population. The by purpose is to answer or test the hypotheses. A hypothesis (plural hypotheses) is a proposed explanation for a phenomenon. Hypothesis tests are thus procedures for making rational decisions about the reality of observed effects. In inferential statistics, the term 'null hypothesis' (H_0) denotes that there is no relationship (difference) between the population variables in question. Alternative hypothesis (H_1) denotes that a statement

between the variables is expected to be true. The p value (or the calculated probability) is the probability of the event occurring by chance if the null hypothesis is true. The p value is a numerical value between 0 and 1 and is interpreted by researchers in deciding whether to reject or retain the null hypothesis. If p value is less than the arbitrarily chosen value (known as the significance level), the null hypothesis (H_0) is rejected.

1.2.4 STATISTICAL SURVEY

A survey is an investigation about the characteristics of a given population by means of collecting data from a sample of that population and estimating their characteristics through the systematic use of statistical methodology. When conducting a statistical survey, there are Stages Of Statistical Survey, that are to be followed in sequential order. Unless we follow these steps systematically, we may not be able to achieve good results from the survey. Some important steps concerning a statistical survey:

- Defining the problem and determining the objective
- Preliminaries to the collection of data.
- Collection and Editing of data.
- Classification and Tabulation of data.
- Analysis and Interpretation of data.
- Writing the report.

1.3 ABOUT COVID-19

COVID-19 (coronavirus disease 2019) is a disease caused by a virus named SARS-CoV-2 and was discovered in December 2019 in Wuhan, China. It is very contagious and has quickly spread around the world. COVID-19 most often causes respiratory symptoms that can feel much like a cold, a flu, or pneumonia. COVID-19 may attack more than your lungs and respiratory system. Other parts of your body may also be affected by the disease.

- Most people with COVID-19 have mild symptoms, but some people become severely ill.
- Some people including those with minor or no symptoms may suffer from post-COVID conditions or “long COVID”.
- Older adults and people who have certain underlying medical conditions are at increased risk of severe illness from COVID-19.
- Hundreds of thousands of people have died from COVID-19 in the United States.
- Vaccines against COVID-19 are safe and effective. Vaccines teach our immune system to fight the virus that causes COVID-19.

The first SARS-CoV-2 positive case in India was reported in the state of Kerala on January 30th, 2020. On 11 March, the World Health Organization (WHO) declared COVID-19 a global pandemic. Covid-19 pandemic-impacted education will be different mainly in the mode of teaching and evaluation. Nationally there was a call for a de facto switch to virtual teaching, learning and evaluation, pushing a huge number of teachers into an unfamiliar mode. Hailed as a more effective, quick and less expensive mode, online teaching/learning is being given precedence over the campus mode as the new normal. Online teaching and evaluation, pushed as a new normal under the pretext of the pandemic crisis, upset objectives of access, equity and excellence in the higher education sector. About 30 per cent of students at home under lockdown were not able to access online lessons due to lack of internet connectivity. Virtual teaching is not a substitute for the Real that has all the exclusive advantages of being real. The Covid-induced virtual mode will bring about several transformations in the concept of higher education institutions, their clients and practices.

1.4 OBJECTIVES

- To find and to interpret if there exist any relation between gender and various factors.
- To find and to interpret if there is any relation between age groups and various factors.

- To examine whether the government implemented schemes or the scholarships provided by other organisations are reaching the deserved ones.

1.5 LITERATURE REVIEW

1) JMIR Publications:- Journal of Medical Internet Research

It is a small but rapidly growing publisher of peer- reviewed journals with an emphasis on medicine, health, and technology titles, is seeking an enthusiastic, self-motivated team members. A group of students from the department of pharmacology, Rajiv Gandhi University of health Sciences, Bangalore conducted a research on the topic 'Impact of covid 19 on mental health of college students in India'. Authors :

- Amar Prasad Chaudhary
- Narayan Sah Sonar
- Jamuna TR
- Moumita Banerjee
- Sheilesh Yadav

The research work was published on 23rd February 2021. Their objective was to investigate symptoms of fear, depression and anxiety due to covid 19 on students of India. For this study, students of Mallige college of Pharmacy in Bangalore, India were selected with access to the internet and Social media. The questionnaire was designed using Google forms and was distributed to the students through the various social media platforms like Whatsapp, Facebook, Messenger, Telegram, etc. All the data were recorded in Microsoft Excel .They received a total of 324 students out of which 180 were males and 144 were females. From the research work they concluded that a very high fear of covid 19 among students along with anxiety and depression symptoms.

2) NCBI :- National centre for Biotechnology Information It's a branch of national Institutes of health. It is approved and funded by the govt of USA. The research was carried out by Wenjun Cao, Ziwei Fang, Guoqiang Hou Mei Han,Xinrong Xu, Jiaxin Dong, and Jianzhong Zheng.

The research was based on 'the psychological impacts of covid 19 epidemic on college students in China'. The targeted population was the UG students from Changzhi medical college. The respondents in the target population were sampled by cluster sampling. They received a total of respondents. Data were analysed with SPSS Version 22.0. A univariate analysis (Nonparametric test) was used to explore the significant associations between sample characteristics and the anxiety level during the COVID-19 epidemic and multivariate logistic regression analysis suggested that living in urban areas in contrast to reducing the anxiety of college students.

3) Indian express article:- The survey was carried out by ASER. ASER (Annual Status of Education Report) is a social welfare centre in Delhi established in 2008 as an autonomous assessment survey. The survey shows an increase in dependence on private tuitions and an absence of ready access to smartphones. They suggested that special attention is needed to help make up learning losses especially in the lower classes.

1.6 SIGNIFICANCE OF STUDY

The rapid and unplanned change to teaching and learning in the online format brought by COVID-19 has likely impacted many students. One of the limitations of emergency remote learning is the lack of personal interaction between teacher and student. Mental health issues are the leading impediment to academic success. Mental illness can affect students' motivation, concentration, and social interactions—crucial factors for students to succeed in higher education. So the purpose of this study is to examine how the various factors (psychological, physical health, academics) during the pandemic has affected students well-being and what role the government and other organisations plays in this context.

1.7 LIMITATIONS OF STUDY

Even though the study yielded major findings, there were a few limitations in our survey. The survey has been restricted to students between the age group 13-24. Students from other age groups were not taken into consideration. As the sample size increases the margin of error decreases. But due to time and other restrictions, the survey was limited to only 470 participants. Only qualitative data has been used in the study. Since the responses received were the personal choices of the respondents there is a chance that the data may or may not be biased.

Chapter 2

METHODOLOGY

2.1 METHODS

The target population for the survey was the population of students from age 13-17 and 18-24. Google form was circulated among the students between age group 13-24, to conduct the survey. The questionnaire consisting of 25 questions including age, gender, educational institution, type of school or college and place of residence was circulated. Out of 25 questions, 23 questions were marked important. The questionnaire included questions regarding psychological, financial, academic and health issues faced by the students.

2.2 CHI-SQUARE TEST

The Chi-Square Test is an important test among the several tests of significance. It was developed by Karl Pearson in 1990. In general, the test that is used to measure the difference between what is observed and what is expected according to an assumed hypothesis is called Chi-Square Test. Simply we can say that Chi-Square Test is a relationship between two variables. H_0 that is the null hypothesis represents that there is no relation between two variables. H_1 that is the alternative hypothesis indicates that there exist a significant relation between two variables. The significant level is the probability of rejecting the null hypothesis, when it is true. In most of the cases, we use significant level as 0.05. First we create the table of observed frequency from obtained

data. Then expected frequency values are calculated using the following equation:-

$$(\text{Row total} \times \text{column total}) \div \text{Grand total}$$

Then, we create the table of expected frequency, we can calculate the Chi-square value using the equation:-

$$\frac{(\text{Observed value} - \text{Expected value})^2}{\text{Expected value}^2} = \frac{(O_i - E_i)^2}{E_i} \quad (2.1)$$

$$\text{Chi-Square} = \frac{(O_i - E_i)^2}{E_i} \quad (2.2)$$

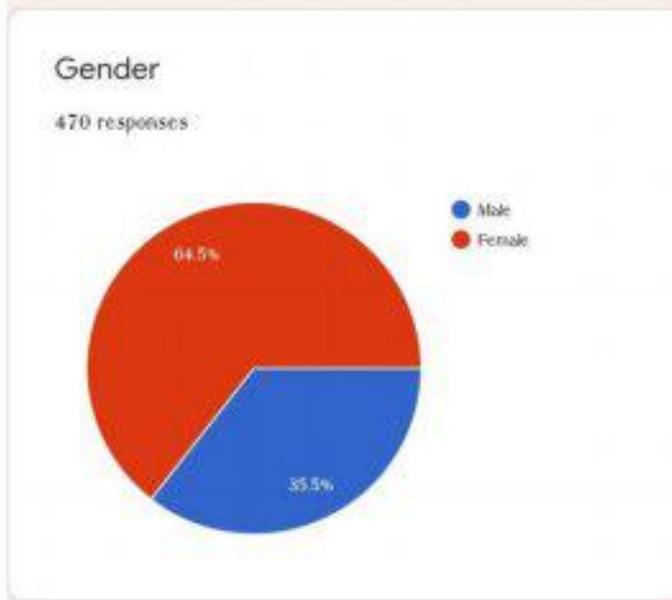
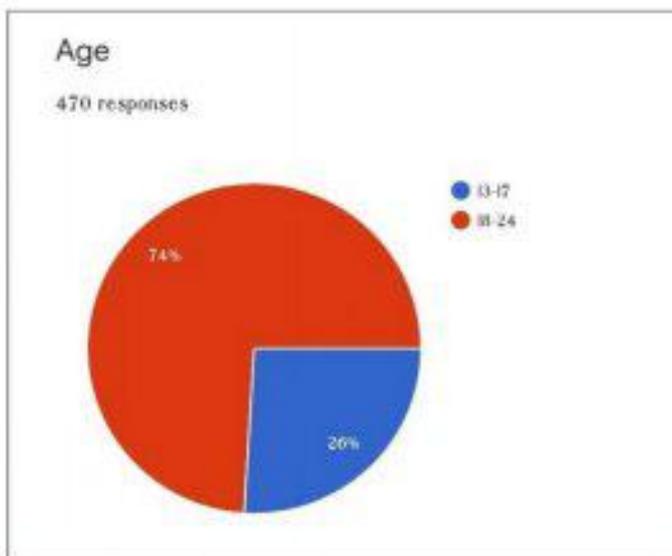
Tabular Chi-Square value can be obtained by using degrees of freedom and significance level.

$$\text{Degrees of freedom} = (\text{column} - 1) \times (\text{rows} - 1)$$

Degrees of freedom refers to the maximum number of logically independent values, which are values that have the freedom to vary, in the data sample. If calculated Chi-Square is greater than tabular Chi-Square, then we reject null hypothesis and accept alternate hypothesis. A p value is a measure of the probability that an observed difference could have occurred just by random chance. The lower the p value the greater the statistical significance of the observed difference. In MS excel, we calculate the p value. Then we compare the p value with significance level. If p value is greater than the significance level, we accept H_0 . Hence we can say that there is no relation between two variables.

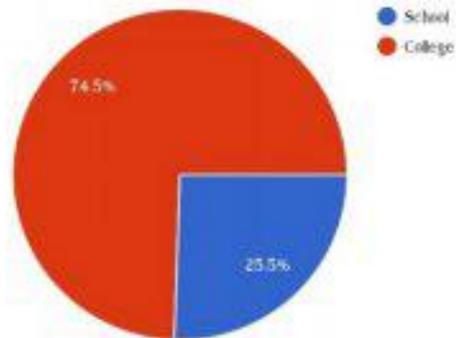
Chapter 3

PRESENTATION OF DATA



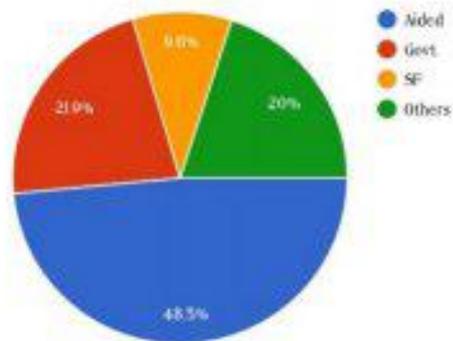
Educational Institution

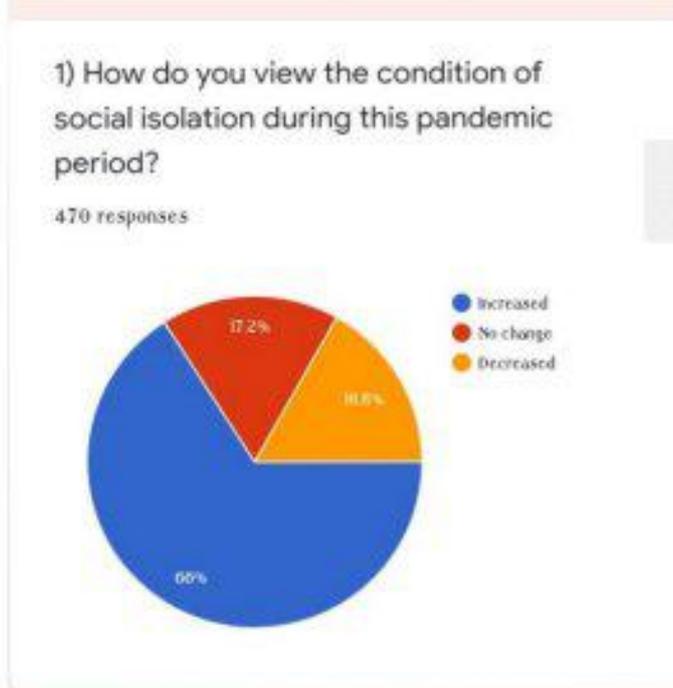
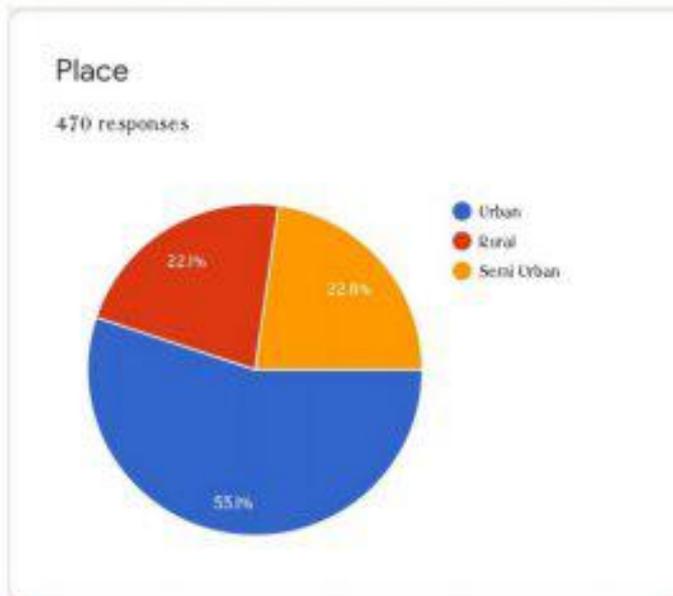
470 responses



Type of School/College

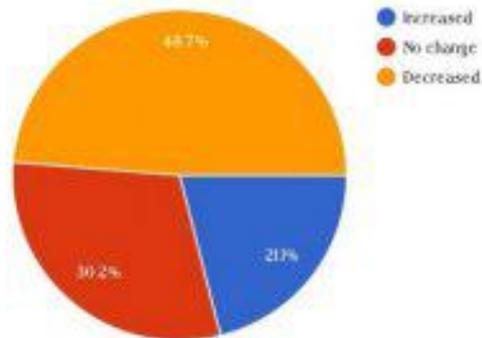
470 responses





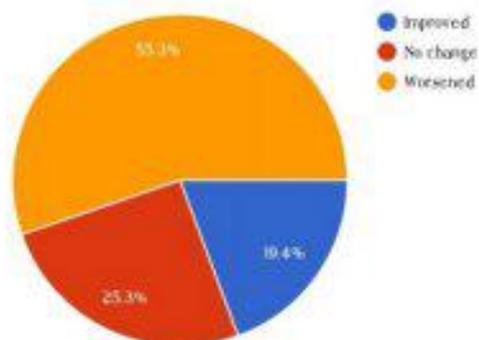
2) Do you think your communication skills has changed since the pandemic?

470 responses



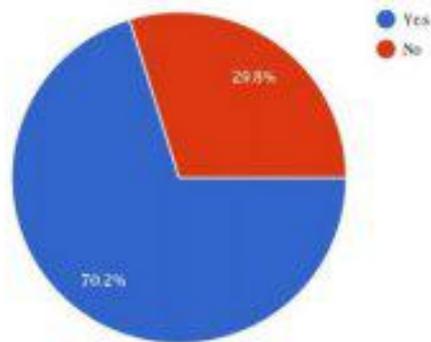
3) How do you think covid 19 has changed your state of mind?

470 responses



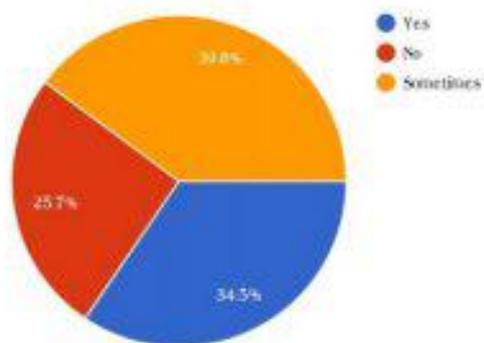
4) Do you feel online class is a hindrance for socialization?

470 responses



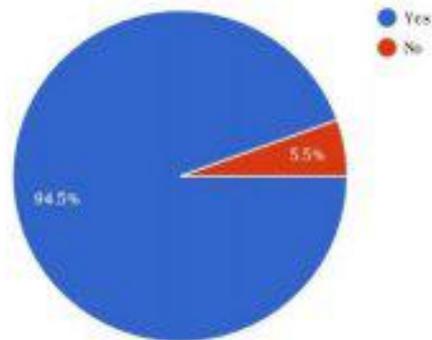
5) Do you participate in online competition, webinars etc.?

470 responses



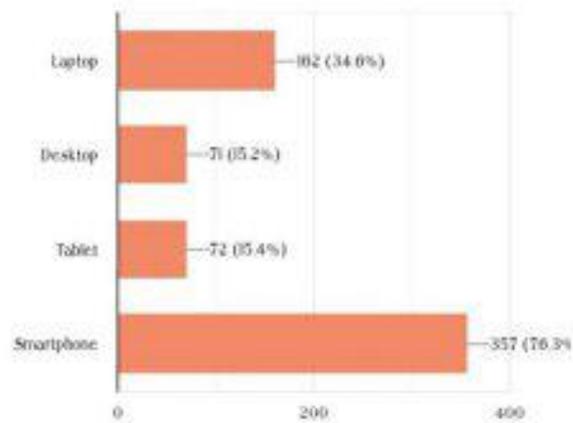
6) Do you have access to a device for online learning?

470 responses

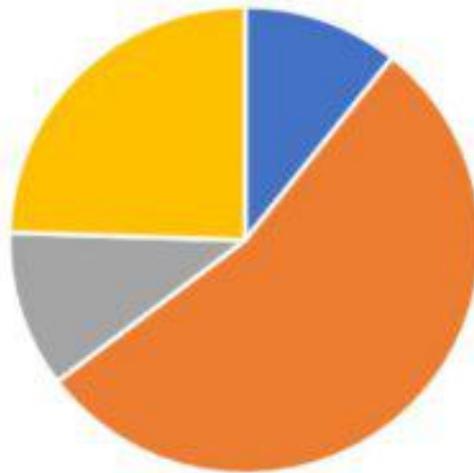


7) Which device do you use for online learning?

468 responses



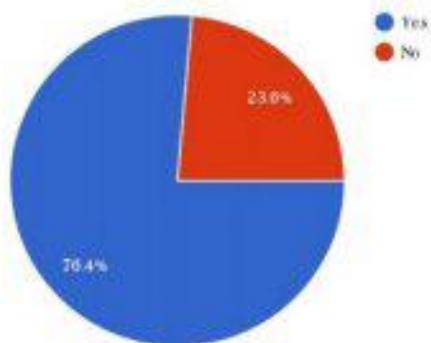
Device used for online learning



■ desktop ■ smartphone ■ tablet ■ laptop

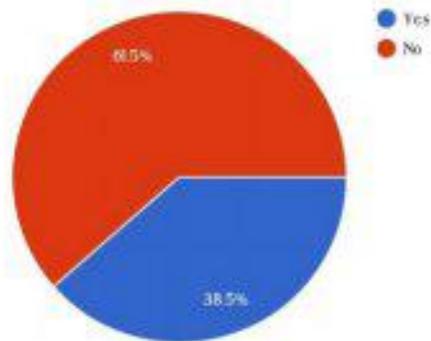
8) Do you experience any network issues during online sessions?

470 responses



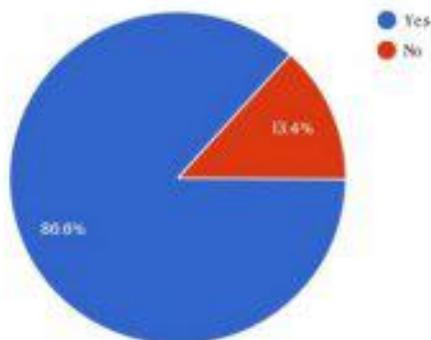
9) Did the online course meet your expectations in terms of quality learning?

470 responses



10) Do you feel that students having practical / lab works are more affected by online class?

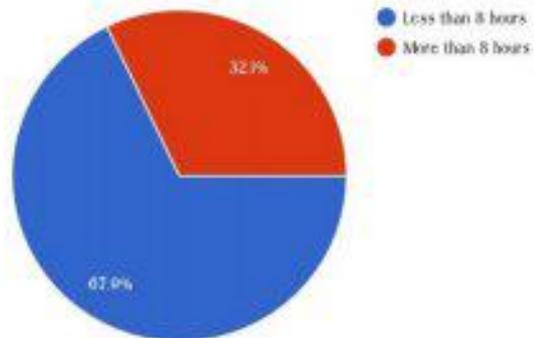
470 responses



11) How many hours of sleep do you get a night?

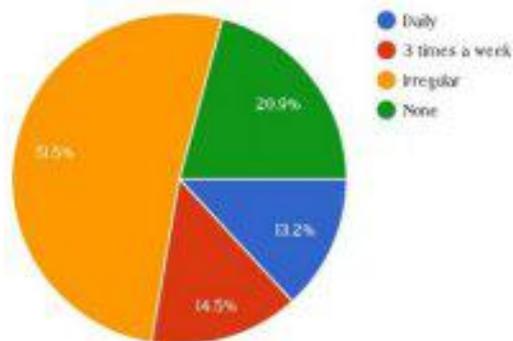


470 responses



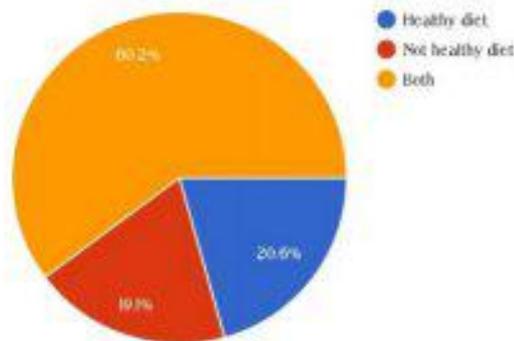
12) How much intentional exercise do you get a week?

470 responses



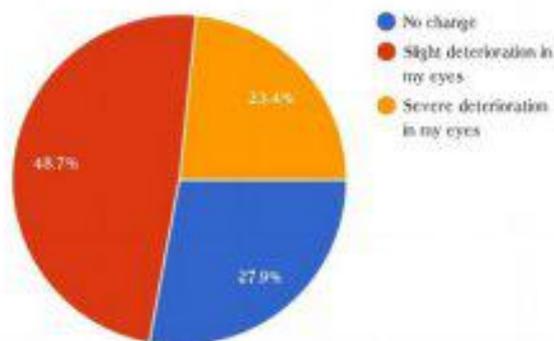
13) What are your eating habits like?

470 responses



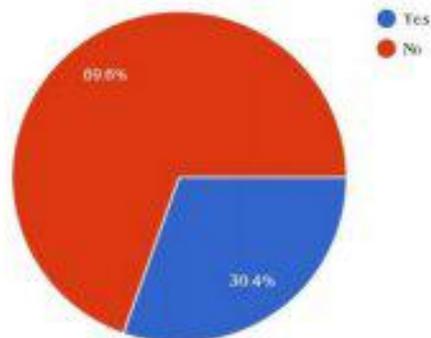
14) In what way did watching the lessons on your computer/tablet/smartphone affect your eye health during the pandemic?

470 responses



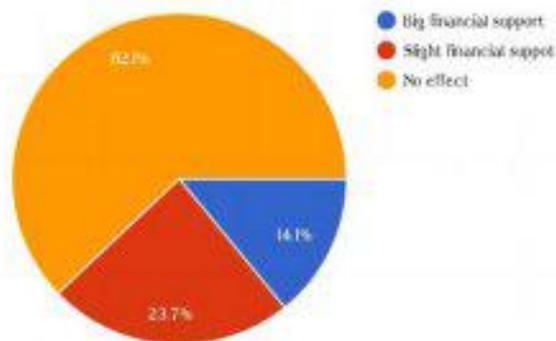
15) Do you get any scholarship?

470 responses



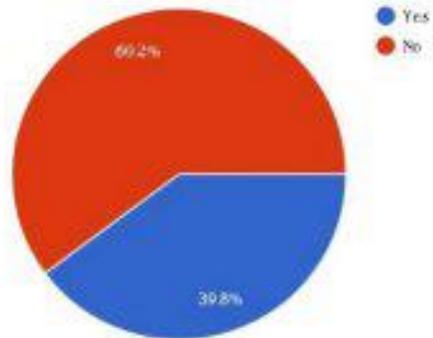
16) How much have scholarships influenced you during this corona era?

396 responses



17) Have you had to pay exorbitant fees since corona arrived?

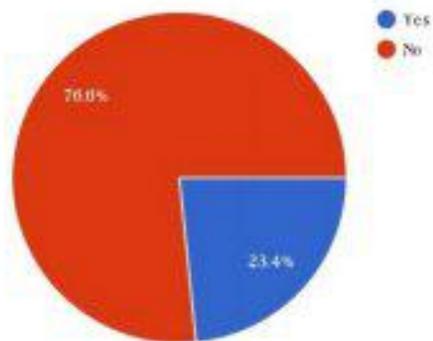
470 responses



18) Has corona time helped you financially(via online opportunities)

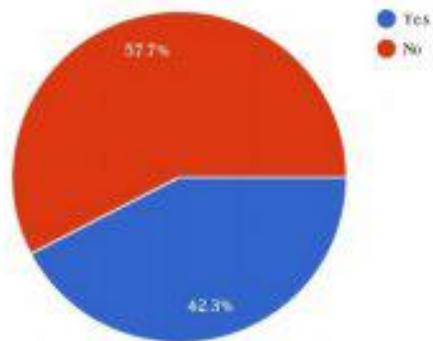


470 responses



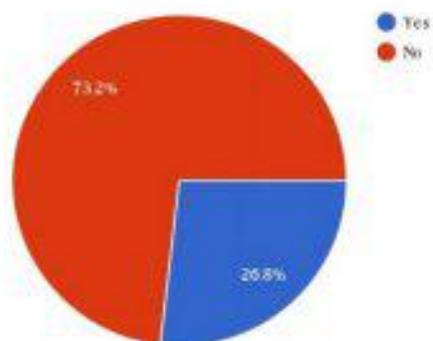
19) Do you welcome the continuation of online classes till the present pandemic situation become totally under control?

470 responses



20) Do you really enjoy online learning?

470 responses



3.1 DATA ANALYSIS

1. SOCIAL ISOLATION-GENDER:

Q) How do you view the condition of social isolation during this pandemic period?

- a) Increased
- b) No change
- c) Decreased

Observed Frequency

Gender	Increased	Decreased	No change	Total
Male	110	24	33	167
Female	199	53	51	303
Total	309	77	84	470

H_0 : There is no relationship between gender and social isolation.

H_1 : There is a relationship between Gender and social isolation.

Critical value: 0.05

Expected frequency

Gender	Increase	Decrease	No change	Total
Male	109.793617	27.35957447	29.84680851	167
Female	199.206383	49.64042553	54.15319149	303
Total	309	77	84	470

$$EF = CT * RT / GT$$

p value 0.560674794

Since p value is greater than 0.05 we will accept the null hypothesis. Hence, we can conclude that there exists no relation between social isolation and gender.

2. ENJOYMENT OF ONLINE LEARNING-GENDER:-

Q) Do you really enjoy online learning?

a) Yes

b) No

Observed frequency

Gender	Yes	No	Total
Male	53	114	167
Female	25	278	303
Total	78	392	470

H_0 : There is no relationship between gender and enjoyment of online learning

H_1 : There is a relationship between Gender and enjoyment of online learning.

Critical value: 0.05

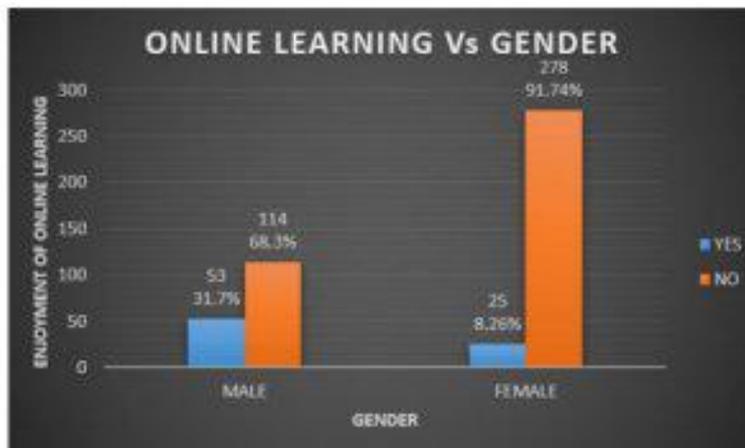
Expected frequency

Gender	Yes	No	Total
Male	27.71489362	139.2851064	167
Female	50.28510628	252.7148936	303
Total	78	392	470

$$EF = CT * RT / GT$$

$$p \text{ value } 5.75348 * 10^{-11}$$

Since p value is less than 0.05 we reject the null hypothesis. Hence, we can conclude that there exists a significant relation between enjoyment of online learning and gender.



3. QUALITY LEARNING-AGE GROUP:-

Q) Did the online course meet your expectations in terms of quality learning?

- a) Yes
- b) No

Observed frequency

Age group	Yes	No	Total
13-17	80	42	122
18-24	100	248	348
Total	180	290	470

H_0 : There is no relationship between quality learning and age group.

H_1 : There is a relationship between quality learning and age group.

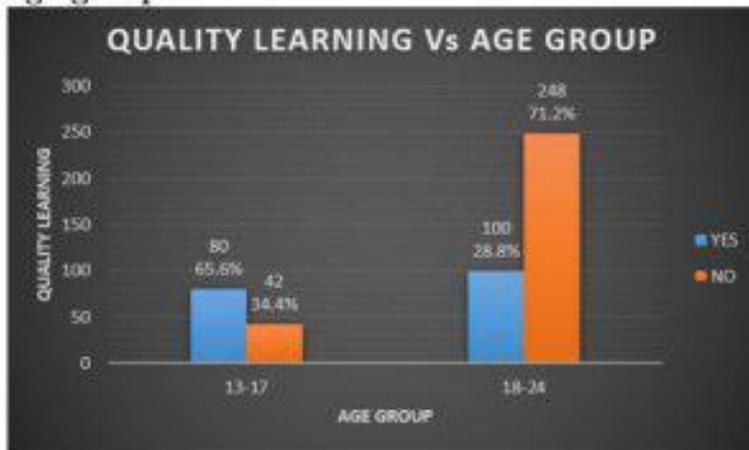
Expected frequency

Age group	Yes	No	Total
13-17	46.72340426	75.27659574	122
18-24	133.2765957	214.7234043	348
Total	180	290	470

$$EF = CT * RT / GT$$

$$p \text{ value } 5.91356 * 10^{-13}$$

As p value is less than 0.05 we reject the null hypothesis. Hence, we can conclude that there exists a relation between quality learning and age groups.



4. HOURS OF SLEEP AND GENDER:

Q) How many hours of sleep did you get a night?

a) Less than 8 hours

b) More than 8 hours

Observed frequency

Gender	Less than 8 hours	More than 8 hours	Total
Male	87	80	167
Female	232	71	303
Total	319	151	470

H_0 : There is no relationship between hours of sleep and gender.

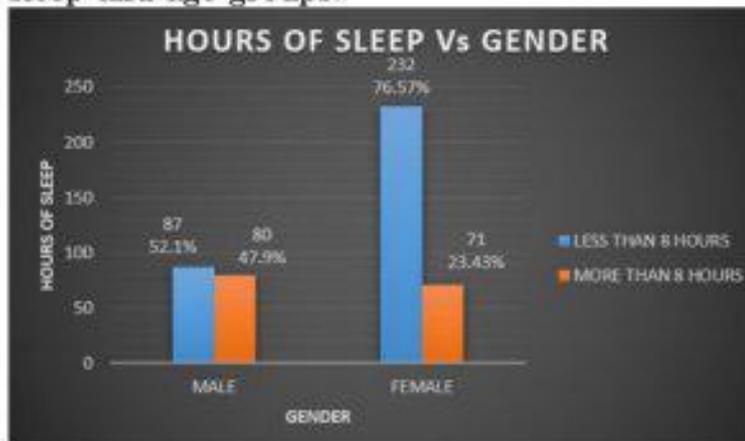
H_1 : There is a relationship between hours of sleep and gender.

Expected frequency

Gender	Less than 8 hours	More than 8 hours	Total
Male	113.3468085	53.65319149	167
Female	205.6531915	97.34680851	303
Total	319	151	470

p value 5.39872×10^{-8}

Since p value is less than 0.05 we will reject the null hypothesis. Hence, we can conclude that there exists a relation between hours of sleep and age groups.



5: EATING HABITS AND AGE GROUPS:

Q) What are your eating habits like?

- Healthy deit
- Not healthy diet
- Both

Observed frequency

Age group	Healthy	Not healthy	Both	Total
13-17	58	27	37	122
18-24	39	63	246	348
Total	97	90	283	470

H_0 : There is no relationship between age group and eating habits

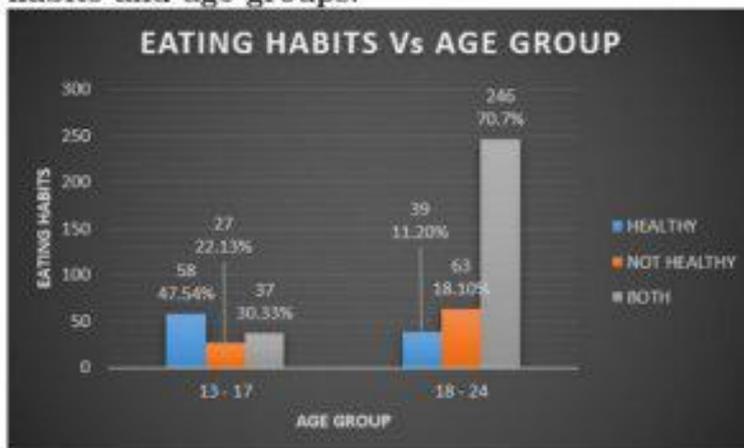
H_1 : There is a relationship between age group and eating habits.

Expected frequency

Age group	Healthy	Not healthy	Both	Total
13-17	25.1787234	23.36170213	73.45957447	122
18-24	71.8212766	66.63829787	209.5404255	348
Total	97	90	283	470

p value 9.53994×10^{-19}

Since p value is less than 0.05 we will reject the null hypothesis. Hence, we can conclude that there exists a relation between eating habits and age groups.



6: EYE HEALTH AND AGE GROUP:

Q) In what way did watching the lessons on your computer/table/smartphone effect your eye health during the pandemic?

a) No change

- b) Slight deterioration in my eyes
- c) Severe deterioration in my eyes

Observed frequency

Age group	No change	severe deterioration	Slight deterioration	Total
13-17	28	50	44	122
18-24	103	60	185	348
Total	131	110	229	479

H_0 : There is no relationship between eye health and age group.

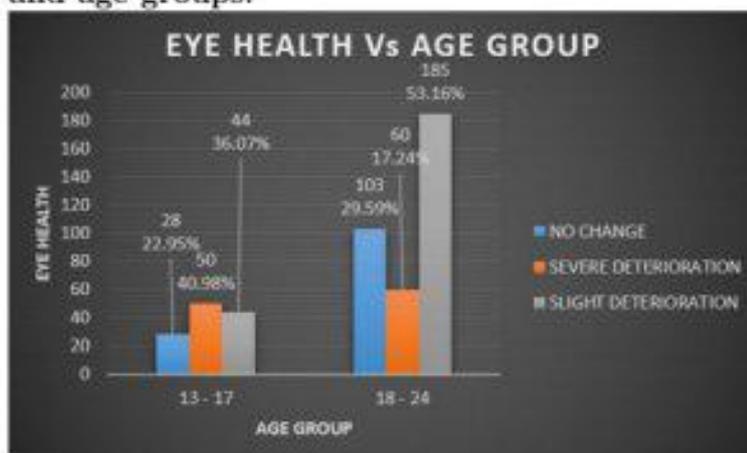
H_1 : There is a relationship between eye health and age group.

Expected frequency

Age group	No change	Severe deterioration	slight deterioration	Total
13-17	34.00425532	28.55319149	59.44255319	122
18-24	96.99574468	81.44680851	169.5574468	348
Total	131	110	229	470

p value 6.1397×10^{-7}

Since p value is less than 0.05 we will reject the null hypothesis. Hence, we can conclude that there exists a relation between eye health and age groups.



Chapter 4

RESULT AND CONCLUSION

4.1 RESULT

1. After carefully analyzing the data, we were able to find out that among 167 males out of 470 responses, 31.7% enjoy online learning and among 303 females, 8.26% enjoy online learning.

2. While examining the collected data, we can deduce that majority of students between 13-17 follows a healthy diet whereas considering the age group 18-24 ,majority of students prefer both healthy and unhealthy diet.

3. From the obtained data, among 122 students between 13-17, 40.98% face severe deterioration in their eyesight and 53.16% of 348 students between age group 18-24 face slight deterioration in their eye sight.

4.2 CONCLUSIONS

From our questionnaire, we were able to find out that at least there are some students who are benefited from the scholarships provided by the various organisations.

From the responses, we identified that the majority of students between the age group of 13-17 faced deterioration in their eye sight due to increased and continuous usage of electronic devices.

We also identified that the majority of students between the age group of 18-24 faced deterioration in their eye sight due to the same reason stated above.

From the responses, we can conclude that a majority of females reported an increase in social isolation and they tend to get lesser amount of sleep.

Similarly a major part of males reported an increase in isolation and tend to get lesser amount of sleep.

From our study, we were able to figure out that students between the age group of 13-17 tend to eat healthy food and spend a lesser amount of time to exercise. Since their diet is healthy, exercise does not become a necessity for them.

When we consider the case of students between the age group 18-24, we can see that they prefer a combination of both healthy and unhealthy diet and they prefer little to no exercise.

Hence we can conclude that a relation exist between age group and lifestyle.

4.3 SUGGESTIONS

1. **Joining peer groups /support groups is a great way to increase communication among students. They provide an opportunity and support for development of an individual's soft skills which might have decreased since online mode of education started.**
2. **Conversation with family and loved ones can be of great help in dealing with stress,anxiety and depression. Students can try and talk to his/her friends,parents,teachers etc about what's worrying them.**
3. **Opening up about one's problems and worries to someone who cares can help him/her to deal with it more efficiently.**
4. **Regular exercise can be beneficial for students whose lifestyles might have changed due to the sudden emergence of covid-19 and online mode of education.**
5. **Maintain a proper diet and sleeping pattern is important for a healthier lifestyle.**
6. **Good study habits like consistent timing, maintaining a proper schedule etc can be very helpful for a student to adjust to his/her new ways of learning.**
7. **Connecting with classmates can be beneficial for both curricular and social aspects of one's life.**

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ANNEXURE

Questions 1-4 indicates the psychological factors that influence students.

Questions 5-10 is regarding how covid has affected the academics of the students.

Questions 11-14 is all about the fitness and lifestyle.

Questions 15-17 is about governments role in helping students.

Questions 18-20 is regarding the financial factors that affect students.

The image shows a Google Forms interface for a questionnaire. At the top, there are tabs for 'Questions', 'Responses' (with a count of 470), and 'Settings'. The form is divided into two sections. Section 1 of 2 is titled 'EFFECTS OF COVID-19 ON VARIOUS FACTORS ON STUDENTS' and includes a description: 'This survey is being conducted in order to study how covid-19 has affected students of different age groups. The data collected will be used only for educational purposes.' It contains three questions: 'Email *' (text input), 'Educational Institution *' (radio buttons for 'School' and 'College'), and 'Type of School/College *' (radio buttons for 'Aided', 'Govt.', 'SF', and 'Others'). Section 2 of 2 is titled 'Questionnaire' and contains three questions: 'Age' (radio buttons for '13-17' and '18-24'), 'Gender' (radio buttons for 'Male' and 'Female'), and 'Place' (radio buttons for 'Urban', 'Rural', and 'Semi Urban'). The final question in Section 2 is '1) How do you view the condition of social isolation during this pandemic period?' with radio buttons for 'Increased', 'No change', and 'Decreased'.

2) Do you think your communication skills has changed since the pandemic? *

- Increased
- No change
- Decreased

3) How do you think covid 19 has changed your state of mind? *

- Improved
- No change
- Worsened

6) Do you have access to a device for online learning? *

- Yes
- No

7) Which device do you use for online learning?

- Laptop
- Desktop
- Tablet
- Smartphone

4) Do you feel online class is a hindrance for socialization? *

- Yes
- No

5) Do you participate in online competition, webinars etc.? *

- Yes
- No
- Sometimes

8) Do you experience any network issues during online sessions? *

- Yes
- No

9) Did the online course meet your expectations in terms of quality learning? *

- Yes
- No

10) Do you feel that students having practical / lab works are more affected by online class?

- Yes
- No

12) How much intentional exercise do you get a week?

- Daily
- 3 times a week
- Irregular
- None

11) How many hours of sleep do you get a night?

- Less than 8 hours
- More than 8 hours

13) What are your eating habits like?

- Healthy diet
- Not healthy diet
- Both

14) In what way did watching the lessons on your computer/tablet/smartphone affect your eye health during the pandemic?

- No change
- Slight deterioration in my eyes
- Severe deterioration in my eyes

16) How much have scholarships influenced you during this corona era?

- Big financial support
- Slight financial support
- No effect

15) Do you get any scholarship?

- Yes
- No

17) Have you had to pay exorbitant fees since corona arrived?

- Yes
- No

18) Has corona time helped you financially (via online opportunities)

Yes

No

19) Do you welcome the continuation of online classes till the present pandemic situation become totally under control?

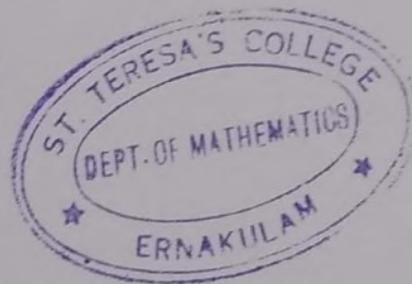
Yes

No

20) Do you really enjoy online learning?

Yes

No



ST. TERESA'S COLLEGE(AUTONOMOUS)
ERNAKULAM
AFFILIATED TO MAHATMA GANDHI UNIVERSITY



COCOTOUR

PROJECT REPORT

In partial fulfilment of the requirements for the award
of the degree of

BACHELOR OF SCIENCE IN
COMPUTER APPLICATIONS [TRIPLE MAIN]

Submitted by

AKSHAYA P V

III B.Sc. Computer Applications [Triple main]

Register No: SB19CA001

Under the guidance of

Smt. ELIZABETH PAUL

DEPARTMENT OF COMPUTER APPLICATIONS

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An ISO 9001:2015 Certified Company



APRIL 5, 2022

TO WHOM SO EVER IT MAY CONCERN

This is to certify that **AKSHAYA .P.V**, 6th semester **BSc COMPUTER APPLICATION (Triple Main)** student of **ST. TERESA'S COLLEGE, ERNAKULAM** has successfully completed a project titled **"COCOTOUR"** from our organization.

The duration of the project was for 3 months. The Project was incorporated in **ANDROID, JAVA** and was implemented successfully.

Thanking you,

For **LCC Computer Education**

A handwritten signature in black ink, appearing to read "T.S. Ramaswamy".

T.S. Ramaswamy
Director



ST. TERESA'S COLLEGE(AUTONOMOUS)
ERNAKULAM
AFFILIATED TO MAHATMA GANDHI UNIVERSITY

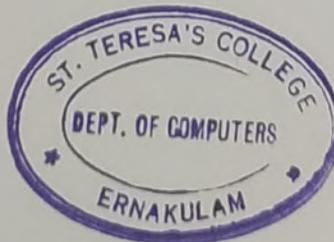


CERTIFICATE

This is to certify that the project report entitled "COCOTOUR", a bona fide record of the work done by AKSHAYA P V during the year 2021-22 and submitted in partial fulfilment of the requirements for the degree of Bachelor of Science in Computer Applications (Triple main) under Mahatma Gandhi University.

R/L

Head of the Department



[Signature]
Internal Examiner

[Signature]
6/4/22
External Examiner

Date: 06.04.2022

DECLARATION

I, **Akshaya P V**, Bsc. Computer Application[Triple Main] final year student of St.Teresa's College (Autonomous),Ernakulam, register no:SB19CA001,hereby declare that the dissertation submitted for Bachelor's Degree in Computer Application is my original work. I further declare that the said work has not previously been submitted to any other university or academic body.

DATE:

PLACE:

AKSHAYA P V

ACKNOWLEDGEMENT

First and foremost, I thank God Almighty for his blessings. I take this opportunity to express my gratitude to all those who helped me in completing this project successfully. I wish to express my sincere gratitude to the **Manager Rev. Dr. Sr. Vinitha CSST**, **Director Rev. Sr Emeline CSST** and **Principal Dr. Lizzy Mathew** for providing all the facilities.

I express my sincere gratitude towards the **Head of the department Smt. Raji S Pillai** for the support. I deeply express my sincere thanks to my guide **Smt. Elizabeth Paul** for her proper guidance and support throughout the project work. I thank all other faculty of the department for their exemplary guidance and appreciation throughout the project.

I am indebted to my external guide at LCC Computer Institute, **Mr. Ajin A** for training me well to develop this project.

My deepest appreciation goes to all my friends and relatives for their support. I convey my hearty thanks to my parents who encouraged me and provided all the opportunities for the completion of this project.

SYNOPSIS

This project Cocotour is used to automate all process of travel in Kerala, ranging from booking places in advance to saving to travel adventures in app and letting other passengers know. In this scenario where the world has started to recover from a global pandemic, Cocotour is a novel attempt to boost tourism in Kerala to its full glory, with less in person interaction yet not leaving behind the fact of having a pleasurable travel opportunity.

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1. INDRODUCTION

1.1 ABOUT PROJECT

This project Cocotour is used to automate all process of travel in kerala, ranging from booking places in advance to saving to travel adventures in app and letting other passengers know.

In this scenario where the world has started to recover from a global pandemic, Cocotour is a novel attempt to boost tourism in kerala to its full glory, with less in person interaction yet not leaving behind the fact of having a pleasurable travel opportunity.

1.2 ABOUT ORGANIZATION

Founded in Cochin back in the year 1992, LCC started its journey as a premier computer coaching centre and later advanced into one of the most reputed brand for computer learning throughout India. LCC has surpassed victory in finding and refining those hidden talents in our pupils, to deliver thousands of IT prosto the evergreen IT Industry every year

1.3 OBJECTIVE OF PROJECT

The main objective of the project is to introduce a concept of travel and tourism in kerala with having less in person interaction with guides and have a safe independent tourism experience .

2. SYSTEM ANALYSIS

2.1 INTRODUCTION

The first step in the system study includes analysis of the system. System analysis involves studying the way an organization currently receives and process data to produce information with the goal of determining how to make it work better. System analysis includes both a preliminary and a detailed stage. During preliminary analysis the analysis takes a quick look at what is needed and whether it benefits the perceived want. Detailed analysis includes an in depth look at what is wanted and contains more refined cost and benefits studies. The preliminary analysis begins when someone perceives a problem, modifications to existing, repairs to an existing system or demands an entirely new system. The analyst summarizes the gained modifications, including personal requirements and potential benefits of the new system in formal report called the preliminary report. Detailed analysis expands the preliminary efforts to include the complete analysis of all possible alternative solutions to the problem and complete expansion of what appears to be the most practical solution.

The system study is the process of gathering and interpreting facts, using this information for further studies on the system. It does various feasibility studies. In these studies, a rough figure of the system activities can be obtained, from which the decisions about the strategies to be followed for effective system study and analysis can be taken. The system study also identifies the method collection to be followed. The system study conducted an initial picture about the system working was got. From the information got from the study, the data collection methods are identified. Even in the first investigation itself drawbacks of the existing system could be identified.

Analysis involves the requirement determination and specifications. Basically, it involves establishing for all the system elements and then mapping these requirements to the software form. The analysis is intended to capture and describe all the requirements of the system and to make a model that defines a key domain classis in the system. The purpose is to provide an understanding and to enable a communication about the system between the developers and the people establishing the requirements. Therefore, the analysis is typically terms of code or programs during

this phase; it is the first step towards really understanding the requirements.

2.2 EXISTING SYSTEM

In the existing system , travelers need to find a guide for travelling to unknown places ,they were unable to find destinations according to their desires to travel and preferences .

2.3 PROPOSED SYSTEM

The proposed system is more efficient in terms of existing system as people can connect with service provider without having an in-person interaction ,as well as view and save travel packages which are more convenient to track down travel expenses .

2.4 SYSTEM SPECIFICATION

A software requirement specification (SRS), a requirements specification for a software system, is a complete description of the behavior of a system to be developed and may include a set of use cases that describe interactions the users will have with the software. In addition, it also contains non-functional requirements. Non-functional requirements impose constraints on the design or implementation (such as performance engineering requirements, quality standards, or design constraints) The software requirements specification document enlists all necessary requirements that are required for the project development. To derive the requirements, we need to have clear and thorough understanding of the products to be developed. This is prepared after detailed communications with the project team and customer.

2.5 SOFTWARE SPECIFICATION

The selection of hardware is very important in the existence and proper working of any software. When selecting hardware, the size and capacity requirements are also important. Below are some of the hardware that is required by the system.

Main Processor	Intel core i3 or above
----------------	------------------------

RAM	8 GB or Above
Keyboard	Standard 108 keys
Mouse	3D Optical mouse
Monitor	15" Standard
Hard disk	10 GB of available disk space minimum or Above

2.6 HARDWARE SPECIFICATION

The most common set of requirements defined by any operating system or software application is the physical computer resources, also known as hardware. A hardware requirements list is often accompanied by a hardware compatibility list (HCL), especially in case of operating systems. An HCL lists tested, compatible, and sometimes incompatible hardware devices for a particular operating system or application.

We require much different software to make the application which is in making to work efficiently. It is very important to select the appropriate software so that the software works properly.

Operating System	64-bit Microsoft® Windows® 8/10/11
Programming Language	Java, Android
RDBMS	MYSQL
Web Server	Apache Tomcat & Glassfish Server
Scripting language	JSP

2.7 ABOUT THE SOFTWARE TOOLS AND PLATFORM

It is very important to select appropriate software so that the software works properly.

FRONT END: ANDROID

Android is a Linux based operating system designed primarily for touch screen mobile devices such as smart phones and tablet computers. Android is open source and Google releases the code under the Apache License This open-source code and permissive licensing allows the software to be freely modified and distributed by device manufacturers, wire- less carriers and enthusiast developers. Additionally, Android has a large community of developers writing applications that extend the functionality of devices, written primarily in a customized version of the Java programming language. Android is an open-source mobile operating system that combines and builds up on parts of many different open-source projects.

ABOUT JAVA

Java is a general-purpose computer-programming language that is concurrent, class- based, object-oriented, and specifically designed to have as few implementation dependencies as possible. It is intended to let application developers "write once, run anywhere" (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of computer architecture.

ABOUT ANDROID STUDIO

Android is a Linux-based operating system designed primarily for touch screen mobile devices such as Smartphone and tablet computers.. Android is open source and Google releases the code under the Apache License. This open-source code and permissive licensing allows the software to be freely modified and distributed by device manufacturers,

Android Studio is Android's official IDE. It is purpose-built for Android to accelerate your development and help you build the highest-quality apps for every Android device.

ABOUT MySQL

MySQL is a relational database management system based on the Structured Query Language, which is the popular language for accessing and managing the records in the database. MySQL is open-source and free software. It is a fast, scalable, and easy to use database management system. It is commonly used in conjunction with PHP scripts for creating powerful and dynamic server-side or web-based enterprise applications.

3. SYSTEM DESIGN

3.1 INTRODUCTION

System design is an interactive process through which requirements are transmitted to a “blue print” for constructing the software initial; the blue print depicts a holistic view of software that is design is represented at a high-level abstraction a level that can be directly traced to specific data, functional and behavioral requirements. System design is the solution to the creation of a new system. This is the important aspect made up of several steps. System design is the process of developing specifications for a candidate system that meet the criteria established in the system analysis. Major step in system design is the preparation of the input forms and output reports in a form applicable to the users.

The main objective of system design is to use the package easily by a computer operator. System design is the creative act of invention, developing new inputs, a database, off-line files, method, procedures and output for processing business to meet an organization objective. System design-built information gathered during the system analysis. As design interaction occurs subset-quant refinement leads to design representation at much lower level of abstraction. System design is a creative art of inventing and developing input, data bases, off line files, method and procedures, for processing data to get meaning full output that satisfy the organization objectives. Through the design phase consideration to the human factor, that is inputs to the users will have on the system.

Some of the main factors that have to be noted using the design of the system are:

Practicability

System must be capable of being operated over a long period of time and must have ease of use.

Efficiency

Make better use of available resources. Efficiency involves accuracy, timeliness and compare- pensiveness of system output.

Cost

Aim of minimum cost and better results.

Security

Ensure physical security of data.

3.2 INPUT DESIGN

Input design is the process of converting user-oriented input to a based format. Inaccurate input data are the most common cause of errors in data processing. Errors entered by data entry operators can be controlled by input design. The goal of designing input data is to make data entry as easy, logical and free from errors. When we approach input data design; we design the data source documents that capture the data and then select the media used to enter them into computer.

User-friendly screen format can reduce the burden on end users, who are not highly proficient in computers. An important step in input design stage is a design of source document. Source document is the form in which the data can initially capture. The next step is the design of the document layout. In the layout organizes the document by placing information, where it will be noticed and establishes the appropriate sequence of items.

User interface design is very important for any application. The interface design describes how the software communicates within itself, to system that interpreted with it and with humans who use it. The input design is the process of converting the user- oriented inputs into the computer-based format. Input design is a part of overall system design, which requires very careful attention. If data going into the system is correct, then the processing and output will magnify these errors. Thus, the designer has a number of clear objectives in the different stages of input design

To produce a cost-effective method of input.

To achieve the highest possible level of accuracy.

To ensure that input is acceptable to and understand by the user.

Inaccurate input data is most common cause of data processing errors. If poor input design-particularly where operators must enter data from source

documents-permits bad data to enter a computer system, the outputs produced are of little value. The input design process was initiated in the study phase were, as a part of the feasibility study:

1. Input data were found to be available for establishing and maintaining master and transaction files and for creating output records
2. The most suitable types of input media, for either off-line or on-line devices were selected after a study of alternative data capture techniques

The data is fed into the system using simple inactive forms. The forms have been supplied with messages so that the user can enter data without facing any difficulty. This data is validated wherever it requires in the project. This ensures that only the correct data have been incorporated into system. The goal of designing input data is to make the automation as easy and free from errors as possible. For providing a good input design for the application easy data input and selection features are adopted. The input design requirements such as user friendliness, consistent format and interactive dialogue for giving the right messages for the user at the right time are also considered for development for this project.

3.3 OUTPUT DESIGN

Computer output is the most important and direct source of information to the user. Efficient and intelligent output design improves the system's relationship and helps user decision-making.

In the output design it is determine how the implementation is to be played for immediate need and also the hardcopy output. A major form of input is a hardcopy from the printer. Print- outs should be designed around the output requirement of the user. Printers, CRT screen display are the examples for providing computer-based output. The output design associated with the system includes the various reports of the table generations and query executions.

A quality output is one, which meets the requirements of end user and presents the information clearly. In any system result of processing are communicated to the user and to the other system through outputs. In the output design it is determined how the information is to be displayed for immediate need. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationships with the user and helps in decision-making. The objective of the output design is to convey the information of all the past activities, current status and to emphasis important events. The output generally refers to the results and information that is generated from the system. Outputs from computers are required primarily to communicate the results of processing to the users.

Output design is one of the, most important features of the information system. The logical design of an information system is analogous to an engineering blue print of an automobile. It shows the major features and how they are related to one another. The outputs, inputs and databases are designed are in this phase. At the beginning of the output design various types of outputs such as external, internal, operational, and interactive and turnaround are defined. Then the format, content, location, frequency, volume and sequence of the outputs are specified. The content of the output must be defined in detail. The system analysis has two specific objectives at this stage.

To interpret and communicate the results of the computer part of a system to the users in a form, which they can understand, and which meets their requirements

To communicate the output design specifications to programmers in a way in which it is unambiguous, comprehensive and capable of being translated into a programming language.

3.3 DATABASE DESIGN

Database Design is a collection of processes. The main aim of database designing is to produce logical and physical design models for the suggested database system. The logical model focuses on the data

requirements and the data to be stored independent of physical components.

The physical data design model translates the logical design of the database onto physical media using hardware resources and software systems.

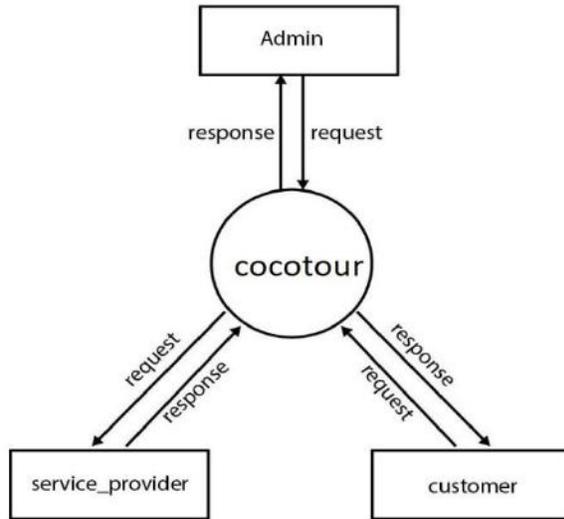
3.4 DATA FLOW DIAGRAM

A data flow diagram (DFD) is a graphical representation of the flow of data through an information system. A DFD is often used as a primary step to create an overview of the system, which can later be elaborated.

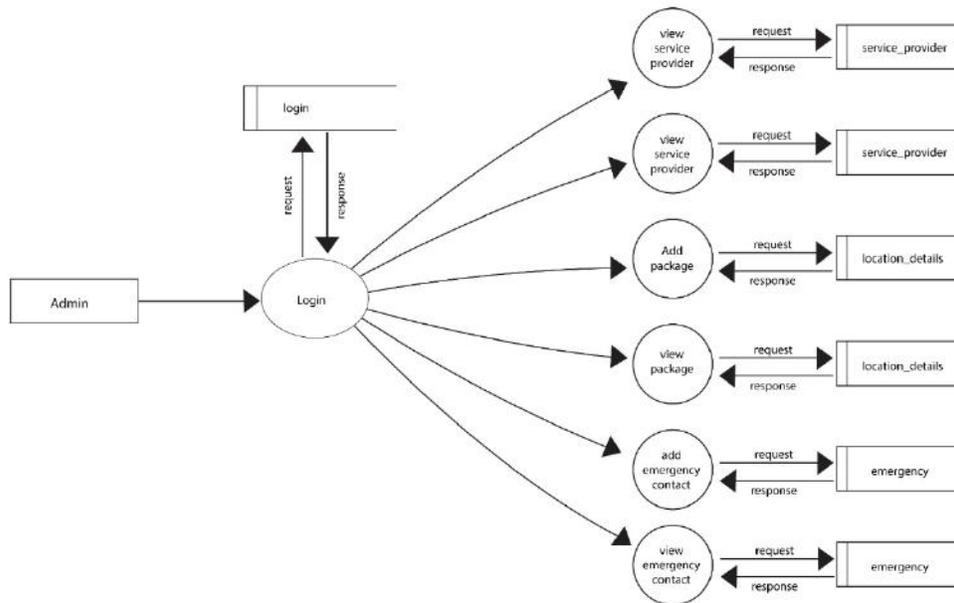
A DFD shows what will be the input of the system as well as the output. It clearly represents where the data will come from and go to, and where the data will be stored. DFD does not have control flow and no loops or decision rules are present. Specific operations depending on the type of data can be explained by a flowchart. Data Flow Diagram can be represented in several ways. Data Flow diagrams are very popular because they help us to visualize the major steps and data involved in software-system processes.

4. DATAFLOW DIAGRAMS

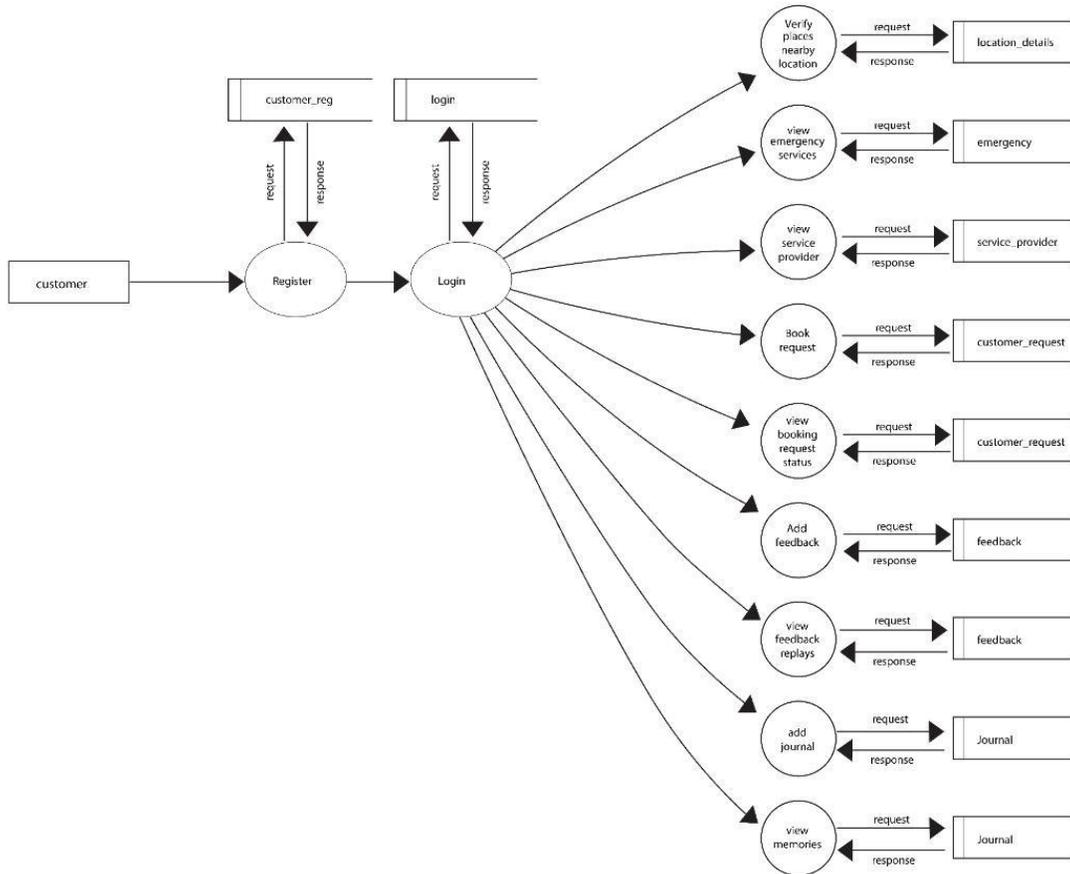
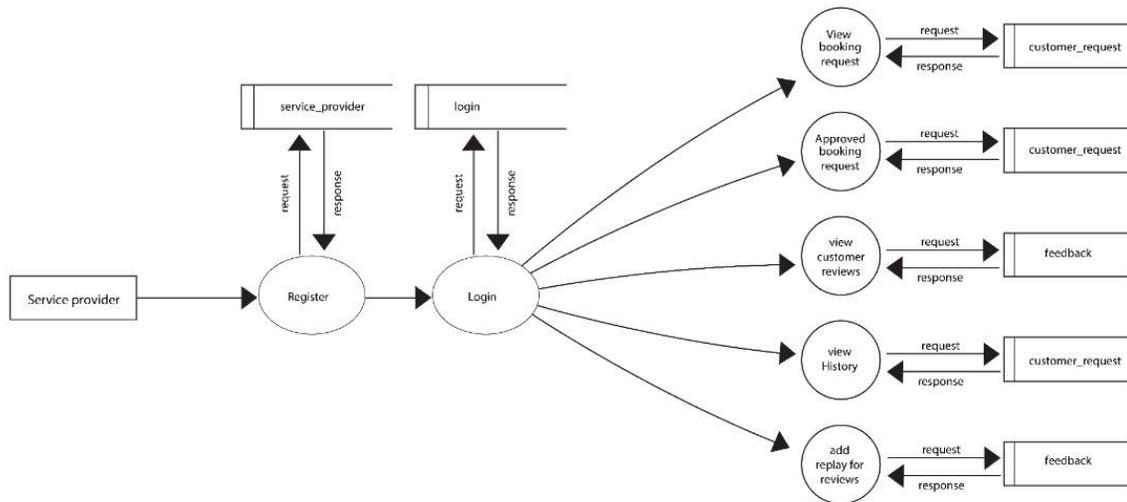
LEVEL 0



LEVEL 1:



COCOTOUR -Travel and Tourism Application



4.1 TABLE DESIGN

Table: customer

Field	Type	Comment
chid	int (20) NOT NULL	PRIMARY KEY
name	varchar (100) NULL	
age	varchar (100) NULL	
gender	varchar (100) NULL	
address	varchar (100) NULL	
phone	varchar (100) NULL	
email	varchar (100) NULL	
autojoin	varchar (100) NULL	
status	varchar (100) NULL	

Table: customer request

Field	Type	Comment
curtsied	int (20) NOT NULL	PRIMARY KEY
chid	int (20) NULL	FORIEGN KEY CUSTOMER
said	varchar (200) NULL	FORIEGN KEY SERVICE PROVIDER
restatement	varchar (100) NULL	
status	varchar (100) NULL	

Table: emergency

Field	Type	Comment
Eid	int (20) NOT NULL	PRIMARY KEY
enamel	varchar (100) NULL	
contact	varchar (100) NULL	
eldest	varchar (1000) NULL	
elate	varchar (100) NULL	
along	varchar (100) NULL	
ectype	varchar (100) NULL	

Table: feedback

Field	Type	Comment
fid	int (11) NOT NULL	PRIMARY KEY
aid	int (20) NULL	FORIEGN KEY USER
said	varchar (20) NULL	FORIEGN KEY SERVICE PROVIDER
rating	varchar (100) NULL	
description	varchar (500) NULL	
response	varchar (500) NULL	
doff	varchar (100) NULL	
door	varchar (100) NULL	

Table: journal

Field	Type	Comment
jig	int (20) NOT NULL	PRIMARY KEY
urid	varchar (20) NULL	FORIEGN KEY USER
jades	varchar (500) NULL	
image	long blob NULL	

Table: location details

Field	Type	Comment
lid	int (11) NOT NULL	PRIMARY KEY
name	varchar (30) NULL	
description	varchar (500) NULL	
district	varchar (30) NULL	
place	varchar (500) NULL	
Cam restrict	varchar (10) NULL	
top things	varchar (500) NULL	
entry fee	varchar (20) NULL	
contact	varchar (30) NULL	
latitude	varchar (30) NULL	
longitude	varchar (30) NULL	
in	varchar (30) NULL	
out	varchar (30) NULL	
agname	varchar (200) NULL	
image	long blob NULL	

holiday	varchar (30) NULL	
----------------	-------------------	--

Table: login

Field	Type	Comment
lid	int (20) NOT NULL	PRIMARY KEY
rigid	varchar (100) NULL	FORIEGN KEY
email	varchar (100) NULL	
password	varchar (100) NULL	
type	varchar (100) NULL	
status	varchar (100) NULL	

Table: service provider

Field	Type	Comment
said	int (100) NOT NULL	PRIMARY KEY
snake	varchar (100) NULL	
sage	varchar (100) NULL	
siphoned	varchar (100) NULL	
address	varchar (100) NULL	
email	varchar (100) NULL	
status	varchar (100) NULL	
work status	varchar (100) NULL	

5. SYSTEM DEVELOPMENT

5.1 MODULE DESCRIPTION

MODULES

Functional requirements

Travel advocate

Local culture

Feedback portal

Travel package

Emergency contact

Travel journal (user profile)

Admin

Verify requests from service providers

Create travel packages

Post videos and photos, related travel information's

Provide emergency contact list

Service Providers

Contact users upon request

Accept user request

Show availability

Register as service provider

Users

Registration and login

Connect to service providers

Upload photos and videos in their journal

6. SYSTEM IMPLEMENTATION

6.1 INTRODUCTION

Software testing is defined as a process to check whether the actual results match the expected results and to ensure that the software system is error free. Software testing also helps to identify defects, gaps or missing requirements in contrary to the actual requirements. It can be done manually or using automated tools.

6.2 IMPLEMENTATION

Implementation is the action that must follow any preliminary thinking in order for something to actually happen. Software/hardware implementations should always be designed with the end user in mind and the implementation process usually benefits from user involvement and support from managers and other top executives in the company. If users participate in the design and implementation of the system, ideally it will serve their business objectives more accurately and reflect their priorities and the ways in which they prefer to work.

6.3 DEBUGGING

Debugging is the process of finding and resolving defects or problems within a system that prevent the proper functioning of the system.

Different types of debugging methods used in this system are:

- *Unit Testing*

The application was divided into smaller components and tested individually. Each code was executed separately to ensure accuracy.

- *Integration Testing*

Each small component was integrated or combined into a module to ensure that each module works properly when put together. This was done to check connectivity between modules.

- *System Testing*

The system as a whole was tested by combining every module. This was to ensure that each process has a particular order. This was to ensure that the system does not crash while using.

□ *Validation Testing*

In the registration fragment, validation is carried out to ensure user enters values in all the fields and the fields like full name, contact number, email and monthly income are validated individually. In the login fragment, incorrect inputs like username incorrect and password incorrect if used for login, then it was ensured that the appropriate error message was displayed. In the health data fragment, validation is carried out in fields like height, weight, hip, waist measurements, blood pressure, total cholesterol, HDL cholesterol, blood sugar, serum triglyceride individually. In activity tracker fragment, validation is carried out to ensure user enters values in the water intake field, energy spent field, diet field.

6.4 SYSTEM SECURITY

Password encryption is used to protect each user's details.

6.5 SCOPE FOR FUTURE ENHANCEMENT

The current system is flexible and can be modified in the future

SYSTEM IMPLEMENTATION

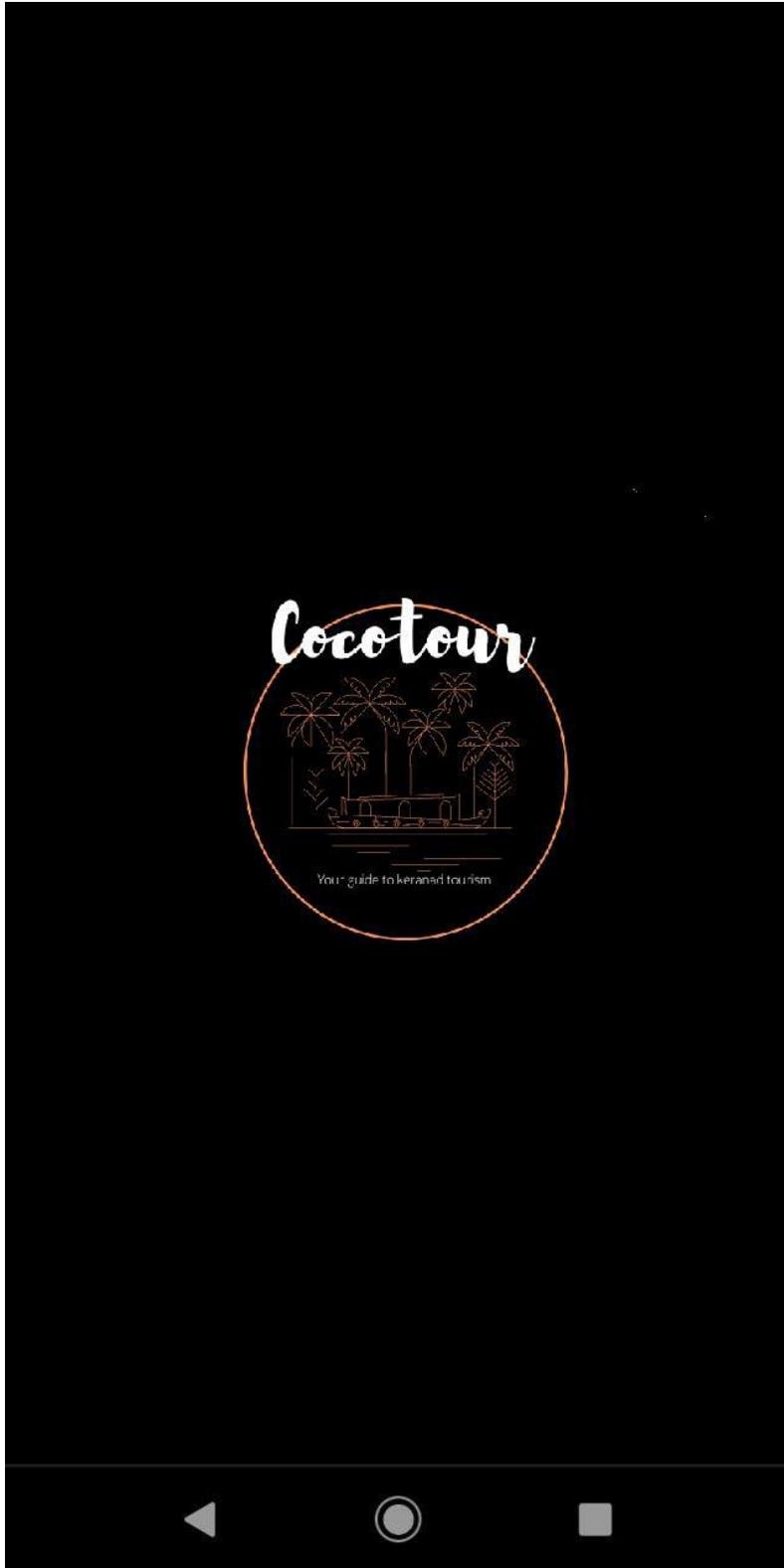
The implementation phase of the software development is concerned with translating design specification into source code. The user tests the developed system and changes are made according to their needs. Our system has been successfully implemented. Before implementation several tests have been conducted to ensure that no errors are encountered during the operation. The implementation phase ends with an evaluation of the system after placing into the operation for a period of time.

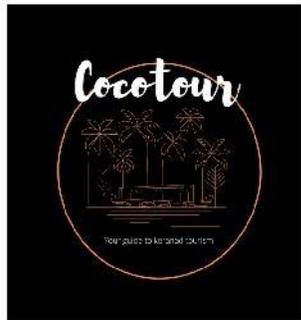
The process of putting the developed system in actual use is called system implementation. This includes all those activities that take place to convert from old system to new system. The system can be implemented only after testing is done and is found to be working to specifications. The implementation stage is a systems project in its own right. The implementation stage involves following tasks:

- Careful planning.
- Investigation of system and constraints.
- Design of method to achieve change over.
- Evaluation of the changeover method.

7. APPENDICES

7.1 SAMPLE INPUT DESIGN OUTPUT DESIGN



A login form is displayed on a dark orange-to-brown gradient background. It contains two input fields: 'Email' and 'Password', each with a horizontal line below it. Below the fields is a white-outlined rectangular button with the text 'Login' centered inside.

Dont you have an account? Sign Up.



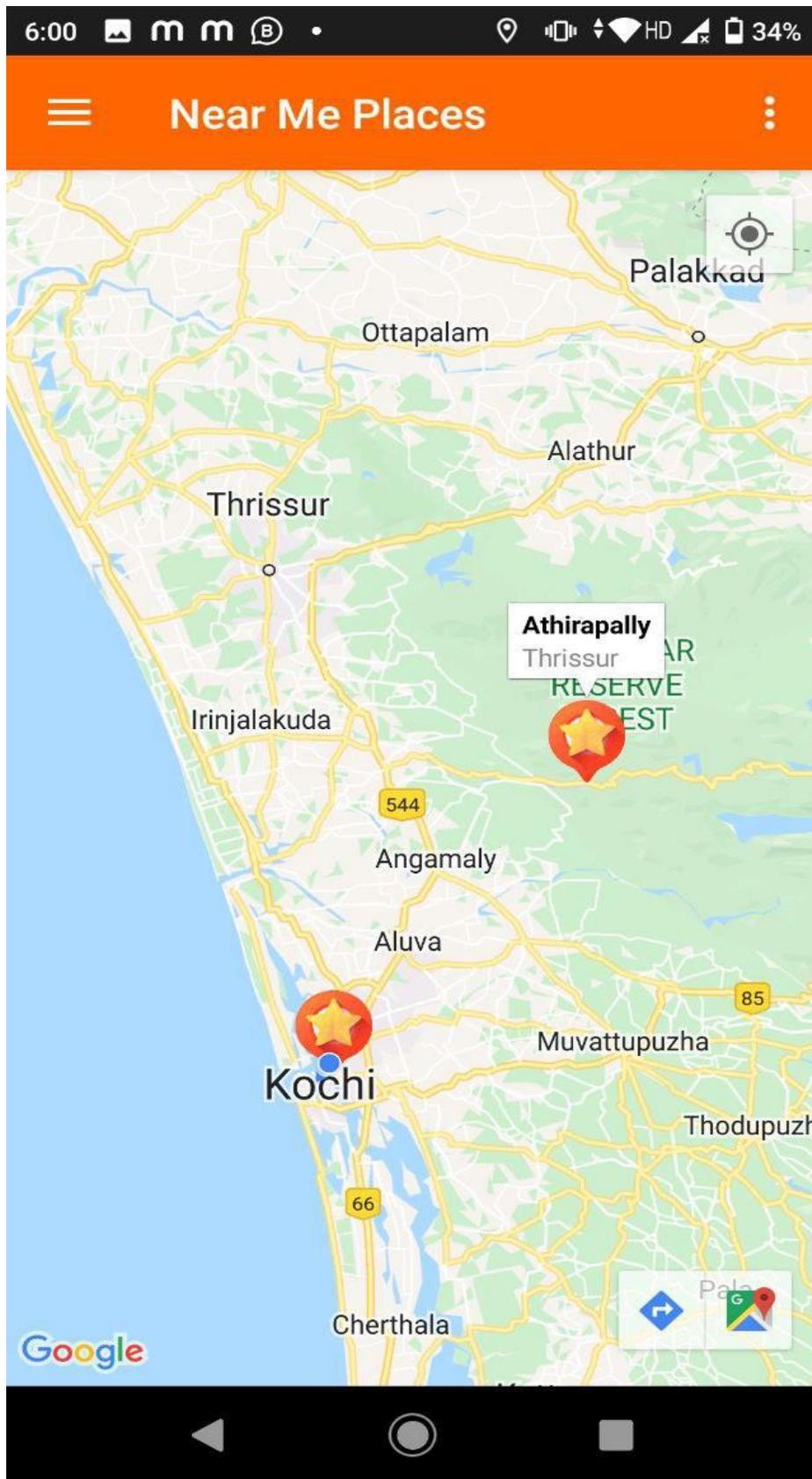


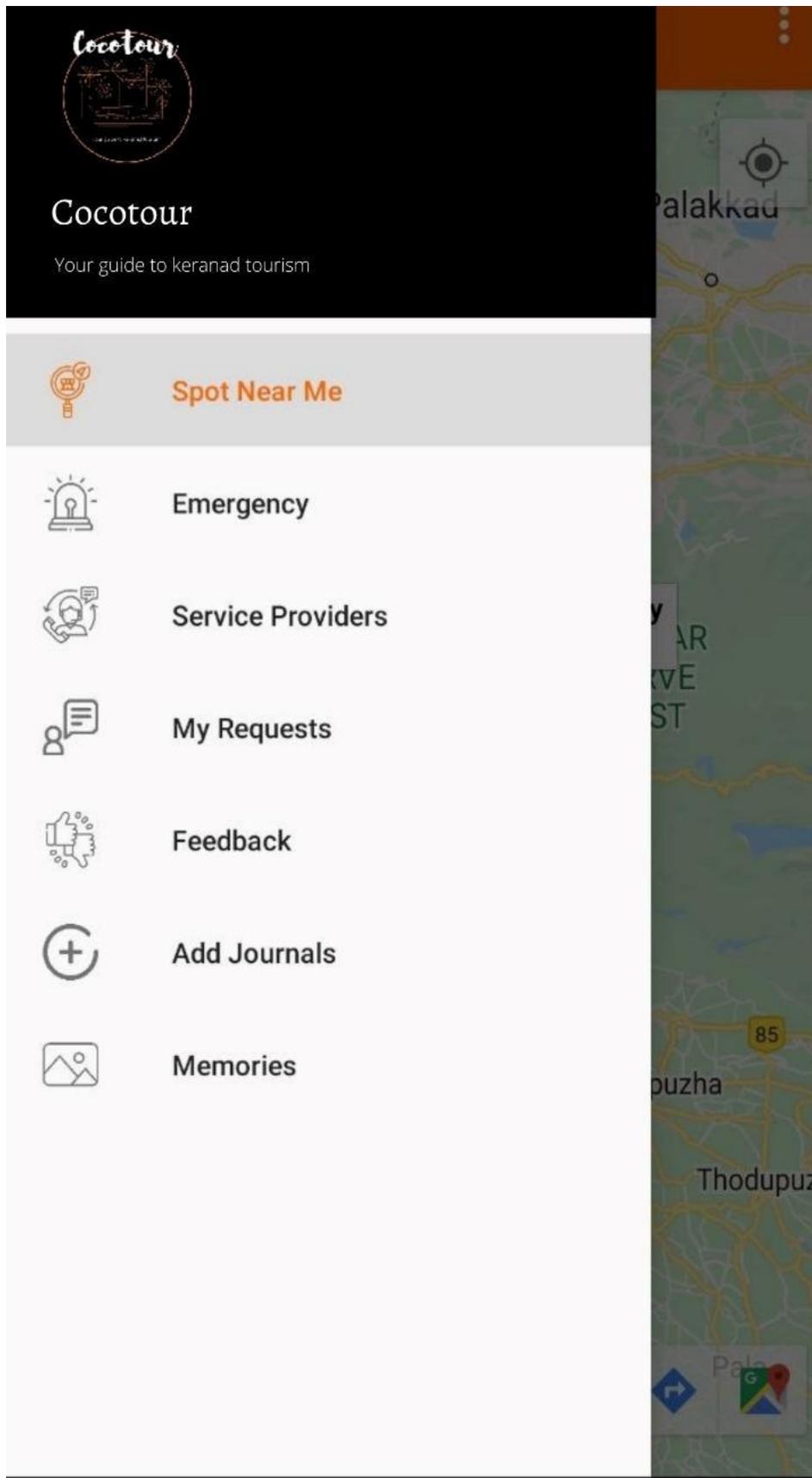
SERVICE PROVIDER

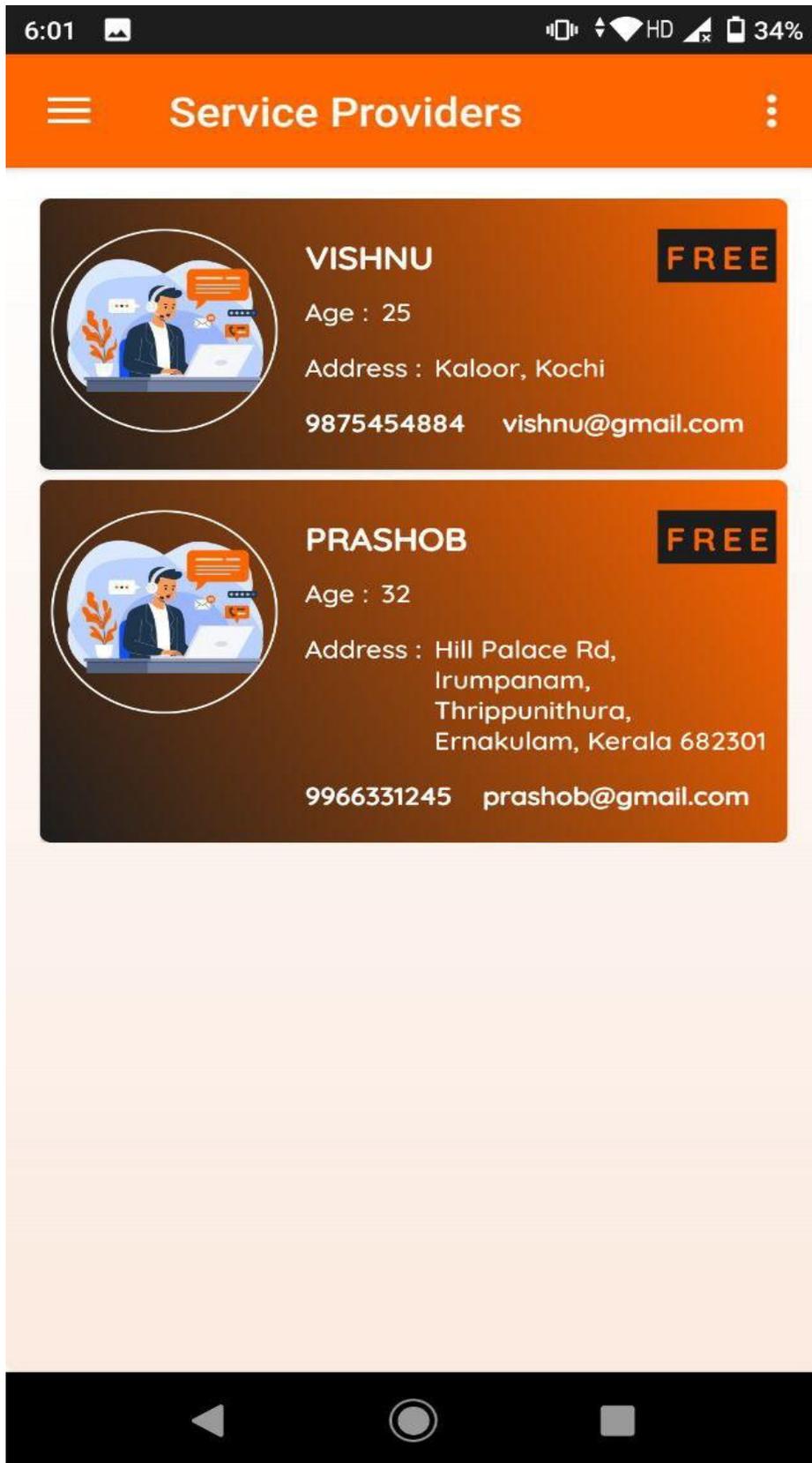


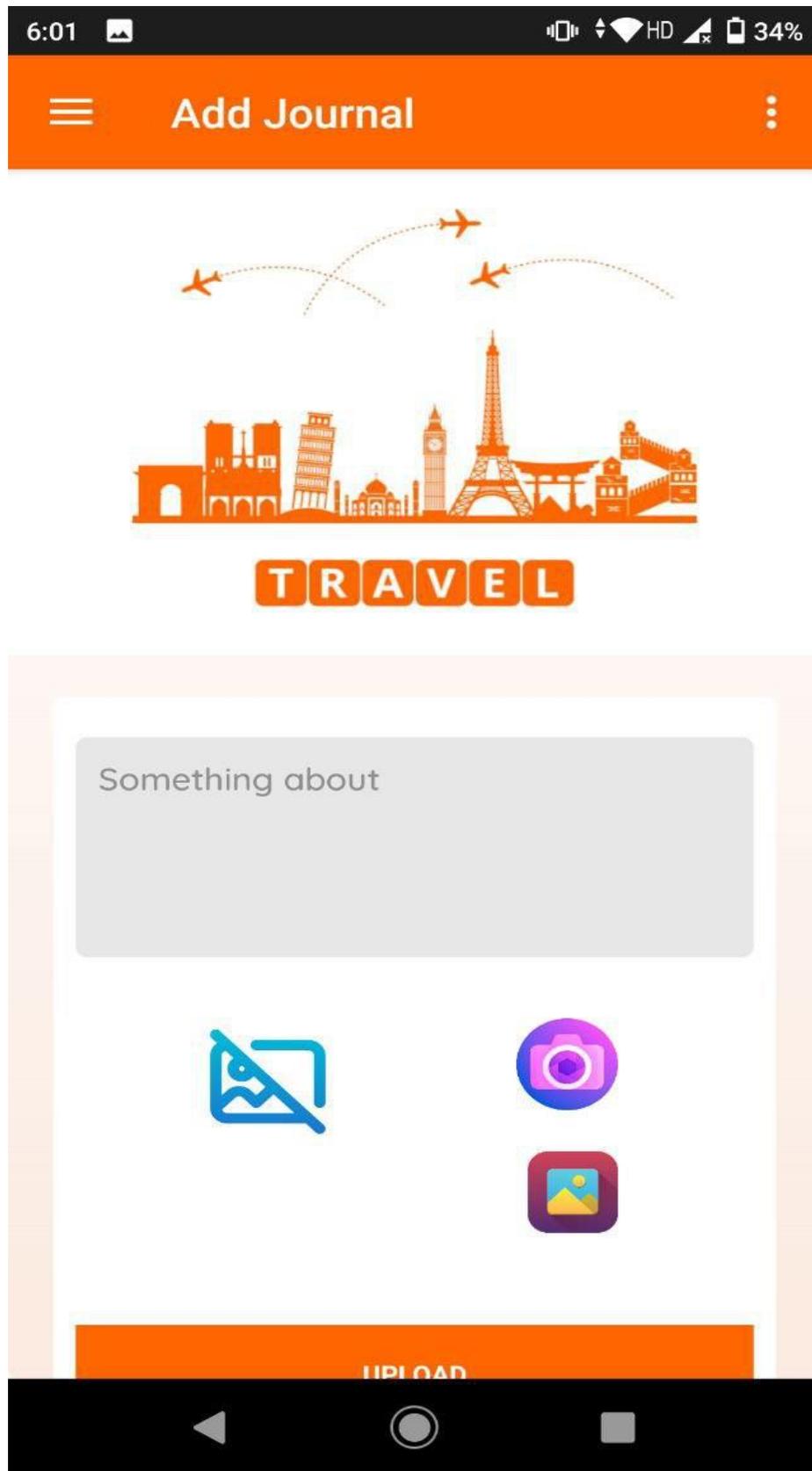
USER

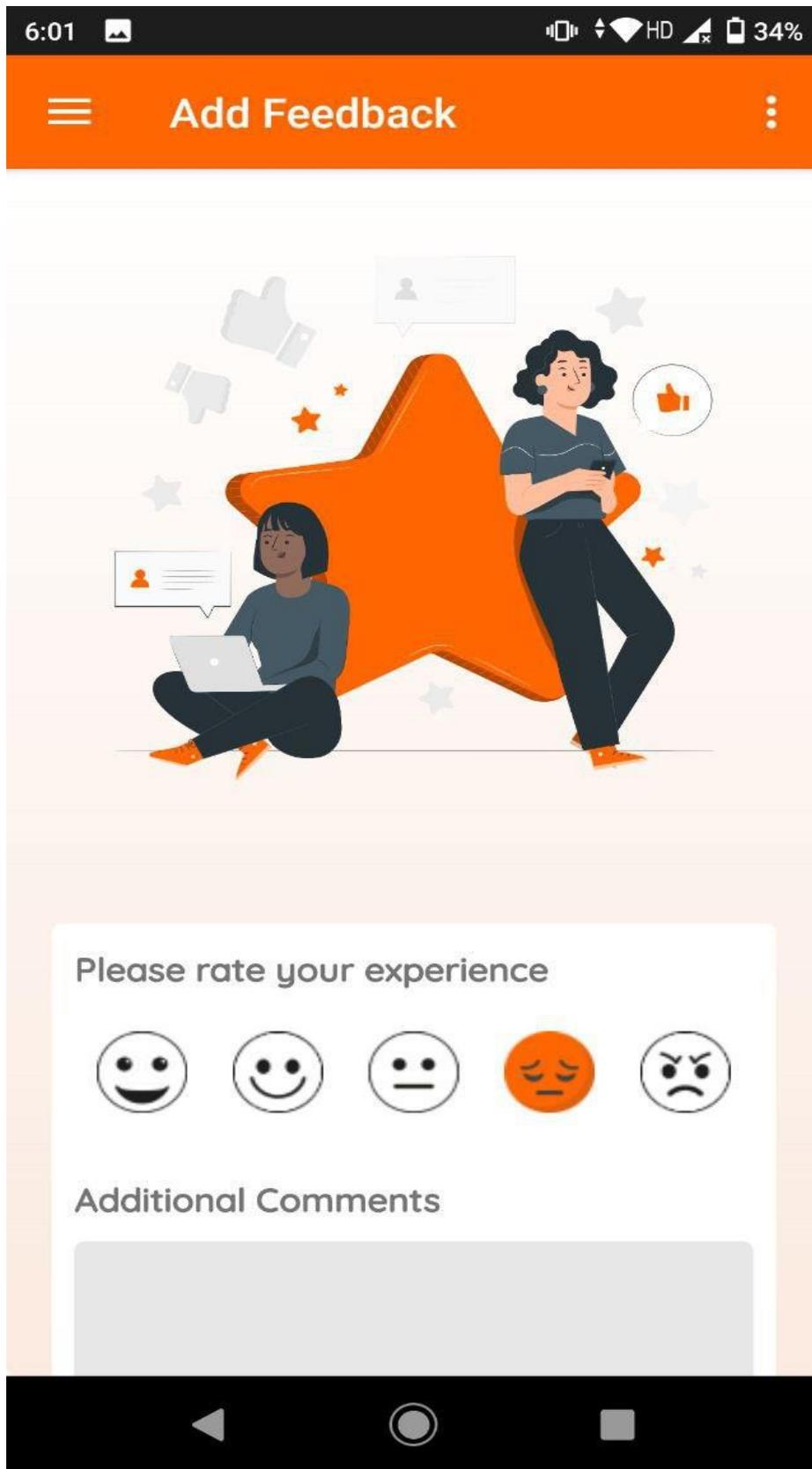


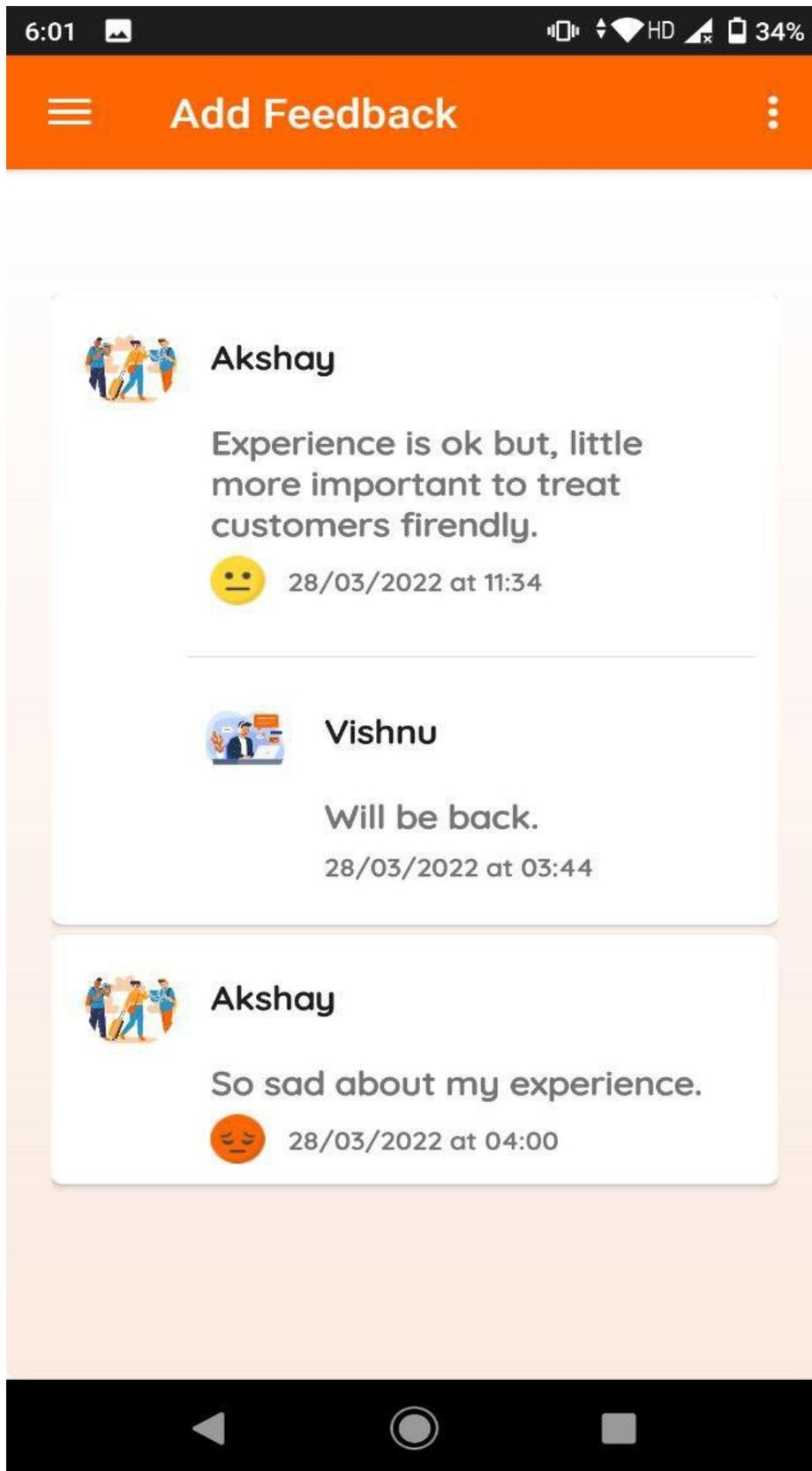


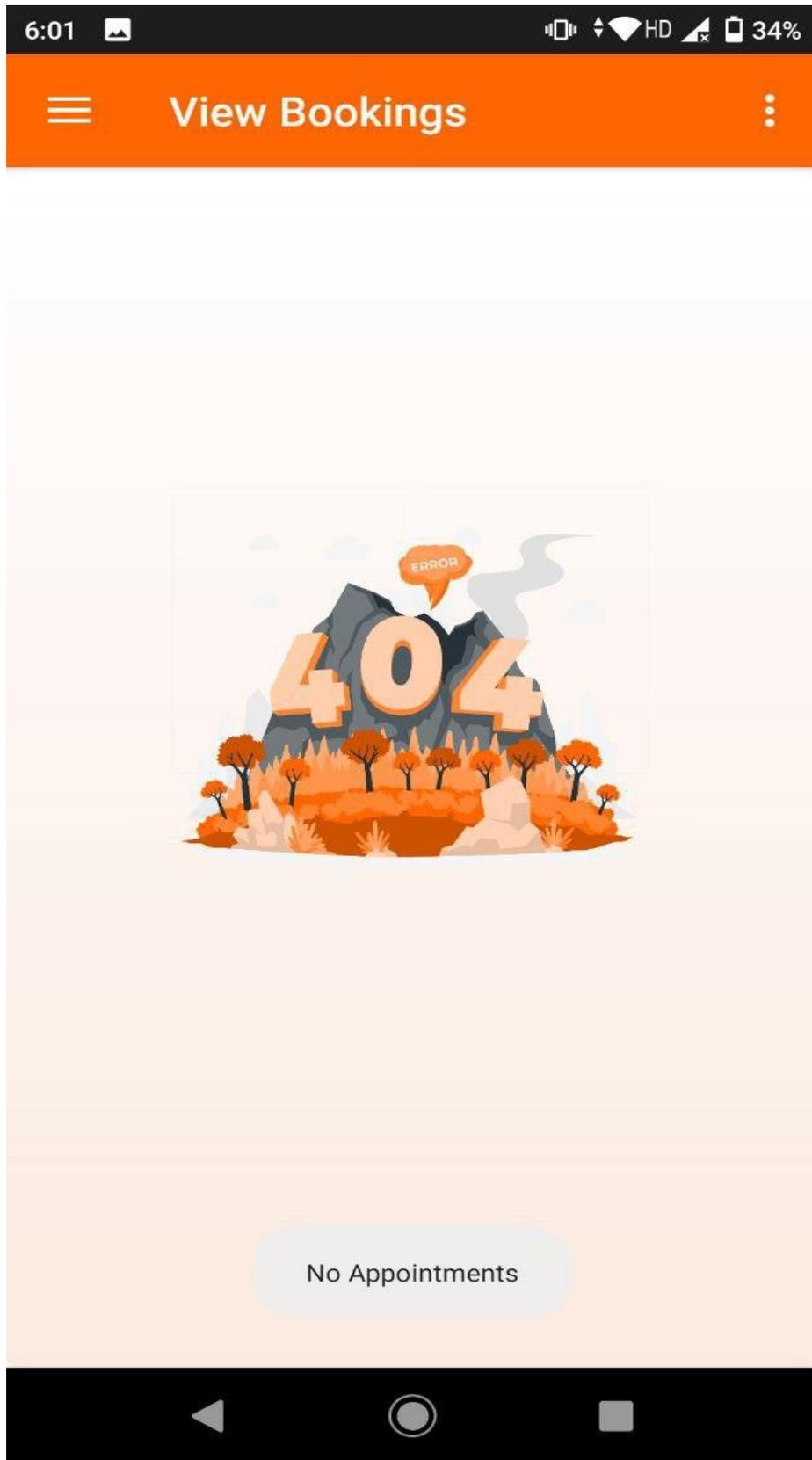


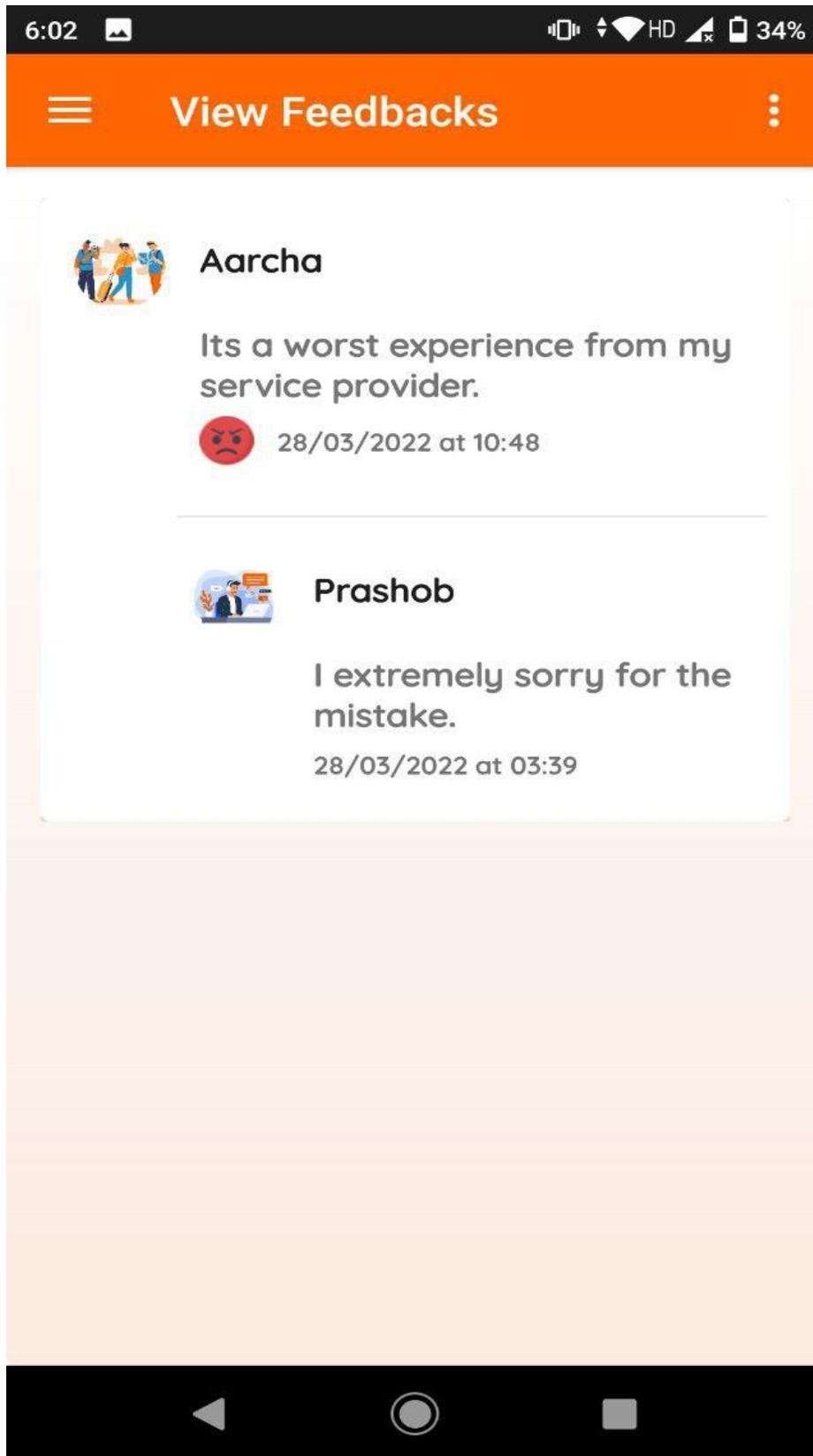


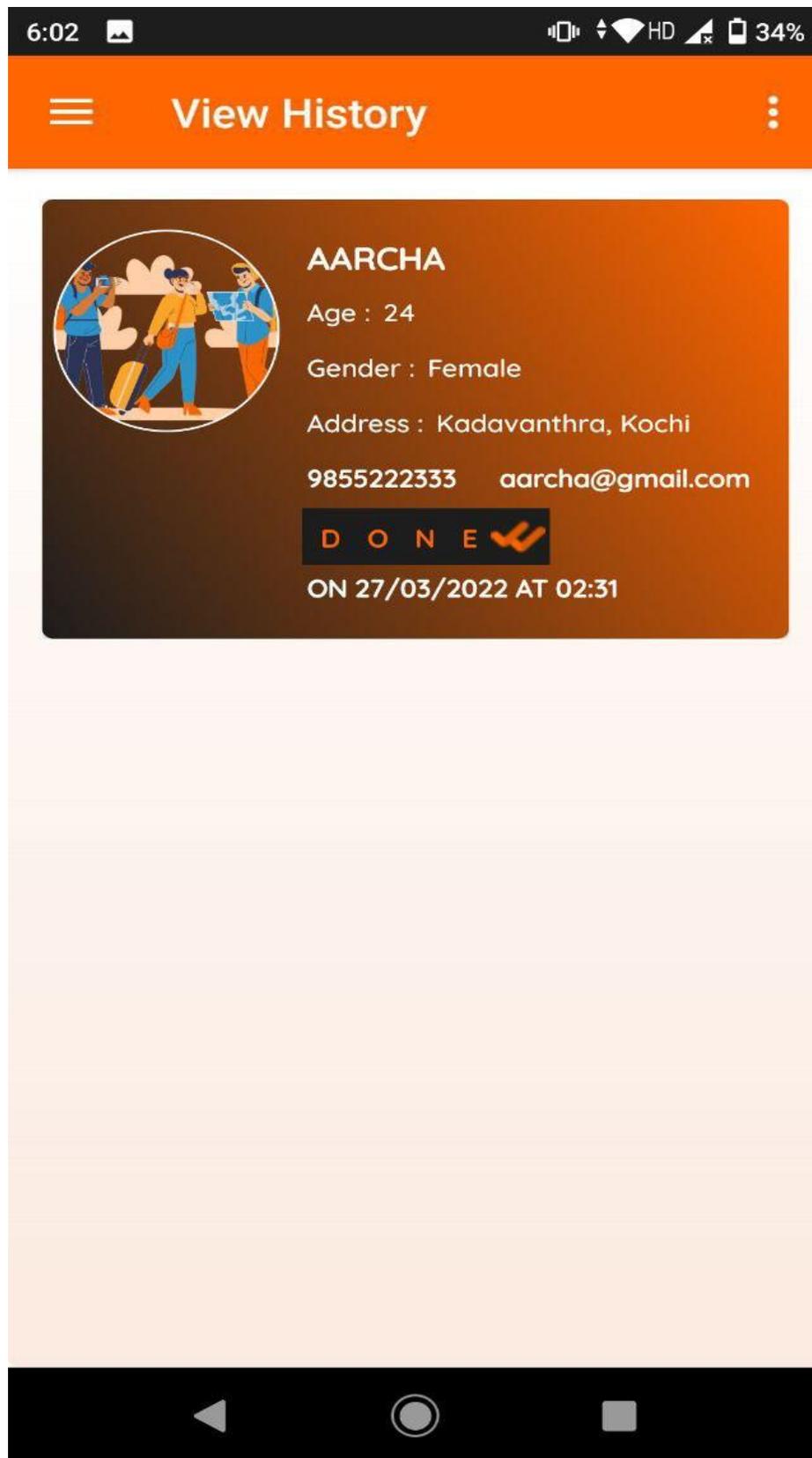


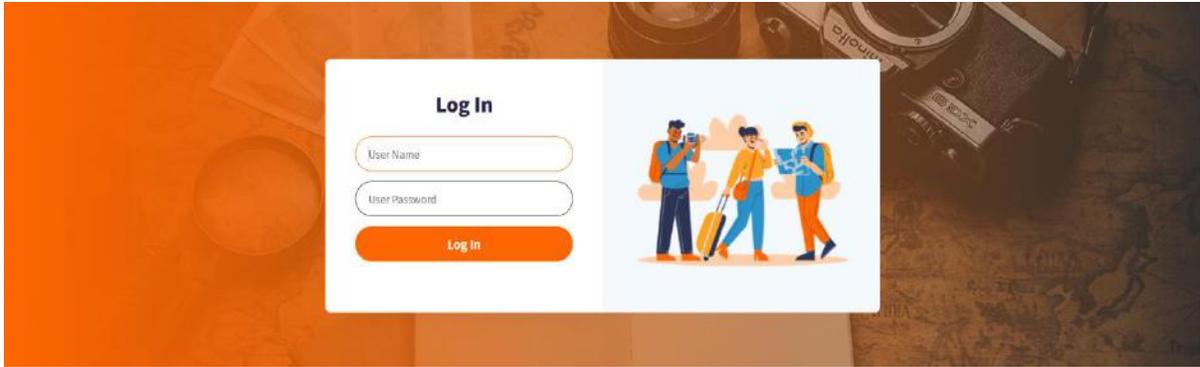








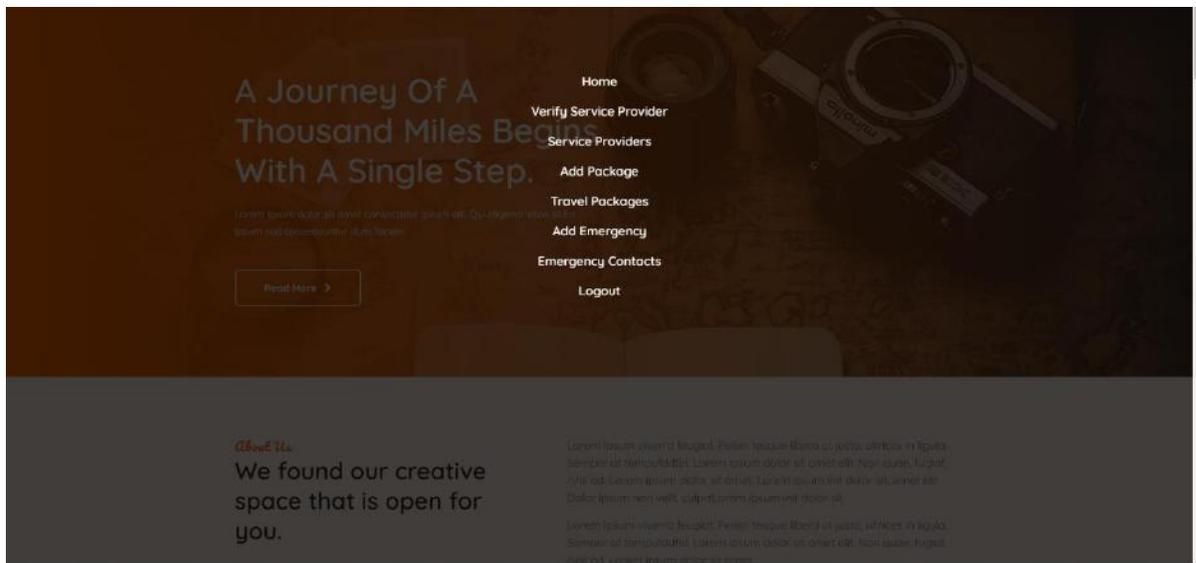




About Us
We found our creative space that is open for you.

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SOURCE CODE

```
package com.syntax.travelfuge;

import android.Manifest;

import android.app.AlertDialog;

import android.content.Context;

import android.content.DialogInterface;

import android.content.Intent;

import android.content.SharedPreferences;

import android.content.pm.PackageManager;

import android.graphics.Color;

import android.graphics.drawable.ColorDrawable;

import android.os.Build;

import android.os.Bundle;

import android.util.Log;

import android.view.View;

import android.widget.Button;

import android.widget.EditText;

import android.widget.TextView;

import android.widget.Toast;

import androidx.appcompat.app.ActionBar;

import androidx.appcompat.app.AppCompatActivity;

import androidx.core.app.ActivityCompat;
```

```
import com.android.volley.Request;
import com.android.volley.Response;
import com.android.volley.VolleyError;
import com.android.volley.toolbox.StringRequest;
import com.android.volley.toolbox.Volley;
import com.syntax.travelfuge.SERVICE_PROVIDER.ServiceProvider;
import com.syntax.travelfuge.USER.User;

import java.util.HashMap;
import java.util.Map;

public class LoginActivity extends AppCompatActivity {
    EditText username, password;
    Button btnlog;
    TextView reg;
    String UNAME, PASS;
    AlertDialog.Builder builder;

    @Override
    protected void onCreate(Bundle savedInstanceState) {

        // requestWindowFeature(Window.FEATURE_NO_TITLE);
        // getWindow().setFlags(WindowManager.LayoutParams.FLAG_FULLSCREEN,
        //     WindowManager.LayoutParams.FLAG_FULLSCREEN);
```

```
super.onCreate(savedInstanceState);  
setContentView(R.layout.activity_login);  
  
ActionBar actionBar = getSupportActionBar();  
actionBar.hide();  
  
int PERMISSION_ALL = 1;  
String[] PERMISSIONS = {  
Manifest.permission.WRITE_EXTERNAL_STORAGE,  
Manifest.permission.READ_EXTERNAL_STORAGE,  
Manifest.permission.ACCESS_FINE_LOCATION,  
Manifest.permission.ACCESS_COARSE_LOCATION,  
Manifest.permission.CAMERA,  
Manifest.permission.READ_SMS,  
Manifest.permission.SEND_SMS,  
Manifest.permission.READ_PHONE_STATE  
  
};  
  
if (!hasPermissions(this, PERMISSIONS)) {  
ActivityCompat.requestPermissions(this, PERMISSIONS, PERMISSION_ALL);  
}
```

```
builder = new AlertDialog.Builder(this);
```

```
username = (EditText) findViewById(R.id.input_Lemail);
```

```
password = (EditText) findViewById(R.id.input_Lpassword);
```

```
btnlog = (Button) findViewById(R.id.user_loginButton);
```

```
reg = (TextView) findViewById(R.id.Userlink_register);
```

```
reg.setOnClickListener(new View.OnClickListener() {
```

```
@Override
```

```
public void onClick(View v) {
```

```
startActivity(new Intent(getApplicationContext(), RegistrationActivity.class));
```

```
}
```

```
});
```

```
btnlog.setOnClickListener(new View.OnClickListener() {
```

```
@Override
```

```
public void onClick(View v) {
```

```
Validate();
```

```
}
```

```
});
```

```
}
```

```
@Override
```

```
public void onBackPressed() {
```

```

builder.setMessage("Do you want to close this application ?")
.setCancelable(false)
.setPositiveButton("Yes", new DialogInterface.OnClickListener() {
    public void onClick(DialogInterface dialog, int id) {
        finish();
    }
})
.setNegativeButton("No", new DialogInterface.OnClickListener() {
    public void onClick(DialogInterface dialog, int id) {
        // Action for 'NO' Button
        dialog.cancel();
    }
});
//Creating dialog box
final AlertDialog alert = builder.create();
//Setting the title manually
alert.setTitle("TravelFuge");
alert.setOnShowListener(new DialogInterface.OnShowListener() {
@Override
public void onShow(DialogInterface dialogInterface) {
alert.getButton(AlertDialog.BUTTON_NEGATIVE).setTextColor(Color.parseColor("#1d1d1d
"));
alert.getButton(AlertDialog.BUTTON_POSITIVE).setTextColor(Color.parseColor("#ff6600"))
;
alert.getButton(AlertDialog.BUTTON_NEUTRAL).setTextColor(Color.parseColor("#ff6600")
);

```

```
}  
});  
alert.show();  
  
alert.getWindow().setBackgroundDrawable(new ColorDrawable(Color.parseColor("#ffffff")));  
  
}  
  
private void Validate() {  
  
UNAME = username.getText().toString();  
PASS = password.getText().toString();  
  
if (UNAME.isEmpty()) {  
username.requestFocus();  
username.setError("enter your email ID");  
} else if (PASS.isEmpty()) {  
password.requestFocus();  
password.setError("enter password");  
} else {  
login();  
}  
}  
  
private void login() {
```

```
com.android.volley.RequestQueue queue = Volley.newRequestQueue(getApplicationContext());
```

```
StringRequest request = new StringRequest(Request.Method.POST, Utility.SERVERUrl, new  
Response.Listener<String>() {
```

```
@Override
```

```
public void onResponse(String response) {
```

```
Log.d("*****", response);
```

```
if (!response.trim().equals("failed")) {
```

```
String data = response;
```

```
String respArr[] = data.trim().split("#");
```

```
SharedPreferences.Editor editor = getSharedPreferences("SharedData",  
MODE_PRIVATE).edit();
```

```
editor.putString("u_id", "" + respArr[0]);
```

```
editor.putString("type", "" + respArr[1]);
```

```
editor.commit();
```

```
if (respArr[1].trim().equals("SERVICE_PROVIDER")) {
```

```
startActivity(new Intent(getApplicationContext(), ServiceProvider.class));
```

```
Toast.makeText(getApplicationContext(), "Login Successful",  
Toast.LENGTH_SHORT).show();
```

```
} else if (respArr[1].trim().equals("CUSTOMER")) {
```

```

        startActivity(new Intent(getApplicationContext(), User.class));

        Toast.makeText(getApplicationContext(), "Login Successful",
        Toast.LENGTH_SHORT).show();

        } else {

        Toast.makeText(LoginActivity.this, "Something Went Wrong",
        Toast.LENGTH_SHORT).show();

        }

    } else {

        Toast.makeText(getApplicationContext(), "Login Failed",
        Toast.LENGTH_SHORT).show();

    }

    }

}, new Response.ErrorListener() {

    @Override

    public void onErrorResponse(VolleyError error) {

        Toast.makeText(getApplicationContext(), "my Error :" + error,
        Toast.LENGTH_LONG).show();

        Log.i("My Error", "" + error);

    }

}) {

    @Override

    protected Map<String, String> getParams() {

        Map<String, String> map = new HashMap<String, String>();

```

```
//      SharedPreferences sp=getSharedPreferences("booking_info",
Context.MODE_PRIVATE);

map.put("key", "login");

map.put("U_name", UNAME);

map.put("P_swd", PASS);

return map;

}

};

queue.add(request);

}

public static boolean hasPermissions(Context context, String... permissions) {

if (android.os.Build.VERSION.SDK_INT >= Build.VERSION_CODES.M && context != null
&& permissions != null) {

for (String permission : permissions) {

if (ActivityCompat.checkSelfPermission(context, permission) !=
PackageManager.PERMISSION_GRANTED) {

return false;

}

}

}

return true;

}

}
```

8. CONCLUSION

The software developed has fulfilled the necessary requirements as required by the user. It is ensured that all the programs are working properly in the “COCOTOUR” application. The system is used to operate in a user-friendly manner. Proper documentation done from different areas provides smooth running of all the operations without difficulty. This project avoids errors, with the help of the application tourism in kerala can be conducted in a safe and independent manner.

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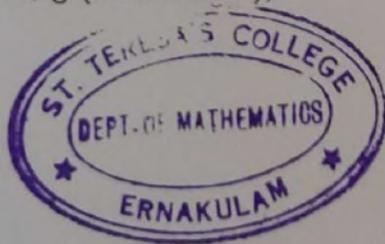
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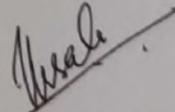
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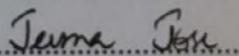
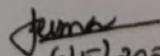
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2:

A STUDY ON THE SCHEMES AVAILABLE FOR WOMEN ENTREPRENEURS IN KERALA

Project Report

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Under the guidance of

Dr. Mary Sruthy Melbin

In partial fulfilment of requirements for award of the degree of

Bachelor of Commerce



**ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM
COLLEGE WITH POTENTIAL FOR EXCELLENCE**

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MAHATMA GANDHI UNIVERSITY

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March 2022

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CERTIFICATE

This is to certify that the project report titled '**A STUDY ON THE SCHEMES AVAILABLE FOR WOMEN ENTREPRENEURS IN KERALA**' submitted by **ALEENA SOHAN ANTONY, ALEENA T S, AMRUTHA G** towards partial fulfilment of the requirements for the award of degree of **Bachelor of Commerce** is a record of bonafide work carried out by them during the academic year 2021-22.

Supervising Guide

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Dept. of Commerce

Place: Ernakulam

Date:

DECLARATION

We, ALEENA SOHAN ANTONY, ALEENA TS, AMRUTHA G do hereby declare that this dissertation entitled, '**A STUDY ON THE SCHEMES AVAILABLE FOR WOMEN ENTREPRENEURS IN KERALA**' has been prepared by us under the guidance of **Dr. Mary Sruthy Melbin**, Assistant Professor, Department of Commerce, St Teresa's College, Ernakulam.

We also declare that this dissertation has not been submitted by us fully or partly for the award of any Degree, Diploma, Title or Recognition before.

Place: Ernakulam

ALEENA SOHAN ANTONY

Date:

ALEENA TS

AMRUTHA G

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We wish to acknowledge all those persons who helped us in completing our project on the topic, **‘A STUDY ON THE SCHEMES AVAILABLE FOR WOMEN ENTREPRENEURS IN KERALA’**

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ALEENA SOHAN ANTONY

ALEENA TS

AMRUTHA G

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

In Kerala, most women receive quality education and better opportunities to develop their potential in comparison to the national average. Yet, women's participation in entrepreneurial segment in Kerala is still subpar. The government of Kerala has introduced several schemes to encourage innovation and among women and bring them in entrepreneurial arena. But the percentage of women in entrepreneurial segment is still subpar. This is because, most of the women are unaware of the available opportunities and schemes available within the state.

1.2 STATEMENT OF PROBLEM

This project is on the topic of "SCHEMES AVAILABLE FOR WOMEN ENTREPRENEURS IN KERALA". This project is an evaluation about the knowledge and availability of these schemes among the women entrepreneurs in Kerala. That means the project is on the basis of the study of awareness of women about these government schemes and their participation in such schemes.

1.3 OBJECTIVES

- To study different schemes introduced by Kerala government for women entrepreneurs in Kerala.
- To analyse the participation of the women in these schemes provided by the government.
- To make a handbook with complete information about various schemes so that women entrepreneurs can participate in these schemes.

1.4 SCOPE OF THE STUDY

This project is conducted on the topic "Schemes available for women entrepreneurs in Kerala". This study is conducted among the women entrepreneurs in Kerala. The main scope of the project is to analyse the knowledge of the women entrepreneurs about the various government schemes established for them. The project also intended to check whether all the schemes are useful and helpful for all women irrespective of their category.

1.5 RESEARCH METHODOLOGY AND DATA COLLECTION

Research design

The study which is descriptive and analytical in nature is being made by analysing the data procured under Primary Data Collection and compiled from Secondary sources

Primary data

All primary data for the project was collected from the working class through an online questionnaire.

Secondary data

Secondary data is collected from various sources such as articles, journals, books, websites etc.

Tools of analysis

The statistical tool used for the purpose of the analysis of this study is percentage technique using pie charts and bar diagrams.

Sample size and sampling method

The sample size of 100 is taken for the study using convenient sampling method.

1.6 LIMITATIONS OF THE STUDY

- The study is only limited to women entrepreneurs.
- The present study is limited to the schemes introduced by Kerala government for women entrepreneurs, and not by Indian government.
- The study is time bound in relation to the existence of schemes.

1.7 SIGNIFICANCE OF STUDY

Empowering women to participate fully in the social and economic life across all sectors and at all levels is essential to build strong economies. There lies the significance of the role played by local governments, which are the real promoters of women empowerment at the grass root level. This study analyses how far the local governments have succeeded in helping women to empower socially, politically and

economically through selected schemes implemented by the Grama Panchayats of Kerala. The study provides close analysis on the plan and non-plan allocations and the expenditure of the Grama Panchayats on women component plans to find how these allocations help in improving the social and economic status of women.

1.8 KEYWORDS

Initiatives: An introductory step took the initiative in attempting to settle the issue, energy or aptitude displayed in initiation of action, enterprise showed great initiative or the right to initiate legislative action.

Schemes: A plan or program of action especially: a crafty or secret one, a systematic or organized configuration, design colour scheme or a statement or table, epitome.

Entrepreneurship: Entrepreneurship is the process by which individuals or a group of individuals (entrepreneurs) exploit a commercial opportunity, either by bringing a new product or process to the market, or by substantially improving an existing good, service, or method of production.

1.9 CHAPTER SCHEME

Chapter 1: Introduction: This chapter deals with a brief introduction of topic, significance, scope of study, problem statement, methodology and objectives of study. It also contains the limitations and the chapter scheme of the study.

Chapter 2: Review of literature: The second chapter includes review of literature. It includes some studies already done by researchers on related topics.

Chapter 3: Theoretical Framework: It shows the theoretical work related to study.

Chapter 4: Data Analysis and interpretation: It contains the analysis of data collected and its diagrammatic representations with the interpretations.

Chapter 5: Summary, findings, recommendations and conclusions: The fifth chapter deals with the results and findings of the data, suggestions and conclusions made on the basis of study.

CHAPTER 2
REVIEW OF LITERATURE

2.1 LITERATURE REVIEW

1. POONAM SINHA (Oct 15,2021)

TITLE: *THE RISE OF ENTREPRENEURSHIP AMONG RURAL WOMEN IN INDIA*

This article speaks about the efforts of rural women and girls around the world who are attempting to shape a more equitable future and recovery from the COVID-19 pandemic through their entrepreneurial ventures. It also mentions about various programs for rural women entrepreneurs. Some of them are Pradhan Mantri Swarozgar Yojana, Udyogini Scheme, Swarnjayanti Gram Swarozgar Yojana (SGSY) and Mahila Udyam Nidhi Scheme are a few of the programs which provide support in building the rural women entrepreneurship ecosystem. Top government schemes to promote women education in India like, Support and Training and Employment Programme for Women (STEP), Mahila Shakti Kendra, which empowers rural women by educating them about digital literacy, employment opportunities, skill development, health, and nutrition also play a pivotal role in inculcating the ‘entrepreneurial mind-set’ amongst the rural women of our nation. As a result of these various schemes and support from government, many inspirational women based in rural areas have overcome challenges and have carved a niche in the male-dominated sector of entrepreneurship.

2. VINISHA BOSE

TITLE: *WOMEN ENTREPRENEURSHIP IN KERALA: PROBLEMS AND PROSPECTS.*

This article is based on a probe carried out to understand the various problems faced by Women Entrepreneurs in Kerala. The study revealed that the Women entrepreneurs of Kerala experience multidimensional constraints. The governments at the center and the states have established a number of specialized institutions to cater to the needs of women entrepreneurs but they still face many problems. Women face a number of difficulties in establishing and maintaining business. Although most of these difficulties are common to both genders, in many cases they tend to be more significant for female entrepreneurs. The problems of industries whether in small, medium or large-scale sector, are almost similar but their nature and scope vary. The rate of growth in the number of sick units is much higher in

Kerala than the rest of the country. While many have closed down, others have fallen sick and are on the verge of closure. The study gives a number of constructive suggestions which will help set matters right and thereby accelerate the process of the creation and promotion of women entrepreneurs. Most of the Women do not see entrepreneurship as a career option. So, if the problems of the existing women entrepreneurs are being solved then it will be a motivating factor for the other women to choose this profession. Despite all the problems faced by them women entrepreneurship do exist. There is a need for motivating them through concerted and systematic efforts in the right direction. All such measures will facilitate women entrepreneurs to get into the mainstream of the socio-economic life in the country.

3. MANJULA R. IYER (July 2016)

TITLE: A STUDY ON PROBLEMS FACED BY WOMEN ENTREPRENEURS IN ERNAKULAM DISTRICT, KERALA

Women Entrepreneur is a person who accepts challenging role to meet her personal needs and become economically independent. The state of Kerala is the industrially developing area in which some of the entrepreneurs excel in small scale industry. Even though the government organizes women by various associations, they are not ready to undertake the business. As compared to men, women are less motivated to start business units due to some unwanted fear and lack of motivation. The principal aim of this article is to identify the major problems faced by women entrepreneurs in Ernakulam District, Kerala and also find the impact of these problems on the working efficiency of these women entrepreneurs. In order to achieve the aforesaid objectives data was gathered from primary sources i.e., from structured questionnaire and secondary data was collected from research papers, Journals etc. It was collected from 240 women entrepreneurs in Ernakulam district and simple statistical tools are used for data analysis. It is identified that the major problems faced by women entrepreneurs in the district are financial constraint, Inadequate Institutional support, Problems in Marketing, Social Attitude, Non-availability of good workers/employees etc. To overcome the above-mentioned limitations it is suggested that, the financial institutions should take steps to facilitate easy availability of credit to encourage the women entrepreneurs and

Government should also think over to solve the problems faced by women entrepreneurs.

4. Dr MOHD ASIF KHAN (May-oct, 2011)

TITLE: *KUDUMBASHREE: TOWARDS A NEW PARADIGM OF COMMUNITY REVITALISATION THROUGH WOMEN ENTREPRENEURSHIP IN KERALA*

Women entrepreneurs can play a vital role in fostering the development of the small business sectors, facilitate in the evolution of enterprises that can results in transition of economies. More recently, there is recognition that women entrepreneurship can have a positive impact on economic prosperity. The number of women in self-employment is increasing in most countries and they are identified as the key agents of sustainable growth and development. Women's equality needs to be the focal point for a more holistic approach towards destabilising new patterns and process of development that are sustainable in nature (Jha, 2009). Micro entrepreneurship along with the support of microfinance has become a modern economic weapon for the poor to fight against poverty and unemployment. Micro enterprises are of great importance for the economy give entrepreneurship's potential to support economic growth.

Kudumbashree, is a woman oriented, community based, State Poverty Eradication Mission (SPEM) of Government of Kerala. The mission aims at the empowerment of women, through forming Self Help Groups (SHGs) and encouraging their entrepreneurial and other wide range of activities. Kudumbashree (KDMS) is a project for poverty alleviation launched on 17 May 1998. The Kudumbashree project is expected to be a new convergence in the agenda of women empowerment and a role model for other states of India in their developmental activities to eradicate poverty. Kudumbashree has proved more popular and more enduring than any other poverty alleviation programme that targeted women. The achievements of Kudumbashree are indeed impressive, several researchers have by now noted that Kudumbashree women do display self-confidence and self-reliance and is a model of developmental activities adopted by many. Women empowerment through women entrepreneurship has generated substantial employment opportunities,

enhanced entrepreneurial traits of women and helped in income generation through sustainable livelihood for women.

5. POORVI GUPTA (AUGUST 1, 2019)

TITLE: *KERALA WOMEN ENTREPRENEURS: GET A JUMP START WITH STATE INITIATIVES.*

The main motivation for women to start their business these days are the state-led initiatives and central government policies which are paving the way for women in this direction. Among the many Indian states that are becoming start-up hubs and bringing up policies to favour a positive change in the number of women entrepreneurs, is Kerala. The state government's Kerala Start-up Mission (KSUM) is leading entrepreneurship through its innovation hub—a focussed space acting as an incubator, accelerator, and whatnot in an extremely gender-responsive manner. It recently framed policies like pre-incubation support, mentorship, a cost-free exhibit of products in national and international events, promotion of women-led start-ups at national and international business meets, marketing and seed-funding support, etc. exclusively for women. The state government's initiative mandates that women entrepreneurs can avail national and international business meets travel tickets for one founder up to four times in the start-up lifecycle. It also aims to establish two cohorts of 10 start-ups exclusively for women.

6. SABRINA KORRECK (25 September 2019)

TITLE: *WOMEN ENTREPRENEURS IN INDIA: WHAT IS HOLDING THEM BACK?*

An increasing number of start-ups and new businesses have been founded in India over the last decade, the majority of them by men. While many Indian women have entrepreneurial ambitions, it is often more difficult for them to succeed. This brief examines the impediments to greater participation of female founders in India's economy by first gathering available data to describe the situation of women entrepreneurs in the country. It then explores the causes of low female entrepreneurship rates, primary of which are unconscious biases, low confidence in business skills, difficult access to finance and networks, a lack of family support and child-care options, as well as insufficient safety in work and public spaces. This journal offers a set of recommendations that can help push

women's entrepreneurial empowerment. This article arrives at five sets of recommendations, which will help women seize entrepreneurial opportunities and increase their chances of success.

First, the low women entrepreneurship rates are part of a broader gender gap in economic participation and opportunity. Thus, it is crucial to provide equal access to education and encourage women to use their acquired skills by joining the workforce. Policies aimed at including more women in senior and leadership positions are needed and will help women gain experience and knowledge, which in turn will enable them to start their own businesses. Second, awareness for unconscious biases and how they disadvantage women entrepreneurs needs to be raised. Sharing their success stories in social and traditional media provides inspiration and proof that business can be a woman's world, too, and therefore strengthen the confidence of younger female entrepreneurs. Third, women entrepreneurs in India need better access to finance and networks. Organisations such as NITI Aayog's Women Entrepreneurship Platform, Catalyst for Women Entrepreneurship, and the accelerator for women in tech initiated by Zone Start-ups India, provide dedicated support for women entrepreneurs. They connect them with relevant people in their industry and foster networking among the women entrepreneurs themselves, so they can learn from each other's experiences. Fourth, more inclusive, non-discriminatory, and safe work environments are needed [42] to help retain qualified women, especially in the tech sector. Measures to improve the safety of public spaces are necessary, so women can commute between their homes and offices without the mental load of having to always worry about their security. Fifth, women entrepreneurs need more support from their families and social circles to pursue their entrepreneurial ambitions. Household and care duties should not be understood as women's sole responsibility. Furthermore, granting maternity benefits to women entrepreneurs, improving childcare, and cultivating social acceptance would help them combine their entrepreneurial pursuits and family responsibilities.

7. SNEHA MARIAM VARGHESE (2021)

TITLE: *A DESCRIPTIVE ANALYSIS ON OPPORTUNITIES AND CHALLENGES OF WOMEN ENTREPRENEURS IN KERALA*

Women entrepreneurship becomes a key factor of women development. Today's world women entrepreneurs are playing an important role and becomes main part of the global business environment and it is important for the sustained economic development and social progress. Entrepreneurship helps them to improve their living standards and helps in the development of country. The Government introduces many schemes for the promotion of women entrepreneurs. Women entrepreneurship has many opportunities but still facing many challenges. Entrepreneurs are the strength of the successful economy in the world. In the process of empowerment women should realize their strength, weakness, opportunities and move forward to achieve their goals through self-development. This paper tries to discuss about the opportunities and challenges facing by the women entrepreneurs in Kerala. 'Women entrepreneur' is a person who accepts challenging role to meet her personal needs and becomes economically independent. Women entrepreneurship is an important source of economic growth. Women entrepreneurs have gradually played an important role in the economic development and job creation. Women today are the proud owners of giant business chains which they are managing extremely well moving abreast will men and undoubtedly outshining them Most studies suggest that women in Kerala take initiative because they are Motivated to generate income. Researches also reveal that women face troubles mostly includes fund mobility and management, marketing and delay in getting payments. The main points discussed in this journal is the challenges faced by women Entrepreneurs in kerala, Women entrepreneurship development programs offered by government of Kerala, solution to various problems faced by the women entrepreneur group. Kerala state woman's Development Corporation, udyogini scheme, we mission, bhartiya mahila bank, Annapurna scheme etc add some off the developmental programs introduced by government, which are discussed in this journal.

8. SK DHAMEJA (2002)

TITLE: WOMEN ENTREPRENEURS: OPPORTUNITIES, PERFOAMANCE AND PROBLEMS

The emergence of women on the economic scene as entrepreneurs is a significant development in the emancipation of women and securing them a place in the society, which they have all along deserved. The hidden entrepreneurial potentials of women have gradually been changing with the

growing sensitivity to the role and economic status in the society. Women are increasingly becoming conscious of their existence, their rights and their work situations. Today, women entrepreneurs represent a group of women who have broken away from the beaten track and are exploring new avenues of economic participation. Among the reasons for women to run organised enterprises are their skill and knowledge, their talents and abilities in business and a compelling desire of wanting to do something positive. What makes their arrival as well as achievements even more significant and commendable are the struggles they have to put up, frustrations they have to experience and the multiple handicaps they have to overcome to emerge as entrepreneurs at the early stage and subsequently achieving success in business at the stage of managing their enterprises. Life for a woman entrepreneur having a small-scale industry it's not a bed of roses. This study was undertaken with a view to find out the entrepreneurial performance and problems of women in business in North western India.

9. VINISHA BOSE

TITLE: AN ANALYSIS OF WOMEN ENTREPRENEURSHIP DEVELOPMENT PROGRAMMES IN THE STATE OF KERALA

This study focuses on Entrepreneurship Development Programmes and its effects on developing entrepreneurship in India. Hundreds of EDPs are conducted by different organisations with the objective of giving entrepreneurial training to various participants. This study carefully analyses EDPs conducted by central and state governments and their success in achieving the desired result. Now a days many central and state governments are organizing EDPs for people. The author has got the opportunity to conduct Central and State Government EDP programmes and also has conducted more than ten programmes in the private sector for the people of Kerala. The paper is based on the field survey of 50 women entrepreneurs who had attended Entrepreneurship Development Training and also from the viewpoints of the author while conducting programmes. The paper also gives suggestions for improving the programmes and it goes into details about the existing supportive agencies in Kerala for development of entrepreneurship.

10. N KARUNAKARAN, SOJI M SEBASTIAN (Published 2020)

TITLE: MOTIVATIONAL FACTORS AND AWARENESS ON FINANCIAL AID TO WOMEN ENTREPRENEURS WITH SPECIAL REFERENCE TO KANNUR AND KASARAGOD DISTRICTS OF KERALA

Women constitute nearly 50 percent of world population. In traditional societies, they are confined to perform household activities and are generally called home makers. In modern society, they are taking part in all areas of life and seen in academic, teaching, politics, administration, software development, banking sector, hospitals and so on. Today, the entrepreneurial world is also open to women folk. It is estimated that women entrepreneurs comprise about 10 percent of the total entrepreneurs in India today. Government across the world and various development organizations are actively involved in the promotion of women entrepreneurs through various schemes, incentives and promotional measures. To understand the motivational factors influencing women to become entrepreneurs and various support systems to look at entrepreneurship is essential and is revealed that most of the women entrepreneurs lack proper awareness of such schemes.

CHAPTER 3
THEORETICAL FRAMEWORK AND PROFILE

3.1 INTRODUCTION

Women constitute around half of the total world population. They are therefore regarded as the better half of the society. In traditional societies, they were confined to the four walls of houses performing household activities. In modern societies they have come out of the four walls to participate in all sorts of activities. The global evidences prove that women have been performing exceedingly well in different spheres of activities like academics, politics, administration, social work and so on. Now they have started plunging into industry also and running their enterprises successfully. Although small businesses owned by women have traditionally focused on fashion, food and other services sector, but recently women entrepreneurs have been moving rapidly into manufacturing, construction and other industrial filed. Women owned business are lightly increasing in the economics of almost all countries. The hidden entrepreneurial potential of women has gradually been changing with the growing sensitivity to the role and economic status in the society. It means women have the potentials, skill, knowledge and adaptability to run a business successfully. Today, women have demonstrated their multitasking ability. Women entrepreneurs can certainly initiate, organize, plan and operate their small and medium venture efficiently. Although, there are certain challenges which is to be faced by a women entrepreneur. Defying social expectations, accessing funding, struggling to be taken seriously, owning your accomplishments, building a support network, Balancing business and family life, coping with fear of failure etc are some of these challenges. In order to help women overcoming these challenges, there are a number of schemes and policies offered by Government and other non-governmental initiatives.

3.2 WOMEN ENTREPRENEURSHIP

Women entrepreneur may be defined as a woman or group of women who initiate, organize, and run a business enterprise.

In terms of **Schumpeterian** concept of innovative entrepreneurs, women who innovate, imitate or adopt a business activity are called “women entrepreneurs”.

The Government of India has defined a women entrepreneurship as “an enterprise owned and controlled by a woman having a minimum financial interest of 51% of the

capital and giving at least 51% of the employment generated in the enterprise to women”.

Kerala Government defined women industrial units as units owned/ organized by women and engages in small scale and cottage industries with not less than 80% of the total workers as women.

3.3 FEATURES OF WOMEN ENTREPRENEURS

1. 1. **Sense of Responsibility:** Women Entrepreneur feel a deep sense of personal responsibilities for the outcomes of ventures they start.
2. 2. **Imagination:** Women entrepreneur have a good sense of imagination, fantasy and creativity. They always remain innovative and thinking for the new.
3. 3. **Persistence:** Women entrepreneur have strong desire to convert their dream into reality. They prefer to achieve self-determine goal.
4. 4. **High level of Optimism:** Women entrepreneur generally succeed in their venture due to their confidence in their ability and a high level of optimism.
5. 5. **Attribute to work hard:** Enterprising women have further ability to work hard. The imaginative ideas have to come to a fair play. Hard work is needed to build up an enterprise.
6. 6. **Flexibility:** Due to feminine nature, women entrepreneurs have their ability to adapt to the changing demands of their customers and their businesses.
7. 7. **Organizing Capacity:** Women are good managers. That is why women entrepreneurs know how to put the right people and resources together to accomplish a task or to achieve a goal.

3.4 ROLE OF WOMEN ENTREPRENEURS IN SOCIETY

i. Employment Generation:

It implies that women entrepreneurs not only establish their enterprise, but provide job to others. Women entrepreneurship is about women’s position in the society and their role as entrepreneurs in the same society. It can be understood in two ways, namely, at the individual level (number of self-employed) and at the firm level (number of firms owned by women and their economic impact). In this way, woman entrepreneurs have an important impact on the economy in terms of their ability to create jobs for themselves as well as for others.

ii. Economic Development:

It signifies that women entrepreneur contribute to the gross domestic product of the country by establishing enterprises and producing goods and services. Due to their entrepreneurial activity, women entrepreneurs bring dynamism in market. In this way, they also help in increasing the national income of the country.

iii. Better Utilization of Resources:

It implies that the involvement of women in industrial development ensure the effective utilization of all available resources (labor, raw materials, capital). The issue of women in the industrialization process has been emphasized only in the last decade when the 'Declaration of Mexico in July 1975', the equality of womanhood and their contribution to individual development became the center of attention.

iv. Improved Quality of Life:

It implies that women entrepreneurs are now economically independent and take decisions independently. They are now capable of upbringing their children according to their wish. They are providing quality education to their children and a better living standard to their family members. They not only improve their living standards, but also the living standards of others by providing them the means of earning.

3.5 CHALLENGES FACED BY WOMEN ENTREPRENEURS IN INDIA

Here are some challenges faced by women entrepreneurs in INDIA: -

1. **FINANCIAL PROBLEMS:** Finance is regarded as "life-blood" for any enterprise, be it big or small. However, women entrepreneurs suffer from shortage of finance on two counts. Firstly, women do not generally have property on their names to use them as collateral for obtaining funds from external sources. Thus, their access to the external sources of funds is limited. Secondly, the banks also consider women less credit-worthy and discourage women borrowers on the belief that they can at any time leave their business. Given such situation, women entrepreneurs are bound to rely on their own savings, if any and loans from friends and relatives who are expectedly meagre and negligible. Thus, women enterprises fail due to the shortage of finance.

2. SCARCITY OF RAW MATERIALS: Most of the women enterprises are plagued by the scarcity of raw material and necessary inputs. Added to this are the high prices of raw material, on the one hand, and getting raw material at the minimum of discount, on the other. The failure of many women co-operatives in 1971 engaged in basket-making is an example how the scarcity of raw material sounds the death-knell of enterprises run by women

3. STIFF COMPETITION: Women entrepreneurs do not have organizational set-up to pump in a lot of money for canvassing and advertisement. Thus, they have to face a stiff competition for marketing their products with both organized sector and their male counterparts. Such a competition ultimately results in the liquidation of women enterprises.

4. LIMITED MOBILITY: Unlike men, women mobility in India is highly limited due to various reasons. A single woman asking for room is still looked upon suspicion. Cumbersome exercise involved in starting an enterprise coupled with the officials humiliating attitude towards women compels them to give up idea of starting an enterprise.

5. FAMILY TIES: In India, it is mainly a women's duty to look after the children and other members of the family. Man plays a secondary role only. In case of married women, she has to strike a fine balance between her business and family. Her total involvement in family leaves little or no energy and time to devote for business. Support and approval of husbands seem necessary condition for women's entry into business. Accordingly, the educational level and family background of husbands positively influence women's entry into business activities.

6. LACK OF EDUCATION: In India, around three-fifths (60%) of women are still illiterate. Illiteracy is the root cause of socio-economic problems. Due to the lack of education and that too qualitative education, women are not aware of business, technology and market knowledge. Also, lack of education causes low achievement motivation among women. Thus, lack of education creates one type or other problems for women in the setting up and running of business enterprises.

7. MALE DOMINATED SOCIETY: Male chauvinism is still the order of the day in India. The Constitution of India speaks of equality between sexes. But, in practice, women are looked upon as abala, i.e., weak in all respects. Women suffer from male reservations about a women's role, ability and capacity and are treated accordingly. In

nutshell, in the male-dominated Indian society, women are not treated equal to men. This, in turn, serves as a barrier to women entry into business.

8. LOW RISK BEARING ABILITY: Women in India lead a protected life. They are less educated and economically not self-dependent. All these reduce their ability to bear risk involved in running an enterprise. Risk-bearing is an essential requisite of a successful entrepreneur.

3.6 SCHEMES OFFERED FOR WOMEM ENTREPRENEURS BY GOVERNMENT OF KERALA

Below are some schemes provided by the Kerala Government for aiding the women entrepreneurs in the State:

- Mahila Vikas Nidhi
- Mahila Udyam Nidhi
- Swarnima Scheme for women in backward classes
- Mahila Samridhi Yojana
- Entrepreneur Support Scheme (ESS)
- Assistance Scheme for Handicrafts Artisans (ASHA)
- Revival & Rehabilitation Scheme
- Interest Subvention Scheme
- State Sponsored Cluster Development Programme (SS-CDP)
- Laghu Vyavasaya Yojana (LVY)
- Micro Finance Scheme [Loan through NGOs]
- Micro Credit Finance Scheme (MCF)
- Kerala Self-Employment Scheme for the Registered Unemployed
- Self-Employment Scheme for the Destitute Women
- Own fund schemes of Kerala State Minorities Development Finance Corporation Ltd. (kSMDFC):
- Self-Employment Scheme for Minorities (KSMDFC Scheme)
- Business Expansion Loan (BEL)/ Business Development Loan (BDL) For Existing Entrepreneurs

PROFILE
VARIOUS GOVERNEMENT ORGANISATIONS
CONTRIBUTING TO ENTREPRENSHIP DEVELOPMENT IN
KERALA

1. District Industries Centre

The 'District Industries Centre' (DICs) programme was started by the central government in 1978 with the objective of providing a focal point for promoting small, tiny, cottage and village industries in a particular area and to make available to them all necessary services and facilities at one place. The District Industries Centre is the institution at the district level, which provides all the services and support facilities to the entrepreneur for setting up Micro, Small and Medium Enterprises. This included identification of suitable schemes, preparation of feasibility reports, arrangements for credit facilities, machinery and equipment, provision of raw materials and development of industrial clusters etc. This Centre caters to Promotion of MSMEs as also Registration and Development of Industrial Cooperatives.

2. Women Entrepreneurs Development Cell (WEDC)

The Ministry of Micro Small and Medium Enterprises (MSME) and all District Industries Centres have constituted a women entrepreneurs development cell as a part of empowering the women industrial sector. The ultimate objective of the setting up of this cell is to generate motivation and confidence in prospective and existing women entrepreneurs by providing all kinds of information, advice and assistance relating to designing of project, procurement of raw materials, technology, finance and marketing by involving governmental and nongovernmental organisation, financial institution and other development agencies.

3. Kerala state Women's Development Corporation (kSWdc)

KSWDC established production - cum - training centers with financial assistance under the NORAD scheme of the women and child development department of the Government of India. The aim of the programme is to

provide vocational training to socially and economically backward women in the state and thus enhance their employment opportunities. After training, as a second phase, the beneficiaries are grouped together to form cooperative societies to start production centers.

4. Prime Ministers Employment generation Programme (PMEgP)

The Government of India introduced a new credit linked subsidy programme called PMEGP from 2008-09 by merging the two schemes viz. PMRY and REGP, which were in operation till 31.3.2008. The Khadi and Village Industries Commission (KVIC) was approved as the nodal agency for implementation of the scheme at the national level whereas the state KVIC directorates, State Khadi and Village Industries Boards (KVIBs) and district industries centres (DICs) and banks will function at the state level. During 2008-09 in Kerala, a target of 708 units was allocated to district industries centres. The selected beneficiaries will have to undergo two weeks mandatory training before the disbursement of the loan.

5. Kerala Institute of entrepreneurship Development (KiED)

KIED is a premier institute promoted by Govt. of Kerala and Govt. of India for promotional development of entrepreneurial activities in the state. The mission of KIED is to develop the spirit of entrepreneurship among the people through entrepreneurial awareness campaign, seminars, workshops, research etc. leading to more and more self-employment their by developing the people of Kerala as an enterprising Society

VARIOUS GOVERNEMENT SCHEMES FOR WOMEN ENTREPRENEURS IN KERALA

1. Mahila Udyam Nidhi

Mahila Udyam Nidhi (MUN) Scheme is a scheme offered under the Small Industrial Development Bank of India (SIDBI) to encourage and empower women entrepreneurs and promote women Entrepreneurship by providing financial assistance at concessional interest rates. The funding provided by

Mahila Udyam Nidhi Scheme can be used by MSMEs to undertake service, manufacturing and production-related activities.

Under Mahila Udyam Nidhi Scheme, women entrepreneurs can avail loans up to Rs. 10 lakhs to start their own business or small-scale enterprise. The interest rates offered under this scheme may vary from bank to bank. The funding support can also be used to upgrade or expand existing projects. The maximum loan repayment period offered under this scheme is up to 10 years with the moratorium period up to 5 years.

2. The Swarnima Scheme

The Swarnima Scheme was introduced by the National Backward Classes Finance and Development Corporation (NBCFDC) for the welfare of Women. Under this scheme, term loan will be provided to women entrepreneur belonging to the target group (backward classes). The implementation of the scheme is performed by the State Channelising Agency (SCA) which act as the nodal agency.

3. Saranya

Saranya is the new self-Employment scheme introduced by the State Government for uplifting the most backward and segregated women in the State, namely widows, divorced, deserted, spinsters above the age of 30 and unwedded mothers of Scheduled Tribe, Differently abled and Wife of Bed Ridden patients.

4. KESRU

KESRU – Kerala Self Employment Scheme for the Registered Unemployed scheme provides for sanction of a bank loan of up to Rs. 1,00,000 for unemployed persons to start a business. The government provides the KESRU loan prior to the commencement of self-employment ventures of individuals. Out of the bank loan, a total of up to 20% reimburses as Government Subsidy via Employment Department. Hence, there is no requirement for contribution

from the beneficiary to avail loan under this scheme. The spouse or parents of the beneficiary would be the guarantor. They do not require the collateral.

5. Micro Credit Finance (MCF)

Under the Scheme loans are provided through State Channelizing Agencies (SCAs), Regional Rural Banks (RRBs) and Nationalized Banks to the target group. Loan under this scheme is provided to Safai Karamchari and Scavenger and their dependants for projects with a maximum cost upto Rs.1,00,000/- per beneficiaries for small and petty trade/business and sundry income generating activities. For a group of 10 Persons, Rs.10.00 lac is the maximum project cost limit, restricted to Rs.1,00,000/- per beneficiary.

6. Laghu Vyavasaya Yojana (LVY)

The beneficiary should be from the Scheduled Caste (SC) Community. Annual family income of the beneficiary(ies) should not exceed Double the Poverty Line (DPL) income limit (presently 98,000/- per annum for rural areas and ` 1,20,000/- per annum for urban areas).

7. Entrepreneur Support Scheme (ESS)

The ESS aims to merge and replace all the previous schemes titled the Entrepreneur Support Scheme 2012 to be operated in the State of Kerala. All MSMEs engaged in manufacturing activities are eligible for assistance. The scheme is operational w.e.f. 01.04.2012.

CHAPTER 4
DATA ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

This research is an attempt to study about the schemes available for the women entrepreneurs in Kerala.

It focuses on the following objectives:

- To study different schemes introduced by Kerala government for women entrepreneurs in Kerala.
- To analyze the participation of the women in these schemes provided by the government.
- To make a handbook with complete information about various schemes so that women entrepreneurs can participate in these schemes.
- To analyze the effectiveness of objectives, the following have been analyzed-

Demographic variables

- Age
- Gender
- Educational qualification
- Recognition

The information collected through questionnaire from a sample size of 100 people helped to reach the following analysis:

DEMOGRAPHIC VARIABLE

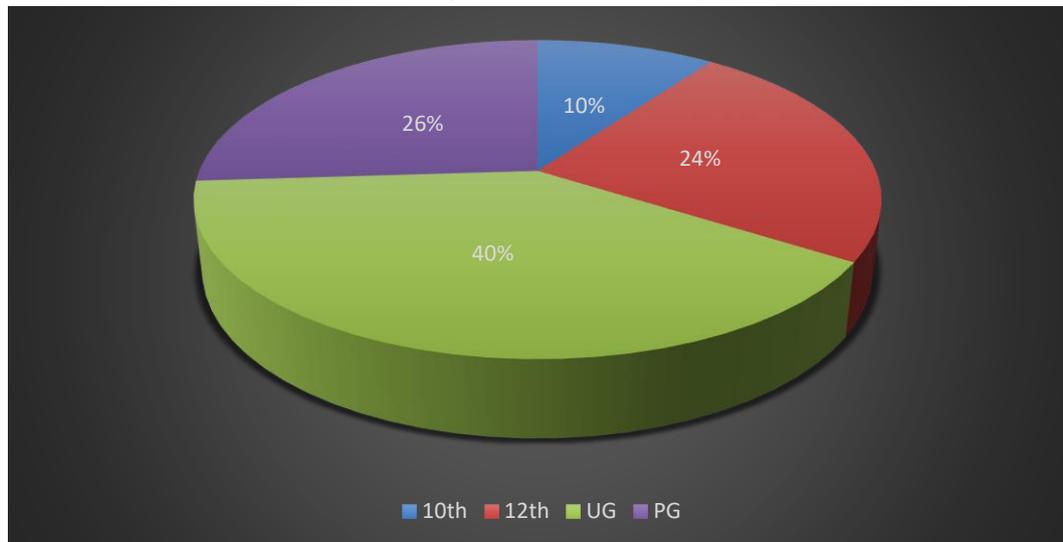
TABLE 4.1

EDUCATIONAL QUALIFICATION OF THE RESPONDENTS

SL. NO	EDUCATIONAL QUALIFICATION	NUMBER	PERCENTAGE (%)
1	10 th	10	10
2	12 th	24	24
3	Under-Graduation	40	40
4	Post-Graduation	26	26
	TOTAL	100	100

Source: Primary Data

FIGURE:4.1 EDUCATIONAL QUALIFICATION OF THE RESPONDENTS



Interpretation:

Above table 4.1 shows the respondents' educational qualification, which is categorized into 10th standard, 12th standard, under-graduation, and post-graduation. The outcomes of the survey include 10 respondents whose qualification is 10th standard, 24 respondents whose qualification is 12th standard, 40 respondents whose qualification is UG, and 26 respondents whose qualification is PG. The majority of respondents' qualification is under-graduation.

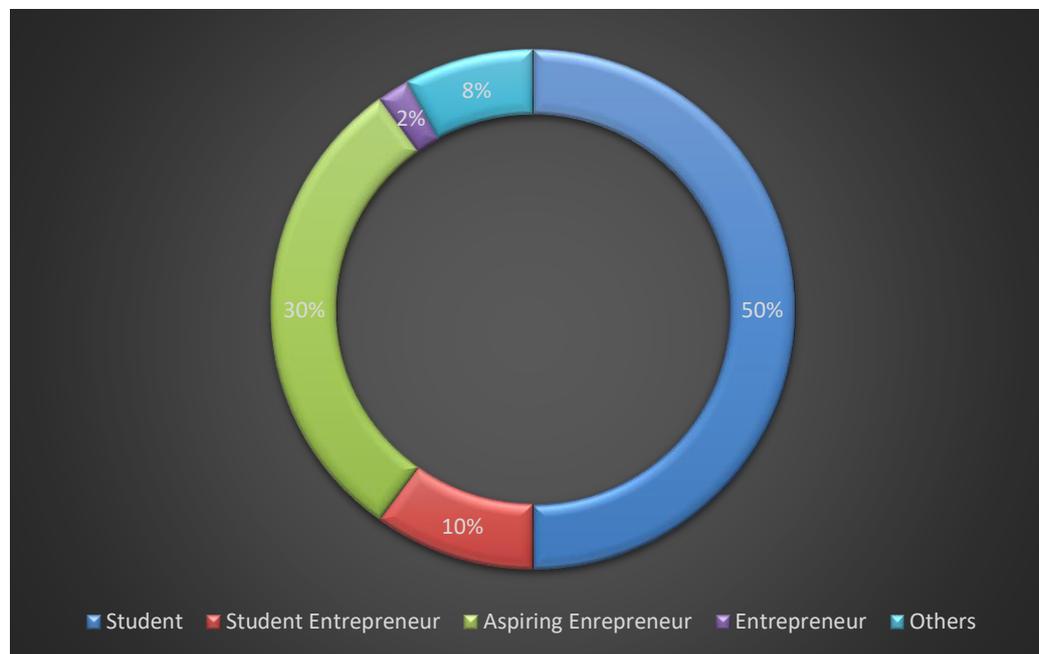
TABLE 4.2

CLASSIFICATION OF RESPONDENTS UNDER SUITABLE TERMS

SL. NO	OPTIONS	NUMBER	PERCENTAGE
1	Student	50	50
2	Student Entrepreneur	10	10
3	Aspiring Entrepreneur	30	30
4	Entrepreneur	2	2
5	Others	8	8
	TOTAL	100	100

Source: Primary Data

FIGURE:4.2 CLASSIFICATION OF RESPONDENTS UNDER SUITABLE TERMS



Interpretation:

The above table shows the classification of the respondents by suitable terms such as student, student entrepreneur, aspiring entrepreneur, entrepreneur, and others. Half of the respondents are students. Also, there are 10 student entrepreneurs, 30 aspiring entrepreneurs, 2 entrepreneurs, and 8 people who belong to other categories. Therefore, here, the majority of the respondents are students.

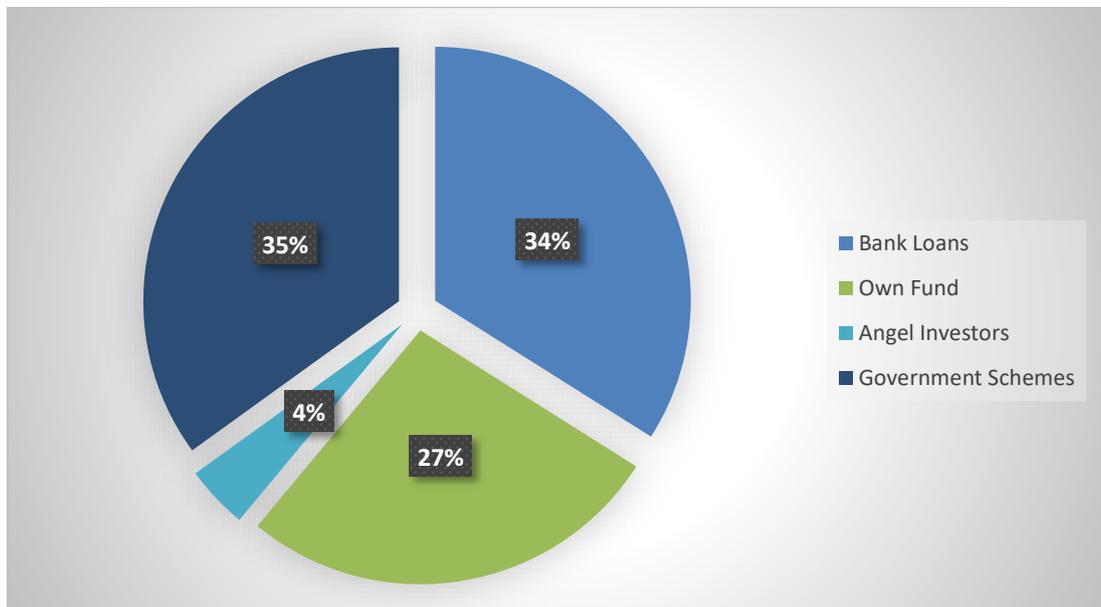
TABLE 4.3

**PREFERED TYPE OF FUNDING OF THEIR ENTREPRENEURIAL UNIT
BY THE RESPONDENTS**

SL. NO	OPTIONS	NUMBER	PERCENTAGE
1	Bank Loans	34	34
2	Own Fund	27	27
3	Angel Investors	4	4
4	Government Schemes	35	35
	TOTAL	100	100

Source: Primary Data

**FIGURE: 4.3 PREFERED TYPE OF FUNDING OF THEIR
ENTREPRENEURIAL UNIT BY THE RESPONDENTS**



Interpretation:

Above table 4.3 shows the types of funding preferred by the respondents for their entrepreneurial unit. Here the majority of the respondents prefer government schemes and bank loans up to several 35 and 34. Other than that, 27 people prefer their own funds and 4 people prefer angel investors.

TABLE 4.4

AWARENESS OF DIFFERENT GOVERNMENT SCHEMES AVAILABLE FOR WOMEN ENTREPRENEURS

SL. NO	OPTIONS	NUMBER	PERCENTAGE
1	Yes	15	15
2	Somewhat	55	55
3	No	30	30
	TOTAL	100	100

Source: Primary Data

FIGURE:4.4 AWARENESS OF DIFFERENT GOVERNMENT SCHEMES AVAILABLE FOR WOMEN ENTREPRENEURS



Interpretation:

The above table 4.4 shows the awareness of respondents regarding the different government schemes available for women entrepreneurs. Here, according to the survey conducted, only 15 people are aware of this, 55 people are somewhat aware of the same, and 30 people are not at all aware of these schemes.

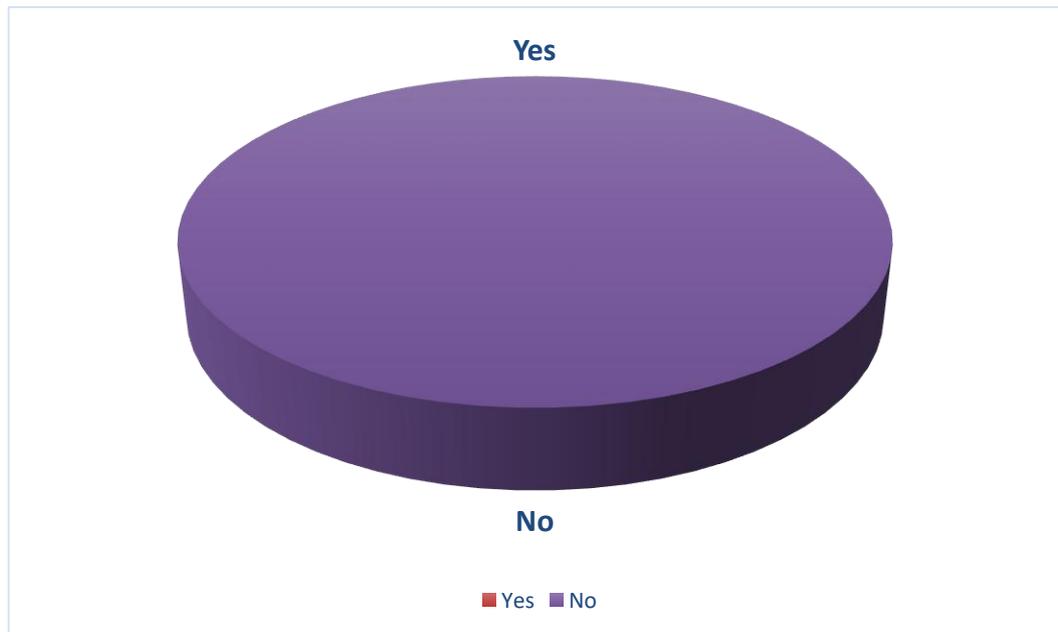
TABLE 4.5

EXPERIENCE/USAGE OF BENEFITS OF ANY OF THE GOVERNMENT SCHEMES

SL. NO	OPTIONS	NUMBER	PERCENTAGE
1	Yes	0	0
2	No	100	100
	TOTAL	100	100

Source: Primary Data

FIGURE:4.5 EXPERIENCE/USAGE OF BENEFITS OF ANY OF THE GOVERNMENT SCHEMES



Interpretation:

Above table 4.5 shows the number of respondents who have experienced or used any of the government schemes. None of the respondents have experienced or used the benefits of any of the government schemes.

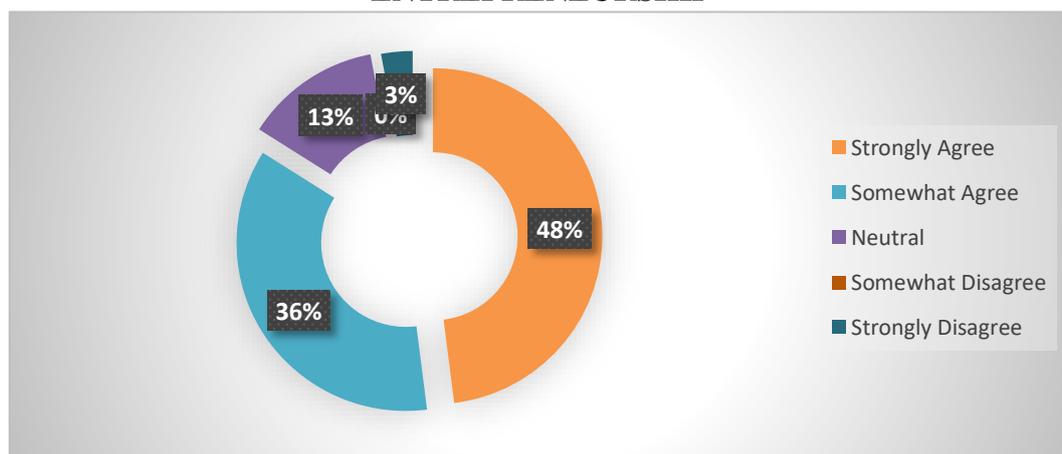
TABLE 4.6

OPINION OF THE RESPONDENT ON THE PHRASE: DESPITE BEING A LITERATE SOCIETY, KERALA WOMEN STILL FACE DISCRIMINATION AND DIFFICULTIES IN THE FIELD OF ENTREPRENEURSHIP

SL. NO	OPTIONS	NUMBER	PERCENTAGE
1	Strongly Agree	48	48
2	Somewhat Agree	36	36
3	Neutral	13	13
4	Somewhat Disagree	0	0
5	Strongly Disagree	3	3
	TOTAL	100	100

Source: Primary Data

FIGURE:4.6 OPINION OF THE RESPONDENT ON THE PHRASE: DESPITE BEING A LITERATE SOCIETY, KERALA WOMEN STILL FACE DISCRIMINATION AND DIFFICULTIES IN THE FIELD OF ENTREPRENEURSHIP



Interpretation:

The above table shows the opinion of the respondents regarding the phrase; despite being a literate society, Kerala women still face discrimination and difficulties in the field of entrepreneurship. Their opinions are as follows: 48 people strongly agree to this, 36 people somewhat agree to this, 13 people have a neutral opinion and 3 people strongly disagree. The majority of the respondents strongly agree with the phrase.

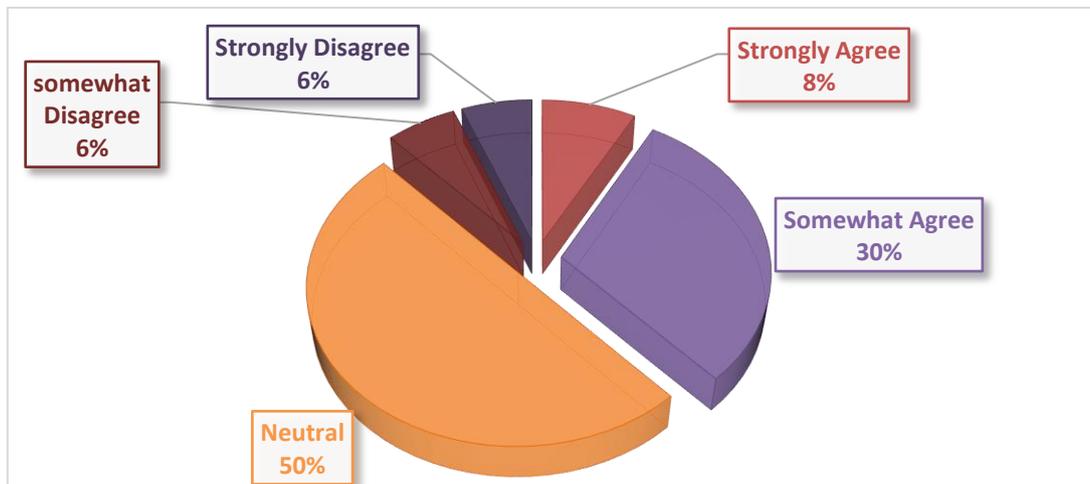
TABLE 4.7

RESPONDENTS OPINION ON ‘THERE ARE ENOUGH SCHEMES FOR WOMEN ENTREPRENEURS BY GOVERNMENT OF KERALA’

SL. NO	OPTIONS	NUMBER	PERCENTAGE
1	Strongly Agree	8	8
2	Somewhat Agree	30	30
3	Neutral	50	50
4	Somewhat Disagree	6	6
5	Strongly Disagree	6	6
	TOTAL	100	100

Source: Primary Data

FIGURE:4.7 RESPONDENTS OPINION ON ‘THERE ARE ENOUGH SCHEMES FOR WOMEN ENTREPRENEURS BY GOVERNMENT OF KERALA



Interpretation:

The above table shows the opinion of the respondents on the phrase; ‘there are enough schemes available for women entrepreneurs by the government of Kerala.’ 8 people strongly agree to this, 30 people somewhat agree, 50 people have no opinion 6 people somewhat disagree, and 6 people strongly disagree. The majority of people have a neutral opinion regarding this.

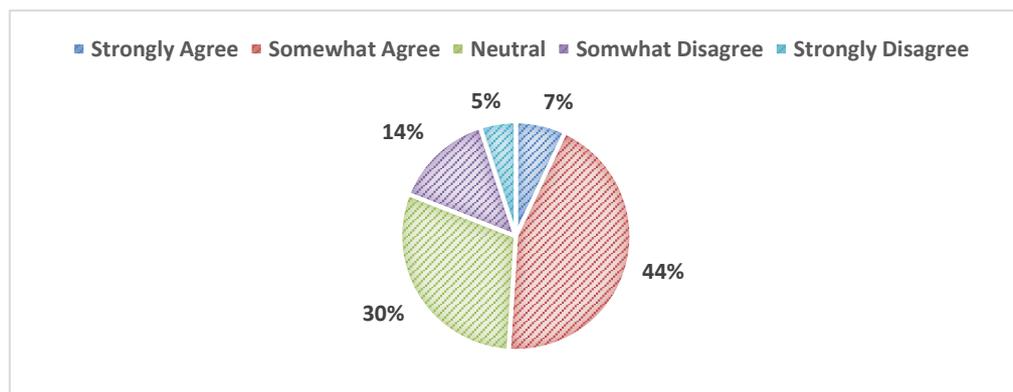
TABLE 4.8

OPINION OF THE RESPONDENTS ON THE PHRASE, 'INFORMATION ABOUT VARIOUS GOVERNMENT SCHEMES FOR WOMEN IS EASILY AVAILABLE AND ACCESSIBLE'

SL. NO	OPTIONS	NUMBER	PERCENTAGE
1	Strongly Agree	7	7
2	Somewhat Agree	44	44
3	Neutral	30	30
4	Somewhat Disagree	14	14
5	Strongly Disagree	5	5
	TOTAL	100	100

Source: Primary Data

FIGURE:4.8 OPINION OF THE RESPONDENTS ON THE PHRASE, 'INFORMATION ABOUT VARIOUS GOVERNMENT SCHEMES FOR WOMEN IS EASILY AVAILABLE AND ACCESSIBLE'



Interpretation:

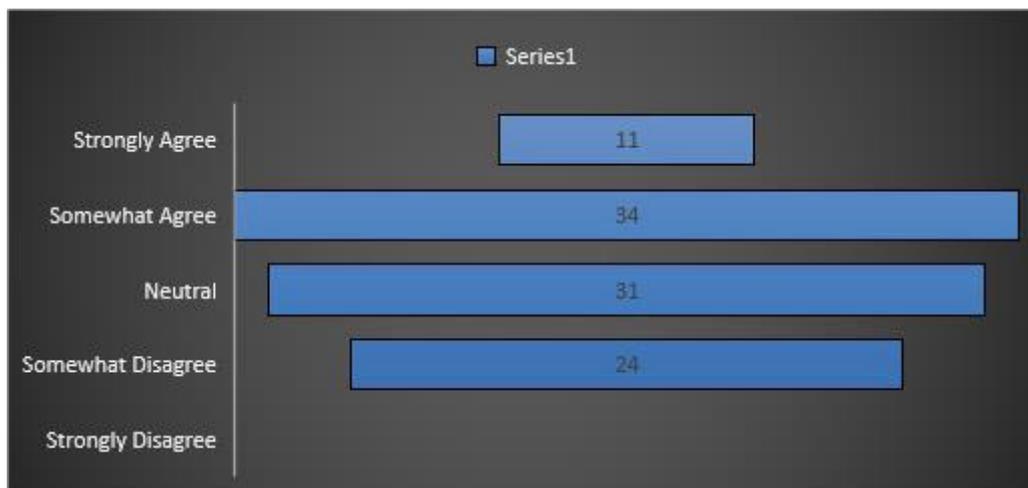
The above table 4.8 shows the opinion of the respondents regarding the phrase; information about various government schemes for women is easily available and accessible. 7 people strongly agree to this, 44 people somewhat agree, 30 people have no opinion 6 people somewhat disagree, and 5 people strongly disagree. The majority of people somewhat agree with this.

TABLE 4.9

OPINION OF THE RESPONDENT ON THE PHRASE- THERE IS ENOUGH INFRASTRUCTURAL SUPPORT FOR WOMEN ENTREPRENEURS IN KERALA

SL. NO	OPTIONS	NUMBER	PERCENTAGE
1	Strongly Agree	11	11
2	Somewhat Agree	34	34
3	Neutral	31	31
4	Somewhat Disagree	24	24
5	Strongly Disagree	0	0
	TOTAL	100	100

FIGURE:4.9 OPINION OF THE RESPONDENT ON THE PHRASE- THERE IS ENOUGH INFRASTRUCTURAL SUPPORT FOR WOMEN ENTREPRENEURS IN KERALA



Interpretation:

The above-given table shows the opinion of the respondents regarding the phrase; there is enough infrastructural support for women entrepreneurs in Kerala. 11 people strongly agree to this, 34 people somewhat agree to the same, 31 people have no opinion at all, and 24 people somewhat disagree.

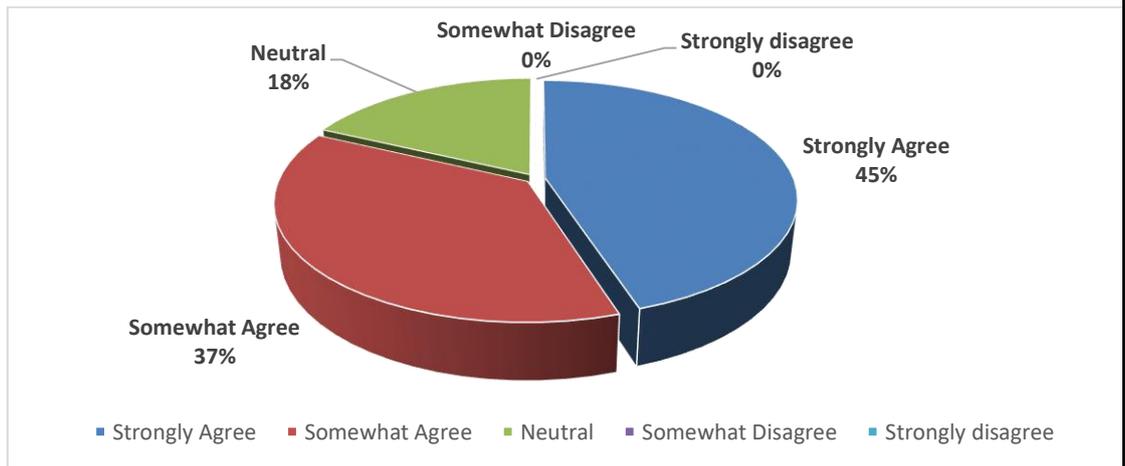
TABLE 4.10

OPINION OF THE RESPONDENTS REGARDING THE PHRASE- WOMEN ENTREPRENEURS NEED MORE GOVERNMENT SCHEMES TO BRIDGE THE GENDER GAP IN OUR PATRIARCHAL SOCIETY

SL. NO	OPTIONS	NUMBER	PERCENTAGE
1	Strongly Agree	45	45
2	Somewhat Agree	37	37
3	Neutral	18	18
4	Somewhat Disagree	0	0
5	Strongly Disagree	0	0
	TOTAL	100	100

Source: Primary Data

FIGURE:4.10 OPINION OF THE RESPONDENTS REGARDING THE PHRASE- WOMEN ENTREPRENEURS NEED MORE GOVERNMENT SCHEMES TO BRIDGE THE GENDER GAP IN OUR PATRIARCHAL SOCIETY



Interpretation:

The above table shows the opinion of the respondents regarding the phrase- women entrepreneurs need more government schemes to bridge the gender gap in our patriarchal society. 45 people strongly agree to this, 37 people somewhat agree to the same, 18 people have no opinion at all

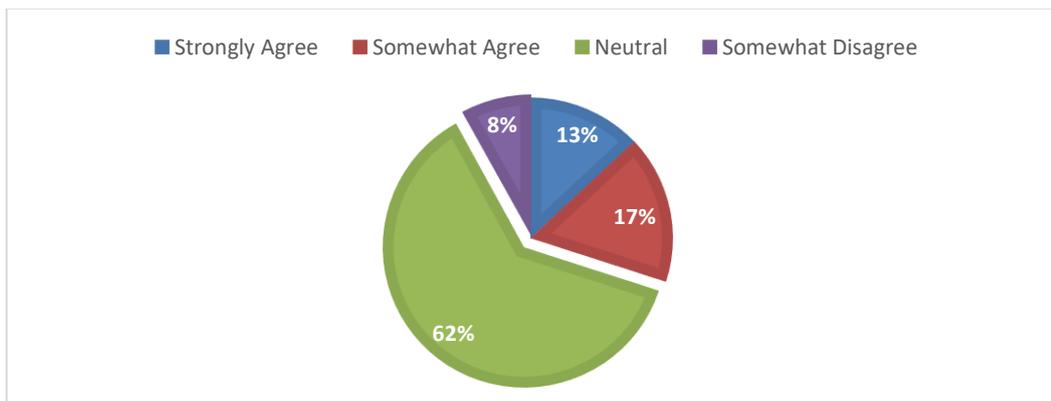
TABLE 4.11

OPINION OF THE RESPONDENTS ON THE PHRASE- EXISTING GOVERNMENT SCHEMES FOR WOMEN ENTREPRENEURS ARE NOT BENEFITTING WOMEN ENTREPRENEURS

SL NO	OPTIONS	NUMBER	PERCENTAGE
1	Strongly Agree	13	13
2	Somewhat Agree	17	17
3	Neutral	62	62
4	Somewhat Disagree	8	8
5	Strongly Disagree	0	0
	TOTAL	100	100

Source: Primary Data

FIGURE :4.11 OPINION OF THE RESPONDENTS ON THE PHRASE- EXISTING GOVERNMENT SCHEMES FOR WOMEN ENTREPRENEURS ARE NOT BENEFITTING WOMEN ENTREPRENEURS



Interpretation:

The above table 4.11 shows the opinion of the respondents regarding the phrase- existing government schemes for women entrepreneurs are not benefitting women entrepreneurs. 13 people strongly agree to this, 17 people somewhat agree to the same, 62 people have no opinion at all, 8 people somewhat disagree.

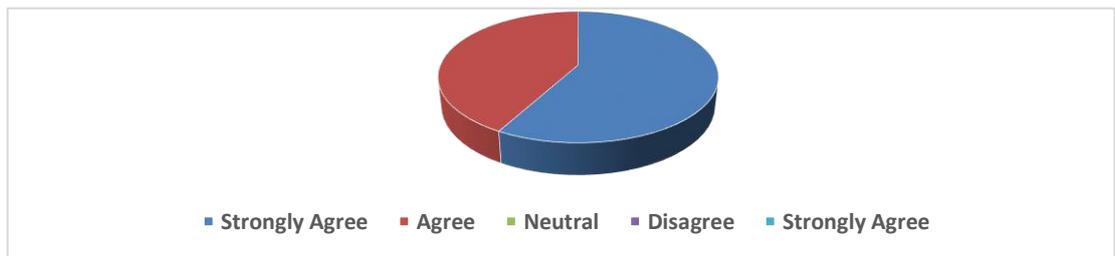
TABLE 4.12

IS THERE A NEED FOR A HANDBOOK TO PROVIDE CONSOLIDATED INFORMATION REGARDING ALL GOVERNMENT SCHEMES FOR WOMEN ENTREPRENEURS IN KERALA?

SL. NO	OPTIONS	NUMBER	PERCENTAGE
1	Strongly Agree	58	58
2	Somewhat Agree	41	41
3	Neutral	0	0
4	Somewhat Disagree	0	0
5	Strongly Disagree	0	0
	TOTAL	100	100

Source: Primary Data

FIGURE: 4.12 IS THERE A NEED FOR A HANDBOOK TO PROVIDE CONSOLIDATED INFORMATION REGARDING ALL GOVERNMENT SCHEMES FOR WOMEN ENTREPRENEURS IN KERALA?



Interpretation:

The above-given table 4.12 shows the opinion of the respondents regarding the need for a handbook to provide consolidated information regarding all government schemes for women entrepreneurs in Kerala. Here, 58 people strongly agree to this and the rest of 42 people agree to the same. None of them have disagreed with the need for a handbook to provide consolidated information regarding the schemes. This points out the lack of knowledge in society regarding the government schemes available for women entrepreneurs in Kerala. Therefore, the result of the survey conducted points out the importance and need of the implementation of a handbook that gives proper information about the latter.

CHAPTER 5
SUMMARY, FINDINGS, RECOMMENDATIONS
AND CONCLUSION

5.1 SUMMARY

This study aims to understand “The schemes available for the women entrepreneurs in Kerala” is to purpose a model for measuring the awareness of the working class. To understand better the overall awareness about these schemes among working class people and their participation in these schemes, a survey was conducted for 100 working class people by the method of convenient sampling technique. It helps to understand the general awareness of the working class. It also helps to study participation of working class in these schemes.

5.2 FINDINGS

After analyzing the primary data collected by distributing questionnaire to the respondents, following findings were obtained:

- Respondents were aged between 18 and 60 and belonged to the working class
- Most of the respondents’ qualification is under-graduation
- Among the respondents, 40% of them possessed a under-graduate degree
- Most of the respondents prefer government schemes and bank loans up to several 35 and 34.
- Among the respondents, 55% of them are somewhat aware of these schemes

5.3 FINDINGS BASED ON OBJECTIVES

- **Awareness of different government schemes available for women entrepreneurs**
 - A total of 15% of the respondents are aware of these schemes provided by the government.
 - Among the respondents, a majority of 55% of the people are somewhat aware of these schemes
 - 30% of the respondents are not aware of these schemes
- **Experience /usage of benefits of any of the government schemes**
 - Among the respondents, majority of them are not experiencing any kind of government scheme benefits
 - 100% of the respondents are not receiving any benefits from the government

- **To assess the awareness about the discriminations experienced by the women in this field of entrepreneurship**
 - Despite being a literate society, Kerala women still face discrimination and difficulties in the field of entrepreneurship
 - Among the respondents, 48% of them are strongly agree to this
 - 36% of people are somewhat agree to this opinion
 - Only 3% of the total respondents are strongly disagree to this opinion
- **Opinion about the availability of schemes for the women entrepreneur by the government of Kerala**
 - 50% of the respondents are neutral about the opinion -there are enough schemes for the women entrepreneurs by government of Kerala
 - only a 38% of people are agree to this opinion
 - Most people have a neutral opinion regarding this
- **To assess the awareness about the accessibility of these schemes among the working class**
 - information about various government schemes for women is easily available and accessible
 - Majority of the people are somewhat agreed to this opinion
 - 30% of respondents have no opinion regarding this
 - 11% of respondents are disagree to this
- **To identify the infrastructure support for women entrepreneur**
 - There is enough infrastructural support for women entrepreneurs in Kerala.
 - A majority of 34% of people are somewhat agree to this
 - 31% of respondents have no opinion to this
 - Only 24% of them are somewhat disagree
 - That is, there is enough infrastructure support for women entrepreneurs
- **To identify the relation between these schemes and gender gap**
 - Women entrepreneurs need more government schemes to bridge the gender gap in our patriarchal society
 - Majority of the people have this same opinion
 - 45% of the respondents are strongly agree that more government schemes for the women entrepreneurs helps to bridge the gender gap
 - 37% of people are somewhat agree to the same
 - 18% people have no opinion regarding this

- Absolutely no one is disagreed to this opinion
- It helps to understand the importance of these schemes to mend the gender gap

➤ **To understand the need for a handbook to provide consolidated information regarding all government schemes for women entrepreneur in Kerala**

- Majority of the people are opining that there is a need for a handbook to provide consolidated information regarding al government schemes for women entrepreneurs
- About a 58% of people a strongly agree to this opinion
- The remaining 42% of the respondents are agree to this opinion
- None of them have disagreed with the need for a handbook to provide consolidated information regarding the schemes.
- This points out the lack of knowledge in society regarding the government schemes available for women entrepreneurs in Kerala
- The result of the survey conducted points out the importance and need of the implementation of a handbook that gives proper information about the latter.

5.4 RECOMMENDATIONS

- Governments should provide more means to the people for the awareness of the different schemes provided
- Gender gap is a bid problem faced by the society. Since these schemes helps to mend the gap, it is advisable for more people to avail these benefits provided by the government.
- Providing a handbook will give a proper information regarding these schemes even to the common people.
- Even though our society is developing in a greater speed, there is still exists the problem of discrimination among women.it should be properly handled.

5.5 CONCLUSION

Through this research paper, it was helpful enough to know in depth about the awareness of the people regarding the various schemes available for the women entrepreneurs in Kerala. It is clear that, majority of the people are somewhat aware about the schemes available for the women entrepreneurs in Kerala. Only a few sectors of people are not aware about these schemes.

This study has suggested that, even though majority of the people are aware about these schemes, no one is ever experienced any of these government benefits. It shows the lack of interest in the working class to participate in the government schemes for the women entrepreneurs.

Despite being a literate society, Kerala women still face discrimination and difficulties in the field of entrepreneurship. Most of the people are aware about this discrimination, but there is no actions are taken to reduce these discrimination and encourage more women entrepreneurs to get into this field.

The encouragement of women entrepreneurship can create a greater impact in the society. It will definitely decrease the gender gap in the society. So, the importance of women entrepreneurship in Kerala is increasing day by day.

Majority of the people are opining that there is a need for a handbook to provide consolidated information regarding all government schemes for women entrepreneurs. Such a handbook will give all the necessary information's for the women entrepreneurs. It will be beneficial for every people in Kerala. It will help to reduce all the hindrance that are faced by the women entrepreneurs in Kerala.

Thus, this research has helped to identify the awareness of the people regarding the schemes available for the women entrepreneurs in Kerala. Also helps to understand the importance of these schemes and the necessity of it in the society.

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APPENDIX

QUESTIONNAIRE

‘A STUDY ON THE SCHEMES AVAILABLE FOR WOMEN ENTREPRENEURS IN KERALA’

1. Name:
2. Age :
18-30 () 31-40 () 41-50 ()
51-60 () Above 60 ()
3. Gender :
Female () Male () Prefer not to say ()
4. Education:
10th () 12th () UG () PG () Ph.D ()
5. Stream of study:
Finance () Non- finance ()
6. Annual salary bracket
Less than 2,00,000 () 2,00,000-5,00,000 ()
5,00,000- 10,00,000 () More than 10,00,000 ()
Not Applicable ()

1. Which of the following term suits you?
 - a. Student
 - b. Student Entrepreneur
 - c. Aspiring Entrepreneur
 - d. Entrepreneur
2. Which industry is your entrepreneurial unit related to?
3. Enter the name of your entrepreneurial units
(if you are an entrepreneur)
4. What is your highest educational qualification?
PG
UG
12th
10th
Nil

5. How do you fund/plan to fund your entrepreneurial unit?
 - a. Bank Loans
 - b. Own fund
 - c. Angel Investors
 - d. Government Schemes

6. Are you aware of different government schemes available for women entrepreneurs?
 - a. Yes
 - b. Somewhat
 - c. No

7. Have you ever used the benefit of government schemes?
 - a. Yes
 - b. No

8. If yes, which government scheme did you use?

9. There are enough schemes for women entrepreneurs by the government of Kerala.
 - Strongly Disagree
 - Somewhat Disagree
 - Neutral
 - Somewhat Agree
 - Strongly Agree

10. Information about various government schemes for women is easily available and accessible.
 - Strongly Disagree
 - Somewhat Disagree
 - Neutral
 - Somewhat Agree
 - Strongly Agree

11. There is enough infrastructural support for women entrepreneurs in Kerala
 - Strongly Disagree
 - Somewhat Disagree

- Neutral
- Somewhat Agree
- Strongly Agree

11.Despite being a literate society, Kerala women still face discrimination and difficulties in the field of entrepreneurship

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

12. Women entrepreneurs need more government schemes to bridge the gender gap in our patriarchal society.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

13.Existing government schemes for women entrepreneurs are not benefitting women entrepreneurs

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

13. There is a need for a handbook to provide consolidated information regarding all government schemes for women entrepreneurs in Kerala.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

ST. TERESA'S COLLEGE (AUTONOMOUS)

ERNAKULAM



B.Sc. PHYSICS

PROJECT REPORT

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Register numbers : AB19PHY028

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This is to certify that this project work entitled '**DETERMINATION OF PLANCK'S CONSTANT USING I-V CHARACTERISTICS OF LED**' is an authentic work done by ALEENA GEORGE.


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Submitted for the University examination held at, St. Teresa's College,
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DATE: 10-05-2022
EXAMINERS:



**ST. TERESA'S COLLEGE (AUTONOMOUS)
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CERTIFICATE

This is to certify that the project report entitled '**DETERMINATION OF PLANCK'S CONSTANT USING I-V CHARACTERISTICS OF LED**' is an authentic work done by ALEENA GEORGE St.Teresa's College Ernakulam, under my supervision at Department of Physics, St. Teresa's College for the partial requirements for the award of Degree of Bachelor of Science in Physics during the academic year 2021-22. The work presented in this dissertation has not been submitted for any other degree in this or any other university.

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PLACE : Ernakulam
DATE : 10-05-2022

DETERMINATION OF PLANCK'S CONSTANT **USING I-V CHARACTERISTICS OF LED**

PROJECT REPORT

Submitted by

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Submitted to

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In partial fulfilment of the requirements for the Award of

BACHELOR DEGREE OF SCIENCE IN PHYSICS



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ABSTRACT

Planck's constant is named after Max Planck, a nineteenth-century physicist who first described it by relating it as $E=hf$, where symbols have their usual meanings. It is a relationship used when comparing a quantum of energy absorbed to that emitted during electron transitions which can be extended to emission by light emitting diodes. The purpose of this study was to determine Planck's constant using the energy needed to excite free electrons in a light emitting diode. Depending on the materials used, LEDs emit radiation with energies corresponding to either near infrared, visible, or near-ultraviolet. In reality, a LED is designed to have a small area (approximately less than 1mm^2). Studies are made by using different LEDs of different wavelength. In this work, an electric current was used to excite electrons and the corresponding energy was measured using a voltmeter. Planck's constant was calculated by substituting the obtained frequency and energy from the voltmeter in the relationship, $E=hf$.

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1. INTRODUCTION

Max Planck (1858-1947) was an early pioneer in the field of quantum physics. Around 1900 Planck developed the concept of energy quantization to explain the spectral distribution of blackbody radiation.

Planck postulated that energy was quantized and could be emitted or absorbed only in integral multiples of a small unit of energy, known as a quantum. The energy of a quantum is proportional to the frequency of the radiation; the proportionality constant h is a fundamental constant (Planck's constant).

This idea is fundamental to the quantum theory of modern physics.

Planck received a Nobel Prize for his work in the early development of quantum mechanics in 1918.

Planck proposed that atoms absorb and emit radiation in discrete quantities given by

$$E = nhf \tag{1}$$

Where, n is an integer known as a quantum number, f is the frequency of vibration of the molecule, and h is Planck's constant. The smallest discrete amount of energy radiated or absorbed by a system results from a change in state whereby the quantum number n of the system changes by one.

In this experiment we make use of the I-V characteristics of LED to determine Planck's constant, using the relation,

$$E=eV_0=hf \quad (2)$$

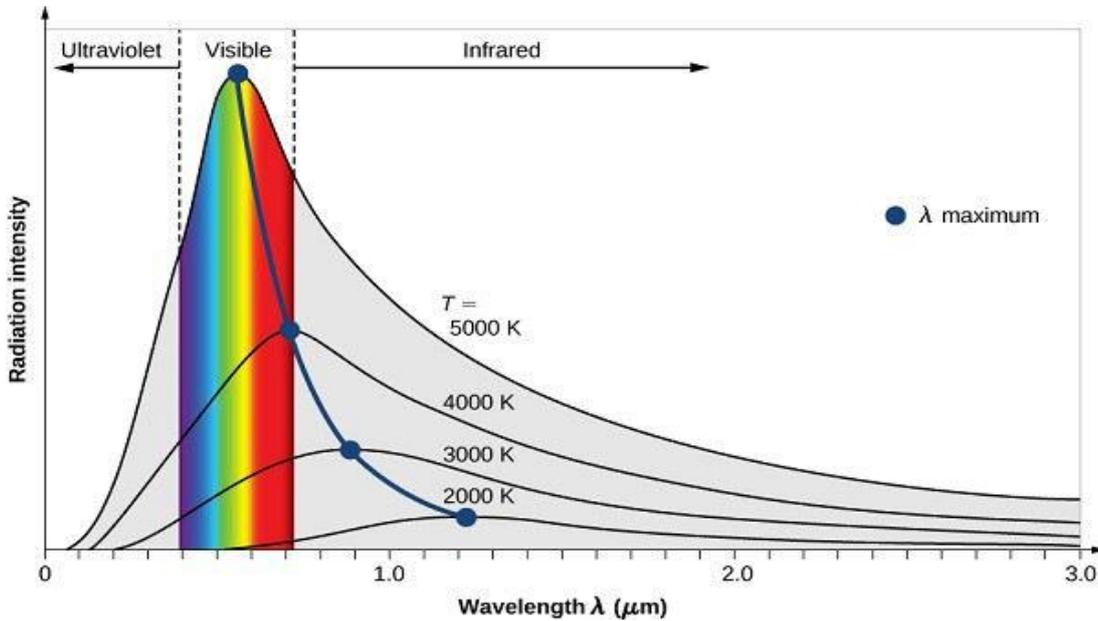
Where, e is the electronic charge, V_0 is the threshold voltage in which the LED starts to glow when an external power is supplied to it.

2. SIGNIFICANCE OF PLANCK'S CONSTANT

2.1. Black Body Radiation

Blackbody is a surface that absorbs all radiant energy falling on it. The term arises because incident visible light will be absorbed rather than reflected, and therefore the surface will appear black. An ideal body or surface that completely absorbs all radiant energy falling upon it with no reflection and that radiates at all frequencies with a spectral energy distribution dependent on its absolute temperature is called a perfect blackbody. Blackbody radiation refers to the spectrum of light emitted by any heated object; common examples include the heating element of a toaster and the filament of a light bulb.

From the curves we note that



- i The intensity reaches a maximum at some frequency ν .
- ii The frequency ν , as well as the height of the peak, increase with temperature.

The application of statistical thermodynamics and the ordinary laws of mechanics and electromagnetic theory led to the Rayleigh-Jeans formula $I(\nu) = 2\pi/c^2 kT \nu^2$

This law, except for very low frequencies, is in total disagreement with experimental results. The law predicts an infinite amount of radiated intensity, actually, the total radiated intensity is finite.

Max Planck resolved this controversy by postulating that the exchange of energy between atoms and radiation involves discrete amounts of energy. At a given frequency ν , the smallest amount of energy that can be exchanged is equal to $E = h\nu$. Only multiples of $h\nu$ are involved in the interaction. Applying this postulate to the problem of black body radiation theory, Planck obtained

$$I(\nu) = (2\pi\nu^2 / c^2) h\nu / (e^{h\nu/kT} - 1)$$

Planck's formula agrees with experimental curves. The notion that field energy is quantized rather than a continuous quantity was a new and profound addition to physics.

The blackbodies are used for lighting, heating, security, thermal imaging, as well as testing and measurement applications. Since the intensity of the energy at any temperature and wavelength can be determined using the Planck Law of radiation.

2.2. Photoelectric Effect

Whenever light or electromagnetic radiation (such as X-rays, Ultraviolet rays) fall on a metal surface, it emits electrons. This process of emission of electrons from a metal plate, when illuminated by light of suitable wavelength, is called the photoelectric effect. The electrons emitted are known as the photoelectrons. In the case of alkali metals, photoelectric emission occurs even under the action of visible light. Zinc, cadmium etc., are sensitive to only ultraviolet light.

Laws of photoelectric emission

For every metal, there is a particular minimum frequency of the incident light, below which there is no photoelectric emission, whatever be the intensity of the radiation. This minimum frequency, which can cause photoelectric emission, is called the threshold frequency.

- i The strength of the photoelectric current is directly proportional to the intensity of the incident light, provided the frequency is greater than the threshold frequency.
- ii The velocity and hence the energy of the emitted photoelectrons is independent of the intensity of light and depends only on the frequency of the incident light and the nature of the metal.
- iii Photoelectric emission is an instantaneous process. The time lag, if any, between incidence of radiation and

iv emission of the electrons, is never more than 3×10^{-9} sec.

Failure of the electromagnetic theory

The above experimental facts could not be explained on the basis of the electromagnetic theory of light.

(1) Calculations showed that it would require about 500 days to dislodge a photoelectron from sodium by exposure to violet light of wavelength 4000 Å. Experimentally, however, we observe that electron ejection commences without delay.

(2) According to the classical theory, light of greater intensity should impart greater K.E. to the liberated electrons. But, this does not happen. Also, the velocity of the emitted electron should not depend on the frequency of the incident light. But it does.

The phenomenon was adequately explained by Einstein on the basis of Planck's Quantum theory of radiation.

According to Planck, the energy of a monochromatic wave with frequency ν can only assume those values which are integral multiples of energy $h\nu$ i.e.,

$$E_n = nh\nu,$$

where n is an integer referring to the number of "Photons".

Thus the energy of a single PHOTON of frequency ν is,

$$E = h\nu$$

2.3. Einstein's Photoelectric Equation

According to Einstein, light of frequency ν consists of a shower of corpuscles or photons each of energy $h\nu$. When a photon of light of frequency ν is incident on a metal, the energy is completely transferred to a free electron in the metal. A part of the energy acquired by the electron is used to pull out the

electron from the surface of the metal and the rest of it is utilised in imparting K.E. to the emitted electron.

Let ϕ be the energy spent in extracting the electron from the emitter to which it is bound (photoelectric work function) and $\frac{1}{2} mv^2$, the K.E. of the photoelectron.

$$\text{Then, } hv = \phi + \frac{1}{2} mv^2 .$$

This relation is known as the Einstein's Photoelectric equation.

If ν_0 is the threshold frequency which just ejects an electron from the metal without any velocity then, $\phi = h\nu_0$.

$$hv = h\nu_0 + \frac{1}{2} mv_{\max}^2 ,$$

where v_{\max} is the maximum velocity acquired by the electron.

$$\frac{1}{2} mv_{\max}^2 = h(\nu - \nu_0)$$

3. THEORETICAL BACKGROUND

An LED is a semiconducting device that emits electromagnetic radiation at optical and infrared frequencies. The device is a p-n junction diode made from p-type and n-type semiconductors, usually GaAs, GaP or SiC. They emit light only when an external applied voltage is used to forward bias the diode above a minimum threshold value. The gain in electrical potential energy delivered by this voltage is sufficient to flow out of the n-type material, across the junction barrier, and into the p-type region. This threshold voltage for the onset of current flow across the junction and the production of light is V_0 . The emission of light occurs after electrons enter the p-region (and holes into the n-region).

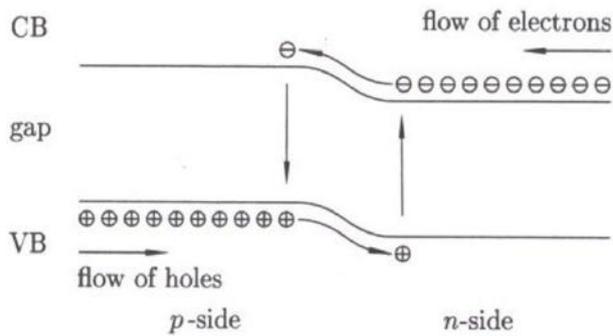


Figure 1- Energy band diagram of LED

These electrons are a small minority surrounded by holes (essentially the anti-particles of the electrons) and they will quickly find a hole to recombine with. Energetically, the electron relaxes from the excited state (conduction band) to the ground state (valence band). The diodes are called light emitting because the energy given up by the electron as it relaxes is emitted as a photon. Above the threshold value, the current and light output increases exponentially with the bias voltage across the diode. The quanta of energy or photon has an energy

$$E = hf \tag{1}$$

This equation explains that the energy of each photons emitted by an LED is determined by the frequency of the radiation and the value of the Planck's constant. The LED starts to emit light when the voltage has reached its minimum threshold and the current is allowed to flow to it. The relation between energy and the minimum threshold voltage can be written as:

$$E = eV_0 \tag{2}$$

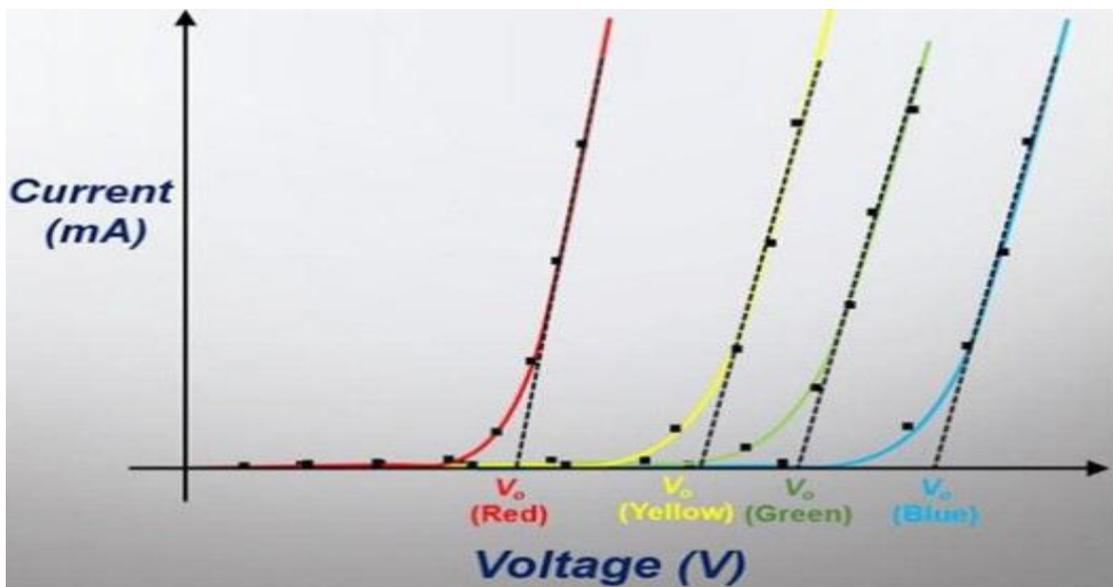
Where e is the charge of electron with the values of 1.6022×10^{-19} C. Equation (1) is comparable with equation (2) and this provides a linear correlation between the frequency and voltage as the LED is turned on. This correlation can be shown as:

$$hf = eV_0 = E_g \tag{3}$$

$$f=hc/\lambda$$

where E_g is the size of the energy gap, V_0 is the threshold voltage, f and λ are the frequency and wavelength of the emitted photons, c is the velocity of light, e is the electronic charge.

The graph below shows the current -voltage curve for a typical LED. The 'turn-on' voltage V_0 times e (electron charge) is about the same as the energy lost by an electron as it falls from the n to the p region, and this is also approximately equal to the energy of the emitted photon.



4. METHOD

In this experiment, we will use LEDs of different colors to make our own measurement of Planck's constant. This is essentially a demonstration of

the photoelectric effect in reverse. A quantum of energy is necessary to create the electron-hole pair, and is released again when the electron and hole recombine. Because multiple states can be excited when the voltage across a diode is increased, photons of increasing energy are emitted with increasing voltage. This means that the light emitted by an LED spans a range of wavelengths that decrease with increasing voltage above the threshold voltage, V_0 , which is numerically equal to the minimum energy necessary to create an electron-hole pair. The maximum wavelength λ occurs at V_0 .

The graph below shows the current-voltage curve for a typical LED. The 'turn on' voltage V_0 times e (electron charge) is about the same as the energy lost by an electron as it falls from the n to the p region, and this is also approximately equal to the energy of the emitted photon.

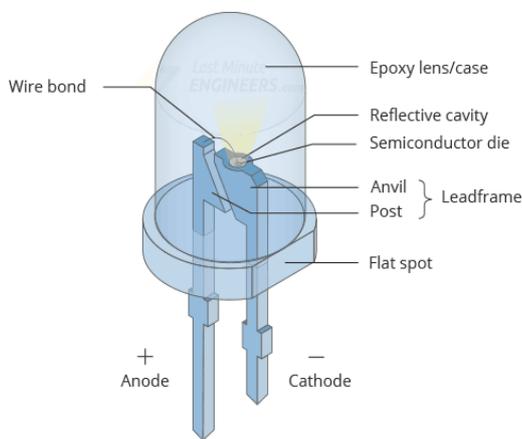


Figure 2- V-I Characteristics of LED

If we measure the minimum voltage V_0 required to cause current to flow and photons to be emitted, and we know the wavelength of the emitted photons and use it to calculate the photon energy hf , we always find that $eV_0 < hf$. Some of the photon energy is supplied by thermal energy.

4.1. PROCEDURE

The main component of the apparatus is a circuit board containing an LED connected with a voltmeter and milliammeter in parallel and series connection respectively, as shown in the figure. And the current and voltage are measured as the external voltage from the power supply is varied.

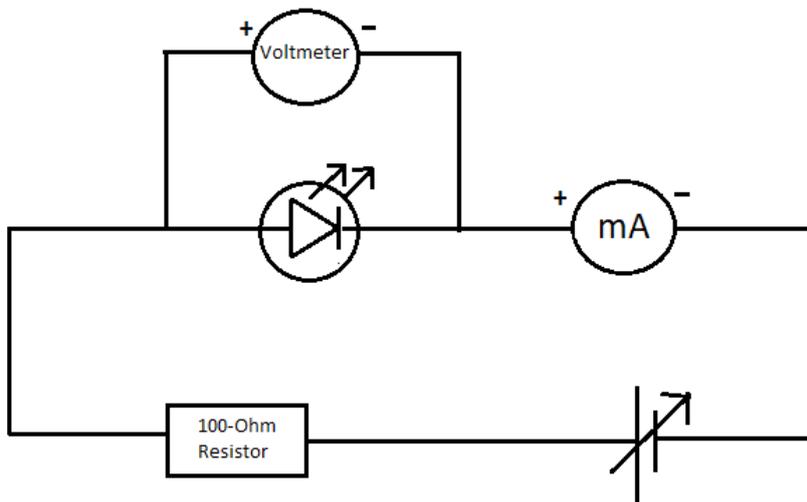


Figure 3-Circuit diagram of the experimental procedure

Include the 100Ω current-limiting resistor into the circuit as shown in the figure. Check that the voltmeter measures the voltage directly across the LED only, i.e. not including the 100Ω resistor. Turn the power supply on and very slowly increase the voltage until the LED just starts to glow. Continually monitor the current so that we do not exceed the maximum current. Measure the current as a function of voltage across the LED, being particularly careful to obtain sufficient readings around the knee of the curve. Typical data is displayed in Fig. 3. Repeat these measurements of the I–V curves for each of the other diodes, noting that 5 of them have a maximum current rating of 20 mA and the IR LED has a 100 mA rating.

4.2. DATA ANALYSIS

Plot graphs of current (ordinate) vs voltage (abscissa) for each LED. The experimental problem here is how to determine V_0 , the turn-on voltage. The human eye has a wavelength dependent sensitivity so that a visual determination will not work. And it is a difficult and error-prone task to measure a small current in the presence of electrical noise.

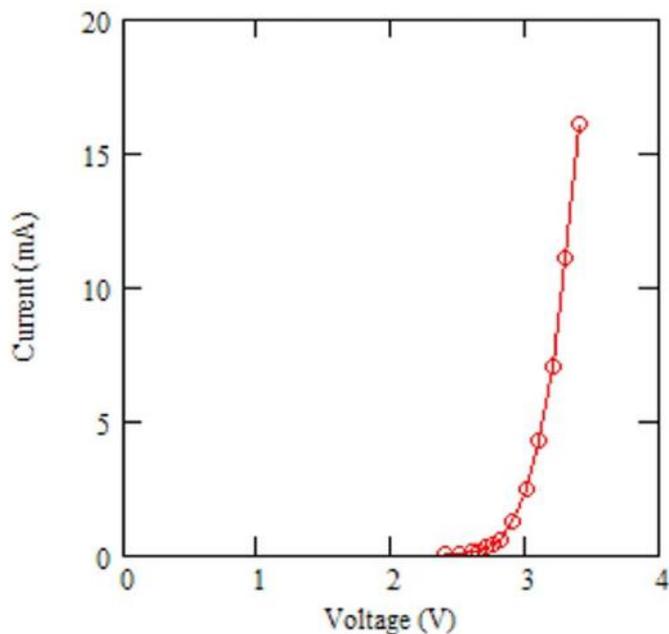


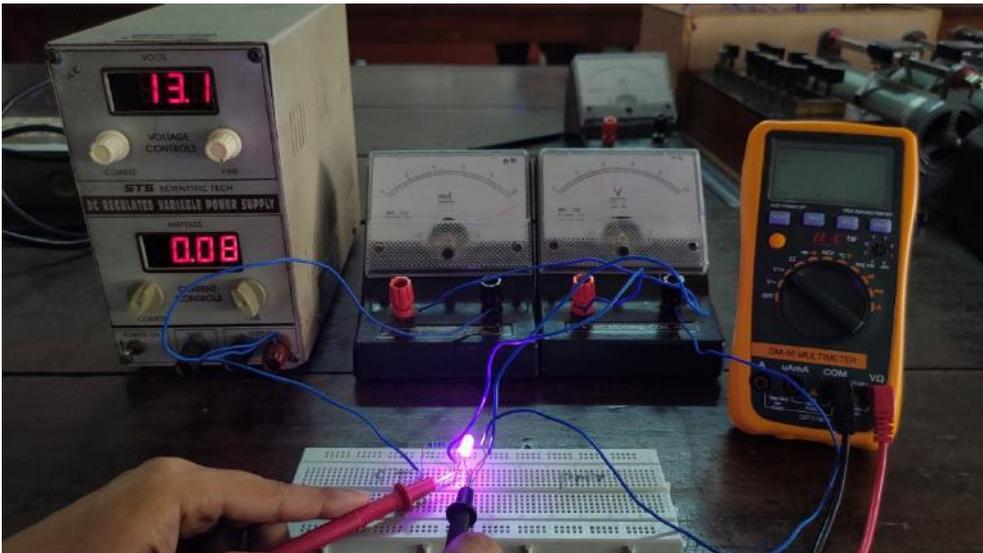
Figure 4-A typical current–voltage curve for an LED. Note that, once the LED turns on, the current increases very quickly with increasing voltage. Be especially careful in this region not to exceed the maximum current.

One method to consider begins with plotting the I–V data on a semi-log graph. Our data should approximate a straight line, indicative of the exponential nature of the current voltage relationship. The I-V of LEDs of different colours are plotted and their turn on voltages are found out, this value is substituted in equation (3) and thus the Planck’s constant is determined.

5. OBSERVATIONS

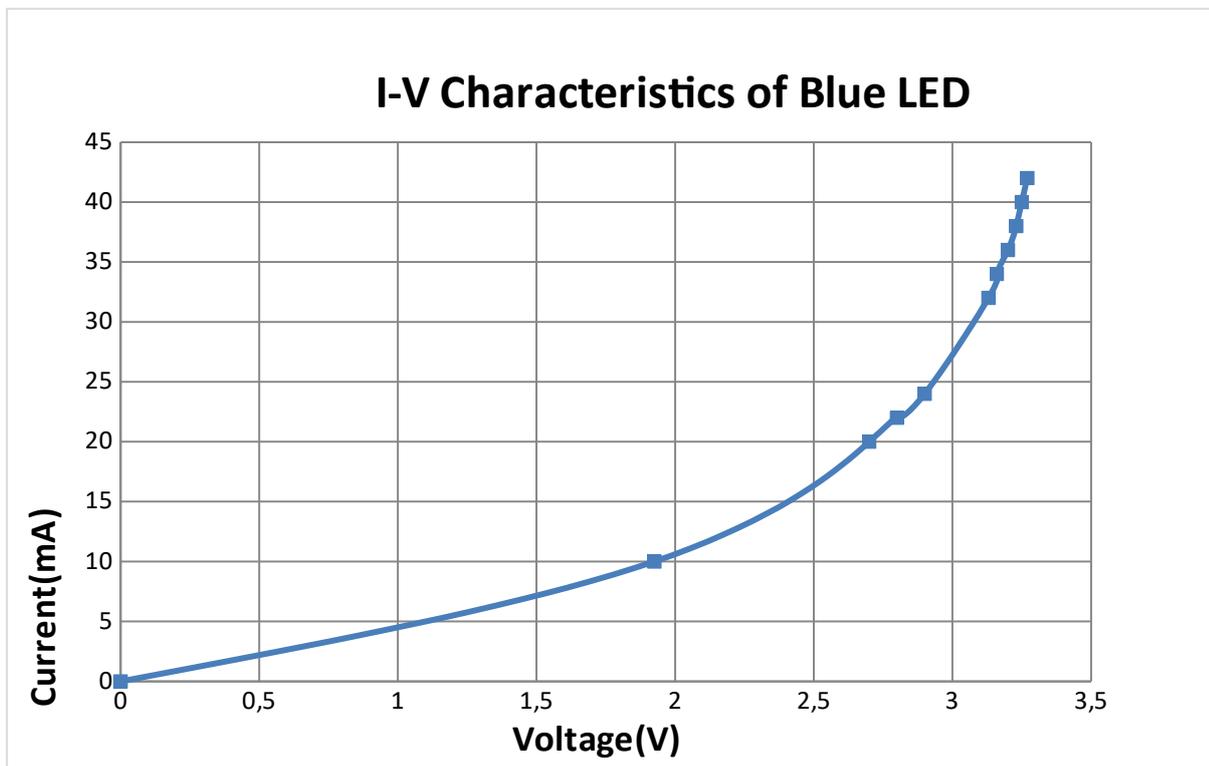
The data obtained by measuring the current as a function of voltage across the five LEDs is given in their respective tables, and the corresponding graphical representation of each table is also given. By extrapolating the respective graphs of each of the five LEDs we obtain their turn on voltages.

1.VIOLET



Wavelength of violet LED, $\lambda = 405\text{nm}$

Voltage(V)	Current(mA)
0	0
1.16	0.2
2.54	0.6
2.56	0.8
2.58	1
2.59	1.2
2.61	1.4
2.62	1.6
2.63	1.8
2.64	2.2
2.65	2.4
2.66	2.8
2.67	3



Turn on voltage (V_0) obtained by extrapolation = 2.56V

We know that $f=c/\lambda$

$$=3 \times 10^8 / 405 \times 10^{-9}$$

$$=7.407 \times 10^{14} \text{ Hz}$$

From equation (2)

$$E=eV_0$$

$$=1.6 \times 10^{-19} \times 2.56$$

$$=4.096 \times 10^{-19} \text{ eV}$$

From equation (1)

$$h=E/f$$

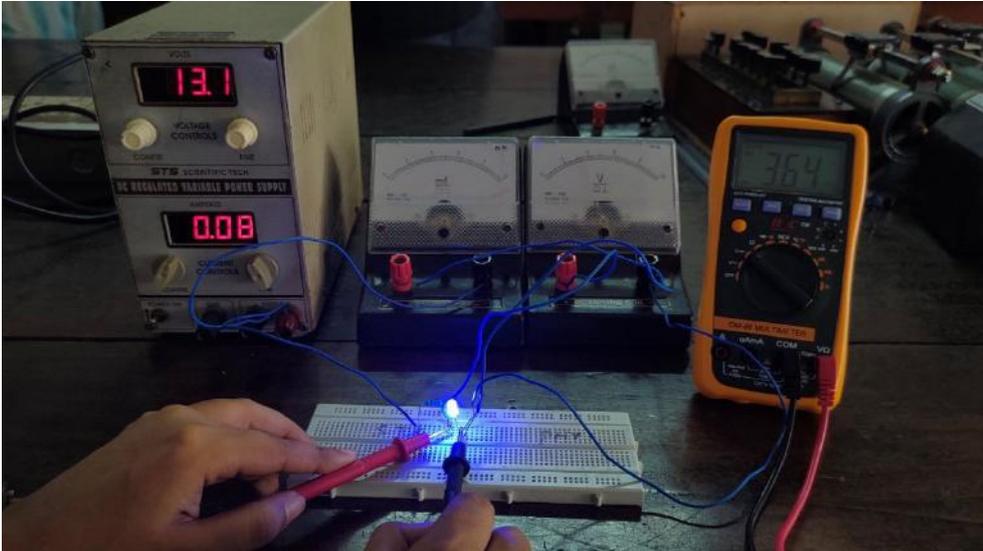
$$=4.096 \times 10^{-19} \text{ eV} / 7.407 \times 10^{14} \text{ Hz}$$

$$=5.5299 \times 10^{-34} \text{ Js}$$

Thus we obtain the Planck's constant for violet LED as $5.5299 \times 10^{-34} \text{ Js}$.

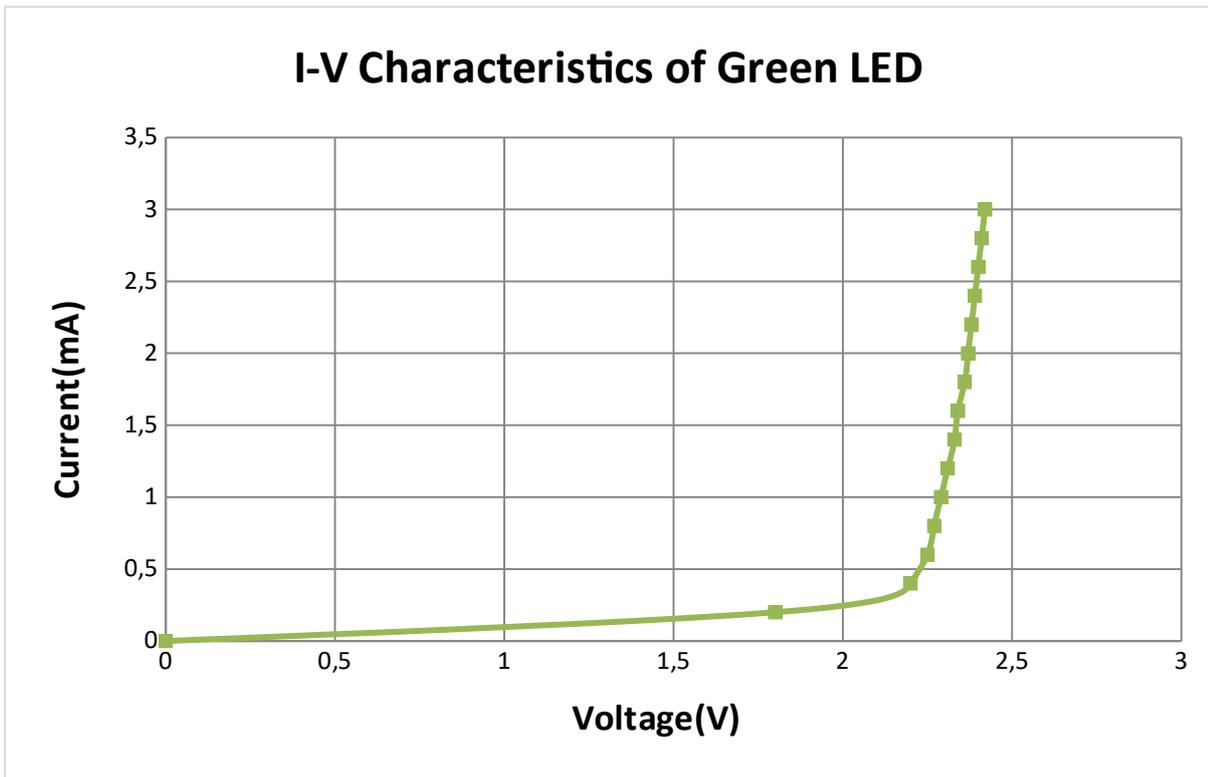
Similarly we can find out the turn on voltages of the remaining four LEDs and thus calculate the value of Planck's constant for each of them.

2.BLUE



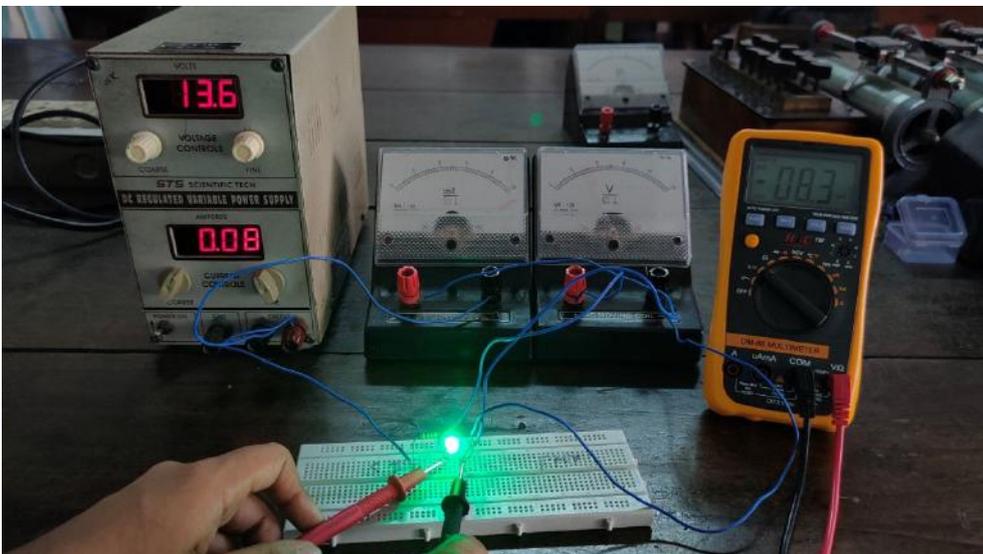
Wavelength of blue LED= 465nm

Voltage(V)	Current(mA)
0	0
1.925	10
2.7	20
2.8	22
2.9	24
3.13	32
3.16	34
3.2	36
3.23	38
3.25	40
3.27	42



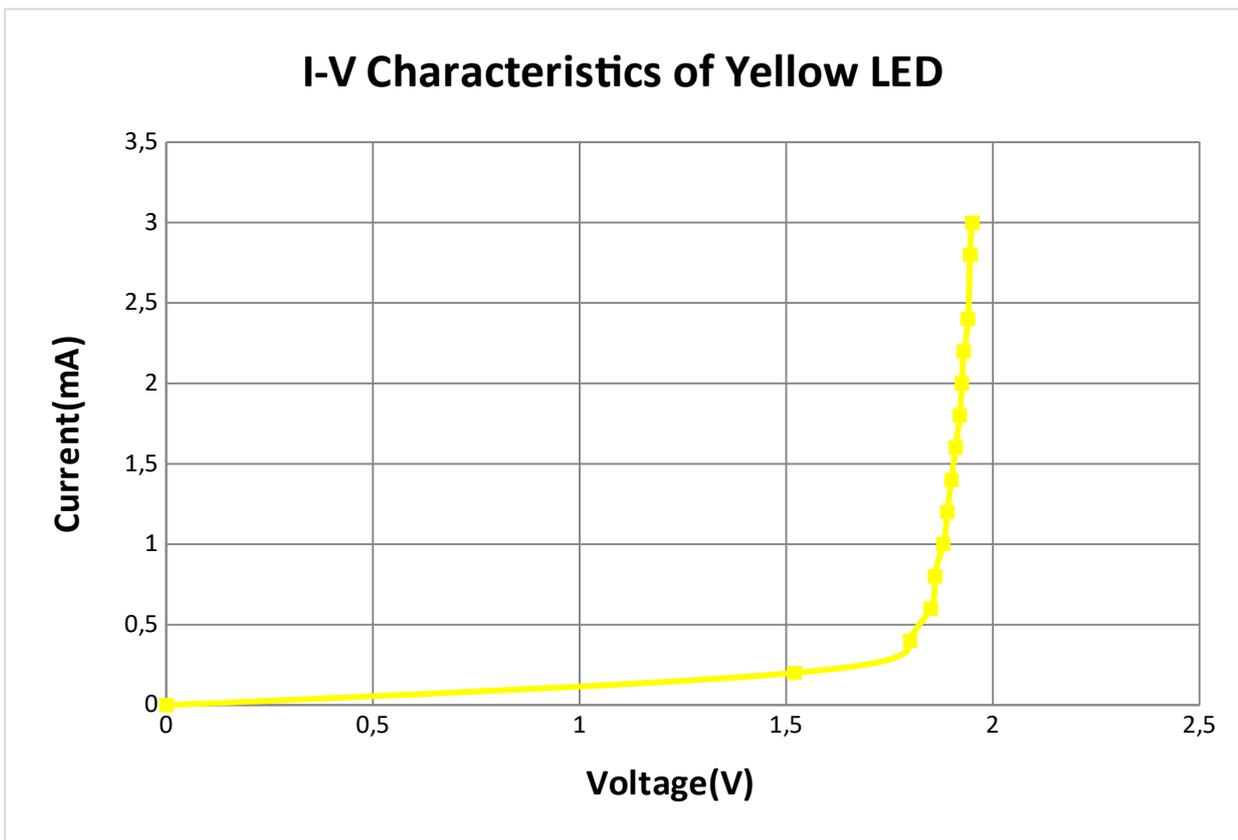
Turn on voltage (V_0) obtained by extrapolation= 2.65 V

3.GREEN



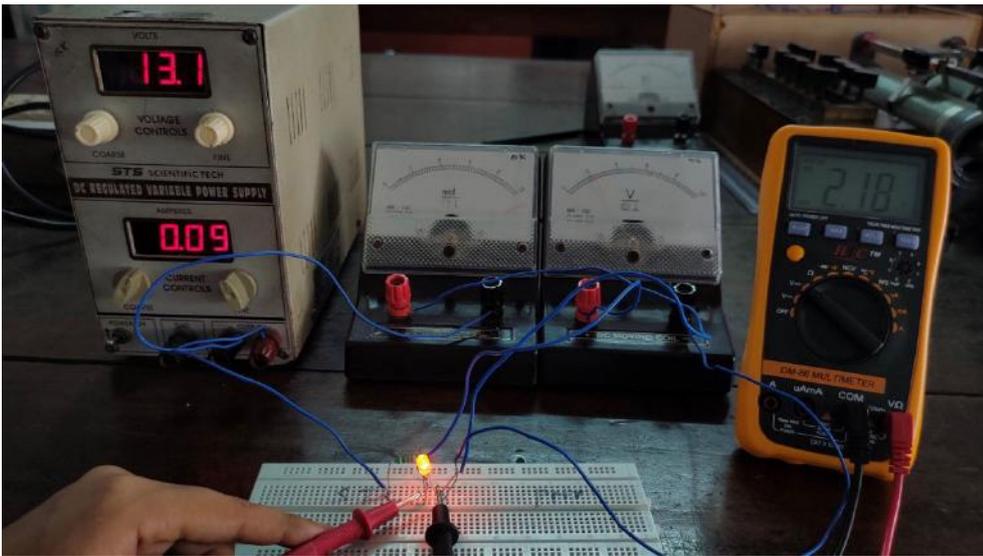
Wavelength of green LED=550nm

Voltage(V)	Current(mA)
0	0
1.8	0.2
2.2	0.4
2.25	0.6
2.27	0.8
2.29	1
2.31	1.2
2.33	1.4
2.34	1.6
2.36	1.8
2.37	2
2.38	2.2
2.39	2.4
2.4	2.6
2.41	2.8
2.42	3



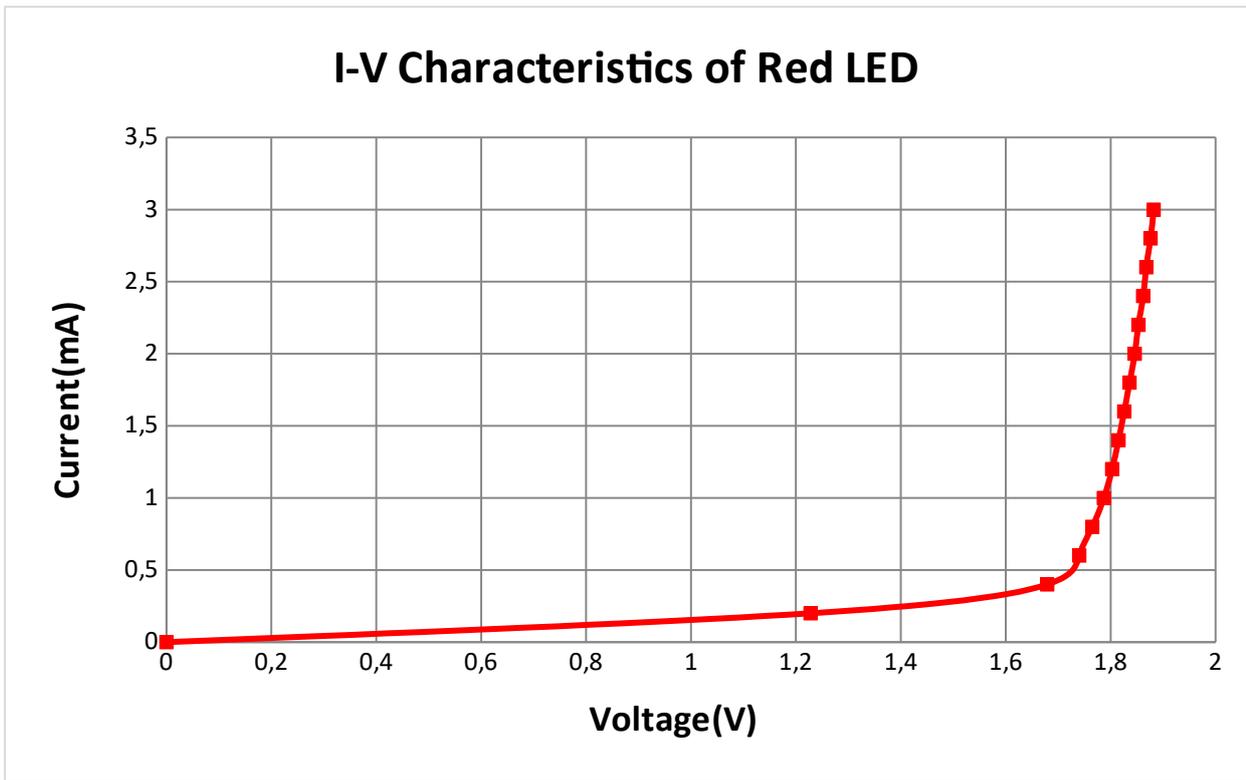
Turn on voltage (V_0) obtained by extrapolation=2.24V

4. YELLOW



Wavelength of yellow LED=650nm

Voltage(V)	Current(mA)
0	0
1.52	0.2
1.8	0.4
1.85	0.6
1.86	0.8
1.88	1
1.89	1.2
1.9	1.4
1.91	1.6
1.92	1.8
1.925	2
1.93	2.2
1.94	2.4
1.945	2.8
1.95	3



Turn on voltage (V_0) obtained by extrapolation = 1.74V

6. RESULT

The final result on the basis of the data collected from the I-V characteristics of all the five LEDs are given in the table below

COLOUR	WAVELENGTH(nm)	TURN ON VOLTAGE(V)	PLANCK'S CONSTANT(Js)
Violet	405	2.56	5.529×10^{-34}
Blue	465	2.65	6.572×10^{-34}
Green	550	2.24	6.571×10^{-34}
Yellow	650	1.86	6.448×10^{-34}
Red	710	1.74	6.588×10^{-34}

7. CONCLUSION

Planck's constant was determined by measuring the energy emitted by a selected number of light emitting diodes having different wavelengths. It has been determined through current-voltage measurements. The mean value obtained is within the limits of experimental error.

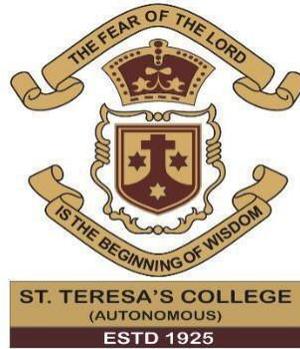
The light emission of the LED starts from a value of potential (V_0) that corresponds to the voltage for which the electrons are able to recombine with "holes" of the valence band. A measure of voltage drop across each light emitting diode was used to Planck's constant by relating it to the energy absorbed/emitted by the diodes through calculating it from the wavelength and voltage. It was found to be approximately similar to the theoretical value whereby it was concluded that the proposed method can be also used to determine the wavelength of light emitted by unknown LED.

There are several other ways to measure Planck's constant; by the study of the photoelectric effect induced by the light emitted from a mercury lamp. Even in this case, the mean value obtained is within the limits of experimental error and in good agreement with the value of literature, considering the available experimental apparatus.

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**A SOCIAL ANATOMIZATION OF SELECT BLACK
MUSIC BY BILLIE HOLIDAY AND ARETHA
FRANKLIN**



*Project submitted to St. Teresa's College (Autonomous) in partial fulfilment of
the requirement for the degree of BACHELOR OF ARTS in English Language
and Literature*

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March 2022

DECLARATION

I hereby declare that this project entitled “A Social Anatomization of Select Black Music by Billie Holiday and Aretha Franklin” is the record of bona fide work done by me under the guidance and supervision of Dr. Preeti Kumar, Assistant Professor, Department of English.

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CERTIFICATE

I hereby declare that this project entitled "A Social Anatomization of Select Black Music by Billie Holiday and Aretha Franklin" by Aleena Jomon is a record of bona fide work carried out by her under my supervision and guidance.

Dr. Preeti Kumar

Department of English

Ernakulam

St Teresa's College (Autonomous)

March 2022

Ernakulam

An Abstract of the Project entitled

**A Social Anatomization of Select Black Music by Billie Holiday and
Aretha Franklin**

By

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BA English Language and

Literature St Teresa's College

(Autonomous) Ernakulam

Register Number: AB19ENG001 (2019-22)

March 2022

Supervising Teacher: Dr. Preeti Kumar

Popular culture has always played an important role in raising the voices of communities that have been discriminated against due to various social practices. In recent years, music is being used as a powerful tool by artists to bring global attention to problems confined within a country. This project analyses two songs by African American female artists: 'Strange Fruit' by Billie Holiday and 'Respect' by Aretha Franklin. Each will be studied by applying the theories of Norman Fairclough's Critical Discourse Analysis, which is a vital tool in examining how the social structure, the social practices and the social events during the time of the release and promotion of both the songs, led to the beginning of reformation and empowerment in the African American community. While 'Strange Fruit' will be examined based on how it was responsible for creating a new genre called 'Protest Music', 'Respect' will be analysed in comparison to its original version by Otis Redding to understand how it influenced the emergence of Black Feminist Organisations that exclusively catered to the needs of African American women.

ACKNOWLEDGEMENT

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Aleena Jomon

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INTRODUCTION

The unequal distribution of power has always been a central theme when it comes to clashes between various communities throughout history. And in this fight for power, those who have been ignored for the most part, use several means for their voices to be heard. Some use violence, some art, and some a combination of both.

Popular culture is one such platform where a dynamic mix of beliefs are voiced through art, in favour of or against certain social incidents or practices. It can be in the form of music, art, theatre or a particular dance form. It becomes the microphone through which the voices of the discriminated are heard. At the same time, it becomes the reason for the development of certain stereotypes about a group of people or a community. The study of popular culture can be considered equal to the study of society at a particular point of time. Therefore, pop culture functions as an index of society and studying it will help unearth the reasons for its development, formation, and decline.

Music is a very powerful tool when it comes to raising your voice or expressing an opinion. It is an art form that has served the purpose of a social platform of expression for a long time, but more prominently during the 20th century. Today, the music industry is one of the most diverse industries that features artists without the barriers of language, race or nationality. However it was initially an industry predominantly dominated by Whites and it took many musical artists from diverse backgrounds to break the mould and raise their voices representing a discriminated community.

This project aims to analyse how music was and is still used as a powerful tool to amplify the voices of the sidelined and the down-trodden. It intends to establish a relationship between music and power by applying the theories of Norman Fairclough's Critical Discourse Analysis. Critical Discourse Analysis is a vital tool in examining different forms of media, particularly the formal kind like newspapers as well as oral, written and visual political discourse. But it can also be used to examine different forms of popular culture to understand how the "internal" study of language

combines with the “external” study of its context, i.e, how the text is affected by social practises and relations (Cheng 360-366)

In this project, two songs from the twentieth century, both by African American female musical artists, have been analysed using discourse analysis to determine how the social structure and practises of that period influenced the making, release of and reaction to the song. The songs chosen to be analysed are ‘Strange Fruit’ by Billie Holiday and ‘Respect’ by Aretha Franklin.

‘Strange Fruit’ became one of Holiday’s most popular hits, owing equally to both the lyrics as well as the way she sang the song. The song was released in the 1920’s at a time when the Black Americans in the South were chained down by the Jim Crow laws. The early 20’s also marked the resurgence of hate groups like the Ku Klux Klan that targeted African Americans and other minorities. Even though ‘Strange Fruit’ is a song that talks about the horrors of lynching, as the years went by, it became a song about large-scale racism in America. It even conditioned the kind of protest music that was to be written and recorded in the future.

In Aretha Franklin’s ‘Respect’, the song will be analysed by comparing it to its initial version, written by Otis Redding. It was released in the 1960’s when, after much struggle and blood-shed, the Civil Right Act was signed and the African Americans were finally emancipated. For Black American women however, the majority of them had to work in domestic service jobs and in agriculture with little to no pay.

Amidst all this, Franklin’s song was empowering, especially for the women of the African American community whose needs and rights were conveniently ignored by the members of their own community. When Feminism became a movement that primarily catered to the needs of White women, Black feminists decided to take matters into their own hands and they did so by excelling in various art forms, especially music.

This project contains the analysis of the aforementioned songs on the basis of the social

structure, social practices and the social events during their time of release and popularisation.

Analysing Billie Holiday's 'Strange Fruit' will be based on how the segregated and racist American society (social structure) and the atrocities suffered by the Black community (social practises) led to the popularisation of songs that helped in empowering the African American community (social events).

On the other hand, an analysis on the song 'Respect' by Aretha Franklin will be conducted taking into mind the hostile environment for women, particularly Black, in America during the 60's. Using

Discourse Analysis, this project aims to prove how America's indifference towards colored women (social structure) and the formation of Black Feminist Organizations in retaliation (social practices) led to the formation of a song that would soon become the anthem for the feminist movement and lead to the empowerment of Black women everywhere (social events).

CHAPTER-1

Fairclough's Discourse Analysis

Norman Fairclough is one of the founders of the Critical Discourse Analysis (CDA) as applied to sociolinguistics. It is a methodology developed to provide a vigorous assessment on how language is used as a tool to exercise power. It is used 'to investigate how such practises, events and texts arise out of and are ideologically shaped by relations of power and struggles over power' (Fairclough 132-133). In simpler terms, when two entities communicate using language, there is an interplay of power between the one who is speaking and the one who is receiving the information.

Discourse analysis challenges "the taken-for-granted nature of language" and unearths deeper meanings that are linked to external factors like the social condition of that particular period of time (Sitz 177-191). It is a tool that proves that texts and discourse are more than just the letters and spaces that make them up. It gives language depth and multiple layers which can be examined through various perspectives.

In his book *Analysing Discourse*, Fairclough talks about the various factors that cause a particular text to be written in the way it has. It can be broadly distinguished as 'two causal 'powers' which shape texts: on the one hand, social structures and social practises; on the other hand, social agents, the people involved in social events' (Archer 195-201) These factors form a linear relationship where the social structures act as abstract entities.

One can think of social structure (such as an economic structure, a social classroom kinship system, or a language) as a defining potential, a set of possibilities. On the other hand, social events, which are the end result of this linear relationship, defines those that actually happen. According to Fairclough, this transition from social structures to social events will not be possible without a mediator

to ease out this transition, namely, social practices.

Critical discourse analysis has two dimensions as detailed by Fairclough: communicative event and discourse order. “Communicative event” includes the reason for the use of a particular type of language during the event. “Discourse order” or “discourse practises” includes the way the language is used during the particular event within a particular institution. Studying a text or discourse through both these dimensions would help in understanding it better in relation to its external factors.

Discourse analysis uses three levels of analysis. The first one constitutes analysing the text itself; the vocabulary as well as the metaphors and other literary devices used, and the grammar and relation between sentences. The second level of analysis includes the discourse practice and how the text reflects or changes it. The third level involves examining the wider social structure that the communicative event is a part of.

Critical discourse analysis can be used to analyse any kind of texts or discourse. In other words, it can be used in anything as long as it involves language. By analysing the usage of language along with its context, discourse analysis helps in studying a text by looking at it through multiple perspectives. Just like how interviews, government policy documents and poetry can be broken down by critical discourse analysis to bring about new meanings, this project intends to use the tool on music and prove how it is a product of particular social practices in a given social structure .

Looking at it from a bird’s eye view, music can be considered as a powerful form of discourse between the creator and the society. While the focus is usually on the singer, music is only made whole when the instruments are taken into account. Therefore, analysing songs using discourse analysis will not just include focusing exclusively on the lyrics, but also the instruments used and how it enhances the meaning of the song to its listeners. Using this tool, two songs from the twentieth century, both by African American female artists, will be analysed to understand how the African American community used music as a tool to amplify their voice and empower their community. The

two popular songs taken from the Jazz and Blues genre, have been chosen particularly for their lyrics, the controversy they sparked, and the changes they brought about in the music industry.

CHAPTER-2

America in her early 20s: Blues, Jazz and Civil Rights

“Jazz music is the power of now. There is no script. It’s conversation. The emotion is given to you by musicians as they make split-second decisions to fulfil what they feel the moment requires.”

- Wynton Marsalis

-

America in the early 20’s saw the Republicans dominate the presidential elections, vowing to bring ‘normalcy back’ after a World War that drastically shifted the economy. The Republicans were in favour of business expansion rather than regulation and the American society was prosperous under them. However this was true only for the White-skinned citizens and not the coloured. Black Americans, 70% of those who lived in the South, were chained down by the infamous Jim Crow laws. And even though the Northern states were known as the considerably ‘liberal’ states because of their refusal to enforce the Jim Crow laws, segregation was still a huge part of the community, with Black musicians only allowed to play their music in Black bars and clubs. Most importantly, the early 20’s also marked the resurgence of hate groups like the Ku Klux Klan that targeted African Americans and other minorities.

A crucial incident that marked the protest against the various injustices Black Americans had to endure, was the Red Summer of 1919 Chicago. All it took was a single act of defiance by a 17 year old African American boy, an act of defiance that was not even motivated by a desire to riot. On July 27, when thousands of citizens sought relief from the beating heat of the Chicago sun, Eugene Williams and his friends inadvertently crossed the invisible line that marked the division between the Whites and the Blacks, which led to a group of Whites stoning and drowning him. What followed was a riot that lasted a whole week, leaving countless Americans killed.

It was against this political backdrop that Jazz was born. It is a musical genre that has been subject to much romanticization since it was an art form born out of the Black man's desire to create something that was solely his own. The musical genre itself became world renown for its improvisation techniques. In many ways than one, Jazz music was famous for being more than just a musical genre; for many, it was a lifestyle. A lifestyle centred around New Orleans, born out of improvisational jam sessions by groups of less renowned, yet talented music artists, sitting inside little bars where the Black American community tasted liberty in their fine bottles of wine like they never did in the South. For the African Americans, New Orleans was where the magic happened.

While Jazz emerged as a popular genre of music among all communities in America, Black and White alike, the radio stations did not permit song recordings of Black artists to be broadcast. As a result, it created a demand in the market, which was soon filled by White musicians like Bix Beiderbecke. But it was African American musicians like Louis Armstrong and Duke Ellington who established Jazz music as an international sensation. Their music and fame rose to such heights that they were even permitted to perform in all-white clubs and bars. Yet, the lesser known Jazz musicians still suffered the brunt of racism and class exploitation, especially women who also had to endure the extra dose of sexism. Many musicians like Dexter Gordon and Randy Weston were forced into exile due to the Jim Crow laws.

The start of the twentieth century saw the popularisation of the latest invention of the century: the phonograph. By the early twenties, popular record companies had emerged, selling records of White musicians exclusively for the White community. As for the Black community, their thirst for music was quenched by a category of records termed 'race records'. These were records containing music by Black musicians, exclusively for the Black community. Before Jazz became the popular genre among the community, Blues and Gospel music dominated the evenings in every Black household as people sat down to relax after a hard day of labour. The popularity of race records was therefore

confined within the Black community. This was because many record companies were reluctant to produce music by African Americans because they believed that it wouldn't be cost-effective.

But after the success of Black American singer Mamie Smith's "That Thing Called Love" and "You Can't Keep a Good Man Down", many phonograph record companies realised how they can profit extensively through Black music artists. It led to record companies like Columbia records, that previously didn't permit recording for Black musicians, produce songs for artists like Bessie Smith, who came to be known as the Empress of Blues.

Thus, race records became a phenomenal part of the music industry and Jazz found itself a niche in the hearts of all Americans, Black and White alike. It created a storm of change in how the Black community was perceived and formed new perceptions about them. And even in this climate of change where the members of the Black community were finding upliftment in better job opportunities and considerably more wages, the advertising of the race records themselves were inherently racist with posters of Black faced characters engaging in lewd activities. But through all such powerfully racist overtones, Jazz rose with music that swayed the hearts of people everywhere.

Not all music artists were dedicated to making swaying music for commercialisation purposes. In the late 30's, with an increasingly racist economy as its backdrop, Jazz Protest music was born. Protest music was a genre that bloomed under chaos and a daring desire to raise the voices of the exploited. In America, Protest music can be dated back as far as the 18th century when songs were sung as part of the abolition of slavery and women's suffrage. Many Black American spiritual singers would often incorporate empowering lyrics in their Gospel music against slavery and oppression.

In the twentieth century, Protest music reached new heights as a music genre especially amidst the Civil Rights movement and the Vietnam War protests. Songs against racial discrimination in America started being released in the 20's and were often banned from playing on radio stations. Protest music, thus became an immensely controversial, yet popular genre, capable of grabbing an

entire nation's attention. Billie Holiday's 'Strange Fruit' was one of the first songs to fall in this genre. A detailed analysis will be conducted on the lyrics as well as the musical style of the song to understand how the segregated and racist American society (social structure) and the atrocities suffered by the Black community (social practises) led to the popularisation of songs that helped in empowering the African American community (social events).

Recognized as the song of the century by Time Magazine in 1999, 'Strange Fruit' by Billie Holiday was, as Ahmet Ertegun, the co-founder of Atlantic records rightfully called it, "a declaration of war...the beginning of the civil rights movement" (Pietsch)

The song, originally a poem, was written by a Jewish school teacher, Abel Meerpol after he saw some disturbing photographs of a lynching that took place in 1930 of two Black men, Thomas Shipp and Abram Smith. Meerpol published the poem, added music to it, and started singing it at union meetings. It was a club manager of Cafe Society who first heard this song and soon, Meerpol was invited to sing it for Billie Holiday.

From the moment she heard it, the song had become close to her heart and Holiday knew she had to sing it. In her biography, she talks about how the song reminded her of her father, a renowned singer himself, who died in a hospital in the South because the doctors wouldn't treat him, on account of the Jim Crow laws (Holiday 95)

Holiday herself had been subject to much racism as a talented music artist. Being the first Black female singer to ever join a White orchestra that toured the South, she described an incident in her autobiography where she was not allowed to sit on the same bandstand as the other vocalists. While touring, she would often be heckled by racist members of the audience. There was even an incident where a man in the audience called Holiday a "nigger wench" and she had to be escorted off the stage before she retorted in anger. Things got so problematic that the band manager was forced to hire a White lead vocalist other than Holiday in an attempt to tone down the criticism he received for having a

Black member in his group. Another incident, which may have contributed to her leaving the band for good, was when she was asked to use the service elevator in a hotel because the White patrons complained about it.

The song ‘Strange Fruit’ became one of Holiday’s most popular hits, owing equally to both the lyrics as well as the way she sang the song. Cultural critic Emily J Lordi describes how “there is a simmering rage in the way she clips the syllables.....but there’s also a deep mournful quality to Holiday’s performance” (Amaoko)

The song starts with the trumpet and the piano playing a sombre tune that lasts a whole minute. This is pretty common in the Jazz music genre where the instruments are given ample time in the beginning to “set the mood” of the song. The instruments play in a slow, eerie manner, with the wails of the trumpet literally engulfing the entire room in a shroud of suspense. Then the piano takes over and Billie starts to sing:

Southern trees bear a strange fruit

Blood on the leaves and blood at the root

Black bodies swingin' in the Southern breeze

Strange fruit hangin' from the poplar trees

The first line clearly indicates that the song is talking about trees in the southern region of America. Known for its blatant racism and horrible treatment of anyone who isn’t White, the South has always been a nightmar-ish land for the Black Americans. The enforcement of the Jim Crow laws are a clear indicator of it.

The second line is where the horror begins. In a way, the Southern trees can be compared to the United States of America itself, the “leaves” being the Northern states and the “root” being the

Southern states. It indicates how the entire country has blood on its hands; the blood of those very people who helped sow the seeds of progress and nurtured the country to the greatness that it now basks in. Even the Northern states do not shy away from letting their Black inhabitants know from time to time, who is really in charge.

Applying discourse analysis, a clear comparison can be formed between the terms ‘blood’ and ‘tree’ and how they have been used together to form a gothic imagery. The term ‘blood’ is often associated with death and suffering. In religion, it also does the meaning of sacrifice. Comparing this to the symbolic meaning of terms like “trees”, “leaves” and “root”, all of which represent nature and life, the combination of such starkly opposing terms only serves to enhance the horrific imagery that the song generates in the minds of the listeners.

By the third line, we can also see how the word ‘swinging’ is pronounced ‘swingin’, replacing the /ŋ/ sound with the /n/ sound. This is a very common linguistic characteristic of Southern American English, which became extensively adopted as a notable feature in African American English. This dialect of English can therefore be heard predominantly in the country music genre as well as Jazz music

The fourth line confirms our suspicions of the ‘strange fruit’ mentioned in the first line, being a metaphor for the lynched and suffering Black Americans of the South. Lynching was a brutal but popular practise in the South of America and Black Americans often fell victim to it in the hands of the Whites. It is also interesting to analyse how they are compared to a fruit, which is a product of labour. It indicates the irony lying deep in the fact that even though they work hard for their country (Holiday’s father was serving in the first World War when he fell ill and was refused treatment because of his race), the fruit of their labour is their own lynched bodies hanging from trees.

Also the mention of poplar trees is also significant here, with regard to what comes in the next line. Poplar trees are often associated with victory and heroism. During those times, the lynching

of Black Americans was not considered a cruel deed, but a heroic one. The people responsible for the act were hailed as protectors of their town, guarding the good American women and children from the wicked hands of the savage Blacks. Here, the bodies hanging from the poplar trees indicates the irony of what the tree really symbolises.

Pastoral scene of the gallant South

The bulgin' eyes and the twisted mouth

Scent of magnolias sweet and fresh

Then the sudden smell of burnin' flesh

The Southern states of America dominated in the agriculture sector. States like Alabama and West Virginia are so famous for their quaint-and-country-side landscapes that they dominate in most of the country songs made by White music artists. For the White folk, the countryside is home. For the Blacks, it is a reminder of the torture that their ancestors suffered as slaves.

The fifth line has clear undertones of mockery and satire attached to it, especially in using the adjective 'gallant' to describe the South. The 'pastoral scene' refers to the countryside of the South, frequently described in popular culture as something that occupies a special place in American hearts. The next line completely reveals the ugly side of the popularized quiet country-side, the one where the slaves who tilled the soil are mercilessly lynched and tortured. The description of the eyes and mouth of the lynched bodies is bound to heighten the feeling of horror in the listeners. The next line talks about the 'scent of magnolias' which is a very interesting metaphor for the South. Magnolias are white, sweet-smelling flowers, popular in the South-western areas of the United States. Southern states and cities like Mississippi and Houston, Texas are even called the 'Magnolia State' and the 'Magnolia City' respectively. They host a large variety of magnolia flower trees and it is even the state flower of both

Mississippi and Louisiana. And the fact that the very flower that apparently symbolises the “purity” and “simplicity” of the country-side, is mentioned in a song about its ugly, brutal side, is an irony in itself. The mention of the scent of the sweet smelling flowers mingling with that of burning flesh as detailed in the eighth line, further explains the disparity between appearance and reality and how the ideal of the ‘American Dream’ did not hold true for an entire community.

Here is a fruit for the crows to pluck

For the rain to gather

For the wind to suck

For the sun to rot

For the tree to drop

Here is a strange and bitter crop

While the initial verses talked about the torture of Black people in the hands of the White race, the last verses talk about the torture that the lifeless bodies endure in the hands of nature. It indicates how even when life is drained out of their bodies, it is still subject to torture and disfigurement. The bodies are compared to a fruit plucked by crows, gathered and sucked by the rain and wind, and left to rot by the sun. And finally, the very tree that they called home, the home that they worked hard to build, drops them like lifeless props, or as described in the song, ‘a strange and bitter crop’. Here, as previously mentioned in the first line, the term ‘tree’ becomes a metaphor for the United State of America which was only home to the Black community in appearance and torture in reality.

As mentioned before, Holiday sings the song in a sharp tone, barely letting the syllables escape her vocal cords longer than they should. By the last few verses, her voice draws each syllable out and by using monosyllabic words with similar rhyme scheme like ‘rot’, ‘crop’ and ‘drop’ and

‘pluck’ and ‘suck’, the finality of the song as well as the brutal practise of lynching is reflected.

When Holiday decided to record the song, Columbia records refused to have any part in it. Hence, ‘Strange Fruit’ was taken up by Commodore Records. Holiday almost didn’t record the song because the CBS radio network rejected it as many feared the wrath of the South. The release of the song really marked the beginning of a protest era against the lynching of Black Americans. Many sent the song to their congressman with an appeal to form a viable anti-lynching bill.

For Billie Holiday and the poet Abel Meerpol, the song led to unfavourable consequences. Meerpol was brought in and questioned about his ties with the US Communist Party and whether they had paid him to write the song. And as for Holiday, it is said that this song was responsible for her tragic end. Apparently the song had caught the attention of the head of the Federal Bureau of Narcotics, Harry Anslinger, who was a known racist. He strongly believed that drugs were what made Jazz singers produce ‘the devil’s music’ It was after the release of this song that Holiday was convicted for using drugs and as a result, lost her licence to perform in bars. Aslinger went so far as to handcuff Holiday to her deathbed, and there was a popular speculation that the officers forbade the doctors to give her further treatment. She died a few days later, a legendary singer reduced to a tragic figure with barely any money left in her name.

According to Discourse Analysis, there are two causal ‘powers’ that shape texts: social structure and practices, and social events and the agents responsible. During the release of Billie Holiday’s ‘Strange Fruit’, the social structure of the United States of America was one that was unfairly and unjustly biased towards the White community. During the 1920’s, almost 70% of the Black Americans were concentrated in the South of America and suffered severely under the Jim Crow laws. Even in the north, segregation was an inseparable part of society in almost every aspect. This was the social structure that formed the foundation for the social practices which heavily influenced Billie Holiday’s song.

The social practises against the Black community involved discrimination and seggregation in various fields like education and employment, exploitation in the domestic areas of work, and severe form of punishment that included the horrors of lynching. Many Black convicts were even sentenced to death by the electric chair without proper trial. And the White perpetrators of torture like the Ku Klux Klan were barely targetted and tried for the atrocities they committed against the Black community.

It was amidst this racially discriminated and exploited social structure where practices like lynching wee porminent with much liberty, that ‘Strange Fruit’ was released as a sign of protest. Thus, the social structure and the prevailing social practices led to the formation of ‘Strange Fruit’ which inspired and empowered the Black community of America.

Even though ‘Strange Fruit’ is a song that talks about the horrors of lynching, as the years went by, it became a song about large-scale racism in America. It even conditioned the kind of protest music that was to be written and recorded in the future. In 2002, the song was added to the National Registry of the Library of Congress. Many musicians have recorded cover versions and sampled the song, including Nina Simone and Kanye West. When British singer Rebecca Ferguson was invited to sing at President Donald Trump’s inauguration in 2017, she said that she would only accept it if she could sing ‘Strange Fruit’. The fact that the song still holds the power that it once carried almost a century ago, speaks volumes of the immortality of music.

And applying Discourse Analysis, it becomes clear that the racist American society which forms the social structure, and the racist practices like lynching against the Black Americans that constitutes the social preactices, led to the formation of ‘Strange Fruit’, a social event that triggered as series of events relating to protests and civil strife.

CHAPTER-3

1960s for the Black Americans: Rising from the Ashes

“The thing the sixties did was to show us the possibilities and the responsibility that we all had. It wasn't the answer. It just gave us a glimpse of the possibility.” - John Lennon

The sixties was a time of change for people of all groups. When John F. Kennedy rose to power, he was confronted with civil unrest and uprising by the Black Americans of his country. The uprising was against the discriminatory acts of segregation in public places, based on race, sex, religion, etc. Even though Kennedy initially brushed off the emerging protests in hopes that it would subsequently quell down, the particularly brutal ways in which the police suppressed these uprisings with the help of savage dogs and high pressure fire hoses, forced him to take action. Thus came to be, the proposal of the Civil Right act and Kennedy's famous quote “The United States of America will not be fully free until all its citizens are free.”

Following the assassination of Kennedy, President Lyndon B. Johnson took up his cause and signed the Civil Right Act in 1964, amid much protest from the Southerners. It detailed on desegregating public places and schools and criminalized discrimination on any basis. The Black Americans were finally emancipated. This dream of theirs that came to be with Abraham Lincoln's declaration to free the slaves finally materialized almost a century later.

However, this did not lead to any major change in the lives of Black American women. They were still shunned from the feminist movement and endured domestic violence at

home. The Black women in America were first considered workers, and then women. Majority of women worked domestic service jobs and in agriculture with little to no pay. They have been working way before the White woman found her way into the workforce. Yet, their wages are not their own. They owe it all to the man of the house.

Even in the sixties, women in America, irrespective of their race, couldn't even own a credit card without their husband's consent. They weren't even granted admission in many Ivy League colleges, nor were they allowed to serve in the jury before the passing of the Civil Rights Act. And as for being in charge of their sexual health, women who used birth control pills were considered immoral and prostitutes. It was only several years later that using the pill as a contraceptive was approved, regardless of marital status.

While it was a far more progressive time for women compared to the previous decades, the repeated emphasis on women's place being in the kitchen making sandwiches for her working husband while foot-rocking her child's cradle, made it impossible for women to break through their shackles. When the second wave of the Feminist Movement, spearheaded by Betty Friedan's 'The Feminine Mystique' came to be, it brought about tides of change in the hearts of American youth. "In the feminine mystique, there is no other way for a woman to dream of creation or of the future. There is no other way she can even dream about herself, except as her children's mother, her husband's wife" (Friedan 78)

The growing demands for equal pay and stricter laws for the protection of women led to the formation of a Commission on the Status of Women with Eleanor Roosevelt as its chairwomen. But in a televised interview with Kennedy, the President stated, "We want to be sure that women are used as effectively as they can to provide a better life for our people, in

addition to meeting their primary responsibility, which is in the home." (Rosen)

In an attempt to attain middle ground between a public made predominantly of misogynists and a small number of feminists who chain themselves to electric posts, we see the President sending mixed signals about the role of women in society. Many women have written extensively about this dilemma they face when it comes to choosing between what they want and what society wants for them. "(A woman) is ceaselessly exhorted to be attractive, tend to her makeup and hair colour, be smart but not too smart, get a good job, but only so as to be able to meet eligible men, all for what? Why, to get married, to stay at home and take care of baby, in soap-powder bliss."(Crow 414)

The rise of the feminist movement was predominantly focused on the interests of White women and overlooked the large score of Black women in America. For the African American women, racism was a double-edged sword. They were not only shunned and denied opportunities because of the colour of their skin, but also because they were women. They were victims in the hands of men from their own race as well as White men.

The sixties saw the emergence of many Black feminists whose primary aim was to shift the society's attention to the plights faced by the women of their race and starkly differentiate it from those put forward by White women. While White feminists dominated the feminist movement, the Black women felt like they were being excluded as they were barely represented.

There have been women who have been able to think better than they've been trained and have produced the canon of literature fondly referred to as "feminist literature": Anais Nin, Simone de Beauvoir, Doris Lessing, Betty Frieden, etc. And the question for us

arises: how relevant are the truths, the experiences, the findings of White women to Black women? (Bambara et al. 5)

It was in these circumstances that Black protest music popularised, not just voicing the interests of a community as whole, but particularly, the women of the community. Unlike how it was a century ago, the American music industry was dotted with African American female stars who shattered records with their songs each year. Most of these artists chose to leave their mark in the music industry by releasing controversial songs that not only catapulted them into international fame, but also donned them as advocates and representatives of their community.

The 1960's was thus a revolutionary time for the musical industry. Black musicians were dominating the music industry, mostly through girl and boy-bands. One of the first girl-band groups to be formed and grace the Rock and Roll Hall of Fame were The Shirelles who were the first girl band to top the US charts.

The start of the sixties also saw many popular Black-owned record companies that soon overtook the predominantly White industry. One of the most successful record Black-owned record labels in the United States at that time was Berry Gordy Jr.'s Motown Record Corporation. From Marvin Gaye to Micheal Jackson, Gordy brought many Black musicians into the limelight of the world through his record label. Along with the emergence and popularisation of funk and rock and roll, soul music also found a significant fan base by the mid-sixties. Singers like Sam Cooke and Ray Charles were at the fore-front when it came to producing soul music, and they were soon joined by singers like Otis Redding and Aretha Franklin.

With the emergence of the second wave of the feminist movement, many female singers started to use the power of music to spread awareness and let the world know that songs need not always be centred around a man's broken and yearning heart; that women need not be toys to be used and played in the hands of men. It is by taking this hostile environment for women, particularly Black, as the social structure that a discourse analysis will be conducted on the song 'Respect' by Aretha Franklin. Mainly falling in the soul genre, the song also combines the characteristics of Rock and Roll, Blues and Gospel music.

In 1965, the upcoming R&B singer Otis Redding wrote and recorded a song called Respect that was about a man who comes home after a hard day's work and pleads with his wife to treat him a little better and give him some respect. The song became a crossover hit and was similar to a multitude of songs talking about a man's plight in the cooking, washing, cleaning, baby-feeding hands of women.

Aretha Franklin, popularly known as the 'Queen of Soul', was a child prodigy who belted out Gospel music from an early age. Her father was a renowned musician himself and his contacts with other popular musicians shaped Aretha's voice and style of music. At the age of 18, she decided to set out on her own to redefine her musical career that was predominantly dominated by Gospel music. She adopted a style that combined the Gospel music style with Rhythm and Blues. Franklin heard Otis Redding's 'Respect' and recounts in an interview about how she felt she "could do something different with it"(Weller)

In a way, the two versions can be seen as a conversation between the man and woman in the song. The difference between Otis Redding's original and Aretha Franklin's version notably underlines specifically why women need more representation in their lives. While

Redding dons the suit of a man whose only demand is a little respect from his wife when he comes home, Franklin cleverly turns the tables and empowers the woman in her song. She expertly changes the tone of the song, from pleading to demand.

While Redding's song starts off with a faster tempo, predominantly in the Jazz style, Franklin adopts a mix of R&B and Jazz. The starting beats of both the songs are responsible for setting its tone and mood and keeping this in mind, the beginning of Redding's song gives a marching band vibe that can be categorised as masculine, while Franklin's song starts off with a lazy but consistent and catchy beat that unnervingly reflects a feminine attitude. The dynamics between the high inflection and the low tones can even mimic a woman's constant battle between what she wants and what the society thinks she is supposed to want.

The original song starts with the line:

What you want, honey, you got it

And what you need, baby, you got it

All I'm askin' is give me a little respect when I come home

Clearly, we are introduced to a generous and loving man in the beginning of the song. The first two lines emphasise on how the man is ready to provide anything and everything that his wife needs. The third line is where the theme of the song is officially introduced. All the man is asking for his generosity and kindness towards his wife, which was a rare thing at that time, is a little respect when he comes home after a hard day's work.

Looking at it from a feminist perspective, the man is clearly painting himself as a

benevolent hearted person for doing his basic duties as a partner. His generosity and open minded attitude is considered a rare and special thing here when in reality, it should be the normalised behaviour of every partner. The fact that it is considered rare tells us a lot about the way men treated their wives at that time.

Plus, for the women of the African American community, staying at home was almost never an option. Usually both partners went to work and earned money to make ends meet. So the fact that even though women work as hard as men, they are asked to be indebted to the male members of their family, just comes to show the patriarchal norms embedded in the society.

Contrasting this with Franklin's version, the song starts with the lines:

What you want

Baby, I got it

What you need

Do you know I got it?

All I'm askin'

Is for a little respect when you get home

Here we have the female perspective entering the scene. Aretha cleverly changed the lyrics by portraying the woman as someone who fulfils her duties as a wife just like the society wants her to. She conforms to its norms and remains the faithful wife that she is and yet, when her partner comes back from work, she is given no respect. In fact, respect is demanded from her without any care about giving it back.

The line “What you want, Baby I got it” clearly contains sexual connotations that portray a strong and passionate woman who clearly knows what she wants. By singing the line “Do you know I got it?” She challenges the male figure in her song for assuming that women often have to be told what to do and want and need.

A difference in the initial line between the original song and Aretha’s version is the vocalisation of the phrase ‘just a little bit’ between each verse. The emphasis on this phrase, which becomes an iconic part of the song itself, can be considered as a satirical plea towards men to at least do the bare minimum.

Both the songs are sung in African American English that is mainly dominated by the avoidance of pronouncing the ‘ŋ’ sound in the end of words like ‘asking’.

The second verse of the Redding’s song again represents a helpless man at the mercy of his wife’s demands:

You can do me wrong, honey, if you wanna

But only do me wrong, honey, while I'm gone

All I'm askin' is give it, give it when I come home

Here we have the man openly telling his wife that if she wants to have affairs with other men, she gladly can, but only when he is not at home. This again feeds into society’s frequent association of women with betrayal. The unfaithful woman is and has always been a popular character from the time of ancient myths. A woman who demands and wants has always been considered a threat to society.

In Aretha's version, the lyrics are cleverly changed to:

I ain't gonna do you wrong while you're gone

Ain't gonna do you wrong 'cause I don't wanna

All I'm askin'

Is for a little respect when you come home

As mentioned before, both the versions of the song can be considered as a conversation happening between the man and his wife. We also get to see the use of words like 'ain't' and 'wanna', all of which are prominent characteristics of the African American language. The word 'ain't' actually came from the word 'amn't' which is a contraction of 'am not'. It was once a very popular word used among Victorian elites. But it soon became associated with the language of the lower class and became a symbol of everything that was not 'proper English'.

The word 'ain't' was and has always been a very prominent characteristic of the African American language. It is also a word that has been popularly and proudly incorporated in all forms of African American art, especially music. For a long time, the word wasn't even considered one and was nowhere to be found in a dictionary until the late 20th century, which in turn created a controversy on how the English language is being butchered.

Words like 'wanna' and 'gonna' are actually considered more American English than African American English. Yet, they are still extensively used in both countries as well as Jazz musical genres.

Another observation made was how often and exclusively, words like 'honey' and

‘baby’ are used in both the songs. While Otis Redding’s version uses both the words to denote the woman, the word ‘honey’ is more frequently used. This clearly highlights the subtle sexist undertones present in the song. Objectification of women has, for a long time, been an issue that feminists have tried to tackle for so long. Calling the woman ‘honey’ while complaining about her lack of attentiveness to the singer’s needs also shows how women are portrayed satirically in the song.

In Aretha’s version, the man is addressed as ‘baby’ more than ‘honey’. By doing so, the male figure in the song is infantilized by the female. While the satirical nature of the song doesn’t change, the reversal of roles automatically adds an element of empowerment in her song. It not only highlights how men are frequently prone to throwing tantrums for not being paid the slightest attention, but also how derogatory the term is in the previous context.

The next verse of Redding’s song goes:

Hey, little girl, you're sweeter than honey

And I wanna give you all of my money

All I'm askin' is give it when I come home

The first line starts with what seems like high praise for the singer’s partner. Again, the issue of objectification comes to light here. The singer also addresses the woman as ‘little girl’ indicating how women were supposed to look like and perceived to be during that time. Here, we get to see infantilization working against the female figure in the song. To be timid and obedient and petite and soft spoken was what it meant to be a woman. They were and still are

treated like little girls who often need to be told what to do because they aren't known to be capable enough to do anything themselves.

The second verse is also interesting because again, we see women being portrayed in a negative light. Here, by talking about giving all his money to his partner, he trivialises the desires of a woman by making it very materialistic. For a long time, women have always been associated with the word 'gold-digger' and this line is another subtle way to mean the same thing.

Aretha's version goes:

I'm about to give you all of my money

And all I'm askin' in return, honey

Is to give me my propers

When you get home

Yeah baby

Whip it to me (respect, just a little bit)

When you get home, now

From the first line itself, we clearly understand that Aretha is talking from a working woman's perspective. And in the African American community, almost all women had to get menial jobs for themselves to make ends meet. These women were forced to give all their money to the man of the house. they couldn't keep it for themselves. It wasn't until 1974 that the Equal Credit Opportunity Act was passed and women could finally open bank accounts irrespective of

their status as widowed or unmarried. Until then, a man was required to accompany women in financial matters.

The next line is an iconic one because it is responsible for actually changing a common adjective into a plural noun. The phrase 'give me my propers' spread like wildfire after the song hit the top of the charts.

Her use of propers (which many heard as profits) in the lyric was her own, not in the words originally written and performed by Otis Redding in 1965. "I do say propers," says the queen of soul. "I got it from the Detroit street. It was common street slang in the 1960's. The persons saying it has a sexual connotation couldn't be further from the truth. 'My propers' means 'mutual respect' -- what you know is right." (Safire)

The use of the word 'propers' is not seen in Redding's version. The very fact that Aretha used it in the way she did, talks loads about the empowering confidence that she has transferred into the song. It can also be compared to the African American community and the state of its women as they try to break off their shackles and be different but equal. Her extensive use of many African American slang words in this song contributed extensively in the normalisation and acceptance of African American English.

Bernard Schneider of Falmouth Foreside, Me., recalled that "during a recently aired Ed Bradley interview of the artist on '60 Minutes,' he inferred that her artistic plea for propers was for adoration and attention of a sexual nature."(Safire)

This just comes to show how even a song about a woman's demand to be respected can be misinterpreted to negative values that are commonly attributed to women. Another phrase she uses is 'Whip it to me'. In slang, 'whip it' means giving up control to the other partner in a

romantic relationship.

The rest of Redding's song includes vocalisation and repetition of a lot of verses right before the song ends:

Respect when I want it

Respect when I need it

Got to, got to have it

We got to have it

Give it to me when I want it

Give it to me when I need it

Give it to me with respect, ah

Got to, got to give it

You got to give it

We got to give it

In these verses, the word 'respect' is less frequently used. Instead, it is replaced with words 'it' which is given more emphasis. Then there's the verse: "Give it to me with respect" which again adds a question mark as to what the word 'it' exactly means. With the way it's being demanded from the woman, the word 'it' may mean her womanly duties as listed and handed out by the society.

Comparing the endings of both versions, it becomes clear that Aretha wanted to end her song dramatically. This is the part that officially landed Aretha Franklin the title "Queen of

Soul”:

R-E-S-P-E-C-T

Find out what it means to me

R-E-S-P-E-C-T

Take care of TCB

Oh (sock it to me, sock it to me

Sock it to me, sock it to me)

A little respect (sock it to me, sock it to me

Sock it to me, sock it to me)

Whoa, babe (just a little bit)

A little respect (just a little bit)

While the original song barely features the word ‘respect’, Aretha Franklin decides to spell it out for the world. The way she belts out the letters with her unnaturally strong vocals sky rocketed the song to the top of the charts. Plus, the use of lines like “Find out what it means to me” and “Take care, TCB” contain so much power in them. We get to see in them, a woman who is so sure of herself and what she really wants.

The word ‘TCB’ stands for ‘Taking Care of Business’. It was first popularised by singer Elvis Presley when he formed a band with that name. There’s been frequent speculation about whether the lyric is actually ‘Take care of TCB’ or “Take out TCP”. It was later confirmed by Franklin herself that it’s TCB. It can be considered as an allusion to the King of Rock and

Roll himself.

Another unique phrase that started trending after the release of this song was the recurring “Sock-it to me” that is harmonised in the background of the chorus by Erma and Carolyn Franklin. The phrase “Sock-it to me” was an expression that was initially used by writer Mark Twain to mean “striking a blow”. By the 1960’s however, the term gained sexual undertones thanks to a song called “Sock it to me Baby” by Mitch Ryder than was banned from several radio stations due to the suggestiveness of the lyrics. But ‘Respect’ really propelled the phrase into popularity and by using it in her song, Aretha probably intended to empower her female audience into taking charge of their own sexuality. At a time when hinting your sexual urges would be equal to pinning a bright, red ‘A’ to yourself, Aretha broke down the mould through her song. After the release of the song, “Sock-it to me” became a household expression.

“...my sister Carolyn and I got together. I was living in a small apartment on the West Side of Detroit. Piano by the window, watching the cars go by, and we came up with that infamous line, the "Sock it to me!" line. It was a cliché of the day. Actually, we didn't just come up with it, it really was cliché. And some of the girls were saying that to the fellows, like, "Sock it to me in this way or sock it to me in that way." Nothing sexual, and it's not sexual. It was nonsexual, just a cliché line.” (Gross)

The rest of the lyrics continue in the style of the chorus till it fades off in the end. The lyrics continue to give power to women till the very end.

I get tired (just a little bit)

Keep on tryin' (just a little bit)

You're runnin' out of foolin' (just a little bit)

And I ain't lyin' (just a little bit)

Re, re, re, re) when you come home

(Re, re, re, re) 'spect

Or you might walk in (respect, just a little bit)

And find out I'm gone (just a little bit)

For a woman to walk away from her marriage was and still is considered disgraceful in our society. Women are taught to adjust and put their needs aside for the sake of their marriage and their social standing in society. Aretha Franklin's 'Respect' is a song that pleads with women to put themselves first. The woman in the song is a strong and fierce example of the fact that demanding what's rightfully yours and walking away when you don't get it shouldn't be something you should ever be ashamed of. The ending of the song states this clearly.

'Respect' became a global anthem for intersectional feminists everywhere. To think that a song that was initially written by a man, whining about not being given respect when he comes home to a wife he does the bare minimum for, was changed by a woman who radiated pure strength and empowerment into it with her powerful vocals, and the fact that the whole world decided to celebrate it, was undoubtedly a great achievement for women everywhere. "Respect' had the biggest impact, truly global in its influence, with overtones for the civil-rights movement and gender equality. It was an appeal for dignity combined with a blatant lubricity." (Wexler)

The song was covered by a lot of musical artists who preferred to sing Aretha's

version rather than Redding's because of its popularity. One of the most notable covers was a collaborative LP by the Supremes and the Temptations. The Supremes are an all-Black women band whose rise to fame coincided with the emergence of the civil rights movement and intersectional feminism much like Aretha's. The Temptations, on the other hand, was an all-Black men's band. The collaborative performance was more in the style of a musical battle between the two groups, each representing the man and the woman in the song. Having a band like The Supremes sing 'Respect' was in every way, an empowering move not just for Black women, but the entire African American community itself. They were one of the first musical bands ever to break down the racial barriers in the musical industry and became international stars.

Aretha Franklin's 'Respect' was released amidst a backdrop of civil strife. The 1960's saw campaigns after campaigns for the abolition of the Jim Crow laws and the unlawful segregation that was prevalent in the United States. At the same time, the racial and gender inequality of Black women from the members of their own community as well as the Whites was also prevalent because of the lack of laws that catered to their rights and exclusion from receiving financial assistance as they were seen as labourers rather than stay-at-home mothers. All of this formed the social structure which is an essential element in analysing Franklin's 'Respect' using Faircloth's theory.

This structure formed the basis for the emergence and formation of the Women's Liberation Movement, the National Association of Coloured Women, and the National Black Feminist Organization. The struggles and powerful campaigns of these organisations are the social practices that led to the empowerment of many Black women. It helped them find their

voice and gave them confidence to fight for their own rights.

Amidst all this, Franklin's song was empowering, especially for the women of the African American community whose needs and rights were conveniently ignored by the members of their own community. When Feminism became a movement that primarily catered to the needs of White women, Black feminists decided to take matters into their own hands and they did so by excelling in various art forms, especially music.

Thus emerged various female musical bands and artists that sought to break the mould in the musical industry and they did so by sky-rocketing their songs to the top of the global charts and entering the hall of fame. And 'Respect' became one such song, the release of which empowered women to come together and demand what is rightfully theirs. The feminist anthem became the ultimate social event that inspired a series of positive events in advocating the interests of African American women.

CONCLUSION

The power of music and its lasting impression on history becomes clear while analysing what inspired them and how it came to be. In the above chapters, two songs, both by African American female musical artists have been analysed using Fairclough's theory to determine how the social structure and practises of that period influenced the making, release of and reaction to the song.

According to Discourse Analysis, there are two causal 'powers' that shape texts: social structure and practices, and social events and the agents responsible. One can think of social structure (such as an economic structure, a social classroom kinship system, or a language) as a defining potential, a set of possibilities. On the other hand, social events, which are the end result of this linear relationship, defines those that actually happen. According to Fairclough, this transition from social structures to social events will not be possible without a mediator to ease out this transition, namely, social practices.

During the release of Billie Holiday's 'Strange Fruit', the social structure of the United States of America was one that was unfairly and unjustly biased towards the White community. In the 1920's, almost 70% of the Black Americans were concentrated in the South of America and suffered severely under the Jim Crow laws. Even in the north, segregation was an inseparable part of society in almost every aspect. Similarly, Aretha Franklin's 'Respect' was released amidst a backdrop of civil strife. The 1960's saw campaigns after campaigns for the abolition of the Jim Crow laws and the unlawful segregation that was prevalent in the United States. At the same time, the racial and gender inequality of Black women from the members of

their own community as well as the Whites was also prevalent because of the lack of laws that catered to their rights and exclusion from receiving financial assistance as they were seen as labourers rather than stay-at-home mothers.

The social practises against the Black community in the 1920's involved discrimination and segregation in various fields like education and employment, exploitation in the domestic areas of work, and severe forms of punishment that included the horrors of lynching. Many Black convicts were even sentenced to death by the electric chair without proper trial. And the White perpetrators of torture like the Ku Klux Klan were barely targeted and tried for the atrocities they committed against the Black community. In the 1960's, while the Black community enjoyed a much more liberal lifestyle than the previous decades, Black women were still suffering, both at home and in the workplace. This led to the emergence and formation of the Women's Liberation Movement, the National Association of Coloured Women, and the National Black Feminist Organization. The struggles and powerful campaigns of these organisations are the social practices that led to the empowerment of many Black women. It helped them find their voice and gave them confidence to fight for their own rights.

Applying Fairclough's theory, in both the cases, it can be concluded that both 'Strange Fruit' and 'Respect' were songs whose production, distribution and reaction were severely influenced by the social structure and the prevailing social practices of that time. While 'Strange Fruit' was a protest song released amidst a racially discriminated and exploited social structure where practices like lynching were prominent with much liberty, 'Respect', which was originally composed by Otis Redding and modified by Aretha Franklin, was a feminist anthem, especially for the women of the African American community whose needs and rights were

conveniently ignored by the members of their own community

Even though 'Strange Fruit' is a song that talks about the horrors of lynching, as the years went by, it became a song about large-scale racism in America. It even conditioned the kind of protest music that was to be written and recorded in the future. In the same way, Aretha Franklin's 'Respect' marked the beginning of large scale feminist rallies against the subjugation and objectification of women, especially Black. It helped in providing a platform for more female artists to emerge from the Black community and use the music industry to express their views and concerns. The feminist anthem became the ultimate social event that inspired a series of positive events in advocating the interests of African American women.

With the help of Discourse Analysis, this project has not only highlighted the social power of music but also how negative social practices can be a trigger for positive social events that aim to spread awareness and protect the interests of the downtrodden. In this case, the Racist American society as well as the discrimination faced by the women in the African American community served as the foundation for the emergence of various negative social practises. These included practices like lynching as well as the establishment of feminst organizations that exclusively catered to the rights of Black women. These social practices, in turn, influenced the making of songs like 'Strange Fruit' and 'Respect' which, according to Fairclough's theory, can be classified under social events that would lead to a chain reaction for reformation in society.

Released in the twentieth century by members of the oppressed sex from an exploited community, these songs became famous, not just because of their powerful lyrics, but also their music. Both the songs served as a benchmark in the music industry for songs released to highlight growing social concerns. Musical artists were inspired by the works of Franklin and

Holiday and it led to the growth of protest music as a genre. Songs like 'Strange Fruit' and 'Respect' harnessed the everlasting power of music and paved the way for the production of future protest songs that bluntly confront the problems of society. The music industry, which was built on the foundations of the entertainment sector, became something more from a social point of view. It became a tool for spreading awareness and expressing and promoting the interests of many discriminated and exploited communities. By using art to express themselves, both the artists helped bring international attention to a national problem that was barely making any progress in finding a solution.

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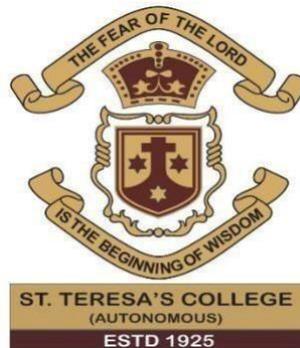
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DRAUPADI AS A DIASPORA: A STUDY OF THE NOVEL *THE PALACE OF ILLUSIONS*



*Project submitted to St. Teresa's College (Autonomous) in partial fulfilment of
the requirement for the degree of BACHELOR OF ARTS in English Language
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DECLARATION

I hereby declare that this project entitled “Draupadi as a Diaspora: A Study of the novel *The Palace Of Illusions*” is the record of bona fide work done by me under the guidance and supervision of Ms. Lakshmipriya P Santhosh, Assistant Professor, Department of English.

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CERTIFICATE

I hereby declare that this project entitled “Draupadi as a Diaspora: A Study of the novel *The Palace Of Illusions*” by Aleena Mathew is a record of bona fide work carried out by her under my supervision and guidance.

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Draupadi as a Diaspora: A study of the novel *The Palace Of Illusions*

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Diaporic dilemmas have been a part of life ever since the past. Diapora is the displacement or migration of a group of people from their homeland. The term was initially used to illustrate Jews, now its meaning has been changed and broadened its causes and its aspects. Diasporic writers from time to time represents their longing for homeland, culture, and their nostalgia through their works. An individual is represented as a diaspora when she/he having diasporic elements like displacement from their homeland, alienation, assimilation, identity crisis, acculturation etc. The novel *The Palace Of Illusions* is a retelling of the great Indian epic, Mahabharata. Draupadi's experiences, a series of her dreams, and her feelings are the central theme that Chitra Banerjee Divakaruni focuses on. This project is an attempt to study the novel on the basis of theories that connect diasporic elements like home, alienation, assimilation and acculturation and to portray Draupadi as a diaspora having identity crisis. This is done mainly with the help of Willam Safran's six characteristics of diaspora. Also several major theories in diaspora attempt to explain the terms such as assimilation, acculturation, and alienation.

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Introduction

Diaspora is a community that is a minority living in exile. The time to time displacement of people from their homeland, their culture, nostalgia for their country, the various difficulties have been brought into the light by these diasporic writers. Sometimes the readers find themselves as the various characters of the stories. The term diaspora has been derived from the Greek word diasperierin which means to disperse. The term refers to the migration or movement of a particular community from their homeland to some other countries. The idea of a homeland, a displacement from their native land and the harsh realities that they had to face is involved in the main aim of diasporic writings. Diasporic writers have set a trend since Independence. Immigrant or diasporic writings occupy a significant role between the cultures and countries. The most important features of diasporic writings are that it includes the quest for identity, nostalgia, multi-cultural milieu etc. Indian diasporic writing has become an important area because it provides the readers different views and opinions on India and about its cultural space. Also, the writers of the Indian diaspora wrote in their works about the various difficult situations they had faced.

Chitra Banerjee Divakaruni is an Indian American author. She was born in India and later migrated to America. She is a poet, essayist, and a short-story writer. She won the American book award in 1995 for her short story collection *Arranged Marriage and other stories*. Her main focus of study is on the experiences of South Asian immigrants. She always

builds the women characters which have the values of self respect and dignity. Her major works are *The Mistress of Spices*, *Sister Of My Heart*, *The Vine Of Desire*, and *The Palace Of Illusions*.

In Chitra Banerjee Divakaruni's *The Palace Of Illusions* one can find the pattern of Diaspora. Divakaruni herself has termed the work as Panchali's Mahabharat. Major theories that are applicable in my study of Draupadi as a diaspora are William Sufran's six main characteristics of diaspora, Assimilation, Acculturation, and Alienation theories. These theories help to analyze the novel from a diasporic perspective. An individual is characterized as a diaspora when he faces an identity crisis, alienation, displacement from the homeland, etc. The theories and concepts that will be discussed shed light on an inevitable relationship between different diasporic elements.

The Palace Of Illusions by Chitra Banerjee Divakaruni is a novel that was published in 2008 is a retelling of the epic The Mahabharata. The novel is narrated by Draupadi, who was born from the fire along with her brother Dhrishtadyumna. Draupadi grows in the palace of King Draupad, who urges him to seek revenge on Dhrona. Once sage Vyasa prophesied that Draupadi would become a powerful queen and would be married to five husbands. When she was old enough to get married King Draupad arranged a swayamvar to find a suitable husband for Draupadi. Initially, Karna passes the swayamvar but Draupadi humiliates him. Later Arjun wins the contest and marries Draupadi. But when she reaches her husband's home Kunti, mother of Pandavas, insists her on marrying the remaining four Pandavas. After Draupadi marries the other four Pandavas according to her father's decision. King Bheeshma divides their kingdom between Kauravas and Pandavas. The kingdom of Kauravas was led by Duryodhan. Then the Pandavas build up the city Indra prastha and start to live in the Palace Of Illusions. Once Duryodhan visits the palace and gets humiliated. Later when Pandavas were invited to the new palace of

Duryodhan, he made the Pandavas and Draupadi be exiled in the forest for thirteen years. During her life in the forest, she was preparing herself to seek revenge on Duryodhan who humiliated her. After their exile, a great war resulted in the death of many people who were close to Draupadi; her father Draupad, Dhri, Karna, her sons all were killed in the war.

Through this project, I try to analyze this novel from a diasporic perspective and to illustrate Draupadi as a diasporic or an individual having an identity crisis. Chapter one deals with the theories. The different theories of diaspora, especially William Sufran's six characteristics of diaspora, helps to portray Draupadi as an individual facing an identity crisis. The chapter also examines the different aspects of theories like Assimilation, Acculturation, and Alienation. Chapter two will be the analysis of the novel, a summary of the novel, and attempts to analyze the novel within the framework of theories that will be discussed in the following chapter.

Chapter 1

Home, Alienation, Assimilation and Acculturation: A Theoretical Framework

In postcolonial diasporic literature, the notion of home is unhomeliness, the feeling that one has no cultural home or sense of cultural belonging. The diasporic people perceive nostalgic links and memories of their original home or homeland. A home is a mythic place of desire in the diasporic imagination (Paudel 71). "Diaspora signified a collective trauma, banishment, where one dreamed of home but lived in exile"(Cohen 9). From the past itself we have been witnessing the shifting of a community or individuals from their homelands to some other countries. The cause of such migration of people can be from natural disasters or some other kinds of contagious diseases or manmade disasters like war. People migrated from their homeland in search of livelihood and some to invaded and dominated the native people. The Jews are an example of such migration from their homeland to other countries. In modern times too people continue migrating to different countries for economical needs. To attain financial stability they leave their homeland and as a result, they lose their families, culture, and identity. Gradually they start to miss their homeland. But to meet their needs, they try to assimilate themselves into Newland. Such assimilation destroys their identity and creates a new identity in them. When these people try to assimilate themselves into a new land or culture they feel alienated in their homeland. Bill Ashcroft lecturer at the University of Hong Kong and the University of NSW, Gareth Griffiths lecturer at the University of Western Australia, and Helen Tiffin at Queen's university Canada define diaspora as the voluntary or forcible movement of people from their homelands into new regions (Ashcroft et al. 68). Several major theories in diaspora attempt to explain the terms such as home, assimilation, alienation, and acculturation.

William Safran was a political scientist and Professor Emeritus of political science at the University of Colorado Boulder. His major works include *Politics in Europe*, *The French Polity*, *Ideology and Politics: The Socialist Party of France*, etc. Nicholas Van Hear, Steven Vertovec, Robin Cohen, George Steiner etc are some major diasporic theoreticians, among them William Safran has listed six main characteristics of diaspora in his book *Diaspora in Modern societies: Myths of Homeland and Return*; 1) they, or their ancestors, have been dispersed from a specific original ‘center ’to two or more ‘peripheral,’ or foreign, regions; 2) they retain a collective memory, vision, or myth about their original homeland—its physical location, history, and achievements; 3) they believe that they are not and perhaps cannot be fully accepted by their host society and therefore feel partly alienated and insulated from it; 4) they regard their ancestral homeland as their true, ideal home and as the place to which they or their descendants would (or should) eventually return when conditions are appropriate; 5) they believe that they should collectively be committed to the maintenance or restoration of their original homeland and to its safety and prosperity; and 6) they continue to relate, personally or vicariously to that homeland in one way or another, and their ethnic communal consciousness and solidarity are importantly defined by the existence of such a relationship (Safran 83-84).

1.1 Assimilation

Assimilation can be clearly understood as a given community to assume the values of the dominant community and thus integrate later. Assimilation is the process of socialization and special personalization, a kind of identity, if individuals are not stylish instill a setting, a value, a behavioral culture, etc., the value of other countries. This means that he is perfect with the retreat of his old national identity, which is integrated into his personality and forms itself before. Assimilation takes place when an individual or a community which is termed as minority takes

over the culture, language, and values of the host country or the majority. There will be a tendency to adapt the features of new culture consequently resulting in the new types of clothing, preparing food, etc. Robert E Park is an American urban sociologist, he interprets the situation of people living on the border of two cultures by his marginal man theory. The assimilation model created by him was for a long time, a paradigm in the study of immigrant adaptation. The contact between people in different cultures leads to adaptation through competition and conflicts and leads to assimilation. Assimilation means losing its old national identity and culture and thus being fully integrated into the host society. Park has seen Assimilation as a linear process and considered as an inevitable consequence of immigration of different ethnic groups, although differentiated in various cases in rhythm, and with different difficulties. Richard Alba and Victor Nee, American sociologists, their main thesis are that assimilation implies the disappearances of ethnic differences and ethnicity, while these differences continue to exist. In the model, they propose the various minority groups enter the majority institutions taking with them their former links and the culture of their community. At the same time according to the Alba-Nee theory, the process of inclusion is incremental, the process gets stronger and quicker as it proceeds (Alba and Nee 17-66).

1.2 Alienation

The word alienation originated from a latin noun alienatio which in turn is derived from a Latin verb alienare meaning to take away, remove or cause a separation to occur. In Hegel's Phenomenology of Mind, he has used two words such as entausserung (surrender) and entfremdung (a state of separation) interchangeably as different types of alienation. According to Hegel alienation in its first form, the individual experiences a state of separation. He ceases to identify with the social substance or the social, political, and cultural institutions. It is rather a

imposed alienation. In the second form of alienation the individual himself surrenders or transfers his rights to someone else (Sarfraz 45-46). It involves a conscious relinquishment or surrender to secure a desired end namely unity with the social substance (Schacht 36).

In social psychology, alienation results in the withdrawal of the individual from society and, such isolation expresses itself in the act of neurosis (Bloom 2). Terrible still is the inferiority of alienation in social theory, in the sense of the individual being out of touch with himself, a fragmenting of oneself. Be it the social, economic, or psychological dimension, alienation manifests arguably in the character's actions, state of being, or state of mind as well as physical uprooting, if not dislocation from one's original home (Chukwumezie 10). So the sense of alienation or rejection is the result of expatriation and migration. Alienation is one of the themes of diasporic writing.

1.3 Acculturation

Acculturation is a concept that spans numerous social science domains such as anthropology, sociology, and psychology. Acculturation strategies have a significant relationship with positive adaptation. Adaptation in terms of acculturation is the long-term way in which people can change their lives and settle down in a more or less satisfactory existence. It is more or less because adaptation can be arranged from very positive to very negative in the way of living in the new cultural setting (Kavitha, Rajkumar 110). Berry, a psychologist, defines acculturation as the cultural interaction between an immigrating person or family and the new host country and the immigrating individuals. Cross-cultural researcher Theodore D Graves has analyzed acculturation into two types; acculturation on a population level and acculturation on an individual level; the latter being known as psychological acculturation (Kavitha, Rajkumar

110). Acculturation refers to changes that take place as a result of contact with culturally dissimilar people, groups, and social influences. Acculturation research generally focuses on immigrants, refugees, and asylum seekers who are assumed to be permanently settled in their new homeland, although these three groups may be quite different from one another (Schwartz et al. 238). When individuals or groups of people who move from the life of a lifestyle of a different culture, censored or to be adapted to new behaviors, values, customs, and cultural languages. The incubation word is the conversion action. It is a process of integrating into a culture, particularly a dominant one. Both assimilation and acculturation result in an identity crisis.

The theories and concepts examined above point to an inevitable relationship between different diasporic elements. It is in the light of these concepts it becomes possible to draw a connection between Chitra Banerjee Divakaruni's *Draupadi* and the above-discussed concepts, thereby analyzing whether the diasporic elements are exhibited in *Draupadi*.

Chapter 2

Diasporic study of *The Palace Of Illusions*

Chitra Banerjee Divakaruni in her novel *The Palace of Illusions* attempts to recreate the epic Mahabharat. Divakaruni tells the story from the perspective of Draupadi. She termed it as Panchaali's Mahabharat. In her novel she makes Draupadi speak or narrate the story, while other characters are spoken occasionally. The novel takes us back to history, myth, and magical elements. Divakaruni gives a new interpretation to the historical story that one has listened to since childhood. In her novel, she attempts to trace the life of Draupadi from its beginning with her birth from fire and following her life as a woman with five husbands who have been tricked out of their father's kingdom. Draupadi supports their quest to reclaim their birthright and she remains at their side through years of exile and a terrible war involving all the important kings of India. Meanwhile one never loses sight of her strategic fight with her mother-in-law, her complicated friendship with Krishna, or her secret affection for Karna who is her husband's most dangerous enemy. Draupadi is a spirited woman redefining for us a world of warriors, gods, and the ever manipulating hands of fate. The main objective of my study is to evaluate the novel from a diasporic viewpoint.

The preliminary focus of study concerns whether the novel exhibits the diasporic element home. In the novel *Palace of Illusions* one can find Willam Safran's six characteristics of diaspora which are; 1) they, or their ancestors, have been dispersed from a specific original 'center' to two or more 'peripheral,' or foreign regions; 2) they retain a collective memory, vision, or myth about their original homeland—its physical location, history and achievements;

3) they believe that they are not and perhaps cannot be fully accepted by their host society and therefore feel partly alienated and insulted from it; 4) they regard their ancestral homeland as their true, ideal home and as the place to which they or their descendants would (or should) eventually return when conditions are appropriate; 5) they believe that they should collectively be committed to the maintenance or restoration of their original homeland and to its safety and prosperity; and 6) they continue to relate, personally or vicariously to that homeland in one way or another, and their ethnocommunal consciousness and solidarity are importantly defined by the existence of such a relationship (Safran 83-84).

From the novel one comes to know about the secret behind the birth of Draupadi. She was born from fire and treated as an unwanted child by her father. King Draupad performed yagna to have a son to take revenge on Drona who had insulted him. But King Draupad got a son and a daughter from the fire with a prophecy that she will “change the course of history” (Divakaruni 5). She heard these stories from Dhai Ma, her nurse and she used to tell the story over and over when Draupadi insisted that she tell her birth story. Then Dhai Ma used to puff her cheek when Draupadi had a tendency to act as sweet and called her the girl who was not invited thus meaning that Draupadi's birth was unexpected. Draupadi, who has been forced to come from heaven to earth like an immigrant, was first rejected from her new home by her father and other members. Even though she was forced to come from heaven she had no nostalgic feeling about her lost home and she was always amused by her new home. Hence one can find Willam Safran’s first characteristic of diaspora here because Draupadi has been dispersed from her homeland in devlok and she becomes an immigrant at King Draupad’s palace.

Draupadi remarks that " there I would finally be at home "(Divakaruni 7) because she hated King Draupad’s palace. She says that when she builds a palace for herself it will be

different from her father's palace. The hate that accumulates in her, against her father's palace will be because of her memories that have been unknowingly inside her heart about her original homeland in heaven. She often thinks about how her palace would be. In her imagination, she sees a riot of colors and sounds of birds singing in the mango and custard apple, orchards, and butterflies that flits among jasmines. Draupadi also thinks that if her brother was not with her, her life at King Draupad's house would be intolerable. It is her brother Dhri who had held her hands when King Draupad did yagya to have a son, " I never forgot the feel of his hand clutching mine, his refusal to abandon me "(Divakaruni 7). One day Draupadi accompanied Dhai Ma to the holy man. Then the holy spirits informed that she would be mistress of the magic of palaces and she from that day was thinking about the palace that the spirits had promised her. She was always in the thought of the Palace. The spirits had described the palace as most magical.

Draupadi wondered about the specialties of the palace. Here Safran's second characteristic of diaspora is evident that Draupadi maintains her memories and vision about her homeland. The palace that she dreamed of may be similar to the heaven where she lived before she came to the earth. Those memories were deep inside her heart and that has reflected on her imagination about how her palace should be built. After her marriage she hopes that Arjun would build a palace that she has been dreaming of for several years " ...he would build me the palace I dreamed of, a place where I finally belonged"(Divakaruni 104). She has always been fascinated with palaces. The reason why she always hated and longed to escape her father's palace was that her birth secret was exposed to her. She often imagines her palace which she hoped to build someday. She plans how to build her palace which she feels finally at home. One day when she asked Krishna about the kind of palace she will have, Krishna, replied " Already you live within a nine gated palace, the most wondrous structure of all"(Divakaruni 113). But she ignored his

answers and she hoped that the palace which she is going to build will be not like Dwarka nor her father's palace. After marriage living in a hovel she always "dreamed of the palace of lac, burnished like wings"(113). Here Sufran's third characteristic of diaspora is clear, even though she had her father's palace; she was not able to assimilate herself completely there. She longed for her imaginative palace.

When they returned to Hastinapur, Draupadi very politely asked Dhai Ma about her new home in Hastinapur and her words increased her eagerness to see her new home. She fantasized about the structure of her palace which she wished to be against her father's palace. She dreamed of airy windows everywhere and doors that opened towards the balconies. For her palace's wall, she decided it to gleaming red sandstone, her gardens with color and birdsongs, her room filled with a cool breeze which carried the fragrance of mango, and her balcony with marbles where she can look over the whole city. But later the palace of Hastinapur makes her uneasy because there were too many people and she says that the palace will never be home to her. And she says "...I would find the home that had eluded me all my life"(Divakaruni 139). Here one can find Sufran's fourth characteristic of diaspora, where Draupadi longed to return to her ancestral home when the right time arrives. When she says that she will find the home which has eluded all her life, the home here may be referred to as her home in heaven.

One day Arjun brings along with him Maya who built palaces for gods and said that he is going to build a palace for them. Then Draupadi started to give directions to Maya that she needs water everywhere, fountains and pools, ponds for birds, a stream wending its way through the palace, fire without fuel, and towers that brushed sun. Kunti gasps when she says there is running water inside her home because according to her belief it will wash away good luck and Kunti calls her a fool. But Maya said she will do all that Draupadi wishes to be in the palace.

Maya enhanced everything that pandavas wanted, a hundredfold and he set a patinal of magic. His arrangements were strange and that made the palace look new each day. The corridors were lighted by the glow of gems and the assembly halls were filled with flowering trees. The structure of the assembly hall allowed anyone to relax because the atmosphere in the garden was so delicate. Maya has also built a pool in each room filled with fragrant water. And Draupadi calls the palace as the palace of illusions. For her these years were good because what she has dreamed for years is now a reality and finally she feels her home and she loves her palace. Here Willam Sufran's fifth characteristic of diaspora is clear: Draupadi is committed to the restoration of her homeland. Her affection for the palace was warned by Krishna not to be attached to the palace and says that once it will make her cry. But Draupadi believed in Maya's words that no human will cause harm to her palace.

Draupadi continues to express her love towards the palace by describing its grandeur " My rooms overlooked the most beautiful garden in the palace, one I had designed myself to create an impression of unplanned abundance. Amidst flowering trees and shrubs with jewel hued leaves was a large, irregularly shaped lake where many birds would come to swim. It was filled with wild lilies and it's water was brilliant blue that shone even on cloudy days. In its center rose, a pavilion with intricately carved pillars depicting stories of gods and goddesses that changed even as one gazed at them. To get to the pavilion, visitors had to use one of several slender bridges suspended over the water. But here Maya had worked his mischief though all the bridges looked solid, only one was real. The others were illusions, made of light and air and trickery,"(Divakaruni 172).

Draupadi was proud to call herself the mistress of the palace of illusions. When she reaches the palace of Duryodhan as he invites she misses her palace very badly. A longing for

her Palace was there in her heart and she always wished to be in her Palace. But her dreams were devastated when Duryodhan fooled her husbands in games and due to that, they lost everything including her most loved palace. After settling in the forest, she dreams that the palace would come back to her with its utmost grandeur and more gorgeous than in life. Also, she believes that she will never find another home like her palace which makes her feel like her palace. She maintains the memories and vision about her home. Being in forest life too she can't completely assimilate, even in her dreams her longing for her palace is evident. Draupadi memorizes that from the beginning of her relationship with Yudhishtir which had been troubled due to marriage but she says that in the palace of illusions, it was a blessed and magical time which was peaceful for her and Yudhishtir and she says that they were busy with doing things that they loved. Then when she sees sudeshna's garden during her disguise period she remembers again about her palace. There is still hope for Draupadi that she will again be the queen of the palace of illusions.

After the fight started Bheem brought Aswathama's most precious possession and placed it in the hands of Draupadi. Then she expressed her delight at having an object which is so unique and she wished to place that unique object as pride in her palace of illusions. She longs to return to her palace. But later she realizes the truth that even her palace with beautiful fantasies, which she loved more than her husbands, and was her greatest pride has brought her sorrow. In her entire life what she craved for is eternal love. What we understood from Draupadi's feeling is that when she says she wants to feel finally at home is related to the love and care that she yearned for. But on her deathbed, she realizes her love for Krishna and realizes that Krishna had loved her even when Draupadi behaved in unlovable manners. She feels that the love Krishna had for her was different from the love she had in her life. The love hadn't changed into

displeasure or anger or even hatred. She says that the love of Krishna had only healed her. Also, she compares her feelings for Karna and Krishna. When Karna's love was like a singing fire. Krishna's love was a balm. And also she curses herself for not recognizing the precious gift of Krishna's love.

Draupadi then questions whether Krishna's existence is divine or not. She considers herself as an ordinary person and she thinks about how she can be in love with divine personality. But after living her mortal body she feels divine and she finds her love in Krishna.

"Krishna touches my hand. If you can call it a hand, these pinpricks of light that are newly coalescing into the shape of fingers and palm. At his touch something breaks, a chain that was tied to the woman's shape crumpled on the snow below. I am buoyant and expansive and uncontainable---but I always was so, only I never knew it! I am beyond name and gender and the imprisoning patterns of ego. And yet, for the first time, I'm truly panchali. I reach with my other hand for karna-- how surprisingly solid his clasp! Above us our palace waits, the only one I have ever needed. It's walls are shapes cluster around us in welcome, dissolving and forming and dissolving again like fireflies in a summer evening"(Divakaruni 360).

Finally, Draupadi finds her home with Krishna like a person who is on his journey finds his way. And also she finds her Palace which is made up of infinity and eternal things. Here William Safran's sixth characteristic of the diaspora can be identified because Draupadi continues to have a relationship with her homeland. It is the process called Diaspora in recent times, as William Safran has conveyed three keywords to clarify the whole process. He has said that a person who can be said to be in exile from his homeland goes through three fundamental processes: displacement, longing for home, and return to that homeland.

1.1 Alienation experienced by Draupadi

When looking into the life of Draupadi, she has experienced triple alienation, alienation at birth, life, and death. During her lifetime she has been rejected in several instances. It has also affected her reactions and decisions. Maybe we can say that the alienation that she has experienced during her life has led her to the war. Draupadi once said that she will make the people call her a peacemaker. The woman who said she will make people call her a peacemaker turned into a rioter. She started to get alienated or rejected from the moment of her birth from fire. She made Dhari Ma tell the story of her over and over like a relief to her wounded ego. She also says why she compels Dhari Ma to tell the story of her over and over like a relief to her wounded ego. Why she compelled Dhari Ma to tell the story is because that made her feel special. It also affirms her desire to make her identity unique by considering her birth as special other than the women in her father's kingdom. King Draupad had expected a son to take revenge for his father but he was astonished when Draupadi came out of the fire. The meaning of the name itself made Draupadi a little egoistic "Dhristadyumna, Destroyer of Enemies. Draupadi, Daughter of Draupad"(Divakaruni 5).

Draupadi herself felt that her father was forced to look after her because he was focused on pleasing his subjects so it was difficult for him to disapprove of Draupadi, she is also aware of the fact that her father needed only her brother. It was her brother Dhari who wouldn't let her hands. These rejections which have been experienced from her childhood made her more rebellious against her father. She makes her father grant her permission to attend lessons along with her brother. Then she gets alienated as a daughter when King Draupad arranges a swayamvar for her and when a situation occurs for her to marry the rest of the brothers; she was

not ready and she believed that her father would call her back to the kingdom. But he paid more importance to his subjects and his status other than her daughter and insisted Draupadi marry five Pandavas and accept them as her husbands because a woman who is sent back to her father's house after marriage, she was considered as a disgraced woman this is what King Draupad said. As a girl too she has been alienated from education. She finds support in her life of alienation in Dhai Ma and Dhri and Krishna. The alienation or rejection that she has faced during her life longed for love and affection. It is evident from the decision to meet her father's wives and it ends in sorrow. Her father's wives avoided her. Her sense of desperation is evident in her words, "What use was all this dressing up when there was no one to admire me?" (Divakaruni 36).

At the swayamvar she consoles herself even though she doesn't get an opportunity to select her husband, she wishes that Arjun will marry her. But fate followed her and she was forced to marry five Pandavas because of Kunti's words `` But as always, whatever you brought should be shared equally amongst all my sons ' '(Divakaruni 107). Then she was married to four other Pandavas one after another. To keep her chaste Vyasa designed a special code of marital code for them which allowed Draupadi to be a wife for each brother for a year at a time. But later each of the Pandava brothers married another woman. This increased her feelings of alienation.

She feels resentment because of her harassment by the prince's other wives. Draupadi from her birth itself gets alienated and she wishes for a home that would feel like her home, and when she is married to Arjun she hopes that she will find love and affection which she had longed for years. But what happens is that by each day her intensity of rejection gets increasing.

Again she is alienated when she hopes for love when her husbands gambled her for their games. She gets offended in front of the people who were in the palace of Duryodhan. Duryodhan even orders to take her clothes away. She looked to Karna, her husbands for help but she was disappointed by their actions. She was like a lifeless body when everyone she loved hesitated to save her from the humiliation of Duryodhan. The humiliation and alienation she has experienced in the palace of Duryodhan make her take the decision to take vengeance which leads to a great war.

During their period of forest life, one year ahead to end the forest life Draupadi and Pandavas decide to live separately because they don't want Duryodhan to find them, if Duryodhan finds them they will have to live another thirteen years in the forest. So Draupadi flees to Sudheshna's palace. There too she gets alienated. Sudheshna's brother Keechak always falls in love with her maids. So one-day Keechak pushes Draupadi to the floor and kicks her for not allowing him to invade her. Witnessing all this cruelty Yudhisthira said Draupadi "Return to women's quarters and stop weeping like an actress"(Divakaruni 230). Also during the war, we see Draupadi alone, alienated. Even after the war those tragedies never left her, she has lost her father, brothers Dhri and Sikhandi, all her sons, and Karna whom loved secretly. Due to the war, many women become widows and had lost their dear ones, but there were many people to console them, but for Draupadi, there was no one to console her.

Draupadi had been alienated even at the time of her death. She accompanies her husbands in the journey of life,"this is the unspoken revelation of her constant desire to belong, mirroring the vacuum that exists in her last journey of life"(Ross 663). Draupadi finds it difficult to accompany her husbands to Mahaprasthan because her feet were stuck in snow. She tries go

ahead but later she finds that she has stepped away from her path. Bheem tries to help Draupadi but he was stopped by Yudhisthir. Then she listens to the conversation between Bheem and Yudhisthir, Bheem asks Yudhisthir, "why did Draupadi fall? Why couldn't she walk any further? Was it because her woman's strength gave out?" (Divakaruni 347). To this Yudhisthir said "No Bheem. It's because although she had many good qualities, she had one major fault.....she married us all. But she loved one man more than everyone else" (Divakaruni 347). "It was Arjun. She cared most for" (Divakaruni 348). Here Yudhisthir, tries to protect her reputation even though he knows about Draupadi's heart and her love for Karna.

1.2 Assimilation and Acculturation in Draupadi

Assimilation and Acculturation are both have the same idea, both refer to the identity crisis. After her childhood when she reaches an age to identify whichever is wrong she heard her story of birth from her nurse Dhai Ma. Then onwards she knows that she was an uninvited child to Draupad. Even though know the truth and she hated her father's palace she assimilated herself to the place she never felt at home. And also her enforced exile from heaven to earth is a way she assimilated herself to her new life on earth. Before her birth from the fire she was with her brother in devlok and when king Draupad called for a son "Dhri wouldn't let go of me..." (Divakaruni 6). Draupadi can be compared to an immigrant, who has left her home and was rejected by her new home. Even though she was displaced from her original home.

She dreamed of a new home where she would feel at home. But she tried to assimilate in King Draupad's palace which she hated. Dhri, Krishna, and Dhai Ma were the people to whom she was attached. After the prophecy by Vysa Draupadi promised herself that she would never pray for the deaths. She decides to teach them how to be survivors. And she herself asks the

question about the necessity of a battle. The women who said this initiated the greatest war and made many women widows. It is clear that she has assimilated or changed according to her changes in life. During that period men married many women, on hearing from Dhai Ma she said that her husband will never marry another woman and also says to Dhai Ma that she will make her husband promise her before she marries him. But when she married she finally hoped that she would get the love and affection from Arjun but fate had made her marry five Pandavas and she lived with everyone each one year. She tried hard to assimilate from a wish to be the wife of Arjun to the wife of five Pandavas. But she at some point starts to love her husbands by understanding their love and loyalty. When they were married to another princess, that made her jealous of their new wives. There is cultural change happening that at that times women only married once but now Draupadi acculturate herself to a new code of culture.

When once she heard about the life of Kunti she told Sorceress how much she has moved by Kunti's sufferings. But only when they met she realize how different Kunti was from Draupadi's imagination. When she was in her father's palace she openly spoke to Dhai Ma, but after her marriage, she had not found a Dhai Ma in Kunti. When she started to live in her husbands' house was different from her father's palace. When Draupadi asked Kunti to have a bit of turmeric and some chilies, Kunti replied "This is all there is. This isn't your father's palace"(Divakaruni 107). Draupadi assimilated herself into her new life. Draupadi says " I couldn't quite believe what a transformation my life had undergone..."(Divakaruni 139). After the humiliation in the palace of Duryodhan, then they were forced to live in the forest for thirteen years without any hesitation or blaming her husbands for her humiliation she accompanied the Pandavas and lived there, she even adjusted to the bad behavior of Keechak. In the end, we can see that Draupadi who neglected the whole prophecy of Vyasa becomes the

reason behind the great war. In the beginning, Draupadi came to the world to “change the course of history”(Divakaruni 5) and her identity came true at the end. So in acculturation how much they are involved in a new culture at the very end their original identity will stay in themselves.

Conclusion

In Chitra Banerjee Divakaruni's *The Palace Of Illusions* one can find the characteristics of diaspora. William Sufran's six characteristics of the diaspora are evident in the novel and his study has helped to portray Draupadi as an individual having an identity crisis. His analysis of diaspora has also helped to study Draupadi as a diaspora. The novel palace of illusions exhibits almost all the recurrent themes of diasporic writings. But the main areas I focused in the study are William Sufran's six main characteristics of diaspora, Alienation, Acculturation, and Assimilation elements in the novel. The central aim of my study was to represent Draupadi as a diaspora and with the help of different theories of diaspora, I was able to portray Draupadi as a diaspora. For that, the initial study was concerned about whether the novel exhibited the diaspora element, home. I have identified all the six characteristics of diaspora that have been noted by William Safran in the novel. The character Draupadi exhibits all the six characteristics of diaspora. Thereby, one can illustrate Draupadi as an Individual longing for the homeland. present. My study was limited because I have only focused on the areas home, acculturation, alienation and assimilation so further studies on different diasporic elements are possible

Also, Draupadi experiences alienation, acculturation and, assimilation. When looking into the life of Draupadi she has experienced triple alienation, alienation at birth, life and, death. Draupadi also assimilated her to the place she never felt at home. Her enforced exile from heaven to earth is also a way she assimilated herself to her new life on earth. The motive of my study was to portray Draupadi as a diaspora and bring out the idea that the diasporas were present from the past and continue till today. The main characteristics of diasporas such as the

quest for an identity, uprooting, re-rooting, nostalgia, displacement from the homeland are experienced by different people nowadays too. Some are forced to leave their homeland and some are due to natural causes. These mental difficulties have been brought to light by these works of myths. These kinds of displacement and harsh experiences were frequently referred to Jews and other communities, but I intended to prove that the diasporas were present in all times, mainly my focus of study made me prove that during Mahabharata times too diasporas were present. My study was limited because I have only focused on the areas home, acculturation, alienation, and assimilation. So further study on different diasporic elements are possible.

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PROJECT REPORT

A STUDY ON THE RELATIONSHIP BETWEEN IRRITABILITY AT HOME AND STRESS AT WORK

Submitted by:

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Register No:

SB19PSY004

Under the guidance of

MS. ASHYA K SALIM

In partial fulfillment of the requirement for award of the degree of

B.Sc. PSYCHOLOGY



ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

Nationally Re-accredited at 'A++' level (4th
cycle) Affiliated to: Mahatma Gandhi University

MARCH 2022

CERTIFICATE

This is to certify that the project report entitled, “THE RELATIONSHIP IRRITABILITY AT HOME AND STRESS AT WORK”, is a bonafide record submitted by MS. ALEENA MERLIN MATHEW, Reg.no. SB19PSY004, in partial fulfillment of the requirements for the award of the Degree of Bachelor of Psychology during the academic year 2019-2022.



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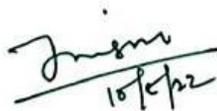
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DECLARATION

I, Aleena Merlin Mathew, hereby declare that the study presented in the dissertation entitled, “The relationship between irritability at home and stress at work”, which is submitted to the Department of Psychology, St. Teresa’s College, Ernakulam is a bonafide record of the research work carried out by me, under the supervision and guidance of Ms. Jisha Sekhar, Assistant Professor, Department of Psychology, St. Teresa’s College, Ernakulam, in partial fulfillment of the requirements for the degree of Bachelor of Science in Psychology and has not previously formed the basis for the award of any degree, diploma, fellowship, title or recognition before.

Place: Ernakulam

Aleena Merlin Mathew

Date:

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Aleena Merlin

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RELATIONSHIP BETWEEN IRRITABILITY AT HOME AND STRESS AT WORK

Abstract

The current study is to examine the relationship between Irritability at home due to stress at work. This study gives an insight of the causes of irritability and stress among men and women. The study uses a convenience sampling research design. 150 adults were assessed using questionnaires and were distributed through google forms. The data was collected using convenience sampling. Spearman's Rank Correlation analysis of the data predicted a significant positive relationship between Irritability at home and stress at work. In this study, the independent variable predicts the dependent variable. This is revealed through the results of a regression analysis and proved the same. It was concluded that as Irritability increases stress also increases which proves that they have a positive correlation between the two variables. This study helps to understand the causes of irritability and increase of stress. This is beneficial to understand and find a solution to control the causes of stress and irritability among working adults.

Keywords: Irritability, Stress at work

CHAPTER 1
INTRODUCTION

INTRODUCTION

Irritability is a common emotion. Many factors can cause or contribute to irritability, including life stress, a lack of sleep, low blood sugar levels, and hormonal changes. Extreme irritability, or feeling irritable for an extended period, can sometimes indicate an underlying condition, such as an infection or diabetes. It may also be a sign of a mental health condition, such as anxiety or depression. Stress can be defined as any type of change that causes physical, emotional, or psychological strain. Stress is your body's response to anything that requires attention or action. Stress may be acute, chronic, or traumatic. In humans, acute stress is characterized by immediate danger that occurs within a short span of time and that activates the fight-or-flight response of the sympathetic nervous system; narrowly avoiding an automobile accident and being chased by a dog are examples of acute stress.

BACKGROUND OF STUDY

The primary purpose of the study was to examine the relationship between irritability and stress among working adults. Irritability is a very common outburst among people these days especially young adults. Sisk (1977) defined stress as a state of strain, tension or pressure and it is a normal reaction resulting from interaction between the individual and the environment. Strain means to make great demand on something; tension is a mental or emotional strain that makes natural relaxed behaviour impossible; and pressure is a powerful demand on somebody's time, attention or energy. Beehr and Newman (1978) perceived stress in an occupational setting to mean a condition wherein job-related factors interact with workers, to change their psychological and physiological conditions such that the person's mind and body are forced to deviate from normal functioning. The similarity in the foregoing definitions reveals that there must be an interaction between the environment and the individual before stress can occur. The interaction arises when man is trying to deal with the problems that his environment produced. It could be in his place of work or marriage which makes it impossible for man to relax his nervous system.

PROBLEM STATEMENT

The study aims to prove that there is a relationship between irritability at home and stress at work. This study will provide specific insight on stress factors and reasons behind them.

NEED AND SIGNIFICANCE OF THE STUDY

The main aim is to find if there is any correlation between irritability at home and stress at work. Going through a stressful period can make a person feel more irritable than usual. They may feel less tolerant of the people around them. Feeling overwhelmed by life stress is normal, but prolonged periods of stress can lead to emotional exhaustion. Recognizing the early signs of stress and taking steps to relieve this feeling can help people avoid burnout. Stress is a normal human reaction that happens to everyone. In fact, the human body is designed to experience stress and react to it. When you experience changes or challenges as stressors, your body produces physical and mental responses. Stress responses help your body adjust to new situations. Stress can be positive, keeping us alert, motivated and ready to avoid danger. For example, if you have an important test coming up, a stress response might help your body work harder and stay awake longer. But stress becomes a problem when stressors continue without relief or periods of relaxation.

SCOPE OF STUDY

Stress is the body's response to pressure. Many different situations or life events can cause stress. It is often triggered when one experiences something new, unexpected or that threatens one's sense of self, or when they feel they have little control over a situation. The ability to cope can depend on the person's genetics, early life events, personality and social and economic circumstances. When a person encounters stress, the body produces stress hormones that trigger a fight or flight response and activates the immune system. Sometimes, this stress response can be useful: for example, it can help push through fear or pain so it helps a person run a marathon or deliver a speech.

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Stress hormones will usually go back to normal quickly once the stressful event is over, and there won't be any lasting effects. Irritability and anger can become common traits in people who are stressed. In one study, higher levels of anger were associated with both mental stress and the possibility of a stress-related heart attack. Another study states that the relationship between anger, depression, and stress levels in caretakers. The researchers found an association between care-related chronic stress and anger levels. The principal differences between low- and high-irritability individuals could be how they manage the impact of perceived stressors on emotions and behavior.

OBJECTIVES OF THE STUDY

- To study the relationship between irritability at home and stress at work among adults
- To examine the role of stress on irritability.

LIMITATIONS

- Lack of previous research studies on the topic
- Limited access to data
- Time constraints
- Target group is small due to lack of contacts with the working group of people therefore it was difficult to get responses.

CHAPTER 2
REVIEW OF LITERATURE

IRRITABILITY, STRESS

REVIEW OF LITERATURE

IRRITABILITY

Disruptive mood dysregulation disorder (DMDD), a newcomer to psychiatric nosology, addresses the need for improved classification and treatment of children exhibiting chronic non-episodic irritability and severe temper outbursts. In recent years, many of these children have been diagnosed with bipolar disorder, despite the lack of distinct mood episodes. This diagnostic practice has raised concerns, in part because of the escalating prescription of atypical antipsychotics. In contrast to bipolar disorder, severe mood dysregulation is defined by non-episodic irritability, exaggerated emotional reactivity, and hyper arousal. Severe mood dysregulation and bipolar disorder differ with regard to familial aggregation, physiological responses to frustration, and neural responses to social stimuli. Reanalysis of longitudinal data from the Great Smoky Mountains Study found associations between severe mood dysregulation and later depression. The relationship between early chronic irritability and later depressive disorders is consistent with findings that irritability symptoms in childhood (i.e., loses temper, easily annoyed) predict later depression

A previous study shows that Dillon, an 8-year-old boy living with his parents and his younger brother, was evaluated because his parents were at their “wits’ end” regarding how to handle his explosive outbursts, which were occurring several times a day. Ms. A, Dillon’s mother, stated, “It has gotten to the point where I dislike my child.

At the time of the evaluation, Dillon was exhibiting temper outbursts several times a day that lasted approximately 10 minutes, and more intense 30-minute outbursts multiple times a week, during which he became physically aggressive. For example, during a recent tantrum, Dillon kicked and punched holes in his bedroom door, causing destruction that warranted the door’s removal. Additionally, Ms. A. reported that she always had bruises on her arms from blocking Dillon’s strikes. Dillon’s parents described him as irritable and cranky for the better part of the day on most days. When irritable, Dillon appeared agitated and restless and often expressed that he wanted to be left alone. Attempts to cheer him up were typically unsuccessful and sometimes

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worsened his irritability.

A comprehensive diagnostic interview, which included the parent version of the Schedule for Affective Disorders and Schizophrenia for School-Age Children, a clinical child interview, and teacher rating scales, confirmed that Dillon's behaviors and mood symptoms were consistent with disruptive mood dysregulation disorder (DMDD). His temper outbursts were frequent (at least three per week), severe, and explosive, causing impairment at home and in school. Between explosive episodes, Dillon's mood was chronically irritable. These symptoms had been present for several years without periods of amelioration. In addition, Dillon met criteria for attention deficit hyperactivity disorder (ADHD), combined type, as well as oppositional defiant disorder. However, according to DSM-5, when criteria for oppositional defiant disorder and DMDD are met, only the latter diagnosis is assigned. Mania symptoms were not reported, and Dillon's irritable mood was chronic, which ruled out bipolar disorder.

Dillon's parents were first provided with an overview of DMDD and ADHD and their impact on Dillon's functioning. Next, they and Dillon consulted with a child psychiatrist to discuss medication. The psychiatrist prescribed methylphenidate in the hope that it would improve Dillon's hyperactivity and frustration tolerance and thus reduce his tantrums. Because Dillon's outbursts at home had become a means of avoiding demands, and his parents were unsure about managing them, the parents were referred for parent management training, which offers specific strategies that enhance effective communication and discipline. At the same time, Dillon received individual cognitive-behavioral therapy aimed at teaching him how to better regulate his mood and improve his frustration tolerance. He was taught coping skills to regulate his anger and to identify and relabel distortions that contributed to his hostile reactions. Finally, a school behavior daily report card was developed that functioned like a token economy through which Dillon was rewarded for specific positive behaviors in the classroom.

STRESS

Stress-related conditions are one of the most common causes for long-term sick-leave. There is limited evidence for the effectiveness of person-directed interventions aimed at reducing stress levels in healthcare workers. Prior research in the relationship

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between support and burnout show somewhat inconsistent results. A randomized controlled trial with peer-support groups as the intervention was conducted with 660 healthcare workers scoring above the 75th percentile on the exhaustion dimension of the Oldenburg Burnout Inventory. One hundred and fifty-one (22·9%) agreed to participate. The intervention started in 2002 with 51 participants (96·1% were women), 80 of whom constituted the control group. Potential differences in outcome measures 12 months after the intervention were compared using anova, and data collected was completed in 2004. Qualitative content analyses were used to analyse reported experiences from group Participation. Statistically significant intervention effects were found for general health, perceived quantitative demands at work, participation and development opportunities at work and in support at work. Seven categories of experiences from participating were identified: talking to others in a similar situation, knowledge, sense of belonging, self-confidence, structure, relief of symptoms and behavioral change.

From the point of Eric Whitfield – Architect – age 54; I was forced to seek some stress management by my wife – life at home was becoming unbearable for her and my kids because of my moods. Work stress was the cause as 30% of my colleagues were made redundant. I was terrified of losing my job and started to put in ridiculous hours and taking on way too much work. My home life pretty much disappeared as my work life took over. I didn't have time for the family at weekends as I was either catching up on work or too tired to go out and do anything enjoyable. My interest in sex evaporated and I didn't have the desire or energy anymore. Even when my family would complain about my behavior I was too stressed to acknowledge I had a problem. I just thought my anxiety and irritability were the side-effect of a miserable time at work and there was nothing I could do about it. Working with Alix (Therapist) helped change all of that. Although I was very hesitant to try this 'therapy' stuff at first (my wife made my first appointment for me), Alix made me feel comfortable and initially talked me through what to expect from our sessions together. What I learned was invaluable – that although I couldn't change external circumstances, I could change how I dealt with them. I became more confident at my job and instead of putting in 200% because of fear. I put my best 100% into the job and started to feel better about

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myself and my performance.

If stress is not managed, it can have a detrimental effect on the person concerned and those closest to them. In Eric's case he didn't even recognize he was experiencing stress which is often the case for people who are working long hours without a break. Because of his anxiety about losing his job, Eric was pushing himself too hard and was losing all perspective. The longer he continued operating this way, the more stressed he was becoming and he was getting close to a state of burnout or a nervous breakdown.

This is where the body shuts down mentally and physically to prevent further damage. Recovery from this state can take a very long time. Hypnotherapy gave Eric time and space to discuss his problems. He was able to take a step back and recognize how counterproductive his working habits had become and how they were having a negative impact on his health and family relationships.

Using hypnotherapy, he was able to recognize what was causing him to lose sleep and feel so stressed. His father had bullied him as a child and now this present situation was creating a similar stress response.

Over three sessions Eric began to deal with his stress more effectively. He overcame his fear of appearing weak and had a conversation with his boss which he had been avoiding. As a result, his workload was adjusted to become more manageable.

The stress counseling and hypnosis helped Eric to adjust his lifestyle, exercising and eating a healthier diet, both essential in managing stress. Needless to say, he's much happier at work and his family relationships have improved significantly.

IRRITABILITY AND STRESS: -

As children get older, their sources of stress expand. Teens are more likely than young children to be stressed by events or situations outside the home. A 2013 survey by APA found that stress was extremely common among teenagers: 83% of the teens surveyed said school was a significant or somewhat significant source of stress. But academics aren't the only thing worrying today's youth. A 2018 APA survey found that young people ages 15 to 21 — Generation Z report significant stress around social issues in the news including gun violence and school shootings, rising suicide rates, climate change, treatment of immigrants and sexual harassment.

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Peers can help buffer stress, but can also be a source of it. Social relationships are especially important in adolescence. Many teens worry about fitting in, their first romantic relationships and peer pressure around substance use and sex. For young children, tension at home is a common source of stress. Children may be troubled by family discord or divorce, for example. Big life changes, such as a new stepparent or new home, can also be hard on a child. That's true even when the changes are happy ones, such as the arrival of a new sibling. School is another frequent source of concern for kids. Young children might be stressed about making friends, dealing with bullies or getting along with their teachers. They might also be anxious about tests and grades. Little is known about the features of depressive symptoms with and without irritability among young adults in college. The primary aim of this study was to characterize the presentation of college students with depressive symptoms and irritability. Two-hundred eighty-seven undergraduate college students with depressive symptoms with and without irritability were compared across several psychiatric and functional outcome variables. Both male and female students with depressive symptoms and severe irritability reported a greater severity of depressive symptoms compared with their peers with no or mild irritability. In the women, the presence of irritability was associated with greater symptoms of anxiety, whereas in the men, it was associated with increased likelihood of engaging in risky behaviors, including compulsive use of alcohol, illicit drugs, and prescription drugs. The male and female college students with depressive symptoms with and without irritability did not differ on severity of suicidal ideation, hopelessness, or cognitive functioning. The findings from this study suggest that depressive symptoms and irritability may characterize a subtype of college students who have a greater symptom burden and with the potential need for more aggressive and prompt treatment. Irritable mood is defined according to the DSM-IV-TR as "persistent anger, a tendency to respond to events with angry outburst or blaming others, or an exaggerated sense of frustration over minor matters". Moreover, irritability is highly prevalent among depressed individuals

CHAPTER 3
THEORETICAL FRAMEWORK

THEORETICAL FRAMEWORK

After a long day at the office, many of us find ourselves taking out our stress on friends, children, or significant others. And if we're not careful, we allow our work stress to become home stress, often at the expense of our families and relationships or our health. How can you minimize the impact that work stress has on your relationship with your significant other, family, and friends? Below are five tips for keeping work stress from becoming home stress.

Develop good mobile device habits. Perhaps the most common way in which work distraction seeps into a person's relationships today is through smartphones. Have you ever finally decompressed in an evening only to look at your email, see something alarming, and become stressed? The average person now checks their phone 46 times per day, spending nearly five hours per day on mobile devices, leading 30% of users to consider their smartphones a "leash." Develop good habits and rules that keep your tablets and phones from tethering you to work. Keep two separate mobile phones as one for work and one for personal use — and leave the work phone in an out-of-the-way place (or turned off) on nights and weekends. And never check your work email in the hour or two prior to bed. Multiple studies have found that staring at a phone before bed can negatively impact your brain's ability to prepare for sleep, and sleep deprivation is linked closely to stress.

Have an end-of-work habit. Sometimes your brain needs a signal to prepare you for time at home. It's even better if this signal can help you decompress. For example, John uses his afternoon commute to unwind taking a more scenic route home, listening to music or the news, and giving himself time to switch gears for family life. Others we've spoken to have mentioned hitting the gym, running, meditating, and other rituals. Think about what helps you unwind, and find space in your schedule for this habit particularly at the end of a long day at work so that when you return home you're free of the baggage that's built up throughout the day. Work stress can be a challenge for home life

THEORIES ASSOCIATED WITH STRESS AND IRRITABILITY

1. James-Lange: Theory of Emotion

In 1884 and in 1885, theorists William James and Carl Lange might have separately proposed their respective theories on the correlation of stress and emotion, but they had a unified idea on this relationship - emotions do not immediately succeed the perception of the stressor or the stressful event; they become present after the body's response to the stress. For instance, when you see a growling dog, your heart starts to race, your breath begins to go faster, then your eyes become wide open. According to James and Lange, the feeling of fear or any other emotion only begins after you experience these bodily changes. This means that the emotional behavior is not possible to occur unless it is connected to one's brain.

2. Cannon-Bard: The Emergency Theory

This theory is quite the opposite of what James and Lange proposed. According to theorist Walter Cannon, emotion in response to stress can actually occur even when the bodily changes are not present. He attempted to prove his theory by means of creating the so-called "decorticated cats", wherein the neural connections of the body are separated from the cortex in the brain of the cats. When faced with a stressful response, the decorticated cats showed emotional behavior which meant feelings of aggression and rage. This emotion was then manifested by bodily changes such as baring of teeth, growling and erect hair. To further enhance Cannon's theory, theorist Philip Bard expanded the ideals of Cannon by arguing that a lower brain stem structure called the thalamus is important in the production of emotional responses. According to Bard, the emotional response is released first, and then sent as signals by the thalamus to the brain cortex for the interpretation alongside with the sending of signals to the sympathetic nervous system or SNS to begin the physiologic response to stress. Therefore, this theory argues that emotional response to stress is not a product of the physiologic response; rather, they occur simultaneously.

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FACTORS INFLUENCING STRESS AND IRRITABILITY

People can experience periods of irritability in response to stressful situations. Persistent irritability may indicate an underlying physical or psychological disorder. Children may appear irritable as a normal part of development. In other cases, irritability may be due to an infection, mood disorder, or behavior disorder, such as ADHD, depression, or anxiety. Older adults may also experience frequent periods of irritability if they feel isolated or lonely. Neurodegenerative diseases, such as Alzheimer's disease, can cause changes in a person's mood or personality. People can speak with a doctor or a trained mental health professional if they feel that they need help managing their irritability.

CHAPTER 4
RESEARCH METHODOLOGY

IRRITABILITY, STRESS

OBJECTIVES OF THE STUDY

- To study the relationship between irritability at home and stress at work among adults.
- To examine the role of stress on irritability.

HYPOTHESIS

1. There is significant relationship between irritability at home due to stress at work among working adults
2. Stress significantly predicts irritability.

RESEARCH DESIGN

The study has been conducted using descriptive research design.

SOURCES OF DATA

Data was collected from the working community and all the individuals the researcher knew who were working, it was also collected from family and friends contact circles.

SAMPLE SIZE

The questionnaire was conducted on all working communities in general without a particular setting in focus. A total of 150 working citizens participated in this study. The age of the participants ranged from 20 to 58. There were almost equal numbers of female participants and male participants.

SAMPLING METHOD

Convenience sampling is a type of non-probability sampling that involves the sample being drawn from that part of the population that is close to hand. The study was administered through google forms on all working populations without being specific.

METHOD OF DATA COLLECTION

Data was collected through Google Forms. Google Forms is a survey administration software included as part of the free, web-based Google Docs. The Google Forms were distributed around the target group through social media like WhatsApp, Instagram and mails.

DRAFTING QUESTIONNAIRE

The questionnaire consisted of four sections. The first section asked for the participant's consent and The second section asked about the participant's simple demographic information. The third asked about their amount of stress they were surrounded with every day. In the fourth and last section the participants were asked about their rate of irritability.

- **Informed Consent:** Agree or Disagree.
- **Demographic Details:** Name, Age, Gender, Education, Occupation, Designation and Locality
- **Perceived Stress Scale:** The Perceived Stress Scale (PSS) is the most widely used psychological instrument for measuring the perception of stress. It is a measure of the degree to which situations in one's life are appraised as stressful. Items were designed to tap how unpredictable, uncontrollable, and overloaded respondents find their lives. The scale also includes a number of direct queries about current levels of experienced stress. The items are easy to understand, and the response alternatives are simple to grasp. There is reverse scoring involved for question numbers 4, 5, 7, and 8. On these 4 questions, change the scores like this: 0 = 4, 1 = 3, 2 = 2, 3 = 1, 4 = 0. Moreover, the questions are of a general nature and hence are relatively free of content specific to any subpopulation group. The questions in the PSS ask about feelings and thoughts during the last month. In each case, respondents are asked how often they felt a certain way.

There is

- **Brief Irritability Test:** Elevated levels of irritability have been reported across a range of psychiatric and medical conditions. However, research on the causes, consequences,

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and treatments of irritability has been hindered by limitations in existing measurement tools. This test contains only positive scoring.

- **DATA ANALYSIS TECHNIQUE**

The data collected from the questionnaire was analyzed using the statistical analysis software (IBM SPSS Statistics).

Spearman's Rank Correlation is a nonparametric measure of rank correlation (statistical dependence between the rankings of two variables). It assesses how well the relationship between two variables can be described using a monotonic function. The Spearman correlation between two variables is equal to the Pearson correlation between the rank values of those two variables; while Pearson's correlation assesses linear relationships, Spearman's correlation assesses monotonic relationships (whether linear or not). If there are no repeated data values, a perfect Spearman correlation of +1 or -1 occurs when each of the variables is a perfect monotone function of the other.

Spearman's coefficient is appropriate for both continuous and discrete ordinal variables.

The Spearman correlation coefficient is defined as the Pearson correlation coefficient between the rank variables.

Regression analysis is a set of statistical processes for estimating the relationships between a dependent variable (often called the 'outcome variable') and one or more independent variables (often called 'predictors', 'covariates', or 'features'). The most common form of regression analysis is linear regression, in which one finds the line (or a more complex linear combination) that most closely fits the data according to a specific mathematical criterion.

Simple linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data. One variable is considered to be an explanatory variable, and the other is considered to be a dependent variable.

CHAPTER 5
DATA ANALYSIS

DATA ANALYSIS

The study was conducted among 150 working citizens who have worked in all sectors. The objectives of the present study are (1) to study the relationship between irritability at home and stress at work (2) to find out if there's a significant statistical relationship between irritability at home and stress at work. The correlational research design was used to meet the objectives of this study. The data was analyzed using Spearman's rank Correlation Coefficient Analysis. Hierarchical regression was used to check the moderating impact of irritability at home due to stress at work.

5.1 Table 1

Reliability of instruments obtained on the sample.

Sl. No.	Instruments	N	Cronbach's α
1.	Irritability	150	.828
2.	Stress	150	.765

The table shows the Reliability of the instruments using Cronbach's α and number of values in the population (N). Cronbach's alpha is a measure of internal consistency, that is how closely related are the set of items in the group. Here, the Cronbach's alpha show that irritability and stress are closely related and N represents 150 participants who responded to the questionnaires.

5.2 Table 2

Result of Kolmogorov-Smirnov^a test of normality of the relationship between irritability at home and stress at work.

	Statistic	df	Sig.
Irritability	.097	150	.002
Stress	.122	150	.001

P<0.05

The Kolmogorov-Smirnov^a test of normality pointed out that the significance level of Irritability and stress are lesser than 0.05 , and hence they are **not** normally distributed. Hence, Spearman's Rank correlation is used to check the correlation between each variables in this study.

Results of hypothesis testing are given below:

5.3 Table

Summary of Spearman's Rank Correlation between Irritability at home and stress at work.

Variable	Stress
Irritability	.700**

** = p<0.01

The above table examines the relationship between irritability at home and stress at work. With reference to the table, it can be noted that there exists a significant positive correlation between irritability at home and stress at work. . Which indicates that high scores in irritability scale would lead to high scores in stress scale as well. All working adults who are stressed from work would also have higher irritability level in them even outside work.

5.4 Table 4

Regression Analysis predicting irritability at home and stress at work.

Variable	R ²	Adjusted R ²	df	F	B	T	Sig.
Stress	.495	.491	149	144.798	.503	12.033	.001

This table shows the results of regression analysis for predicting the relationship between Irritability and stress at work.

Eric Whitfield – Architect – age 54; from literature review is a great example to understand as irritability increases stress increases.

CHAPTER 6
FINDINGS

FINDINGS

Irritability at home showed a positive correlation with stress at work. According to the results, it can be noted that there is a weak relationship between irritability at home and stress at work. This shows that as stress increases, irritability at home also increases. This was predicted using bi-variate regression analysis which also proved the same. This indicates that there is a relationship between irritability and stress within your surroundings affecting one's behavior.

In hypothesis 1, the aim was to understand the relationship between irritability at home and stress at work. It was proven that there is a positive correlation between irritability at home and stress at work through spearman's correlation technique.

In hypothesis 2, the aim was to prove that stress significantly predicts irritability and that was also proven by doing the Regression test. As stress increases, irritability also increases

CHAPTER 7
RECOMMENDATIONS

RECOMMENDATIONS

This study has encountered many limitations that might have had an impact on its ability to solve the problem statement to its full potential. There were limitations due to time constraints which held back the research in terms of quality. It is recommended this topic be more thoroughly researched especially in the theoretical framework.

The findings of this study have difficulty being generalized due to the low number of participants in the sample. It is recommended that further study on this topic be conducted with a larger sample size so views can be more universal.

The sampling method of this study was not up to research standards due to inability to be truly random. This was due to inaccessibility to resources and connections. It is recommended this topic be studied further based on a truly random selection of participants from the population.

This study has a low number of male participants which make it difficult to generalize findings onto male school teachers. It is recommended that future studies have more male participants in their population for more acceptable findings.

CHAPTER 8
CONCLUSION

CONCLUSION

The study at hand was primarily conducted to examine the relationship between irritability at home and stress at work. The study was conducted on all working citizens ageing from young adults and above. The objective of the study was to provide a scientific base for improving stress levels and reducing irritability among people. It has been concluded that there is a significant relationship between irritability at home and stress at work. This indicates that there is a positive correlation between stress at work can cause irritability at home.

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CHAPTER 9
APPENDIX

APPENDIX A

INFORMED CONTENT

I understand that my participation in this study is voluntary and I can decline my participation without giving any reason. I understand that this study requires demographic details and questionnaires to be filled out. I have been given a sufficient amount of time to review the information and have sought the required clarification too.

By ticking on the "I agree" option, I give my full consent to participate in this study:

I agree

I disagree

DEMOGRAPHIC SHEET

Name :

Age:

Gender: Male/ Female/ Prefer not to say

Education:

Occupation:

Designation:

Locality: Urban/Rural

APPENDIX B

QUESTIONNAIRES

Brief Irritability Test (BITe) Copyright Holtzman, All rights reserved, 2015							
The following questions needs to be answered honestly. Please check one response for each item that best indicates your irritability.	N e v e r	R a r e l y	S o m e t i m e s	O f t e n	V e r y o f t e n	A l w a y s	
1. I have been grumpy	0	1	2	3	4	5	
2. I have been feeling like I might snap	0	1	2	3	4	5	
3. Other people have been getting on my nerves	0	1	2	3	4	5	
4. Things have been bothering me more than they normally do	0	1	2	3	4	5	
5. I have been feeling irritable	0	1	2	3	4	5	

Perceived Stress Scale						
Copyright, All rights reserved, 1983						
<p>The following questions needs to be answered honestly. Please check one response for each item that best indicates how often you've experienced each emotion at work over the past 30 days.</p>		N e v e r	A l m o s t N e v e r	S o m e t i m e s	F a i r l y O f t e n	V e r y O f t e n
1. In the last month, how often have you been upset because of something that happened unexpectedly?		0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?		0	1	2	3	4
3. In the last month, how often have you felt nervous and stressed?		0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?		4	3	2	1	0
5. In the last month, how often have you felt that things were going your way?		4	3	2	1	0
6. In the last month, how often have you found that you could not cope with all the things that you had to do?		0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?		4	3	2	1	0
8. In the last month, how often have you felt that you were on top of things?		4	3	2	1	0
9. In the last month, how often have you been angered because of things that happened that were outside of your control?		0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?		0	1	2	3	4

ST. TERESA'S COLLEGE
(AUTONOMOUS)
AFFILIATED TO MAHATMA GANDHI UNIVERSITY, KOTTAYAM



**An Ancient Katapayadi Encoding Technique for Malayalam
Character to Numeric Translation**

PROJECT REPORT

In partial fulfillment of the requirements for the award of the degree of

**BACHELOR OF SCIENCE IN
COMPUTER APPLICATIONS
[TRIPLE MAIN]**

By

Aleena Miju

III B.Sc. Computer Applications [Triple Main]

Register No: SB19CA002

Under the guidance of
Ms. Sangeetha Chandran

&

Ms. Remya C J

DEPARTMENT OF COMPUTER APPLICATIONS
2019-2022

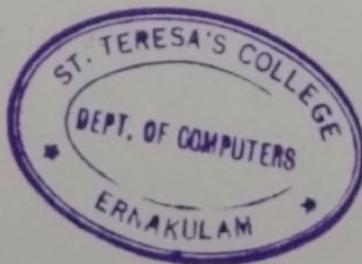
CERTIFICATE



This is to certify that the project report entitled "An Ancient Katapayadi Encoding Technique for Malayalam Character to Numeric Translation", a bona fide record of the work done by ALEENA MIJU (Register no: SB19CA002) during the year 2019-22 and submitted in partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Applications [Triple Main] under Mahatma Gandhi University, Kottayam.

Head of the Department

Internal Examiner



External Examiner

DECLARATION

I, ALEENA MIJU (Register no: SB19CA002), B.Sc. Computer Applications [Triple Main] final year student of St. Teresa's College (Autonomous), Ernakulam, hereby declare that the project submitted named "An Ancient Katapayadi Encoding Technique for Malayalam Character to Numeric Translation" for the Bachelor's Degree in Computer Applications [Triple Main] is my original work. I further declare that the said work has not previously been submitted to any other university or academic body.

Place: Ernakulam

ALEENA MIJU

Date:

ACKNOWLEDGEMENT

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ALEENA MIJU

ABSTRACT

Cryptography is the art of encoding and decoding data for secure communication. The technique came into existence centuries back in 400BC. Mlecchita Vikalpa, Kautilya, Muladeviya are some cryptographic systems believed to be used in ancient India. Katapayadi, an ancient encoding system used by mathematicians and astronomers to deal with huge numbers, is considered an encoding and cryptography technique. This system has been used extensively in the southern part of India by scholars and musicians. There are many numeric systems to relate numbers and letters. Some express just a word in numbers, whereas others represent a word by numbers using its meaning. In the case of the Katapayadi system, letters act in the place of numbers. The system was popular because of its flexibility and ease of use. Multiple syllables were assigned to a single number which eases the formation of meaningful words or verses from the set of numbers. This system is applied in many disciplines, including mathematics, astronomy, literature, and music. The paper presents some instances from the past where katapayadi was believed to be used. In addition, as a contribution to this theory, the Katapayadi scheme was applied to the data set of Malayalam language months, names of Kauravas (from Mahabharata), names of planets, and incarnations of Lord Vishnu.

Keywords: *Katapayadi, Malayalam, Encoding, Cryptography*

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1. INTRODUCTION

India has made several contributions to the area of mathematics which include the concepts like zero, trigonometry, negative numbers, algebra and decimal number system. Baudhayana, Katyayana, Pingala, Aryabhata, Brahmagupta, Mahavira, Bhaskara II and Madhava of Sangamagrama are some renowned figures mathematician and philosophers from history whose work contributed to the advancement of ancient mathematics. Almost all works which were done in Sanskrit are complex formulas, rules and numbers. These words were later converted into some meaningful words or shlokas for easy memorization. For the purposes of memorization and numeric representation, numerical systems like Aryabhata numeration, Bhutasankhya and Katapayadi were introduced in history.

Katapayadi system is not extremely clear whether this is a finding of Kerala mathematicians, or which has been elsewhere. Some historians credit the origin of the system to Vararuchi, a brilliant scholar from Kerala who lived during the 4th century CE. There are several examples of the Katapayadi being extensively used in mathematics and astronomy works of scholars from Kerala of the 14th to the 18th century. The paper is organized as follows:

- A detailed description of Katapayadi system is given,
- Literature survey on the topic,
- Some applications of Katapayadi in ancient times
- Methodology, where Katapayadi is applied on some selected dataset.
- Result
- Conclusion
- References

2. KATAPAYADI SYSTEM

Katapayadi is an ancient encoding system that denote letters to numbers. In Malayalam, the regional language of Kerala the Katapayadi System is popularly known as Paral Peru or Akshara Sankhya. Below given is a table that shows the letters and their corresponding numbers in Katapayadi system (in Malayalam).

KaTaPaYaDi System									
1	2	3	4	5	6	7	8	9	0
ക	ഖ	ഗ	ഘ	ങ	ച	ഛ	ജ	ഝ	ഞ
ട	ഠ	ഡ	ഢ	ണ	ത	ഥ	ദ	ധ	ന
പ	ഫ	ബ	ഭ	മ					
യ	ര	ല	വ	ശ	ഷ	സ	ഹ	ള	ഴ, റ
Transliteration- English									
1	2	3	4	5	6	7	8	9	0
Ka	Kha	Ga	Gha	Nga	Ca	Cha	Ja	Jha	Nya
Ta	Tha	Da	Dha	Na	Ta	Tha	Da	Dha	Na
Pa	Pha	Ba	Bha	Ma					
Ya	Ra	La	Va	Sha	Shha	Sa	Ha	Lla	Zha, Rra

Table 1 Katapayadi Table

Thus, the first consonant “ka” is assigned to the numerical value 1, the second consonant “Kha” is assigned the value 2 and so on up to nine. Nine is assigned to Jha and zero is assigned to “Nya”. The numbers are

then assigned to the next set of 10 consonants in a similar manner. Eventually multiple syllables represent the same number. The name Katapayadi is emerged by combining the letters “Ka” “Ta” “Pa” and “Ya” whose corresponding number is one according to the system which when pronounced together gives Katapayadi where Adi means “etc”

2.1 RULES

1. In conjunct consonants only the last consonant is taken into account.
2. A vowel not preceded by a consonant is represented by zero and vowels following consonants have no value.
3. In this method the numbers are read from right to left.
4. There is no way for representation of decimal separator in this system.[24]

The following shlokas constitute the entire rules set mentioned above in two lines:

नजावचश्च शून्यानि संख्याः कटपयादयः।

मिश्रे तूपान्त्यहल् संख्या न च चिन्त्यो हलस्वरः॥[24]

English translation: -

nanyāvacaśca śūnyāni saṁkhyāḥ kaṭapayādayaḥ

miśre tūpāntyahal saṁkhyā na ca cintyo halasvaraḥ

For example, consider the word ജലം. Using Katapayadi system we get “ജ” as 8 and “ല” as 3 after reversing we get 38.

2.2 ASSUMPTIONS

There are some instances in epics where Katapayadi scheme is used. But there is less evidence for ascertaining it. Some of them are:

At the time of Dhritrashtra, since he was blind, he faced many difficulties in day-to-day life activities. In order to make his life convenient Vidur measured the number of steps the King had to walk to reach different locations in his Kingdom and converted these numbers into a beautiful poem and asked the king to memorize it. It is believed that Katapayadi was used for the conversion [25].

Another interesting fact is that the following shlokas are from Mahabharata which is believed to be written by Vyasa where the word “Jaya” when converted into numbers using Katapayadi scheme, number 18 is obtained.

naaraayaNam namaskrutya naram chaiva narOththamam |

deveem saraswatim vyaasam tathO jaya mudheerayet ||[23]

The number 18 has some significance in Mahabharata such as it has 18 books, Kurukshetra war was fought for 18 days, army that took part in the greatest War was 18 akshouhinis, the number of Elephants in one Akshouhini= 21870=2+1+8+7+0=18[23].

3. LITERATURE SURVEY

The following table consists of some works that are done based on the Katapayadi system.

SL. NO	TITLE	AUTHOR	YEAR OF PUBLICATIONS	SUMMARY	REFERENCE
1.	The ancient katapayadi formula and the modern hashing technique	Anand Raman	1997	In this paper the author has stated that the katapayadi scheme of deriving numbers from names was the anticipation of modern hashing technique of retrieving a record from a table based upon a given key. But from an observation there are several important differences between the two techniques. Notably a hashing formula gives a valid bucket number for any given name, but the Katapayadi scheme only gives meaningful results for some names. It also explains how the katapayadi scheme is applied in South Indian Musicology.	[1]
2.	Kaṭapayādi Notation on a Sanskrit Astrolabe	Sreeramula Rajeswara Sarma	1999	This paper provides a full technical description of the Astrolabe, now preserved in the Sarasvati Bhavan Library of Sampurnanand Sanskrit University, Varanasi, and explains the use of Katapayadi notation on this astrolabe. The paper concluded by stating that the use of katapayadi system was not just confined to South India but it was known well in North India to be employed in an astrolabe.	[2]
3.	Indian binary numbers and the Katapayadi notation	Subhash Kak	2000	This paper provides evidence that there existed variant forms of katapayadi scheme. The author has mentioned the katayasadi scheme which in analogy with Katapayadi. The paper also suggests that the variant Katayasadi might have other variants, including katapayadi as well. This takes the history of katapayadi mapping more than a thousand years earlier than had been supposed.	[3]
4.	Aryabhata and Axial Rotation of Earth	Amartya Kumar Dutta	2006	The paper states that the Katapayadi system was used by Indian astronomers along with other ancient decimal-numeral systems. It was also used to compose	[4]

				sufficiently brief but pleasant-sounding chronograms often with connected meanings and also was applied in Karnatic music.	
5.	KaTaPaYaDi – World's Oldest Hashing Algorithm	Gurudev	2007	A detailed description about how the Katapayadi system was used to convert numbers into texts. Some relevant applications of this system are given which includes Madhava sin table, as a hashing algorithm in Classical Indian Music System, in Chandravakyas written by Vararuchi that contains the longitudes of the Moon at different intervals of time.	[5]
6.	The Katapayadi-system of numerical notation	Sreeramula Rajeswara Sarma	2012	The paper gives a detailed explanation about the Katapayadi system, the rules used in it, various statements regarding its origin, its popularity in Kerala and its spread to the neighbouring state Tamil Nadu. It also states that there is evidence of the usage of Katapayadi system in Northern India, and mentions about the variants of the system.	[6]
7.	Katapayadi SanKhya	Sapan	2013	This article gives some instances where the Katapayadi scheme is used. One such is that when a particular shloka in Karanapaddhati when converted into numbers using the scheme yields the value of pi. When the pairs of letters of a particular shloka in Malayalam are substituted in accordance with the scheme yields the number of days in each month.	[7]
8.	Ancient Kalapayadi System Sanskrit Encryption Technique Unified (AKS-SETU)	Aman Kishore Agarwal, Deepesh Kumar Srivastava	2014	This paper proposes a system known as AKS-SETU which uses the katapayadi system for encryption. An attempt to reduce the file size along with encryption is also done. A conceptual model description and working illustrated in this paper is just a theoretical idea. Practical implementation of this system is completely another aspect and formalization of the system may require the proper integration of Hindi/Sanskrit or to	[8]

				say Devanagari system of language with the computer system.	
9.	Katapayadi Sankhya	Pradeep Singh	2015	The article explains the rules and mechanism of the katapayadi system. Here, the use of this system in Madhava sin table, Carnatic music, etc. are given.	[9]
10.	Coding the encoded: automatic decryption of katapayadi and Aryabhata's systems of numeration.	R. Anusha, C. Nithya, R. Venketeswara Pai V. Ramanathan	2017	This paper describes the process of decryption and decoding the numbers that had been encoded in Sanskrit words using the Aryabhata and Katapayadi system. An automated protocol for decryption of encoded numbers in Sanskrit strings using both the katapayadi and Aryabhata's system is developed. This protocol is reliable and free from any kind of defect. It can be a helping hand for the researchers in the field of history of Indian mathematics and astronomy who constantly deal with such decryption processes.	[10]
11.	A Study on the Encoding Systems in Vedic Era and Modern Era	K. Lakshmi Priya, R. Parameswaran	2017	In this paper the Katapayadi system used in vedic times is applied to modern ciphers– Vigenere Cipher and Affine Cipher. The author has demonstrated the application of katapayadi system in vigenere cipher and affine cipher by making necessary changes in the rules of encryption and decryption. The observation is that this system gives more than one interpretation when ciphertext C, is obtained as a string of numbers, each number may represent more than one letter which make the decryption a troublesome job. If this ambiguity is solved, this system can be implemented as a very effective cipher system.	[11]
12.	International Journal of Mathematical Education in Science and Technology	M. More	2017	The paper gives a brief explanation about the Katapayadi system and translation of some shlokas using the scheme that yields the value of pi and the concept of infinity.	[12]

13.	Novel Space Efficient Indices for Kannada Text: V-KTPY Trie Family	Yashawini Hegde, Padma S. K	2019	In this paper they present V-KTPY Trie Family which is a group space efficient indices designed to store and search Kannada text. It uses Vistruta Katapayadi sutra (V-KTPY) and prefix trees (Trie). This rule is an extension of the ancient Katapayadi Sutra which can convert characters of scripts to numbers. The experimental results have shown that this technique are space efficient with almost same time complexity and suitable for indexing huge corpora text.	[13]
14.	KaTaPaYadi System	Hrishikesh Terdalkar, Arnab Bhattacharya	2019	The paper presents a web-based system that uses the kaṭapayādi numbering scheme. The system can both decode a word into its corresponding number and can encode a number into word(s). While decoding is easy since each character represents only a single digit, encoding is tricky since there can be many possible combinations. Demonstration of both encoding and decoding is provided.	[14]
15.	Katapayadi Number System	Sreejith Kaimal	2020	The article gives a brief description about the Katapayadi system, its usage in the astronomical realm, some examples of the conversion of some shlokas using the scheme yields meaningful numbers such as the value of pi, and also its usage in music.	[15]
16.	Vedic Encoding using the Katapayadi System	Raja Srinivasan	2020	This article explains about the Katapayadi system which is used for encoding words into numbers and some examples of converting shlokas using the system is given. One such is that the very first hymn of the Rig Veda when converted gives the speed of light.	[16]
17.	The Katapayadi Code: An Ancient Practice of Encryption	Anand Narayanan, Neena Sekharan	2021	A detailed description about Katapayadi system and its rules, how it is used in astrology in Kerala, for finding sin values, for naming Ragas in music, and also how authors used to embed the date on which a literature was completed in	[17]

				a set of words within the same work are given in this article.	
18.	Cryptography in ancient India	Pramod Prakash Ghogare	Not specified	This paper gives a brief description about the Katapayadi scheme and a small illustration.	[18]
19.	Numerals as letters: Iudic language in chronographic writing	Stephen Chrisomalis	Not specified	A brief description of the Katapayadi System and its rules is given.	[19]
20.	Rig Veda Magic Squares	John Frederick Sweeney	Not specified	The paper states that Madhava's Sine Table is encoded in the letters of Devanagari using the Katapayadi system. This gives the entries in the table an appearance of the verses of a poem in Sanskrit (page no.:27)	[20]
21.	India invented zero – Really?	S. Parthasarathy	Not specified	A brief explanation stating that Sidhanta texts were closely related to the “katapayadi” system of coding and how the system is used to depict letters to numerals for easy remembrance of numbers as phonetic words or verses. (page no.:4, section 3.1)	[21]
22.	Carnatic Classical Music	K. R. Suresh	Not specified	A brief explanation about how Katapayadi Scheme was applied to the nomenclature of the melakarta ragas.	[22]

Table 2 Literature Survey

4. APPLICATIONS OF KATAPAYADI SYSTEM

The scholars in ancient time had used the concept of Katapayadi in their works in different ways. Some of them are:

4.1 ASTRONOMY

Chandravakyas written by Vararuchi is a work related to the prediction of the position of the Moon. This is also known as Chandravakyani, Vararucivakyani, or Pancangavakyani. It is a collection of numbers, arranged in the form of lists, corresponding to the movement of the Moon in its orbit around the Earth. These numbers are converted into words or verses in Sanskrit using the Katapayadi system.

The Parahita system was promulgated by Haridatta and was included in his works namely Grahacarandibandhana and Mahamargandibandhana. It is commonly known as Parandhitaganita. The main aim was to reduce the complexity of Aryabhata's theory of astronomy. The complex system of notation was replaced by Katapayadi. The numbers were converted to verses so that it can be easily remembered. Many followed this system due to its accuracy.

4.2 MATHEMATICS

Madhava's sin table was constructed by Madhava of Sangamagrama which contains the values of sines. His original work has not been discovered, but it is mentioned in Yuktidipika written by Sankara Variar in the form of shlokas. Given below is the shloka:

श्रेष्ठं नाम वरिष्ठानां हिमाद्रिवेदभावनः ।
 तपनो भानुसूक्तज्ञो मध्यमं विद्धि दोहनम् ॥
 भिगाज्यो नाशनं कष्टं छन्नभोगाशयाम्बिका ।
 भ्रिगाहारो नरेशोऽयं वीरो रगाजयोत्सुकः ॥
 मूलं विशुद्धं नाळस्य गानेषु विरळा नराः ।
 अशुद्धिगुप्ता चोरश्रीः शङ्कुकर्णो नगेश्वरः ॥
 तनुजो गर्भजो मित्रं श्रीमानत्र सुखी सखे ! ।
 शर्मा रात्रो हिमाहारो वेगज्ञः पथि सिन्धुरः ॥
 छायालयो गजो नीलो निर्मलो नास्ति सत्कुले ।
 रात्रो दर्पणमभ्राङ्गं नागस्तुङ्गनसो बली ॥
 भीरो युवा कपालोलः पूज्यो नारीजनैर्भगः ।
 कन्यागारे नागवल्ली देवो विश्वस्थली भृगुः ॥
 तत्परादिकलान्तास्तु महाज्या माधवोदिताः ।
 स्वस्वपूर्वविशुद्धे तु शिष्टास्तत्खगडमौर्विकाः ॥ २.९.५ ॥

[28]

Fig.1 Shloka from Yuktidipika

These verses are written in Devanagari. When these are decoded using Katapayadi scheme, it yields the sine values of the angles from 3.75° to 90°. In this each angle is obtained by adding 3.75°. There is a total of 24 angles. In short, the entire Madhava sin table is encoded into these verses.

Karanapaddhati is a work which is believed to be done by Puthumana Somayaji. The sixth chapter of this contains the following shloka which when decoded using the Katapayadi scheme, gives the value of Pi

അനൂനനൂനാനനനൂനനീതൈ-
 സ്സമാഹതാശ്ചക്രകലാവിഭക്താഃ
 ചണ്ഡാംശുചന്ദ്രായമകുന്ദിപാലൈർ-
 വ്യാസസ്തദർദ്ധം ത്രിഭജുർവിക സ്യാത്[24]

Where അനൂനനൂനാനനനൂനനീതൈ gives 10,000,000,000 the diameter of the circle and ചണ്ഡാംശുചന്ദ്രായമകുന്ദിപാലൈർ gives 31415926536.

The shloka in the Sadratnamala by Sankara Varman also gives the value of Pi when Katapayadi is applied.

भद्राम्बुधिसिद्धजन्मगणितश्रद्धा स्म यद् भूपगी:[24]

After the conversion, 314159265358979324 is obtained.

4.3 MUSIC

Chaturdandiprakashika, a notable work by Venkatamakhi that uses the melakarta system to classify ragas based on their swaras in Carnatic music. The swaras are arranged in increasing frequency i.e., Sa Ri Ga Ma Pa Dha Ni. Sa and Pa are fixed, but the other five swaras have variants. This can be given in the form Sa

Ri1,Ri2,Ri3 Ga1,Ga2,Ga3, Ma1,Ma2 Pa Dha1,Dha2,Dha3 Ni1,Ni2,Ni3. There are a total of 72 melakarta ragas and it is grouped into two. The first group is from 1 to 36 and contains Sa, Pa and Ma1 and the second group is from 37 to 72 and contains Sa, Pa and Ma2. There is six possible combinations of Ri-Ga and Dha-Ni which is as follows

Ri1-Ga1, Ri1-Ga2, Ri1-Ga3, Ri2-Ga2, Ri2-Ga2, Ri2-Ga3

Dha1-Ni1, Dha1-Ni2, Dha1-Ni3, Dha2-Ni2, Dha2-Ni3, Dha3-Ni3

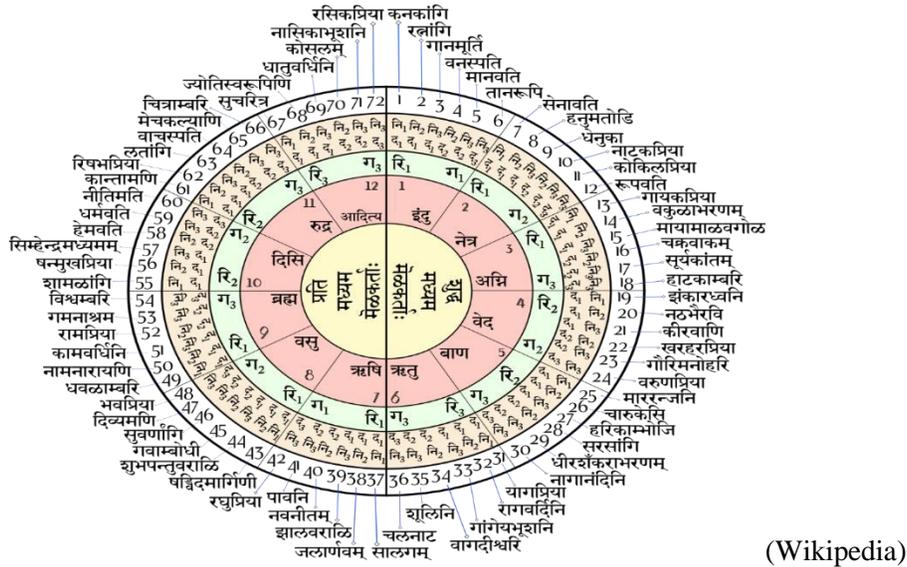


Fig.2 Melakarta chart

To remember the swaras scale that each melakarta ragas represents is a difficult task. In order to memorize it easily, the Katapayadi scheme is applied. The first two letters of the name of the ragas when converted using katapayadi yields the melakarta number. The quotient and remainder which is obtained when dividing one less than melakarta number by 6 gives the corresponding Ri-Ga and Dha-Ni combinations. If the quotient obtained is 0 then Ri1-Ga1 is taken, if it is 1 then Ri1-Ga2 and so on up to quotient 5 that denotes Ri2-Ga3. Similar in the case of Dha-Ni combinations where remainder is considered. If the melakarta number is greater than 36, first 36 is subtracted from the corresponding melakarta number and the above operation is performed.

For example: The first two letters of the "shanmuKapriya", "sha" and "mu" represents 6 and 5 respectively when converted using Katapayadi and reversing we get 56 which implies it is 56th melakarta raga. Here 56 is more than 36 so it belongs to the second group with Sa, Pa and Ma2 hence subtracting 36 from it we get 20. Subtracting 1 from 20 and dividing it by 6 we get quotient as 3 which implies Ri2-Ga2 and remainder as 1 which implies Dha1-Ni2. The raga scale is Sa Ri2 Ga2 Ma2 Pa Dha1 Ni2.

4.4 DATES HIDDEN IN SHLOKAS

പലഹാരേ പാലു നല്ലു, പുലർന്നാലോ കലക്കിലാ
 ഇല്ലാ പാലെന്നു ഗോപാലൻ - ആംഗുമാസദിനം ക്രമാൽ [24]

The above verses in Malayalam written by Kodunnallur Kunnikkuttan Tampuran when decoded using Katapayadi System gives the number of days in each month according to the Gregorian calendar. It can be illustrated as follows:

പല -31 ഹാരേ- 28 പാലു- 31 നല്ലു-30 പുലർ-31 ന്നാലോ-30 കല-31 ക്കിലാം-31 ഇല്ലാ-30 പാലെ-31 ന്നു ഗോ-30 പാലൻ-31

Narayaniyam written by Melpathur Narayana Bhattathiri ends with ആയുരാദേശാഗ്യസൗഖ്യം which when converted into numbers by applying Katapayadi yields the number 1712210. This number is marked to be the day on which the work was completed in Kali Yuga.

हे विष्णो निहितं कृत्स्नं जगत् त्वय्येव कारणे ।
ज्योतिषां ज्योतिषे तस्मै नमो नारायणाय ते ॥ १ ॥ [17]

The above verses are from Tantrasangraha written by Nilakanta Somayaji. The words

हे विष्णो निहितं कृत्स्नं

when converted to numbers gives 1680548 which is believed to be the day of completion of the work in Kali Yuga.

4.5 EXCEPTIONS

गोपीभाग्यमधुव्रात-शृङ्गिशोदधिसन्धिग।
खलजीवितखाताव गलहालारसंधर ॥[24]

The above shloka is written in praise Of Lord Krishna and when converted using Katapayadi yields the value of Pi. After decoding 31415926535897932384626433832792 is obtained.

अग्निमीळे पुरोहितं यज्ञस्य देवमृत्विजम् ।
होतारं रत्नधातमम्[20]

The above is the first verse of the Rig Veda in Sanskrit. It gives the volumetric rate of light radiated in cubic yards per unit time of one vedic second when Katapayadi scheme is applied i.e.,
35312861871845648862226955

In both these cases, the letters are converted to numbers using the katapayadi, but read from left to right. According to the rule, it had to be read from right to left.

5. METHODOLOGY

This section illustrates how the Katapayadi system is applied on the datasets of names of Kauravas, names of planets, Malayalam months, and incarnation of Lord Vishnu to decode into a particular set of numbers. The decoding is implemented using python.

5.1 DATASET

Given below are the datasets consider for decoding

Names of Kauravas

ദുര്യോധനൻ	ദുർവിഗാഹൻ	പാശി	ഉഗ്രശായി
ദുഷ്ടാസനൻ	വിവിത്സു	വൃന്ദാരകൻ	കവചി
ദുഷ്ടഹൻ	വികടിനന്ദൻ	ദുധവർമ്മൻ	ക്രമനൻ
ദുഷ്ടലൻ	ഉരർണ്ണനാഭൻ	ദുധക്ഷത്രൻ	കുമ്മനം
ജലഗന്ധൻ	സുനാഭൻ	സോമകീർത്തി	ഭീമവിക്രൻ
സമൻ	നന്ദൻ	അനുഭരൻ	ധനുർദ്ധരൻ
സഹൻ	ഉപനന്ദൻ	ദുണസന്ധൻ	വീരബാഹു
മിന്ദൻ	ചിത്രബാണൻ	ജരാസന്ധൻ	അലോലുപൻ
അനുവിന്ദൻ	ചിത്രവർമ്മൻ	സത്യസന്ധൻ	അഭയൻ
ദുർദ്ധർഷൻ	സുവർമ്മൻ	സദാസുവാക്	ദുധകർമ്മാവ്
സുബാഹു	ദുർവീമോചൻ	ഉഗ്രശ്രവസ്സ്	ദുണരമാശ്രയൻ
ദുഷ്പ്രധർഷണൻ	അയോബാഹു	ഉഗ്രസേനൻ	അനാധ്യക്ഷ്യൻ

ദുർമ്മർഷണൻ	മഹാബാഹു	സേനാനി	കുണ്ഡഭേദി
ദുർമ്മുഖൻ	ചിത്രാംഗദൻ	ദുഷ്കരജിതൻ	വിരാവി
ദുഷ്കർണ്ണൻ	ചിത്രകുണ്ഡലൻ	അപരാജിതൻ	ചിത്രകുണ്ഡലൻ
വിവികർണ്ണൻ	ഭീമവേഗൻ	കുണ്ഡശായി	പ്രഥമൻ
വികർണ്ണൻ	ഭീമബാലൻ	നിശാലാക്ഷൻ	അപ്രഥാമി
ശലൻ	വാലകി	ദുരായരൻ	ദീർഘരോമൻ
സതപൻ	ബാലവർദ്ധനൻ	ദുഡഹസ്തൻ	സുവീര്യവാൻ
സുലോചനൻ	ഉഗ്രായുധൻ	സുഹസ്തൻ	ദീർഘബാഹു
ചിത്രൻ	സുഷേണൻ	വാതവേഗൻ	സുവർമ്മൻ
ഉപചിത്രൻ	കുണ്ഡധാരൻ	സുവർച്ചൻ	കാഞ്ചനധാജൻ
ചിത്രാക്ഷൻ	മഹോദരൻ	ആദിത്യകേതു	കുണ്ഡാശി
ചാരുചിത്രൻ	ചിത്രായുധൻ	ബഹ്വാശി	വിരജസ്ത്വ
ശരാസനൻ	നിഷംഗി	നാഗദത്തൻ	ദുശ്ശള
ദുർമ്മദൻ			

Avatars of Lord Vishnu

മത്സ്യം	പരശുരാമൻ
കുർമം	രാമൻ
വരാഹം	കൃഷ്ണൻ
നരസിംഹം	ബുദ്ധൻ
വാമനൻ	കൽക്കി

Names of Planets

ബുധൻ	ശനി
ശുക്രൻ	യുറാനസ്
ഭൂമി	നെപ്റ്റ്യൂൺ
ചൊവ്വ	പ്ലൂട്ടോ
വ്യാഴം	

Names of Malayalam months

ചിങ്ങം	കുംഭം
കന്നി	മീനം
തുലാം	മേടം
വൃശ്ചികം	ഇടവം
ധനു	മിഥുനം
മകരം	കർക്കിടകം

5.2 ALGORITHM

Step-1: Input a string

Step-2: check whether the string contains a conjunct consonant or not. If yes, go to step-3 else go to step4.

Step-3: the value of the last consonant in the conjunction is taken into account.

Step-4: the letter in the string is assigned to numbers according to katapayadi table

Step-5: the obtained set of numbers is reversed.

5.3 CODE

```

value1=input('Enter your word to be encoded :')
asp=[]
new=[]
unicode={'അ':0D05,'ആ':0D06,'ഇ':0D07,'ഈ':0D08,'ഉ':0D09,'ഊ':0D0A,'ഋ':0D0B,
        'ൠ':0D0E,'ഌ':0D0F,'഍':0D10,'ഒ':0D12,'ഓ':0D13,'ഔ':0D14,'ഈ':0D02,'ഊ':0D03,
        'ക':0D15,'ഖ':0D16,'ഗ':0D17,'ഘ':0D18,'ങ':0D19,
        'ച':0D1A,'ഛ':0D1B,'ജ':0D1C,'ഝ':0D1D,'ഞ':0D1E,
        'ട':0D1F,'ഠ':0D20,'ഡ':0D21,'ഡ':0D22,'ണ':0D23,
        'ത':0D24,'ഥ':0D25,'ദ':0D26,'ധ':0D27,'ന':0D28,
        'പ':0D2A,'ഫ':0D2B,'ബ':0D2C,'ഭ':0D2D,'മ':0D2E,'യ':0D2F,
        'ര':0D30,'ല':0D32,'വ':0D35,'ശ':0D36,'ഷ':0D37,'സ':0D38,'ഹ':0D39,'ള':0D33,
        'ഴ':0D34,'റ':0D31,'ണ':0D7A,'ൻ':0D7B,'ർ':0D7C,'ൽ':0D7D,'ൾ':0D7F,
        'ഠ':0D3E,'ഡ':0D3F,'ഢ':0D40,'ണ':0D41,'വ':0D42,'ശ':0D43,
        'ഷ':0D46,'ഠ':0D47,'ഡ':0D48,'ഢ':0D57,'ണ':0D4D,'വ':0D4A,'ശ':0D4B,
        'ഷ':0D4C,' ': ' ' }
print("Unicode:")
for element in range(0,len(value1)):
    print(unicode.get(value1[element]),end=' ')
    w=unicode.get(value1[element])
    asp.append(w)
i=0
while i<len(asp):
    if asp[i]=='ഢ':
        j=i-1
        asp.pop(j)
        i+=1

```

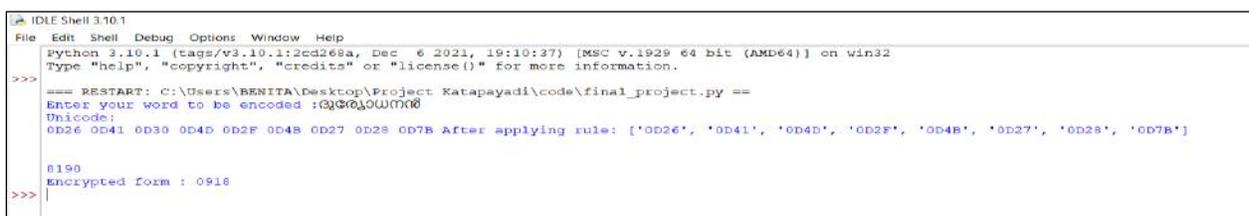
```

new=asp
print("After applying rule:",new)
s=' '

katacode={'0D05':'0','0D06':'0','0D07':'0','0D08':'0','0D09':'0','0D0A':'0','0D0B':'0','0D0E':'0','0D0F':'0',
          '0D10':'0','0D12':'0','0D13':'0','0D14':'0','0D02'::',','0D03'::',','0D1E':'0','0D28':'0','0D34':'0','0D31':'0',
          '0D7A'::',','0D7B'::',','0D7C'::',','0D7D'::',','0D7F'::',','0D4A'::',','0D4B'::',','0D4C'::',
          '0D3E'::',','0D3F'::',','0D40'::',','0D41'::',','0D42'::',','0D43'::',
          '0D46'::',','0D47'::',','0D48'::',','0D57'::',','0D4D'::',
          '0D15':'1','0D1F':'1','0D2A':'1','0D2F':'1',
          '0D16':'2','0D20':'2','0D2B':'2','0D30':'2',
          '0D17':'3','0D21':'3','0D2C':'3','0D32':'3',
          '0D18':'4','0D22':'4','0D2D':'4','0D35':'4',
          '0D19':'5','0D23':'5','0D2E':'5','0D36':'5',
          '0D1A':'6','0D24':'6','0D37':'6',
          '0D1B':'7','0D25':'7','0D38':'7',
          '0D1C':'8','0D26':'8','0D39':'8',
          '0D1D':'9','0D27':'9','0D33':'9',' ':' '}

for i in new:
    s=s+katacode.get(i)
print('\n')
print(s)
y=s[::-1]
print('Encrypted form :',y)

```



```

IDLE Shell 3.10.1
Python 3.10.1 (tags/v3.10.1:2cd268a, Dec 6 2021, 19:10:37) [MSC v.1929 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==== RESTART: C:\Users\BENITA\Desktop\Project_Katapayadi\code\final_project.py ====
Enter your word to be encoded : അപ്സര
Unicode:
0D26 0D41 0D30 0D4D 0D2F 0D4B 0D28 0D27 0D28 0D7B After applying rule: ['0D26', '0D41', '0D4D', '0D2F', '0D4B', '0D27', '0D28', '0D7B']
8190
Encrypted form : 0918
>>>

```

Fig. 3 Program output

6. RESULT

The decoded numbers were obtained as per the rules of the Katapayadi system. The aim was to find whether there exists any relation between these sets of numbers. But as per the inference, there exist no such relations. The resultant decoded numbers are:

ദുര്യോധനൻ	0918	ദുർവിഗാഹൻ	8348	പാശി	51	ഉഗ്രശായി	1520
ദുശ്ശാസനൻ	0758	വിവിത്സു	744	വുന്ദാരകൻ	1284	കവചി	641
ദുശ്ശഹൻ	858	വികടിനന്ദൻ	80114	ദുഡവർമ്മൻ	5438	ക്രമനൻ	072
ദുശ്ശലൻ	358	ഊർണ്ണനാഭൻ	4050	ദുഡക്ഷത്രൻ	2638	കുമ്മനം	051
ജലഗന്ധൻ	9338	സുനാഭൻ	407	സോമകീർത്തി	6157	ഭീമവിക്രൻ	2454
സമൻ	57	നന്ദൻ	80	അനുഭരൻ	2400	ധനുർദ്ധരൻ	2909
സഹൻ	87	ഉപനന്ദൻ	8010	ദുണസന്ധൻ	9758	വീരബാഹു	8324
മിന്ദൻ	85	ചിത്രബാണൻ	5326	ജരാസന്ധൻ	9728	അലോലുപൻ	1330
അനുവിന്ദൻ	8400	ചിത്രവർമ്മൻ	5426	സത്യസന്ധൻ	9717	അഭയൻ	140
ദുർലർഷൻ	698	സുവർമ്മൻ	547	സദാസുവാക്	14787	ദുഡകർമ്മാവ്	5138
സുബാഹു	837	ദുർവിമോചൻ	6548	ഉഗ്രശ്രവസ്സ്	74220	ദുണരമാശ്രയൻ	127258
ദുഷ്പ്രധർഷണൻ	56928	അയോബാഹു	8310	ഉഗ്രസേനൻ	0720	അനായുഷ്യൻ	1900
ദുർമ്മർഷണൻ	5658	മഹാബാഹു	8385	സേനാനി	007	കുണ്ഡഭേദി	8431
ദുർമ്മുഖൻ	258	ചിത്രാംഗദൻ	8326	ദുഷ്കരജിതൻ	68218	വീരാവി	424
ദുഷ്കർണ്ണൻ	518	ചിത്രകുണ്ഡലൻ	33126	അപരാജിതൻ	68210	ചിത്രകുണ്ഡലൻ	33126
വിവികർണ്ണൻ	5144	ഭീമവേഗൻ	3454	കുണ്ഡശായി	1531	പ്രഥമൻ	572
വികർണ്ണൻ	514	ഭീമബാലൻ	3354	നിശാലാക്ഷൻ	6350	അപ്രഥാഥി	7520
ശലൻ	35	വാലകി	134	ദുരാധരൻ	2928	ദീർഘരോമൻ	5248
സത്യൻ	47	ബാലവർദ്ധനൻ	09433	ദുഡഹസ്തൻ	6838	സുവീര്യവാൻ	4147
സുലോചനൻ	0637	ഉഗ്രായുധൻ	9120	സുഹസ്തൻ	687	ദീർഘബാഹു	8348
ചിത്രൻ	26	സുഷേണൻ	567	വാതവേഗൻ	3464	സുവർമ്മൻ	547
ഉപചിത്രൻ	2610	കുണ്ഡധാരൻ	2931	സുവർച്ചൻ	647	കാഞ്ചനധജൻ	84061
ചിത്രാക്ഷൻ	626	മഹോദരൻ	2885	ആദിത്യകേതു	61180	കുണ്ഡാശി	531
ചാരുചിത്രൻ	2626	ചിത്രായുധൻ	9126	ബഹാശി	543	വിരജസ്സ്	824
ശരാസനൻ	0725	നിഷംഗി	360	നാഗദത്തൻ	6830	ദുശ്ശള	958
ദുർമ്മദൻ	858						

Table 3 Names of Kauravas

മത്സ്യം	15	പരശുരാമൻ	52521
കുർമം	51	രാമൻ	52
വരാഹം	824	കൃഷ്ണൻ	51
നരസിംഹം	8720	ബുദ്ധൻ	93
വാമനൻ	054	കർക്കി	11

Table 4 Avatar's of Lord Vishnu

ചിങ്ങം	56	കുംഭം	41
കന്നി	01	മീനം	05
തുലാം	36	മേടം	15
വൃശ്ചികം	164	ഇടവം	410
ധനു	09	മിഥുനം	075
മകരം	215	കർക്കിടകം	1111

Table 5 Names of Malayalam Months

ബുധൻ	93	ശനി	05
ശുക്രൻ	25	യുറാനസ്	001
ഭൂമി	54	നെപ്റ്റ്യൂൺ	10
ചൊവ്വ	46	പ്ലൂട്ടോ	13
വ്യാഴം	01		

Table 6 Names of Planets

7. CONCLUSION

Even though it resembles a cipher system, its ability of mapping multiple syllables to a single number may cause ambiguity during encoding and decoding, since multiple combinations of words can be formed from a single set of numbers. If this could be resolved, it can be used as a powerful cryptographic system.

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ERNAKULAM**



CERTIFICATE

This is to certify that the project report entitled "**GREEN SYNTHESIS OF SILVER NANOPARTICLES USING TULSI EXTRACT**" is a bonafide work by **ALEENA N THOMAS**, St. Teresa's College Ernakulam, under my supervision at Department of Physics, St. Teresa's College, Ernakulam for the partial fulfilment of the award of Degree of Bachelor of Science in Physics during the academic year 2021-22. The work presented in this dissertation has not been submitted for any other degree in this or any other university.

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GREEN SYNTHESIS OF SILVER NANOPARTICLES
USING TULSI EXTRACT

PROJECT REPORT

Submitted by

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In partial fulfilment of the requirement for the award of

BACHELOR'S DEGREE OF SCIENCE IN PHYSICS

MARCH 2022



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Submitted for the University examination held at St. Teresa's College, Ernakulam.

DATE: 07/05/2022

EXAMINERS:

DECLARATION

I, **ALEENA N THOMAS**, Register number: **AB19PHY001**, hereby declare that this project work entitled “**GREEN SYNTHESIS OF SILVER NANOPARTICLES USING TULSI EXTRACT**” is an original work done by me under the guidance and supervision of Dr. Kala M.S., Associate Professor, Department of Physics, St. Teresa’s College (Autonomous), Ernakulam in the partial fulfilment of the award of Degree of Bachelor of Physics under Mahatma Gandhi University. I further declare that this project is not partly or wholly submitted for any other purpose and the data included in this project is collected from various sources and are true to the best of our knowledge.

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DATE : 07/05/2022

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ABSTRACT

Synthesis of metal nanoparticles using plant extracts is one of the most simple, convenient, economical and environmentally friendly methods that mitigate the involvement of toxic chemicals. Hence in recent years, several eco-friendly processes for the rapid synthesis of silver nanoparticles have been reported using aqueous extracts of plant parts such as the leaf, bark, roots, etc. Green synthesis of nanoparticles is an important area in the field of nanotechnology, which has cost effective and environment friendly benefit over physical and chemical methods. Though there are many chemical as well as physical methods, green synthesis of nanomaterials is the most emerging method of synthesis. In this project we had synthesized silver nanoparticles from silver nitrate through green synthesis method.

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CHAPTER -1

NANOSCIENCE AND TECHNOLOGY

INTRODUCTION

Nanostructure science and technology is a broad and interdisciplinary area of research and development activity that has been growing explosively worldwide in the past few years. It has the potential for revolutionizing the ways in which materials and products are created and the range and nature of functionalities that can be accessed. It is already having a significant commercial impact, which will assuredly increase in the future.

Advances in Nanomaterials

- The history of nanomaterials began immediately after the big bang when Nanostructures were formed in the early meteorites.
- Nature later evolved many other Nanostructures like seashells, skeletons etc. Nano scaled smoke particles were formed during the use of fire by early humans. The scientific story of nanomaterials however began much later. One of the first scientific reports is the colloidal gold particles synthesised by Michael Faraday as early as 1857. Nanostructured catalysts have also been investigated for over 70 years.
- Nanosized amorphous silica particles have found large-scale applications in many everyday consumer products, ranging from non-diary coffee creamer to automobile tires, optical fibres and catalyst supports. In the 1960s and 1970's metallic nano powders for magnetic recording tapes were developed
- Today nanophase engineering expands in a rapidly growing number of structural and functional materials, both inorganic and organic, allowing to manipulate mechanical, catalytic, electric, magnetic, optical and electronic functions.
- The production of nanophase or cluster-assembled materials is usually based upon separated small clusters which then fused into a bulk-like material e.g., nanophase silicon, which differs from normal silicon in physical and electronic properties, could be applied to

macroscopic semiconductor processes to create new devices. For instance, when ordinary glass is doped with quantized semiconductor "colloids," it becomes a high-performance optical medium with potential applications in optical computing.

A nanoparticle is a small particle whose size ranges from 1 to 100 nanometres. Undetectable by the human eye, nanoparticles can exhibit significantly different physical and chemical properties to their larger material counterparts.

Importance of nanomaterials

These materials have created a high interest in recent years by virtue of their unusual mechanical, electrical, optical and magnetic properties. Some examples are given below:

- (i) Nanophase ceramics are of particular interest because they are more ductile at elevated temperatures as compared to the coarse-grained ceramics.
- (ii) Nanostructured semiconductors are known to show various non-linear optical properties. Semiconductor Q-particles also show quantum confinement effects which may lead to special properties, like the luminescence in silicon powders and silicon germanium quantum dots as infrared optoelectronic devices. Nanostructured semiconductors are used as window layers in solar cells.
- (iii) Nanosized metallic powders have been used for the production of gas tight materials, dense parts and porous coatings. Cold welding properties combined with ductility make them suitable for metal-metal bonding especially in the electronic industry.
- (iv) Single nanosized magnetic particles are mono-domains and very small particles have special atomic structures with discrete electronic states, which give rise to special properties in addition to the super-paramagnetism behaviour. Magnetic nanocomposites have been used for mechanical force transfer (ferrofluids), for high density information storage and magnetic refrigeration.
- (v) Nanostructured metal clusters and colloids of monometallic composition have a special impact in catalytic applications. They may serve as precursors for new type of heterogeneous catalysts and have been shown to offer substantial advantages

concerning activity, selectivity and lifetime in chemical transformations and electrocatalysis (fuel cells).

- (vi) Nanostructured metal-oxide thin films are receiving a growing attention for the realization of gas sensors (NO_x, CO, CO₂, CH₄ and aromatic hydrocarbons) with enhanced sensitivity and selectivity. Nanostructured metal-oxide (MnO₂) finds application for rechargeable batteries for cars or consumer goods.
- (vii) Polymer based composites with a high content of inorganic particles leading to a high dielectric constant are interesting materials for photonic band gap structure.
- (viii) The energy band structure and charge carrier density in the materials can be modified quite differently from their bulk and in turn will modify the electronic and optical properties of the materials. For example, lasers and light emitting diodes (LED) from both of the quantum dots and quantum wires are very promising in the future optoelectronics. High density information storage using quantum dot devices is also a fast-developing area.

Properties of Nanomaterials

Nanomaterials have the structural features in between of those of atoms and the bulk materials. While most micro structured materials have similar properties to the corresponding bulk materials, the properties of materials with nanometre dimensions are significantly different from those of atoms and bulks materials. This is mainly due to the nanometre size of the materials which render them: (i) large fraction of surface atoms; (ii) high surface energy; (iii) spatial confinement; (iv) reduced imperfections, which do not exist in the corresponding bulk materials.

Due to their small dimensions, nanomaterials have extremely large surface area to volume ratio, resulting in more “surface” dependent material properties. Especially when the sizes of nanomaterials are comparable to length, the entire material will be affected by the surface properties of nanomaterials. This in turn may enhance or modify the properties of the bulk materials. For example, metallic nanoparticles can be used as very active catalysts.

Chemical sensors from nanoparticles and nanowires enhance the sensitivity and sensor selectivity. The nanometre feature sizes of nanomaterials also have spatial confinement effect on the materials, which bring the quantum effects.

Reduced imperfections are also an important factor in determination of the properties of the nanomaterials. Nanostructures and Nanomaterials favours of a self- purification process in that the impurities and intrinsic material defects will move to near the surface upon thermal annealing. For example, the chemical stability for certain nanomaterials may be enhanced, the mechanical properties of nanomaterials will be better than the bulk materials. The superior mechanical properties of carbon nanotubes are well known. Due to their nanometre size, nanomaterials are already known to have many novel properties. Many novel applications of the nanomaterials rose from these novel properties like optical, electrical, mechanical and magnetic properties.

Optical properties

One of the most fascinating and useful aspects of nanomaterials is their optical properties. Applications based on optical properties of nanomaterials include optical detector, laser, sensor, imaging, phosphor, display, solar cell, photocatalysis, photo electrochemistry and biomedicine. The optical properties of nanomaterials depend on parameters such as feature size, shape, surface characteristics and other variables including doping and interaction with the surrounding environment or other nanostructures. Likewise, shape can have dramatic influence on optical properties of metal nanostructures. With the CdSe semiconductor nanoparticles, a simple change in size alters the optical properties of the nanoparticles. When metal nanoparticles are enlarged, their optical properties change only slightly as observed for the different samples of gold nanospheres. However, when an anisotropy is added to the nanoparticle, such as growth of nanorods, the optical properties of the nanoparticles change dramatically.

Optical properties of nanomaterials can be significantly different from bulk crystals. For example, the optical absorption peak of a semiconductor nanoparticle shifts to a short wavelength, due to an increased band gap. The colour of metallic nanoparticles may change with their sizes due to surface plasmon resonance.

Electrical properties

Electrical Properties of Nanoparticles discuss about fundamentals of electrical conductivity in nanotubes and nanorods, carbon nanotubes, photoconductivity of nanorods, electrical conductivity of nanocomposites etc. Conductivity of a bulk or large material does not depend upon dimensions like diameter or area of cross section and twist in the conducting wire etc. However, it is found that in case of carbon nanotubes conductivity changes with change in area of cross section. It is also observed that conductivity also changes when some shear force is given to nanotube. Conductivity of a multiwalled carbon nanotube is different than that of single nanotube of same dimensions. The carbon nanotubes can act as conductor or semiconductor in behaviour but we all know that large carbon (graphite) is good conductor of electricity. One interesting method which can be used to demonstrate the steps in conductance is the mechanical thinning of a nanowire and measurement of the electrical current at a constant applied voltage. With decreasing diameter of the wire, the number of electron wave modes contributing to the electrical conductivity is becoming increasingly smaller by well-defined quantized steps.

Mechanical properties

Mechanical Properties of Nanoparticles deal with bulk metallic and ceramic materials, influence of porosity, influence of grain size, super plasticity, filled polymer composites, particle-filled polymers, polymer-based nanocomposites filled with platelets, carbon nanotube-based composites etc. However, two materials, neither of which is produced by pressing and sintering, have attracted much greater interest as they will undoubtedly achieve industrial importance. These materials are polymers which contain nanoparticles or nanotubes to improve their mechanical behaviours, and severely plastic-deformed metals, which exhibit astonishing properties. However, because of their larger grain size, the latter are generally not accepted as nanomaterials. Experimental studies on the mechanical properties of bulk nanomaterials are generally impaired by major experimental problems in producing specimens with exactly defined grain sizes and porosities. Filling polymers with nanoparticles or nanorods and nanotubes, respectively, leads to significant improvements in their mechanical properties. Such improvements depend heavily on the type of the filler and the way in which the filling is conducted. The latter point is of special importance, as any specific advantages of a

nanoparticulate filler may be lost if the filler forms aggregates, thereby mimicking the large particles. The larger the particles of the filler or agglomerates, the poorer are the properties obtained. Although, potentially, the best composites are those filled with nanofibers or nanotubes, experience teaches that sometimes such composites have the least ductility. On the other hand, by using carbon nanotubes it is possible to produce composite fibres with extremely high strength and strain at rupture. Among the most exciting nanocomposites are the polymer-ceramic nanocomposites. Composites consisting of a polymer matrix and defoliated phyllosilicates exhibit excellent mechanical and thermal properties.

Application of nanomaterials

Nanomaterials find wide range of applications in the field of electronics, fuel cells, batteries, agriculture, food industry, and medicines.

(a) Fuel cells

A fuel cell is an electrochemical energy conversion device that converts the chemical energy from fuel (on the anode side) and oxidant (on the cathode side) directly into electricity. The performance of a fuel cell electrode can be optimized in two ways; by improving the physical structure and by using more active electro catalyst. A good structure of electrode must provide ample surface area, provide maximum contact of catalyst, reactant gas and electrolyte, facilitate gas transport and provide good electronic conductance. In this fashion the structure should be able to minimize losses.

Microbial fuel cell is a device in which bacteria consume water-soluble waste such as sugar, starch and alcohols and produces electricity plus clean water. This technology will make it possible to generate electricity while treating domestic or industrial wastewater. Different carbohydrates and complex substrates present in wastewaters can be turned into source of electricity with microbial fuel cell. Performance of the fuel cell mainly depends on the efficient electron transfer between the microorganism and the anode of the microbial fuel cell. When converting them into simpler molecules like CO_2 the organic molecules present in the wastewater release a certain amount of chemical energy. Thus, microbial fuel cell is a device that converts the chemical energy present in water-soluble waste into electrical energy by the catalytic reaction of microorganisms.

Carbon nanotubes (CNTs) have chemical stability, good mechanical properties and high surface area, making them ideal for the design of sensors and provide very high surface area due to its structural network. Since carbon nanotubes are also suitable supports for cell growth, electrodes of microbial fuel cells can be built using of CNT.

(b) Catalysis

Higher surface area available with the nanomaterial counterparts, nano-catalysts tend to have exceptional surface activity. For example, reaction rate at nano-aluminium can go so high, that it is utilized as a solid-fuel in rocket propulsion, whereas the bulk aluminium is widely used in utensils. Nano-aluminium becomes highly reactive and supplies the required thrust to send off pay loads in space. Similarly, catalysts assisting or retarding the reaction rates are dependent on the surface activity, and can very well be utilized in manipulating the rate-controlling step.

(c) Phosphors for High-Definition TV

The resolution of a television, or a monitor, depends greatly on the size of the pixel. These pixels are essentially made of materials called "phosphors," which glow when struck by a stream of electrons inside the cathode ray tube (CRT). The resolution improves with a reduction in the size of the pixel, or the phosphors. Nanocrystalline zinc selenide, zinc sulphide, cadmium sulphide, and lead telluride synthesized by the sol-gel techniques are used for improving the resolution of monitors. The use of nanophosphors is envisioned to reduce the cost of these displays so as to render high-definition televisions (HDTVs) and personal computers affordable to be purchase.

(d) Next-Generation Computer Chips

The microelectronics industry has been emphasizing miniaturization, whereby the circuits, such as transistors, resistors, and capacitors, are reduced in size. By achieving a significant reduction in their size, the microprocessors, which contain these components, can run much faster, thereby enabling computations at far greater speeds. However, there are several technological impediments to these advancements, including lack of ultrafine precursors to manufacture these components; poor dissipation of tremendous amount of heat generated by these microprocessors due to faster speeds; short mean time to failures (poor reliability), etc.

Nanomaterials help the industry break these barriers down by providing the manufacturers with nanocrystalline starting materials, ultra-high purity materials, materials with better thermal conductivity, and longer-lasting, durable interconnections (connections between various components in the microprocessors).

(e) Elimination of Pollutants

Nanomaterials possess extremely large grain boundaries relative to their grain size. Hence, they are very active in terms of their chemical, physical, and mechanical properties. Due to their enhanced chemical activity, nanomaterials can be used as catalysts to react with such noxious and toxic gases as carbon monoxide and nitrogen oxide in automobile catalytic converters and power generation equipment to prevent environmental pollution arising from burning gasoline and coal.

(f) Sun-screen lotion

Prolonged UV exposure causes skin-burns and cancer. Sun-screen lotions containing nano-TiO₂ provide enhanced sun protection factor (SPF) while eliminating stickiness. The added advantage of nano skin blocks (ZnO and TiO₂) arises as they protect the skin by sitting onto it rather than penetrating into the skin. Thus, they block UV radiation effectively for prolonged duration. Additionally, they are transparent, thus retain natural skin colour while working better than conventional skin-lotions.

(g) Sensors

Sensors rely on the highly active surface to initiate a response with minute change in the concentration of the species to be detected. Engineered monolayers (few Angstroms thick) on the sensor surface are exposed to the environment and the peculiar functionality is utilized in sensing.

CHAPTER 2

SYNTHESIS AND OPTICAL CHARACTERISATION OF

NANOMATERIALS

Nanotechnology is a branch of material science in which nanoparticles with specific intended properties are synthesized or produced by the application of physical or chemical processes. Synthesis of nanoparticles is carried out through various methods. The main classification for the production of nanoparticles is broadly divided into two methods:

Top Down

Bottom Up

The first approach of synthesis starts with a solid mass and making it into smaller nanosized particles by applying any mechanical method (i.e., mechanical grinding) and later stabilizing the particles to the required size. However, with this method it is difficult to achieve the expected narrow size. The second approach starts with atomic size material, which is fabricated to the required nanoscale by applying chemical methods, such as the hydrothermal method, sol-gel method, gas phase method, thermolysis, and hydrolysis. Although UV irradiation, aerosol technologies, laser ablation, and photochemical reduction processes lead to production of nanoparticles, these methods are costlier and also lead to the release of harmful by-products. Moreover, by these methods, it is difficult to have control over the surface chemistry, size, and structure of the nanoparticles. Nevertheless, a bottom-up approach is preferred to produce nanoparticles because it starts with simpler molecules to clusters and then to nanoparticles and will achieve greater control over the shape and size of the particles formed.

Most of these methods are extremely expensive and also involve the use of toxic, hazardous chemicals, which may pose potential environmental and biological risks. Since noble metal nanoparticles are widely applied to areas of human contact, there is a growing need to develop environmentally friendly processes for nanoparticle synthesis that do not use toxic chemicals. A quest for an environmentally sustainable synthesis process has led to a few biomimetic approaches. Biomimetics refers to applying biological principles in materials formation. One of the fundamental processes in biomimetic synthesis involves bio reduction. Biological methods of nanoparticle synthesis using microorganisms, enzymes, fungus, and plants or plant

extracts have been suggested as possible eco-friendly alternatives to chemical and physical methods. In the recent past, vast research has been carried out on biological systems, including bacteria, fungi, yeast, and plants and this has led to the transformation of inorganic metal ions to metal nanoparticles. The utilization of metal oxide nanoparticles has received much attention due to their unique properties, such as extremely small size, high surface-area-to-volume ratio, surface modifiability, excellent magnetic properties, and great biocompatibility. Hence, the production of nanoparticles should be economically viable, environmentally sustainable, and well accepted by society. Sometimes the synthesis of nanoparticles using plants or parts of plants can prove advantageous over other biological processes by eliminating the elaborate processes of maintaining microbial cultures

The degradation of any organic compounds by the green approach (plant extracts) is mainly due to the presence of polyphenols in the biodegradable material used for treatment purposes. A great deal of research is carried out on a wide range of plant extracts and their chemical constituents.

In materials science, “green” synthesis has gained extensive attention as a reliable, sustainable, and eco-friendly protocol for synthesizing a wide range of nanomaterials including metal/metal oxides nanomaterials, hybrid materials, and bioinspired materials.

Green synthesis methodologies based on biological precursors depend on various reaction parameters such as solvent, temperature, pressure, and pH conditions (acidic, basic, or neutral). For the synthesis of metal/metal oxide nanoparticles, plant biodiversity has been broadly considered due to the availability of effective phytochemicals in various plant extracts, especially in leaves such as ketones, aldehydes, flavones, amides, terpenoids, carboxylic acids, phenols, and ascorbic acids. These components are capable of reducing metal salts into metal nanoparticles. The basic features of such nanomaterials have been investigated for use in biomedical diagnostics, antimicrobials, catalysis, molecular sensing, optical imaging, and labelling of biological systems. Plants have biomolecules (like carbohydrates, proteins, and coenzyme) with exemplary potential to reduce metal salt into nanoparticles. Like other biosynthesis processes, gold and silver metal nanoparticles were first investigated in plant extract-assisted synthesis. Various plants including aloe vera (*Aloe barbadensis* Miller), Oat (*Avena sativa*), alfalfa (*Medicago sativa*), Tulsi (*Osimum sanctum*), Lemon (*Citrus limon*), Neem (*Azadirachta indica*), Coriander (*Coriandrum sativum*), Mustard (*Brassica juncea*) and lemon grass (*Cymbopogon flexuosus*) have been utilized to synthesize silver nanoparticles and

gold nanoparticles. Also, ZnO nanoparticles have been prepared with a great variety of plant leaf extracts such as coriander (*Coriandrum sativum*) , crown flower (*Calotropis gigantean*), copper leaf (*Acalypha indica*) , China rose (*Hibiscus rosa-sinensis*) , Green Tea (*Camellia sinensis*) , and aloe leaf broth extract (*Aloe barbadensis* Miller).

For nanoparticle synthesis mediated by plant leaf extract, the extract is mixed with metal precursor solutions at different reaction conditions. The parameters determining the conditions of the plant leaf extract are admitted to control the rate of nanoparticle formation as well as their yield and stability. The phytochemicals present in plant leaf extracts have uncanny potential to reduce metal ions in a much shorter time as compared to fungi and bacteria, which demands the longer incubation time. Therefore, plant leaf extracts are considered to be an excellent and benign source for metal as well as metal oxide nanoparticle synthesis. Additionally, plant leaf extract plays a dual role by acting as both reducing and stabilizing agents in nanoparticles synthesis process to facilitate nanoparticles synthesis. The composition of the plant leaf extract is also an important factor in nanoparticle synthesis, for example different plants comprise varying concentration levels of phytochemicals. The main phytochemicals present in plants are flavones, terpenoids, sugars, ketones, aldehydes, carboxylic acids, and amides, which are responsible for bioreduction of nanoparticles. Sugars such as glucose and fructose exist in plant extracts can also be responsible for the formation of metallic nanoparticles.



Optical Absorption

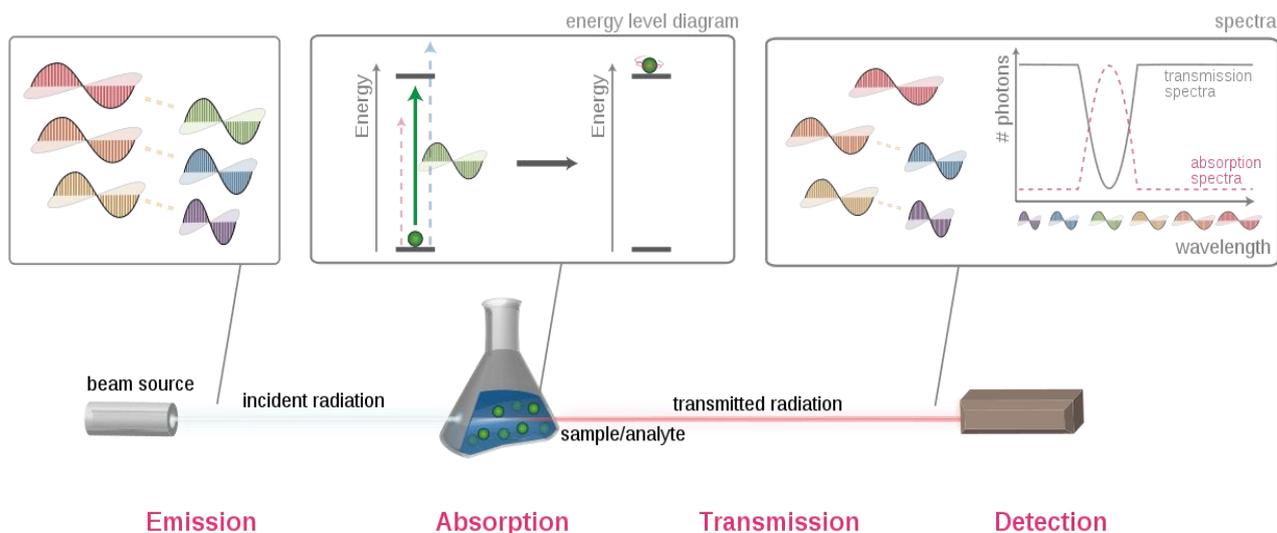
A spectrum of electromagnetic radiation transmitted through a substance, showing dark lines or bands due to absorption at specific wavelengths.

Absorption spectroscopy refers to spectroscopic techniques that measure the absorption of radiation, as a function of frequency or wavelength, due to its interaction with a sample. The sample absorbs energy, i.e., photons, from the radiating field. The intensity of the absorption varies as a function of frequency, and this variation is the absorption spectrum. Absorption spectroscopy is performed across the electromagnetic spectrum. A material's absorption spectrum is the fraction of incident radiation absorbed by the material over a range of frequencies of Electromagnetic Radiation. The absorption spectrum is primarily determined by the atomic and molecular composition of the material. Radiation is more likely to be absorbed at frequencies that match the energy difference between two quantum mechanical states of the molecules. The absorption that occurs due to a transition between two states is referred to as an absorption line and a spectrum is typically composed of many lines.

The frequencies will also depend on the interactions between molecules in the sample, the crystal structure in solids, and on several environmental factors (e.g., temperature, pressure, electromagnetic field). The lines will also have a width and shape that are primarily determined by the spectral density or the density of states of the system.

Absorption spectroscopy is employed as an analytical chemistry tool to determine the presence of a particular substance in a sample and, in many cases, to quantify the amount of the substance present. Infrared and ultraviolet–visible spectroscopy are particularly common in analytical applications. Absorption spectroscopy is also employed in studies of molecular and atomic physics, astronomical spectroscopy and remote sensing.

There is a wide range of experimental approaches for measuring absorption spectra. The most common arrangement is to direct a generated beam of radiation at a sample and detect the intensity of the radiation that passes through it. The transmitted energy can be used to calculate the absorption. The source, sample arrangement and detection technique vary significantly depending on the frequency range and the purpose of the experiment.



An overview of electromagnetic radiation absorption is shown in the figure.

A white beam source – emitting light of multiple wavelengths – is focused on a sample (the complementary colour pairs are indicated by the yellow dotted lines). Upon striking the sample, photons that match the energy gap of the molecules present (green light in this example) are absorbed in order to excite the molecule. Other photons transmit unaffected and, if the radiation is in the visible region (400–700 nm), the sample colour is the complementary colour of the absorbed light. By comparing the attenuation of the transmitted light with the incident, an absorption spectrum can be obtained.

Theory

Absorption lines are typically classified by the nature of the quantum mechanical change induced in the molecule or atom. Rotational lines, for instance, occur when the rotational state of a molecule is changed. Rotational lines are typically found in the microwave spectral region. Vibrational lines correspond to changes in the vibrational state of the molecule and are typically found in the infrared region. Electronic lines correspond to a change in the electronic state of an atom or molecule and are typically found in the visible and ultraviolet region. X-ray absorptions are associated with the excitation of inner shell electrons in atoms. These changes can also be combined (e.g., rotation-vibration transitions), leading to new absorption lines at the combined energy of the two changes.

The energy associated with the quantum mechanical change primarily determines the frequency of the absorption line but the frequency can be shifted by several types of interactions. Electric and magnetic fields can cause a shift. Interactions with neighbouring

molecules can cause shifts. For instance, absorption lines of the gas phase molecule can shift significantly when that molecule is in a liquid or solid phase and interacting more strongly with neighbouring molecules.

The width and shape of absorption lines are determined by the instrument used for the observation, the material absorbing the radiation and the physical environment of that material. It is common for lines to have the shape of a Gaussian or Lorentzian distribution. It is also common for a line to be described solely by its intensity and width instead of the entire shape being characterized.

The integrated intensity—obtained by integrating the area under the absorption line—is proportional to the amount of the absorbing substance present. The intensity is also related to the temperature of the substance and the quantum mechanical interaction between the radiation and the absorber. This interaction is quantified by the transition moment and depends on the particular lower state the transition starts from, and the upper state it is connected to.

The width of absorption lines may be determined by the spectrometer used to record it. A spectrometer has an inherent limit on how narrow a line it can resolve and so the observed width may be at this limit. If the width is larger than the resolution limit, then it is primarily determined by the environment of the absorber. A liquid or solid absorber, in which neighbouring molecules strongly interact with one another, tends to have broader absorption lines than a gas. Increasing the temperature or pressure of the absorbing material will also tend to increase the line width. It is also common for several neighbouring transitions to be close enough to one another that their lines overlap and the resulting overall line is therefore broader yet.

Relation to transmission spectrum

Absorption and transmission spectra represent equivalent information and one can be calculated from the other through a mathematical transformation. A transmission spectrum will have its maximum intensities at wavelengths where the absorption is weakest because more light is transmitted through the sample. An absorption spectrum will have its maximum intensities at wavelengths where the absorption is strongest.

Relation to emission spectrum

Emission is a process by which a substance releases energy in the form of electromagnetic radiation. Emission can occur at any frequency at which absorption can occur, and this allows the absorption lines to be determined from an emission spectrum. The emission spectrum will typically have a quite different intensity pattern from the absorption spectrum, though, so the two are not equivalent. The absorption spectrum can be calculated from the emission spectrum using Einstein coefficients.

Relation to scattering and reflection spectra

The scattering and reflection spectra of a material are influenced by both its index of refraction and its absorption spectrum. In an optical context, the absorption spectrum is typically quantified by the extinction coefficient, and the extinction and index coefficients are quantitatively related through the Kramers-Kronig relation. Therefore, the absorption spectrum can be derived from a scattering or reflection spectrum. This typically requires simplifying assumptions or models, and so the derived absorption spectrum is an approximation.

Applications

Absorption spectroscopy is useful in chemical analysis because of its specificity and its quantitative nature. The specificity of absorption spectra allows compounds to be distinguished from one another in a mixture, making absorption spectroscopy useful in wide variety of applications. For instance, Infrared gas analysers can be used to identify the presence of pollutants in the air, distinguishing the pollutant from nitrogen, oxygen, water and other expected constituents.

The specificity also allows unknown samples to be identified by comparing a measured spectrum with a library of reference spectra. In many cases, it is possible to determine qualitative information about a sample even if it is not in a library. Infrared spectra, for instance, have characteristic absorption bands that indicate if carbon-hydrogen or carbon-oxygen bonds are present.

An absorption spectrum can be quantitatively related to the amount of material present using the Beer-Lambert law. Determining the absolute concentration of a compound requires

knowledge of the compound's absorption coefficient. The absorption coefficient for some compounds is available from reference sources, and it can also be determined by measuring the spectrum of a calibration standard with a known concentration of the target.

CHAPTER 3

EXPERIMENTAL

PREPARATION OF SILVER NANOPARTICLES USING GREEN SYNTHESIS METHOD

1. PREPARATION OF LEAF EXTRACT

- Healthy *Ocimum tenuiflorum*, commonly known as holy basil, tulsi or tulasi were collected in a beaker and washed several times with water to remove the dust and finally with distilled water.



- The samples were allowed to dry at room temperature.
- About 40g of leaves were weighed out with the help of weighing machine and were cut in to small pieces.



- Finally cut pieces are mixed with 200ml distilled water. The Mixture is then kept boiling for 30 minutes.



- After cooling it at room temperature, it is filtered using Whatman no-40 filter paper. 100 ml of the filtered extract was taken for the preparation of silver nanoparticles.

2. PREPARATION OF 50 ml OF 1 MOLAR SILVER NITRATE SOLUTION

- 50 ml of 1 molar silver nitrate solution is prepared by dissolving 8.4935 g of AgNO_3 in 50ml of distilled water.

3. SYNTHESIS OF SILVER NANOPARTICLES

- 100 ml of the plant extract solution was added to 50 ml of 1 molar silver nitrate solution
- The solution was allowed to settle at room temperature.
- Silver nanoparticles formed were allowed to settle down.



The formed silver nanoparticles are filtered from the solution using Whatman no-40 filter paper. It is then dried with the help of oven. Then it is crushed into powder form. Crushed powder is made dissolve in gellatin. The resulting solution is analysed using uv spectrophotometer.

4.PREPARATION 90 ml OF 1 ml MOLAR SILVER NITRATE SOLUTION

- 90 ml of 1 milli molar silver nitrate solution is prepared by dissolving 0.0152g of AgNO_3 in 90 ml of distilled water.

5.PREPARATION OF COLLOIDAL SOLUTION OF SILVER

A colloidal solution of silver is also prepared from 1ml molar silver nitrate using following procedure

- 90 ml of 1 milli molar silver nitrate solution was mixed with 10 ml of plant extract.
- The colour of the mixture changes gradually from colourless to brown.
- The mixture is kept undisturbed for 24 hours. The silver particles do not settle down in this time frame and remain suspended in the solution

The resulting colloidal solution of silver is analysed using UV spectrophotometer.

CHAPTER 4

ABSORPTION SPECTRUM OF SILVER NANOPARTICLES

UV – Visible spectroscopy is the most important technique and the simplest way to confirm the formation of nanoparticles. The absorbance spectrum of the colloidal sample was obtained in the range of 300–800 nm, using a UV – Visible spectrophotometer with distilled water as a reference.

Silver nanoparticles absorb and scatter light with extraordinary efficiency. Their strong interaction with light occurs because the conduction electrons on the metal surface undergo a collective oscillation when they are excited by light at specific wavelengths. This oscillation is known as a surface plasmon resonance (SPR), and it causes the absorption and scattering intensities of silver nanoparticles to be much higher than identically sized non-plasmonic nanoparticles. In metal nanoparticles such as in silver, the conduction band and valence band lie very close to each other in which electron moves freely. These free electrons give rise to a SPR absorption band occurring due to the collective oscillation of electrons of metal nanoparticles in resonance with the light wave. This absorption strongly depends on the particle size, dielectric medium and chemical surroundings. For small metal particles, absorption spectra significantly depend only on the dipole oscillation. Theoretically and experimentally, it is found that when size decreases, the SPR peak shifts towards shorter wavelength side. It is also found that with the decrease in size, absorption spectra become weak and broad.

Silver nanoparticle absorption and scattering properties can be tuned by controlling the particle size, shape, and the local refractive index near the particle surface. The optical properties of spherical silver nanoparticles are highly dependent on the nanoparticle diameter. Smaller nanospheres primarily absorb light and have peaks near 400 nm, while larger spheres exhibit increased scattering and have peaks that broaden and shift towards longer wavelengths (known as red-shifting).

Silver nanoparticle optical properties also depend on the refractive index near the nanoparticle surface. As the refractive index near the nanoparticle surface increases, the nanoparticle extinction spectrum shifts to longer wavelengths (known as red-shifting). Practically, this means that the nanoparticle extinction peak location will shift to shorter wavelengths (blue-shift) if the particles are transferred from water ($n=1.33$) to air ($n=1.00$), or shift to longer wavelengths if the particles are transferred to oil ($n=1.5$). Increasing the refractive index from

1.00 to 1.60 results in an extinction peak shift of over 90 nm, moving the peak from the ultraviolet to the visible region of the spectrum. Similarly, the extinction peak can be tuned by coating aqueous nanoparticles with nonconducting shells including silica ($n=1.5$), biomolecules ($n=1.4-1.45$), or aluminum oxide ($n=1.58-1.68$). The optical properties of silver nanoparticles change when particles aggregate and the conduction electrons near each particle surface become delocalized and are shared amongst neighbouring particles. When this occurs, the surface plasmon resonance shifts to lower energies, causing the absorption and scattering peaks to red-shift to longer wavelengths. UV-Visible spectroscopy can be used as a simple and reliable method for monitoring the stability of nanoparticle solutions. As the particles destabilize, the original extinction peak will decrease in intensity (due to the depletion of stable nanoparticles), and often the peak will broaden or a secondary peak will form at longer wavelengths (due to the formation of aggregates). The rapid and irreversible change in the extinction spectrum clearly demonstrates that the nanoparticles are agglomerating. UV/Visible spectroscopy can be used as a characterization technique that provides information on whether the nanoparticle solution has destabilized over time.

RESULT

The figure shows the UV- vis absorption spectra of the nanoparticle synthesized from AgNO_3 solution using green synthesis method.

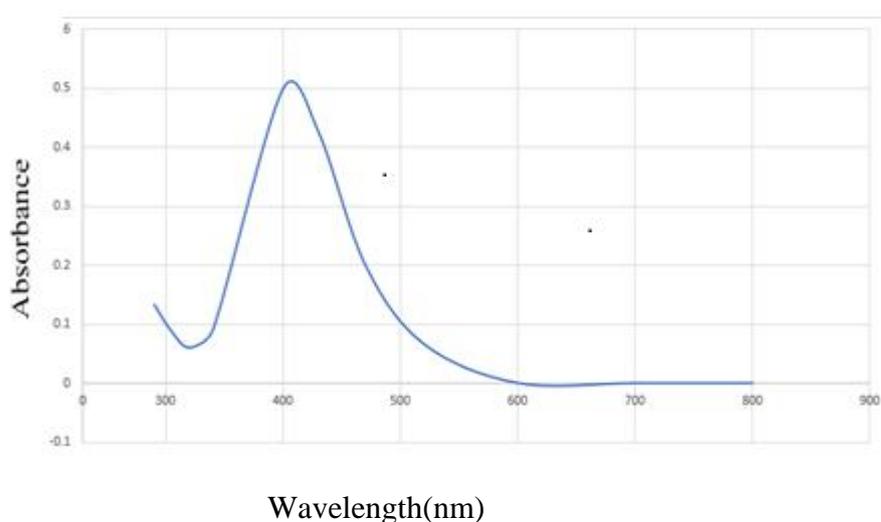


Fig: Absorption spectra of silver nanoparticles synthesized using tulsi extract

When we compare it with the uv-vis absorption spectra of silver nanoparticles synthesized from different experiments, the peak observed around 420 nm coincide with other studies.

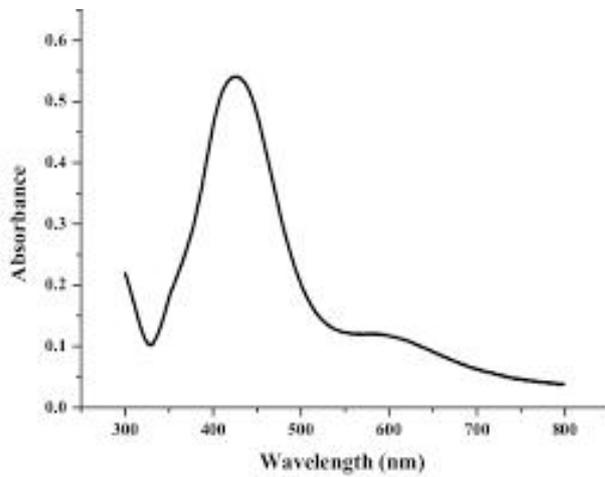


Fig: UV-visible absorption spectrum of Silver Nanoparticles Using a Biosurfactant from *Bacillus cereus* UCP 1615 as Stabilizing Agent

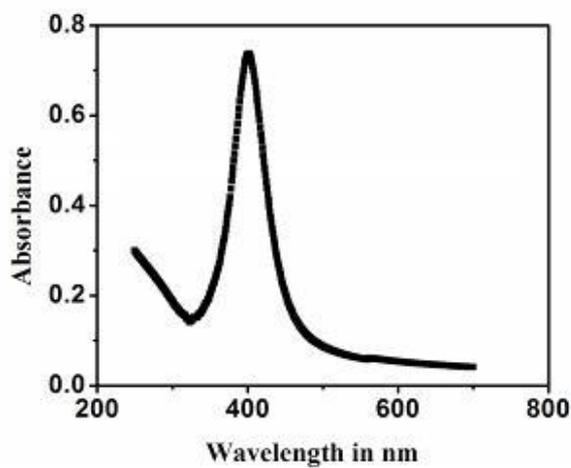
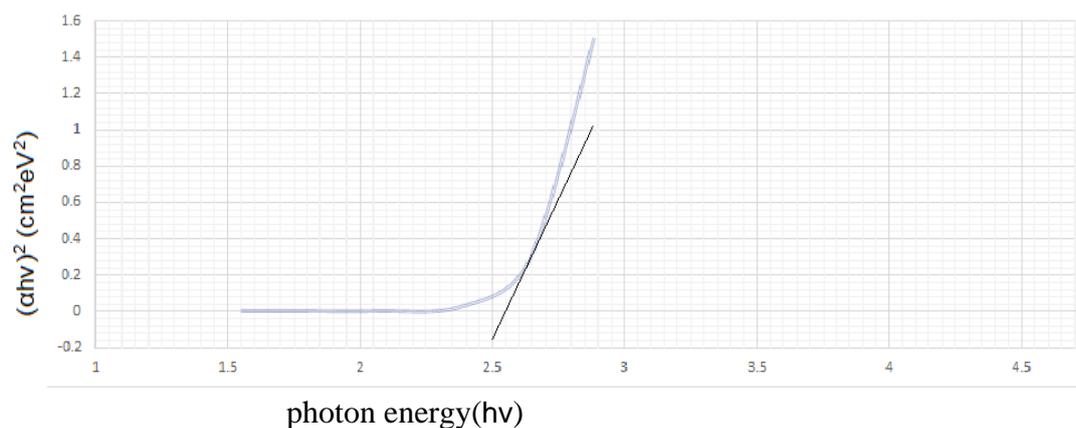


Fig: The UV-visible absorption spectrum of Ag nanoparticles synthesized from Reetha and Shikakai plant extract.

Hence it is evident that the nanoparticles formed were silver nanoparticles.

A Tauc plot is used to determine the optical bandgap in amorphous thin materials. Tauc plot of silver nanoparticle deduce from its absorption spectrum is shown below.



It is drawn by plotting photon energy $h\nu$ on x axis and $(\alpha h\nu)^2$ on y axis where h is the Planck's constant and α is the absorbance. We get a curve while plotting. To find the band gap energy we need to extrapolate the linear part of the curve to the energy axis as shown in the above figure. The point where the extrapolated line coincide at x axis gives the band gap energy of the silver nanoparticle and it is found to be 2.51 eV.

DISCUSSION

The experiment was performed by taking fresh and healthy Tulasi leaves and these were rinsed with tap water followed by distilled water to remove dust particles and were further dried. About 40g of leaves were transferred to a beaker containing 200ml of distilled water and was boiled for 30 minutes. Then the extracts were cooled to room temperature and filtered through Whatman filter paper No 40 to remove particulate matter. One molar silver nitrate solution is prepared by dissolving 8.4935g of AgNO₃ in 50ml of distilled water.

Then 100ml of plant extract solution was added to 500 ml of one molar silver nitrate solution. After the addition of the plant leaf extract to aqueous silver nitrate solution, the colour of the solution changed from light yellow to reddish-brown and finally to the colloidal brown indicating reduction of silver thus leading to nanoparticle synthesis. Silver nanoparticles appear yellowish-brown in colour in an aqueous medium as a result of surface plasmon vibrations.

The reduction of silver ions (Ag⁺) was monitored by measuring the UV spectrum of the reaction medium after diluting the sample into distilled water. UV spectral analysis was done by using a UV spectrophotometer (SUV-S2100) at room temperature operated at a resolution of 1nm between 300-800nm ranges. The silver nanoparticles exhibited a maximum absorption spectrum at 420nm. The flat curves of the graph indicated the formation of polydisperse large nanoparticles due to the slow reduction rates.

Measuring the band gap is an important parameter in the nanomaterial industry. It is used to analyze the conductivity of the synthesized nanomaterial. The term band gap refers to the energy difference between the top of the valence band and bottom of the conduction band. For an electron to jump from a valence band to conduction band it requires a specific minimum amount of energy for the transition called as band energy. The band energy of silver nanoparticles was found out using its Tauc plot and it shown that silver nanoparticles exhibit a direct band gap of 2.51 eV.

Applications of silver nanoparticles

Silver nanoparticles are increasingly used in various fields, including medical, food, health care, consumer, and industrial purposes, due to their unique physical and chemical properties. These include optical, electrical, and thermal, high electrical conductivity, and biological properties. Due to their peculiar properties, they have been used for several applications, including as antibacterial agents, in industrial, household, and healthcare-related products, in consumer products, medical device coatings, optical sensors, and cosmetics, in the pharmaceutical industry, the food industry, in diagnostics, orthopedics, drug delivery, as anticancer agents, and have ultimately enhanced the tumor-killing effects of anticancer drugs. Recently, AgNPs have been frequently used in many textiles, keyboards, wound dressings, and biomedical devices. Nanosized metallic particles are unique and can considerably change physical, chemical, and biological properties due to their surface-to-volume ratio; therefore, these nanoparticles have been exploited for various purposes.

The biological activity of AgNPs depends on factors including surface chemistry, size, size distribution, shape, particle morphology, particle composition, coating/capping, agglomeration, and dissolution rate, particle reactivity in solution, efficiency of ion release, and cell type, and the type of reducing agents used for the synthesis of AgNPs are a crucial factor for the determination of cytotoxicity. The physicochemical properties of nanoparticles enhance the bioavailability of therapeutic agents after both systemic and local administration and other hand it can affect cellular uptake, biological distribution, penetration into biological barriers, and resultant therapeutic effects. Therefore, the development of AgNPs with controlled structures that are uniform in size, morphology, and functionality are essential for various biomedical applications.

Cancer is a complex, multifactorial disease which has the characteristic feature of the uncontrolled growth and spread of abnormal cells caused by several factors, including a combination of genetic, external, internal, and environmental factors, and it is treated by various treatments including chemotherapy, hormone therapy, surgery, radiation, immune therapy, and targeted therapy. Therefore, the challenge is to identify effective, cost-effective, and sensitive lead molecules that have cell-targeted specificity and increase the sensitivity.

Recently, AgNPs have been shown much interest because of their therapeutic applications in cancer as anticancer agents, in diagnostics, and in probing.

CHAPTER 5

CONCLUSION

This project was undertaken to present a simple and reproducible way for the synthesis of silver nanoparticles. The use of natural extracts, distilled water and non-toxic reagents allows the synthesis pathways presented to be considered as "green". The results of the experiment are used for the further study of the properties of the absorption spectrum.

Based on the previous discussion the synthesis of nanoparticles may serve as a future direction in biomedical nanotechnology in developing antimicrobial compounds. The previously used metal antimicrobial may come with lots of possibilities with the advancement of green nanotechnology in combating multidrug resistance. Nanoparticles are seen to have the ability to cross and disrupt the membrane. Thus, loading drugs on the nanoparticle surface may increase the efficiency of biocidal motion by additional effect than disrupting the membrane. Thus, it can have the future option to decode bacterial lipopolysaccharide Achilles. The toxicity of silver nanoparticles is also a major issue. Although biomolecular capping in the green synthesis process reduces the toxicity, it is imperative to develop more efficient capping and reducing agents for particular uses.

The current trend of research is mainly carried out using whole plant extracts as reducing and capping agents. This serves as a drawback regarding not clearly understanding the role of isolated pure biomolecules in the synthesis and activity of nanoparticles. Synthesis using the pure compound in an optimized condition may additionally give a solution regarding the poly disparity of green nanoparticle synthesis.

The biosynthesis of silver nanoparticles using leaf extract provides an eco-friendly, simple and wound healing and other medical and electronic applications, make this method potentially exciting for the large-scale synthesis of other nanomaterials. Thus, we can conclude that this is an efficient method. These silver nanoparticles were rich sources of proteins and metabolites such as terpenoids, phenols etc. Applications of such eco-friendly nanoparticles in bactericidal, the plant extract could be used in various fields for the

biosynthesis of nanoparticles as well as this method doesn't require sophisticated types of equipment and toxic chemicals.

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Project Report

On

**EFFECTS OF COVID 19 ON VARIOUS
FACTORS ON STUDENTS**

Submitted

in partial fulfilment of the requirements for the degree of

BACHELOR OF SCIENCE

in

MATHEMATICS

by

ALEENA P JOHNSON

(REGISTER NO: AB19AMAT038)

Under the Supervision of

Smt. SHANTY B P



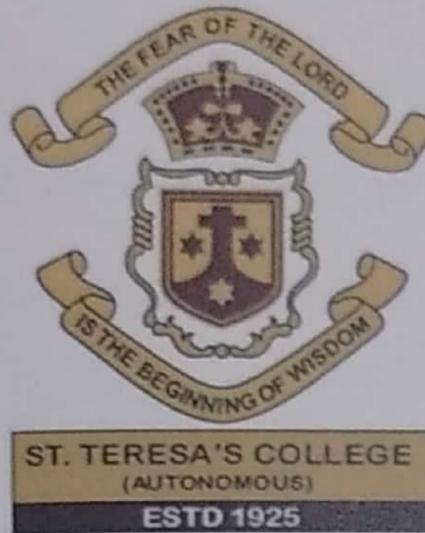
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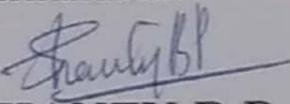
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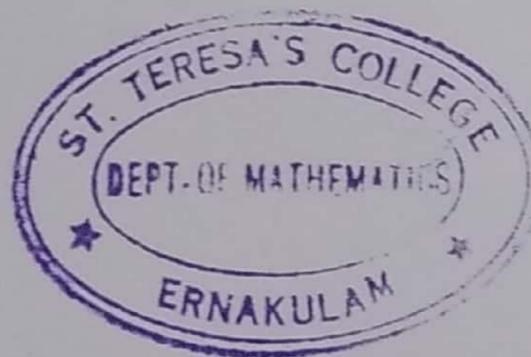


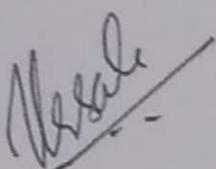
CERTIFICATE

This is to certify that the dissertation entitled, **EFFECTS OF COVID 19 ON VARIOUS FACTORS ON STUDENTS** is a bonafide record of the work done by Ms. **ALEENA P JOHNSON** under my guidance as partial fulfilment of the award of the degree of **Bachelor of Science in Mathematics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

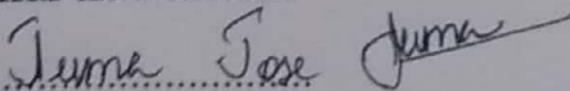
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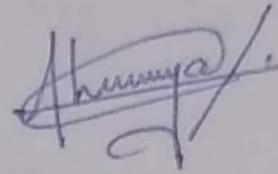
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DECLARATION

I hereby declare that the work presented in this project is based on the original work done by me under the guidance of Smt. Shanty B P, Assistant Professor, Department of Mathematics, St. Teresa's College(Autonomous), Ernakulam and has not been included in any other project submitted previously for the award of any degree.

Ernakulam.

Date: 04/03/2022



ALEENA P JOHNSON

AB19AMAT038

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Ernakulam.

Date: 04/03/2022

ALEENA P JOHNSON

AB19AMAT038

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Chapter 1

INTRODUCTION

1.1 ABSTRACT

The main purpose of the study was to identify and analyze the impacts of the pandemic on students . Through the study we were able to figure out how various factors like mental and physical health, academics etc has influenced the students. After analyzing the factors we were able to put up some suggestions.

1.2 STATISTICS

Statistics is a branch of science that deals with the collection, organisation, analysis of data and drawing of inferences from the samples to the whole population. This requires a proper design of the study, an appropriate selection of the study sample and choice of a suitable statistical test. An adequate knowledge of statistics is necessary for proper designing of a study or a clinical trial. Improper statistical methods may result in erroneous conclusions which may lead to unethical practice.

1.2.1 VARIABLES

Variable is a characteristic that varies from one individual member of population to another individual. Variables such as height and weight are measured by some type of scale, that conveys quantitative information and are called as quantitative variables. Sex and eye colour give qualitative information and are called as qualitative variables.

1.2.2 STATISTICS: DESCRIPTIVE AND INFERENCE

Descriptive statistics try to describe the relationship between variables in a sample or population. Descriptive statistics provide a summary of data in the form of mean, median and mode. Inferential statistics use a random sample of data taken from a population to describe and make inferences about the whole population. It is valuable when it is not possible to examine each member of an entire population.

1.2.3 INFERENCE

In inferential statistics, data are analysed from a sample to make inferences in the larger collection of the population. The by purpose is to answer or test the hypotheses. A hypothesis (plural hypotheses) is a proposed explanation for a phenomenon. Hypothesis tests are thus procedures for making rational decisions about the reality of observed effects. In inferential statistics, the term 'null hypothesis' (H_0) denotes that there is no relationship (difference) between the population variables in question. Alternative hypothesis (H_1) denotes that a statement

between the variables is expected to be true. The p value (or the calculated probability) is the probability of the event occurring by chance if the null hypothesis is true. The p value is a numerical value between 0 and 1 and is interpreted by researchers in deciding whether to reject or retain the null hypothesis. If p value is less than the arbitrarily chosen value (known as the significance level), the null hypothesis (H_0) is rejected.

1.2.4 STATISTICAL SURVEY

A survey is an investigation about the characteristics of a given population by means of collecting data from a sample of that population and estimating their characteristics through the systematic use of statistical methodology. When conducting a statistical survey, there are Stages Of Statistical Survey, that are to be followed in sequential order. Unless we follow these steps systematically, we may not be able to achieve good results from the survey. Some important steps concerning a statistical survey:

- Defining the problem and determining the objective
- Preliminaries to the collection of data.
- Collection and Editing of data.
- Classification and Tabulation of data.
- Analysis and Interpretation of data.
- Writing the report.

1.3 ABOUT COVID-19

COVID-19 (coronavirus disease 2019) is a disease caused by a virus named SARS-CoV-2 and was discovered in December 2019 in Wuhan, China. It is very contagious and has quickly spread around the world. COVID-19 most often causes respiratory symptoms that can feel much like a cold, a flu, or pneumonia. COVID-19 may attack more than your lungs and respiratory system. Other parts of your body may also be affected by the disease.

- Most people with COVID-19 have mild symptoms, but some people become severely ill.
- Some people including those with minor or no symptoms may suffer from post-COVID conditions or “long COVID”.
- Older adults and people who have certain underlying medical conditions are at increased risk of severe illness from COVID-19.
- Hundreds of thousands of people have died from COVID-19 in the United States.
- Vaccines against COVID-19 are safe and effective. Vaccines teach our immune system to fight the virus that causes COVID-19.

The first SARS-CoV-2 positive case in India was reported in the state of Kerala on January 30th, 2020. On 11 March, the World Health Organization (WHO) declared COVID-19 a global pandemic. Covid-19 pandemic-impacted education will be different mainly in the mode of teaching and evaluation. Nationally there was a call for a de facto switch to virtual teaching, learning and evaluation, pushing a huge number of teachers into an unfamiliar mode. Hailed as a more effective, quick and less expensive mode, online teaching/learning is being given precedence over the campus mode as the new normal. Online teaching and evaluation, pushed as a new normal under the pretext of the pandemic crisis, upset objectives of access, equity and excellence in the higher education sector. About 30 per cent of students at home under lockdown were not able to access online lessons due to lack of internet connectivity. Virtual teaching is not a substitute for the Real that has all the exclusive advantages of being real. The Covid-induced virtual mode will bring about several transformations in the concept of higher education institutions, their clients and practices.

1.4 OBJECTIVES

- To find and to interpret if there exist any relation between gender and various factors.
- To find and to interpret if there is any relation between age groups and various factors.

- To examine whether the government implemented schemes or the scholarships provided by other organisations are reaching the deserved ones.

1.5 LITERATURE REVIEW

1) JMIR Publications:- Journal of Medical Internet Research

It is a small but rapidly growing publisher of peer-reviewed journals with an emphasis on medicine, health, and technology titles, is seeking an enthusiastic, self-motivated team members. A group of students from the department of pharmacology, Rajiv Gandhi University of health Sciences, Bangalore conducted a research on the topic 'Impact of covid 19 on mental health of college students in India'. Authors :

- Amar Prasad Chaudhary
- Narayan Sah Sonar
- Jamuna TR
- Moumita Banerjee
- Sheilesh Yadav

The research work was published on 23rd February 2021. Their objective was to investigate symptoms of fear, depression and anxiety due to covid 19 on students of India. For this study, students of Mallige college of Pharmacy in Bangalore, India were selected with access to the internet and Social media. The questionnaire was designed using Google forms and was distributed to the students through the various social media platforms like Whatsapp, Facebook, Messenger, Telegram, etc. All the data were recorded in Microsoft Excel .They received a total of 324 students out of which 180 were males and 144 were females. From the research work they concluded that a very high fear of covid 19 among students along with anxiety and depression symptoms.

2) NCBI :- National centre for Biotechnology Information It's a branch of national Institutes of health. It is approved and funded by the govt of USA. The research was carried out by Wenjun Cao, Ziwei Fang, Guoqiang Hou Mei Han, Xinrong Xu, Jiaxin Dong, and Jianzhong Zheng.

The research was based on ‘the psychological impacts of covid 19 epidemic on college students in China’. The targeted population was the UG students from Changzhi medical college. The respondents in the target population were sampled by cluster sampling. They received a total of respondents. Data were analysed with SPSS Version 22.0. A univariate analysis (Nonparametric test) was used to explore the significant associations between sample characteristics and the anxiety level during the COVID-19 epidemic and multivariate logistic regression analysis suggested that living in urban areas in contrast to reducing the anxiety of college students.

3) Indian express article:- The survey was carried out by ASER. ASER (Annual Status of Education Report) is a social welfare centre in Delhi established in 2008 as an autonomous assessment survey. The survey shows an increase in dependence on private tuitions and an absence of ready access to smartphones. They suggested that special attention is needed to help make up learning losses especially in the lower classes.

1.6 SIGNIFICANCE OF STUDY

The rapid and unplanned change to teaching and learning in the online format brought by COVID-19 has likely impacted many students. One of the limitations of emergency remote learning is the lack of personal interaction between teacher and student. Mental health issues are the leading impediment to academic success. Mental illness can affect students’ motivation, concentration, and social interactions—crucial factors for students to succeed in higher education. So the purpose of this study is to examine how the various factors (psychological, physical health, academics)during the pandemic has affected students well-being and what role the government and other organisations plays in this context.

1.7 LIMITATIONS OF STUDY

Even though the study yielded major findings, there were a few limitations in our survey. The survey has been restricted to students between the age group 13-24. Students from other age groups were not taken into consideration. As the sample size increases the margin of error decreases. But due to time and other restrictions, the survey was limited to only 470 participants. Only qualitative data has been used in the study. Since the responses received were the personal choices of the respondents there is a chance that the data may or may not be biased.

Chapter 2

METHODOLOGY

2.1 METHODS

The target population for the survey was the population of students from age 13-17 and 18-24. Google form was circulated among the students between age group 13-24, to conduct the survey. The questionnaire consisting of 25 questions including age, gender, educational institution, type of school or college and place of residence was circulated. Out of 25 questions, 23 questions were marked important. The questionnaire included questions regarding psychological, financial, academic and health issues faced by the students.

2.2 CHI-SQUARE TEST

The Chi-Square Test is an important test among the several tests of significance. It was developed by Karl Pearson in 1990. In general, the test that is used to measure the difference between what is observed and what is expected according to an assumed hypothesis is called Chi-Square Test. Simply we can say that Chi-Square Test is a relationship between two variables. H_0 that is the null hypothesis represents that there is no relation between two variables. H_1 that is the alternative hypothesis indicates that there exist a significant relation between two variables. The significant level is the probability of rejecting the null hypothesis, when it is true. In most of the cases, we use significant level as 0.05. First we create the table of observed frequency from obtained

data. Then expected frequency values are calculated using the following equation:-

$$(\text{Row total} \times \text{column total}) \div \text{Grand total}$$

Then, we create the table of expected frequency, we can calculate the Chi-square value using the equation:-

$$\frac{(\text{Observed value} - \text{Expected value})^2}{\text{Expected value}^2} = \frac{(O_i - E_i)^2}{E_i} \quad (2.1)$$

$$\text{Chi-Square} = \frac{(O_i - E_i)^2}{E_i} \quad (2.2)$$

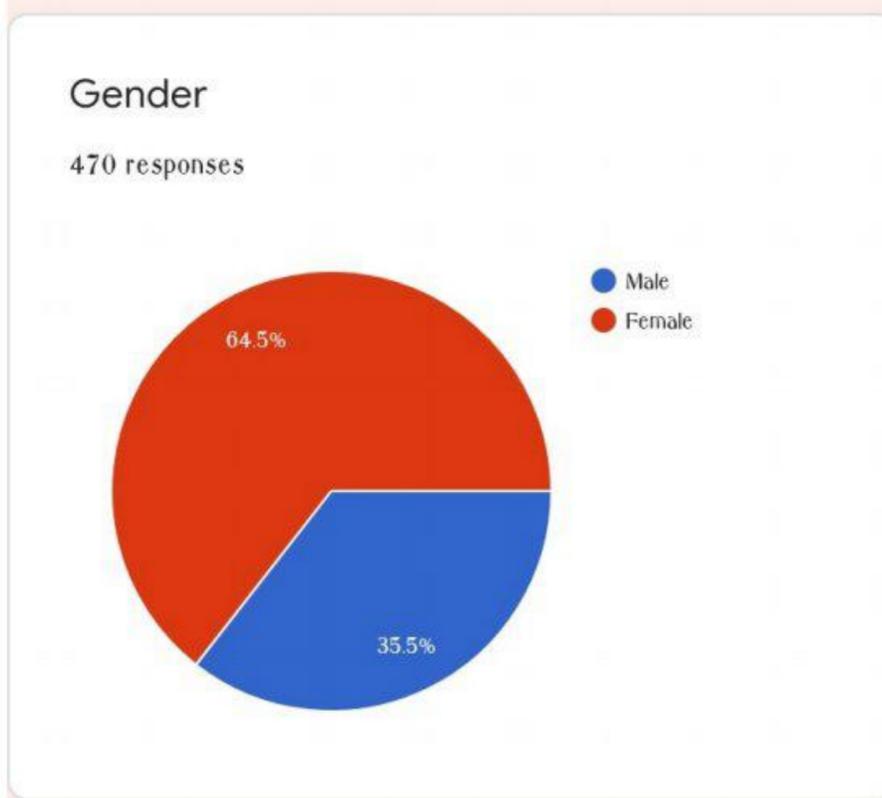
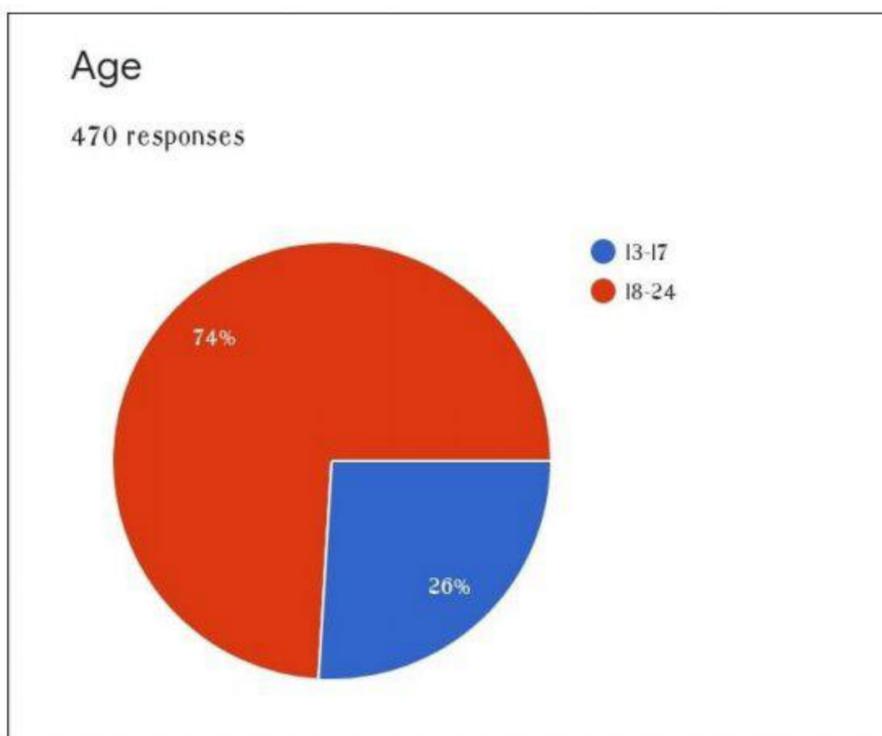
Tabular Chi-Square value can be obtained by using degrees of freedom and significance level.

$$\text{Degrees of freedom} = (\text{column} - 1) \times (\text{rows} - 1)$$

Degrees of freedom refers to the maximum number of logically independent values, which are values that have the freedom to vary, in the data sample. If calculated Chi-Square is greater than tabular Chi-Square, then we reject null hypothesis and accept alternate hypothesis. A p value is a measure of the probability that an observed difference could have occurred just by random chance. The lower the p value the greater the statistical significance of the observed difference. In MS excel, we calculate the p value. Then we compare the p value with significance level. If p value is greater than the significance level, we accept H_0 . Hence we can say that there is no relation between two variables.

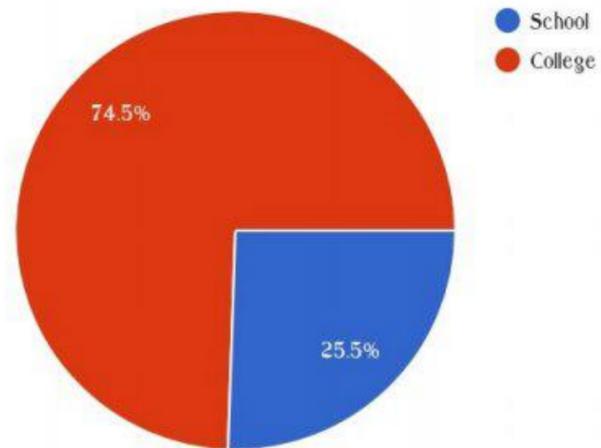
Chapter 3

PRESENTATION OF DATA



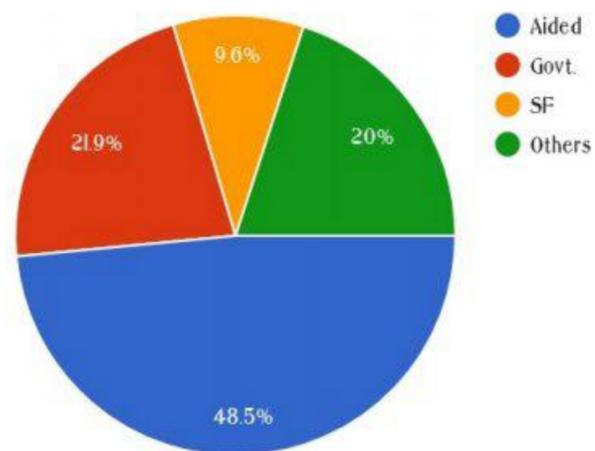
Educational Institution

470 responses



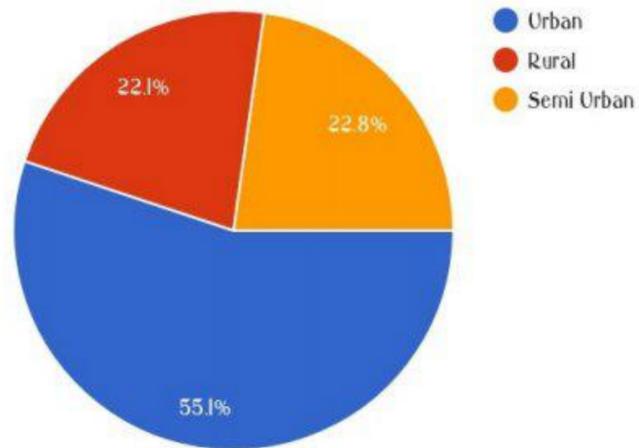
Type of School/College

470 responses



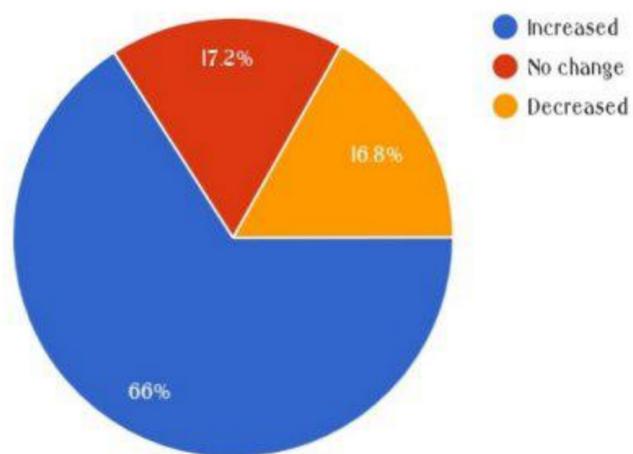
Place

470 responses



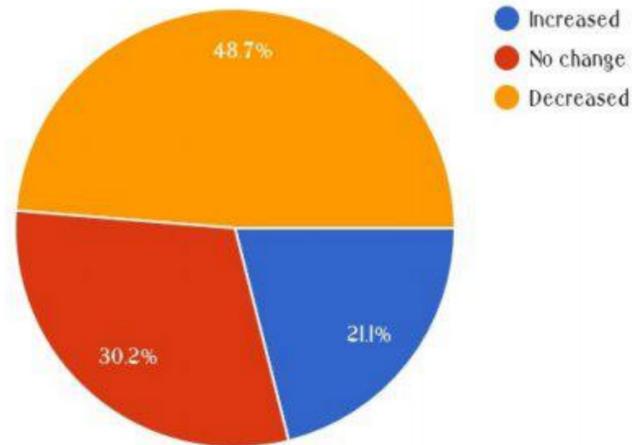
1) How do you view the condition of social isolation during this pandemic period?

470 responses



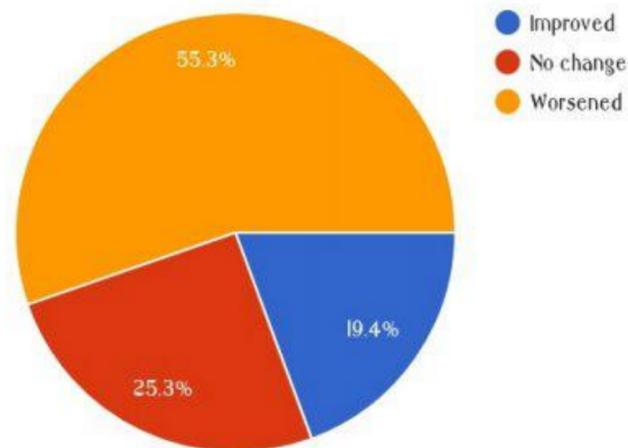
2) Do you think your communication skills has changed since the pandemic?

470 responses



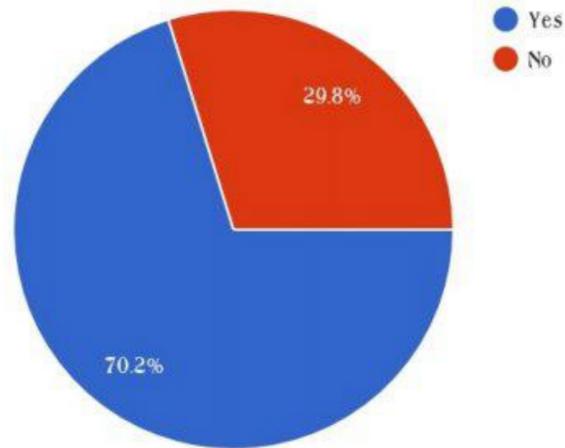
3) How do you think covid 19 has changed your state of mind?

470 responses



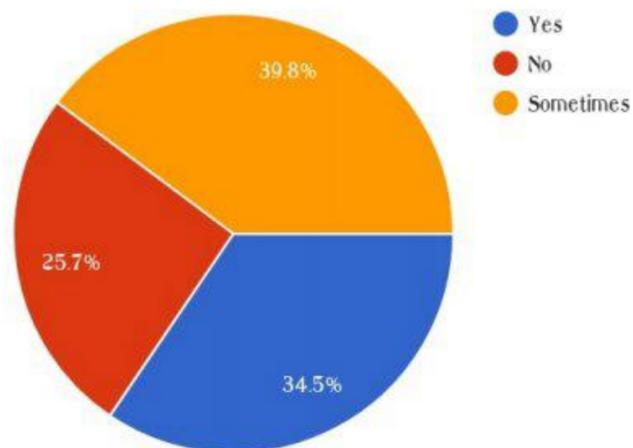
4) Do you feel online class is a hindrance for socialization?

470 responses



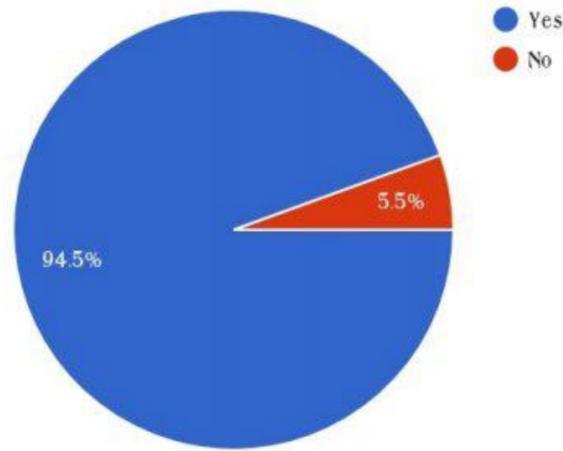
5) Do you participate in online competition, webinars etc.?

470 responses



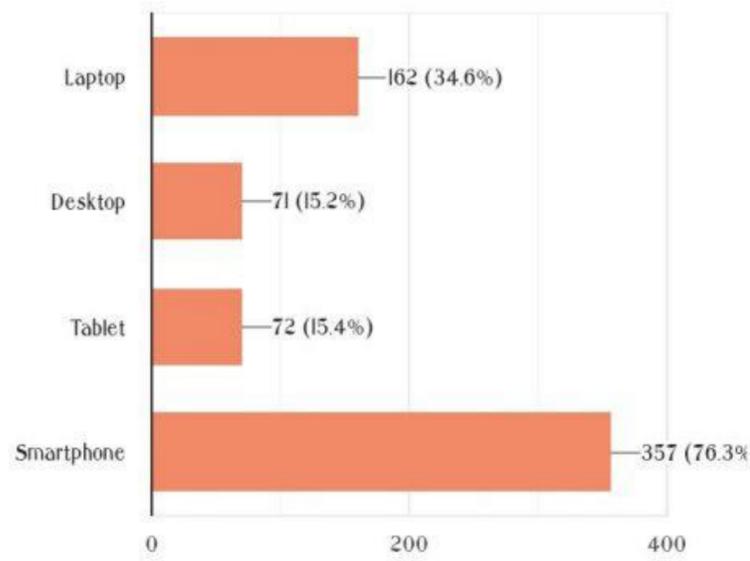
6) Do you have access to a device for online learning?

470 responses

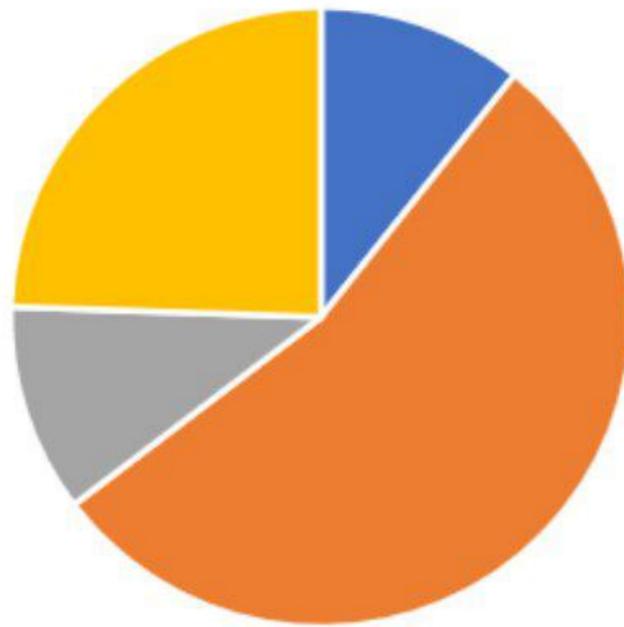


7) Which device do you use for online learning?

468 responses



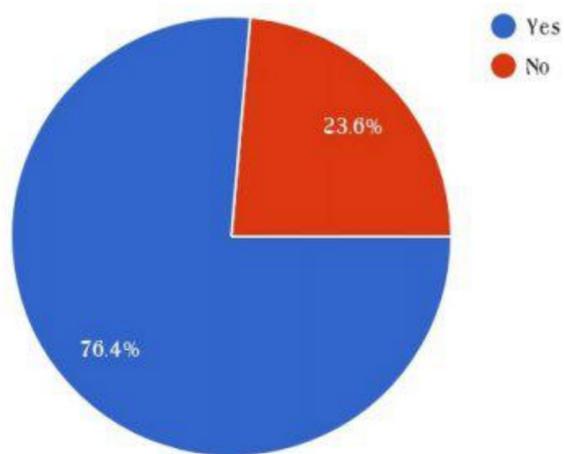
Device used for online learning



■ desktop ■ smartphone ■ tablet ■ laptop

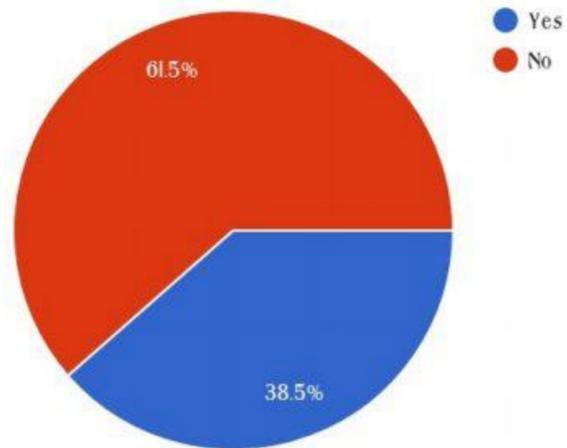
8) Do you experience any network issues during online sessions?

470 responses



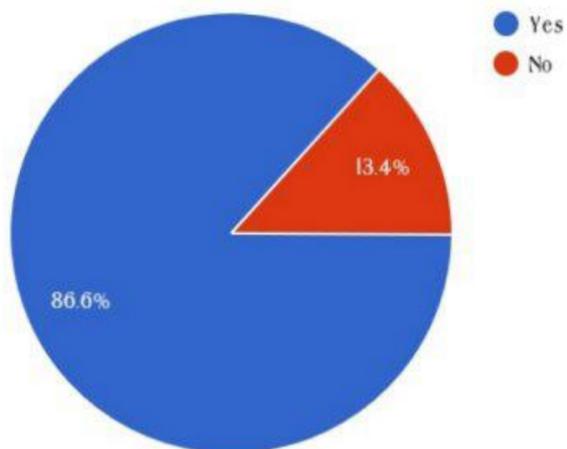
9) Did the online course meet your expectations in terms of quality learning?

470 responses



10) Do you feel that students having practical / lab works are more affected by online class?

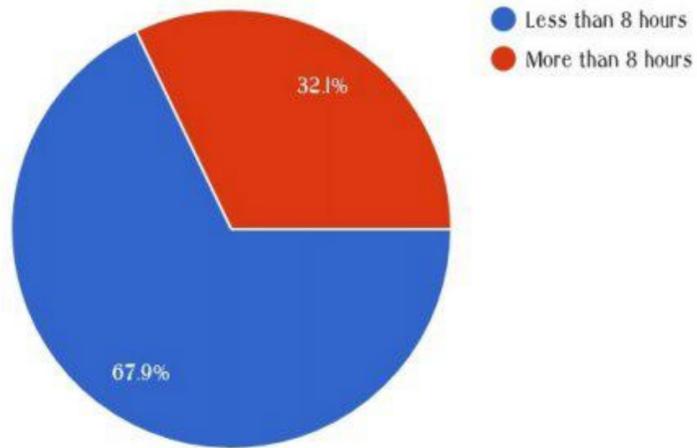
470 responses



11) How many hours of sleep do you get a night?

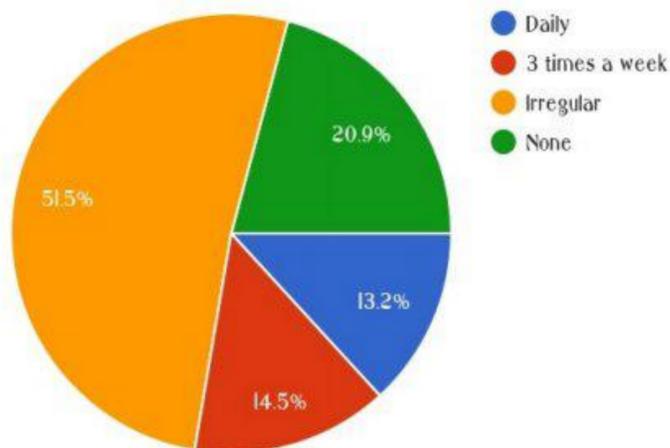


470 responses



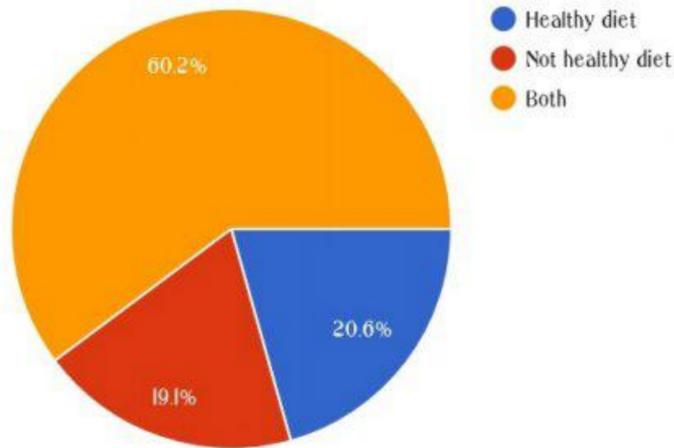
12) How much intentional exercise do you get a week?

470 responses



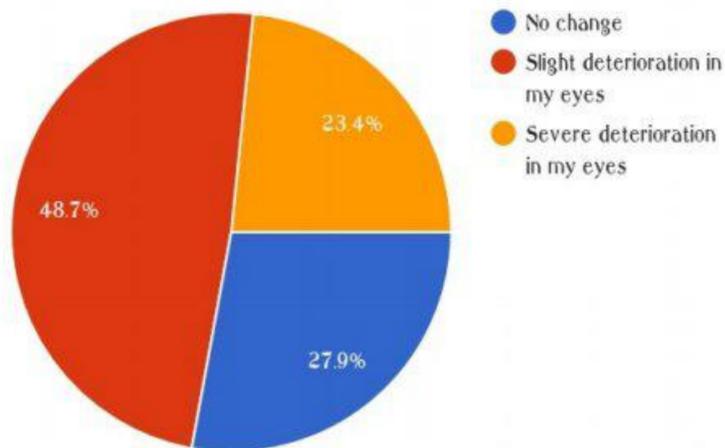
13) What are your eating habits like?

470 responses



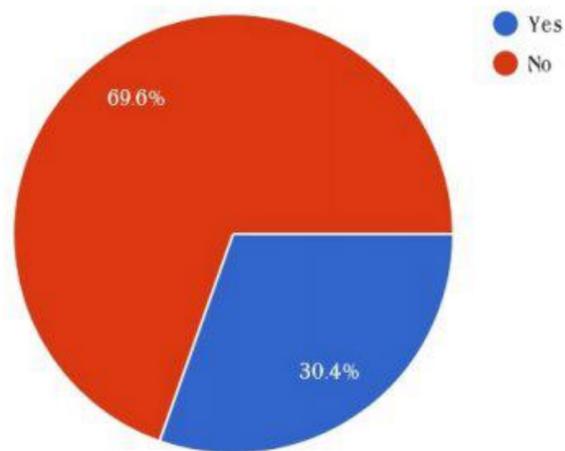
14) In what way did watching the lessons on your computer/tablet/smartphone affect your eye health during the pandemic?

470 responses



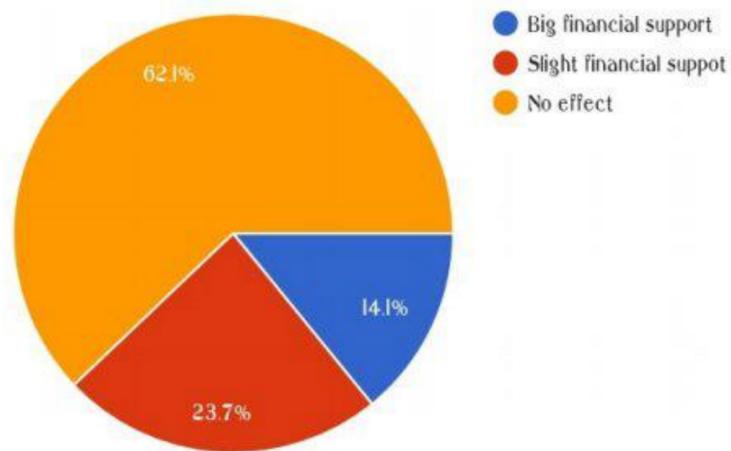
15) Do you get any scholarship?

470 responses



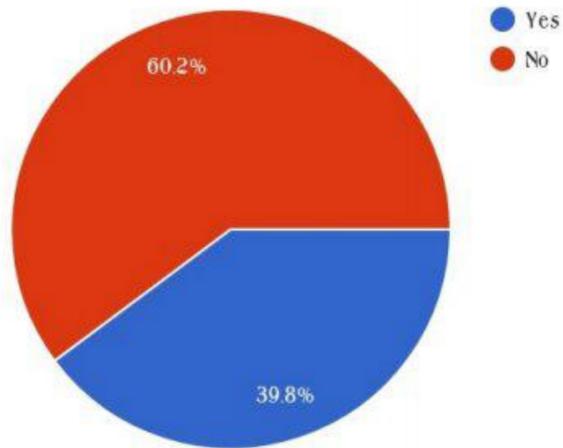
16) How much have scholarships influenced you during this corona era?

396 responses



17) Have you had to pay exorbitant fees since corona arrived?

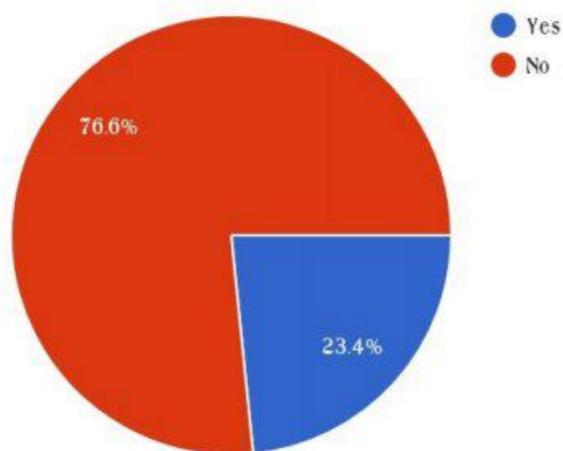
470 responses



18) Has corona time helped you financially(via online opportunities)

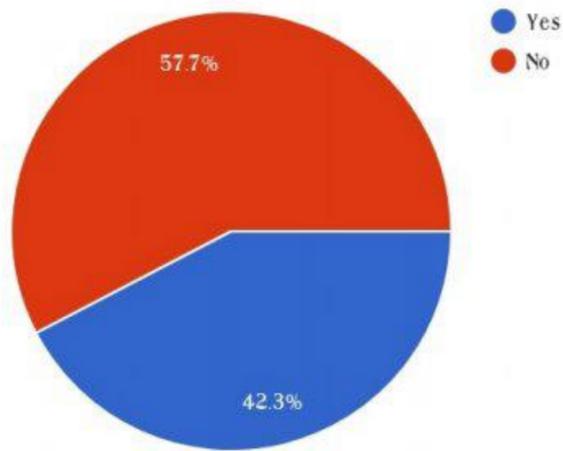


470 responses



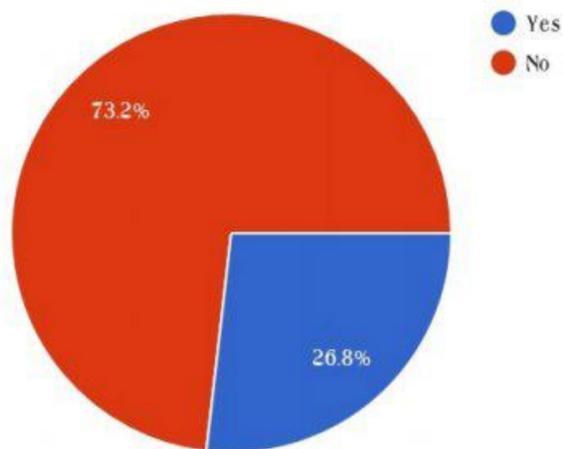
19) Do you welcome the continuation of online classes till the present pandemic situation become totally under control?

470 responses



20) Do you really enjoy online learning?

470 responses



3.1 DATA ANALYSIS

1. SOCIAL ISOLATION-GENDER:

Q) How do you view the condition of social isolation during this pandemic period?

- a) Increased
- b) No change
- c) Decreased

Observed Frequency

Gender	Increased	Decreased	No change	Total
Male	110	24	33	167
Female	199	53	51	303
Total	309	77	84	470

H_0 : There is no relationship between gender and social isolation.

H_1 : There is a relationship between Gender and social isolation.

Critical value: 0.05

Expected frequency

Gender	Increase	Decrease	No change	Total
Male	109.793617	27.35957447	29.84680851	167
Female	199.206383	49.64042553	54.15319149	303
Total	309	77	84	470

$$EF = CT * RT / GT$$

p value 0.560674794

Since p value is greater than 0.05 we will accept the null hypothesis. Hence, we can conclude that there exists no relation between social isolation and gender.

2. ENJOYMENT OF ONLINE LEARNING-GENDER:-

Q) Do you really enjoy online learning?

a) Yes

b) No

Observed frequency

Gender	Yes	No	Total
Male	53	114	167
Female	25	278	303
Total	78	392	470

H_0 : There is no relationship between gender and enjoyment of online learning

H_1 : There is a relationship between Gender and enjoyment of online learning.

Critical value: 0.05

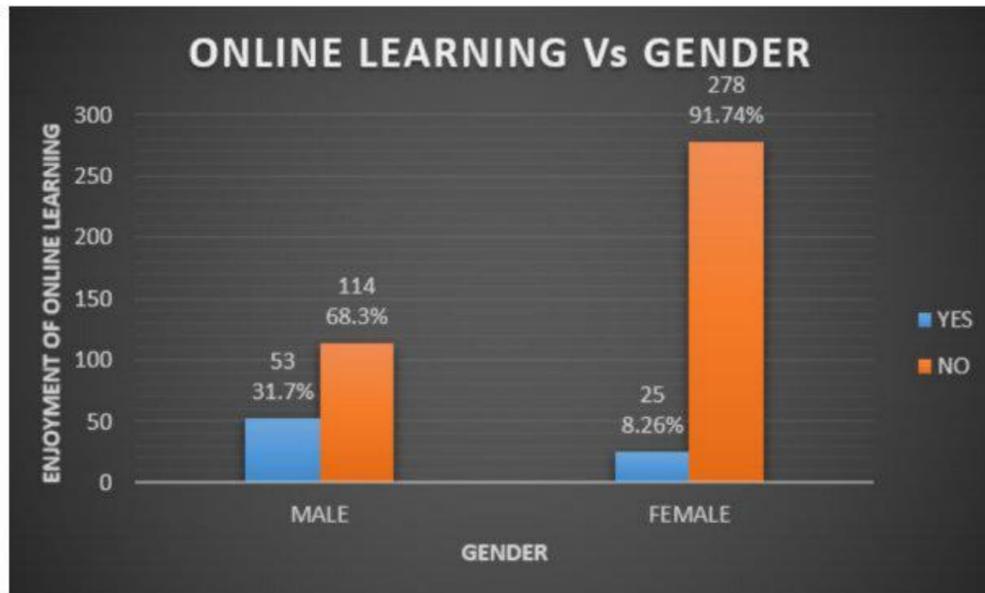
Expected frequency

Gender	Yes	No	Total
Male	27.71489362	139.2851064	167
Female	50.28510628	252.7148936	303
Total	78	392	470

$$EF = CT * RT / GT$$

$$p \text{ value } 5.75348 * 10^{-11}$$

Since p value is less than 0.05 we reject the null hypothesis. Hence, we can conclude that there exists a significant relation between enjoyment of online learning and gender.



3. QUALITY LEARNING-AGE GROUP:-

Q) Did the online course meet your expectations in terms of quality learning?

- a) Yes
- b) No

Observed frequency

Age group	Yes	No	Total
13-17	80	42	122
18-24	100	248	348
Total	180	290	470

H_0 : There is no relationship between quality learning and age group.

H_1 : There is a relationship between quality learning and age group.

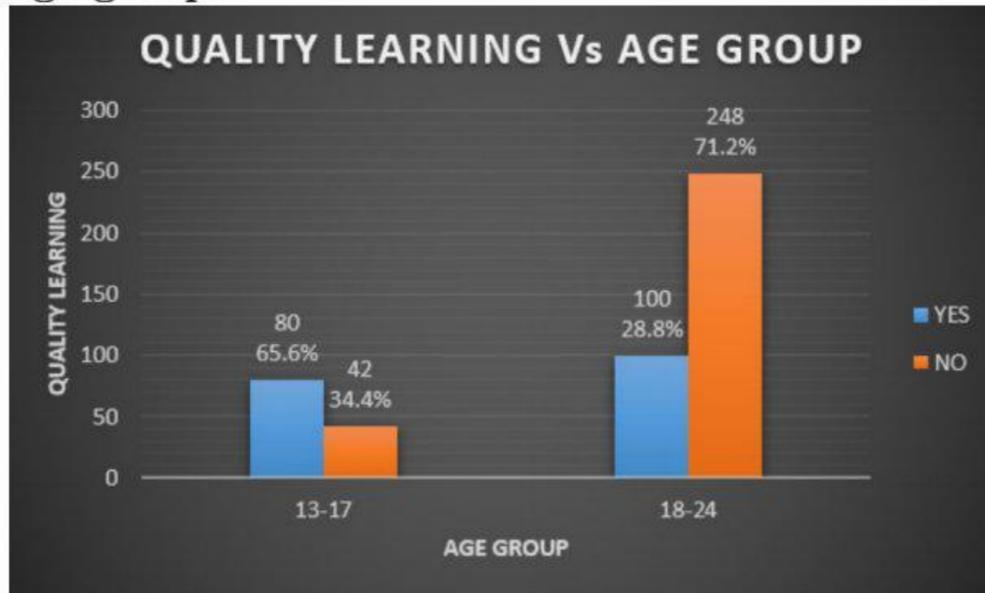
Expected frequency

Age group	Yes	No	Total
13-17	46.72340426	75.27659574	122
18-24	133.2765957	214.7234043	348
Total	180	290	470

$$EF = CT * RT / GT$$

$$p \text{ value } 5.91356 * 10^{-13}$$

As p value is less than 0.05 we reject the null hypothesis. Hence, we can conclude that there exists a relation between quality learning and age groups.



4. HOURS OF SLEEP AND GENDER:

Q) How many hours of sleep did you get a night?

a) Less than 8 hours

b) More than 8 hours

Observed frequency

Gender	Less than 8 hours	More than 8 hours	Total
Male	87	80	167
Female	232	71	303
Total	319	151	470

H_0 : There is no relationship between hours of sleep and gender.

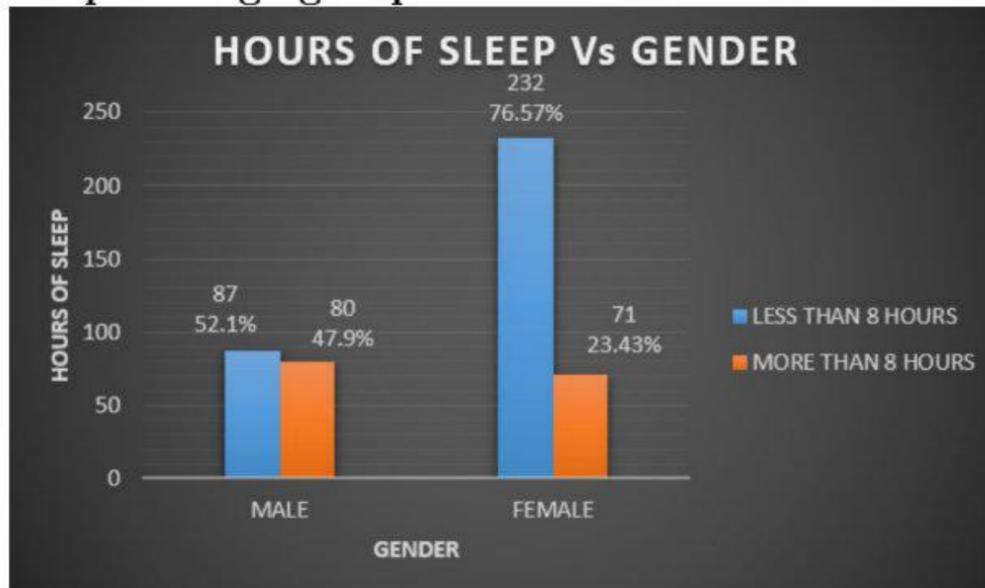
H_1 : There is a relationship between hours of sleep and gender.

Expected frequency

Gender	Less than 8 hours	More than 8 hours	Total
Male	113.3468085	53.65319149	167
Female	205.6531915	97.34680851	303
Total	319	151	470

p value 5.39872×10^{-8}

Since p value is less than 0.05 we will reject the null hypothesis. Hence, we can conclude that there exists a relation between hours of sleep and age groups.



5: EATING HABITS AND AGE GROUPS:

Q) What are your eating habits like?

- a) Healthy deit
- b) Not healthy diet
- c) Both

Observed frequency

Age group	Healthy	Not healthy	Both	Total
13-17	58	27	37	122
18-24	39	63	246	348
Total	97	90	283	470

H_0 : There is no relationship between age group and eating habits

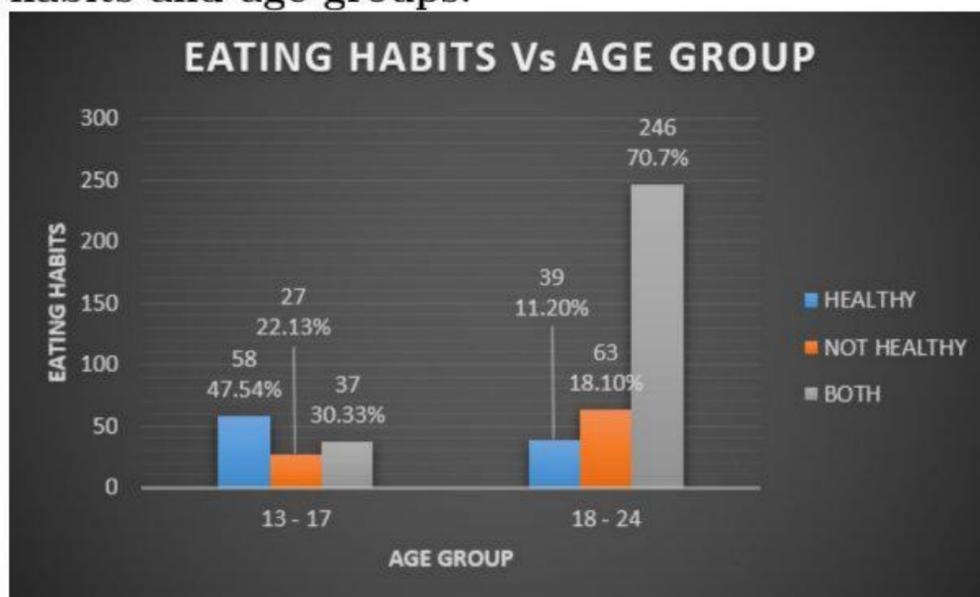
H_1 : There is a relationship between age group and eating habits.

Expected frequency

Age group	Healthy	Not healthy	Both	Total
13-17	25.1787234	23.36170213	73.45957447	122
18-24	71.8212766	66.63829787	209.5404255	348
Total	97	90	283	470

p value 9.53994×10^{-19}

Since p value is less than 0.05 we will reject the null hypothesis. Hence, we can conclude that there exists a relation between eating habits and age groups.



6: EYE HEALTH AND AGE GROUP:

Q) In what way did watching the lessons on your computer/table/smartphone effect your eye health during the pandemic?

a) No change

- b) Slight deterioration in my eyes
- c) Severe deterioration in my eyes

Observed frequency

Age group	No change	severe deterioration	Slight deterioration	Total
13-17	28	50	44	122
18-24	103	60	185	348
Total	131	110	229	479

H_0 : There is no relationship between eye health and age group.

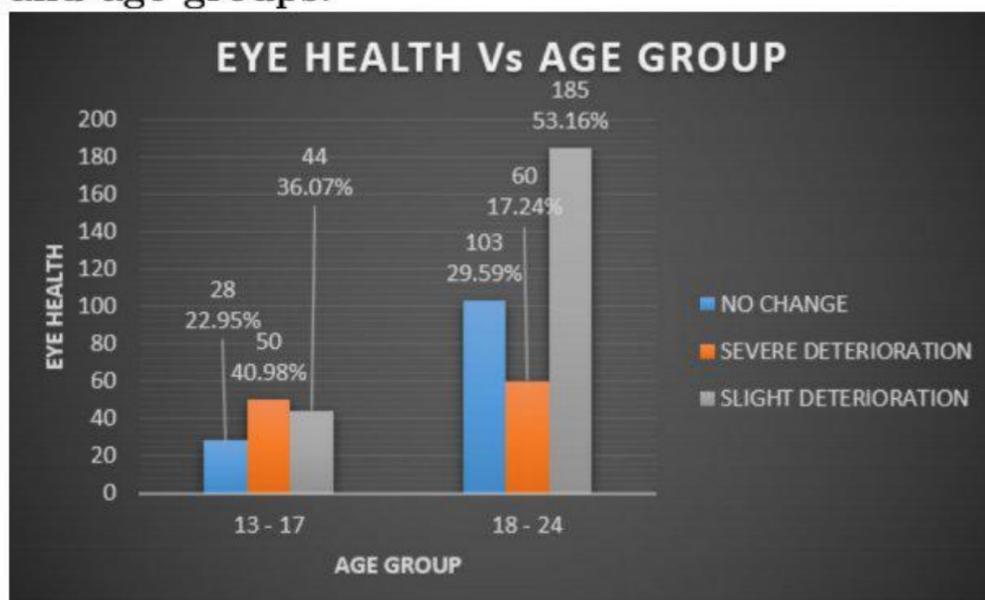
H_1 : There is a relationship between eye health and age group.

Expected frequency

Age group	No change	Severe deterioration	slight deterioration	Total
13-17	34.00425532	28.55319149	59.44255319	122
18-24	96.99574468	81.44680851	169.5574468	348
Total	131	110	229	470

p value 6.1397×10^{-7}

Since p value is less than 0.05 we will reject the null hypothesis. Hence, we can conclude that there exists a relation between eye health and age groups.



Chapter 4

RESULT AND CONCLUSION

4.1 RESULT

1. After carefully analyzing the data, we were able to find out that among 167 males out of 470 responses, 31.7% enjoy online learning and among 303 females, 8.26% enjoy online learning.
2. While examining the collected data, we can deduce that majority of students between 13-17 follows a healthy diet whereas considering the age group 18-24, majority of students prefer both healthy and unhealthy diet.
3. From the obtained data, among 122 students between 13-17, 40.98% face severe deterioration in their eyesight and 53.16% of 348 students between age group 18-24 face slight deterioration in their eye sight.

4.2 CONCLUSIONS

From our questionnaire, we were able to find out that at least there are some students who are benefited from the scholarships provided by the various organisations.

From the responses, we identified that the majority of students between the age group of 13-17 faced deterioration in their eye sight due to increased and continuous usage of electronic devices.

We also identified that the majority of students between the age group of 18-24 faced deterioration in their eye sight due to the same reason stated above.

From the responses, we can conclude that a majority of females reported an increase in social isolation and they tend to get lesser amount of sleep.

Similarly a major part of males reported an increase in isolation and tend to get lesser amount of sleep.

From our study, we were able to figure out that students between the age group of 13-17 tend to eat healthy food and spend a lesser amount of time to exercise. Since their diet is healthy, exercise does not become a necessity for them.

When we consider the case of students between the age group 18-24, we can see that they prefer a combination of both healthy and unhealthy diet and they prefer little to no exercise.

Hence we can conclude that a relation exist between age group and lifestyle.

4.3 SUGGESTIONS

- 1. Joining peer groups /support groups is a great way to increase communication among students. They provide an opportunity and support for development of an individual's soft skills which might have decreased since online mode of education started.**
- 2. Conversation with family and loved ones can be of great help in dealing with stress, anxiety and depression. Students can try and talk to his/her friends, parents, teachers etc about what's worrying them.**
- 3. Opening up about one's problems and worries to someone who cares can help him/her to deal with it more efficiently.**
- 4. Regular exercise can be beneficial for students whose lifestyles might have changed due to the sudden emergence of covid-19 and online mode of education.**
- 5. Maintain a proper diet and sleeping pattern is important for a healthier lifestyle.**
- 6. Good study habits like consistent timing, maintaining a proper schedule etc can be very helpful for a student to adjust to his/her new ways of learning.**
- 7. Connecting with classmates can be beneficial for both curricular and social aspects of one's life.**

REFERENCES

[1] Literature review :

1. <https://preprints.jmir.org/preprint/28158>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7102633/>
3. <https://indianexpress.com/article/explained/explained-covids-impact-learning-7628500/>

[2] Introduction :

1. <https://www.cdc.gov/coronavirus/2019-ncov/your-health/about-covid-19/basics-covid-19.html> - About COVID-19
2. Complementary Statistics:- Author-Ramakrishna Pillai
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<https://ani.stat.fsu.edu/undergrad/statinf2.php>
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5037948/>
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<https://www.idfcinstitute.org/knowledge/publications/working-and-briefing-papers/covid-19-pandemic-in-kerala/>

ANNEXURE

Questions 1-4 indicates the psychological factors that influence students.

Questions 5-10 is regarding how covid has affected the academics of the students.

Questions 11-14 is all about the fitness and lifestyle.

Questions 15-17 is about governments role in helping students.

Questions 18-20 is regarding the financial factors that affect students.

The image shows a Google Forms interface for a questionnaire. At the top, there are tabs for 'Questions', 'Responses' (with a count of 470), and 'Settings'. The form is divided into two sections. Section 1 of 2 is titled 'EFFECTS OF COVID-19 ON VARIOUS FACTORS ON STUDENTS' and includes a description: 'This survey is being conducted in order to study how covid-19 has affected students of different age groups. The data collected will be used only for educational purposes.' It contains four questions: 'Email *' (text input), 'Educational Institution *' (radio buttons for School and College), 'Type of School/College *' (radio buttons for Aided, Govt., SF, and Others), and '1) How do you view the condition of social isolation during this pandemic period?' (radio buttons for Increased, No change, and Decreased). Section 2 of 2 is titled 'Questionnaire' and includes a description field and three questions: 'Age *' (radio buttons for 13-17 and 18-24), 'Gender *' (radio buttons for Male and Female), and 'Place *' (radio buttons for Urban, Rural, and Semi Urban).

2) Do you think your communication skills has changed since the pandemic? *

- Increased
- No change
- Decreased

3) How do you think covid 19 has changed your state of mind? *

- Improved
- No change
- Worsened

6) Do you have access to a device for online learning? *

- Yes
- No

7) Which device do you use for online learning?

- Laptop
- Desktop
- Tablet
- Smartphone

4) Do you feel online class is a hindrance for socialization? *

- Yes
- No

5) Do you participate in online competition, webinars etc.? *

- Yes
- No
- Sometimes

8) Do you experience any network issues during online sessions? *

- Yes
- No

9) Did the online course meet your expectations in terms of quality learning? *

- Yes
- No

10) Do you feel that students having practical *
/ lab works are more affected by online
class?

- Yes
- No

12) How much intentional exercise do you get *
a week?

- Daily
- 3 times a week
- Irregular
- None

11) How many hours of sleep do you get a *
night?

- Less than 8 hours
- More than 8 hours

13) What are your eating habits like? *

- Healthy diet
- Not healthy diet
- Both

14) In what way did watching the lessons on *
your computer/tablet/smartphone affect
your eye health during the pandemic?

- No change
- Slight deterioration in my eyes
- Severe deterioration in my eyes

16) How much have scholarships influenced you during
this corona era?

- Big financial support
- Slight financial support
- No effect

15) Do you get any scholarship? *

- Yes
- No

17) Have you had to pay exorbitant fees since *
corona arrived?

- Yes
- No

18) Has corona time helped you financially(via online opportunities)

Yes

No

19) Do you welcome the continuation of online classes till the present pandemic situation become totally under control?

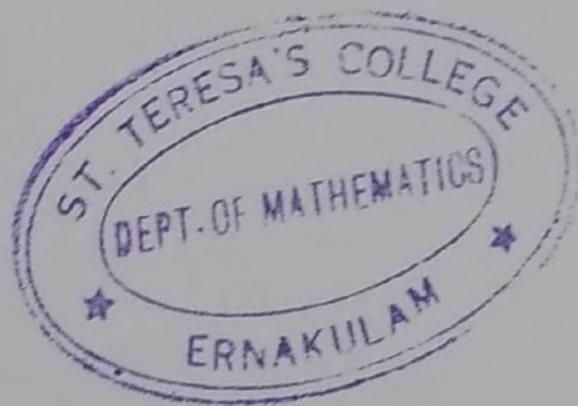
Yes

No

20) Do you really enjoy online learning?

Yes

No



Project Report

On

**EFFECTS OF COVID 19 ON VARIOUS
FACTORS ON STUDENTS**

Submitted

in partial fulfilment of the requirements for the degree of

BACHELOR OF SCIENCE

in

MATHEMATICS

by

ALISHA JAMES

(REGISTER NO: AB19AMAT039)

Under the Supervision of

Smt. SHANTY B P



DEPARTMENT OF MATHEMATICS

ST. TERESA'S COLLEGE (AUTONOMOUS)

ERNAKULAM, KOCHI - 682011

APRIL 2022

ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM



CERTIFICATE

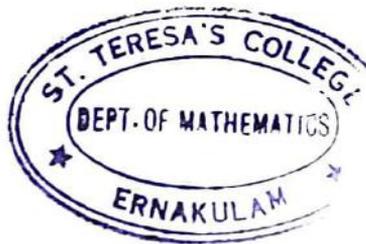
This is to certify that the dissertation entitled, **EFFECTS OF COVID 19 ON VARIOUS FACTORS ON STUDENTS** is a bonafide record of the work done by Ms. **ALISHA JAMES** under my guidance as partial fulfilment of the award of the degree of **Bachelor of Science in Mathematics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

Date: 04/03/2022

Place: Ernakulam

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External Examiners

1:.....*James Per Juma*.....

2:

DECLARATION

I hereby declare that the work presented in this project is based on the original work done by me under the guidance of Sint. Shanty B P, Assistant Professor, Department of Mathematics, St. Teresa's College(Autonomous), Ernakulam and has not been included in any other project submitted previously for the award of any degree.

Ernakulam.

ALISHA JAMES

Date: 04/03/2022

AB19AMAT039

ACKNOWLEDGEMENT

I take this opportunity to express my sincere gratitude towards Smt. Shanty B P of the Department of Mathematics and Statistics of St. Teresa's college who encouraged me to carry out this work. Her continuous invaluable knowledgeable guidance throughout this study helped me complete the work up to this stage. I will always be thankful to you in this regard. I also express my profound thanks to Ms Vrinda Muraleedharan and Smt. Betty Joseph of the Department of Mathematics and Statistics and all those who have indirectly guided and helped me in the completion of this project.

Ernakulam

Date: 04/03/2022

ALISHA JAMES

AB19AMAT039

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Chapter 1

INTRODUCTION

1.1 ABSTRACT

The main purpose of the study was to identify and analyze the impacts of the pandemic on students . Through the study we were able to figure out how various factors like mental and physical health, academics etc has influenced the students. After analyzing the factors we were able to put up some suggestions.

1.2 STATISTICS

Statistics is a branch of science that deals with the collection, organisation, analysis of data and drawing of inferences from the samples to the whole population. This requires a proper design of the study, an appropriate selection of the study sample and choice of a suitable statistical test. An adequate knowledge of statistics is necessary for proper designing of a study or a clinical trial. Improper statistical methods may result in erroneous conclusions which may lead to unethical practice.

1.2.1 VARIABLES

Variable is a characteristic that varies from one individual member of population to another individual. Variables such as height and weight are measured by some type of scale, that conveys quantitative information and are called as quantitative variables. Sex and eye colour give qualitative information and are called as qualitative variables.

1.2.2 STATISTICS: DESCRIPTIVE AND INFERENCE

Descriptive statistics try to describe the relationship between variables in a sample or population. Descriptive statistics provide a summary of data in the form of mean, median and mode. Inferential statistics use a random sample of data taken from a population to describe and make inferences about the whole population. It is valuable when it is not possible to examine each member of an entire population.

1.2.3 INFERENCE STATISTICS

In inferential statistics, data are analysed from a sample to make inferences in the larger collection of the population. The by purpose is to answer or test the hypotheses. A hypothesis (plural hypotheses) is a proposed explanation for a phenomenon. Hypothesis tests are thus procedures for making rational decisions about the reality of observed effects. In inferential statistics, the term 'null hypothesis' (H_0) denotes that there is no relationship (difference) between the population variables in question. Alternative hypothesis (H_1) denotes that a statement

between the variables is expected to be true. The p value (or the calculated probability) is the probability of the event occurring by chance if the null hypothesis is true. The p value is a numerical value between 0 and 1 and is interpreted by researchers in deciding whether to reject or retain the null hypothesis. If p value is less than the arbitrarily chosen value (known as the significance level), the null hypothesis (H_0) is rejected.

1.2.4 STATISTICAL SURVEY

A survey is an investigation about the characteristics of a given population by means of collecting data from a sample of that population and estimating their characteristics through the systematic use of statistical methodology. When conducting a statistical survey, there are Stages Of Statistical Survey, that are to be followed in sequential order. Unless we follow these steps systematically, we may not be able to achieve good results from the survey. Some important steps concerning a statistical survey:

- Defining the problem and determining the objective
- Preliminaries to the collection of data.
- Collection and Editing of data.
- Classification and Tabulation of data.
- Analysis and Interpretation of data.
- Writing the report.

1.3 ABOUT COVID-19

COVID-19 (coronavirus disease 2019) is a disease caused by a virus named SARS-CoV-2 and was discovered in December 2019 in Wuhan, China. It is very contagious and has quickly spread around the world. COVID-19 most often causes respiratory symptoms that can feel much like a cold, a flu, or pneumonia. COVID-19 may attack more than your lungs and respiratory system. Other parts of your body may also be affected by the disease.

- Most people with COVID-19 have mild symptoms, but some people become severely ill.
- Some people including those with minor or no symptoms may suffer from post-COVID conditions or “long COVID”.
- Older adults and people who have certain underlying medical conditions are at increased risk of severe illness from COVID-19.
- Hundreds of thousands of people have died from COVID-19 in the United States.
- Vaccines against COVID-19 are safe and effective. Vaccines teach our immune system to fight the virus that causes COVID-19.

The first SARS-CoV-2 positive case in India was reported in the state of Kerala on January 30th, 2020. On 11 March, the World Health Organization (WHO) declared COVID-19 a global pandemic. Covid-19 pandemic-impacted education will be different mainly in the mode of teaching and evaluation. Nationally there was a call for a de facto switch to virtual teaching, learning and evaluation, pushing a huge number of teachers into an unfamiliar mode. Hailed as a more effective, quick and less expensive mode, online teaching/learning is being given precedence over the campus mode as the new normal. Online teaching and evaluation, pushed as a new normal under the pretext of the pandemic crisis, upset objectives of access, equity and excellence in the higher education sector. About 30 per cent of students at home under lockdown were not able to access online lessons due to lack of internet connectivity. Virtual teaching is not a substitute for the Real that has all the exclusive advantages of being real. The Covid-induced virtual mode will bring about several transformations in the concept of higher education institutions, their clients and practices.

1.4 OBJECTIVES

- To find and to interpret if there exist any relation between gender and various factors.
- To find and to interpret if there is any relation between age groups and various factors.

- To examine whether the government implemented schemes or the scholarships provided by other organisations are reaching the deserved ones.

1.5 LITERATURE REVIEW

1) JMIR Publications:- Journal of Medical Internet Research

It is a small but rapidly growing publisher of peer-reviewed journals with an emphasis on medicine, health, and technology titles, is seeking an enthusiastic, self-motivated team members. A group of students from the department of pharmacology, Rajiv Gandhi University of health Sciences, Bangalore conducted a research on the topic 'Impact of covid 19 on mental health of college students in India'. Authors :

- Amar Prasad Chaudhary
- Narayan Sah Sonar
- Jamuna TR
- Moumita Banerjee
- Sheilesh Yadav

The research work was published on 23rd February 2021. Their objective was to investigate symptoms of fear, depression and anxiety due to covid 19 on students of India. For this study, students of Mallige college of Pharmacy in Bangalore, India were selected with access to the internet and Social media. The questionnaire was designed using Google forms and was distributed to the students through the various social media platforms like Whatsapp, Facebook, Messenger, Telegram, etc. All the data were recorded in Microsoft Excel .They received a total of 324 students out of which 180 were males and 144 were females. From the research work they concluded that a very high fear of covid 19 among students along with anxiety and depression symptoms.

2) NCBI :- National centre for Biotechnology Information It's a branch of national Institutes of health. It is approved and funded by the govt of USA. The research was carried out by Wenjun Cao, Ziwei Fang, Guoqiang Hou Mei Han, Xinrong Xu, Jiaxin Dong, and Jianzhong Zheng.

The research was based on ‘the psychological impacts of covid 19 epidemic on college students in China’. The targeted population was the UG students from Changzhi medical college. The respondents in the target population were sampled by cluster sampling. They received a total of respondents. Data were analysed with SPSS Version 22.0. A univariate analysis (Nonparametric test) was used to explore the significant associations between sample characteristics and the anxiety level during the COVID-19 epidemic and multivariate logistic regression analysis suggested that living in urban areas in contrast to reducing the anxiety of college students.

3) Indian express article:- The survey was carried out by ASER. ASER (Annual Status of Education Report) is a social welfare centre in Delhi established in 2008 as an autonomous assessment survey. The survey shows an increase in dependence on private tuitions and an absence of ready access to smartphones. They suggested that special attention is needed to help make up learning losses especially in the lower classes.

1.6 SIGNIFICANCE OF STUDY

The rapid and unplanned change to teaching and learning in the online format brought by COVID-19 has likely impacted many students. One of the limitations of emergency remote learning is the lack of personal interaction between teacher and student. Mental health issues are the leading impediment to academic success. Mental illness can affect students’ motivation, concentration, and social interactions—crucial factors for students to succeed in higher education. So the purpose of this study is to examine how the various factors (psychological, physical health, academics)during the pandemic has affected students well-being and what role the government and other organisations plays in this context.

1.7 LIMITATIONS OF STUDY

Even though the study yielded major findings, there were a few limitations in our survey. The survey has been restricted to students between the age group 13-24. Students from other age groups were not taken into consideration. As the sample size increases the margin of error decreases. But due to time and other restrictions, the survey was limited to only 470 participants. Only qualitative data has been used in the study. Since the responses received were the personal choices of the respondents there is a chance that the data may or may not be biased.

Chapter 2

METHODOLOGY

2.1 METHODS

The target population for the survey was the population of students from age 13-17 and 18-24. Google form was circulated among the students between age group 13-24, to conduct the survey. The questionnaire consisting of 25 questions including age, gender, educational institution, type of school or college and place of residence was circulated. Out of 25 questions, 23 questions were marked important. The questionnaire included questions regarding psychological, financial, academic and health issues faced by the students.

2.2 CHI-SQUARE TEST

The Chi-Square Test is an important test among the several tests of significance. It was developed by Karl Pearson in 1990. In general, the test that is used to measure the difference between what is observed and what is expected according to an assumed hypothesis is called Chi-Square Test. Simply we can say that Chi-Square Test is a relationship between two variables. H_0 that is the null hypothesis represents that there is no relation between two variables. H_1 that is the alternative hypothesis indicates that there exist a significant relation between two variables. The significant level is the probability of rejecting the null hypothesis, when it is true. In most of the cases, we use significant level as 0.05. First we create the table of observed frequency from obtained

data. Then expected frequency values are calculated using the following equation:-

$$(\text{Row total} \times \text{column total}) \div \text{Grand total}$$

Then, we create the table of expected frequency, we can calculate the Chi-square value using the equation:-

$$\frac{(\text{Observed value} - \text{Expected value})^2}{\text{Expected value}^2} = \frac{(O_i - E_i)^2}{E_i} \quad (2.1)$$

$$\text{Chi-Square} = \frac{(O_i - E_i)^2}{E_i} \quad (2.2)$$

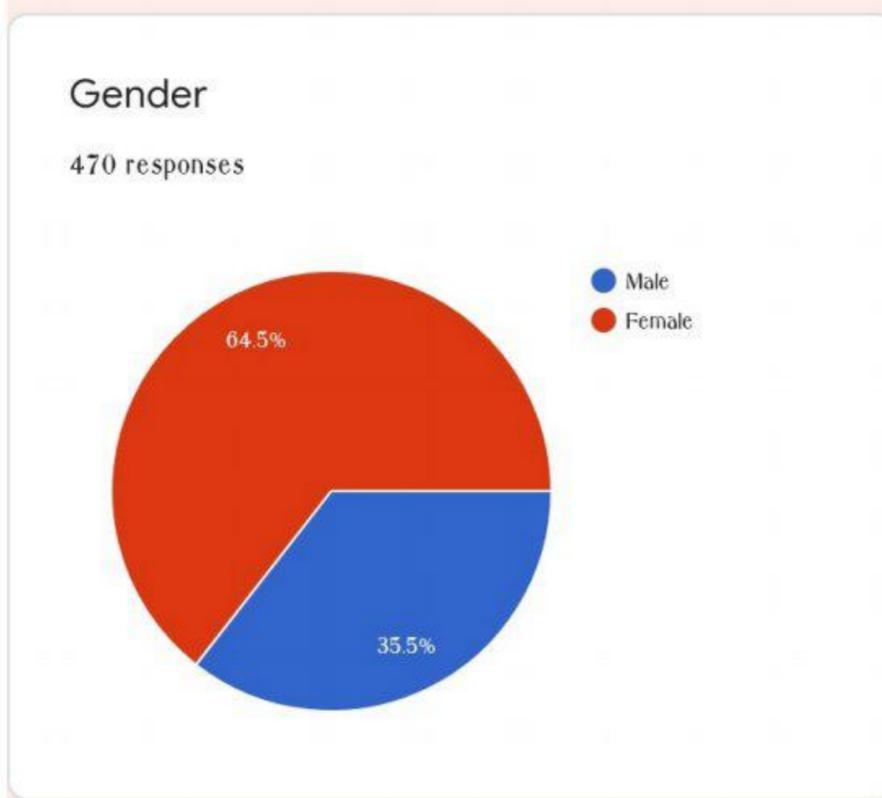
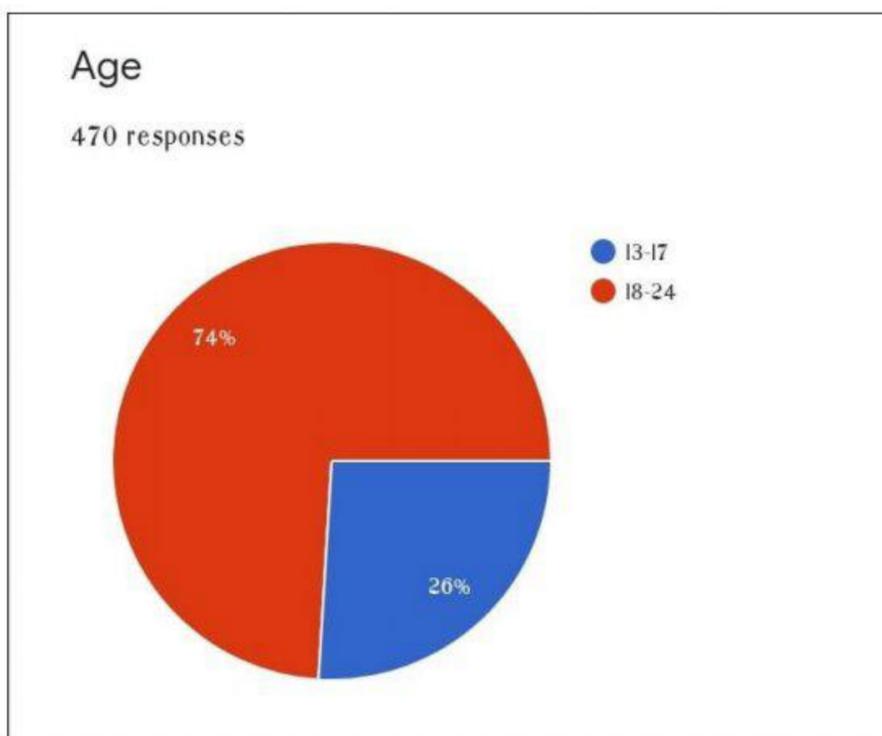
Tabular Chi-Square value can be obtained by using degrees of freedom and significance level.

$$\text{Degrees of freedom} = (\text{column} - 1) \times (\text{rows} - 1)$$

Degrees of freedom refers to the maximum number of logically independent values, which are values that have the freedom to vary, in the data sample. If calculated Chi-Square is greater than tabular Chi-Square, then we reject null hypothesis and accept alternate hypothesis. A p value is a measure of the probability that an observed difference could have occurred just by random chance. The lower the p value the greater the statistical significance of the observed difference. In MS excel, we calculate the p value. Then we compare the p value with significance level. If p value is greater than the significance level, we accept H_0 . Hence we can say that there is no relation between two variables.

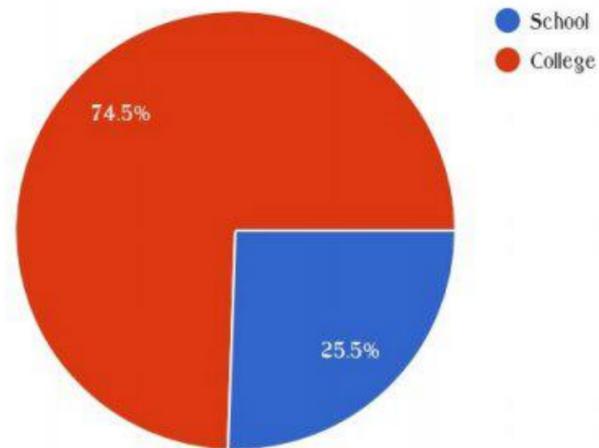
Chapter 3

PRESENTATION OF DATA



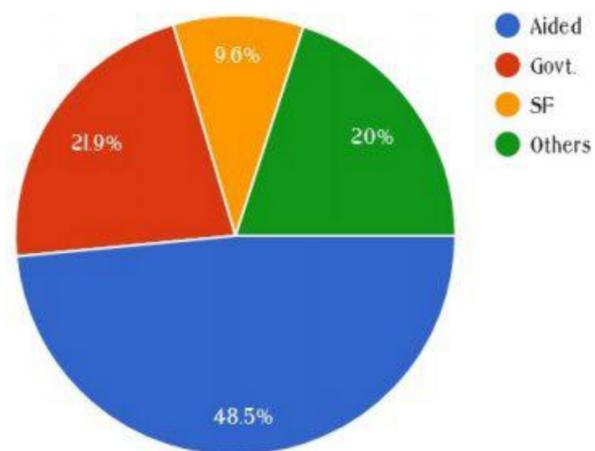
Educational Institution

470 responses



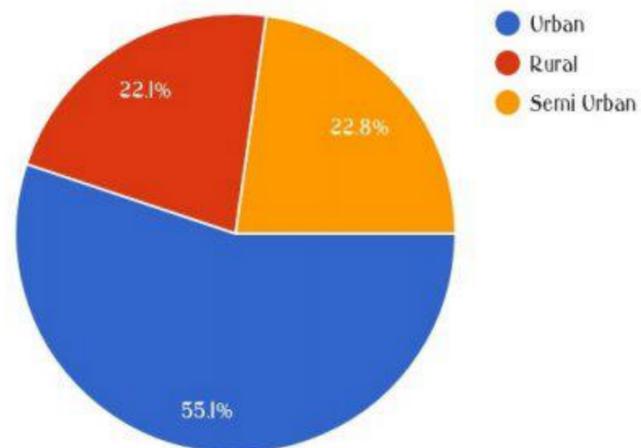
Type of School/College

470 responses



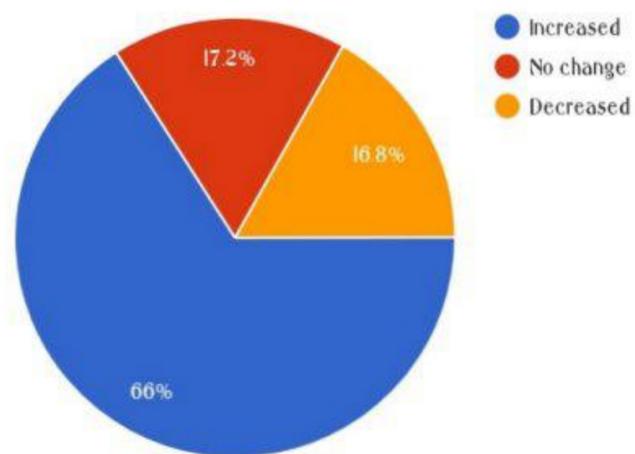
Place

470 responses



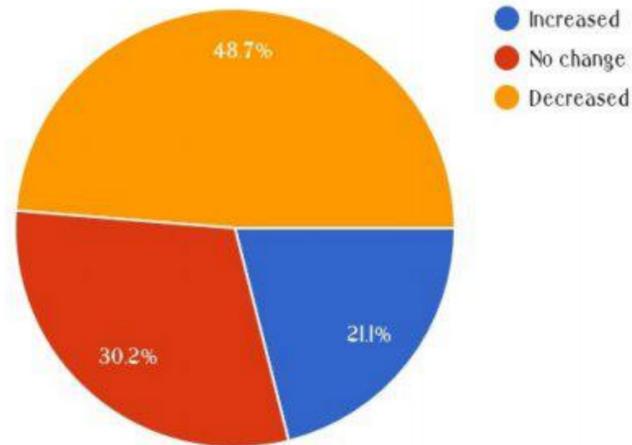
1) How do you view the condition of social isolation during this pandemic period?

470 responses



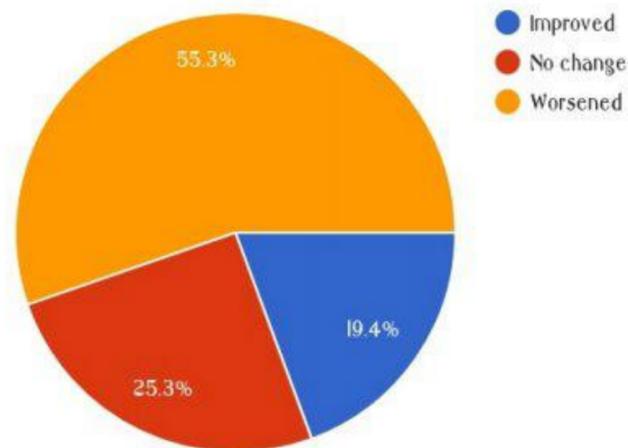
2) Do you think your communication skills has changed since the pandemic?

470 responses



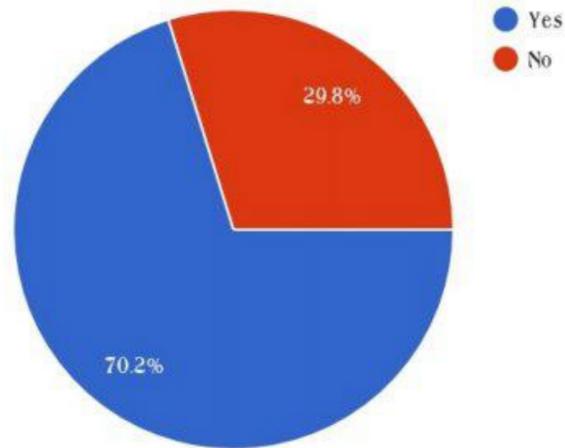
3) How do you think covid 19 has changed your state of mind?

470 responses



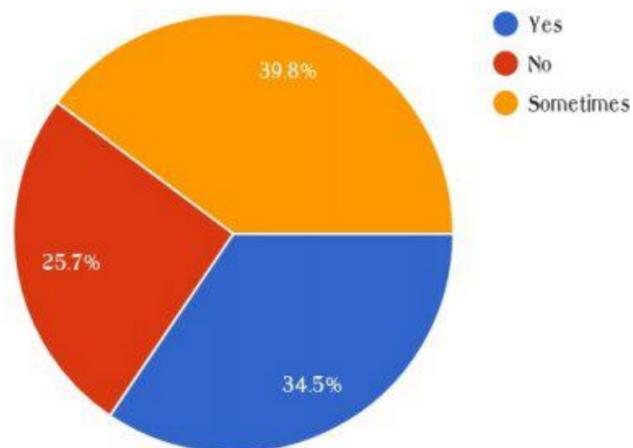
4) Do you feel online class is a hindrance for socialization?

470 responses



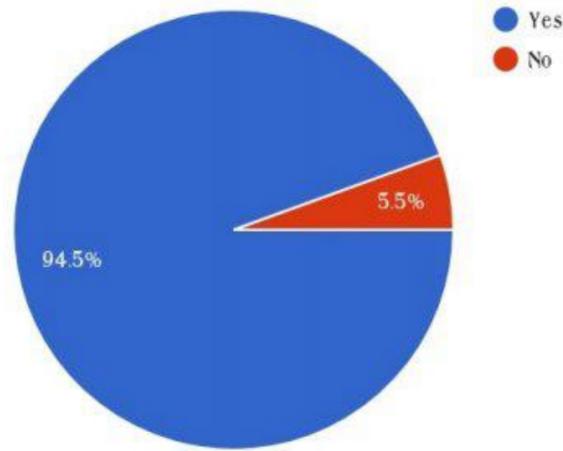
5) Do you participate in online competition, webinars etc.?

470 responses



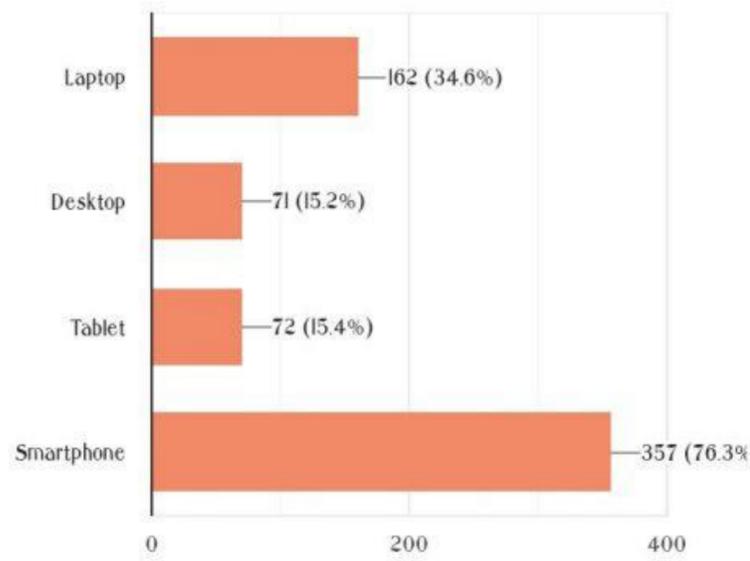
6) Do you have access to a device for online learning?

470 responses

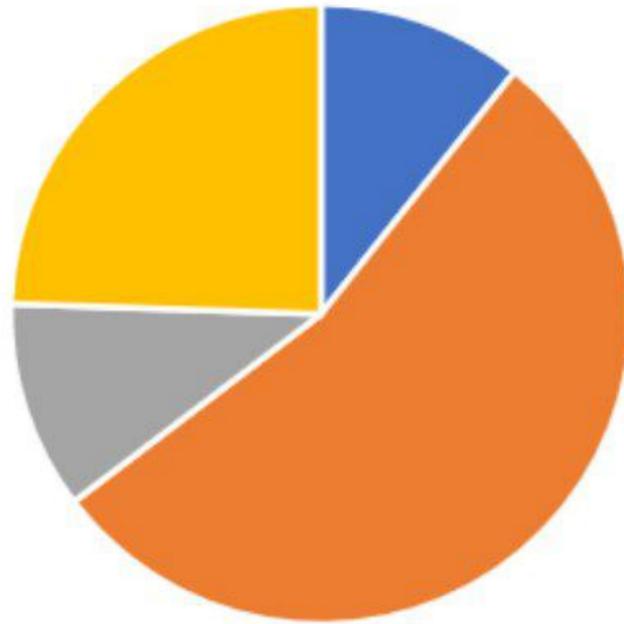


7) Which device do you use for online learning?

468 responses



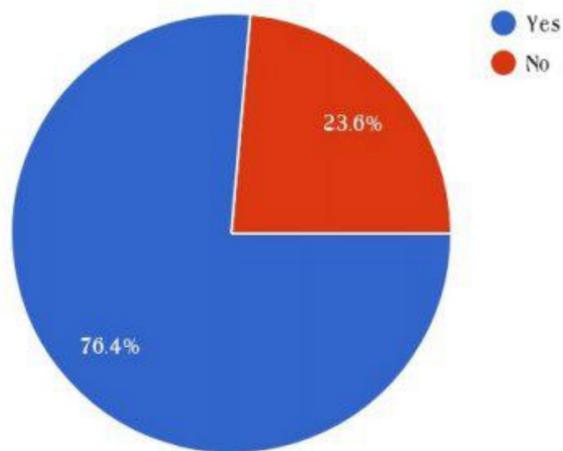
Device used for online learning



■ desktop ■ smartphone ■ tablet ■ laptop

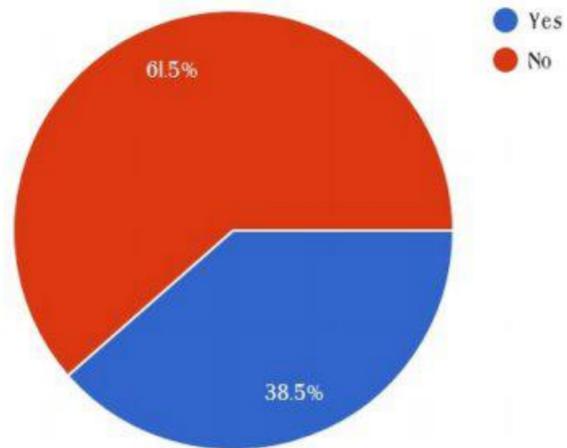
8) Do you experience any network issues during online sessions?

470 responses



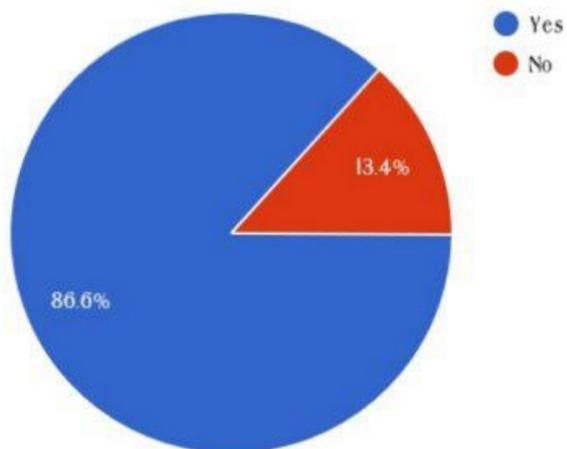
9) Did the online course meet your expectations in terms of quality learning?

470 responses



10) Do you feel that students having practical / lab works are more affected by online class?

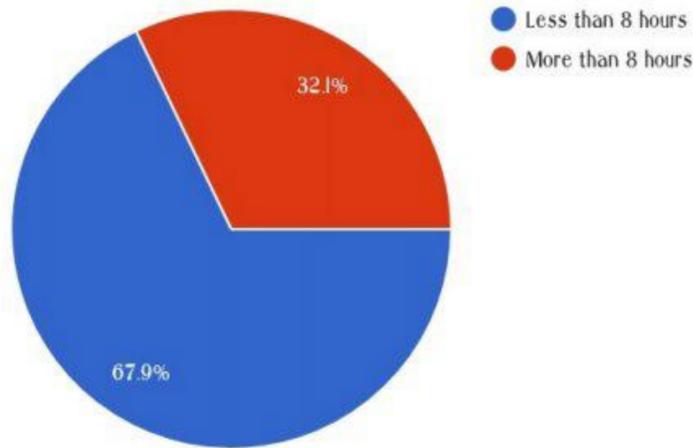
470 responses



11) How many hours of sleep do you get a night?

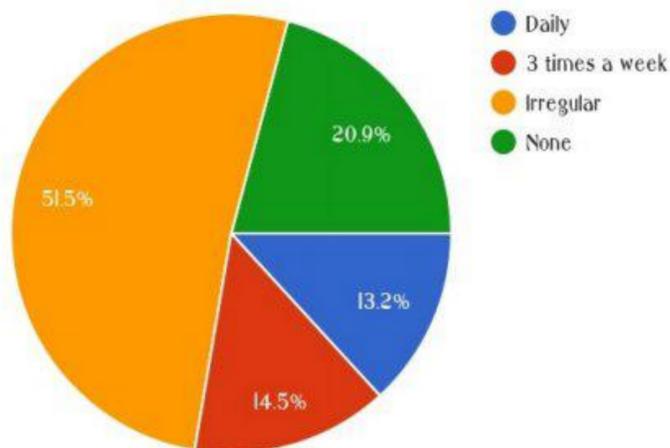


470 responses



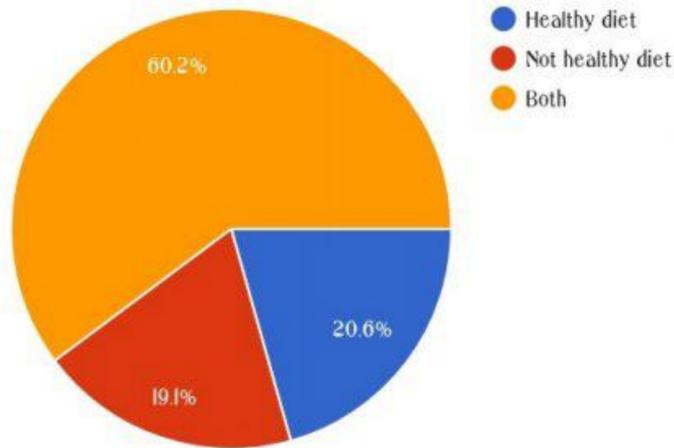
12) How much intentional exercise do you get a week?

470 responses



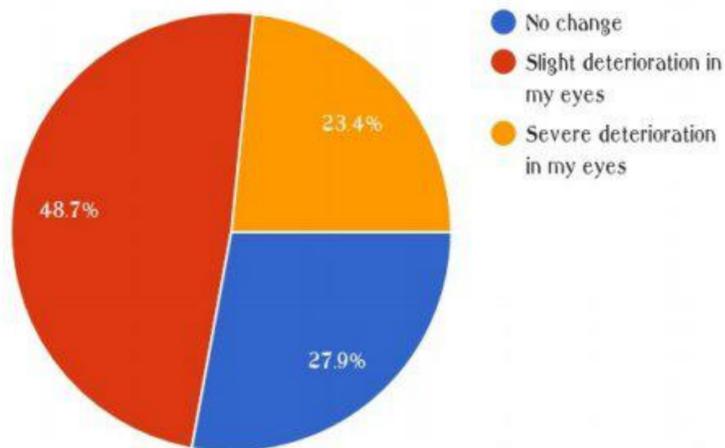
13) What are your eating habits like?

470 responses



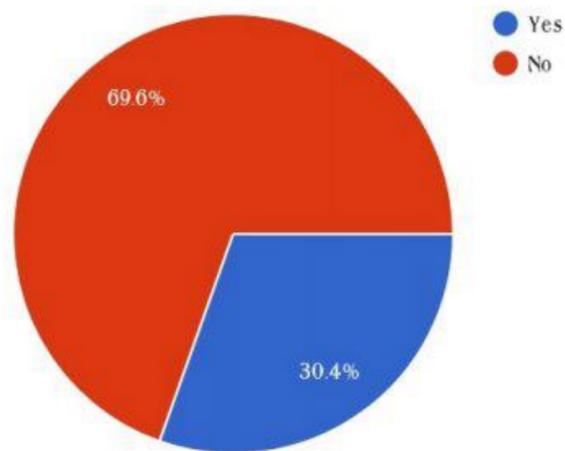
14) In what way did watching the lessons on your computer/tablet/smartphone affect your eye health during the pandemic?

470 responses



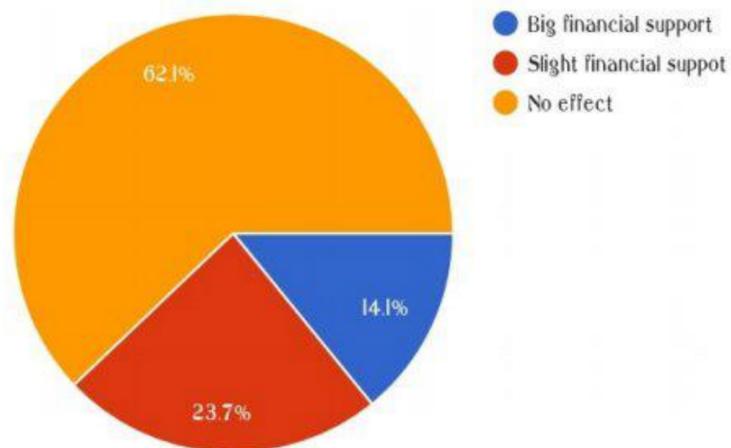
15) Do you get any scholarship?

470 responses



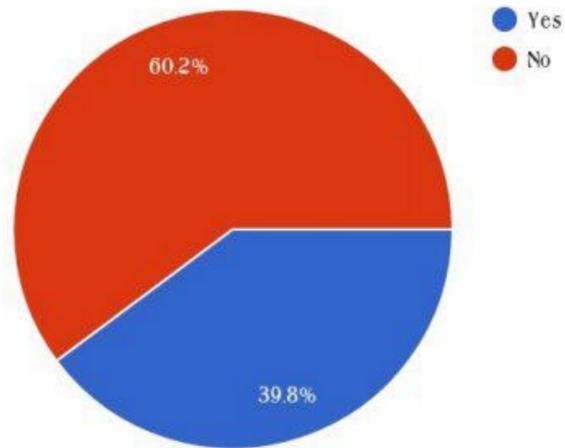
16) How much have scholarships influenced you during this corona era?

396 responses



17) Have you had to pay exorbitant fees since corona arrived?

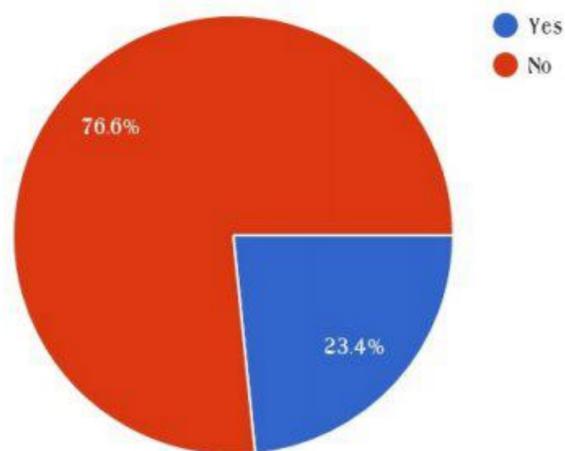
470 responses



18) Has corona time helped you financially(via online opportunities)

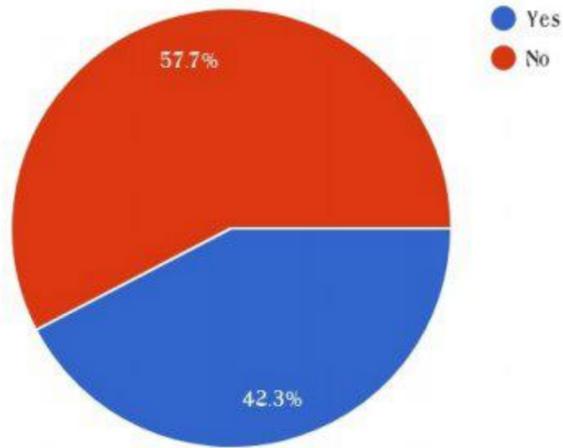


470 responses



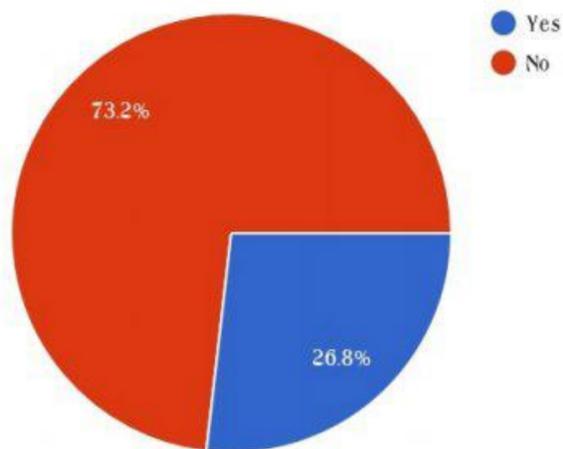
19) Do you welcome the continuation of online classes till the present pandemic situation become totally under control?

470 responses



20) Do you really enjoy online learning?

470 responses



3.1 DATA ANALYSIS

1. SOCIAL ISOLATION-GENDER:

Q) How do you view the condition of social isolation during this pandemic period?

- a) Increased
- b) No change
- c) Decreased

Observed Frequency

Gender	Increased	Decreased	No change	Total
Male	110	24	33	167
Female	199	53	51	303
Total	309	77	84	470

H_0 : There is no relationship between gender and social isolation.

H_1 : There is a relationship between Gender and social isolation.

Critical value: 0.05

Expected frequency

Gender	Increase	Decrease	No change	Total
Male	109.793617	27.35957447	29.84680851	167
Female	199.206383	49.64042553	54.15319149	303
Total	309	77	84	470

$$EF = CT * RT / GT$$

p value 0.560674794

Since p value is greater than 0.05 we will accept the null hypothesis. Hence, we can conclude that there exists no relation between social isolation and gender.

2. ENJOYMENT OF ONLINE LEARNING-GENDER:-

Q) Do you really enjoy online learning?

a) Yes

b) No

Observed frequency

Gender	Yes	No	Total
Male	53	114	167
Female	25	278	303
Total	78	392	470

H_0 : There is no relationship between gender and enjoyment of online learning

H_1 : There is a relationship between Gender and enjoyment of online learning.

Critical value: 0.05

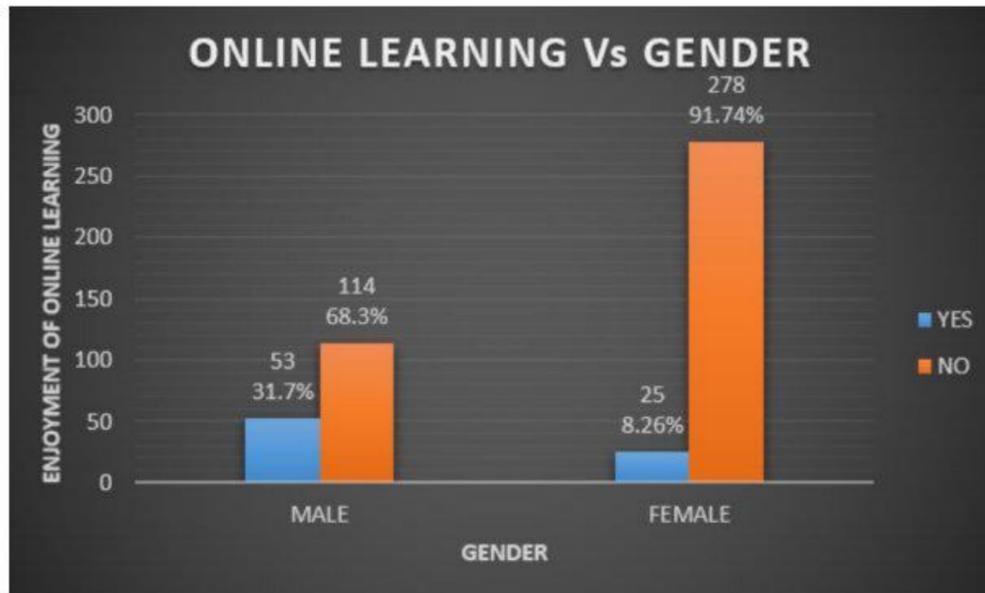
Expected frequency

Gender	Yes	No	Total
Male	27.71489362	139.2851064	167
Female	50.28510628	252.7148936	303
Total	78	392	470

$$EF = CT * RT / GT$$

$$p \text{ value } 5.75348 * 10^{-11}$$

Since p value is less than 0.05 we reject the null hypothesis. Hence, we can conclude that there exists a significant relation between enjoyment of online learning and gender.



3. QUALITY LEARNING-AGE GROUP:-

Q) Did the online course meet your expectations in terms of quality learning?

- a) Yes
- b) No

Observed frequency

Age group	Yes	No	Total
13-17	80	42	122
18-24	100	248	348
Total	180	290	470

H_0 : There is no relationship between quality learning and age group.

H_1 : There is a relationship between quality learning and age group.

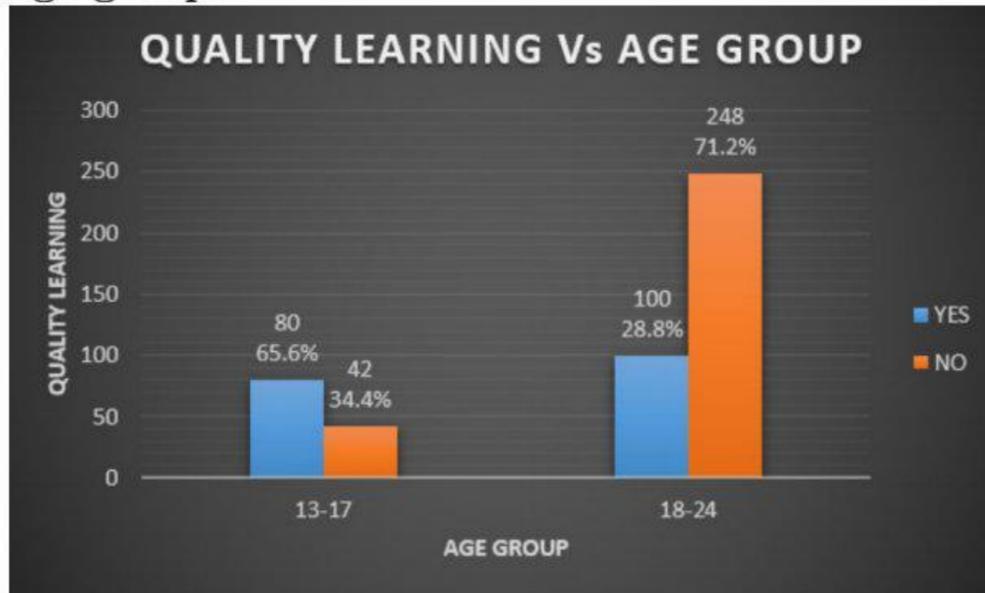
Expected frequency

Age group	Yes	No	Total
13-17	46.72340426	75.27659574	122
18-24	133.2765957	214.7234043	348
Total	180	290	470

$$EF = \frac{CT * RT}{GT}$$

p value $5.91356 * 10^{-13}$

As p value is less than 0.05 we reject the null hypothesis. Hence, we can conclude that there exists a relation between quality learning and age groups.



4. HOURS OF SLEEP AND GENDER:

Q) How many hours of sleep did you get a night?

a) Less than 8 hours

b) More than 8 hours

Observed frequency

Gender	Less than 8 hours	More than 8 hours	Total
Male	87	80	167
Female	232	71	303
Total	319	151	470

H_0 : There is no relationship between hours of sleep and gender.

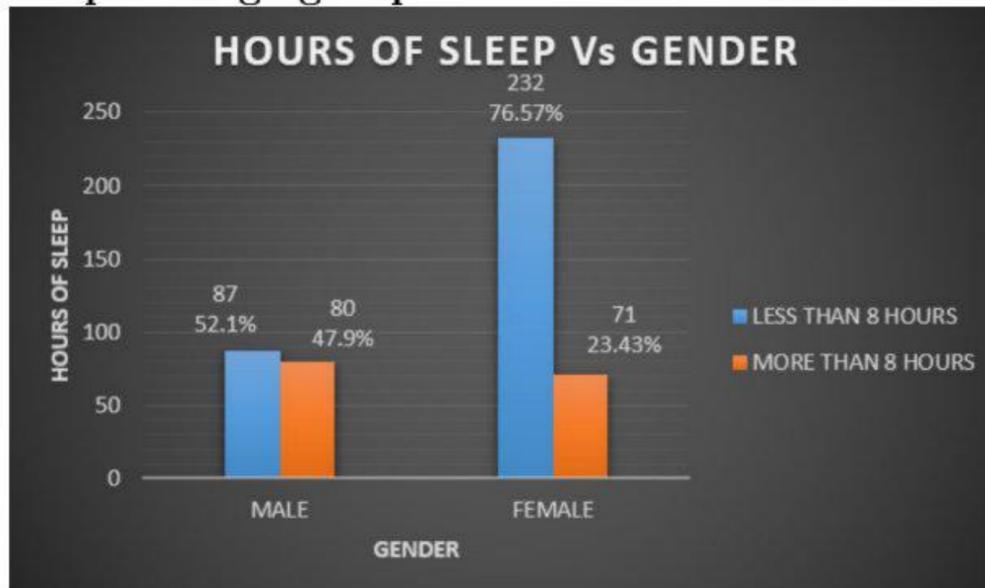
H_1 : There is a relationship between hours of sleep and gender.

Expected frequency

Gender	Less than 8 hours	More than 8 hours	Total
Male	113.3468085	53.65319149	167
Female	205.6531915	97.34680851	303
Total	319	151	470

p value 5.39872×10^{-8}

Since p value is less than 0.05 we will reject the null hypothesis. Hence, we can conclude that there exists a relation between hours of sleep and age groups.



5: EATING HABITS AND AGE GROUPS:

Q) What are your eating habits like?

- a) Healthy deit
- b) Not healthy diet
- c) Both

Observed frequency

Age group	Healthy	Not healthy	Both	Total
13-17	58	27	37	122
18-24	39	63	246	348
Total	97	90	283	470

H_0 : There is no relationship between age group and eating habits

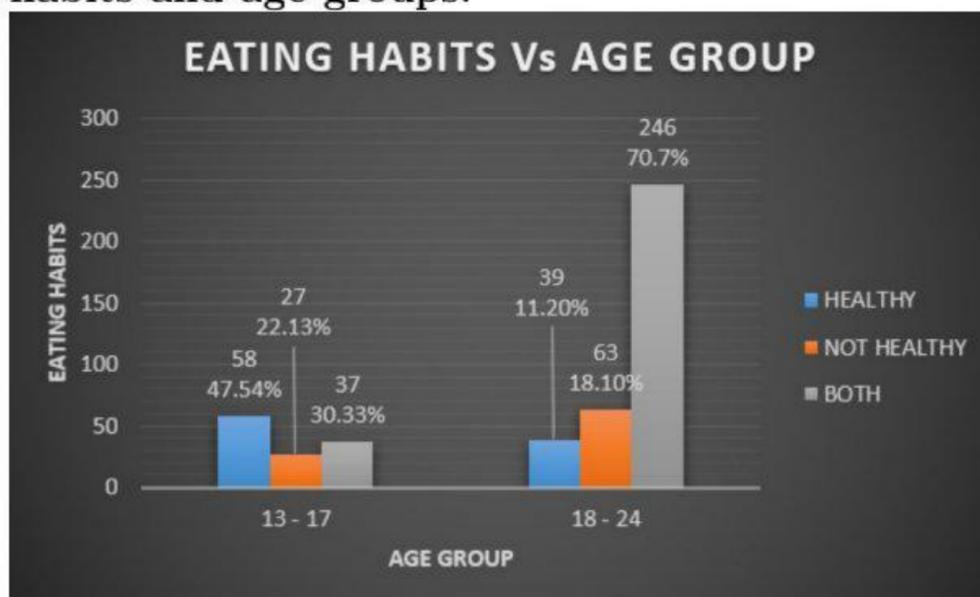
H_1 : There is a relationship between age group and eating habits.

Expected frequency

Age group	Healthy	Not healthy	Both	Total
13-17	25.1787234	23.36170213	73.45957447	122
18-24	71.8212766	66.63829787	209.5404255	348
Total	97	90	283	470

p value 9.53994×10^{-19}

Since p value is less than 0.05 we will reject the null hypothesis. Hence, we can conclude that there exists a relation between eating habits and age groups.



6: EYE HEALTH AND AGE GROUP:

Q) In what way did watching the lessons on your computer/table/smartphone effect your eye health during the pandemic?

a) No change

- b) Slight deterioration in my eyes
- c) Severe deterioration in my eyes

Observed frequency

Age group	No change	severe deterioration	Slight deterioration	Total
13-17	28	50	44	122
18-24	103	60	185	348
Total	131	110	229	479

H_0 : There is no relationship between eye health and age group.

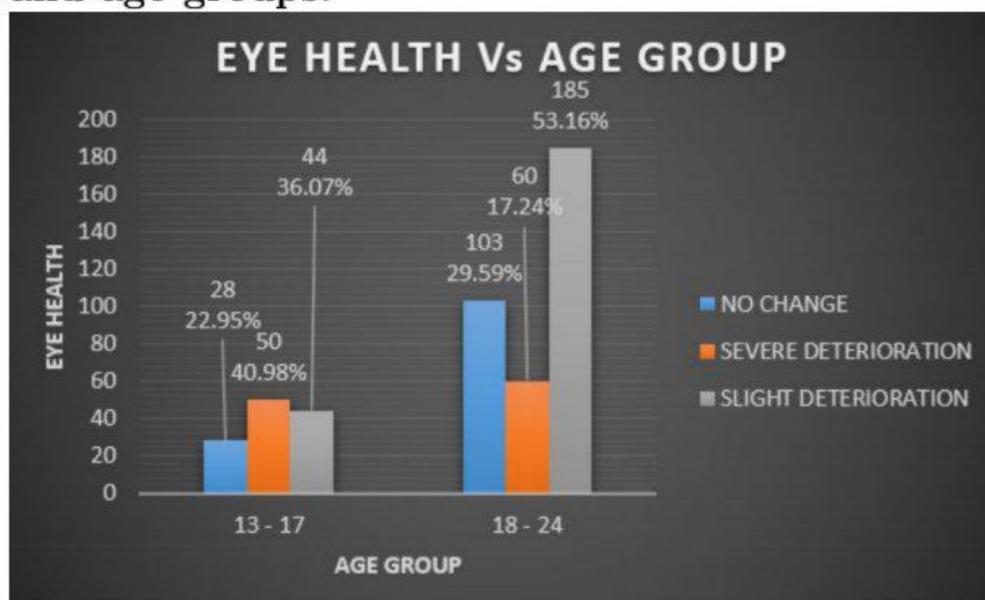
H_1 : There is a relationship between eye health and age group.

Expected frequency

Age group	No change	Severe deterioration	slight deterioration	Total
13-17	34.00425532	28.55319149	59.44255319	122
18-24	96.99574468	81.44680851	169.5574468	348
Total	131	110	229	470

p value 6.1397×10^{-7}

Since p value is less than 0.05 we will reject the null hypothesis. Hence, we can conclude that there exists a relation between eye health and age groups.



Chapter 4

RESULT AND CONCLUSION

4.1 RESULT

1. After carefully analyzing the data, we were able to find out that among 167 males out of 470 responses, 31.7% enjoy online learning and among 303 females, 8.26% enjoy online learning.
2. While examining the collected data, we can deduce that majority of students between 13-17 follows a healthy diet whereas considering the age group 18-24, majority of students prefer both healthy and unhealthy diet.
3. From the obtained data, among 122 students between 13-17, 40.98% face severe deterioration in their eyesight and 53.16% of 348 students between age group 18-24 face slight deterioration in their eye sight.

4.2 CONCLUSIONS

From our questionnaire, we were able to find out that at least there are some students who are benefited from the scholarships provided by the various organisations.

From the responses, we identified that the majority of students between the age group of 13-17 faced deterioration in their eye sight due to increased and continuous usage of electronic devices.

We also identified that the majority of students between the age group of 18-24 faced deterioration in their eye sight due to the same reason stated above.

From the responses, we can conclude that a majority of females reported an increase in social isolation and they tend to get lesser amount of sleep.

Similarly a major part of males reported an increase in isolation and tend to get lesser amount of sleep.

From our study, we were able to figure out that students between the age group of 13-17 tend to eat healthy food and spend a lesser amount of time to exercise. Since their diet is healthy, exercise does not become a necessity for them.

When we consider the case of students between the age group 18-24, we can see that they prefer a combination of both healthy and unhealthy diet and they prefer little to no exercise.

Hence we can conclude that a relation exist between age group and lifestyle.

4.3 SUGGESTIONS

- 1. Joining peer groups /support groups is a great way to increase communication among students. They provide an opportunity and support for development of an individual's soft skills which might have decreased since online mode of education started.**
- 2. Conversation with family and loved ones can be of great help in dealing with stress, anxiety and depression. Students can try and talk to his/her friends, parents, teachers etc about what's worrying them.**
- 3. Opening up about one's problems and worries to someone who cares can help him/her to deal with it more efficiently.**
- 4. Regular exercise can be beneficial for students whose lifestyles might have changed due to the sudden emergence of covid-19 and online mode of education.**
- 5. Maintain a proper diet and sleeping pattern is important for a healthier lifestyle.**
- 6. Good study habits like consistent timing, maintaining a proper schedule etc can be very helpful for a student to adjust to his/her new ways of learning.**
- 7. Connecting with classmates can be beneficial for both curricular and social aspects of one's life.**

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<https://www.idfcinstitute.org/knowledge/publications/working-and-briefing-papers/covid-19-pandemic-in-kerala/>

ANNEXURE

Questions 1-4 indicates the psychological factors that influence students.

Questions 5-10 is regarding how covid has affected the academics of the students.

Questions 11-14 is all about the fitness and lifestyle.

Questions 15-17 is about governments role in helping students.

Questions 18-20 is regarding the financial factors that affect students.

The image shows a Google Forms interface for a questionnaire. At the top, there are tabs for 'Questions', 'Responses' (with a count of 470), and 'Settings'. The form is divided into two sections. Section 1 of 2 is titled 'EFFECTS OF COVID-19 ON VARIOUS FACTORS ON STUDENTS' and includes a description: 'This survey is being conducted in order to study how covid-19 has affected students of different age groups. The data collected will be used only for educational purposes.' Below the description are four required questions: 'Email *' (with a 'Valid email' hint), 'Educational Institution *' (with options 'School' and 'College'), 'Type of School/College *' (with options 'Aided', 'Govt.', 'SF', and 'Others'), and '1) How do you view the condition of social isolation during this pandemic period? *' (with options 'Increased', 'No change', and 'Decreased'). Section 2 of 2 is titled 'Questionnaire' and includes a 'Description (optional)' field. The form is styled with a light orange and white color scheme.

2) Do you think your communication skills has changed since the pandemic? *

- Increased
- No change
- Decreased

3) How do you think covid 19 has changed your state of mind? *

- Improved
- No change
- Worsened

6) Do you have access to a device for online learning? *

- Yes
- No

7) Which device do you use for online learning?

- Laptop
- Desktop
- Tablet
- Smartphone

4) Do you feel online class is a hindrance for socialization? *

- Yes
- No

5) Do you participate in online competition, webinars etc.? *

- Yes
- No
- Sometimes

8) Do you experience any network issues during online sessions? *

- Yes
- No

9) Did the online course meet your expectations in terms of quality learning? *

- Yes
- No

10) Do you feel that students having practical *
/ lab works are more affected by online
class?

- Yes
- No

12) How much intentional exercise do you get *
a week?

- Daily
- 3 times a week
- Irregular
- None

11) How many hours of sleep do you get a *
night?

- Less than 8 hours
- More than 8 hours

13) What are your eating habits like? *

- Healthy diet
- Not healthy diet
- Both

14) In what way did watching the lessons on *
your computer/tablet/smartphone affect
your eye health during the pandemic?

- No change
- Slight deterioration in my eyes
- Severe deterioration in my eyes

16) How much have scholarships influenced you during
this corona era?

- Big financial support
- Slight financial support
- No effect

15) Do you get any scholarship? *

- Yes
- No

17) Have you had to pay exorbitant fees since *
corona arrived?

- Yes
- No

18) Has corona time helped you financially(via online opportunities)

Yes

No

19) Do you welcome the continuation of online classes till the present pandemic situation become totally under control?

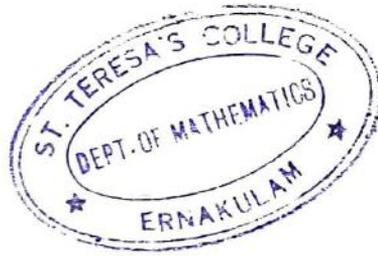
Yes

No

20) Do you really enjoy online learning?

Yes

No



**A study on
THE ROLE OF PANDEMIC ON USAGE OF OTT PLATFORMS WITH SPECIAL
REFERENCE TO COCHIN CITY**

Project Report

Submitted by

ALEENA JOSE: (SB19ACOM001)

ANIT K. CYRIAC: (SB19ACOM005)

ELNA DORIS: (SB19ACOM020)

Under the guidance of

Ms. LIYA XAVIER

**In partial fulfillment of the requirement for the Degree of
BACHELOR OF COMMERCE**



ST. TERESA'S COLLEGE ESTD 1925

ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

COLLEGE WITH POTENTIAL FOR EXCELLENCE

Nationally Re-Accredited with A++ Grade

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Kottayam-686560

March-2022

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COLLEGE WITH POTENTIAL FOR EXCELLENCE

Nationally Re-Accredited with A++ Grade



CERTIFICATE

This is to certify that the project titled "A STUDY ON THE ROLE OF PANDEMIC ON USAGE OF OTT PLATFORMS WITH SPECIAL REFERENCE TO COCHIN CITY" submitted to Mahatma Gandhi University in partial fulfillment of the requirement for the award of Degree of Bachelor in Commerce is a record of the original work done by Ms. ANIT K. CYRIAC, Ms. ALEENA JOSE, Ms. ELNA DORIS under my supervision and guidance during the academic year 2021-22.

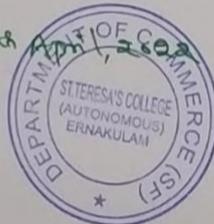
Project Guide

Ms. Liya Xavier

Assistant Professor

Department of Commerce (SF)

Viva Voce Examination held on 28th April 2022



Smt. Jini Justin D'Costa

(Head of the Department)

Department of Commerce (SF)

Dr. Joseph George
External Examiner(s)

DECLARATION

We, ALEENA JOSE, ANIT K. CYRIAC and ELNA DORIS, final year B.Com students, Department of Commerce (SF), St. Teresa's College (Autonomous) do hereby declare that the project report entitled A STUDY ON THE ROLE OF PANDEMIC ON USAGE OF OTT PLATFORMS WITH SPECIAL REFERENCE TO COCHIN CITY submitted to Mahatma Gandhi University is a bonafide record of the work done under the supervision and guidance of Ms. Liya Xavier, Assistant Professor of Department of Commerce (SF), St. Teresa's College (Autonomous) and this work has not previously formed the basis for the award of any academic qualification, fellowship, or other similar title of any other university or board.

PLACE: ERNAKULAM

ALEENA JOSE

DATE:

ANIT K. CYRIAC

ELNA DORIS

Acknowledgement

First of all, we are grateful to God Almighty for his blessings showered upon us for the successful completion of our project.

It is our privilege to place a word of gratitude to all persons who have helped us in the successful completion of the project.

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We will remain always indebted to our family and friends who helped us in the completion of this project.

Last but not the least; we would like to thank the respondents of our questionnaire who gave their precious time from work to answer our questions.

ALEENA JOSE

ANIT K. CYRIAC

ELNA DORIS

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CHAPTER I
INTRODUCTION

1.1 INTRODUCTION

Over-the-top (OTT) media service is a streaming media service offered directly to viewers via the internet. OTT bypasses cable, broadcast, and satellite television platforms, the companies that traditionally act as a controller or distributor of such content. It has also been used to describe no-carrier cellphones, where all communications are charged as data or apps for phones that transmit data in this manner, including both those that replace other call methods and those that update software. The OTT initially started as the content hosting platforms, but soon dived into making originals of their own. You need an internet connection and a compatible hardware component, which can be your mobile phones, tablets, laptops, or smart TVs, to watch the content. One can stream OTT content any time via these platforms instead of following a guide or waiting for their favourite shows and movies to air. This among the many reasons why OTT platforms are gaining popularity. OTT could also refer to the subscription model whereby the platform (i.e., Netflix) charges the fees on top of what you'd have to pay to your ISP or cable provider or allows you to avoid the fees of the operator (i.e., WhatsApp is a great example here, giving its subscribers the convenience of "free" "SMS" service using their internet connection. This definition would make WhatsApp an OTT platform).

While OTT is commonly used to denote video content, many audio services fit this definition just as well. Spotify is to music what Netflix is to TV - offering a massive trove of music via the internet connection. OTT also enables access to live streaming. These work much like channels in regular TV, but the content is streamed using the Internet connection to the audience's OTT devices / set-top boxes. The first dependent Indian OTT platform was BIGFlix, launched by Reliance Entertainment in 2008. In 2010 Digivive launched India's first OTT mobile app called nexGTV, which provides access to both live TV and on-demand content. There are currently about 40 providers of OTT in India, which distribute streaming

media over the internet. In fiscal year 2018, the OTT market in India was worth Rs. 2,150 crore. The streaming marketing in India is predicted to be worth \$15 billion by 2030, with \$12.5 billion coming from the video market and \$2.5 billion from audio. The OTT market in fiscal year 2020 was estimated to be worth \$1.7 billion.

OTT Platform in recent years has empowered customers by providing them with a variety of choices for their entertainment needs. Users are no longer tied down to traditional mediums such as satellite cable. Surfing through channels are now a thing of the past, and one can now make informed decisions about what to watch. Since the outbreak of COVID-19 and consequent national lockdown in March 2020, India witnessed a significant growth in the usage of OTT and emerged as a threat to the Television industry. Until then, the popularity of OTT platforms were limited to urban area and above middle class. Today, television is increasingly delivered over the internet and new media companies are joining the race towards market dominance. Netflix has been around for so long you might think its market position is unflinching. But it's still not too late for new players to try to establish their market presence. The successes of Disney+ launched only last year but managed to exceed 28 million subscribers already.

1.2 SIGNIFICANCE OF THE STUDY

The project brings to the fore the role of pandemic on the usage of OTT platforms as it has led to reshaping consumer content preferences. The entertainment industry was massively hit in the first lockdown as all the ongoing production projects - new shows and films - came to a halt leading to a fresh content deficit on the television as well as theatres. The theatres were shut and television channels were playing reruns of the old shows. It forced consumers to look for alternate choices of entertainment and they started sampling the existing OTT platforms. These platforms had a huge library of movie and original show in multiple languages that promised to entertain the consumers. The shift from conventional media to OTT media, particularly in the lockdown period due to the COVID-19, has resulted in the war between streaming service providers to attract and retain customers. The findings of this study show that lockdown has played a major role in the increase in viewership of OTT platforms.

1.3 OBJECTIVES OF THE STUDY

- To find out the consumer consumption trends pertaining to the usage of OTT platforms.
- To understand the nature of content being consumed and timings for different genres of consumption, consumer age and commensurate content consumption.
- To analyse the innovative deals and discount packaging of OTT platforms since pandemic.
- To examine the factors influencing consumers' choice of OTT platforms over DTH.

1.4 SCOPE OF THE STUDY

The study is to track out the consumers/ preferences, priorities and their awareness toward different OTT platforms. The study is limited only to the consumers residing in Kerala. The OTT platforms were limited to cities. However, now it is available in every nook and corner of even villages, during this pandemic period. Data for the study is collected from a sample of 120 respondents using stratified sampling. The 120 respondents best represent the entire population to be studied.

1.5 STATEMENT OF PROBLEM

The entertainment industry was massively hit in the first lockdown as all the ongoing production projects – new shows and films – came to a halt leading to a fresh content deficit on the television as well as theatres. Affordable subscription fees, easier access to the internet and the increased time spent at home proved to be a boon to the OTT industry as binge-watching became the new trend. Several published reports have suggested that the time spent on OTT increased to nearly 2-3 hours during the Covid times. By conducting this study we will be able to analyse the increase in consumption of OTT platforms during the pandemic and the evolution of OTT platforms in India.

1.6 RESEARCH METHODOLOGY

1.6.1 Research design: The present study is descriptive, quantitative and analytical in nature. It is descriptive in the sense that it tries to identify various characteristics of research problem. It is quantitative because it involved numerical expression. And it is analytical since it examines, analyses and interprets collected data in order to arrive at conclusion.

1.6.2 Collection of data: Both primary and secondary data were used for data collection.

- **Primary data:** Primary data was collected by means of structured questionnaire. It was distributed to sample respondents of Cochin City.
- **Secondary data:** Information from secondary sources like journals, newspapers, books, magazines, reports, websites etc has contributed to this study.

1.6.3 Sample design: Random sampling technique was used to select the samples from population.

- **Population:** 120 residents of Kochi.
- **Sample size:** A sample of 120 respondents completed the entire survey within a timeframe of two weeks and this sample was evaluated for the purpose of the study.

1.6.4 Tools for analysis: The collected data were used with the help of statistical tool like percentages. The technique of ranking was used to study the effects of OTT platforms on the whole population of the city. Tabular and graphical presentations were used for presentation of data. Graphical presentation includes bar diagram, pie chart etc...

1.7 LIMITATIONS

- The report had to be complete in a subject area within a specified time line.
- The approach to the study has been made from the point of view of individual.
- Paucity of time.
- The respondents might not have disclosed their actual opinion on certain issues.

1.8 CHAPTERISATION

Chapter 1 - Introduction: This chapter contains a brief introduction of the topic, its significance, and statement of the problem, objectives, methodology, limitations and chapterization of the study.

Chapter 2 - Review of literature: This chapter deals with the literature review which includes the study on role of OTT platforms during the pandemic conducted by other organizations.

Chapter 3 - Theoretical framework: This chapter includes the professional introduction of the role of OTT platforms during the pandemic conducted by other organizations.

Chapter 4 - Data analysis and interpretation: In this chapter data collected are analysed and interpreted based on various observations from the questionnaire obtained after the survey.

Chapter 5 - Findings, suggestions and conclusions: This chapter contains the summary of findings and recommendations. It also contains the final conclusion of the study.

CHAPTER II
LITERATURE REVIEW

An Overview of Study Constructs: Literature Review

1) JOURNAL OF CONTENT, COMMUNITY AND COMMUNICATION VOLUME 2 YEAR 6, DECEMBER- 2020

**ROLE OF COVID AS A CATALYST IN INCREASING ADOPTION OF OTTS IN INDIA:
A STUDY OF EVOLVING CONSUMER CONSUMPTION PATTERNS AND FUTURE
BUSINESS SCOPE**

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COVID-19 is an unprecedented global pandemic which has changed the way audience consume media. An undeniable trend surfaced in this period– adoption of OTTs. There are many reports which point to the growing market and consumer appetite for content of choice available on OTT platforms. OTTs offer a never before consumer advantage– choice of content, ease of access, choice of device / mediums (hand phone, laptop, tablet or TV screen). Gone are the days when family members fought for screen time of choice on family’s singular home device i.e. TV. With this study, the researchers studied the evolution of OTT space in India and reviewed the dynamic OTT space – evaluate some firsts like big banner movie releases on platforms like Amazon and Netflix, return of old content like Mythological programmes from the DD era on Hotstar etc. To complete the study, it was imperative to evaluate the impact of growing content consumption on psychographics across generations (children, adults and elderlies) as there is limited censorship in the OTT space. With this background, the researchers worked on the objectives and tried to evaluate the role played by the pandemic in evolving OTT media consumption trends; a qualitative mapping of increase in OTT adoption – Pre and Post COVID 19 in India; study underlying trends around increasing

consumer appetite for the medium and analyse psychographic impact on children, adults and elderly – listing pros and cons for freely available content with minimal censorship. The researchers adopted a combined qualitative and quantitative approach to extrapolate the data. A survey was also conducted to do audience mapping and analysis. In addition to primary data, content from news articles, industry research reports, international journals for accumulation of key trends were analysed.

2) INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND TECHNOLOGY VOLUME 1, ISSUE 2

A STUDY ON FACTORS LEADING TO ADOPTION OF OTT SERVICES AMONG MILLENNIAL CONSUMERS IN INDIA

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In today's era OTT (over the top video) has become big buzzword when we talk about Digital media and availability of latest video content among consumers, especially the Generation Y category. There was an era when all the family members sit together in the evening to watch traditional shows on TV like Ramayana, Mahabharata etc . But since 2013 OTT platforms have gained significant growth and it is estimated that this video streaming content shall exceed \$332 billion by 2025. However this research is about understanding various factors which lead to adoption of OTT services among millennial consumers . Due to 5G technology and advancement in IT sector the future of OTT platform will be bright because upcoming generations will have greater capacity to cope up with highly advanced systems like delivering users the experience of virtual reality in high definition video quality. Hence the users will enjoy better services in this industry. The biggest audience for OTT businesses will be the millennial consumers who are grown up as digital natives and they don't have patience to wait for movies, TV shows etc to air on television. They want to watch the content just like preparing maggi noodles which is masala -daar, instant and on demand. Therefore this research is attempt to understand why millennial consumers are addicted to binge watch video content on the OTT platforms, what benefits they enjoy while watching video content on OTT platforms etc. This research paper will also help companies to look at the bigger picture of

adopting OTT services in their business models. As the paper will brief them about the reasons for consumer preference for this service and ways to induce repeated purchase and final adoption of OTT platforms in India.

**3) INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN
COMMERCE, MANAGEMENT & SOCIAL SCIENCE
(IJARCMSS)**

Volume 04, No. 02(II), April - June, 2021

A STUDY ON CONSUMERS' PERCEPTION TOWARDS OVER THE TOP (OTT)
PLATFORMS WITH SPECIAL REFERENCE TO GUWAHATI CITY

Jay Chopdar

Dr. Tanima Tarafdar

Over The Top platforms commonly termed as OTT platforms are online streaming media services which from past few years is gaining a lot of popularity amidst the masses. NETFLIX, AMAZON PRIME VIDEO, DISNEY + HOTSTAR are some of the many OTT channels offered to the viewers in India. As per reports the Indian OTT market is expecting \$5 Billion Customers by the year 2023. The present study hereby is an attempt to analyze the perception of consumers towards OTT platform with special reference to the City of Guwahati in Assam. The study further attempts to identify the factors influencing consumers choice towards OTT platforms and also their level of satisfaction towards the services of OTT.

4) GLOBAL MEDIA JOURNAL

The Global Network of Global Media Journal

Pankaj Thakur

Department of Business Management, University of Horticulture and Forestry, Nauni Solan
HP-173230, India

A REMARKABLE EVOLUTION OF OVER-THE-TOP MEDIA PLATFORMS IN INDIA:
A CASE STUDY OF BUSINESS AND REGULATORY TRENDS

The Indian film and entertainment industry has shown a shift from conventional TV and big screen to Over-the-top media platforms. These platforms provide ease of access to

stream anytime anywhere over the internet. With this study the researcher explored the remarkable evolution of these OTT platforms in India. To critically examine the study, the reasons of popularization of these platforms in Indian audiences were explored. As these platforms also have to face the criticism for showing inappropriate content, the researcher put insight into the regulatory changes made by the Government. The study implied that the evolution of OTT platforms started in 2008 with the launch of BIGFlix. A huge rise in consumer base had shown due to increased internet and smartphone base after 2015. The quality and creative content, youth-oriented population and lockdown due to COVID were the main reason of popularization of OTT platforms. The Government suggested self-classifying of the content and three-Tier mechanism to handle the grievances associated with these media platforms. The researcher adopted exploratory research design to have insights into the study. The secondary data from various news articles, blogs, reports, quality research papers were analyzed.

5) ADOPTION OF OTT PLATFORM IN INDIA DURING COVID-19

Author: Dr. S. Anbumalar.

Head Commerce Dept, Sri Krishna Arts and Science College, Coimbatore

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COVID-19 is global pandemic which has changed the audience in India on the way of consume media. There is an increasingly growing number of consumers adapting to OTT Platform. While global players like Netflix and Amazon prime have steadily grown their market share in India, Indian streaming services like Hot star and JIO Cinema has gained a stronger foothold. This paper explores the role played by the pandemic in evolving OTT media consumption trends; a qualitative Analyses of increase in OTT adoption; impact of OTT on children, adults and elder lies, and future of streaming service in India through an analytical research. Other than primary data content from news articles, industry research reports, International journals for accumulation of key trends were also analyses.

6) INTERNATIONAL JOURNAL OF BUSINESS, MANAGEMENT AND SOCIAL RESEARCH

EMERGENCE AND FUTURE OF OVER-THE-TOP (OTT) VIDEO SERVICES IN INDIA: AN ANALYTICAL RESEARCH

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Over-the-Top (OTT) video platforms, once considered a luxury is today a commodity. In India, there is an increasingly growing number of consumers adapting to it. While Indian streaming services like Hotstar and Jio Cinema has gained a stronger foothold, global players like Netflix and Amazon Prime have steadily grown their market share in India. This paper explores the emergence, advantage, and future of streaming service in India through an analytical research. We also present the various OTT services, their growth factors, technology background, audience characteristics, content, censorship and future developments expected in the industry. Traditionally, the consumption of movies and other audio and video content has always been in the form of mediums like theatre and television. As the technology developed, it was easily accessible at home and whenever required with the introduction of VHS, DVDs, Blu-rays and disc rental services. Further, cable television brought the content through Co-axial cables and fibre optic cables. Another better service emerged as Direct-to-home (DTH) technology through satellite and dish connectivity that brought high-quality broadcast and on-demand content directly to the consumer. Recently, technological advancements have made the movie or TV watching more convenient through online streaming or Video on Demand (VoD) services. VoD refers to streaming of video content over the Internet, through applications typically referred to as Over-The-Top (OTT). Unlike traditional media, streaming services tell varied stories that are not restricted by censors, box office or demographic. It gives a viewing experience with greatly improved sound and visual quality, provided the consumers have a stable Internet.

**7) OTT VIEWERSHIP AND PANDEMIC: A STUDY ON NEW
TRENDS OF ONLINE VIDEO CONTENT AND CINEMA HALL
FOOTFALLS.**

Viewer's Dynamic Watching Experien

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Today the world is going through an epidemic situation. In such a situation, it is the biggest challenge to make better use of your time at home. But the new trends in technology and the availability of audio video content made our problem much easier. One of them is OTT (Over The Top) video streaming services platforms like Netflix, Hotstar, Amazon Prime and Zee5, etc. In the era of this technology and the Internet, everyone likes to spend their free time in front of the digital screen, where they have many options to see. The ever-increasing viewership of the OTT video streaming services and the big star's inclination towards this platform justifies this. Today, the time we spent looking at our screens has increased immensely. As the cinema halls shut and film release has been suspended nationwide, this technological shift by the internet has created a new kind of viewing experience and that might end up changing the collective movie-watching experience in cinema hall which result in a dent in the footfall whenever the screens open again. This change in viewing experience created by OTT has a greatest fear for cinema hall owners. This paper tries to analyse the impact of these new trends, especially increasing OTT video streaming platforms viewership in lockdown, to assess the future of collective watching experience in India. It frames the attitude of Indian people towards cinema halls by assessing different vantage points that mark shifts in the watching experience. In the end, it gives the conclusion and recommendation contextualized the immensely increasing OTT viewership during lock down and its resultant effects on the collective watching experience.

8) HOW OVER-THE-TOP (OTT) PLATFORMS ENGAGE YOUNG CONSUMERS OVER TRADITIONAL PAY TELEVISION SERVICE? AN ANALYSIS OF CHANGING CONSUMER PREFERENCES AND GAMIFICATION

Authors: Mayank Sadana, Dipasha Sharma

Source: Young Consumers: Insight and Ideas for responsible marketers Volume 22, Number 3, 2021

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This paper aims to analyse how the top over-the-top (OTT) platform is becoming a preferred source of entertainment amongst young consumers over traditional Pay TV service (Cable TV/DTH) in India and what factors play a vital role in such preferences along with gamification of content. The study follows the theoretical framework of use and gratifications theory and Niche analysis.

9) CAMPAIGN INDIA

SAB Group's chairman, co-founder, managing director speaks with Campaign India that stringent lockdowns topped with impressive content libraries containing original series, newly released blockbuster films, affordable plans, and regional flavour has led to this enriched digital shift. Due to Covid-19 restrictions, traditional TV was in the backseat with production halts and a lack of fresh content. Even as the market began to look promising and production houses gained a footing in the new pandemic market, the appeal for OTT did not die down. Having launched a media conglomerate back in 1985, navigating the testing waters of the Covid pandemic wasn't new to Markand Adhikari, as he has undergone many media transitions over four decades. In conversation with Campaign India, Adhikari talking about the pandemic blues, said, "This unprecedented circumstance is a once in a century experience and a learning curve for our businesses."

10) VIDHYA HATTANGADI, FINANCIAL EXPRESS:

Covid-19 led to a situation like a house lockup initially, and slowed down the economy like never before, taking its toll in the form of business closures, sweeping unemployment, increasing death toll, isolation and overall slowing down of all things. But this strict lockdown boosted media consumption. The over-the-top (OTT) platform saw an immense boom, and it became a major source of entertainment for viewers. In India, Arre, Disney+ Hotstar, Eros Now, BigFlix, Hooq, Netflix, Hungama Play and some 30-odd platforms have mushroomed and are being watched by majority households. A recent news story in a national daily noted that there are currently about 40 providers of OTT services, which distribute streaming media over the internet. There is no doubt that OTT has disrupted the entertainment sector. It has made watching films convenient and handy. Anybody with a mobile phone and an internet connection can watch a film, sitting anywhere in the world. Not all households have PCs and laptops for each member; the pandemic has restricted movements of people, making social life difficult. To add to that, shopping also means buying from one of the many apps that offer home delivery services; from videoconference calls with family, kids learning via online education to streaming online workouts, a lot of things have changed. Post-pandemic, some of these habits are likely to stick. Companies that had been grappling with integrating technology have had to act quicker. When life has turned topsy-turvy, what would you expect the people to do? Well, the world is busy binge watching TV shows and films. A recent study showed that mobile data is cheapest in India and this has played a key role in mushrooming of OTT platforms. OTT pricing is also quite affordable, and delivered over the affordable internet, and it does not require a traditional broadcast or cable video infrastructure for distribution. For telecom, cable, media and content businesses, OTT video subscriptions represent a new business model built around ongoing customer relationships.

11) RESEARCHDIVE.COM

IMPACT ANALYSIS OF COVID-19 ON OVER-THE-TOP MARKET

The global over-the-top (OTT) market was valued over \$110.1 billion in 2018 and is projected to generate a revenue of \$438.5 billion by 2026, at a CAGR of 19.1%. In the previous years, the global market has experience a noticeable growth due to growing demand for over-the-top (OTT) services across the all industry verticals. In addition, owing to unpredicted COVID-19 pandemic, the market is anticipated to experience a substantial growth in 2020 due

to constantly rising demand for over-the-top (OTT) services. This is majorly attributed to continuous growth in online communications services due to the lockdown since people are communicating through online platforms. Our analysts have expected the condition of the over-the-top (OTT) market during the COVID-19 pandemic and have provided few assumptions.

12) BRAND EQUITY.COM FROM ECONOMIC TIMES

HOW THE PANDEMIC EMERGED AS A BLESSING FOR INDIA'S OTT INDUSTRY

The entertainment industry was massively hit in the first lockdown as all the ongoing production projects – new shows and films – came to a halt leading to a fresh content deficit on the television as well as theatres. The theatres were shut and television channels were playing reruns of the old shows. It forced consumers to look for alternate choices of entertainment and they started sampling the existing OTT platforms. These platforms had a huge library of movies (in multiple languages) and original shows that promised to entertain the consumers.

Manish Kalra, Chief Business Officer, ZEE5 India, says, “The year 2020 bolstered the growing popularity of OTT to an all-time high. With people confined to their homes during the nationwide pandemic, consumers turned to OTT platforms for their daily dose of entertainment. Not only did they look forward to their usually preferred genres, but OTT had opened gates for them to experience many new ones. Platforms saw an increase in their overall growth (ZEE5, grew a phenomenal 200%!), watch-time increased, and platforms even saw an uptick in their subscription numbers.”

13) RISE OF OTT PLATFORMS: EFFECT OF THE C-19 PANDEMIC”

Prof Ria Patnaik

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Prof Upendra More

The Covid-19 pandemic has changed the way the Indians consumer consume entertainment. While previously cinema theatres were synonyms to hangout places and movies nowadays consumers are more interested in Netflix-n-Chill. For more than a year now, the pandemic has caused consumers to stay indoors and hence search for more adaptive ways of entertainment. This has naturally propelled the rise of the OTT platforms which were at a very nascent and struggling stage before the pandemic. Previously unknown platforms such Disney+Hotstar, Netflix, Amazon Prime etc have become households. Right from the youngest to the oldest member, these OTT platforms have something to offer to everyone. This research tries to study the rise of OTT platforms during the pandemic. It is important to know the extent of increase in the popularity of OTT platforms during pandemic to know their future scope. It is evident that since their launch OTT platforms have only observed an upward curve in their popularity and usage but, due to the pandemic there has been an exponential increase in its popularity due to the change in consumption patterns of people for entertainment through various media platforms. This research analyses the opinions of people regarding OTT platforms, their consumption patterns, and it's comparison with cinema to see if OTT platforms were slowly taking over the most popular conventional medium of entertainment. It was found that people used OTT more than any other platforms out of TV and YouTube to pass their time or for entertainment. Most of them experienced an increase in their consumption times and were looking forward for movies to be released on OTT at the same time as in cinemas. People were also okay with watching movies on OTT rather than cinema. But for some it depended on the movie. This research has shown that there is a huge scope for OTT platforms in the future and the pandemic has played a major role in it. The research methodology used in this study is descriptive in nature. A questionnaire was administered to the relevant target group to analyse their behaviour. Basic statistical tools were used to analyse and generalize their behaviour. The target audience considered relevant for this study was between the age group of 14-45. Since, OTT platforms cater to all age segments, this particular TG was considered to be apt for the study. Apart from that, consumers belonging to this age category were also able enough to give their valuable opinion regarding the OTT platforms.

14) SAGE JOURNALS

CONSUMPTION OF OTT MEDIA STREAMING IN COVID-19 LOCKDOWN: INSIGHTS FROM PLS ANALYSIS

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In light of the current ecosystem of technological advancements in telecommunication and enhanced capability of devices, the present work brings to the fore the changes in consumers' media consumption. The shift from conventional media to over-the-top (OTT) media, particularly in the lockdown period due to the COVID-19, has resulted in a war between streaming service providers to attract and retain customers. In the light of this change, the present study conducts partial least squares structural equation modeling (PLS-SEM) analysis to examine the impact of two key antecedents, namely, customer engagement (CE) and quality of service experience (QoSE) for their impact on users' willingness to continue and subscribe (WCS) streaming services in future. The paper also delves into the indirect role of satisfaction and habit in affecting the aforesaid linkages. With the world facing the impact of the pandemic, the implications emerging from the study present an opportunity to the providers of OTT platforms to capitalize on the perceived change to the best of their advantage.

15)INTERNATIONAL JOURNAL OF ENGINEERING AND ADVANCED TECHNOLOGY (IJEAT)

ANALYSING THE MEDIA CONSUMER TRENDS DURING THE COVID-19 PERIOD- THE RISE OF OTTS IN INDIA

Sristy Lalaika V, Kalathila Uthej, Shreeya Rishi K

In the wake of an unprecedented COVID-19 widespread, there is a massive development in the media and entertainment industry through OTT (Over-the-Top) platforms which offer video streaming directly to viewers via the internet without cable, broadcast, and satellite television supports. During the self-isolation period, OTTs have increased the overall

media consumption to a real high and are now gradually becoming mainstream entertainment destination amidst the growing internet users. This mass intrusion has given an opportunity for many independent platforms to grow and run alongside the likes of already established biggies, Netflix and Amazon Prime. The telecom operators chipped in this aspect and are extensively working on optimizing their operations with advertising revenue and bringing in effective content strategies in order to reach out to more people. The present study focuses on this new development by using the technique of quantitative content analysis in order to know the cause of this sudden increase in OTT channels' viewership among millennials during the lockdown period in India and its impact on traditional modes of communication.

CHAPTER III
THEORETICAL FRAMEWORK

Chapter 3. Theoretical framework

Over The Top Platforms (OTT)

The world has seen drastic changes in the way it consumes content over the past few decades. One of the more recent is the content shift from television to OTT platforms. Over the Top platforms (OTT) like Netflix, Amazon Prime, Disney+ Hotstar, etc., are becoming more popular by each passing day and increasing its subscriber base. OTT refers to film and television content provided via a highspeed Internet connection rather than a cable or satellite provider. An OTT platform has a large repository of movies and TV serials from across the globe which can be accessed through different devices like phones, laptops, Android Televisions, etc. These platforms even produce their original shows and gives their users a different experience altogether. It is basically a media streaming service which is available for the users through internet connectivity.

In India, Big Flix also termed as “Personal Blockbuster Theatre” was the first OTT platform which was launched by Reliance Entertainment in 2012 which offered numerous movies on demand with a subscription fees. Netflix on the other hand was launched in the year 1997 in California, USA. Originally a rent by mail DVD service that used a Pay Per -Rent- Model. It was in the year 2015 that Netflix successfully launched its streaming services in India. Thereafter the Indian internet streaming market kept evolving with the entry of players like Amazon Prime Video, Sony LIV, Zee5,VOOT etc.

During the unfortunate time of global pandemic such a COVID-19, these video-on-demand platforms have seen a surge in their viewership. Owing to lockdown and statutory social distancing norms adopted by most countries affected by the pandemic, people have registered higher presence on these platforms. The study finds that use of OTT content platforms such as Netflix, Amazon Prime, Voot, Hotstar(now Disney Hotstar), etc. has seen a rise especially among the younger age The rise of OTT platforms, this trend has seen a new dawn. OTT platforms such as Netflix, Amazon Prime Video, Voot, Disney Hotstar, etc have given a catalytic impetus to the shrinking of globe into village. During the unfortunate time of global pandemic such a COVID-19, these video-on-demand platforms have seen a surge in their viewership. Owing to lockdown and statutory social distancing norms adopted by most countries affected by the pandemic, people have registered higher presence on these platforms. The study finds that use of OTT content platforms such as Netflix, Amazon Prime, Voot,

Hotstar(now Disney Hotstar), etc. cohorts of population. This trend implies a rise in demand of OTT content and signals a growing popularity of OTT video on demand platforms. OTT or Over-the-top content platforms are the media platforms that according to Tata Consultancy Services are the platforms that deliver film and television content, by passing the conventional distribution streams of cable and satellite TV, from producer to consumer directly, an exchange driven by Internet.” Some of the commonest OTT platforms in India and elsewhere Include Netflix, Disney Hotstar, Eros Now, Amazon Prime Video, Voot, etc. Much like the global trends that indicate a rise in the use of tablets, smartphones, laptops and other internet enabled devices for content consumption by the audiences, India too has seen a steep growth in the number of internet users. India currently has the second largest users of internet after China and with a rapid growth rate, the market promises a huge potential. As a report by Deloitte states “Online entertainment services lead by audio and video content is the cusp of inflection point in India.” With the audience focused on infotainment and increasing demand for global content, India is a thriving marketplace for OTT platforms.

Market Scenario of OTT platform in India

With over 40 over the top media services (OTT) in India, more and more people are opting to watch content online. As per reports in the fiscal year 2018, the OTT market in India was worth ₹21.5 billion and in 2019 its value grew up to ₹35 billion. The OTT sector in India witnessed a 30% rise in the number of paid subscribers, from 22.2 million to 29.0 million between March and July 2020. India’s video streaming industry is set to be valued by ₹ 11.9k billion by 2023. This growth is directly connected to the surge in the number of internet users which are expected to cross 735 million by 2021 with more than 73% of them consuming content in Indian regional languages.

Disney+ Hotstar has 43 million subscribers, which makes it the most comprehensive OTT outlet in India, followed by Netflix with 5 million subscribers and Amazon Prime with 17 million subscribers. Hotstar has captured the OTT market and accounts for 29 percent of the total viewership. The platform's income in 2020 was around 16 billion Indian rupees.

Impact of OTT platforms In Indian market:

COVID-19, a deadly strain of coronavirus, with Abnormally high rate of infection and the absence of a concrete cure for this outbreak have led countries all across the world to go into complete lockdown to tackle the spread of the virus. Crores of people suddenly have more time on their hands than they can possibly spend. In this situation, films and entertainment content have emerged as the saviour especially on-demand video content. This study aims to understand the trends in Over-the-top content consumption as pertains to lockdown amidst COVID-19 outbreak in India, the reasons for its prevalence over the traditional entertainment media and the implication it may have on media market and industry in the long run.

A decade ago, everyone in a family used to gather and sit together in front of the television to watch whatever was showing on the cable channel. But today, you can choose your own show and device where you want to stream content with your group. Technology has changed everyone to a certain degree, and it has made life effortless. You now have the freedom to watch whatever you want, whenever you want, and that's the reason why in March 2020 alone, OTT has gained more than 30% paid subscribers. The most wanted names in the OTT platforms are Disney Plus, Netflix, and Amazon Prime, more than any other apps. But there are also some other streaming platforms that regularly satisfy the viewers with new kinds of content. And thus, all of them combined to create a great impact on the OTT market in India. Not to mention that the OTT platform also somehow replaces the cinema halls and other types of traditional mediums for entertainment. A report published by the Data Sciences Division of Dentsu Aegis Network (DAN) India showed that OTT platforms increased the popularity of binge-watching video content in the comfort of the home. The younger generation or Gen Z spend more time watching video content while eating and before sleeping. And Indian youngsters spend more than 11 hours a week watching videos online, while the number is 8 hours a week on a global timeline on average.

OTT offers a never before consumer advantage – choice of content, easy to access, choice of device / mediums (hand phone, laptop, tablet or tv screen). Gone are the days when family members fought for screen time of choice on family's singular home device i.e. TV. With this study, the researchers studied the evolution of OTT space in India and reviewed the dynamic OTT space. It was an imperative to evaluate the impact of growing content consumption on the psychographics across generations (children, adults and elders) as there is limited censorship in the OTT space. The objectives and tired to evaluate the role played by the pandemic - pre and post COVID 19 in India, study underlying trends around increase in the

consumers appetite for the psychographic impact on children, adults and elders. The research adopted combined qualitative and quantitative approach to extrapolate the data.

The Limelight Networks, Inc released a ‘State of Online Video 2020’ report that states that the cost of most OTT platforms is the reason why many people don’t use apps like Netflix or Amazon Prime. Indian viewers tend to cancel a premium subscription due to the high costs of these apps. So, if the OTT platform ever loses its popularity, prices will be the foremost culprit. According to the “Indian Over-the-Top (OTT) Platforms Report 2020” report published by the MICA Ahmedabad, the number of male viewers of OTT apps is more than female viewers in India. The most viewed apps in India by males are Netflix, Amazon Prime, and Hotstar. The least traffic in females is of around 25-45 age groups. But Voot has around 54% of female users. The MICA report also analysed the gaming trends in India. Here again, as expected, men outdid women. Indians on average, in 2020, spent 63 billion minutes on playing games, against 42 billion minutes in March 2019, a 49 per cent increase. Consumers also clocked 4 hours 5 minutes of gaming consumption in the week of April 25, 2020. “The clear leader among all the players goes to the male members between 18 and 24,” the report said.

Gamification, not games, is one of the strong mechanisms to boost engagement on the platform. On OTT platforms, gamification is not limited only to mainstream gaming. Movies, contents can be gamified; even watching experience can be gamified. The list is long but impressive. It can increase viewers’ stickiness and would transform viewing into an interactive two-way process. If this is true, would the brands be left far behind? They are sure to step in. We have to wait and watch if this would spoil the joy of uninterrupted watching. Only time will tell.

Typically, the industry life cycle consists of five stages — startup, growth, shakeout, maturity, and decline. These stages can last for different lengths of time. We have seen these phases in the Insurance and airlines industries where we witnessed the entry of huge numbers of players when the sectors were opened up initially and during shakeout, many fell apart and disappeared. Similarly, we see a large number of players entering this industry now. Surely, one can expect a shakeout sometimes in future and only a few competitive players are expected to remain.

With the COVID pandemic playing havoc, it is OTT’s time. Unwittingly, OTT is also enabling the family watch the programme jointly thereby increasing the family bondage. Thus, in, my opinion, OTT is having both positive and negative effect on the family.

Another important feature of OTT is its impact on movie theatres. Because of people preferring to watch content mostly on OTT platforms and less in movie theatres certain movies producers and distributors are electing the OTT media to reach its target customers (Varghese&Chinnaiah, 2021). In the present circumstances, it is difficult to judge its effect on the theatres though, generally it is felt that it will have some but may not lead to their closure.

Indians for long have earned for diversity of content. A common family television enabled with limited channels restricted the imagination of young India. This imagination was tapped and explored by OTT players optimally during COVID 19 and the flexibility of accessing a range of content on personal devices including smartphones and tablets gave to young India, the freedom to watch what they desired. OTT players has the immense potential to dive deeper into the regional Indian market in times to come. With just 40 OTT platforms and limited regional content, this medium has created a new niche for itself in urban India. COVID 19 has played a very sufficient role in mass adoption of the medium in the urban regions where people have better playing power than semi-urban or rural India.

OTTs are fast converting the fence sitters across age groups and demographic regional. COVID 19 brought with itself some factors which became the new normal, like working from home, which have seemed to offer flexibility of schedules to many. All the researches point to the growing duration of video content consumption year on year and COVID 19 has proved to be a turned point in furthering this behavior change The State government's proposed foray into the online content streaming space with the launch of an over-the-top (OTT) platform is a cultural intervention, rather than something prompted by the market or revenues, according to Kerala State Film Development Corporation (KSFDC) chairman Shaji.N.Karun.

Speaking to The Hindu, he said the plan is to launch the platform by November 1.

“Even though the market is crowded with too many platforms, the government is taking this up as a cultural intervention, rather than looking at its viability. We do have an audience which is spread out across the globe. Even an OTT platform like Mubi, which has curated content, has its set of audiences. But, our priority will still be the big screen, with the films first getting a screening in the cinemas and then coming to the OTT platform,” Mr. Karun said.

Though major players such as Netflix and Amazon have been showing more interest in Malayalam cinema, it is mostly limited to films which they are ensured of a revenue. In the past one year, only fewer than 15 Malayalam films, a majority of them featuring big stars, have

been taken up by these streaming platforms. Smaller, home-grown OTT platforms such as Neestream and Mainstream TV do not have the financial muscle to match the bigger players. The government's proposed platform might ensure space as well as some sort of revenue share for the lower budget, independent films that are struggling to see the light of the day.

Impact of OTT on Age Groups:

- Children between the ages of 8-15 like these apps more than anyone. The reason is the OTT platforms serve unlimited entertainment from various genres that are also children-friendly. This content entertains children as well as educates them.
- OTT platforms also help entrepreneurs to grow their own businesses while bringing value to the younger generation through entertainment and education. There is a term “Netflix and chill,” which typically applies to viewers aged between 18-32 as a form of entertainment and relaxation.
- However, OTT platforms also entertain the older generations or senior people to a certain level. Since these platforms constantly update their database with new content, it helps older people reduce their loneliness.

OTT platforms are not limited to entertainment only, but also they bring health & fitness and education to the table for different kinds of audiences. And for that reason, people from all over the world and different areas in a country (rural & urban) use OTT platforms more than anything. OTT market also has a significant influence in the urban areas because of the religious language content that some of the over-the-top channels provide, such as Zee TV, Sun TV, etc.

But in the urban areas, most people watch western or Indian movies, and in that case, Amazon Prime, Netflix, etc., are more popular. Therefore as you can see, OTT platforms have made and continue making a huge place in the hearts of everyone, starting from kids to senior people. The key fact is the OTT platform brings the world to your smartphone.

Impact of OTT Platforms on Youth:

The content, language, and presentation of the programs of OTT (over the top) platforms such as Netflix, Disney Hotstar, Amazon Prime, Voot, MX Player, zee5, Alt Balaji etc. have been a cause of concern in recent times in the light of the multiple impacts, especially

on the youth. These OTT platforms are making huge and enormous profit at the cost of challenging the Indian cultural values and ethos among the youth by posing film, television content flooded with the offensive and abusive language and sex scenes. Our country has gone through a tremendous technological revolution which promoted the new entertainment platforms through hi-speed Internet, Video-on-Demand and OTT platforms and it is assumed that an average Indian youth spends approximately 8 hours 29 minutes watching online video content, which is much more than the worldwide trend of 6 hours and 45 minutes.

Television programs & Films have been recognized as prime mode of entertainment in India especially in urban and semi-urban areas. Undoubtedly, these programs have immense potential and capacity to influence thought process, attitudes, and behaviour of the people. It is normally observed that the youth, particularly kids and teens are apt to learn the dialogues and songs from movies or TV programs, and it has a deep impact in their mind both consciously and subconsciously for long. Subsequently it plays a major role in shaping up the personality and moulding the character also. But through these online platforms, mainly anti-national or anti-religious content is presented that provokes the masses to react instantly and thus, it can be said that OTT platforms are spreading negative culture among the youth.

It is well understood that youths are more likely to follow and acclimate one's behaviour as they can easily relate to what is displayed on online platforms and other video content. Subsequently, it develops a lot of behavioural changes in youth. It has a serious and long-term impact on their behaviour and in their thoughts.

Besides, it leads them for following repercussions:

- the entire process of socialization of youth has got affected.
- the disease such as insomnia, depression, obesity, and eyes disorder amongst the youth have increased.
- the academic performance of the youth has also been affected.
- web shows rarely mentions anything about sexually transmitted infections and unwanted pregnancy.
- the web series have become a platform to advertise Alcohol, Smoking, Tobacco, Drugs and Weed without mentioning their adverse effects

Online platforms need proper regulations and should be censored in order to protect the cultural values among the youth and create a positive and healthy environment. The present government has shown the willingness on numerous occasions to intact the Indian culture and values. It is in this context; the ministry of Information and Broadcast (MIB) has emphasized on certain kind of regulation of OTT Platforms to rationalize the sector and convened consultations with numerous stakeholders. In this background, the MIB recently notified the Information Technology (Guidelines for Intermediaries and Digital Media Ethics Code) Rules 2021 (Rules). The new rules seek to maintain a balance between self-regulation and government control. As per these rules, OTT platforms are required to establish a strong three-tier grievance redressal mechanism. The first level will include regulation by the OTT Platform itself through a grievance officer. The second level will be an institutional self-regulatory body formed by publishers of content and their associations. This self-regulatory body will consist of experts from industry headed by a retired Supreme Court/ High Court judge /eminent personality in the relevant field. Further, the third level is an inter-department committee constituted by the Ministry of information and Broadcast which will give oversight and listen to appeals for decisions taken at level two or if a complaint is referred to the inter-department committee by MIB. The code of ethics announced under the Rules, set out guidelines for classification of content based on viewer's age, themes, content, tone and impact, and target audience. Besides the regulations and guidelines by the government, it is the responsibility of each citizen to avoid the use of any such content at any level which pollute the mind of youths and pose a serious threat to the cultural values.

Millennial consumers

Millennials are those people who are born between 1980 and early 2000s. They represent a large segment of population and are consider target market for many consumer companies. Millennial consumers are grown up as digital natives so they have the ability to command to technology which can do anything they don't like feel getting up to do. Many millennials conduct a research online, seek out honest reviews, test in stores etc before buying any product. While many are unemployed and burden with student debt today, but in near future millennials will be richer over time, thus for marketers and consumer companies there is more scope of having young talents.

Binge watching addiction

In 2013 Netflix stated that binge watching refers to normal behavior among humans where an individual sits at one place and watches several episodes of the same show in a day. This kind of behavior produces dopamine into the brain which makes us feel so good about it over time. It

also happens in other kinds of addictions like gambling, smoking, getting high on drugs etc. Since 2013 the rate of binge watching has increased from 61% to 75% according to latest deloitte

figures. It is observed that millennial's exhibit stronger binge-watching behaviors as compared to

other generations. The psychology of majority Millennial's behind binge watching is that they want to keep the storyline ongoing. (Mosacho, 2018) It is estimated that more than 3-5 hours is

considered as the average time to binge watch.

Majority of millennials consider binge watching a harmless pleasure rather than a harmful addiction. The act of binge watching builds a community around the show known as "shared cultural space" This helps viewers to establish beneficial social connections. This beneficial social connections strengthens relationships as people share mutual interest and they can spend easy time together. Binge watching makes a show more fulfilling as watching several episodes.

Benefits of Over The Top Platforms:

There are multiple benefits of using OTT platforms and why they have become so famous within no time in India.

- **Cost-Effective** – Anyone willing to watch online digital content, can register themselves and pay a monthly or yearly subscription amount which makes it cost-effective
- **Easy Access** – One can log in to these OTT platforms through mobile applications, smart TV, laptops, tablets, etc. The only requirement is an internet connection
- **Creative and Unusual Content** – Through these over the top platforms, various creative ideas have come to the forefront which could not be brought across due to censorship or regulatory laws

- **An open platform for Entertainment Industry** – The biggest advantage of this platform is that it has provided a medium for new talent to get more opportunities as the number of projects are much higher in comparison to television or films
- **Platform for International content** – Any Indian content uploaded on these platforms can be viewed internationally. This gives a broader outreach of content and talent

Disadvantages of OTT Platforms:

Along with advantages the OTT platforms have various issues and challenges which they need to overcome:

- **May affect social-political harmony** – Since there is no censor board to review the content, there are chances that the content may affect social or political harmony and hurt people's sentiments on certain issues
- **No regulatory board** – No organisation, department, or body is held responsible for the content that goes online. This has always been one of the biggest concerns for the Government of the country
- **Threat to Culture and Tradition** – The modern and fresh content releasing on OTT platforms has been accepted and appreciated by the people in India. However, there still are a few who have not been able to accept this unique content. Thus, the government needs to be accountable to them as well

Moving forward, the Ministry of Information and Broadcasting shall have to focus on maintaining the quality of content being added digitally, ensure that it does not hurt the sentiments of the people, and promote new and fresh talent and content.

Effect of censorship in OTT platforms in Indian market:

Digital platforms have seen exponential growth over past few months, mostly because of the ongoing pandemic that has forced people to stay at home and seek entertainment inside the premises of their own houses. However, they also faced a setback when the Indian government rejected a proposal for self-regulation of content online.

After 15 digital platforms signed a self-regulation code for content streaming online, the ministry for information ad broadcasting wrote a letter asking the code itself to be re-framed.

In September, Netflix, ZEE 5, SonyLiv, Viacom's VIAB 0.0% Voot, Amazon Prime Video, Disney+ Hotstar, ALTBalaji, Arre, Discovery+, Eros Now, Flickstree, Hoichoi, Hungama, MX Player, Shemaroo, VOOT, Jio Cinema, and Lionsgate Play signed a self-regulatory code that asked signatories to not show content "disrespectful to national symbols and religions".

The Indian government, however, wrote to Internet and Mobile Association of India (IAMAI) asking for an alternate code. The ministry objected to a lack of a third party involvement in the advisory panel (the current draft suggests forming a body from among the content providers itself unlike the previous suggestion for the Digital Curated Content Complaints Council. A final word on the regulation and/or censorship is yet to come, but those in the business of providing curated content online view it as a clear negative effect on their earnings and subscriptions.

The OTT (Over The Top) video market in India is beginning to challenge current conventional broadcasting, as an entire generation is now migrating away from television to OTT and subscribed Video on Demand. Recent data from PwC reveals that the Indian OTT market is growing at a CAGR of about 23 per cent and is expected to rake in Rs 5,595 crore by 2022, pushing India to join the top ten OTT markets of the world.

Netflix, Amazon and Hotstar, currently, India's top OTT video streaming platforms, recently met to explore a voluntary censorship code in India to cover online content. While the currently unregulated nature of the market is one of the main USPs of the OTT market, given that viewers have unrestricted access to online content, the lack of a code is also beginning to raise questions of spreading inappropriate content, which could corrupt or enrage audience sentiment. On the other hand, having a code might bring censorship seesaw and court rulings, which could seriously impact the businesses of such platforms. To a degree, it is a sensible idea for OTT platforms in India to introduce self-censorship measures, because it could assist parents and help make them feel that their children are safe when accessing certain content, while unsupervised. However, according to Arvapally, it can also be a slippery slope.

Growth of OTT platforms during the pandemic:

The use of digital technology is essential in every sector, and OTT platforms offer such versatile content. The pandemic was also responsible for the OTT viewership surge in India. The platforms are mainly popular between the 15-35 years population. MICA's Center for

Media and Entertainment Studies (CMES) reports indicate, "India is expected to witness an increase in the number of OTT viewers by 2023, compared to the current 350 million consumers." This increase projects nearly 500 million consumers.

OTT platforms have garnered acclaim due to their convenience and minimal requirements-reliable internet connections and a viewing device.

However, in India, the popularity of these platforms was not overnight. OTT platforms like Netflix faced a difficult journey to acquire 5 million subscribers. However, affordable technology like smartphones and cheap internet access through service providers like JIO made it possible for OTT platforms to garner a rural subscriber base.

The influence of OTT channels varies among the rural and urban crowd. The survey by Ascent Group India suggests, "almost 65% of the OTT content consumption is from rural India which only has 40 % internet connectivity." These figures suggest regional language content is prominent on OTT platforms, thus offering prospects to regional content developers.

OTT entertainment is not just limited to adults but has been making a way in children's lives through educational media. The informative and free edutainment content on these apps facilitates entertainment and education.

Indian youth is another prominent segment of the OTT subscriber base. Today, college students and working professionals use OTT channels for entertainment and information. Netflix and Chill have become a go-to trend in the urban Indian population.

It does not mean OTT platforms are just limited to the younger crowds. Features such as content updates and spiritual and regional language availability make it easy for the older Indian population to enjoy their favorite content.

OTT platform expansion is prominent in health and fitness, education, and other sectors. These platforms also provide lucrative prospects to budding content creators.

The Indian population today uses the OTT platform beyond entertainment. The Indian OTT market is humongous, as well as, diverse and requires systematic planning.

The demand for new content has led global OTT channels like Amazon and Netflix to offer lucrative subscription plans to the consumers, the recent one where Netflix slashed its price to 149 monthly plans for mobile users along with its other plans.

The drop in prices of smartphones and cellular data has enabled a large chunk of the population to gain access to online platforms. India currently has about 220-250 million smartphone users which is expected to hit 500 million by 2020.

There are also platforms like Saavn, Wynk, etc. that have become more popular due to its wide variety of choices in music. YouTube is the 4th most used app in India, as the number of smartphone users increases in India, there is scope for an increase in viewership.

One of the major challenges that OTT platforms face in developed countries is competition like HBO, CBS, Amazon Prime Video, Netflix, etc. The production cost that is incurred to cater to niche audiences are also high. Entertaining content is a prerequisite to drive subscription and grow consumer affinity. And mainly, the market in developed countries like the USA is saturated which leads to expensive marketing budgets to push for viewership.

Platforms like Voot, Sony Liv and Zee 5 are OTT platforms developed by existing broadcast channels to remain relevant and to cater to the shift in audience from TV viewership to OTT platforms. However, most of their content on these platforms are the same as the ones broadcasted on TV.

OTT platforms' business model would blanket subscribership with sponsored content. Their revenue would be mainly generated from advertisements

There are 30+ OTT players in India in different languages targeting different audiences depending on what content they roll out. 40% of viewership on OTT platforms is mainly regional content.

The target group of major OTT platforms should ideally be "millennials" or the age group of 18-35 years. This number, however, is largely contrasting due to the Digital India campaign, increasing number of smartphone and data users and is also an effect of globalization which has led the population to be more aware. With major data service providers like Jio bringing down data costs, there has been a significant shift in viewership in India with number of Indian users growing at the rate of 4-8%.. This essentially means that there is massive potential for

rural India to subscribe to such platforms on a large scale – making rural India also a target group for platforms.

In 2017, OTT platforms in India generated Rs. 2019 crore, this is expected to increase to Rs. 5595 crore by 2022. Digital streaming platforms overtook film entertainment to rank the third-largest Indian Media & Entertainment sector in 2019, according to the latest EY-FICCI Indian Media & Entertainment Report.

When most OTT platforms made an entry in the Indian market, they mainly had catch-up shows. However, with the entry of global players like Netflix and Amazon Prime Video, users are offered a plethora of original content. Hotstar is currently the most popular OTT platform in India according to data from a mobile advertising and Internet service provider. Although in my opinion, Netflix will be the market leader in the medium term among millennials as it is a giant global player and it entered India powerful, mainly due to the youth inspired by western culture.

Netflix also wants to indulge itself in the Indian market by creating original Indian content which may prove to be an extremely profitable move. Shows like Sacred Games and Ghoul have already left audiences wanting more from India. Netflix has also confirmed that it is going to experiment with ads for its original content between episodes, this will increase its revenue exponentially. And lastly, there is a “cool” factor to using Netflix, a privilege Voot or Alt Balaji does not have yet. However, such platforms are garnering more attention due to the content they have been posting.

In July this year, commerce and industry minister Piyush Goyal, while citing the poor portrayal of India, asked the entertainment industry to self-regulate their content. The rapid growth in viewership and popularity of OTT platforms like Netflix, Prime Video, Hotstar, etc. among others due to their raw and unfiltered content. The Indian government, as we all know, is quite big on moral policing – from banning beef to their obvious dislike towards PDA and couples hanging out on Valentine’s Day, it is apparent that anything that they don’t like, they’ll ban in “public interest”. Therefore, the ministry may try to justify the existing laws to cope with “objectionable content” but it is not adequate.

The Central Board of Film Certification (Censor Board) was set up under the Cinematographic Act, 1952. The Act, along with Rules (1983) and guidelines (1991), have set out the manner in which films are to be certified by the Censor Board. The Act states that “a

film shall not be certified for public exhibition if, in the opinion of the authority competent to grant the certificate, the film or any part of it is against the interests of, inter alia, decency.” Additionally, the guidelines stipulated that the certification must ensure artistic expression and creative freedom and that the certification is responsive to social change.

The Indian audience that enjoys raw content is extremely unsure about the censorship of content on OTT platforms simply because they do not want saas-bahu serials on such platforms too, they are looking for great content, which, let’s get real, these serials can never be. The audience seems to be extremely disappointed by this move and we are all hoping that OTT platforms will find a way to put out their content without having to go through the entire process of censorship.

OTT platforms in India to face stiff competition with the entry of foreign video streaming services?

With foreign players like HBO Max entering Indian markets, OTT players like Netflix, Amazon Prime and Disney+Hotstar are likely to face stiff competition. Subscription plans along with a price list of the Warner Bros-owned platform were leaked in early September. The platform is expected to launch in India early next year. There has been no official confirmation on the same by the company. However, they have hinted at it by appointing a managing director for Southeast Asia and India.

Meanwhile, Lionsgate Play, the OTT platform owned by Hollywood studio Lionsgate has already entered into the domestic OTT market and has just announced its first Indian show Hiccups and Hookups, starring Prateik Babbar and Lara Dutta. This could add to the rising competition among OTT players with media analysts reportedly pointing to the need for local programming from all new players while established players are enhancing their appeal with content in multiple languages and advertising campaigns.

One of the challenges for OTT platforms has been customer retention. Amit Dhanuka, executive vice-president, Lionsgate India, told Mint that while viewers like to try multiple services, keeping them hooked for a whole month is difficult. A media analyst told the portal that few people in India would sign up on a new platform but would continue to use the subscription of other players as a smartphone can host at least around three OTT apps. The analyst was quoted saying, "Any new player would need significant investment in local

programming but with talent and production costs increasingly escalating, that is a never-ending game." There are also speculations that HBO Max may choose to remain niche, catering only to the upper end of the audience.

According to Mint, Rahul Vengalil, managing partner at media agency Isobar India said that the platform that can democratise content best will lead the way. Disney+ Hotstar now seems to be leading with the kind of subscription basis it has and the wide content it offers. Sport is a popular category on the platform. He further said that Netflix and Amazon Prime Video are only catching up in India catering to a niche segment and not a mass audience.

Media Partners Asia (MPA), an independent research firm, recently released a report which suggested that the subscription of Netflix is expected to grow to 5.5 million by the end of this year while Amazon Prime and Disney+ Hotstar have projected a growth, estimating its total subscription base to 21.8 million and 46 million respectively.

Mihir Shah, vice-president, MPA said that the OTT market is still at a nascent stage in India. He also predicts mergers and acquisitions amongst existing players to 'build scale, which will heat up the streaming wars in India'. He further told the portal that OTT players may try to seize the opportunity and invest heavily in local content, sports and new products. "An increase in competitive intensity will drive up content investment through both volumes and inflationary pressures," he said.

Classification of video on demand on OTT Platforms

- Transactional video on demand (TVOD): Here the users are required to purchase separately in order to watch movie or episode of TV shows, the most common example is iTunes and Distrify
- Subscription video on demand(SVOD): This is the most widely used online streaming system across the world. Here the users can access to watching unlimited high quality content like TV shows, movies, web series , sports etc by paying a nominal fee . The time period of service depends upon what kind of subscription have you availed like standard,

premium, VIP etc. OTT platforms which comes under this category are Netflix, Disney+Hotstar, Amazon prime video etc

- Advertisement video on demand (AVOD): This is also very popular among consumers, here the users enjoy watching movies,TV shows, sports etc without availing any kind of subscription plans. However as the name explains in this viewers will get to watch short ads during the streaming of video. These ads are precise which means it will cater users interest. OTT platforms which uses this kind of system are Youtube, Voot etc.

Best Malayalam OTT Platforms in India 2022:

1. Manorama Max:

Producers have noticed that the network has expanded since the pandemic when people are at home. The growth it got was expected and is organic as well.

From a brand perspective and overall scale, Ningalkkum Aakaam Kodeeshwaran has done well. Just for this show during the season, it reached over 100 million impressions. Manorama MAX got a good uptake on the OTT side with "Play along" and helped to gain a higher subscriber base. The show was previously on a rival network, and after almost four years, they took the show back to Kerala.

2. NeeStream:

With the release of 'The Great Indian Kitchen,' which has already created ripples among the audience, NeeStream became popular. For this OTT platform, subscriptions are monthly, annual, or per movie with discounts applied with NeeStream coupons. NeeStream is an OTT platform based in Kerala and is not just focused on films in Malayalam, It also has other languages, and originals and documentaries are also featured. The platform is well made and has a great list of movies. Subscriptions are monthly, annual, or per movie.

3. Prime Reels:

Prime Reels is an exclusive film release platform dedicated to movies in Malayalam. It was launched in August 2020 and is a platform for a certain period where new films are released. On an online platform, it reflects the rules of theatrical releases. It had movies like Guardian and Confession of a Cuckoo released on it already and has several other films lined up for release. The platform offers a great viewing experience by offering reasonable offers using PrimeReels coupons, and the subscription is in the format of pay per watch. We truly hope that the platform

will reach more viewers and get the membership it deserves.

4. Koode:

Recently, an independent OTT platform was launched exclusively for Malayalam content called 'Koode.' This app was launched with a vision to help Malayalis discover content close to their hearts throughout the world with some affordable discounts by using Koode coupons. Koode was launched by Studio Mojo, the same team that introduced one of the first OTT platforms in India, iStream.com. In digital media, the platform will offer talented young creators an alternative space. The team is also in Tamil and Telugu talks with many leading OTT platforms to produce web series.

5. Saina Play:

'Saina' is not an obscure Malayalam name. Saina was a significant film and music distributor for almost 35 years in the '90s and early 2000s, before YouTube started catering to our content requirements. The company has now launched a 'Sainaplay' digital platform with great price packages using Saina Play coupons. This OTT app offers free of charge more than 200 Malayalam movies in HD quality. The list includes films such as 'Kolambi,' which has received three awards already. On Google Play, the app is already available.

6. M Flix:

M Flix is Kerala's new streaming site for exclusive content. Trending movies, short movies, and web series can be viewed for free here. Download the app, sit down and enjoy the subscription using M Flix coupons. Old and new films, web shows, short films, and much more. Content creators can stream content (movies, web series, and short films) with a massive audience with the M Flix App.

7. Netflix:

Netflix doesn't need an introduction. Tons of amazing and highly-streamed original Malayalam shows and movies, such as Comrade in America, Forensic, Uyare, Vikrithi, Maniyarayile Ashokan, Kappela, and Varane Avashyamund, have been delivered by the American over-the-top video channel. Not only for Malayalam, Netflix tops the list when it comes to Best English OTT platforms. Several Netflix subscription plans are available, namely Mobile, Basic, Regular, and Premium, starting at just Rs 199 a month. But you can enjoy all the content by applying Netflix Subscription coupons for much more flexible prices. In India, the Netflix plans vary in terms of resolution and the amount of simultaneous streaming, although the content catalog remains the same.

8. Amazon Prime Video:

Amazon Prime Video membership is free with the Prime membership of the e-commerce website, which also offers free Amazon Prime Music subscription and unlimited free and easy delivery, exclusive sales and promotions, and access to ebooks with Amazon coupons for discounts. For its original web series and other Malayalam movies like Lucifer, Kumbalangi Nights, Neelakasham Pachakadal Chuvanna Bhoomi, C U Soon, Helen, Trance, Ayyappanum Koshiyum. It is also home to several international TV shows and movies, regional entertainment, Bollywood, content for kids, and iconic TV shows critically acclaimed. Membership with Amazon Prime costs Rs 129 a month and Rs 999 a year.

9. Sony Liv:

Sony Liv has more than 18 years of content, including 8 MALAYALAM channels such as Flowers TV, Mazhavil Manorama, Kairali TV, We TV, Amrita TV, Kerala Vision Kerala HD, Media One, Janam TV, WWE, European football, La Liga, Champions League, and other sporting events that are broadcast live on Sony SIX, Sony TEN 1, Sony TEN 2, and Sony TEN 3 channels through the OTT platform. Other than Malayalam, it can be on the Best Hindi OTT platforms as it provides best content in Hindi films too. With its plans in India starting at just Rs 199 a month, the Sony Liv app is also subscription-based, but you can save the deal prices with SonyLiv coupons. It also provides the premium shows and premium episodes of the respective shows with a rightful subscription.

How will 5G technology impact the broadcast industry and OTT services?

In future 5G technology will allow faster data rates, which will completely change scenario of how we consume content. The 5G technology will enable users to download a full HD movie in less than 10 seconds which is far better than 10 min on the current 4G network. The current latency speed on 4G network is around 30-40 milliseconds, but with the help of 5G technology this delay will be chopped to about 1 millisecond or maybe less. Thus users will enjoy unbelievable video streaming on various OTT platforms. The biggest attraction of 5G technology is that upcoming generations of network will have greater capacity, which means the systems will cope up with high demand applications like virtual reality experience with simultaneous HD video streaming. The 5G technology will simply enhance mobile media experience which will significantly disrupt the entertainment business models. It is estimated that the media revenue will be twice in 2028 which is (\$420 billion) from the current \$170billion (2018). (Lapsiwala, 2019)

Future growth of OTT platforms in India:

India's video OTT market is expected to touch \$12.5 billion by 2030 from about \$1.5 billion in 2021 on the back of access to better networks, digital connectivity and smartphones, according a report by RBSA Advisors. The report noted that the next wave of growth in the OTT

landscape will come from tier II, III and IV cities and the Indian language speaking population. "OTT industry is poised for aggressive growth prospects with access to better networks, digital connectivity and smartphones. OTT platforms in India have been increasingly attracting subscribers on a daily basis. Apart from top favourites Disney+ Hotstar, Amazon Prime Video and Netflix, the space is seeing a plethora of local and regional OTT players," it added. These include players like SonyLIV, Voot, Zee5, ErosNow, ALTBalaji, Hoichoi and Adda Times among others. The report said the Indian video OTT market in India is expected to grow from \$1.5 billion in 2021 to \$4 billion in 2025 and further to \$12.5 billion by 2030. The audio OTT market - which sees participation from players like Gaana, JioSaavn, Wynk Music, Spotify and others - is also poised to grow from \$0.6 billion in 2021 to \$1.1 billion in 2025 and further to \$2.5 billion by 2030, it added. "The OTT market in India is expected to grow at a CAGR of 28.6 per cent over the next four years. RBSA believes that this industry has the potential to grow to be \$15 billion industry over the next 9 to 10 years," it said. The report highlighted that Covid-19 pandemic has been a game-changer and OTT video streaming platforms including Netflix, Amazon Prime Video, Disney+ Hotstar, Voot, SonyLIV and others had gained immense popularity in India. It added that the OTT landscape is expected to get hyper competitive in next 4-5 years, and the OTT service providers will strive to emerge as the preferred platform among the consumers. The massive investments made by OTT services like Netflix, Amazon, Disney+ Hotstar and others in originals as well as acquired content will help subscription video-on-demand make up 93% of the total OTT revenue (as compared to 87% globally), increasing at a CAGR of 30.7% between 2019-2024, it said. The report said the ARPU (average revenue per user) in the OTT video segment in India is projected at \$7.2 (about Rs 537.25) in 2021. Also, the OTT userbase is expected to be at 462.7 million by 2025. "The viewing habits of Indian consumers have evolved a lot in the last few years. While on the one hand, short-form video content consumption on smartphones and social platforms has been on the rise, binge-watching shows on various OTT platforms have also become more common on the other hand," it added.

CHAPTER IV
DATA ANALYSIS AND
INTERPRETATION

4. DATA ANALYSIS AND INTERPRETATION

This data is collected to analyse the role of pandemic on usage of OTT platforms. This analysis had been made on the basis of primary data collected from a sample of 120 respondents. The data has been collected through questionnaire method. Random sampling has been used for the selection of samples. Following are the table figures and interpretations of primary data collected.

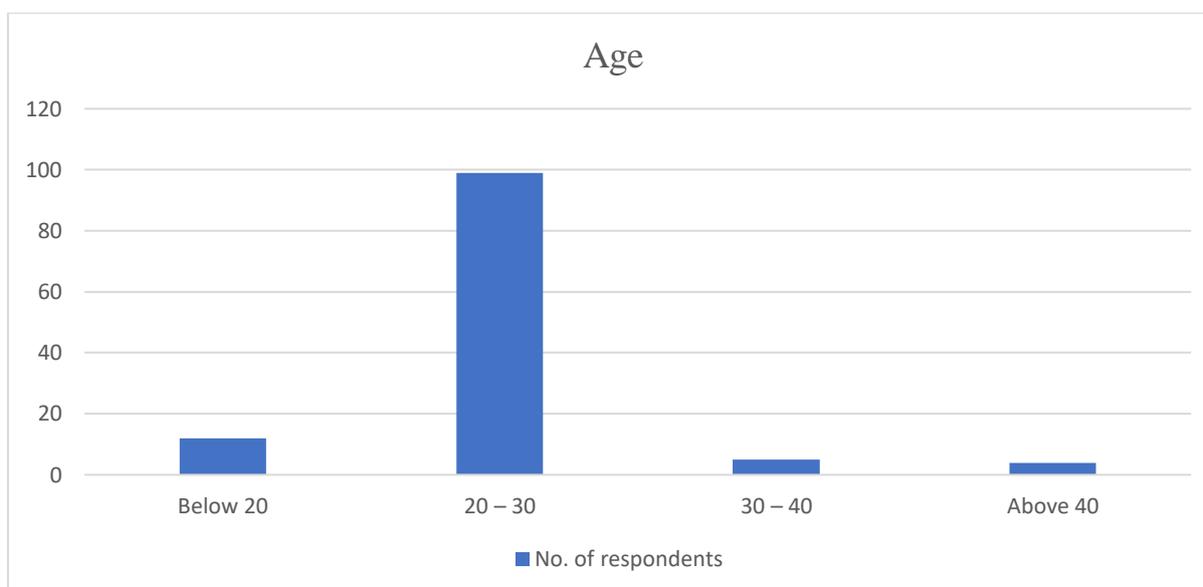
4.1 AGE GROUP

Table 4.1 Table showing age group of the respondents.

Age group	No. of respondents	Percentage (%)
Below 20	12	10%
20-30	99	82.5%
30-40	5	4.17%
Above 40	4	3.33%
TOTAL	120	100%

(Source: primary data)

Graph 4.1 Graph showing age group of the respondents.



Interpretation: From the above-mentioned bar diagram, we can estimate that in the recent years the number of OTT platform users are high among the age group 20-30 years which is 99 respondents out of 120. This kind of spike in the number of OTT platform users among the

youth is mainly seen during the last two years because of the COVID-19 pandemic. The least number of users are found in the age group – Above 40, which is 4 respondents out of 120. 12 respondents out of 120 belong to age group – Below 20. 5 respondents out of 120 respondents belong to age group 30-40.

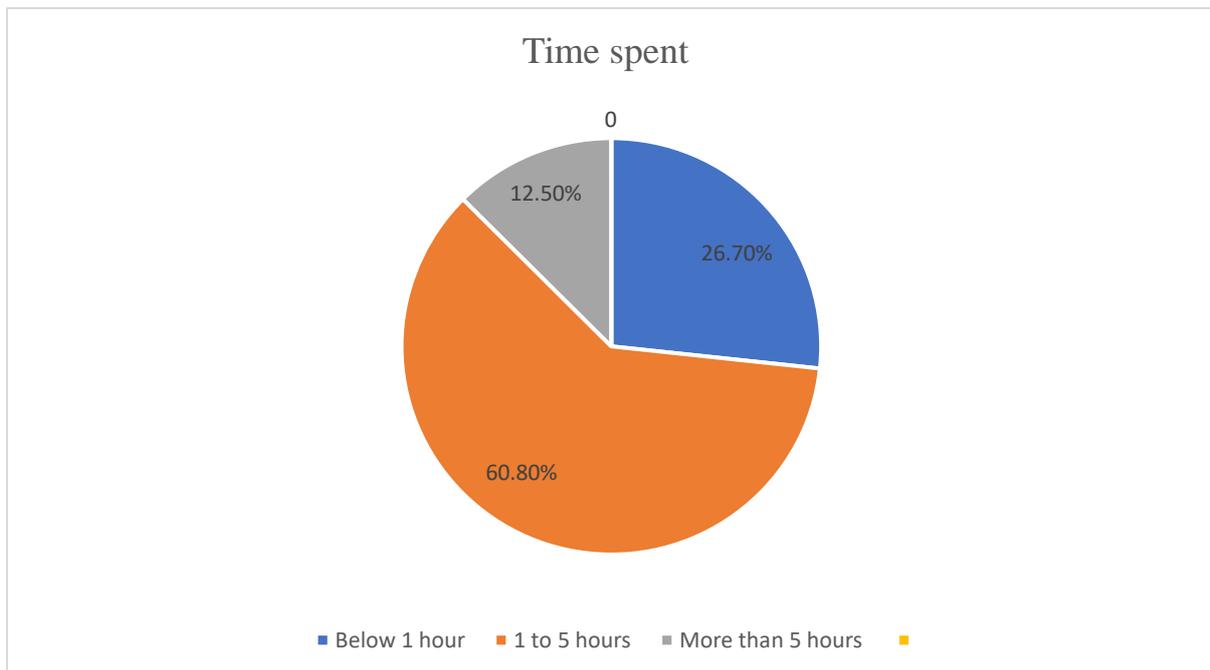
4.2 TIME SPENT IN OTT PLATFORMS

Table 4.2 Table showing time spent in OTT platforms

Time spent	No. of respondents	Percentage (%)
Below 1 hour	32	26.7%
1 or 5 hours	73	60.8%
More than 5 hours	15	12.5%
TOTAL	120	100%

(Source: primary data)

Graph 4.2 Pie chart showing the time spend on OTT platforms a day of the respondents.



Interpretation: From the above pie chart, out of 120 respondents we can estimate that 73 (60.8%) spend 1 to 5 hours a day in OTT platforms whereas only 15 (12.5%) spend more than 5 hours. 32 (26.7%) respondents spend below 1 hour in OTT platforms.

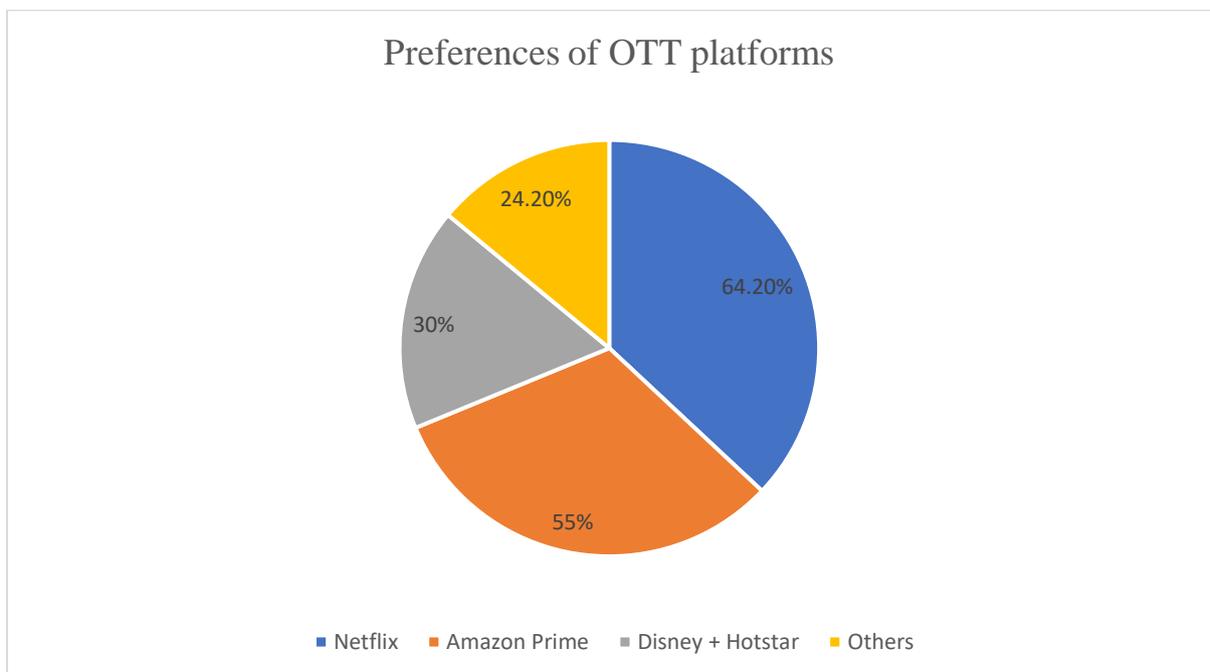
4.3 PREFERENCES OF OTT PLATFORMS

Table 4.3 Table showing preferences of OTT platforms.

OTT platforms	No. of respondents	Percentage (%)
Netflix	55	45.8%
Amazon Prime	44	36.7%
Disney +Hotstar	14	11.7%
Others	7	5.8%
TOTAL	120	100%

(Source: primary data)

Graph 4.3 Graph showing the preference of OTT platforms by the respondents.



Interpretation: The pie chart mentioned above shows that out of the 120 respondents, almost 77(64.2%) of them chose the 'Netflix' category while the remaining 66(55%) chose the category amazon prime,36(30%) chose Disney+Hotstar and 29(24.2%) respondents chose the category others.

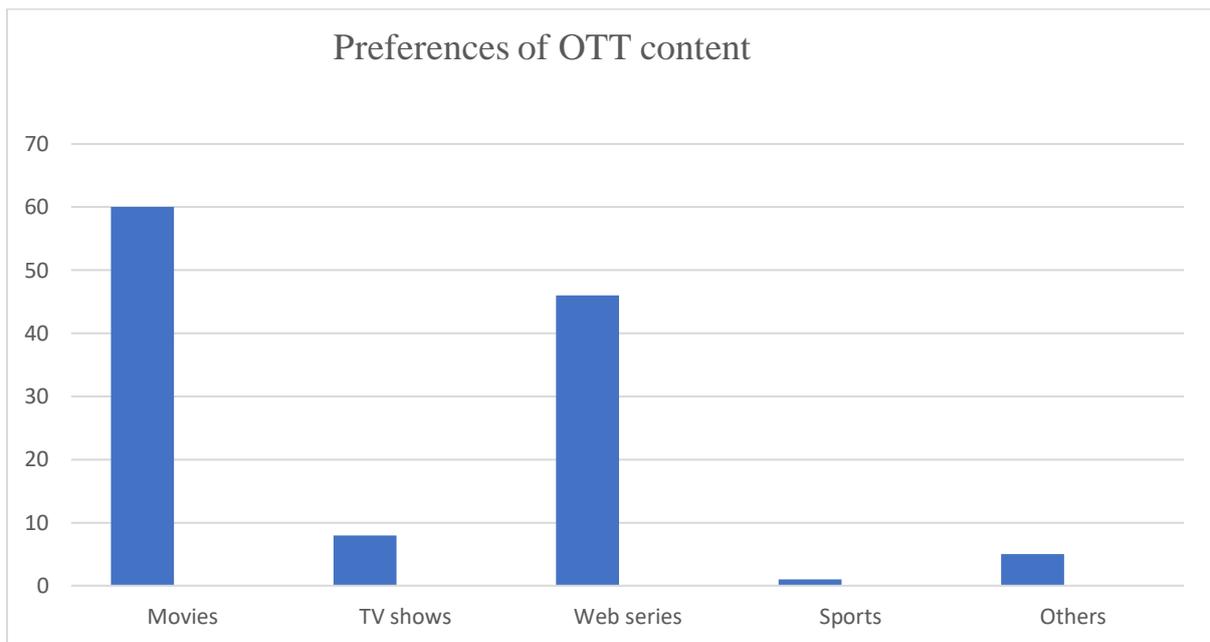
4.4 PREFERENCES OF OTT CONTENT

Table 4.4 Table showing preferences of OTT content.

Content	No. of respondents	Percentage (%)
Movies	60	50%
TV shows	8	6.7%
Web series	46	38.3%
Sports	1	0.8%
Others	5	4.2%
TOTAL	120	100%

(Source: primary data)

Graph 4.4 Graph showing the preference of respondents to watch on OTT platforms.



Interpretation: From the above-mentioned bar diagram, we can understand that most of them, that is, 60 respondents out of 120 preferred to watch movies. Only 1 respondent out of 120 has chosen sports hence making it the least preferred OTT content. 46 out of 120 respondents chose to watch web series in OTT platforms. 8 preferred TV shows and the rest 5 went for watching other content.

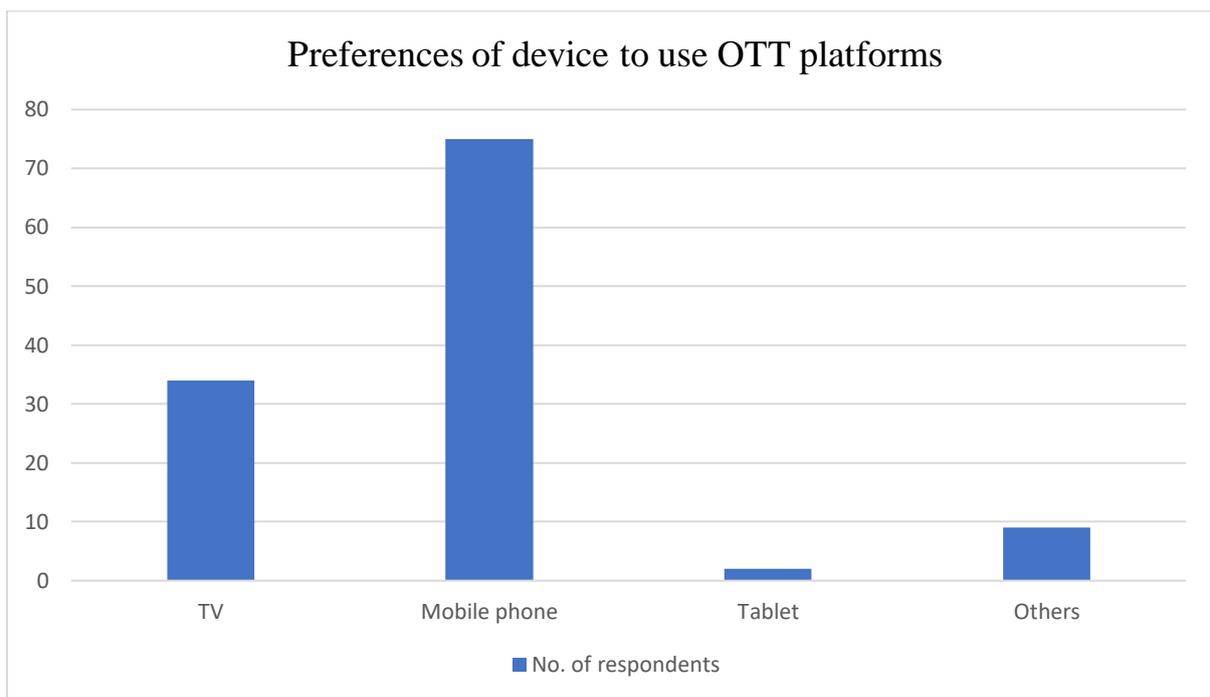
4.5 PREFERENCES OF DEVICES TO USE OTT PLATFORMS

Table 4.5 Table showing preferences of devices to use OTT platforms.

Devices	No. of respondents	Percentage (%)
TV	34	28.3%
Mobile phone	75	62.5%
Tablet	2	1.7%
Others	9	7.5%
TOTAL	120	100%

(Source: primary data)

Graph 4.5 Graph showing the device preference of the respondents to use OTT platforms.



Interpretation: The bar diagram mentioned above shows that out of the 120 respondents, almost 75 of them chose mobile phones to use OTT platforms while only 2 preferred table. 34 chose TV and 9 chose other devices to use OTT platforms.

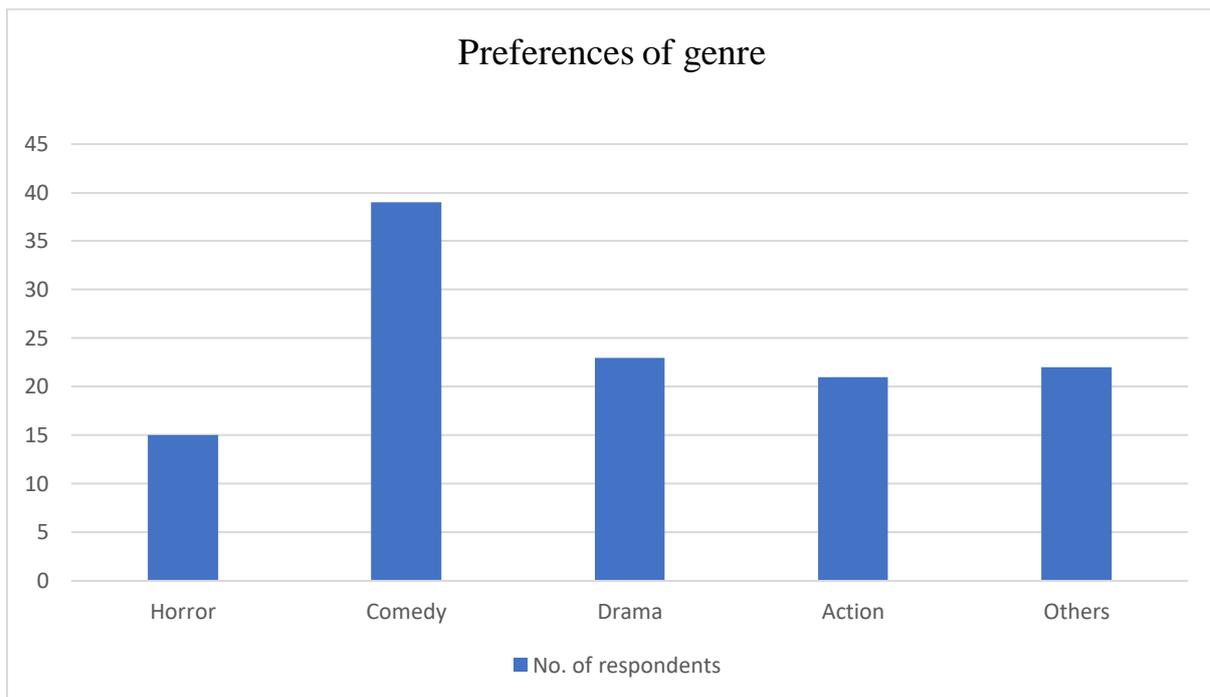
4.6 PREFERENCES OF GENRE

Table 4.6 Table showing preferences of genre.

Genre	No. of respondents	Percentage (%)
Horror	15	12.5%
Comedy	39	32.5%
Drama	23	19.2%
Action	21	17.5%
Others	22	18.3%
TOTAL	120	100%

(Source: primary data)

Graph 4.6 Graphical representation showing the genre preference of the respondents.



Interpretation: From the above-mentioned bar diagram, we can understand that out of the 120 respondents, 39 of them preferred to watch comedy genre. The least chosen category is horror, preferred by only 15 respondents. 23 respondents chose drama, 21 respondents chose action and 22 went for other genres.

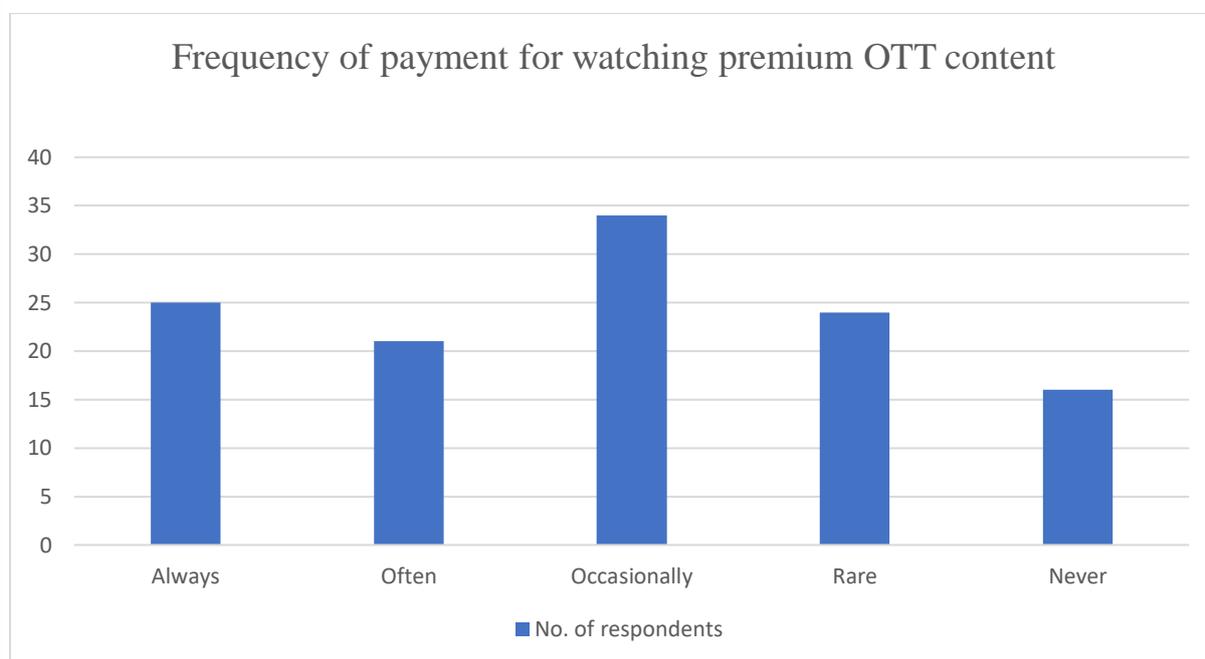
4.7 FREQUENCY OF PAYMENT FOR WATCHING PREMIUM OTT CONTENT

Table 4.7 Table showing frequency of payment for watching premium OTT content.

Category	No. of respondents	Percentage (%)
Always	26	21.7%
Often	20	16.7%
Occasionally	34	28.3%
Rare	24	20%
Never	16	13.3%
TOTAL	120	100%

(Source: primary data)

Graph 4.7 Graph showing the preference of the respondents to pay for watching premium content on OTT platforms.



Interpretation: From the above-mentioned bar diagram, we can understand that most of the respondents which is 34 out of 120, occasionally pays for watching premium content while 16 respondents never pays for premium content. 26 respondents always pay, 24 pays rarely and 20 pays often for watching premium content in OTT platforms.

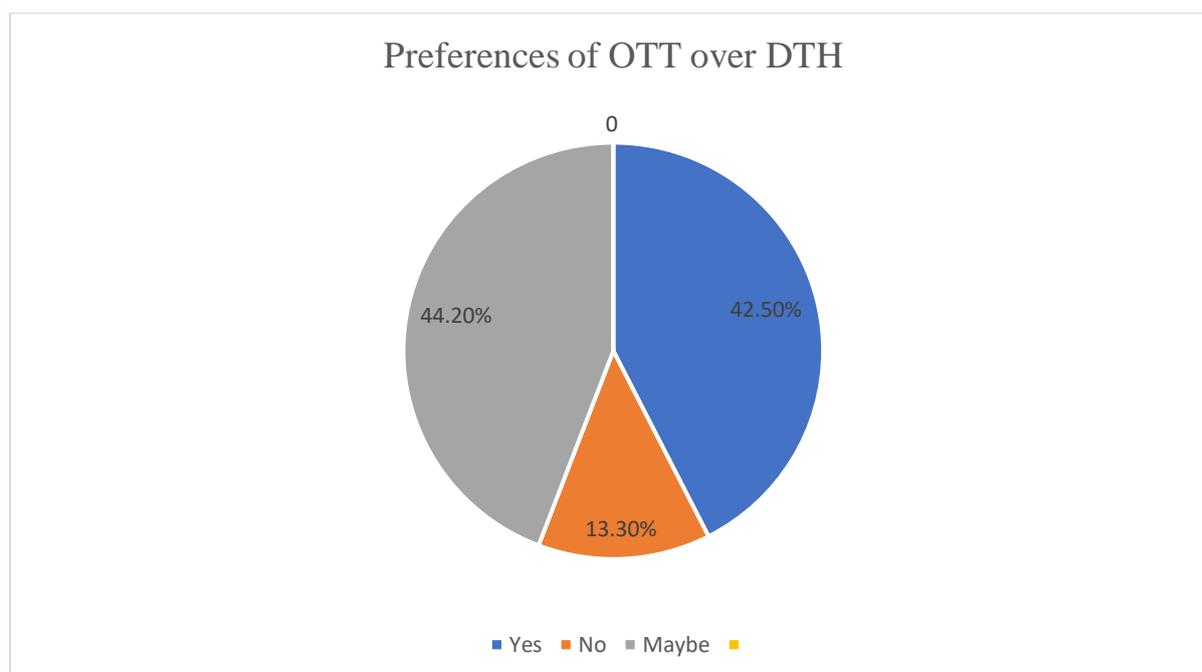
4.8 PREFERENCES OF OTT PLATFORMS OVER DTH

Table 4.8 Table showing preferences of OTT platforms over DTH.

Preferences	No. of respondents	Percentage (%)
Yes	51	42.5%
No	16	13.3%
Maybe	53	44.2%
TOTAL	120	100%

(Source: primary data)

Graph 4.8 Pie chart showing the preference of OTT platforms over DTH of the respondents.



Interpretation: From the above pie chart, we can estimate the 53 (44.2%) respondents out of 120, maybe preferring OTT platforms over DTH while only 16 (13.3%) respondents doesn't choose OTT platforms over DTH. 51 (42.5%) respondents chose OTT platforms over DTH.

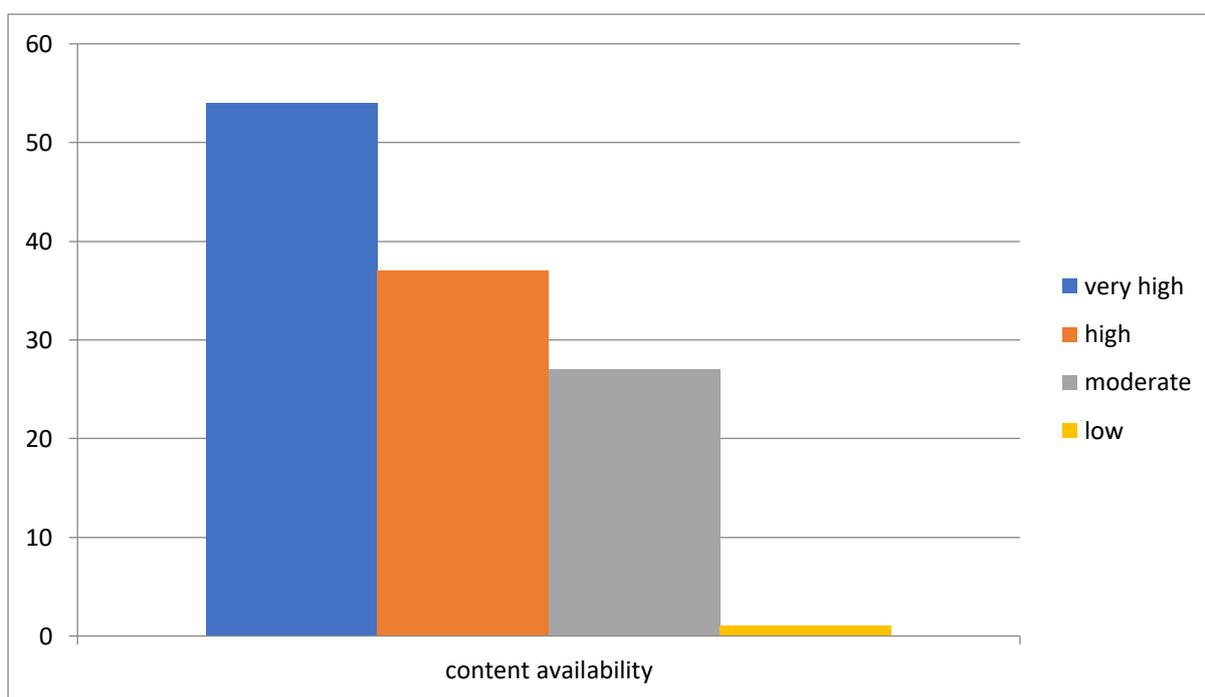
4.9 DEGREE OF VARIOUS FACTORS INFLUENCING THE CHOICE OF OTT PLATFORMS OVER DTH

Table 4.9 Table showing degree of various factors influencing the choice of OTT platforms over DTH.

Category	Very high	High	Moderate	Low	Total
Content availability	54	37	27	1	120
Subscription	29	34	50	6	120
Mobility	34	41	39	5	120
Customer service	28	44	41	6	120

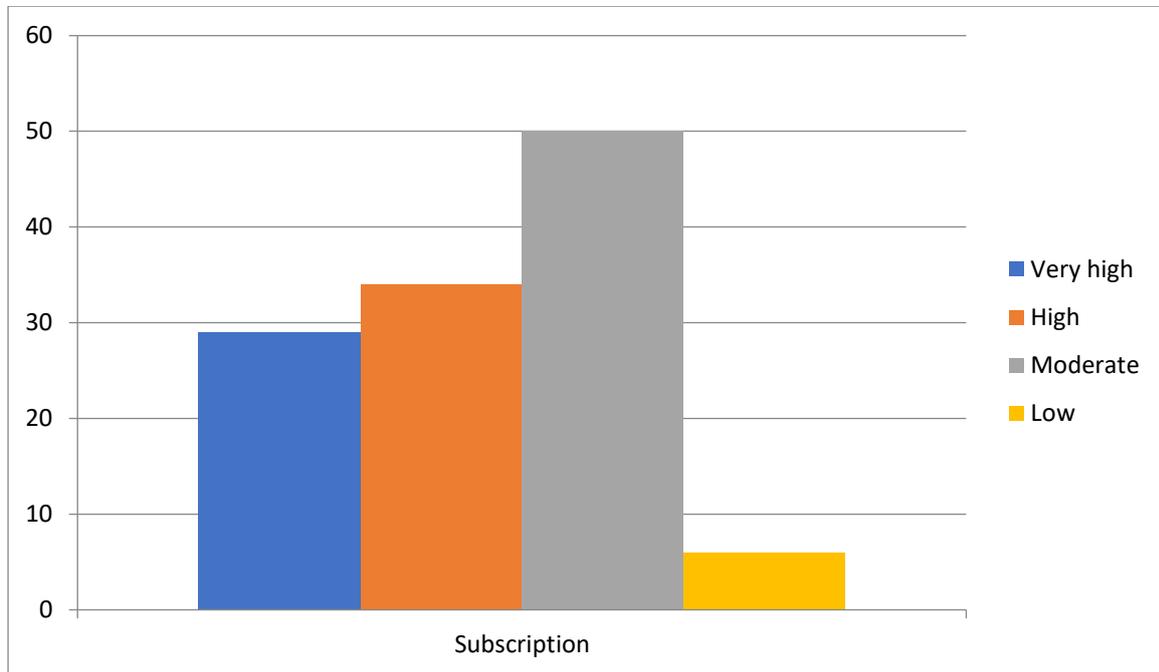
(Source: primary data)

Graph 4.9.1 Graph showing the influence of content availability regarding the choice of OTT platforms over DTH of the respondents.



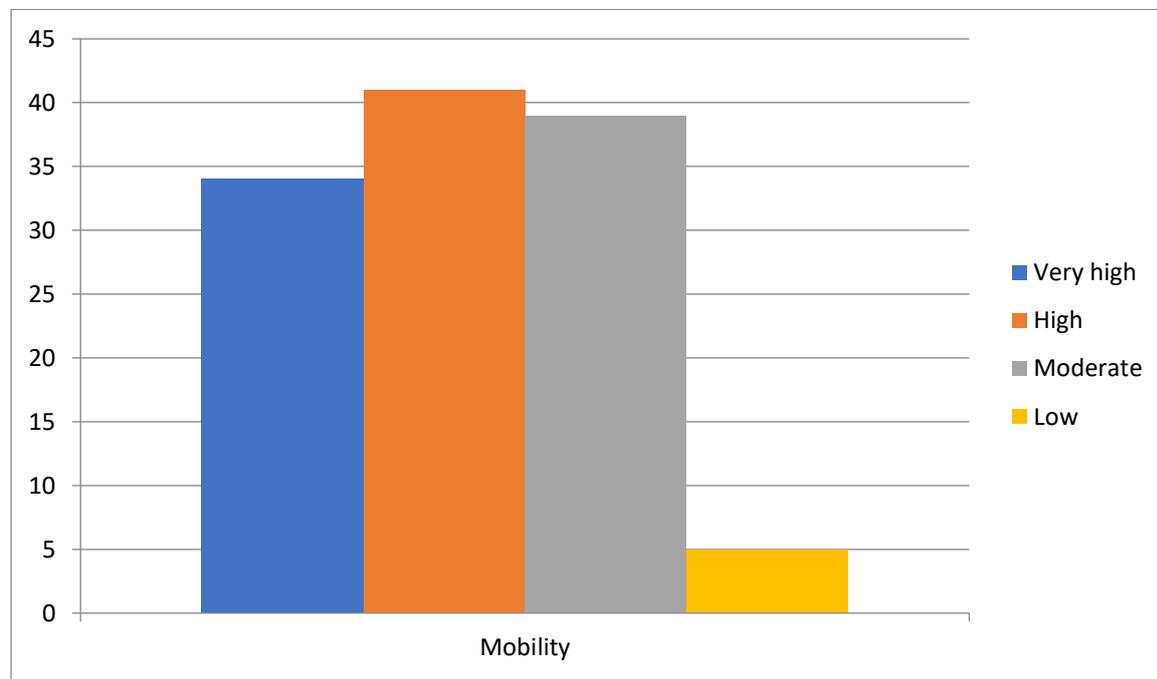
Interpretation: From the above diagram we can understand that 54 respondents out of 120, chose “Very high” making content availability the major factor influencing the customers’ choice of OTT platforms over DTH. Only 1 respondent chose “Low”. 37 chose “high” and 27 chose “Moderate”.

Graph 4.9.2 Graph showing the influence of subscription regarding the choice of OTT platforms over DTH of the respondents.



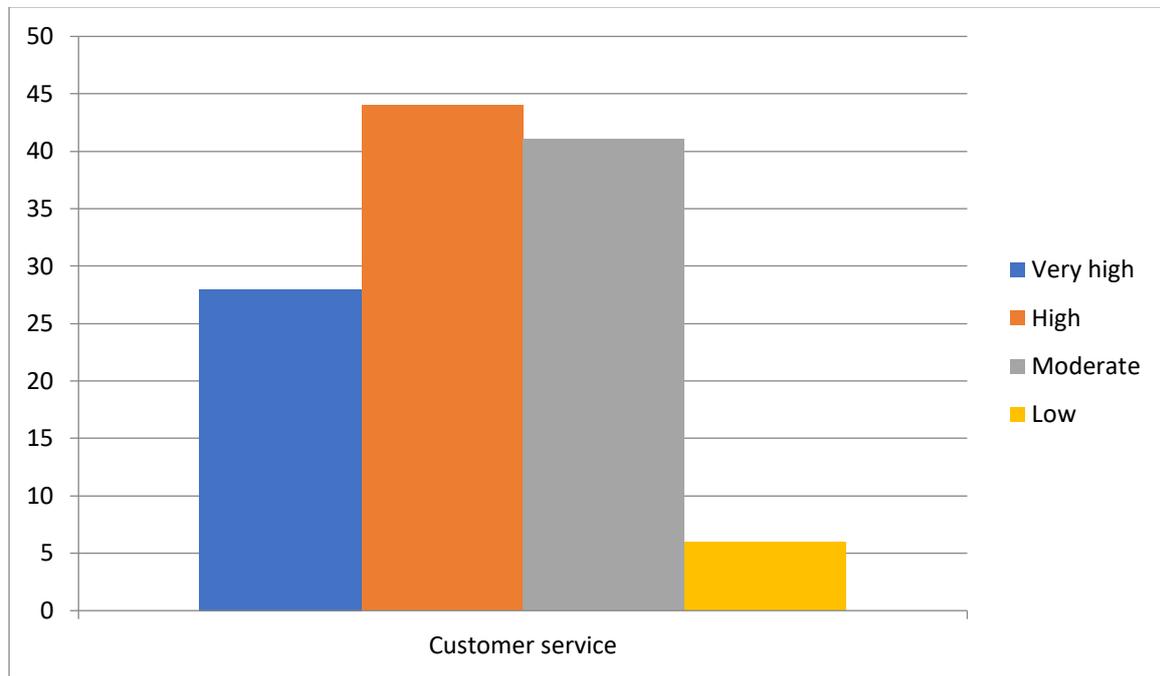
Interpretation: The diagram illustrates that 50 respondents out of 120, chose “Moderate” making subscription, the third major factor influencing the customers’ choice of OTT platforms over DTH. 6 chose “low”. 29 chose “Very high” and 34 chose “High”.

Graph 4.9.3 Graph showing the influence of mobility regarding the choice of OTT platforms over DTH of the respondents.



Interpretation: The diagram illustrates that 50 respondents out of 120, chose “Moderate” making subscription, the fourth major factor influencing the customers’ choice of OTT platforms over DTH. 6 chose “low”. 29 chose “Very high” and 34 chose “High”.

Graph 4.9.4 Graph showing the influence of customer service regarding the choice of OTT platforms over DTH of the respondents.



Interpretation: The diagram illustrates that 44 respondents out of 120, chose “High” making customer service, the second major factor influencing the customers’ choice of OTT platforms over DTH. 6 chose “low”. 28 chose “Very high” and 41 chose “Moderate”.

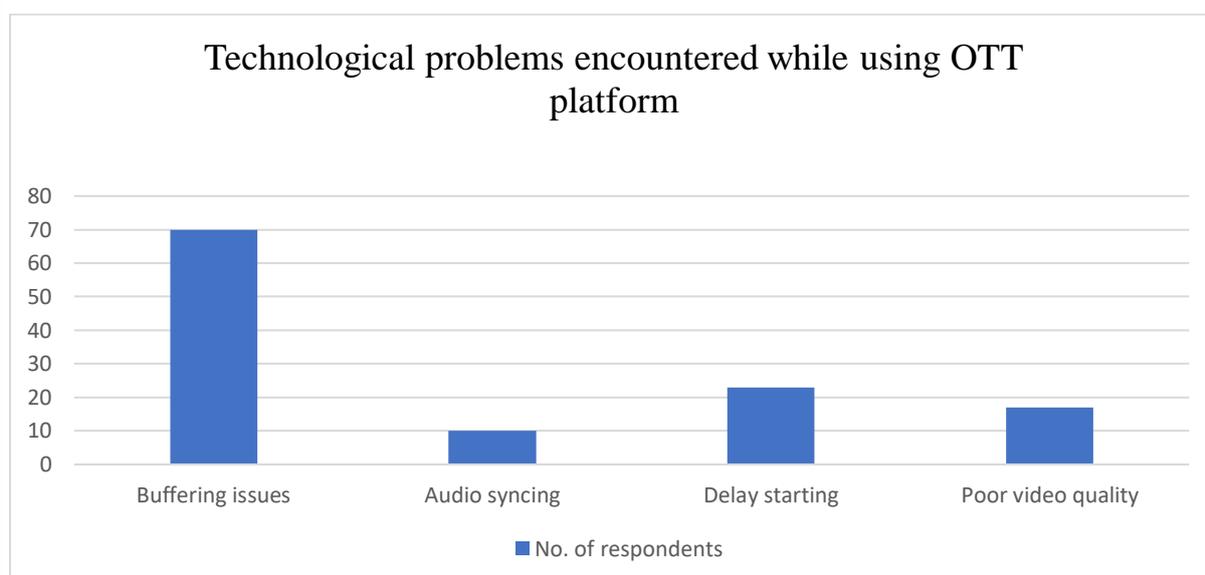
4.10 TECHNOLOGICAL PROBLEMS ENCOUNTERED WHILE USING OTT PLATFORMS

Table 4.10 Table showing technological problems encountered while using OTT platforms.

Technological problems	No. of respondents	Percentage (%)
Buffering issues	70	58.3%
Audio syncing	10	8.3%
Delay starting	23	19.2%
Poor video quality	17	14.2%
TOTAL	120	100%

(Source: primary data)

Graph 4.10 Graph showing the technological problems faced by the respondents while using OTT platforms.



Interpretation: From the above bar diagram, we can understand that buffering issues is the major issue during online streaming. Out of 120 respondents, 70 of them faced it while delay starting issue is encountered by 23 and poor video quality faced by 17 respondents. Audio syncing is the least encountered problem being only by 10 respondents.

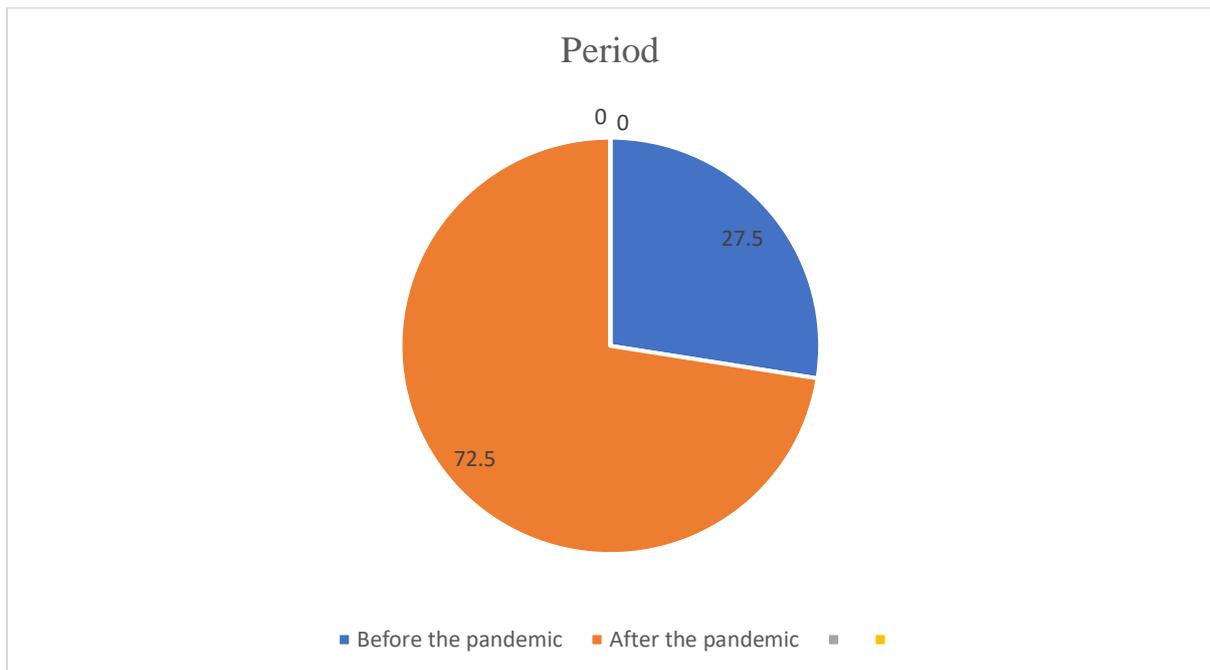
4.11 PERIOD OF TIME WHEN RESPONDENTS STARTED USING OTT PLATFORMS, THE MOST

Table 4.11 Table showing period of time when respondents started using OTT platforms, the most.

Period of time	No. of respondents	Percentage (%)
Before the pandemic	33	27.5%
During the pandemic	87	72.5%
TOTAL	120	100%

(Source: primary data)

Graph 4.11 Pie chart showing the when did the respondents start using the OTT platforms.



Interpretation: The above pie chart illustrates that majority of the respondents i.e., 87 (72.5) respondents began using OTT platforms during the pandemic, the most whereas 33 (27.5%) respondents have already been using OTT mostly, before the pandemic itself.

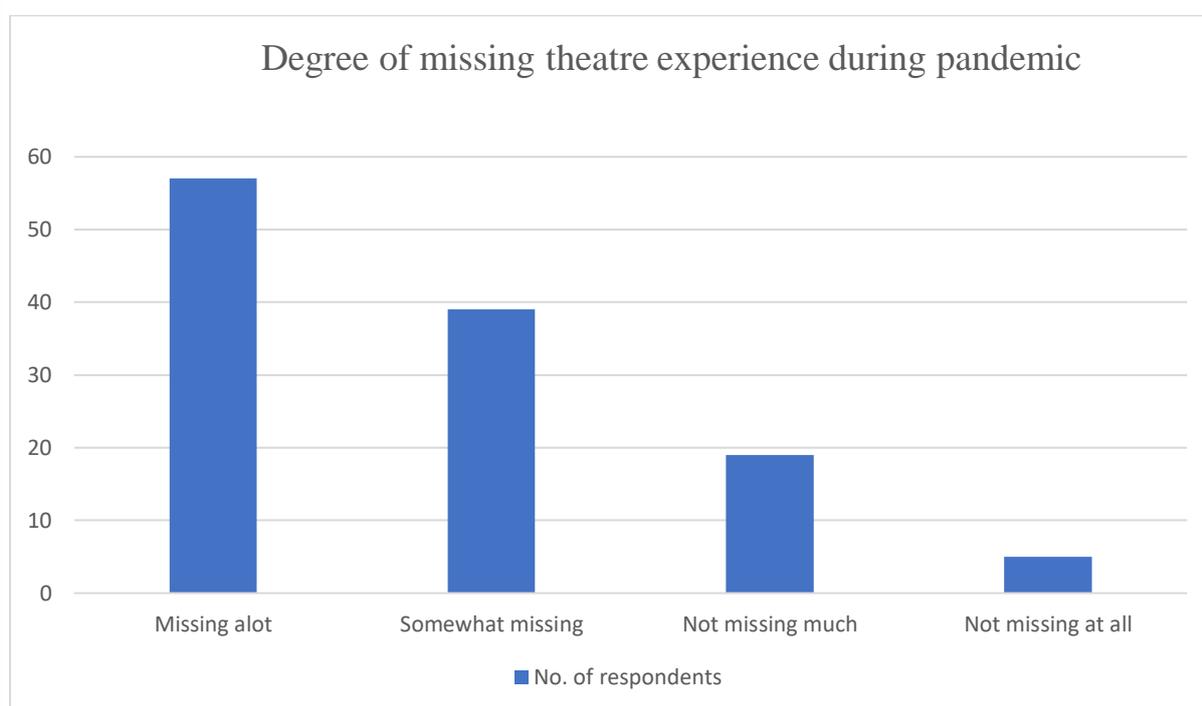
4.12 DEGREE OF MISSING THEATRE EXPERIENCE DURING PANDEMIC

Table 4.12 Table showing degree of missing theatre experience during pandemic.

Category	No. of respondents	Percentage (%)
Missing alot	57	47.5%
Somewhat missing	39	32.5%
Not missing much	19	15.8%
Not missing at all	5	4.2%
TOTAL	120	100%

(Source: primary data)

Graph 4.12 Graph showing the whether the respondents miss theatre experience during the pandemic.



Interpretation: The above bar diagram interprets that 57 respondents miss theatre experience alot while 39 somewhat miss and 19 are not missing theatre experience much. 5 respondents are not missing theatre at all.

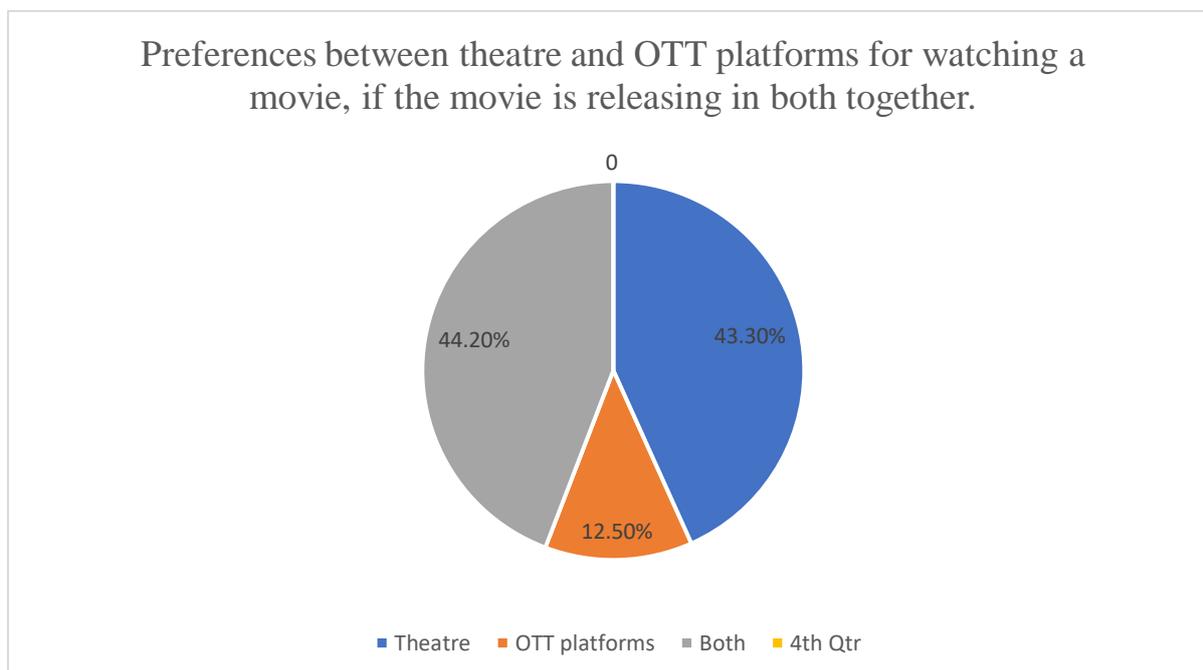
4.13 PREFERENCES BETWEEN THEATRE AND OTT PLATFORMS FOR WATCHING A MOVIE, IF THE MOVIE IS RELEASING IN BOTH TOGETHER

Table 4.13 Table showing preferences between theatre and OTT platforms for watching a movie, if the movie is releasing in both together.

Preferences	No. of respondents	Percentage (%)
Theatre	52	43.3%
OTT platforms	15	12.5%
Both	53	44.2%
TOTAL	120	100%

(Source: primary data)

Graph 4.13 Pie chart showing the preference of the respondents to watch a movie in theatre and on OTT platforms.



Interpretation: From the pie chart, we can understand that in future, if a movie releases in theatre and OTT together then 53 (44.2%) respondents mostly choose to watch movie in both (theatre and OTT). It is also another significant matter that there is only minor difference between number of respondents who choose ‘both’ and ‘theatre’ (43.3%). 15 (12.5%) respondents mostly prefers to watch movie solely in OTT platforms.

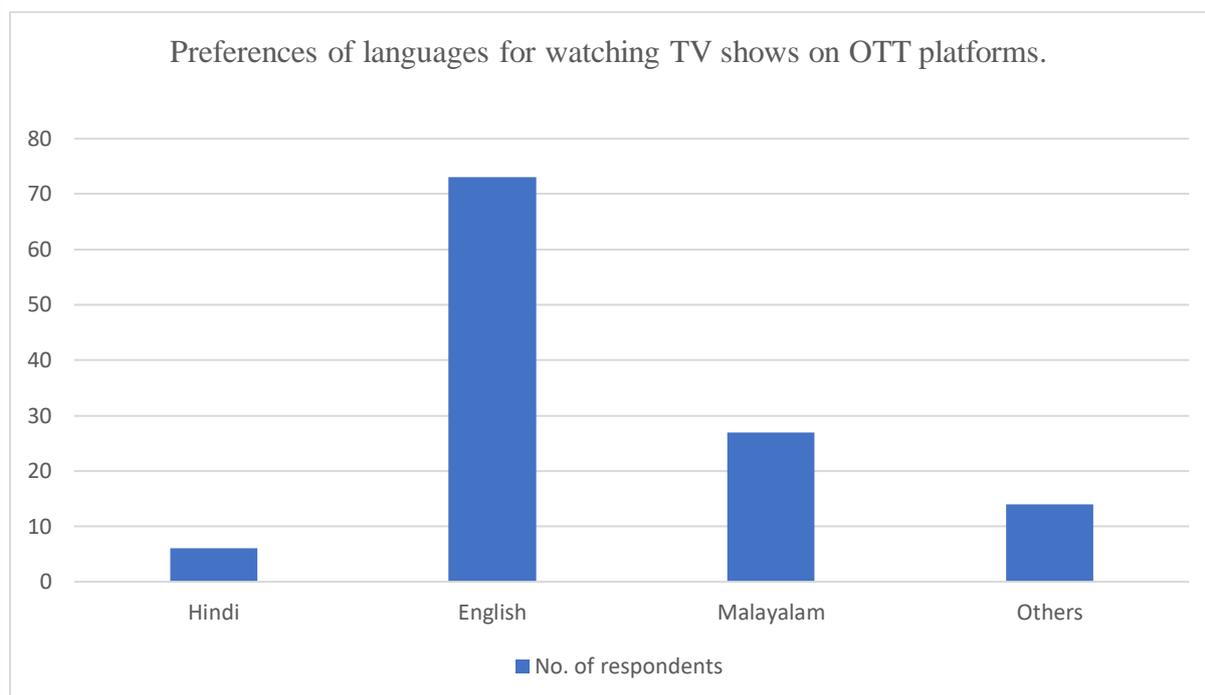
4.14 PREFERENCES OF LANGUAGES FOR WATCHING TV SHOWS ON OTT PLATFORMS

Table 4.14 Table showing preferences of languages for watching TV shows on OTT platforms.

Languages	No. of respondents	Percentage (%)
Hindi	6	5%
English	73	60.8%
Malayalam	27	22.5%
Others	14	11.7%
TOTAL	120	100%

(Source: primary data)

Graph 4.14 Graph showing the language preference of tv shows of the respondents.



Interpretation: The bar diagram shows that majority of the respondents i.e., 73 out of 120 would rather go for watching English TV shows on OTT platforms while 27 respondents prefers to watch Malayalam and 14 would choose other languages. Hindi is the least preferred option being chosen by only 6 respondents.

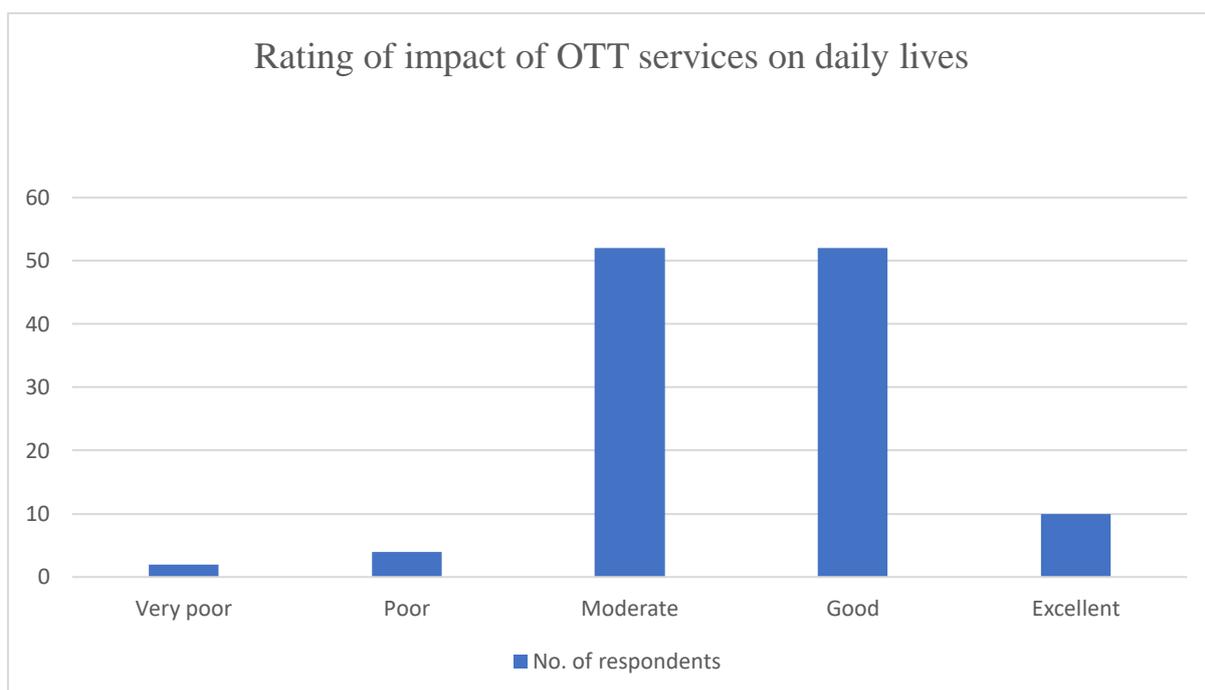
4.15 RATING OF IMPACT OF OTT SERVICES ON DAILY LIVES

Table 4.15 Table showing rating of impact of OTT services on daily lives.

Category	No. of respondents	Percentage (%)
Very poor	2	1.7%
Poor	4	3.3%
Moderate	51	42.5%
Good	53	44.2%
Excellent	10	8.3%
TOTAL	120	100%

(Source: primary data)

Graph 4.15 Graphical representation showing the impact of OTT services on day-to-day life of the respondents.



Interpretation: The above bar diagram illustrates that 53 respondents out of 120, feel that OTT services have good impact while only 2 respondents feel that OTT services have very poor impact on their day-to-day lives. 51 respondents chose “Moderate”, 10 chose “Excellent” and 4 chose “poor” about the impact of OTT services on their daily lives.

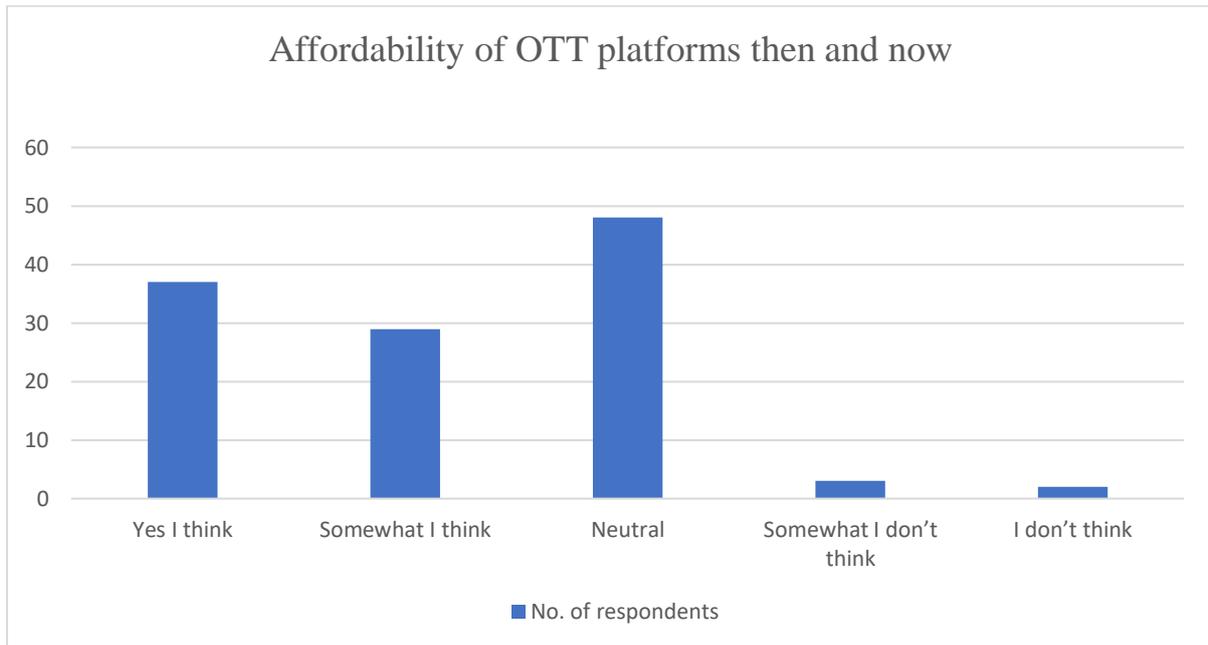
4.16 AFFORDABILITY OF OTT PLATFORMS THEN AND NOW

Table 4.16 Table showing affordability of OTT platforms then and now.

Category	No. of respondents	Percentage (%)
Yes, I think	37	30.8%
Somewhat I think	30	25%
Neutral	48	40%
Somewhat I don't think	3	2.5%
I don't think	2	1.7%
TOTAL	120	100%

(Source: primary data)

Graph 4.16 Graphical representation showing the affordability of OTT platforms of the respondents.



Interpretation: From the above bar diagram, it's clear that majority of the respondents, to be precise, 48 of them have a neutral opinion about whether the OTT platforms are more affordable now than earlier. 37 respondents truly believe that OTT platforms are more affordable now than earlier while only 2 respondents don't think that OTT platforms are affordable even now. 30 respondents somewhat think that OTT platforms are comparatively affordable now and 3 respondents somewhat don't think that OTT platforms are comparatively affordable now.

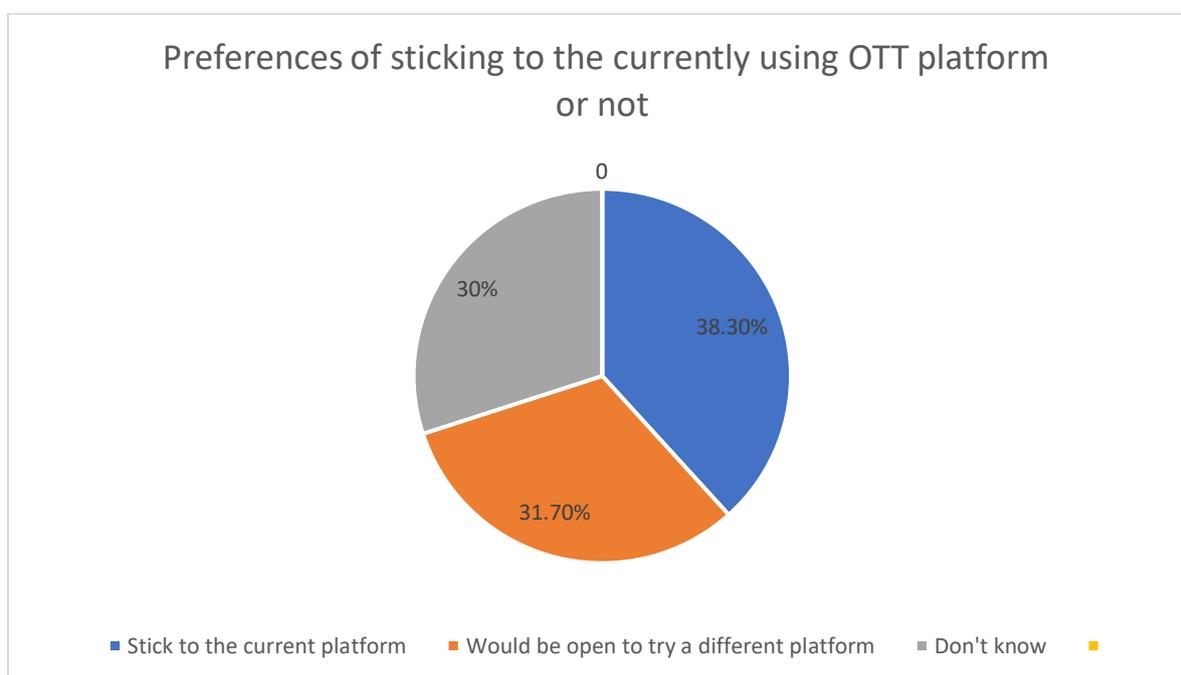
4.17 PREFERENCES OF STICKING TO THE CURRENTLY USING OTT PLATFORMS OR NOT

Table 4.17 Table showing preferences of affordability of OTT platforms then and now.

Category	No. of respondents	Percentage
Stick to the current platform	46	38.3%
Would be open to try a different platform	38	31.7%
Don't know	36	30%
TOTAL	120	100%

(Source: primary data)

Graph 4.17 Pie chart showing the preference of the respondents stick on to the OTT service they currently use.



Interpretation: The pie chart clearly describes that 46 (38.3) out of 120 respondents would choose to stick on to the current platform whereas 36 (30%) responds that they don't know. 38 (31.7%) respondents would be open to try a different platform.

CHAPTER V
FINDINGS,
SUGGESTIONS AND
CONCLUSION

5. FINDINGS, SUGGESTIONS AND CONCLUSION

5.1 FINDINGS

- It is stated that the majority of respondents belong to 20 - 30 age group (82.5%)
- Most of the respondents spend 1 - 5 hours in OTT platforms (60.8%)
- Netflix is the OTT platform preferred by major number of respondents (64.2%)
- From the study we can understand large number of respondents choose to watch movies rather than TV shows, web series, sports or any others (50%)
- The majority of respondents prefer mobile phones to use OTT platforms (62.5%)
- Comedy is the highly chosen genre among the respondents (32.5%)
- Most of the respondents prefer to occasionally pay for watching premium OTT content (28.3%)
- The majority of respondents may or may not prefer OTT platforms over DTH (44.2%)
- Content availability is the main factor that influence the choice of OTT platforms over DTH for majority of the respondents (54 respondents out of 120)
- It is stated that highest faced technological problem while using OTT platforms is buffering issues (50.8%)
- From the study we can understand that most of the respondents started using OTT platforms highly during the pandemic (72.3%)
- It is understood that large number of respondents miss theatre experience a lot during the pandemic (47.1%)
- Equal number of the respondents prefer to watch newly releasing movies in theatre alone as well as in both theatre and OTT platforms (43.7%)
- English is the highly preferred language to watch TV shows on OTT platforms (61.3%)
- Most of the respondents is of the opinion that OTT services have good impact on their daily lives (43.7%)
- The majority of respondents chose “neutral” option about the affordability of OTT platforms then and now (40.3%)
- Highest number of respondents prefer to stick to the currently using OTT platform (38.7%)

5.2 SUGGESTIONS

Regional OTT platforms must penetrate deeper into the market in order to cater to the content needs of native audiences, especially in rural areas. India is a country with rich heritage and culture brimming with stories that are worthy of a far-reaching platform to connect with its target audience. The 19,500 plus languages and dialects spoken in India is a huge opportunity for regional content developers. While the mainstream movie business focuses on commercial cinema, regional content on OTT can become an active passage to showcase our tradition. Pay per view model or subscriptions per movie must be encouraged rather than just monthly or yearly subscriptions among OTT platforms making the OTT content much more affordable. Payment models integrated into the mobile ecosystem, are very unique to the country and any OTT platform hoping to win favour with the Indian audience will have to factor in phone compatibility while designing their user experience. Now, UPI autopay is one of the highly used payment methods in India. Hence it should be also included among the payment modes in OTT platforms. In case of regional OTT platforms, steps should be also taken towards ensuring smooth payments especially for viewers abroad who may not have an Indian number. Since lot of consumers have mobile data limit (data caps), methods should be developed by OTT platforms to reduce data consumption such as compression algorithms. Inconsistent internet connectivity exists in our country. So, these platforms have to build intelligence to adjust video resolution as network and bandwidth change. Streaming quality must be adjusted to the internet speed of consumers.

5.3 CONCLUSION

Viewing content on any medium is a matter of behaviour which converts into a habit over a period of time. Indians for long have yearned for diversity of content. A common family television enabled with limited channels restricted the imagination of young India. This imagination was tapped and explored by OTT players optimally during COVID 19 and the flexibility of accessing a range of content on personal devices including smartphones and tablets gave young India the freedom to watch what they desired. OTT is a perfect place to get home entertainment. Yet, OTT players have just been able to touch the tip of the ice berg, there is immense potential to dive deeper into the regional Indian market in times to come. With just 40 OTT platforms and limited regional content, this medium has created a new niche for itself in urban India. The OTT video streaming service will continue to spread its feet and it is going

to have a huge impact on our traditional medium like television and cinema theatres. COVID 19 has played a very significant role in mass adoption of the medium in urban regions where people have better paying power than semi-urban or rural India. Smartphone penetration, international collaborations between media moguls, digital quality of the medium, cost effectiveness and access liberty are some of the reasons behind growth of streaming media in India. COVID 19 brought with itself some factors which became the new normal, like working from home, which have seemed to offer flexibility of schedules to many. A random walk and tea time with a colleague have been replaced with a 20-30min quick episode of one's favourite series available on an OTT platform. All researches point to the growing duration of video content consumption year on year and COVID 19 has proved to be a turned point in furthering this behaviour change.

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- Sant Singh
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APPENDIX

QUESTIONNAIRE

We, the students of St. Teresa's College have prepared a questionnaire for the purpose of understanding the role of pandemic on usage of OTT platforms. In order to complete our research, a few questions must be answered and the information's or feedbacks will be kept confidential.

Name

Age

1. How much time do you spend in OTT platforms a day?

- Below 1 hour
- 1 to 5 hours
- More than 5 hours

2. Which OTT platforms do you prefer?

- Netflix
- Amazon Prime
- Disney+hotstar
- Others

3. What do you prefer to watch the most to use OTT platforms?

- Movies
- TV shows
- Web series
- Sports
- Others

4. In which device you prefer the most to use OTT platforms?

- TV
- Mobile phone
- Tablet
- Others

5. Which genre do you prefer to watch on OTT platforms?

- Horror
- Comedy
- Drama
- Action
- Others

6. Do you frequently pay for watching premium content on OTT platforms?

- Always
- Often
- Occasionally
- Rare
- Never

7. Do you prefer OTT platforms over DTH?

- Yes
- No
- Maybe

8. How do the following factors influence your choice of OTT platforms over DTH?

	Very High	High	Moderate	Low
Content Availability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Subscription	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mobility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Customer Service	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9. Which of these technological problems have you encountered most often while using an OTT platform?

- Buffering issues
- Audio syncing
- Delay starting
- Poor video quality

10. When did you start using OTT platforms, the most?

- Before the pandemic
- During the pandemic

11. How much do you miss the theatre experience during the pandemic?

- Missing alot
- Somewhat missing
- Not missing much
- Not missing at all

12. In the future, if a movie releases in theatre and on OTT platforms together, what would you prefer mostly?

- Theatre
- OTT platforms
- Both

13. In which language do you prefer most to watch TV shows on the platforms?

- Hindi
- English
- Malayalam
- Others

14. How do you rate the impact by OTT services on your day to day?

- Positive
- Negative
- Not at all

15. Do you think that the OTT platforms are more affordable now than earlier?

- Yes I think
- Somewhat I think
- Neutral
- Somewhat I don't think
- Others I don't think

16. Do you prefer to stick to the OTT services you are currently using?

- Stick to the current platform
- Would be open to try a different platform
- Don't know

1.1 INTRODUCTION

Over-the-top (OTT) media service is a streaming media service offered directly to viewers via the internet. OTT bypasses cable, broadcast, and satellite television platforms, the companies that traditionally act as a controller or distributor of such content. It has also been used to describe no-carrier cellphones, where all communications are charged as data or apps for phones that transmit data in this manner, including both those that replace other call methods and those that update software. The OTT initially started as the content hosting platforms, but soon dived into making originals of their own. You need an internet connection and a compatible hardware component, which can be your mobile phones, tablets, laptops, or smart TVs, to watch the content. One can stream OTT content any time via these platforms instead of following a guide or waiting for their favourite shows and movies to air. This among the many reasons why OTT platforms are gaining popularity. OTT could also refer to the subscription model whereby the platform (i.e., Netflix) charges the fees on top of what you'd have to pay to your ISP or cable provider or allows you to avoid the fees of the operator (i.e., WhatsApp is a great example here, giving its subscribers the convenience of "free" "SMS" service using their internet connection. This definition would make WhatsApp an OTT platform).

While OTT is commonly used to denote video content, many audio services fit this definition just as well. Spotify is to music what Netflix is to TV - offering a massive trove of music via the internet connection. OTT also enables access to live streaming. These work much like channels in regular TV, but the content is streamed using the Internet connection to the audience's OTT devices / set-top boxes. The first dependent Indian OTT platform was BIGFlix, launched by Reliance Entertainment in 2008. In 2010 Digivive launched India's first OTT mobile app called nexGTV, which provides access to both live TV and on-demand content. There are currently about 40 providers of OTT in India, which distribute streaming media over the internet. In fiscal year 2018, the OTT market in India was worth Rs. 2,150 crore. The streaming marketing in India is predicted to be worth \$15 billion by 2030, with \$12.5 billion coming from the video market and \$2.5 billion from audio. The OTT market in fiscal year 2020 was estimated to be worth \$1.7 billion.

OTT Platform in recent years has empowered customers by providing them with a variety of choices for their entertainment needs. Users are no longer tied down to traditional mediums such as satellite cable. Surfing through channels are now a thing of the past, and one can now make informed decisions about what to watch. Since the outbreak of COVID-19 and consequent national lockdown in March 2020, India witnessed a significant growth in the usage of OTT and emerged as a threat to the Television industry. Until then, the popularity of OTT platforms were limited to urban area and above middle class. Today, television is increasingly delivered over the internet and new media companies are joining the race towards market dominance. Netflix has been around for so long you might think its market position is unflinching. But it's still not too late for new players to try to establish their market presence. The successes of Disney+ launched only last year but managed to exceed 28 million subscribers already.

1.2 SIGNIFICANCE OF THE STUDY

The project brings to the fore the role of pandemic on the usage of OTT platforms as it has led to reshaping consumer content preferences. The entertainment industry was massively hit in the first lockdown as all the ongoing production projects - new shows and films - came to a halt leading to a fresh content deficit on the television as well as theatres. The theatres were shut and television channels were playing reruns of the old shows. It forced consumers to look for alternate choices of entertainment and they started sampling the existing OTT platforms. These platforms had a huge library of movie and original show in multiple languages that promised to entertain the consumers. The shift from conventional media to OTT media, particularly in the lockdown period due to the COVID-19, has resulted in the war between streaming service providers to attract and retain customers. The findings of this study show that lockdown has played a major role in the increase in viewership of OTT platforms.

1.3 OBJECTIVES OF THE STUDY

- To find out the consumer consumption trends pertaining to the usage of OTT platforms.
- To understand the nature of content being consumed and timings for different genres of consumption, consumer age and commensurate content consumption.

- To analyse the innovative deals and discount packaging of OTT platforms since pandemic.
- To examine the factors influencing consumers' choice of OTT platforms over DTH.

1.4 SCOPE OF THE STUDY

The study is to track out the consumers/ preferences, priorities and their awareness toward different OTT platforms. The study is limited only to the consumers residing in Kerala. The OTT platforms were limited to cities. However, now it is available in every nook and corner of even villages, during this pandemic period. Data for the study is collected from a sample of 120 respondents using stratified sampling. The 120 respondents best represent the entire population to be studied.

1.5 STATEMENT OF PROBLEM

The entertainment industry was massively hit in the first lockdown as all the ongoing production projects – new shows and films – came to a halt leading to a fresh content deficit on the television as well as theatres. Affordable subscription fees, easier access to the internet and the increased time spent at home proved to be a boon to the OTT industry as binge-watching became the new trend. Several published reports have suggested that the time spent on OTT increased to nearly 2-3 hours during the Covid times. By conducting this study we will be able to analyse the increase in consumption of OTT platforms during the pandemic and the evolution of OTT platforms in India.

1.6 RESEARCH METHODOLOGY

1.6.1 Research design: The present study is descriptive, quantitative and analytical in nature. It is descriptive in the sense that it tries to identify various characteristics of research problem. It is quantitative because it involved numerical expression. And it is analytical since it examines, analyses and interprets collected data in order to arrive at conclusion.

1.6.2 Collection of data: Both primary and secondary data were used for data collection.

- **Primary data:** Primary data was collected by means of structured questionnaire. It was distributed to sample respondents of Cochin City.

- **Secondary data:** Information from secondary sources like journals, newspapers, books, magazines, reports, websites etc has contributed to this study.

1.6.3 **Sample design:** Random sampling technique was used to select the samples from population.

- **Population:** 120 residents of Kochi.
- **Sample size:** A sample of 120 respondents completed the entire survey within a timeframe of two weeks and this sample was evaluated for the purpose of the study.

1.6.4 **Tools for analysis:** The collected data were used with the help of statistical tool like percentages. The technique of ranking was used to study the effects of OTT platforms on the whole population of the city. Tabular and graphical presentations were used for presentation of dat. Graphical presentation includes bar diagram, pie chart etc...

1.7 LIMITATIONS

- The report had to be complete in a subject area with in a specified time line time.
- The approach to the study has been made from the point of view of individual.
- Paucity of time.
- The respondents might not have disclosed their actual opinion on certain issues.

1.8 CHAPTERISATION

Chapter 1 - Introduction: This chapter contains a brief introduction of the topic, its significance, and statement of the problem, objectives, methodology, limitations and chapterization of the study.

Chapter 2 - Review of literature: This chapter deals with the literature review which includes the study on role of OTT platforms during the pandemic conducted by other organizations.

Chapter 3 - Theoretical framework: This chapter includes the professional introduction of the role of OTT platforms during the pandemic conducted by other organizations.

Chapter 4 - Data analysis and interpretation: In this chapter data collected are analysed and interpreted based on various observations from the questionnaire obtained after the survey.

Chapter 5 - Findings, suggestions and conclusions: This chapter contains the summary of findings and recommendations. It also contains the final conclusion of the study.

CHAPTER II
LITERATURE REVIEW

An Overview of Study Constructs: Literature Review

14) JOURNAL OF CONTENT, COMMUNITY AND COMMUNICATION VOLUME 2 YEAR 6, DECEMBER- 2020

**ROLE OF COVID AS A CATALYST IN INCREASING ADOPTION OF OTTS IN INDIA:
A STUDY OF EVOLVING CONSUMER CONSUMPTION PATTERNS AND FUTURE
BUSINESS SCOPE**

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COVID-19 is an unprecedented global pandemic which has changed the way audience consume media. An undeniable trend surfaced in this period– adoption of OTTs. There are many reports which point to the growing market and consumer appetite for content of choice available on OTT platforms. OTTs offer a never before consumer advantage– choice of content, ease of access, choice of device / mediums (hand phone, laptop, tablet or TV screen). Gone are the days when family members fought for screen time of choice on family’s singular home device i.e. TV. With this study, the researchers studied the evolution of OTT space in India and reviewed the dynamic OTT space – evaluate some firsts like big banner movie releases on platforms like Amazon and Netflix, return of old content like Mythological programmes from the DD era on Hotstar etc. To complete the study, it was imperative to evaluate the impact of growing content consumption on psychographics across generations (children, adults and elderlies) as there is limited censorship in the OTT space. With this background, the researchers worked on the objectives and tried to evaluate the role played by the pandemic in evolving OTT media consumption trends; a qualitative mapping of increase in OTT adoption – Pre and Post COVID 19 in India; study underlying trends around increasing consumer appetite for the medium and analyse psychographic impact on children, adults and elderlies – listing pros and cons for freely available content with minimal censorship. The

researchers adopted a combined qualitative and quantitative approach to extrapolate the data. A survey was also conducted to do audience mapping and analysis. In addition to primary data, content from news articles, industry research reports, international journals for accumulation of key trends were analysed.

**15) INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY
RESEARCH AND TECHNOLOGY VOLUME 1, ISSUE 2**

**A STUDY ON FACTORS LEADING TO ADOPTION OF OTT SERVICES AMONG
MILLENNIAL CONSUMERS IN INDIA**

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In today's era OTT (over the top video) has become big buzzword when we talk about Digital media and availability of latest video content among consumers, especially the Generation Y category. There was an era when all the family members sit together in the evening to watch traditional shows on TV like Ramayana, Mahabharata etc . But since 2013 OTT platforms have gained significant growth and it is estimated that this video streaming content shall exceed \$332 billion by 2025. However this research is about understanding various factors which lead to adoption of OTT services among millennial consumers . Due to 5G technology and advancement in IT sector the future of OTT platform will be bright because upcoming generations will have greater capacity to cope up with highly advanced systems like delivering users the experience of virtual reality in high definition video quality. Hence the users will enjoy better services in this industry. The biggest audience for OTT businesses will be the millennial consumers who are grown up as digital natives and they don't have patience to wait for movies, TV shows etc to air on television. They want to watch the content just like preparing maggi noodles which is masala -daar, instant and on demand. Therefore this research is attempt to understand why millennial consumers are addicted to binge watch video content on the OTT platforms, what benefits they enjoy while watching video content on OTT platforms etc. This research paper will also help companies to look at the bigger picture of adopting OTT services in their business models. As the paper will brief them about the reasons

for consumer preference for this service and ways to induce repeated purchase and final adoption of OTT platforms in India.

**16) INTERNATIONAL JOURNAL OF ADVANCED RESEARCH
IN COMMERCE, MANAGEMENT & SOCIAL SCIENCE
(IJARCMSS)**

Volume 04, No. 02(II), April - June, 2021

A STUDY ON CONSUMERS' PERCEPTION TOWARDS OVER THE TOP (OTT)
PLATFORMS WITH SPECIAL REFERENCE TO GUWAHATI CITY

Jay Chopdar

Dr. Tanima Tarafdar

Over The Top platforms commonly termed as OTT platforms are online streaming media services which from past few years is gaining a lot of popularity amidst the masses. NETFLIX, AMAZON PRIME VIDEO, DISNEY + HOTSTAR are some of the many OTT channels offered to the viewers in India. As per reports the Indian OTT market is expecting \$5 Billion Customers by the year 2023. The present study hereby is an attempt to analyze the perception of consumers towards OTT platform with special reference to the City of Guwahati in Assam. The study further attempts to identify the factors influencing consumers choice towards OTT platforms and also their level of satisfaction towards the services of OTT.

17) GLOBAL MEDIA JOURNAL

The Global Network of Global Media Journal

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A REMARKABLE EVOLUTION OF OVER-THE-TOP MEDIA PLATFORMS IN INDIA:
A CASE STUDY OF BUSINESS AND REGULATORY TRENDS

The Indian film and entertainment industry has shown a shift from conventional TV and big screen to Over-the-top media platforms. These platforms provide ease of access to stream anytime anywhere over the internet. With this study the researcher explored the

remarkable evolution of these OTT platforms in India. To critically examine the study, the reasons of popularization of these platforms in Indian audiences were explored. As these platforms also have to face the criticism for showing inappropriate content, the researcher put insight into the regulatory changes made by the Government. The study implied that the evolution of OTT platforms started in 2008 with the launch of BIGFlix. A huge rise in consumer base had shown due to increased internet and smartphone base after 2015. The quality and creative content, youth-oriented population and lockdown due to COVID were the main reason of popularization of OTT platforms. The Government suggested self-classifying of the content and three-Tier mechanism to handle the grievances associated with these media platforms. The researcher adopted exploratory research design to have insights into the study. The secondary data from various news articles, blogs, reports, quality research papers were analyzed.

18) ADOPTION OF OTT PLATFORM IN INDIA DURING COVID-19

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COVID-19 is global pandemic which has changed the audience in India on the way of consume media. There is an increasingly growing number of consumers adapting to OTT Platform. While global players like Netflix and Amazon prime have steadily grown their market share in India, Indian streaming services like Hot star and JIO Cinema has gained a stronger foothold. This paper explores the role played by the pandemic in evolving OTT media consumption trends; a qualitative Analyses of increase in OTT adoption; impact of OTT on children, adults and elder lies, and future of streaming service in India through an analytical research. Other than primary data content from news articles, industry research reports, International journals for accumulation of key trends were also analyses.

**19) INTERNATIONAL JOURNAL OF BUSINESS,
MANAGEMENT AND SOCIAL RESEARCH**

**EMERGENCE AND FUTURE OF OVER-THE-TOP (OTT) VIDEO SERVICES IN INDIA:
AN ANALYTICAL RESEARCH**

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Over-the-Top (OTT) video platforms, once considered a luxury is today a commodity. In India, there is an increasingly growing number of consumers adapting to it. While Indian streaming services like Hotstar and Jio Cinema has gained a stronger foothold, global players like Netflix and Amazon Prime have steadily grown their market share in India. This paper explores the emergence, advantage, and future of streaming service in India through an analytical research. We also present the various OTT services, their growth factors, technology background, audience characteristics, content, censorship and future developments expected in the industry. Traditionally, the consumption of movies and other audio and video content has always been in the form of mediums like theatre and television. As the technology developed, it was easily accessible at home and whenever required with the introduction of VHS, DVDs, Blu-rays and disc rental services. Further, cable television brought the content through Co-axial cables and fibre optic cables. Another better service emerged as Direct-to-home (DTH) technology through satellite and dish connectivity that brought high-quality broadcast and on-demand content directly to the consumer. Recently, technological advancements have made the movie or TV watching more convenient through online streaming or Video on Demand (VoD) services. VoD refers to streaming of video content over the Internet, through applications typically referred to as Over-The-Top (OTT). Unlike traditional media, streaming services tell varied stories that are not restricted by censors, box office or demographic. It gives a viewing experience with greatly improved sound and visual quality, provided the consumers have a stable Internet.

20) OTT VIEWERSHIP AND PANDEMIC: A STUDY ON NEW TRENDS OF ONLINE VIDEO CONTENT AND CINEMA HALL FOOTFALLS.

Viewer's Dynamic Watching Experienc

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Today the world is going through an epidemic situation. In such a situation, it is the biggest challenge to make better use of your time at home. But the new trends in technology and the availability of audio video content made our problem much easier. One of them is OTT (Over The Top) video streaming services platforms like Netflix, Hotstar, Amazon Prime and Zee5, etc. In the era of this technology and the Internet, everyone likes to spend their free time in front of the digital screen, where they have many options to see. The ever-increasing viewership of the OTT video streaming services and the big star's inclination towards this platform justifies this. Today, the time we spent looking at our screens has increased immensely. As the cinema halls shut and film release has been suspended nationwide, this technological shift by the internet has created a new kind of viewing experience and that might end up changing the collective movie-watching experience in cinema hall which result in a dent in the footfall whenever the screens open again. This change in viewing experience created by OTT has a greatest fear for cinema hall owners. This paper tries to analyse the impact of these new trends, especially increasing OTT video streaming platforms viewership in lockdown, to assess the future of collective watching experience in India. It frames the attitude of Indian people towards cinema halls by assessing different vantage points that mark shifts in the watching experience. In the end, it gives the conclusion and recommendation contextualized the immensely increasing OTT viewership during lock down and its resultant effects on the collective watching experience.

**21) HOW OVER-THE-TOP (OTT) PLATFORMS ENGAGE
YOUNG CONSUMERS OVER TRADITIONAL PAY
TELEVISION SERVICE? AN ANALYSIS OF CHANGING
CONSUMER PREFERENCES AND GAMIFICATION**

Authors: Mayank Sadana, Dipasha Sharma

Source: Young Consumers: Insight and Ideas for responsible marketers Volume 22, Number
3, 2021

Article publication date: 8 April 2021

Issue publication date: 20 July 2021

This paper aims to analyse how the top over-the-top (OTT) platform is becoming a preferred source of entertainment amongst young consumers over traditional Pay TV service (Cable TV/DTH) in India and what factors play a vital role in such preferences along with gamification of content. The study follows the theoretical framework of use and gratifications theory and Niche analysis.

22) CAMPAIGN INDIA

SAB Group's chairman, co-founder, managing director speaks with Campaign India that stringent lockdowns topped with impressive content libraries containing original series, newly released blockbuster films, affordable plans, and regional flavour has led to this enriched digital shift. Due to Covid-19 restrictions, traditional TV was in the backseat with production halts and a lack of fresh content. Even as the market began to look promising and production houses gained a footing in the new pandemic market, the appeal for OTT did not die down. Having launched a media conglomerate back in 1985, navigating the testing waters of the Covid pandemic wasn't new to Markand Adhikari, as he has undergone many media transitions over four decades. In conversation with Campaign India, Adhikari talking about the pandemic blues, said, "This unprecedented circumstance is a once in a century experience and a learning curve for our businesses."

23) VIDHYA HATTANGADI, FINANCIAL EXPRESS:

Covid-19 led to a situation like a house lockup initially, and slowed down the economy like never before, taking its toll in the form of business closures, sweeping unemployment, increasing death toll, isolation and overall slowing down of all things. But this strict lockdown boosted media consumption. The over-the-top (OTT) platform saw an immense boom, and it became a major source of entertainment for viewers. In India, Arre, Disney+ Hotstar, Eros Now, BigFlix, Hooq, Netflix, Hungama Play and some 30-odd platforms have mushroomed and are being watched by majority households. A recent news story in a national daily noted that there are currently about 40 providers of OTT services, which distribute streaming media over the internet. There is no doubt that OTT has disrupted the entertainment sector. It has made watching films convenient and handy. Anybody with a mobile phone and an internet connection can watch a film, sitting anywhere in the world. Not all households have PCs and laptops for each member; the pandemic has restricted movements of people, making social life difficult. To add to that, shopping also means buying from one of the many apps that offer home delivery services; from videoconference calls with family, kids learning via online education to streaming online workouts, a lot of things have changed. Post-pandemic, some of these habits are likely to stick. Companies that had been grappling with integrating technology have had to act quicker. When life has turned topsy-turvy, what would you expect the people to do? Well, the world is busy binge watching TV shows and films. A recent study showed that mobile data is cheapest in India and this has played a key role in mushrooming of OTT platforms. OTT pricing is also quite affordable, and delivered over the affordable internet, and it does not require a traditional broadcast or cable video infrastructure for distribution. For telecom, cable, media and content businesses, OTT video subscriptions represent a new business model built around ongoing customer relationships.

24) RESEARCHDIVE.COM

IMPACT ANALYSIS OF COVID-19 ON OVER-THE-TOP MARKET

The global over-the-top (OTT) market was valued over \$110.1 billion in 2018 and is projected to generate a revenue of \$438.5 billion by 2026, at a CAGR of 19.1%. In the previous years, the global market has experience a noticeable growth due to growing demand for over-the-top (OTT) services across the all industry verticals. In addition, owing to unpredicted COVID-19 pandemic, the market is anticipated to experience a substantial growth in 2020 due

to constantly rising demand for over-the-top (OTT) services. This is majorly attributed to continuous growth in online communications services due to the lockdown since people are communicating through online platforms. Our analysts have expected the condition of the over-the-top (OTT) market during the COVID-19 pandemic and have provided few assumptions.

25) BRAND EQUITY.COM FROM ECONOMIC TIMES

HOW THE PANDEMIC EMERGED AS A BLESSING FOR INDIA'S OTT INDUSTRY

The entertainment industry was massively hit in the first lockdown as all the ongoing production projects – new shows and films – came to a halt leading to a fresh content deficit on the television as well as theatres. The theatres were shut and television channels were playing reruns of the old shows. It forced consumers to look for alternate choices of entertainment and they started sampling the existing OTT platforms. These platforms had a huge library of movies (in multiple languages) and original shows that promised to entertain the consumers.

Manish Kalra, Chief Business Officer, ZEE5 India, says, “The year 2020 bolstered the growing popularity of OTT to an all-time high. With people confined to their homes during the nationwide pandemic, consumers turned to OTT platforms for their daily dose of entertainment. Not only did they look forward to their usually preferred genres, but OTT had opened gates for them to experience many new ones. Platforms saw an increase in their overall growth (ZEE5, grew a phenomenal 200%!), watch-time increased, and platforms even saw an uptick in their subscription numbers.”

26) RISE OF OTT PLATFORMS: EFFECT OF THE C-19 PANDEMIC”

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Prof Upendra More

The Covid-19 pandemic has changed the way the Indians consumer consume entertainment. While previously cinema theatres were synonyms to hangout places and movies nowadays consumers are more interested in Netflix-n-Chill. For more than a year now, the pandemic has caused consumers to stay indoors and hence search for more adaptive ways of entertainment. This has naturally propelled the rise of the OTT platforms which were at a very nascent and struggling stage before the pandemic. Previously unknown platforms such Disney+Hotstar, Netflix, Amazon Prime etc have become households. Right from the youngest to the oldest member, these OTT platforms have something to offer to everyone. This research tries to study the rise of OTT platforms during the pandemic. It is important to know the extent of increase in the popularity of OTT platforms during pandemic to know their future scope. It is evident that since their launch OTT platforms have only observed an upward curve in their popularity and usage but, due to the pandemic there has been an exponential increase in its popularity due to the change in consumption patterns of people for entertainment through various media platforms. This research analyses the opinions of people regarding OTT platforms, their consumption patterns, and it's comparison with cinema to see if OTT platforms were slowly taking over the most popular conventional medium of entertainment. It was found that people used OTT more than any other platforms out of TV and YouTube to pass their time or for entertainment. Most of them experienced an increase in their consumption times and were looking forward for movies to be released on OTT at the same time as in cinemas. People were also okay with watching movies on OTT rather than cinema. But for some it depended on the movie. This research has shown that there is a huge scope for OTT platforms in the future and the pandemic has played a major role in it. The research methodology used in this study is descriptive in nature. A questionnaire was administered to the relevant target group to analyse their behaviour. Basic statistical tools were used to analyse and generalize their behaviour. The target audience considered relevant for this study was between the age group of 14-45. Since, OTT platforms cater to all age segments, this particular TG was considered to be apt for the study. Apart from that, consumers belonging to this age category were also able enough to give their valuable opinion regarding the OTT platforms.

14) SAGE JOURNALS

CONSUMPTION OF OTT MEDIA STREAMING IN COVID-19 LOCKDOWN: INSIGHTS FROM PLS ANALYSIS

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In light of the current ecosystem of technological advancements in telecommunication and enhanced capability of devices, the present work brings to the fore the changes in consumers' media consumption. The shift from conventional media to over-the-top (OTT) media, particularly in the lockdown period due to the COVID-19, has resulted in a war between streaming service providers to attract and retain customers. In the light of this change, the present study conducts partial least squares structural equation modeling (PLS-SEM) analysis to examine the impact of two key antecedents, namely, customer engagement (CE) and quality of service experience (QoSE) for their impact on users' willingness to continue and subscribe (WCS) streaming services in future. The paper also delves into the indirect role of satisfaction and habit in affecting the aforesaid linkages. With the world facing the impact of the pandemic, the implications emerging from the study present an opportunity to the providers of OTT platforms to capitalize on the perceived change to the best of their advantage.

16)INTERNATIONAL JOURNAL OF ENGINEERING AND ADVANCED TECHNOLOGY (IJEAT)

ANALYSING THE MEDIA CONSUMER TRENDS DURING THE COVID-19 PERIOD- THE RISE OF OTTS IN INDIA

Sristy Lalaika V, Kalathila Uthej, Shreya Rishi K

In the wake of an unprecedented COVID-19 widespread, there is a massive development in the media and entertainment industry through OTT (Over-the-Top) platforms which offer video streaming directly to viewers via the internet without cable, broadcast, and satellite television supports. During the self-isolation period, OTTs have increased the overall

media consumption to a real high and are now gradually becoming mainstream entertainment destination amidst the growing internet users. This mass intrusion has given an opportunity for many independent platforms to grow and run alongside the likes of already established biggies, Netflix and Amazon Prime. The telecom operators chipped in this aspect and are extensively working on optimizing their operations with advertising revenue and bringing in effective content strategies in order to reach out to more people. The present study focuses on this new development by using the technique of quantitative content analysis in order to know the cause of this sudden increase in OTT channels' viewership among millennials during the lockdown period in India and its impact on traditional modes of communication.

CHAPTER III
THEORETICAL FRAMEWORK

Chapter 3. Theoretical framework

Over The Top Platforms (OTT)

The world has seen drastic changes in the way it consumes content over the past few decades. One of the more recent is the content shift from television to OTT platforms. Over the Top platforms (OTT) like Netflix, Amazon Prime, Disney+ Hotstar, etc., are becoming more popular by each passing day and increasing its subscriber base. OTT refers to film and television content provided via a highspeed Internet connection rather than a cable or satellite provider. An OTT platform has a large repository of movies and TV serials from across the globe which can be accessed through different devices like phones, laptops, Android Televisions, etc. These platforms even produce their original shows and gives their users a different experience altogether. It is basically a media streaming service which is available for the users through internet connectivity.

In India, Big Flix also termed as “Personal Blockbuster Theatre” was the first OTT platform which was launched by Reliance Entertainment in 2012 which offered numerous movies on demand with a subscription fees. Netflix on the other hand was launched in the year 1997 in California, USA. Originally a rent by mail DVD service that used a Pay Per -Rent- Model. It was in the year 2015 that Netflix successfully launched its streaming services in India. Thereafter the Indian internet streaming market kept evolving with the entry of players like Amazon Prime Video, Sony LIV, Zee5,VOOT etc.

During the unfortunate time of global pandemic such a COVID-19, these video-on-demand platforms have seen a surge in their viewership. Owing to lockdown and statutory social distancing norms adopted by most countries affected by the pandemic, people have registered higher presence on these platforms. The study finds that use of OTT content platforms such as Netflix, Amazon Prime, Voot, Hotstar(now Disney Hotstar), etc. has seen a rise especially among the younger age The rise of OTT platforms, this trend has seen a new dawn. OTT platforms such as Netflix, Amazon Prime Video, Voot, Disney Hotstar, etc have given a catalytic impetus to the shrinking of globe into village. During the unfortunate time of global pandemic such a COVID-19, these video-on-demand platforms have seen a surge in their viewership. Owing to lockdown and statutory social distancing norms adopted by most countries affected by the pandemic, people have registered higher presence on these platforms. The study finds that use of OTT content platforms such as Netflix, Amazon Prime, Voot,

Hotstar(now Disney Hotstar), etc. cohorts of population. This trend implies a rise in demand of OTT content and signals a growing popularity of OTT video on demand platforms. OTT or Over-the-top content platforms are the media platforms that according to Tata Consultancy Services are the platforms that deliver film and television content, by passing the conventional distribution streams of cable and satellite TV, from producer to consumer directly, an exchange driven by Internet.” Some of the commonest OTT platforms in India and elsewhere Include Netflix, Disney Hotstar, Eros Now, Amazon Prime Video, Voot, etc. Much like the global trends that indicate a rise in the use of tablets, smartphones, laptops and other internet enabled devices for content consumption by the audiences, India too has seen a steep growth in the number of internet users. India currently has the second largest users of internet after China and with a rapid growth rate, the market promises a huge potential. As a report by Deloitte states “Online entertainment services lead by audio and video content is the cusp of inflection point in India.” With the audience focused on infotainment and increasing demand for global content, India is a thriving marketplace for OTT platforms.

Market Scenario of OTT platform in India

With over 40 over the top media services (OTT) in India, more and more people are opting to watch content online. As per reports in the fiscal year 2018, the OTT market in India was worth ₹21.5 billion and in 2019 its value grew up to ₹35 billion. The OTT sector in India witnessed a 30% rise in the number of paid subscribers, from 22.2 million to 29.0 million between March and July 2020. India’s video streaming industry is set to be valued by ₹ 11.9k billion by 2023. This growth is directly connected to the surge in the number of internet users which are expected to cross 735 million by 2021 with more than 73% of them consuming content in Indian regional languages.

Disney+ Hotstar has 43 million subscribers, which makes it the most comprehensive OTT outlet in India, followed by Netflix with 5 million subscribers and Amazon Prime with 17 million subscribers. Hotstar has captured the OTT market and accounts for 29 percent of the total viewership. The platform's income in 2020 was around 16 billion Indian rupees.

Impact of OTT platforms In Indian market:

COVID-19, a deadly strain of coronavirus, with Abnormally high rate of infection and the absence of a concrete cure for this outbreak have led countries all across the world to go into complete lockdown to tackle the spread of the virus. Crores of people suddenly have more time on their hands than they can possibly spend. In this situation, films and entertainment content have emerged as the saviour especially on-demand video content. This study aims to understand the trends in Over-the-top content consumption as pertains to lockdown amidst COVID-19 outbreak in India, the reasons for its prevalence over the traditional entertainment media and the implication it may have on media market and industry in the long run.

A decade ago, everyone in a family used to gather and sit together in front of the television to watch whatever was showing on the cable channel. But today, you can choose your own show and device where you want to stream content with your group. Technology has changed everyone to a certain degree, and it has made life effortless. You now have the freedom to watch whatever you want, whenever you want, and that's the reason why in March 2020 alone, OTT has gained more than 30% paid subscribers. The most wanted names in the OTT platforms are Disney Plus, Netflix, and Amazon Prime, more than any other apps. But there are also some other streaming platforms that regularly satisfy the viewers with new kinds of content. And thus, all of them combined to create a great impact on the OTT market in India. Not to mention that the OTT platform also somehow replaces the cinema halls and other types of traditional mediums for entertainment. A report published by the Data Sciences Division of Dentsu Aegis Network (DAN) India showed that OTT platforms increased the popularity of binge-watching video content in the comfort of the home. The younger generation or Gen Z spend more time watching video content while eating and before sleeping. And Indian youngsters spend more than 11 hours a week watching videos online, while the number is 8 hours a week on a global timeline on average.

OTT offers a never before consumer advantage – choice of content, easy to access, choice of device / mediums (hand phone, laptop, tablet or tv screen). Gone are the days when family members fought for screen time of choice on family's singular home device i.e. TV. With this study, the researchers studied the evolution of OTT space in India and reviewed the dynamic OTT space. It was an imperative to evaluate the impact of growing content consumption on the psychographics across generations (children, adults and elders) as there is limited censorship in the OTT space. The objectives and tired to evaluate the role played by the pandemic - pre and post COVID 19 in India, study underlying trends around increase in the

consumers appetite for the psychographic impact on children, adults and elders. The research adopted combined qualitative and quantitative approach to extrapolate the data.

The Limelight Networks, Inc released a ‘State of Online Video 2020’ report that states that the cost of most OTT platforms is the reason why many people don’t use apps like Netflix or Amazon Prime. Indian viewers tend to cancel a premium subscription due to the high costs of these apps. So, if the OTT platform ever loses its popularity, prices will be the foremost culprit. According to the “Indian Over-the-Top (OTT) Platforms Report 2020” report published by the MICA Ahmedabad, the number of male viewers of OTT apps is more than female viewers in India. The most viewed apps in India by males are Netflix, Amazon Prime, and Hotstar. The least traffic in females is of around 25-45 age groups. But Voot has around 54% of female users. The MICA report also analysed the gaming trends in India. Here again, as expected, men outdid women. Indians on average, in 2020, spent 63 billion minutes on playing games, against 42 billion minutes in March 2019, a 49 per cent increase. Consumers also clocked 4 hours 5 minutes of gaming consumption in the week of April 25, 2020. “The clear leader among all the players goes to the male members between 18 and 24,” the report said.

Gamification, not games, is one of the strong mechanisms to boost engagement on the platform. On OTT platforms, gamification is not limited only to mainstream gaming. Movies, contents can be gamified; even watching experience can be gamified. The list is long but impressive. It can increase viewers’ stickiness and would transform viewing into an interactive two-way process. If this is true, would the brands be left far behind? They are sure to step in. We have to wait and watch if this would spoil the joy of uninterrupted watching. Only time will tell.

Typically, the industry life cycle consists of five stages — startup, growth, shakeout, maturity, and decline. These stages can last for different lengths of time. We have seen these phases in the Insurance and airlines industries where we witnessed the entry of huge numbers of players when the sectors were opened up initially and during shakeout, many fell apart and disappeared. Similarly, we see a large number of players entering this industry now. Surely, one can expect a shakeout sometimes in future and only a few competitive players are expected to remain.

With the COVID pandemic playing havoc, it is OTT’s time. Unwittingly, OTT is also enabling the family watch the programme jointly thereby increasing the family bondage. Thus, in, my opinion, OTT is having both positive and negative effect on the family.

Another important feature of OTT is its impact on movie theatres. Because of people preferring to watch content mostly on OTT platforms and less in movie theatres certain movies producers and distributors are electing the OTT media to reach its target customers (Varghese&Chinnaiah, 2021). In the present circumstances, it is difficult to judge its effect on the theatres though, generally it is felt that it will have some but may not lead to their closure.

Indians for long have earned for diversity of content. A common family television enabled with limited channels restricted the imagination of young India. This imagination was tapped and explored by OTT players optimally during COVID 19 and the flexibility of accessing a range of content on personal devices including smartphones and tablets gave to young India, the freedom to watch what they desired. OTT players has the immense potential to dive deeper into the regional Indian market in times to come. With just 40 OTT platforms and limited regional content, this medium has created a new niche for itself in urban India. COVID 19 has played a very sufficient role in mass adoption of the medium in the urban regions where people have better playing power than semi-urban or rural India.

OTTs are fast converting the fence sitters across age groups and demographic regional. COVID 19 brought with itself some factors which became the new normal, like working from home, which have seemed to offer flexibility of schedules to many. All the researches point to the growing duration of video content consumption year on year and COVID 19 has proved to be a turned point in furthering this behavior change The State government's proposed foray into the online content streaming space with the launch of an over-the-top (OTT) platform is a cultural intervention, rather than something prompted by the market or revenues, according to Kerala State Film Development Corporation (KSFDC) chairman Shaji.N.Karun.

Speaking to The Hindu, he said the plan is to launch the platform by November 1.

“Even though the market is crowded with too many platforms, the government is taking this up as a cultural intervention, rather than looking at its viability. We do have an audience which is spread out across the globe. Even an OTT platform like Mubi, which has curated content, has its set of audiences. But, our priority will still be the big screen, with the films first getting a screening in the cinemas and then coming to the OTT platform,” Mr. Karun said.

Though major players such as Netflix and Amazon have been showing more interest in Malayalam cinema, it is mostly limited to films which they are ensured of a revenue. In the past one year, only fewer than 15 Malayalam films, a majority of them featuring big stars, have

been taken up by these streaming platforms. Smaller, home-grown OTT platforms such as Neestream and Mainstream TV do not have the financial muscle to match the bigger players. The government's proposed platform might ensure space as well as some sort of revenue share for the lower budget, independent films that are struggling to see the light of the day.

Impact of OTT on Age Groups:

- Children between the ages of 8-15 like these apps more than anyone. The reason is the OTT platforms serve unlimited entertainment from various genres that are also children-friendly. This content entertains children as well as educates them.
- OTT platforms also help entrepreneurs to grow their own businesses while bringing value to the younger generation through entertainment and education. There is a term “Netflix and chill,” which typically applies to viewers aged between 18-32 as a form of entertainment and relaxation.
- However, OTT platforms also entertain the older generations or senior people to a certain level. Since these platforms constantly update their database with new content, it helps older people reduce their loneliness.

OTT platforms are not limited to entertainment only, but also they bring health & fitness and education to the table for different kinds of audiences. And for that reason, people from all over the world and different areas in a country (rural & urban) use OTT platforms more than anything. OTT market also has a significant influence in the urban areas because of the religious language content that some of the over-the-top channels provide, such as Zee TV, Sun TV, etc.

But in the urban areas, most people watch western or Indian movies, and in that case, Amazon Prime, Netflix, etc., are more popular. Therefore as you can see, OTT platforms have made and continue making a huge place in the hearts of everyone, starting from kids to senior people. The key fact is the OTT platform brings the world to your smartphone.

Impact of OTT Platforms on Youth:

The content, language, and presentation of the programs of OTT (over the top) platforms such as Netflix, Disney Hotstar, Amazon Prime, Voot, MX Player, zee5, Alt Balaji etc. have been a cause of concern in recent times in the light of the multiple impacts, especially

on the youth. These OTT platforms are making huge and enormous profit at the cost of challenging the Indian cultural values and ethos among the youth by posing film, television content flooded with the offensive and abusive language and sex scenes. Our country has gone through a tremendous technological revolution which promoted the new entertainment platforms through hi-speed Internet, Video-on-Demand and OTT platforms and it is assumed that an average Indian youth spends approximately 8 hours 29 minutes watching online video content, which is much more than the worldwide trend of 6 hours and 45 minutes.

Television programs & Films have been recognized as prime mode of entertainment in India especially in urban and semi-urban areas. Undoubtedly, these programs have immense potential and capacity to influence thought process, attitudes, and behaviour of the people. It is normally observed that the youth, particularly kids and teens are apt to learn the dialogues and songs from movies or TV programs, and it has a deep impact in their mind both consciously and subconsciously for long. Subsequently it plays a major role in shaping up the personality and moulding the character also. But through these online platforms, mainly anti-national or anti-religious content is presented that provokes the masses to react instantly and thus, it can be said that OTT platforms are spreading negative culture among the youth.

It is well understood that youths are more likely to follow and acclimate one's behaviour as they can easily relate to what is displayed on online platforms and other video content. Subsequently, it develops a lot of behavioural changes in youth. It has a serious and long-term impact on their behaviour and in their thoughts.

Besides, it leads them for following repercussions:

- the entire process of socialization of youth has got affected.
- the disease such as insomnia, depression, obesity, and eyes disorder amongst the youth have increased.
- the academic performance of the youth has also been affected.
- web shows rarely mentions anything about sexually transmitted infections and unwanted pregnancy.
- the web series have become a platform to advertise Alcohol, Smoking, Tobacco, Drugs and Weed without mentioning their adverse effects

Online platforms need proper regulations and should be censored in order to protect the cultural values among the youth and create a positive and healthy environment. The present government has shown the willingness on numerous occasions to intact the Indian culture and values. It is in this context; the ministry of Information and Broadcast (MIB) has emphasized on certain kind of regulation of OTT Platforms to rationalize the sector and convened consultations with numerous stakeholders. In this background, the MIB recently notified the Information Technology (Guidelines for Intermediaries and Digital Media Ethics Code) Rules 2021 (Rules). The new rules seek to maintain a balance between self-regulation and government control. As per these rules, OTT platforms are required to establish a strong three-tier grievance redressal mechanism. The first level will include regulation by the OTT Platform itself through a grievance officer. The second level will be an institutional self-regulatory body formed by publishers of content and their associations. This self-regulatory body will consist of experts from industry headed by a retired Supreme Court/ High Court judge /eminent personality in the relevant field. Further, the third level is an inter-department committee constituted by the Ministry of information and Broadcast which will give oversight and listen to appeals for decisions taken at level two or if a complaint is referred to the inter-department committee by MIB. The code of ethics announced under the Rules, set out guidelines for classification of content based on viewer's age, themes, content, tone and impact, and target audience. Besides the regulations and guidelines by the government, it is the responsibility of each citizen to avoid the use of any such content at any level which pollute the mind of youths and pose a serious threat to the cultural values.

Millennial consumers

Millennials are those people who are born between 1980 and early 2000s. They represent a large segment of population and are consider target market for many consumer companies. Millennial consumers are grown up as digital natives so they have the ability to command to technology which can do anything they don't like feel getting up to do. Many millennials conduct a research online, seek out honest reviews, test in stores etc before buying any product. While many are unemployed and burden with student debt today, but in near future millennials will be richer over time, thus for marketers and consumer companies there is more scope of having young talents.

Binge watching addiction

In 2013 Netflix stated that binge watching refers to normal behavior among humans where an individual sits at one place and watches several episodes of the same show in a day. This kind of behavior produces dopamine into the brain which makes us feel so good about it over time. It

also happens in other kinds of addictions like gambling, smoking, getting high on drugs etc. Since 2013 the rate of binge watching has increased from 61% to 75% according to latest deloitte

figures. It is observed that millennial's exhibit stronger binge-watching behaviors as compared to

other generations. The psychology of majority Millennial's behind binge watching is that they want to keep the storyline ongoing. (Mosacho, 2018) It is estimated that more than 3-5 hours is

considered as the average time to binge watch.

Majority of millennials consider binge watching a harmless pleasure rather than a harmful addiction. The act of binge watching builds a community around the show known as "shared cultural space" This helps viewers to establish beneficial social connections. This beneficial social connections strengthens relationships as people share mutual interest and they can spend easy time together. Binge watching makes a show more fulfilling as watching several episodes.

Benefits of Over The Top Platforms:

There are multiple benefits of using OTT platforms and why they have become so famous within no time in India.

- **Cost-Effective** – Anyone willing to watch online digital content, can register themselves and pay a monthly or yearly subscription amount which makes it cost-effective
- **Easy Access** – One can log in to these OTT platforms through mobile applications, smart TV, laptops, tablets, etc. The only requirement is an internet connection
- **Creative and Unusual Content** – Through these over the top platforms, various creative ideas have come to the forefront which could not be brought across due to censorship or regulatory laws

- **An open platform for Entertainment Industry** – The biggest advantage of this platform is that it has provided a medium for new talent to get more opportunities as the number of projects are much higher in comparison to television or films
- **Platform for International content** – Any Indian content uploaded on these platforms can be viewed internationally. This gives a broader outreach of content and talent

Disadvantages of OTT Platforms:

Along with advantages the OTT platforms have various issues and challenges which they need to overcome:

- **May affect social-political harmony** – Since there is no censor board to review the content, there are chances that the content may affect social or political harmony and hurt people's sentiments on certain issues
- **No regulatory board** – No organisation, department, or body is held responsible for the content that goes online. This has always been one of the biggest concerns for the Government of the country
- **Threat to Culture and Tradition** – The modern and fresh content releasing on OTT platforms has been accepted and appreciated by the people in India. However, there still are a few who have not been able to accept this unique content. Thus, the government needs to be accountable to them as well

Moving forward, the Ministry of Information and Broadcasting shall have to focus on maintaining the quality of content being added digitally, ensure that it does not hurt the sentiments of the people, and promote new and fresh talent and content.

Effect of censorship in OTT platforms in Indian market:

Digital platforms have seen exponential growth over past few months, mostly because of the ongoing pandemic that has forced people to stay at home and seek entertainment inside the premises of their own houses. However, they also faced a setback when the Indian government rejected a proposal for self-regulation of content online.

After 15 digital platforms signed a self-regulation code for content streaming online, the ministry for information ad broadcasting wrote a letter asking the code itself to be re-framed.

In September, Netflix, ZEE 5, SonyLiv, Viacom's VIAB 0.0% Voot, Amazon Prime Video, Disney+ Hotstar, ALTBalaji, Arre, Discovery+, Eros Now, Flickstree, Hoichoi, Hungama, MX Player, Shemaroo, VOOT, Jio Cinema, and Lionsgate Play signed a self-regulatory code that asked signatories to not show content "disrespectful to national symbols and religions".

The Indian government, however, wrote to Internet and Mobile Association of India (IAMAI) asking for an alternate code. The ministry objected to a lack of a third party involvement in the advisory panel (the current draft suggests forming a body from among the content providers itself unlike the previous suggestion for the Digital Curated Content Complaints Council. A final word on the regulation and/or censorship is yet to come, but those in the business of providing curated content online view it as a clear negative effect on their earnings and subscriptions.

The OTT (Over The Top) video market in India is beginning to challenge current conventional broadcasting, as an entire generation is now migrating away from television to OTT and subscribed Video on Demand. Recent data from PwC reveals that the Indian OTT market is growing at a CAGR of about 23 per cent and is expected to rake in Rs 5,595 crore by 2022, pushing India to join the top ten OTT markets of the world.

Netflix, Amazon and Hotstar, currently, India's top OTT video streaming platforms, recently met to explore a voluntary censorship code in India to cover online content. While the currently unregulated nature of the market is one of the main USPs of the OTT market, given that viewers have unrestricted access to online content, the lack of a code is also beginning to raise questions of spreading inappropriate content, which could corrupt or enrage audience sentiment. On the other hand, having a code might bring censorship seesaw and court rulings, which could seriously impact the businesses of such platforms. To a degree, it is a sensible idea for OTT platforms in India to introduce self-censorship measures, because it could assist parents and help make them feel that their children are safe when accessing certain content, while unsupervised. However, according to Arvapally, it can also be a slippery slope.

Growth of OTT platforms during the pandemic:

The use of digital technology is essential in every sector, and OTT platforms offer such versatile content. The pandemic was also responsible for the OTT viewership surge in India. The platforms are mainly popular between the 15-35 years population. MICA's Center for

Media and Entertainment Studies (CMES) reports indicate, "India is expected to witness an increase in the number of OTT viewers by 2023, compared to the current 350 million consumers." This increase projects nearly 500 million consumers.

OTT platforms have garnered acclaim due to their convenience and minimal requirements-reliable internet connections and a viewing device.

However, in India, the popularity of these platforms was not overnight. OTT platforms like Netflix faced a difficult journey to acquire 5 million subscribers. However, affordable technology like smartphones and cheap internet access through service providers like JIO made it possible for OTT platforms to garner a rural subscriber base.

The influence of OTT channels varies among the rural and urban crowd. The survey by Ascent Group India suggests, "almost 65% of the OTT content consumption is from rural India which only has 40 % internet connectivity." These figures suggest regional language content is prominent on OTT platforms, thus offering prospects to regional content developers.

OTT entertainment is not just limited to adults but has been making a way in children's lives through educational media. The informative and free edutainment content on these apps facilitates entertainment and education.

Indian youth is another prominent segment of the OTT subscriber base. Today, college students and working professionals use OTT channels for entertainment and information. Netflix and Chill have become a go-to trend in the urban Indian population.

It does not mean OTT platforms are just limited to the younger crowds. Features such as content updates and spiritual and regional language availability make it easy for the older Indian population to enjoy their favorite content.

OTT platform expansion is prominent in health and fitness, education, and other sectors. These platforms also provide lucrative prospects to budding content creators.

The Indian population today uses the OTT platform beyond entertainment. The Indian OTT market is humongous, as well as, diverse and requires systematic planning.

The demand for new content has led global OTT channels like Amazon and Netflix to offer lucrative subscription plans to the consumers, the recent one where Netflix slashed its price to 149 monthly plans for mobile users along with its other plans.

The drop in prices of smartphones and cellular data has enabled a large chunk of the population to gain access to online platforms. India currently has about 220-250 million smartphone users which is expected to hit 500 million by 2020.

There are also platforms like Saavn, Wynk, etc. that have become more popular due to its wide variety of choices in music. YouTube is the 4th most used app in India, as the number of smartphone users increases in India, there is scope for an increase in viewership.

One of the major challenges that OTT platforms face in developed countries is competition like HBO, CBS, Amazon Prime Video, Netflix, etc. The production cost that is incurred to cater to niche audiences are also high. Entertaining content is a prerequisite to drive subscription and grow consumer affinity. And mainly, the market in developed countries like the USA is saturated which leads to expensive marketing budgets to push for viewership.

Platforms like Voot, Sony Liv and Zee 5 are OTT platforms developed by existing broadcast channels to remain relevant and to cater to the shift in audience from TV viewership to OTT platforms. However, most of their content on these platforms are the same as the ones broadcasted on TV.

OTT platforms' business model would blanket subscribership with sponsored content. Their revenue would be mainly generated from advertisements

There are 30+ OTT players in India in different languages targeting different audiences depending on what content they roll out. 40% of viewership on OTT platforms is mainly regional content.

The target group of major OTT platforms should ideally be “millennials” or the age group of 18-35 years. This number, however, is largely contrasting due to the Digital India campaign, increasing number of smartphone and data users and is also an effect of globalization which has led the population to be more aware. With major data service providers like Jio bringing down data costs, there has been a significant shift in viewership in India with number of Indian users growing at the rate of 4-8%.. This essentially means that there is massive potential for

rural India to subscribe to such platforms on a large scale – making rural India also a target group for platforms.

In 2017, OTT platforms in India generated Rs. 2019 crore, this is expected to increase to Rs. 5595 crore by 2022. Digital streaming platforms overtook film entertainment to rank the third-largest Indian Media & Entertainment sector in 2019, according to the latest EY-FICCI Indian Media & Entertainment Report.

When most OTT platforms made an entry in the Indian market, they mainly had catch-up shows. However, with the entry of global players like Netflix and Amazon Prime Video, users are offered a plethora of original content. Hotstar is currently the most popular OTT platform in India according to data from a mobile advertising and Internet service provider. Although in my opinion, Netflix will be the market leader in the medium term among millennials as it is a giant global player and it entered India powerful, mainly due to the youth inspired by western culture.

Netflix also wants to indulge itself in the Indian market by creating original Indian content which may prove to be an extremely profitable move. Shows like Sacred Games and Ghoul have already left audiences wanting more from India. Netflix has also confirmed that it is going to experiment with ads for its original content between episodes, this will increase its revenue exponentially. And lastly, there is a “cool” factor to using Netflix, a privilege Voot or Alt Balaji does not have yet. However, such platforms are garnering more attention due to the content they have been posting.

In July this year, commerce and industry minister Piyush Goyal, while citing the poor portrayal of India, asked the entertainment industry to self-regulate their content. The rapid growth in viewership and popularity of OTT platforms like Netflix, Prime Video, Hotstar, etc. among others due to their raw and unfiltered content. The Indian government, as we all know, is quite big on moral policing – from banning beef to their obvious dislike towards PDA and couples hanging out on Valentine’s Day, it is apparent that anything that they don’t like, they’ll ban in “public interest”. Therefore, the ministry may try to justify the existing laws to cope with “objectionable content” but it is not adequate.

The Central Board of Film Certification (Censor Board) was set up under the Cinematographic Act, 1952. The Act, along with Rules (1983) and guidelines (1991), have set out the manner in which films are to be certified by the Censor Board. The Act states that “a

film shall not be certified for public exhibition if, in the opinion of the authority competent to grant the certificate, the film or any part of it is against the interests of, inter alia, decency.” Additionally, the guidelines stipulated that the certification must ensure artistic expression and creative freedom and that the certification is responsive to social change.

The Indian audience that enjoys raw content is extremely unsure about the censorship of content on OTT platforms simply because they do not want saas-bahu serials on such platforms too, they are looking for great content, which, let’s get real, these serials can never be. The audience seems to be extremely disappointed by this move and we are all hoping that OTT platforms will find a way to put out their content without having to go through the entire process of censorship.

OTT platforms in India to face stiff competition with the entry of foreign video streaming services?

With foreign players like HBO Max entering Indian markets, OTT players like Netflix, Amazon Prime and Disney+Hotstar are likely to face stiff competition. Subscription plans along with a price list of the Warner Bros-owned platform were leaked in early September. The platform is expected to launch in India early next year. There has been no official confirmation on the same by the company. However, they have hinted at it by appointing a managing director for Southeast Asia and India.

Meanwhile, Lionsgate Play, the OTT platform owned by Hollywood studio Lionsgate has already entered into the domestic OTT market and has just announced its first Indian show Hiccups and Hookups, starring Prateik Babbar and Lara Dutta. This could add to the rising competition among OTT players with media analysts reportedly pointing to the need for local programming from all new players while established players are enhancing their appeal with content in multiple languages and advertising campaigns.

One of the challenges for OTT platforms has been customer retention. Amit Dhanuka, executive vice-president, Lionsgate India, told Mint that while viewers like to try multiple services, keeping them hooked for a whole month is difficult. A media analyst told the portal that few people in India would sign up on a new platform but would continue to use the subscription of other players as a smartphone can host at least around three OTT apps. The analyst was quoted saying, "Any new player would need significant investment in local

programming but with talent and production costs increasingly escalating, that is a never-ending game." There are also speculations that HBO Max may choose to remain niche, catering only to the upper end of the audience.

According to Mint, Rahul Vengalil, managing partner at media agency Isobar India said that the platform that can democratise content best will lead the way. Disney+ Hotstar now seems to be leading with the kind of subscription basis it has and the wide content it offers. Sport is a popular category on the platform. He further said that Netflix and Amazon Prime Video are only catching up in India catering to a niche segment and not a mass audience.

Media Partners Asia (MPA), an independent research firm, recently released a report which suggested that the subscription of Netflix is expected to grow to 5.5 million by the end of this year while Amazon Prime and Disney+ Hotstar have projected a growth, estimating its total subscription base to 21.8 million and 46 million respectively.

Mihir Shah, vice-president, MPA said that the OTT market is still at a nascent stage in India. He also predicts mergers and acquisitions amongst existing players to 'build scale, which will heat up the streaming wars in India'. He further told the portal that OTT players may try to seize the opportunity and invest heavily in local content, sports and new products. "An increase in competitive intensity will drive up content investment through both volumes and inflationary pressures," he said.

Classification of video on demand on OTT Platforms

- Transactional video on demand (TVOD): Here the users are required to purchase separately in order to watch movie or episode of TV shows, the most common example is iTunes and Distrify
- Subscription video on demand(SVOD): This is the most widely used online streaming system across the world. Here the users can access to watching unlimited high quality content like TV shows, movies, web series , sports etc by paying a nominal fee . The time period of service depends upon what kind of subscription have you availed like standard,

premium, VIP etc. OTT platforms which comes under this category are Netflix, Disney+Hotstar, Amazon prime video etc

- Advertisement video on demand (AVOD): This is also very popular among consumers, here the users enjoy watching movies,TV shows, sports etc without availing any kind of subscription plans. However as the name explains in this viewers will get to watch short ads during the streaming of video. These ads are precise which means it will cater users interest. OTT platforms which uses this kind of system are Youtube, Voot etc.

Best Malayalam OTT Platforms in India 2022:

1. Manorama Max:

Producers have noticed that the network has expanded since the pandemic when people are at home. The growth it got was expected and is organic as well.

From a brand perspective and overall scale, Ningalkkum Aakaam Kodeeshwaran has done well. Just for this show during the season, it reached over 100 million impressions. Manorama MAX got a good uptake on the OTT side with "Play along" and helped to gain a higher subscriber base. The show was previously on a rival network, and after almost four years, they took the show back to Kerala.

2. NeeStream:

With the release of 'The Great Indian Kitchen,' which has already created ripples among the audience, NeeStream became popular. For this OTT platform, subscriptions are monthly, annual, or per movie with discounts applied with NeeStream coupons. NeeStream is an OTT platform based in Kerala and is not just focused on films in Malayalam, It also has other languages, and originals and documentaries are also featured. The platform is well made and has a great list of movies. Subscriptions are monthly, annual, or per movie.

3. Prime Reels:

Prime Reels is an exclusive film release platform dedicated to movies in Malayalam. It was launched in August 2020 and is a platform for a certain period where new films are released. On an online platform, it reflects the rules of theatrical releases. It had movies like Guardian and Confession of a Cuckoo released on it already and has several other films lined up for release. The platform offers a great viewing experience by offering reasonable offers using PrimeReels coupons, and the subscription is in the format of pay per watch. We truly hope that the platform

will reach more viewers and get the membership it deserves.

4. Koode:

Recently, an independent OTT platform was launched exclusively for Malayalam content called 'Koode.' This app was launched with a vision to help Malayalis discover content close to their hearts throughout the world with some affordable discounts by using Koode coupons. Koode was launched by Studio Mojo, the same team that introduced one of the first OTT platforms in India, iStream.com. In digital media, the platform will offer talented young creators an alternative space. The team is also in Tamil and Telugu talks with many leading OTT platforms to produce web series.

5. Saina Play:

'Saina' is not an obscure Malayalam name. Saina was a significant film and music distributor for almost 35 years in the '90s and early 2000s, before YouTube started catering to our content requirements. The company has now launched a 'Sainaplay' digital platform with great price packages using Saina Play coupons. This OTT app offers free of charge more than 200 Malayalam movies in HD quality. The list includes films such as 'Kolambi,' which has received three awards already. On Google Play, the app is already available.

6. M Flix:

M Flix is Kerala's new streaming site for exclusive content. Trending movies, short movies, and web series can be viewed for free here. Download the app, sit down and enjoy the subscription using M Flix coupons. Old and new films, web shows, short films, and much more. Content creators can stream content (movies, web series, and short films) with a massive audience with the M Flix App.

7. Netflix:

Netflix doesn't need an introduction. Tons of amazing and highly-streamed original Malayalam shows and movies, such as Comrade in America, Forensic, Uyare, Vikrithi, Maniyarayile Ashokan, Kappela, and Varane Avashyamund, have been delivered by the American over-the-top video channel. Not only for Malayalam, Netflix tops the list when it comes to Best English OTT platforms. Several Netflix subscription plans are available, namely Mobile, Basic, Regular, and Premium, starting at just Rs 199 a month. But you can enjoy all the content by applying Netflix Subscription coupons for much more flexible prices. In India, the Netflix plans vary in terms of resolution and the amount of simultaneous streaming, although the content catalog remains the same.

8. Amazon Prime Video:

Amazon Prime Video membership is free with the Prime membership of the e-commerce website, which also offers free Amazon Prime Music subscription and unlimited free and easy delivery, exclusive sales and promotions, and access to ebooks with Amazon coupons for discounts. For its original web series and other Malayalam movies like Lucifer, Kumbalangi Nights, Neelakasham Pachakadal Chuvanna Bhoomi, C U Soon, Helen, Trance, Ayyappanum Koshiyum. It is also home to several international TV shows and movies, regional entertainment, Bollywood, content for kids, and iconic TV shows critically acclaimed. Membership with Amazon Prime costs Rs 129 a month and Rs 999 a year.

9. Sony Liv:

Sony Liv has more than 18 years of content, including 8 MALAYALAM channels such as Flowers TV, Mazhavil Manorama, Kairali TV, We TV, Amrita TV, Kerala Vision Kerala HD, Media One, Janam TV, WWE, European football, La Liga, Champions League, and other sporting events that are broadcast live on Sony SIX, Sony TEN 1, Sony TEN 2, and Sony TEN 3 channels through the OTT platform. Other than Malayalam, it can be on the Best Hindi OTT platforms as it provides best content in Hindi films too. With its plans in India starting at just Rs 199 a month, the Sony Liv app is also subscription-based, but you can save the deal prices with SonyLiv coupons. It also provides the premium shows and premium episodes of the respective shows with a rightful subscription.

How will 5G technology impact the broadcast industry and OTT services?

In future 5G technology will allow faster data rates, which will completely change scenario of how we consume content. The 5G technology will enable users to download a full HD movie in less than 10 seconds which is far better than 10 min on the current 4G network. The current latency speed on 4G network is around 30-40 milliseconds, but with the help of 5G technology this delay will be chopped to about 1 millisecond or maybe less. Thus users will enjoy unbelievable video streaming on various OTT platforms. The biggest attraction of 5G technology is that upcoming generations of network will have greater capacity, which means the systems will cope up with high demand applications like virtual reality experience with simultaneous HD video streaming. The 5G technology will simply enhance mobile media experience which will significantly disrupt the entertainment business models. It is estimated that the media revenue will be twice in 2028 which is (\$420 billion) from the current \$170billion (2018). (Lapsiwala, 2019)

Future growth of OTT platforms in India:

India's video OTT market is expected to touch \$12.5 billion by 2030 from about \$1.5 billion in 2021 on the back of access to better networks, digital connectivity and smartphones, according a report by RBSA Advisors. The report noted that the next wave of growth in the OTT

landscape will come from tier II, III and IV cities and the Indian language speaking population. "OTT industry is poised for aggressive growth prospects with access to better networks, digital connectivity and smartphones. OTT platforms in India have been increasingly attracting subscribers on a daily basis. Apart from top favourites Disney+ Hotstar, Amazon Prime Video and Netflix, the space is seeing a plethora of local and regional OTT players," it added. These include players like SonyLIV, Voot, Zee5, ErosNow, ALTBalaji, Hoichoi and Adda Times among others. The report said the Indian video OTT market in India is expected to grow from \$1.5 billion in 2021 to \$4 billion in 2025 and further to \$12.5 billion by 2030. The audio OTT market - which sees participation from players like Gaana, JioSaavn, Wynk Music, Spotify and others - is also poised to grow from \$0.6 billion in 2021 to \$1.1 billion in 2025 and further to \$2.5 billion by 2030, it added. "The OTT market in India is expected to grow at a CAGR of 28.6 per cent over the next four years. RBSA believes that this industry has the potential to grow to be \$15 billion industry over the next 9 to 10 years," it said. The report highlighted that Covid-19 pandemic has been a game-changer and OTT video streaming platforms including Netflix, Amazon Prime Video, Disney+ Hotstar, Voot, SonyLIV and others had gained immense popularity in India. It added that the OTT landscape is expected to get hyper competitive in next 4-5 years, and the OTT service providers will strive to emerge as the preferred platform among the consumers. The massive investments made by OTT services like Netflix, Amazon, Disney+ Hotstar and others in originals as well as acquired content will help subscription video-on-demand make up 93% of the total OTT revenue (as compared to 87% globally), increasing at a CAGR of 30.7% between 2019-2024, it said. The report said the ARPU (average revenue per user) in the OTT video segment in India is projected at \$7.2 (about Rs 537.25) in 2021. Also, the OTT userbase is expected to be at 462.7 million by 2025. "The viewing habits of Indian consumers have evolved a lot in the last few years. While on the one hand, short-form video content consumption on smartphones and social platforms has been on the rise, binge-watching shows on various OTT platforms have also become more common on the other hand," it added.

CHAPTER IV
DATA ANALYSIS AND
INTERPRETATION

4. DATA ANALYSIS AND INTERPRETATION

This data is collected to analyse the role of pandemic on usage of OTT platforms. This analysis had been made on the basis of primary data collected from a sample of 120 respondents. The data has been collected through questionnaire method. Random sampling has been used for the selection of samples. Following are the table figures and interpretations of primary data collected.

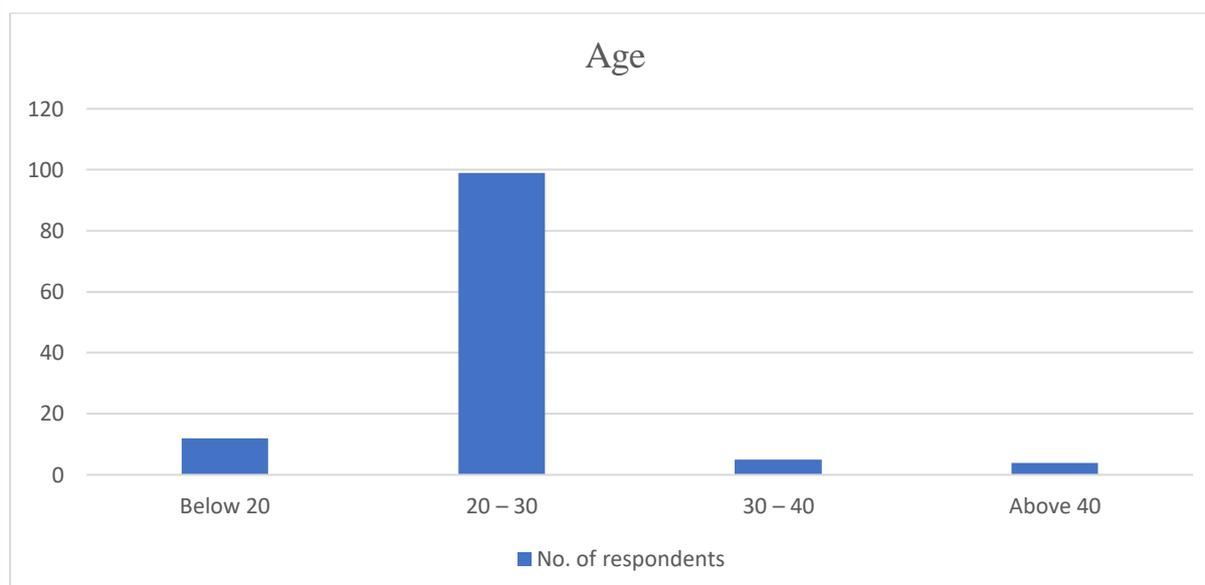
4.1 AGE GROUP

Table 4.1 Table showing age group of the respondents.

Age group	No. of respondents	Percentage (%)
Below 20	12	10%
20-30	99	82.5%
30-40	5	4.17%
Above 40	4	3.33%
TOTAL	120	100%

(Source: primary data)

Graph 4.1 Graph showing age group of the respondents.



Interpretation: From the above-mentioned bar diagram, we can estimate that in the recent years the number of OTT platform users are high among the age group 20-30 years which is 99 respondents out of 120. This kind of spike in the number of OTT platform users among the

youth is mainly seen during the last two years because of the COVID-19 pandemic. The least number of users are found in the age group – Above 40, which is 4 respondents out of 120. 12 respondents out of 120 belong to age group – Below 20. 5 respondents out of 120 respondents belong to age group 30-40.

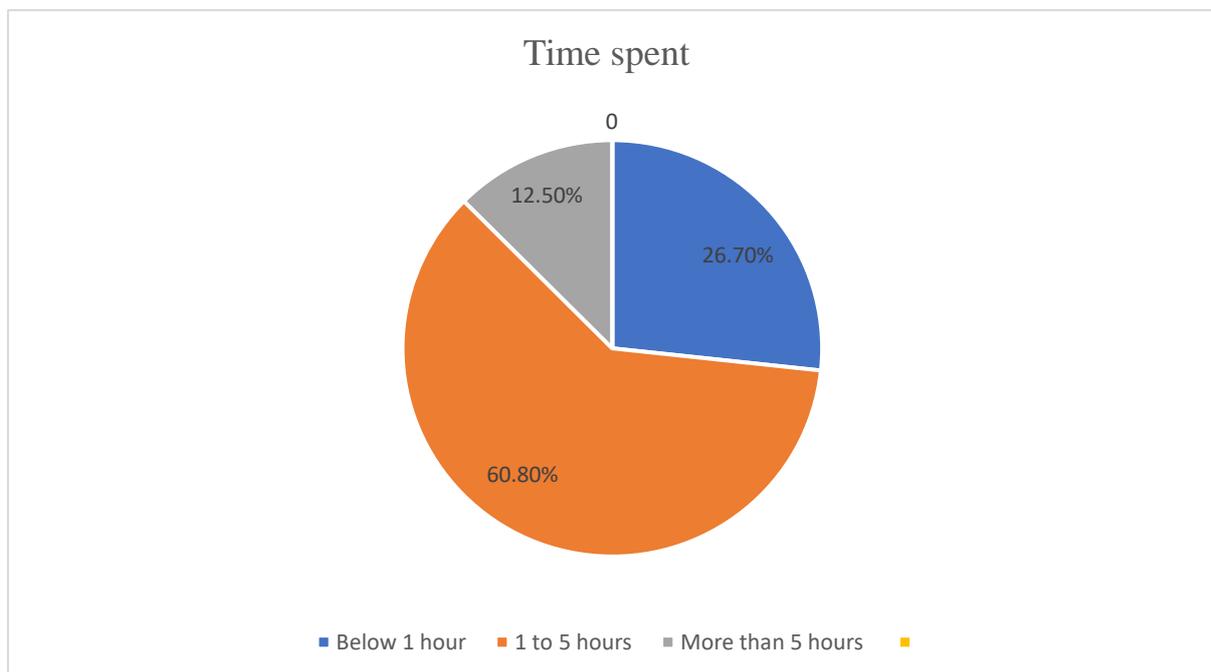
4.2 TIME SPENT IN OTT PLATFORMS

Table 4.2 Table showing time spent in OTT platforms

Time spent	No. of respondents	Percentage (%)
Below 1 hour	32	26.7%
1 or 5 hours	73	60.8%
More than 5 hours	15	12.5%
TOTAL	120	100%

(Source: primary data)

Graph 4.2 Pie chart showing the time spend on OTT platforms a day of the respondents.



Interpretation: From the above pie chart, out of 120 respondents we can estimate that 73 (60.8%) spend 1 to 5 hours a day in OTT platforms whereas only 15 (12.5%) spend more than 5 hours. 32 (26.7%) respondents spend below 1 hour in OTT platforms.

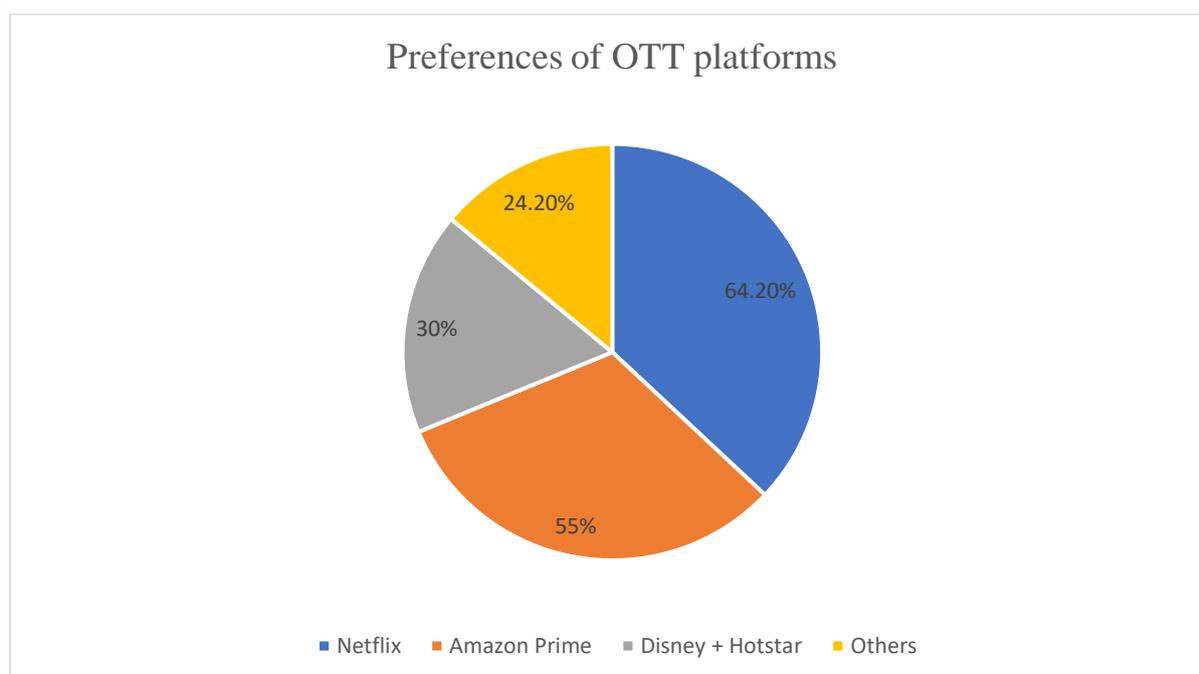
4.3 PREFERENCES OF OTT PLATFORMS

Table 4.3 Table showing preferences of OTT platforms.

OTT platforms	No. of respondents	Percentage (%)
Netflix	55	45.8%
Amazon Prime	44	36.7%
Disney +Hotstar	14	11.7%
Others	7	5.8%
TOTAL	120	100%

(Source: primary data)

Graph 4.3 Graph showing the preference of OTT platforms by the respondents.



Interpretation: The pie chart mentioned above shows that out of the 120 respondents, almost 77(64.2%) of them chose the 'Netflix' category while the remaining 66(55%) chose the category amazon prime,36(30%) chose Disney+Hotstar and 29(24.2%) respondents chose the category others.

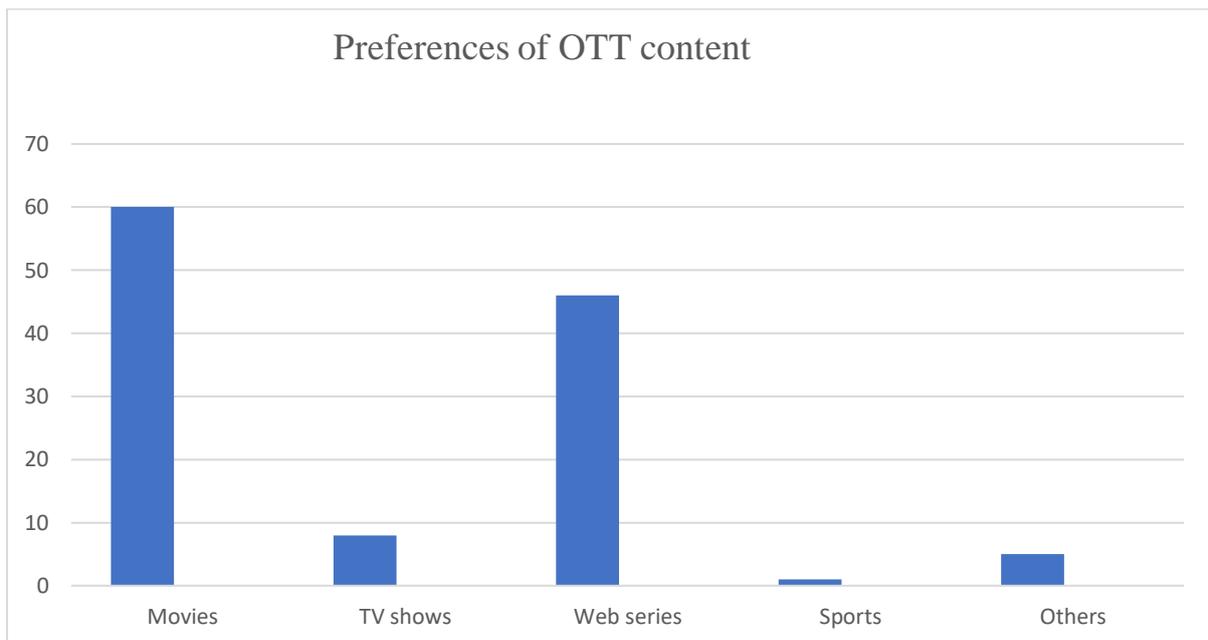
4.4 PREFERENCES OF OTT CONTENT

Table 4.4 Table showing preferences of OTT content.

Content	No. of respondents	Percentage (%)
Movies	60	50%
TV shows	8	6.7%
Web series	46	38.3%
Sports	1	0.8%
Others	5	4.2%
TOTAL	120	100%

(Source: primary data)

Graph 4.4 Graph showing the preference of respondents to watch on OTT platforms.



Interpretation: From the above-mentioned bar diagram, we can understand that most of them, that is, 60 respondents out of 120 preferred to watch movies. Only 1 respondent out of 120 has chosen sports hence making it the least preferred OTT content. 46 out of 120 respondents chose to watch web series in OTT platforms. 8 preferred TV shows and the rest 5 went for watching other content.

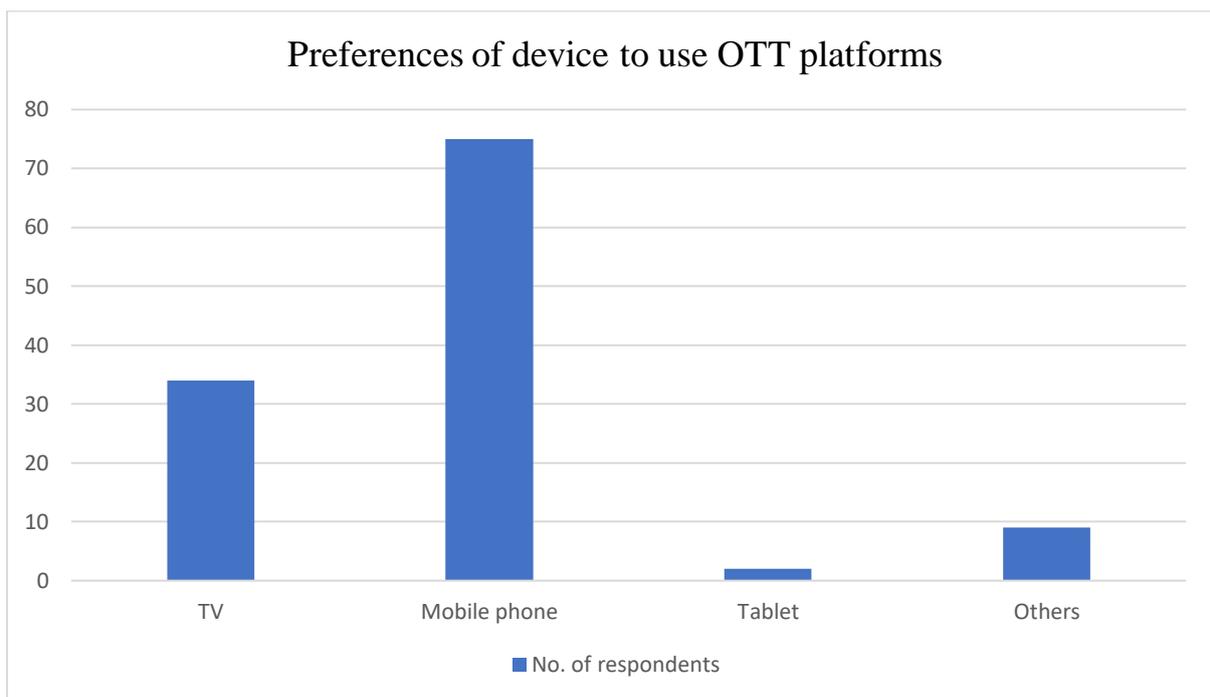
4.5 PREFERENCES OF DEVICES TO USE OTT PLATFORMS

Table 4.5 Table showing preferences of devices to use OTT platforms.

Devices	No. of respondents	Percentage (%)
TV	34	28.3%
Mobile phone	75	62.5%
Tablet	2	1.7%
Others	9	7.5%
TOTAL	120	100%

(Source: primary data)

Graph 4.5 Graph showing the device preference of the respondents to use OTT platforms.



Interpretation: The bar diagram mentioned above shows that out of the 120 respondents, almost 75 of them chose mobile phones to use OTT platforms while only 2 preferred table. 34 chose TV and 9 chose other devices to use OTT platforms.

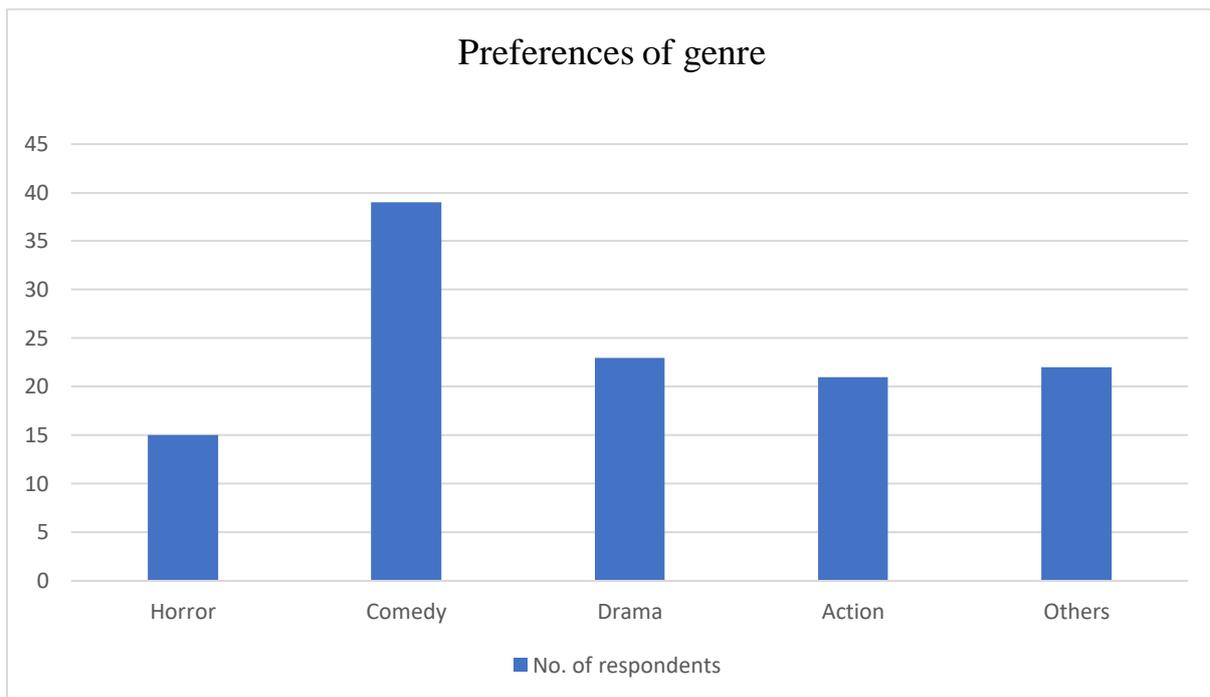
4.6 PREFERENCES OF GENRE

Table 4.6 Table showing preferences of genre.

Genre	No. of respondents	Percentage (%)
Horror	15	12.5%
Comedy	39	32.5%
Drama	23	19.2%
Action	21	17.5%
Others	22	18.3%
TOTAL	120	100%

(Source: primary data)

Graph 4.6 Graphical representation showing the genre preference of the respondents.



Interpretation: From the above-mentioned bar diagram, we can understand that out of the 120 respondents, 39 of them preferred to watch comedy genre. The least chosen category is horror, preferred by only 15 respondents. 23 respondents chose drama, 21 respondents chose action and 22 went for other genres.

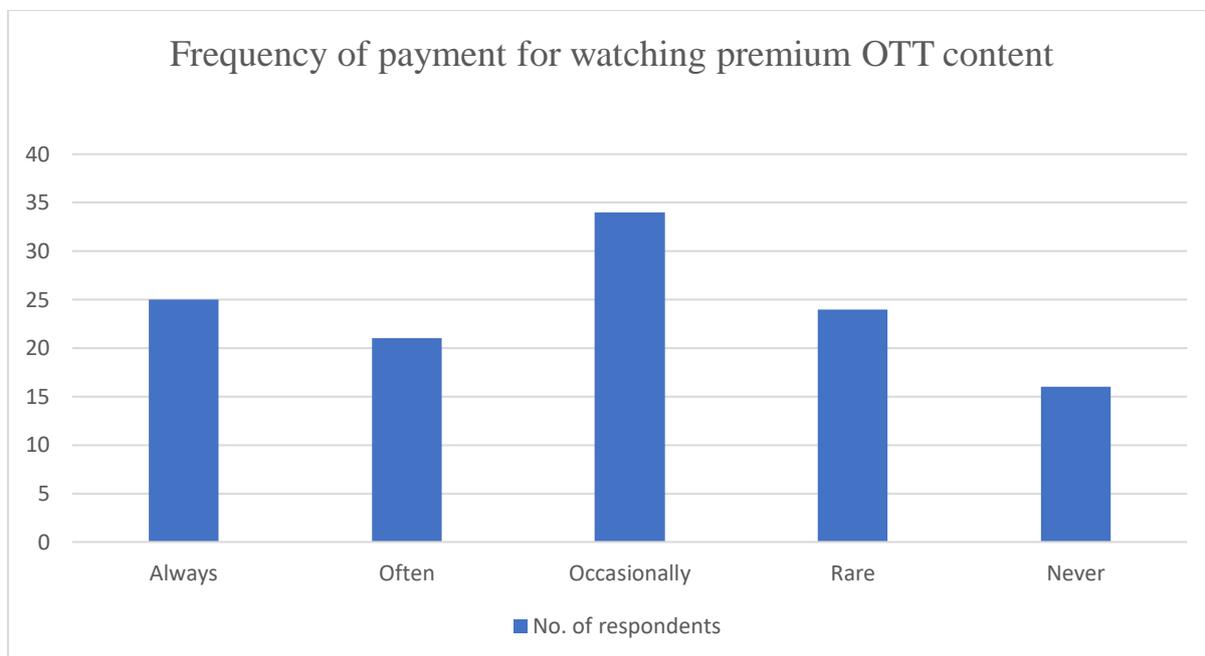
4.7 FREQUENCY OF PAYMENT FOR WATCHING PREMIUM OTT CONTENT

Table 4.7 Table showing frequency of payment for watching premium OTT content.

Category	No. of respondents	Percentage (%)
Always	26	21.7%
Often	20	16.7%
Occasionally	34	28.3%
Rare	24	20%
Never	16	13.3%
TOTAL	120	100%

(Source: primary data)

Graph 4.7 Graph showing the preference of the respondents to pay for watching premium content on OTT platforms.



Interpretation: From the above-mentioned bar diagram, we can understand that most of the respondents which is 34 out of 120, occasionally pays for watching premium content while 16 respondents never pays for premium content. 26 respondents always pay, 24 pays rarely and 20 pays often for watching premium content in OTT platforms.

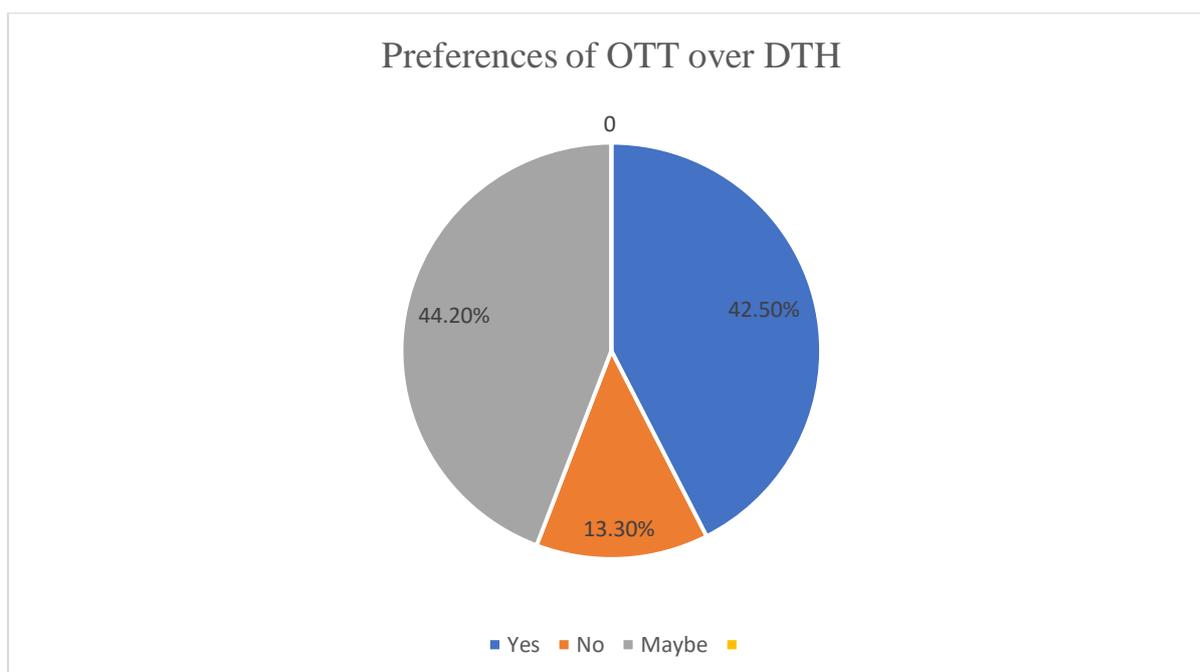
4.8 PREFERENCES OF OTT PLATFORMS OVER DTH

Table 4.8 Table showing preferences of OTT platforms over DTH.

Preferences	No. of respondents	Percentage (%)
Yes	51	42.5%
No	16	13.3%
Maybe	53	44.2%
TOTAL	120	100%

(Source: primary data)

Graph 4.8 Pie chart showing the preference of OTT platforms over DTH of the respondents.



Interpretation: From the above pie chart, we can estimate the 53 (44.2%) respondents out of 120, maybe preferring OTT platforms over DTH while only 16 (13.3%) respondents doesn't choose OTT platforms over DTH. 51 (42.5%) respondents chose OTT platforms over DTH.

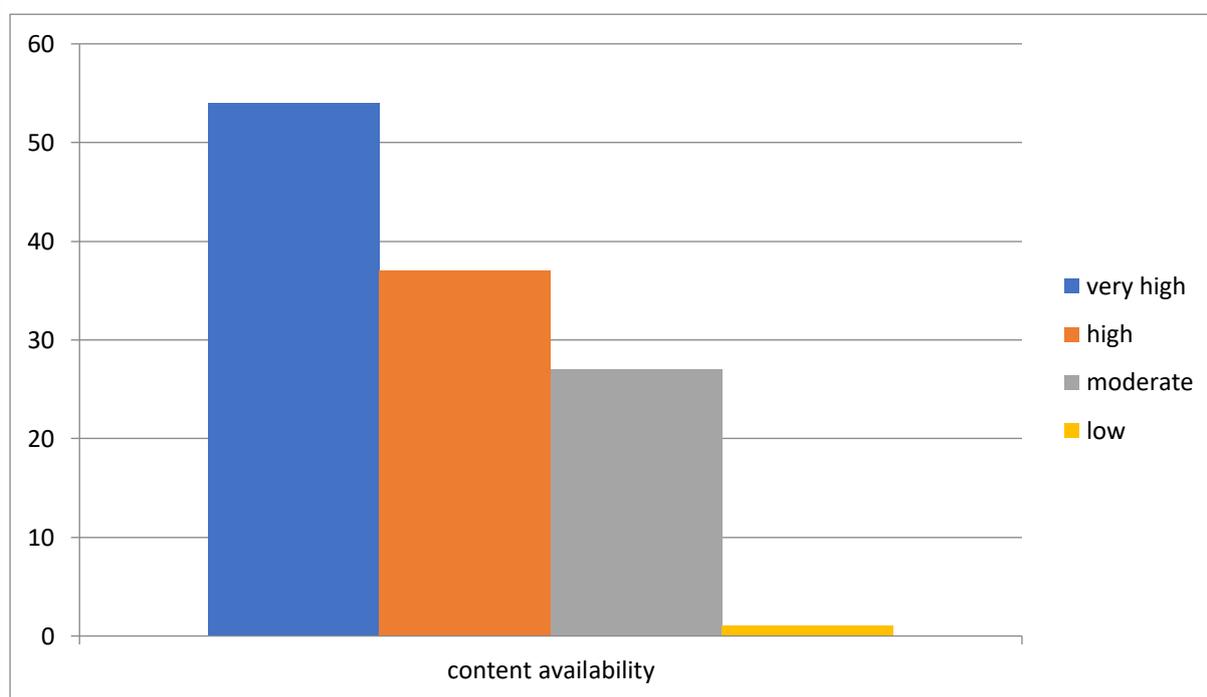
4.9 DEGREE OF VARIOUS FACTORS INFLUENCING THE CHOICE OF OTT PLATFORMS OVER DTH

Table 4.9 Table showing degree of various factors influencing the choice of OTT platforms over DTH.

Category	Very high	High	Moderate	Low	Total
Content availability	54	37	27	1	120
Subscription	29	34	50	6	120
Mobility	34	41	39	5	120
Customer service	28	44	41	6	120

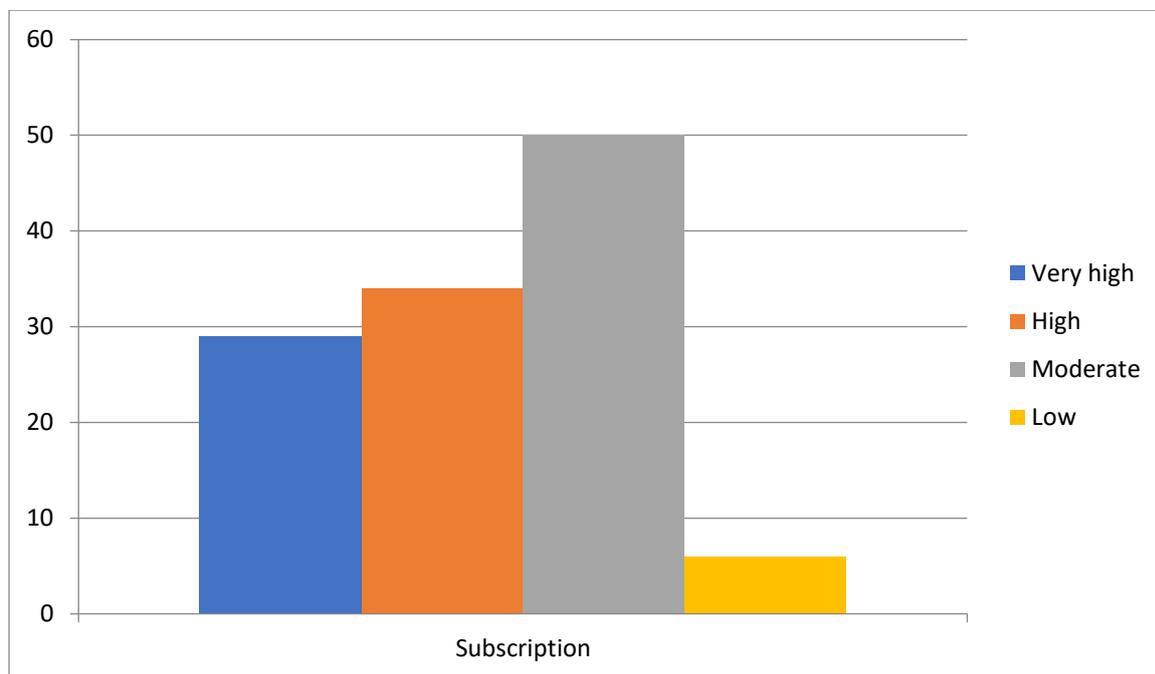
(Source: primary data)

Graph 4.9.1 Graph showing the influence of content availability regarding the choice of OTT platforms over DTH of the respondents.



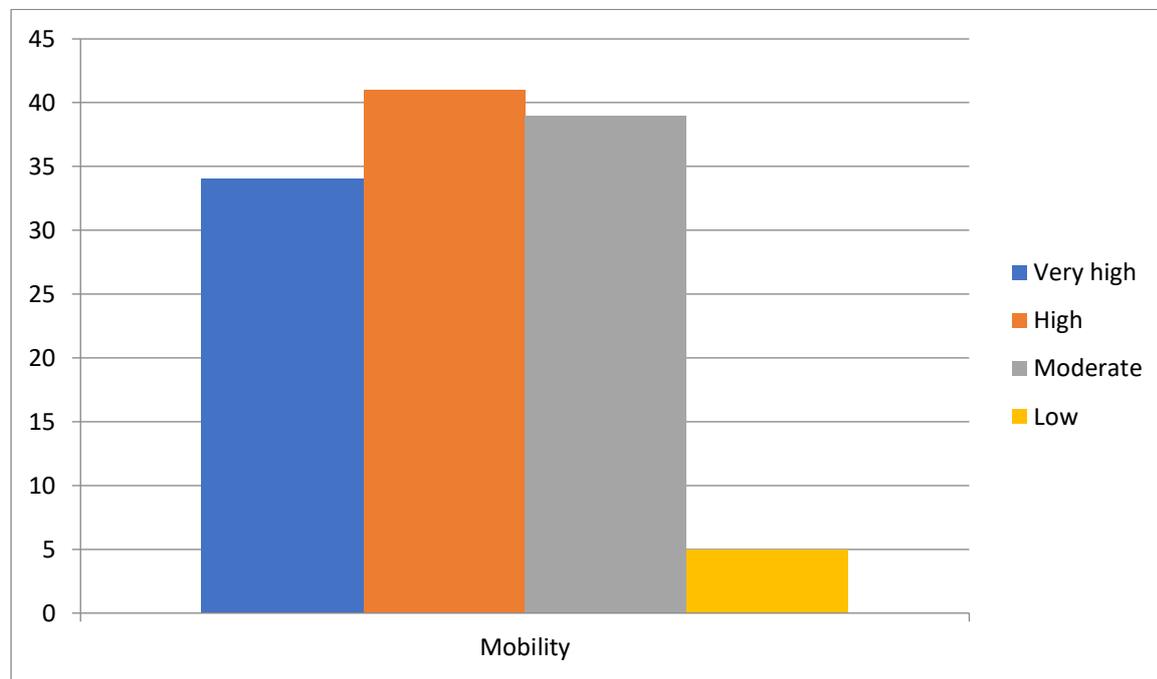
Interpretation: From the above diagram we can understand that 54 respondents out of 120, chose “Very high” making content availability the major factor influencing the customers’ choice of OTT platforms over DTH. Only 1 respondent chose “Low”. 37 chose “high” and 27 chose “Moderate”.

Graph 4.9.2 Graph showing the influence of subscription regarding the choice of OTT platforms over DTH of the respondents.



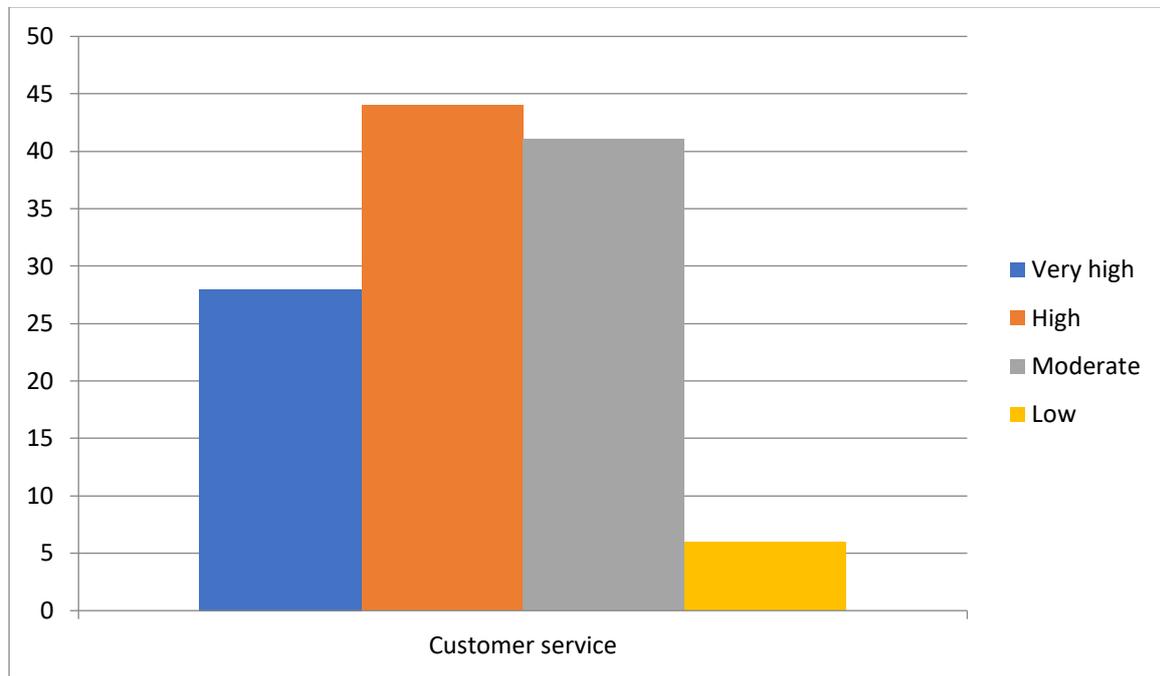
Interpretation: The diagram illustrates that 50 respondents out of 120, chose “Moderate” making subscription, the third major factor influencing the customers’ choice of OTT platforms over DTH. 6 chose “low”. 29 chose “Very high” and 34 chose “High”.

Graph 4.9.3 Graph showing the influence of mobility regarding the choice of OTT platforms over DTH of the respondents.



Interpretation: The diagram illustrates that 50 respondents out of 120, chose “Moderate” making subscription, the fourth major factor influencing the customers’ choice of OTT platforms over DTH. 6 chose “low”. 29 chose “Very high” and 34 chose “High”.

Graph 4.9.4 Graph showing the influence of customer service regarding the choice of OTT platforms over DTH of the respondents.



Interpretation: The diagram illustrates that 44 respondents out of 120, chose “High” making customer service, the second major factor influencing the customers’ choice of OTT platforms over DTH. 6 chose “low”. 28 chose “Very high” and 41 chose “Moderate”.

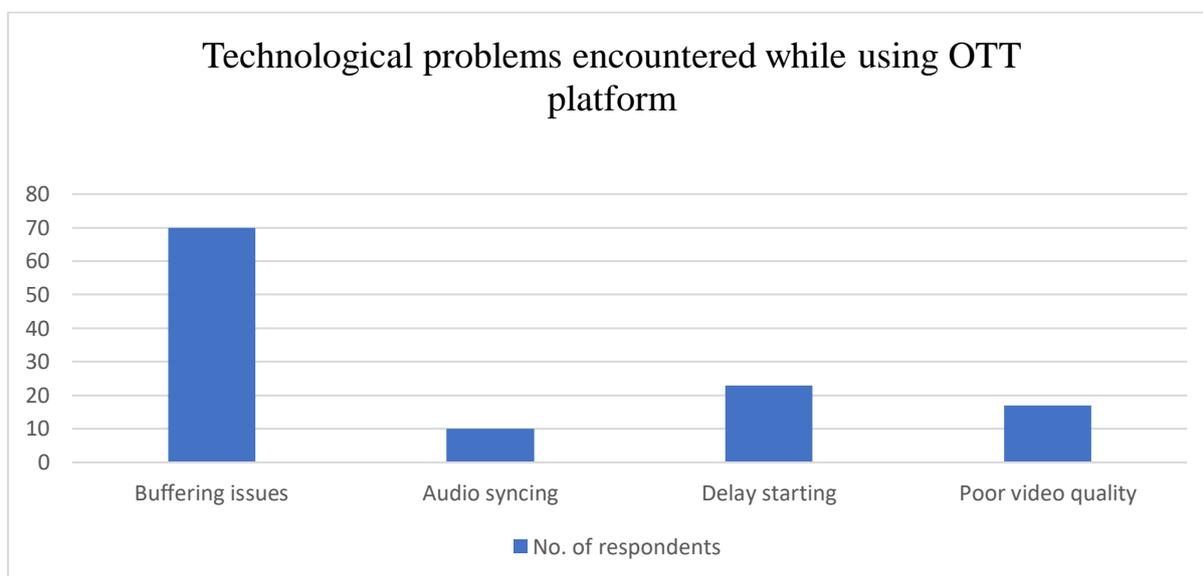
4.10 TECHNOLOGICAL PROBLEMS ENCOUNTERED WHILE USING OTT PLATFORMS

Table 4.10 Table showing technological problems encountered while using OTT platforms.

Technological problems	No. of respondents	Percentage (%)
Buffering issues	70	58.3%
Audio syncing	10	8.3%
Delay starting	23	19.2%
Poor video quality	17	14.2%
TOTAL	120	100%

(Source: primary data)

Graph 4.10 Graph showing the technological problems faced by the respondents while using OTT platforms.



Interpretation: From the above bar diagram, we can understand that buffering issues is the major issue during online streaming. Out of 120 respondents, 70 of them faced it while delay starting issue is encountered by 23 and poor video quality faced by 17 respondents. Audio syncing is the least encountered problem being only by 10 respondents.

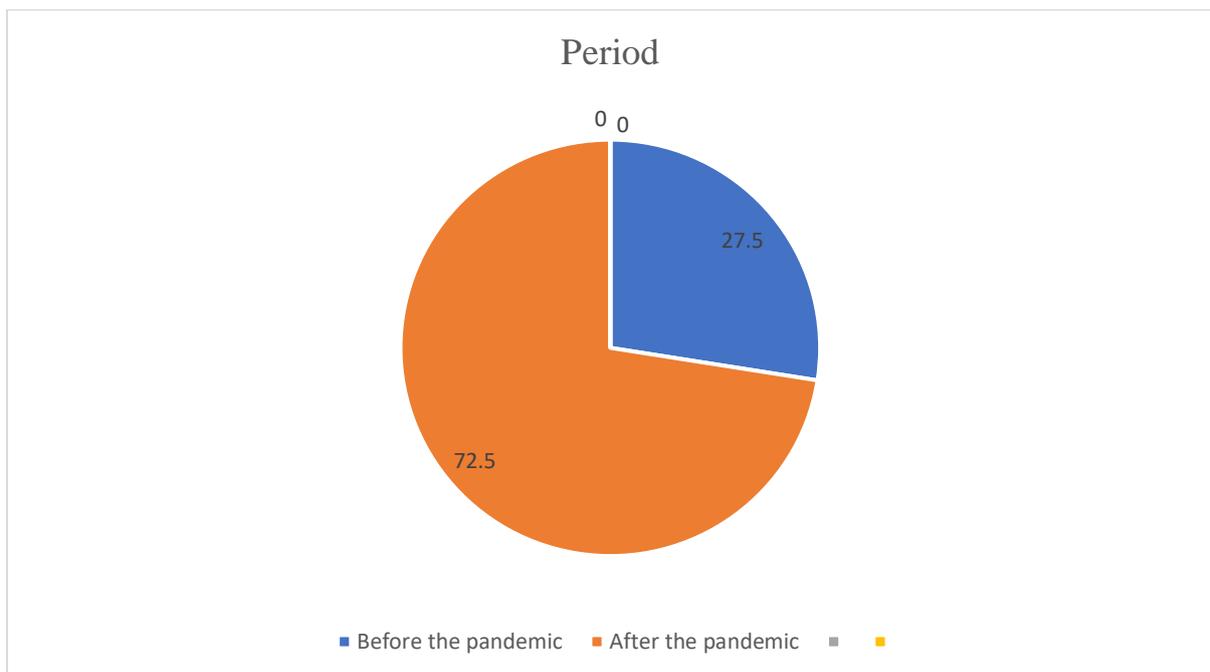
4.11 PERIOD OF TIME WHEN RESPONDENTS STARTED USING OTT PLATFORMS, THE MOST

Table 4.11 Table showing period of time when respondents started using OTT platforms, the most.

Period of time	No. of respondents	Percentage (%)
Before the pandemic	33	27.5%
During the pandemic	87	72.5%
TOTAL	120	100%

(Source: primary data)

Graph 4.11 Pie chart showing the when did the respondents start using the OTT platforms.



Interpretation: The above pie chart illustrates that majority of the respondents i.e., 87 (72.5) respondents began using OTT platforms during the pandemic, the most whereas 33 (27.5%) respondents have already been using OTT mostly, before the pandemic itself.

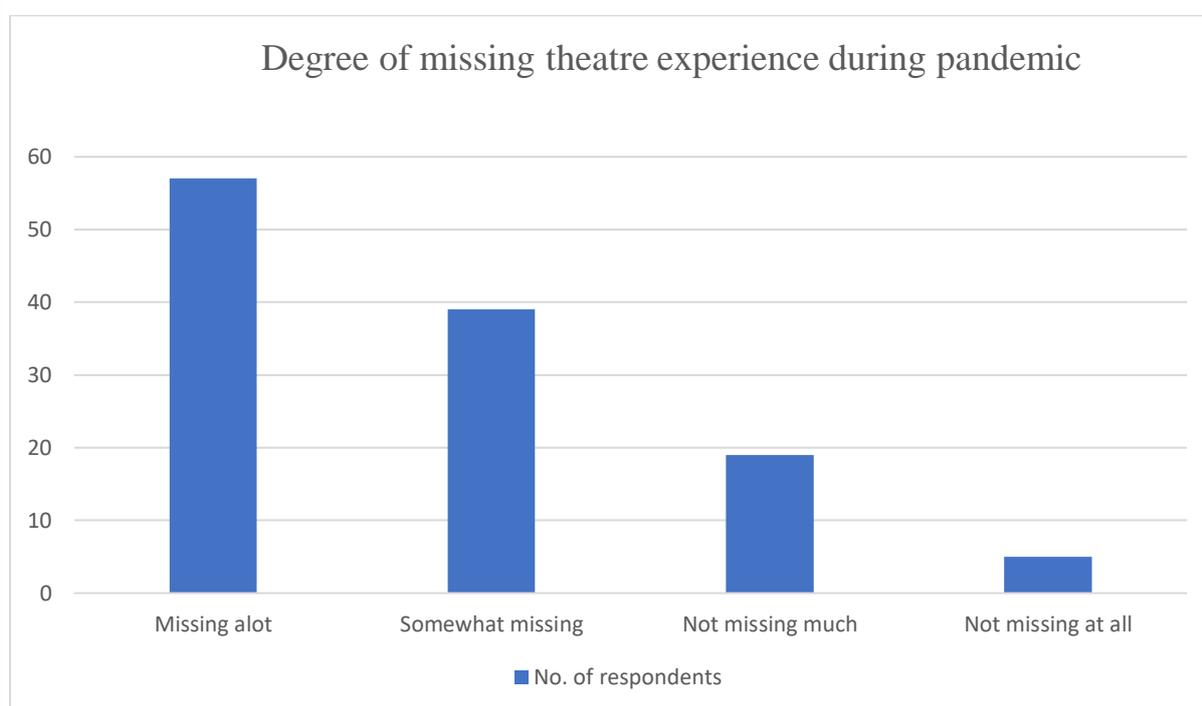
4.12 DEGREE OF MISSING THEATRE EXPERIENCE DURING PANDEMIC

Table 4.12 Table showing degree of missing theatre experience during pandemic.

Category	No. of respondents	Percentage (%)
Missing alot	57	47.5%
Somewhat missing	39	32.5%
Not missing much	19	15.8%
Not missing at all	5	4.2%
TOTAL	120	100%

(Source: primary data)

Graph 4.12 Graph showing the whether the respondents miss theatre experience during the pandemic.



Interpretation: The above bar diagram interprets that 57 respondents miss theatre experience alot while 39 somewhat miss and 19 are not missing theatre experience much. 5 respondents are not missing theatre at all.

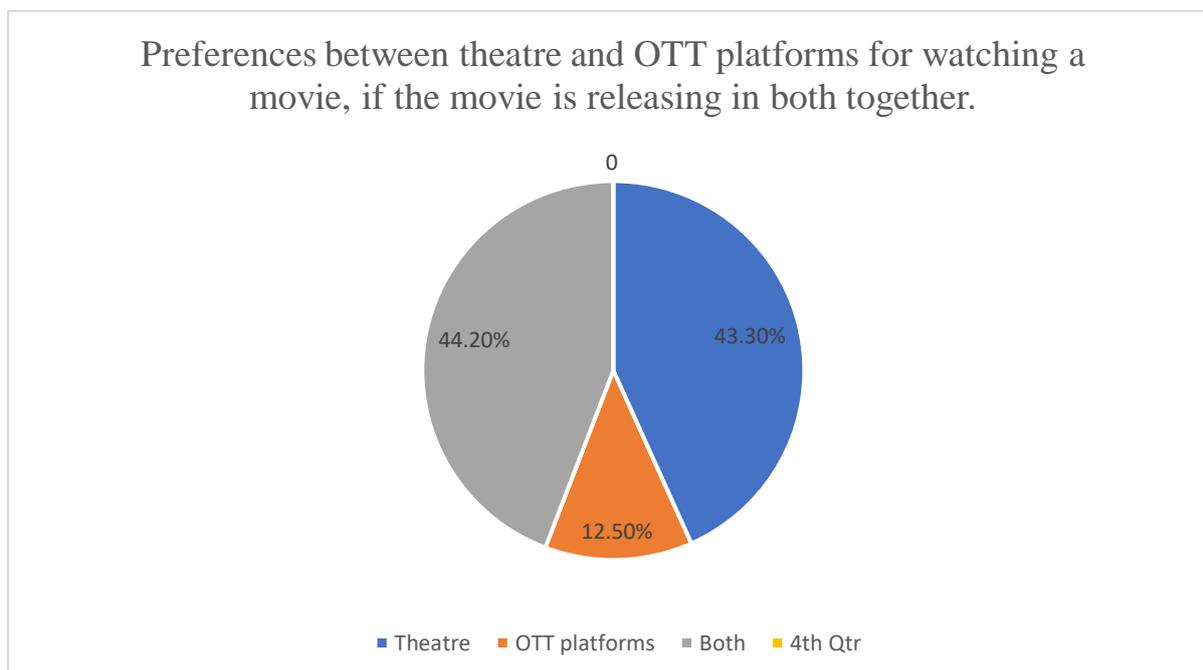
4.13 PREFERENCES BETWEEN THEATRE AND OTT PLATFORMS FOR WATCHING A MOVIE, IF THE MOVIE IS RELEASING IN BOTH TOGETHER

Table 4.13 Table showing preferences between theatre and OTT platforms for watching a movie, if the movie is releasing in both together.

Preferences	No. of respondents	Percentage (%)
Theatre	52	43.3%
OTT platforms	15	12.5%
Both	53	44.2%
TOTAL	120	100%

(Source: primary data)

Graph 4.13 Pie chart showing the preference of the respondents to watch a movie in theatre and on OTT platforms.



Interpretation: From the pie chart, we can understand that in future, if a movie releases in theatre and OTT together then 53 (44.2%) respondents mostly choose to watch movie in both (theatre and OTT). It is also another significant matter that there is only minor difference between number of respondents who choose ‘both’ and ‘theatre’ (43.3%). 15 (12.5%) respondents mostly prefers to watch movie solely in OTT platforms.

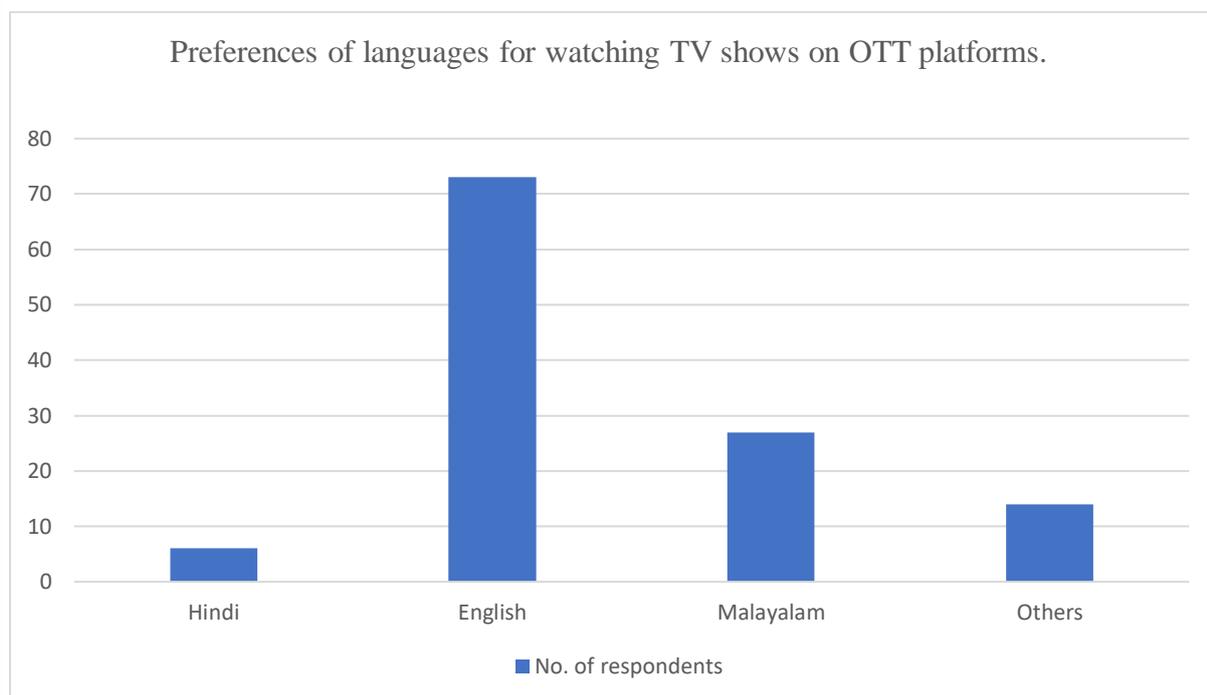
4.14 PREFERENCES OF LANGUAGES FOR WATCHING TV SHOWS ON OTT PLATFORMS

Table 4.14 Table showing preferences of languages for watching TV shows on OTT platforms.

Languages	No. of respondents	Percentage (%)
Hindi	6	5%
English	73	60.8%
Malayalam	27	22.5%
Others	14	11.7%
TOTAL	120	100%

(Source: primary data)

Graph 4.14 Graph showing the language preference of tv shows of the respondents.



Interpretation: The bar diagram shows that majority of the respondents i.e., 73 out of 120 would rather go for watching English TV shows on OTT platforms while 27 respondents prefers to watch Malayalam and 14 would choose other languages. Hindi is the least preferred option being chosen by only 6 respondents.

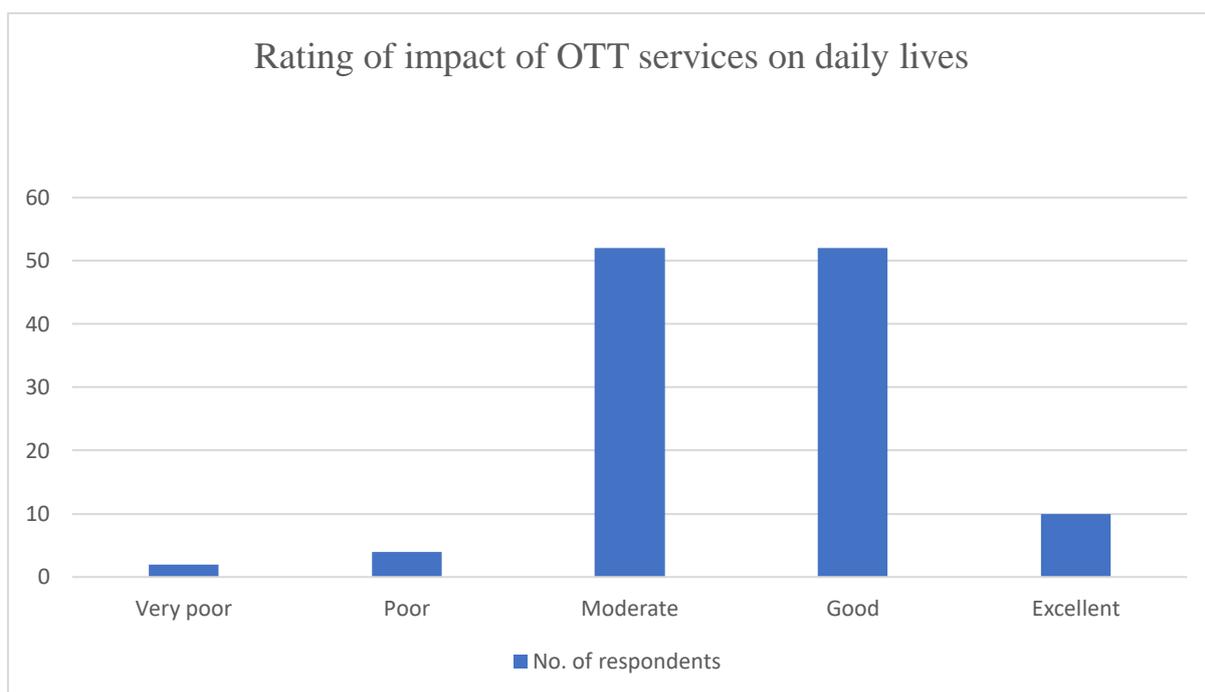
4.15 RATING OF IMPACT OF OTT SERVICES ON DAILY LIVES

Table 4.15 Table showing rating of impact of OTT services on daily lives.

Category	No. of respondents	Percentage (%)
Very poor	2	1.7%
Poor	4	3.3%
Moderate	51	42.5%
Good	53	44.2%
Excellent	10	8.3%
TOTAL	120	100%

(Source: primary data)

Graph 4.15 Graphical representation showing the impact of OTT services on day-to-day life of the respondents.



Interpretation: The above bar diagram illustrates that 53 respondents out of 120, feel that OTT services have good impact while only 2 respondents feel that OTT services have very poor impact on their day-to-day lives. 51 respondents chose “Moderate”, 10 chose “Excellent” and 4 chose “poor” about the impact of OTT services on their daily lives.

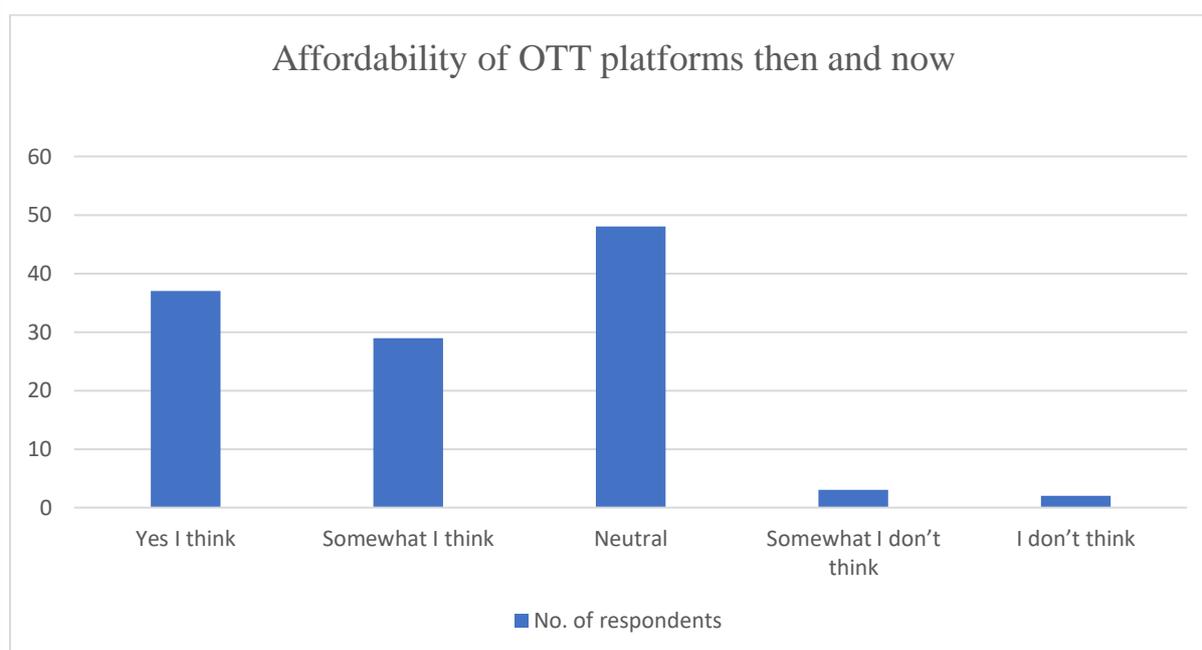
4.16 AFFORDABILITY OF OTT PLATFORMS THEN AND NOW

Table 4.16 Table showing affordability of OTT platforms then and now.

Category	No. of respondents	Percentage (%)
Yes, I think	37	30.8%
Somewhat I think	30	25%
Neutral	48	40%
Somewhat I don't think	3	2.5%
I don't think	2	1.7%
TOTAL	120	100%

(Source: primary data)

Graph 4.16 Graphical representation showing the affordability of OTT platforms of the respondents.



Interpretation: From the above bar diagram, it's clear that majority of the respondents, to be precise, 48 of them have a neutral opinion about whether the OTT platforms are more affordable now than earlier. 37 respondents truly believe that OTT platforms are more affordable now than earlier while only 2 respondents don't think that OTT platforms are affordable even now. 30 respondents somewhat think that OTT platforms are comparatively affordable now and 3 respondents somewhat don't think that OTT platforms are comparatively affordable now.

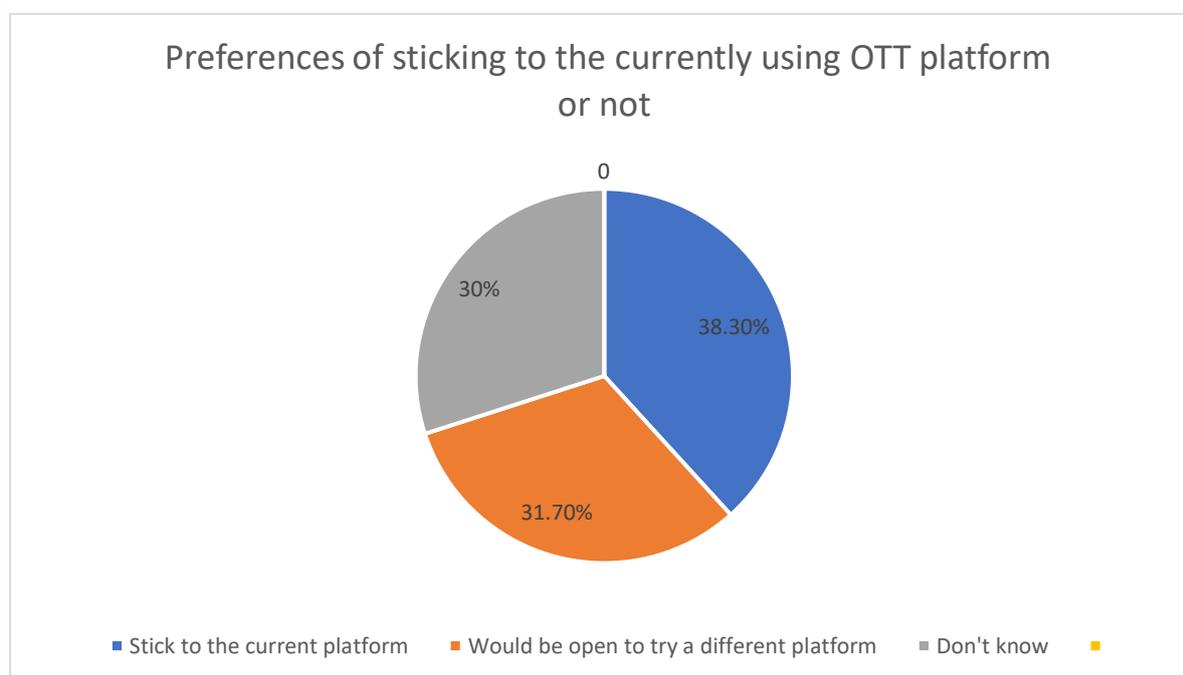
4.17 PREFERENCES OF STICKING TO THE CURRENTLY USING OTT PLATFORMS OR NOT

Table 4.17 Table showing preferences of affordability of OTT platforms then and now.

Category	No. of respondents	Percentage
Stick to the current platform	46	38.3%
Would be open to try a different platform	38	31.7%
Don't know	36	30%
TOTAL	120	100%

(Source: primary data)

Graph 4.17 Pie chart showing the preference of the respondents stick on to the OTT service they currently use.



Interpretation: The pie chart clearly describes that 46 (38.3) out of 120 respondents would choose to stick on to the current platform whereas 36 (30%) responds that they don't know. 38 (31.7%) respondents would be open to try a different platform.

CHAPTER V
FINDINGS,
SUGGESTIONS AND
CONCLUSION

5. FINDINGS, SUGGESTIONS AND CONCLUSION

5.1 FINDINGS

- It is stated that the majority of respondents belong to 20 - 30 age group (82.5%)
- Most of the respondents spend 1 - 5 hours in OTT platforms (60.8%)
- Netflix is the OTT platform preferred by major number of respondents (64.2%)
- From the study we can understand large number of respondents choose to watch movies rather than TV shows, web series, sports or any others (50%)
- The majority of respondents prefer mobile phones to use OTT platforms (62.5%)
- Comedy is the highly chosen genre among the respondents (32.5%)
- Most of the respondents prefer to occasionally pay for watching premium OTT content (28.3%)
- The majority of respondents may or may not prefer OTT platforms over DTH (44.2%)
- Content availability is the main factor that influence the choice of OTT platforms over DTH for majority of the respondents (54 respondents out of 120)
- It is stated that highest faced technological problem while using OTT platforms is buffering issues (50.8%)
- From the study we can understand that most of the respondents started using OTT platforms highly during the pandemic (72.3%)
- It is understood that large number of respondents miss theatre experience a lot during the pandemic (47.1%)
- Equal number of the respondents prefer to watch newly releasing movies in theatre alone as well as in both theatre and OTT platforms (43.7%)
- English is the highly preferred language to watch TV shows on OTT platforms (61.3%)
- Most of the respondents is of the opinion that OTT services have good impact on their daily lives (43.7%)
- The majority of respondents chose “neutral” option about the affordability of OTT platforms then and now (40.3%)
- Highest number of respondents prefer to stick to the currently using OTT platform (38.7%)

5.2 SUGGESTIONS

Regional OTT platforms must penetrate deeper into the market in order to cater to the content needs of native audiences, especially in rural areas. India is a country with rich heritage and culture brimming with stories that are worthy of a far-reaching platform to connect with its target audience. The 19,500 plus languages and dialects spoken in India is a huge opportunity for regional content developers. While the mainstream movie business focuses on commercial cinema, regional content on OTT can become an active passage to showcase our tradition. Pay per view model or subscriptions per movie must be encouraged rather than just monthly or yearly subscriptions among OTT platforms making the OTT content much more affordable. Payment models integrated into the mobile ecosystem, are very unique to the country and any OTT platform hoping to win favour with the Indian audience will have to factor in phone compatibility while designing their user experience. Now, UPI autopay is one of the highly used payment methods in India. Hence it should be also included among the payment modes in OTT platforms. In case of regional OTT platforms, steps should be also taken towards ensuring smooth payments especially for viewers abroad who may not have an Indian number. Since lot of consumers have mobile data limit (data caps), methods should be developed by OTT platforms to reduce data consumption such as compression algorithms. Inconsistent internet connectivity exists in our country. So, these platforms have to build intelligence to adjust video resolution as network and bandwidth change. Streaming quality must be adjusted to the internet speed of consumers.

5.3 CONCLUSION

Viewing content on any medium is a matter of behaviour which converts into a habit over a period of time. Indians for long have yearned for diversity of content. A common family television enabled with limited channels restricted the imagination of young India. This imagination was tapped and explored by OTT players optimally during COVID 19 and the flexibility of accessing a range of content on personal devices including smartphones and tablets gave young India the freedom to watch what they desired. OTT is a perfect place to get home entertainment. Yet, OTT players have just been able to touch the tip of the ice berg, there is immense potential to dive deeper into the regional Indian market in times to come. With just 40 OTT platforms and limited regional content, this medium has created a new niche for itself in urban India. The OTT video streaming service will continue to spread its feet and it is going

to have a huge impact on our traditional medium like television and cinema theatres. COVID 19 has played a very significant role in mass adoption of the medium in urban regions where people have better paying power than semi-urban or rural India. Smartphone penetration, international collaborations between media moguls, digital quality of the medium, cost effectiveness and access liberty are some of the reasons behind growth of streaming media in India. COVID 19 brought with itself some factors which became the new normal, like working from home, which have seemed to offer flexibility of schedules to many. A random walk and tea time with a colleague have been replaced with a 20-30min quick episode of one's favourite series available on an OTT platform. All researches point to the growing duration of video content consumption year on year and COVID 19 has proved to be a turned point in furthering this behaviour change.

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APPENDIX

QUESTIONNAIRE

We, the students of St. Teresa's College have prepared a questionnaire for the purpose of understanding the role of pandemic on usage of OTT platforms. In order to complete our research, a few questions must be answered and the information's or feedbacks will be kept confidential.

Name

Age

1. How much time do you spend in OTT platforms a day?

- Below 1 hour
- 1 to 5 hours
- More than 5 hours

2. Which OTT platforms do you prefer?

- Netflix
- Amazon Prime
- Disney+hotstar
- Others

3. What do you prefer to watch the most to use OTT platforms?

- Movies
- TV shows
- Web series
- Sports
- Others

4. In which device you prefer the most to use OTT platforms?

- TV
- Mobile phone
- Tablet
- Others

5. Which genre do you prefer to watch on OTT platforms?

- Horror
- Comedy
- Drama
- Action
- Others

6. Do you frequently pay for watching premium content on OTT platforms?

- Always
- Often
- Occasionally
- Rare
- Never

7. Do you prefer OTT platforms over DTH?

- Yes
- No
- Maybe

8. How do the following factors influence your choice of OTT platforms over DTH?

	Very High	High	Moderate	Low
Content Availability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Subscription	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mobility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Customer Service	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9. Which of these technological problems have you encountered most often while using an OTT platform?

- Buffering issues
- Audio syncing
- Delay starting
- Poor video quality

10. When did you start using OTT platforms, the most?

- Before the pandemic
- During the pandemic

11. How much do you miss the theatre experience during the pandemic?

- Missing alot
- Somewhat missing
- Not missing much
- Not missing at all

12. In the future, if a movie releases in theatre and on OTT platforms together, what would you prefer mostly?

- Theatre
- OTT platforms
- Both

13. In which language do you prefer most to watch TV shows on the platforms?

- Hindi
- English
- Malayalam
- Others

14. How do you rate the impact by OTT services on your day to day?

- Positive
- Negative
- Not at all

15. Do you think that the OTT platforms are more affordable now than earlier?

- Yes I think
- Somewhat I think
- Neutral
- Somewhat I don't think
- Others I don't think

16. Do you prefer to stick to the OTT services you are currently using?

- Stick to the current platform
- Would be open to try a different platform
- Don't know

PROJECT REPORT

A STUDY ON THE EFFECT OF BIRTH ORDER ON PERSONALITY, SELF-ESTEEM AND SATISFACTION WITH LIFE

Submitted by:

ALEXIS SHERYL NISHIL

Register No: SB19PSY050

Under the guidance of

MS. ASHYA K SALIM

In partial fulfillment of the requirement for award of the degree of

B.Sc. PSYCHOLOGY



ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

Nationally Re-accredited at 'A++' level (4th
cycle) Affiliated to: Mahatma Gandhi University

MARCH 2022

CERTIFICATE

This is to certify that the project report entitled, “A STUDY ON THE EFFECT OF BIRTH ORDER ON PERSONALITY, SELF-ESTEEM AND SATISFACTION WITH LIFE”, is a bonafide record submitted by MS. ALEXIS SHERYL NISHIL, Reg.No. SB19PSY050, in partial fulfillment of the requirements for the award of the Degree of Bachelor of Psychology during the academic year 2019-2022.



Ms. Bindu John

Head of the Department

Department of Psychology

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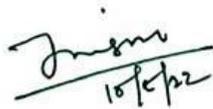
Ms. Ashya K Salim

Assistant Professor

Department of Psychology

St. Teresa's College, Ernakulam

External Examiner:



DECLARATION

I, Alexis Sheryl Nishil, hereby declare that the study presented in the dissertation entitled, “The Effect of Birth Order on Personality, Self-esteem and Satisfaction with life”, which is submitted to the Department of Psychology, St. Teresa’s College, Ernakulam is a bonafide record of the research work carried out by me, under the supervision and guidance of Ms. Ashya K Salim, Assistant Professor, Department of Psychology, St. Teresa’s College, Ernakulam, in partial fulfillment of the requirements for the degree of Bachelor of Science in Psychology and has not previously formed the basis for the award of any degree, diploma, fellowship, title or recognition before.

Place: Ernakulam

Alexis Sheryl Nishil

Date:

ACKNOWLEDGEMENT

I would like to express my deep heartfelt gratitude to the Department of Psychology, St. Teresa's College, Ernakulam for providing me with the opportunity to undertake the research. I would like to express my thanks to Mrs. Bindu John, Head of the Department of Psychology, for her guidance and support. I acknowledge my indebtedness and deep sense of gratitude to my research guide, Ms. Ashya K Salim, Assistant Professor, Psychology, for encouraging and guiding me throughout all the phases of my research. I sincerely thank her for being patient with me and for her valuable advice and insight. I extend my sincere thanks to my parents, teachers and my friends who all have supported me throughout the time. I am grateful to each and every one who has given me guidance, encouragement, suggestions and constructive criticisms which has contributed immensely for this project. Above all, I thank God Almighty for blessing me in all the stages of the project and for helping me complete the project successfully.

Thanking you

Alexis Sheryl Nishil

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THE EFFECT OF BIRTH ORDER ON PERSONALITY, SELF-ESTEEM AND SATISFACTION WITH LIFE

ABSTRACT

This study aims to investigate the controversial concept of birth order and its effects on personality, self-esteem and satisfaction with life between 18-25 years. Participants (n=301) completed online questionnaires measuring birth order, personality, self-esteem, satisfaction with life and age. Correlations examined relationships between personality, satisfaction with life and self-esteem. ANOVA's tested differences between birth order and personality, birth order and self-esteem. The Findings of this research was First-borns scored significantly higher on Extraversion than last-borns. Satisfaction with life positively correlated with extraversion and negatively associated with neuroticism. There was no significant relation between birth order and self-esteem as well between self-esteem and satisfaction with life. Findings will be contributable to lifespan developmental psychology, Personality develop counselor, career –counseling, teachers, social – workers etc.

Keywords: birth order, personality, self-esteem, satisfaction with life.

CHAPTER 1
INTRODUCTION

INTRODUCTION

The birth order is the order in which a child is born. The first child is normally the oldest child that is born into a family. The middle child is can be the second or third child all the way to the last born or the baby of the family. Birth order is an extensively researched and controversial concept in the social science literature which has attracted much debate through history (Eckstein et al, 2010) because this kind of a research is a challenge of its difficulty of controlling all the variables that are statistically related to birth order. Family size and a number of social and demographic variables are associated with birth order and serve as potential confounds.

Alfred Adler (1870–1937), an Austrian psychiatrist, and a contemporary of Sigmund Freud and Carl Jung, was one of the first theorists to suggest that birth order influences personality. He argued that birth order can leave an indelible impression on an individual's style of life, which is one's habitual way of dealing with the tasks of friendship, love, and work.

This study aims to investigate the effects birth order has on personality, self-esteem and satisfaction with life. It will also explore whether these effects significantly differ between age categories 18-25 years of age on Indian students through the use of online questionnaires which have been distributed to potential participants through social networking sites.

1.1 BACKGROUND OF THE STUDY

The primary purpose of this study was to examine the relationship between birth order and personality, self-esteem and satisfaction with life among young adults.

We posit that India's steep birth order gradient is due to favoritism toward eldest child and gradually they are portrayed to be responsible and a role – model to the younger ones which leads to pressuring them to meet the societal needs. Often, the younger siblings are either compared to or are competitive towards their elder siblings which makes them insecure or concerned. The final point is that often younger siblings are like to be pampered the most by their parents. Pampering creates weakness because children develop the belief that others should do everything for them which makes them to lose their ability to do things by oneself.

1.2. PROBLEM STATEMENT

A child's birth order position may influence interaction with other children at school or how the child forms relationships with family members. Therefore, birth order may be an important factor in understanding individual behavior and experience.

Most schools, colleges and work places in India do not provide personality development programs. Personality Development should start early in a student's life which is a true reflection of their inner being. Help must be provided to students to work on latest social skills. Counseling, guidance has to be provided to enhance self-confidence.

Low self-esteem or lack of confidence leaves students doubting their ability to succeed, making them hesitant to engage in learning or take appropriate academic growth risks

Life satisfaction is associated with better physical health, higher performance, and stronger social relationships. Some studies on life dissatisfaction predicted increased long-term morbidity, work disability, and mortality. Low levels of average national life satisfaction were also related to a higher prevalence of suicide.

1.3. NEED AND SIGNIFICANCE OF THE STUDY

The reason for doing this study is because there are few or no studies conducted on birth order studies testing these variables in specific, along with the age group 18-25 years have been carried out on an Indian population or worldwide.

There has been an abundance of birth order research investigating behavioral effects, such as academic achievement and rebelliousness within family environments. Early theorists agreed that early childhood experiences set the foundation of future adult implications.

1.4. SCOPE OF THE STUDY

The hypothesis made on the research topic The Effect on Birth order has on personality, self-esteem and satisfaction with life is true, then the result can be used in various fields for the upbringing of the Indian students on shaping their personality, and healthy self-esteem as well as gaining an awareness on how to be satisfied with their life. The result of this study would be

beneficial for Personality develop counselor, career –counseling, developmental psychologists, teachers, social – workers etc.

1.5. OBJECTIVES OF THE STUDY

- To investigate the relationship between birth order categories and personality traits.
- To identify the relationship between personality and satisfaction with life.
- To identify the relationship between birth order categories and self-esteem.
- To find a relationship between self-esteem and satisfaction with life.

1.6. LIMITATIONS OF THE STUDY

- In regards to family structure, participation required all respondents to have at least one sibling and the third born child and the only born children were excluded.
- Then the second limitation is the lack of control for background factors such as social class often confused differences in personality, resulting from social background, with difference due to birth order.
- The third limitation is that the study completely focuses on students in Ernakulum district.
- The fourth limitation was there are higher probabilities of misinformation in the collected data due to online collection and no direct communication with the participants.

CHAPTER 2
LITERATURE REVIEW

LITERATURE REVIEW

Birth order is an extensively researched and controversial concept in the social science literature which has attracted much debate through history (Eckstein et al, 2010). Birth order has been a consistent standard variable in psychological research since Alfred Adler first applied the idea in 1918 (Cervone & Pervin, 2008). From a historical point of view, it is likely that Alfred Adler was influenced by Charles Darwin and his theory of evolution and adaptation (Cervone & Pervin, 2008). Adler used the concept of birth order in his work, while combining it with other information in order to access life-style (Ansbacher & Ansbacher, 1956 cited in Eckstein et al, 2010).

- **BIRTH ORDER**

Shulman and Mosak (1977) enunciated two definitions of birth order. The first definition, the ordinal position, is referred to as the actual birth order of sibling (Shulman & Mosak, 1977). Adler places particular importance on the psychological position of the child, he highlights that it is not the child's birth order number that influences their character, but rather the situation into which they are born and how they subsequently interpret it (Eckstein et al, 2010).

Both the ordinal position and the psychological position have been used in a vast range of research. Ernst and Angst (1983) conducted an extensive review of world literature from 1946 to 1980 and concluded that most established and accepted effects of birth order on personality were methodological artifacts of poor research design. Ernst and Angst stated that through lack of control for significant background factors such as family size and social class, researchers often confused differences in personality resulting from social background with differences due to birth order (Ernst & Angst, 1983).

Sullo way's (1996) publication of 'Born to Rebel' represented a response to Ernst and Angst, by offering a new theoretical perspective on birth order. Sullo way (2007) believed that a child's development is explained by functional and not biological birth order (Healey & Ellis, 2007) and his theory focuses within-family. He examined the strength and status attained by siblings of different birth order within families of differing sizes. He subsequently concluded that birth order

influences the unique strategies adopted by children for increasing parental interest in their welfare (Healey and Ellis, 2007).

First-borns are presented with the first opportunity to create a personal niche within the family unit and tend to receive a greater investment from their parents (Paulhus et al, 1999). They tend to be responsible, ambitious, competitive, conservative, organized and often serving as surrogate parents for their younger siblings (Jefferson et al, 1998). In addition, they often attempt to please their parents by sharing their interests and show a strong willingness to fulfil parental expectations and wishes (Healey & Ellis, 2007), often through academic success and responsible behaviour (Paulhus et al, 1999).

Paulhus, Trapnell and Chen (1999) later conducted a study from both Canada and the United States of America using within-family designs, also found first-born child related to higher academic achievement. This theory is further supported by a study which highlighted that firstborns tend to be positioned in occupations which require higher levels of education and greater professional requirements (Ivancevich, et al, 1987).

Despite first-borns being afforded the first opportunity to establish their niche within the family, dethronement is felt by the first-born with the arrival of another sibling as they are no longer the primary focus of their parent's attention (Eckstein et al, 2010). Dethronement was observed in Adler's theory and Sulloway's (1996) findings on birth order characteristics and it is believed that dethronement arises more frequently in families viewed as being more competitive (Stein 1999).

Middle-born children, even when parental investment is spread equally, still receive fewer resources compared to their first-born and last-born siblings (Sulloway, 2001). First-borns and last- borns often experience some period of their childhood as only children, in contrast middle children always share parental resources with another sibling (Sulloway, 2007). As a result, middle children are often described as being peer oriented and independent of the family (Sulloway, 2007). Middle-borns have also been found to be less closely attached to the family, less likely to report having been loved during childhood.

Last-borns are generally described as being more adventurous, altruistic, cooperative easy going, empathic, open to experience, rebellious, risk-takers, sociable and unconventional (Eckstein et al,

2010). These characteristics which are associated with first-borns have been demonstrated in research and studies focusing upon birth order.

Zweigenhaft and Von Ammon (2000) tested Sulloway's hypothesis among a group of college students in the United States of America who had participated in civil disobedience as part of a labour dispute. Interviews were conducted with 17 of the 20 arrested individuals (Zweigenhaft & Von Ammon, 2000). The study discovered a relationship between birth order and the number of arrests (Zweigenhaft & Von Ammon, 2000). Furthermore, the results highlighted that of the 12 later-born individuals, 6 had been arrested once previously and all of those who had been arrested more than once were also later-borns (Zweigenhaft & Von Ammon, 2000).

- **PERSONALITY**

The Big Five Personality Traits are relatively consistent over the lifespan of an individual (Roberts & Del Vecchio, 2000). These include Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness (Cervone & Pervin, 2008). The meaning of the factors can be observed by examining trait adjectives that describe individuals who score high and low on each (Cervone & Pervin, 2008). Despite their theoretical differences, early personality theorists such as Sigmund Freud, Alfred Adler and Carl Jung agreed that the early formation of childhood experiences were significant for future adult implications (Eckstein & Kaufman, 2012) and subsequent academic research has provided adjectival explanations of the effect of birth order on personality.

Nyman (1995) found the first-born to be dominant-aggressive, intelligent, ambitious, responsible, caring and friendly. This was the only birth position that was found to be directly associated with leadership (Nyman, 1995). He described the eldest male as self-centred and both the eldest female and male as spoilt (Nyman, 1995). The first-born female scored high on nurturance and responsibility and the first-born male on dominance and independence (Nyman, 1995).

Nyman described the middle birth position as being sociable, thoughtful, responsible, ambitious and independent (Nyman, 1995). He linked open mindedness and dominant aggressive characteristics with middle-born males and intelligence with females (Nyman, 1995). Negative attributes such as insecurity, confusion, neglect and rebelliousness were associated with both males

and females, while males were also seen as irresponsible (Nyman, 1995). The middle birth position was the only birth position which was not viewed as being 'spoilt' and middle-borns were further described as neglected or overlooked (Nyman, 1995). Finally, the youngest was viewed as dependent, irresponsible, rebellious and immature (Nyman, 1995). In addition to this, males were portrayed as being self-centred, insecure and lazy while females were described as passive (Nyman, 1995).

Sulloway (1995) conducted a review of 196 personality studies and hypothesized specific traits which were associated with certain birth orders. Sulloway stated that first-borns exhibit greater respect for parental authority and consequently should score higher on conscientiousness (Sulloway, 1995). Jefferson, Herbst and McCrae (1998) found the traits of neuroticism, extraversion and conscientiousness were more highly associated with first-borns, however, they scored lower on openness to experience and agreeableness compared to later-borns.

Later Paulhus, Trapnell and Chen (1999) conducted four individual within-family studies. Their third study of 194 students (excluding only children) was a take-home study which included the Five-Factor Model traits (Paulhus et al, 1999). The researchers used four of the Big Five Traits, excluding neuroticism as they believed it had the weakest effect (Paulhus et al, 1999). They found that the pattern was consistent across sibling sizes (Paulhus et al, 1999). First-borns were found to be most conscientious and higher achieving, supporting Sulloway's theory and later-borns were found to be associated higher as more liberal, agreeable and rebellious (Paulhus et al, 1999). A possible explanation of these results forwarded by the researchers related to the last-born of the family being most likely to be in their teenage years and therefore of an age where rebelliousness is common (Paulhus et al, 1999). This explanation gave rise to a fourth study to challenge this explanation.

This study involved 309 adults in Vancouver, Canada who were provided with take-home packages (Paulhus et al, 1999). As all participants were over 40 years of age, it was considered that they would be beyond their 'rebellious' teenage years (Paulhus et al, 1999). Significantly, the study provided similar findings to that of the third study, supporting previous research and supporting the concept of consistency of personality over an individual's lifespan (Paulhus et al 1999).

Healey and Ellis (2007) also found similar findings in their first study of 161 second year personality psychology students at the University of Canterbury. The results indicated that first-borns scored significantly higher on consciousness compared to their second-born siblings and lower on openness to experience (Healey & Ellis, 2007).

Jefferson, Herbt and McCrae (1998), Paulhus, Trapnell and Chen (1999) made significant findings which illustrate that first-borns score higher on extraversion and conscientiousness and lower on openness to experience and agreeableness compared with later-born individual.

- **SELF-ESTEEM**

As previously noted, studies have supported the view that birth order has an effect on the personality (Healey & Ellis, 2007; Jefferson et al, 1998; Nyman, 1995 and Saroglou & Fiasse, 2003) and an individual's subsequent achievements (Fergusson et al, 2006 and Paulhus et al, 1999). Another key area of interest is whether birth order influences self- esteem.

Falbo (1981) suggested that birth order affects self-esteem in adolescents and young adults. The study, consisting of 841 males and 944 female undergraduate university students, examined the relationship between birth order and personality traits (Falbo, 1981). Falbo (1981) used several personality instruments, a background questionnaire and the Rosenberg Self-Esteem Scale. The results revealed first-borns tended to have higher self-esteem compared to later-born children, with the lowest self-esteem occurring in middle-born females (Falbo, 1981).

Birth order may also relate to how an individual understands how they are viewed and perceived by others (Schwab & Laudgren, 1978). Schwab and Laudgren (1978) carried out two relevant studies, involving 236 female and 236 male undergraduate college students, examining the relationships between birth order, perceived evaluations of self by others and self-esteem. The study found first-borns to have a higher self-esteem compared to later-borns and these characteristics are greater again in females compared to males (Schwab & Laudgren, 1978). It was also found that perceived appraisals of significant others are important in explaining differences in birth order (Schwab & Laudgren, 1978). Furthermore, they suggested that perceived appraisals of authority figures, for example fathers, are most influential for first-born females, while

perceived appraisals of close peers are of most importance for first-born males (Schwab & Laudgren, 1978).

Several studies have demonstrated that the parent-child relationship is amongst the most significant indicators of self-esteem (Parker & Benson, 2004). Parker and Benson (2004) suggested the perceptions of closeness with parents are positively correlated with adolescent self-esteem.

Baker and Ben-Ami (2011) conducted an internet study of 118 adults whose parents divorced before the age of 15 years. They discovered those who experienced parental alienation exhibited low self-esteem, insecure relationship attachments, higher rates of depression and decreased self-sufficiency in adulthood (Baker & Ben-Ami, 2011).

The current study will investigate whether birth order categories are significantly correlated with self-esteem as suggested by Falbo (1981) and Schwab and Laudgren (1978). Both studies found first-borns to have higher levels of self-esteem compared with their later-born siblings. Baker and Ben-Ami (2011) discovered that adults with parents who divorced before early adolescence were found to exhibit lower self-esteem compared with those with a two-parent family living environment. Therefore, the third requirement for participation is based on Baker and Ben-Ami's findings. This study will alter the age range to respondents requiring a two-parent family between the ages of 0 to 12 years of age enabling us to focus purely on the childhood affects.

- **SATISFACTION WITH LIFE**

Since the time of Aristotle, the pursuit of happiness has been a fundamental part of psychology explored by philosophers and theologians (Proctor et al, 2009). In recent years, a large body of research has emerged on the topic of happiness, referring to subjective well-being, satisfaction with life, or happiness across different categories of people (Proctor et al, 2009; Ho, Cheung, & Cheung, 2008 & Joshanloo & Afshari, 2011). Cross-sectional, longitudinal and experimental data studies have illustrated that well-being and happiness positively correlate with personal, psychological, behavioural and social outcomes (Lyubomirsky et al, 2005).

Several studies have also highlighted family factors as predictors of satisfaction with life (Henry, 1994; Onyishi & Okongwu, 2013). Henry (1994) highlighted that parental support, such as encouragement, praise and physical affection was associated with greater family life satisfaction. The study also found that adolescences who reported living in single parent families reported a lower life satisfaction with their family life, compared to those with two parent families (Henry, 1994).

Different theoretical perspectives offer different explanations of the determinants of satisfaction with life (OECD, 2013). Early classical theories of subjective well-being suggest an individual's happiness results most directly from the objective circumstances in an individual's own life (Baird et al, 2010). More recently, an essentialist perspective has been forwarded (Baird et al, 2010). Diener and Lucas (1999) argued that demographic characteristics and objective circumstances, rather than influencing satisfaction with life directly, possibly affect well-being through an array of subjective processes.

In support of this idea, researchers such as Shimmack, Oishi, Furr and Funder (2004) have noted subjective well-being to significantly correlate with personality traits. Their research involved 136 students from the University of Illinois (Shimmack et al, 2004). The sample included 100 female and 36 male participants with a mean age of 20 (Shimmack et al, 2004). Their results demonstrated that extraversion and neuroticism were significant predictors of satisfaction with life (Shimmack et al, 2004). They discovered that extraversion was positively correlated with satisfaction with life, whereas neuroticism was negatively correlated with satisfaction with life (Shimmack et al, 2004).

Diener and Seligman's (2002) study screened a sample of 222 undergraduates in the University of Illinois. They compared the upper 10% of consistently 'very happy' participants with 'average' and 'very unhappy' participants (Diener & Seligman, 2002). The 'very happy' group were found to score higher on extraversion, agreeableness and lower on neuroticism (Diener & Seligman, 2002). Diener and Seligman (2002) concluded that good social relations were necessary for happiness.

In contrast to the classical and essentialist perspectives, the socio-emotional selectivity theory suggests that individuals may become happier over their lifespan. However, there has been a

variety of cross-sectional studies that have found stable levels of satisfaction with life across different cohorts (Costa, McCrae, & Zonderman, 1987). Veenhoven (1996) conducted a cross-cultural study from 1980 to 1990 which examined the relationship between the age range of 18-90 years of age and social well-being in eight European countries. They discovered almost no change in the level of life satisfaction between young and old (Veenhoven, 1996).

Henry (1994) highlighted that lower satisfaction with life is associated with those living in a single parent environment. Shimmack, Oishi, Furr and Funder (2004) and Diener and Seligman (2002) found the personality trait extraversion to positively correlate with satisfaction with life and neuroticism to negatively correlate with satisfaction with life. Therefore, one requirement for participation in this study includes growing up in a with a sibling, the participants for the study are the first and last borns and this study will seek to explore the relationship between specific personality traits and satisfaction with life.

2.2 RESEARCH GAP

The study is conducted because there are few or no studies conducted on birth order studies testing these variables in specific, along with the age group 18-25 years have been carried out on an Indian population or worldwide.

There has been an abundance of birth order research investigating behavioral effects, such as academic achievement and rebelliousness within family environments etc but there are few or no studies using all the four variables. Early theorists agreed that early childhood experiences set the foundation of future adult implications.

CHAPTER 3
THEORETICAL FRAMEWORK

THEORETICAL FRAMEWORK

Birth order is an extensively researched and controversial concept in the social science literature which has attracted much debate throughout history (Eckstein et al, 2010). Birth order has been a consistent standard variable in psychological research since Alfred Adler first applied the idea in 1918 (Cervone & Pervin, 2008). From a historical point of view, it is likely that Alfred Adler was influenced by Charles Darwin and his theory of evolution and adaptation (Cervone & Pervin, 2008). Adler used the concept of birth order in his work, while combining it with other information in order to assess life-style (Ansbacher & Ansbacher, 1956 cited in Eckstein et al, 2010).

This study aims to investigate the effects birth order has on personality, self-esteem and satisfaction with life. It will also explore whether these effects significant age categories, 18-25 years of age, through the use of online questionnaires which have been distributed to potential participants through social networking sites. Therefore, the purpose of this mixed design study is to investigate whether or not birth order is a predictor of personality, self-esteem, satisfaction with life and age.

DEFINITION

- Birth order- Birth order, defined as an individual's rank by age among siblings, has long been of interest to psychologists as well as lay-people. Birth order refers to the order a child is born in their family; first-born and second-born are examples. Birth order is often believed to have a profound and lasting effect on psychological development. Much of the fascination has focused on the possible role of birth order in shaping personality and behavior.
- Personality- Personality is the characteristic sets of behaviors, cognitions, and emotional patterns that evolve from biological and environmental factors. According to Gordon Allport (1937), "Personality is the dynamic organisation within the individual of those psycho-physical systems that determine his unique adjustment to his environment". While there is no generally agreed upon definition of personality, most theories focus on motivation and psychological interactions with the environment one is surrounded by.

- Self-esteem- The term self-esteem is used to describe a person's overall subjective sense of personal worth or value. In other words, self-esteem may be defined as how much you appreciate and like yourself regardless of the circumstances. Your self-esteem is defined by many factors including: Self-confidence, Feeling of security, Identity, Sense of belonging, Feeling of competence
- Satisfaction with life-Satisfaction with life as a whole refers to subjective well-being and constitutes a cognitive, overall judgement. This judgement results from comparing one's own circumstances with what is considered an appropriate standard (Diener, Emmons, & Larsen, 1985). Satisfaction with life can be described in different terms, which all have more or less the same meaning.

Theories of Birth order

Alfred Adler (1870–1937), an Austrian psychiatrist, and a contemporary of Sigmund Freud and Carl Jung, was one of the first theorists to suggest that birth order influences personality. He argued that birth order can leave an indelible impression on an individual's style of life, which is one's habitual way of dealing with the tasks of friendship, love, and work. According to Adler, firstborns are "dethroned" when a second child comes along, and this loss of perceived privilege and primacy may have a lasting influence on them. Middle children may feel ignored or overlooked, causing them to develop the so-called middle child syndrome. Younger and only children may be pampered and spoiled, which was suggested to affect their later personalities. All of this assumes what Adler believed to be a typical family situation, where a nuclear family living apart from the extended family, without the children being orphaned, with average spacing between births, without twins and other multiples, and with surviving children not having severe physical, intellectual, or psychiatric disabilities.

Theories of Personality

Personality theories have been used throughout history to address what makes up the personality of an individual. A personality is how a person thinks, feels, and behaves. This influences how the person interacts with their environment. Personality is generally stable, although it can be influenced by environmental factors. An individual's personality causes them to react to certain scenarios and people. The four personality theories are:

- **Psychoanalytic Personality Theory**

The Psychoanalytic Theory is the personality theory, which is based on the notion that an individual gets motivated more by unseen forces that are controlled by the conscious and the rational thought. Sigmund Freud is closely related to the psychoanalytic theory. According to him, the human behavior is formed through an interaction between three components of the mind, i.e. Id, Ego and Super Ego.

Id: Id is the primitive part of the mind that seeks immediate gratification of biological or instinctual needs. The biological needs are the basic physical needs and while the instinctual needs are the natural or unlearned needs, such as hunger, thirst, sex, etc. Id is the unconscious part of the mind; that act instantaneously without giving much thought to what is right and what is wrong.

Super-Ego: The Super-Ego is related to the social or the moral values that an individual inculcates as he matures. It acts as an ethical constraint on behavior and helps an individual to develop his conscience. As the individual grows in the society, he learns the cultural values and the norms of the society which help him to differentiate between right and wrong.

Ego: Ego is the logical and the conscious part of the mind which is associated with the reality principle. This means it balances the demands of Id and super-ego in the context of real life situations. Ego is conscious and hence keep a check on Id through a proper reasoning of an external environment.

Freud hypothesized that children developed their personalities by progressing through a succession of stages that focused on particular regions of the body. If a child progressed through the stages without incidence, they would be well-developed in that area. If not, they may develop an

infatuation later in life. For example, if a child does not successfully pass the oral stage in life, they may develop an eating disorder later in life or may become a chronic thumb-sucker.

- **Humanistic Personality Theory**

The Humanistic Theory of Personality states that people are intrinsically good, with an innate drive to make themselves better. The Humanistic theory is built on the premise of a person's self-concept, consisting of their real self and their ideal self. People are motivated by a drive towards self-actualization, which describes transforming your real self into your ideal self. This self-actualizing tendency develops best in an unconditionally positive environment. Importantly, this theory places extra emphasis on the idea of free will, with the ability to change one's personality for the better

- **Trait theory**

A trait is a personality characteristic that has met three criteria: it must be consistent, stable, and vary from person to person. Based on this definition, a trait can be thought of as a relatively stable characteristic that causes individuals to behave in certain ways. The trait approach to personality is one of the major theoretical areas in the study of personality. Trait theory suggests that individual personalities are composed of broad dispositions.

Five-Factor Model of Personality

This five-factor model of personality represents five core traits that interact to form human personality. While researchers often disagree about the exact labels for each dimension, the following are described most commonly:

Agreeableness: level of cooperation and caring for others

Conscientiousness: level of thoughtfulness and structure

Extraversion: level of socialness and emotional expressiveness

Neuroticism: level of mood stability and emotional resilience

Openness: level of adventure and creativity

Theories of Self –Esteem

Many early theories suggested that self-esteem is a basic human need or motivation.

Abraham Maslow

Maslow included self-esteem in his hierarchy of human needs. He described two different forms of "esteem": the need for respect from others in the form of recognition, success, and admiration, and the need for self-respect in the form of self-love, self-confidence, skill, or aptitude.

Respect from others was believed to be more fragile and easily lost than inner self-esteem. According to Maslow, without the fulfillment of the self-esteem need, individuals will be driven to seek it and unable to grow and obtain self-actualization. Maslow also states that the healthiest expression of self-esteem "is the one which manifests in the respect we deserve for others, more than renown, fame, and flattery".

Modern theories of self-esteem explore the reasons humans are motivated to maintain a high regard for themselves.

- **Sociometer theory**

Sociometer theory, one of the prominent theories about the nature and function of self-esteem, argues that self-esteem monitors the degree of social acceptance that one enjoys from one's social circle and alerts the self to any threats to belonging that may arise

- **Terror Management Theory**

Terror management theory is an empirically supported theory developed to explain the psychological functions of self-esteem and culture. The theory proposes that people strive to sustain the belief they are significant contributors to a meaningful universe to minimize the potential for terror engendered by their awareness of their own mortality. Cultures provide their members with meaning-imbuing worldviews and bases of self-esteem to serve this terror management function.

Theories of Life Satisfaction

Life satisfaction (LS) is the way in which people show their emotions, feelings (moods) and how they feel about their directions and options for the future.

There are two main types of theories about life satisfaction:

- Bottom-up theories hold that we experience satisfaction in many domains of life, like work, relationships, family and friends, personal development, and health and fitness. Our satisfaction with our lives in these areas combines to create our overall life satisfaction.
- On the other hand, top-down theories state that our overall life satisfaction influences (or even determines) our life satisfaction in the many different domains. This debate is ongoing, but for most people it is enough to know that overall life satisfaction and satisfaction in the multiple domains of life are closely related.

CHAPTER 4
RESEARCH & METHODOLOGY

RESEARCH METHODOLOGY

4.1. OBJECTIVES

- To investigate the relationship between birth order categories and personality traits.
- To identify the relationship between personality and satisfaction with life.
- To identify the relationship between birth order categories and self-esteem.
- To find a relationship between self-esteem and satisfaction with life.

4.2. HYPOTHESIS

1. There will be a significant relationship between birth order categories and personality traits.
2. There will be a significant correlation between personality and satisfaction with life.
3. There will be a significant correlation between birth order categories and self-esteem.
4. There will be a significant relationship between self-esteem and satisfaction with life.

4.3. RESEARCH DESIGN

Descriptive research design and correlational research design is used in the current study. Descriptive research design is a type of research design that aims to obtain information to systematically describe a phenomenon. In this method, unlike in experimental research, the researcher does not control or manipulate any variables. Instead, the variables are only identified, observed and measured. A correlational research design investigates relationships between variables without the researcher controlling or manipulating any of them. A correlation reflects the

strength and/or direction of the relationship between two (or more) variables. The direction of a correlation can be either positive or negative.

4.4. SOURCES OF DATA

The sources of data collected were by Survey method. The survey method is the process of research where a list of relevant questions are asked and answers are noted down. The survey method can be obtained in both online and offline mode like through website forms and email. Then that survey answers are stored for analyzing data. The survey was distributed via Google forms through the mode of social media networks.

4.5. SAMPLE METHOD

The sampling method used is a convenience sample which is a type of non-probability sampling method where the sample is taken from a group of people easy to contact or to reach.

4.6. SAMPLE SIZE

A total of 301 participants completed the questionnaire. These individuals consisted of both males (n=100) and females(n=189) and prefer not say (n=12). Eligibility required participants to be over the age of 18-25 years, from a home environment with have and a minimum requirement of a secondary school qualification. From the participants who completed the questionnaire the participants who are the first and last borns will be included in the study.

4.7. METHOD OF DATA COLLECTION

The questionnaire was uploaded and distributed online through the means of social networking sites so as to avoid participants having previous knowledge of the variables involved, in particular birth order. The online questionnaires were distributed between the months of March to April 2022. Participation time was approximately 10 minutes. The cover page explained voluntary participation, with the right to withdraw up and until the time of submission. Extra information included the researcher's personal contact details, aim of the study and requirements for participation. The questionnaire required completion of demographic and background questions. The last page provided participants with relevant support contacts following its completion. Data

was received into an excel spreadsheet, which was transferred into SPSS. All data was then recoded in SPSS and prepared for later analysis and safely stored in a password protected folder.

4.8. DRAFTING QUESTIONNAIRE

The cover page included the researcher's personal college contact details, the aims and objectives, requested consent, participation eligibility, while highlighting that participation was to be voluntary, anonymous and confidential. The first page of the questionnaire consisted of demographic and background questions relating to the participant's family structure, including age, gender, birth order, number of siblings and level of education. Three scales are-

- The Big Five Inventory Scale (BFI)

The scale consists of 44 items measuring the five trait dimensions of personality (John & Srivastava, 1999). The five measured traits, often referred to as OCEAN, are Openness to experience (9 items), Conscientiousness (9 items), Extraversion (8 items), Agreeableness (9 items) and Neuroticism (8 items) (John & Srivastava, 1999). The scale uses a 5-point Likert scale ranging from 1= Strongly Disagree, 2= Disagree a little, 3= Neither agree nor disagree ,4 = Agree a little, 5= Agree Strongly

BFI scale scoring ("R" denotes reverse-scored items):

Extraversion: 1, 6R, 11, 16, 21R, 26, 31R, 36

Agreeableness: 2R, 7, 12R, 17, 22, 27R, 32, 37R, 42

Conscientiousness: 3, 8R, 13, 18R, 23R, 28, 33, 38, 43R

Neuroticism: 4, 9R, 14, 19, 24R, 29, 34R, 39

Openness: 5, 10, 15, 20, 25, 30, 35R, 40, 41R, 44

- The Rosenberg Self Esteem Scale (Rosenberg, 1965)

The RSES measures self-esteem using ten items answered on a four-point Likert-type scale — from strongly agree, agree, disagree and strongly disagree. The RSES is one of the most widely

used measures of self-esteem (Sinclair et al., 2010). To score the items, assign a value to each of the 10 items as follows:

- For items 1,2,4,6,7: Strongly Agree=3, Agree=2, Disagree=1, and Strongly Disagree=0.
- For items 3,5,8,9,10 (which are reversed in valence) Strongly Agree=0, Agree=1, Disagree=2, and Strongly Disagree=3.

The minimum total score is 0 and the maximum is 30, with higher scores representing higher self-esteem.

- The Satisfaction with Life Scale (Diener, Emmons, Larsen and Griffin, 1985)

To score the items, assign a value to each of the 5 items as follows by adding up the total of the numbers you score against each of the statements. So, remembering that Strongly Agree =7, Agree=6, Slightly Agree=5, Neither Agree nor Disagree, Slightly Disagree=3, Disagree=2 and Strongly Disagree=1. The total score from 31-35 is Extremely satisfied to 5-9 that is Extremely dissatisfied.

4.10. DATA ANALYSIS TECHNIQUES

The instrument used in this study for data analysis was a statistical package for the social science (SPSS, version 28 for Windows). SPSS, a windows based program, was used to perform data entry, analysis and to create tables and graphs.

The sample size was greater than 50, thus the Kolmogorov test was used to find normality. Age was taken as the variable to test normality of the data, as it is a quantitative data. The variables such as Birth order is an ordinal variable, personality, self-esteem and satisfaction with life are considered here as nominal scales,

The techniques administered for this test is One way ANOVA and Pearson correlation test.

- ANOVA TEST

Analysis of Variance (ANOVA) in SPSS, is used for examining the differences in the mean values of the dependent variable associated with the effect of the controlled independent variables, after

taking into account the influence of the uncontrolled independent variables. Essentially, ANOVA in SPSS is used as the test of means for two or more populations.

ANOVA in SPSS must have a dependent variable which should be metric (measured using an interval or ratio scale). ANOVA in SPSS must also have one or more independent variables, which should be categorical in nature. In ANOVA in SPSS, categorical independent variables are called factors. A particular combination of factor levels, or categories, is called a treatment.

Anova test was conducted to find a significant relation between birth order categories and personality traits as well as between the birth order categories and self-esteem.

- CORRELATION

Correlation is a statistical term describing the degree to which two variables move in coordination with one another. A correlation coefficient of 1 means that for every positive increase in one variable, there is a positive increase of a fixed proportion in the other. For example, shoe sizes go up in (almost) perfect correlation with foot length. A correlation coefficient of -1 means that for every positive increase in one variable, there is a negative decrease of a fixed proportion in the other.

Pearson r correlation

Correlation between sets of data is a measure of how well they are related. The most common measure of correlation in stats is the Pearson Correlation. The full name is the Pearson Product Moment Correlation (PPMC). It shows the linear relationship between two sets of data.

Pearsons correlation used in this study to correlate personality and satisfaction with life and relation between self-esteem and satisfaction with life.

CHAPTER 5
DATA ANALYSIS

DATA ANALYSIS

This study aims to investigate the effects birth order has on personality, self-esteem and satisfaction with life. It will also explore whether these effects significantly differ between age categories 18-25 years of age through the use of online questionnaires which have been distributed to potential participants through social networking sites.

The sample consists of 301 samples were individuals consisted of both males (n=100) and females(n=189) and prefer not say (n=12). The three scales used are The Big Five Inventory Scale (John & Srivastava, 1999), The Rosenberg Self Esteem Scale (Rosenberg, 1965), and The Satisfaction with Life Scale (Diener, Emmons, Larsen and Griffin, 1985), were employed.

The instrument used in this study for data analysis was a statistical package for the social science (SPSS, version 28 for Windows). SPSS, a windows based program, was used to perform data entry, analysis and to create tables and graphs

Table 5.1 Shows the means and standard deviations of birth order categories on the personality trait Extraversion

	Mean	Std. deviation	Df	F	P
First born	26.12	5.28	2	7.175	.008
Last born	24.48	5.31	299	-	-
Total	25.38	5.35	301	-	-

A one-way Analysis of Variance (ANOVA) was conducted to compare the effects of birth order on personality in first-borns, and last-borns. There was no statistically significant between birth order and Openness to experience ($M_1=35.7$, $SD_1=4.39$ and $M_2=35.14$, $SD_2=5.32$) agreeableness ($M_1=32.53$, $SD_1=4.94$ and $M_2=32.47$, $SD_2=5.5$), conscientiousness ($M_1=28.9$, $SD_1=4.1$ and $M_2=28.5$, $SD_2=5.3$) and neuroticism ($M_1=25.9$, $SD_1=5.7$ and $M_2=26.82$, $SD_2=6.39$). Therefore, the hypothesis can be rejected for these dimensions.

While comparing the effect of birth order on Extraversion in first-borns and last-borns. There was a statistically significant difference between birth order and extraversion determined by a one-way Analysis of Variance ($f(2,299) = 7.175, p < 0.05$).

The mean scores for first born ($M = 26.12, SD = 5.28$) were significantly different to last-borns ($M = 24.48, SD = 5.31$). Therefore, first borns were found to have higher levels of extraversion than last-borns. Our findings are supporting the findings of Jefferson, Herbst and McCrae (1998). Thus the hypothesis for first borns have higher level of extraversion than later borns can be accepted.

Table 5.2 – Shows the Pearson correlation coefficient illustrating the significant relationship between Neuroticism and Satisfaction with life.

Variable	Satisfaction with Life
Neuroticism	-.259**
p value	<0.001

** $p < .001$ (One –tailed test)

A Pearson correlation coefficient was used to test significant correlations between specific personality traits and satisfaction with life. The mean score for satisfaction with life was 22.02 ($SD = 6.39$) and for neuroticism was 26.33 ($SD = 6.04$). A Pearson correlation coefficient found that there was a strong negative significant relationship between satisfaction with life and neuroticism ($r(299) = -.259, p < .001, 1$ -tailed). Therefore, the hypothesis is accepted.

Table 5.3 – Shows the Pearson correlation coefficient illustrating the significant relationship between Extraversion and Satisfaction with life.

Variable	Satisfaction with Life
Extraversion	.217**
p value	<0.001

**p<.001 (One –tailed test)

The mean score for satisfaction with life was 22.02 (SD = 6.39) and for extraversion was 25.38 (SD = 5.35). A Pearson correlation coefficient found that there was a positive significant relationship between satisfaction with life and extraversion ($r(299) = .217, p < .001, 1\text{-tailed}$). As scores in satisfaction with life increase, levels of extraversion also increase. Our findings is supporting the findings of Shimmack, Oishi, Furr and Funder (2004) and Diener and Seligman (2002). Therefore, the hypothesis is accepted.

Table 5.4- Shows the means and standard deviations of birth order categories on Self-Esteem

	Mean	Std. deviation	df	F	P
First born	15.71	2.70	2	.002	.960
Last born	15.69	2.27	299	-	-
Total	15.70	2.51	301	-	-

A one-way Analysis of Variance was conducted to compare the effect of birth order on self-esteem in first-borns and last-borns. There was no statistically significant difference between birth order and self-esteem as determined by one-way analysis of variance ($f(2, 299) = .002, p = .960$). The mean of first born self-esteem is ($M = 15.71, SD = 2.7-$) compared to last borns ($M= 15.69, SD = 2.27$). Therefore, the hypothesis is rejected.

Table 5.5 – Shows the Pearson correlation coefficient illustrating the significant relationship between Self -Esteem and Satisfaction with life.

Variable	Satisfaction with Life
Self-esteem	.098
p value	0.090

p=0.90 (2 – tailed test)

A Pearson correlation coefficient was used to test significant correlations between self-esteem and satisfaction with life. The mean score for satisfaction with life was 22.02 (SD = 6.39) and for self-esteem was 15.70 (SD = 2.51). A Pearson correlation coefficient found that there was no significant relationship between satisfaction with life and self-esteem ($r(299) = .098, p=0.090, 2$ -tailed). Therefore, the hypothesis is rejected.

CHAPTER 6
FINDINGS

FINDINGS

This study aims to investigate the effects birth order has on personality, self-esteem and satisfaction with life. It will also explore whether these effects significantly differ between age categories 18-25 years of age through the use of online questionnaires which have been distributed to potential participants through social networking sites. The sample consists of 301 samples were individuals consisted of both males (n=101) and females(n=100) and prefer not say (n=12). The findings that we received for the four hypothesis by conducting tests like One way ANOVA and pearson correlation test was-

A one-way Analysis of Variance (ANOVA) was conducted to compare the effects of birth order on personality in first-borns, and last-borns. There was no statistically significant between birth order and Openness to experience, agreeableness, conscientiousness and neuroticism. Therefore, the hypothesis can be rejected for these dimensions. While comparing the effect of birth order on Extraversion in first-borns and last-borns. There was a statistically significant difference between birth order and extraversion determined by a one-way Analysis of Variance. Therefore, first borns were found to have higher levels of extraversion than last-borns.

A Pearson correlation coefficient was used to test significant correlations between specific personality traits and satisfaction with life. It was found that there was a strong negative significant relationship between satisfaction with life and neuroticism Therefore, the hypothesis is accepted. A Pearson correlation coefficient found that there was a positive significant relationship between satisfaction with life and extraversion scores in satisfaction with life increase, levels of extraversion also increase.

There was no significant relation between birth order and self-esteem as determined by one-way analysis of variance. This finding, does not support Falbo (1981) and Kidwell (1982) results.

There was no significant relationship between satisfaction with life and self-esteem. This result does not support the findings of Diener and Diener results.

CHAPTER 7
RECOMENNDATIONS

RECOMENNDATIONS

The purpose of this research study was to investigate whether birth order influenced individual's personalities, self-esteem, satisfaction with life between the ages of 18-25 years of age. From analyzing the results, it can be concluded birth order has been proven to influence personality traits. This study found that the first-borns to have higher levels of Extraversion compared to their last-born siblings.

The significance of extraversion and self-esteem correlating positively, and neuroticism correlating negatively, with satisfaction with life can be implicated in many domains of psychology. These include personality psychology, abnormal psychology and clinical psychology. They can also provide useful information to counsellors who help individuals gain a better understanding of oneself. Although no significant differences were found on the effects of birth order between personality, self-esteem, satisfaction with life and age, these findings are of significance. This study extended previous literature regarding the different individual variables. These findings can assist in the area of lifespan developmental psychology.

The further research in the future based on the analysis can be by including First borns, second-born, last-born and only born and conduct an in –depth study based on the variables given and the study should be focused on the Indian or within worldwide population as this study focused on only the samples from Ernakulum district. Then the family structure questions could be altered to include more accurate background information such as social class, ethnicity, nationality and questions regarding step-siblings or half-siblings.

The participants received were more of the female population. So, I would like to recommend conducting a larger sample study which includes both male and female population.

I would also like to recommend the study to be conducted on older people as certain theorists have mentioned. Despite their theoretical differences, early personality theorists such as Sigmund Freud, Alfred Adler and Carl Jung agreed that the early formation of childhood experiences were significant for future adult implications.

CHAPTER 8
CONCLUSION

CONCLUSION

This study sought to investigate the influence birth order has on personality, self-esteem, satisfaction with life of age 18-25 years. Personality was measured using the Big Five Inventory Scale (John & Srivastava, 1999), self-esteem using the Rosenberg Self-Esteem Scale (1965) and satisfaction with life using the Satisfaction with Life Scale (Diener et al, 1985). These scales along with the inclusion of demographic and background questions were administered through the use of online questionnaires, which were distributed to 300 participants through social networking sites. These individuals consisted of both males (n=101) and females(n=189). The current study found statistically significant differences between birth order and the personality trait Extraversion where it was higher in first –born than last-born. Other statistical findings included a positive significant relationship between extraversion and satisfaction with life, a negative significant relationship between neuroticism and there was no significant relationship between birth order and self-esteem as well as self-esteem and satisfaction with life.

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APPENDIX

APPENDIX A

We, Alexis and Swathi are currently pursuing Bachelors in Psychology as a part of our final year project entitled 'Effect of Birth Order on Personality, Self Esteem and Satisfaction with Life'.

INFORMED CONTENT

I understand that my participation in this study is voluntary and I can decline my participation without giving any reason. I understand that this study requires demographic details and questionnaires to be filled out. I have been given a sufficient amount of time to review the information and have sought the required clarification too.

By ticking on the "I agree" option, I give my full consent to participate in this study:

- I agree

- I disagree

Socio-demographic Details

Q1. Name:

Q2. Age:

Q3. Gender:

Male_____

Female_____

Prefer not to say _____

Q4. Highest level of education completed:

Q5. Nationality

Q6. What birth order are you?

First_____

Second____

Q7. Number of siblings:

Q8. Number of years between you and your closest sibling:

Q9. Who is the highest academic achiever?

Q10. Who do you consider the rebel of the family?

APPENDIX B

THE BIG FIVE INVENTORY SCALE

The Big Five Inventory (BFI) is a self-report scale that is designed to measure ones personality traits. There are five responses to each item. Please indicate how much you agree and disagree with each statement.

1	2	3	4	5
Strongly	Disagree	Neither agree	Agree	Strongly
Disagree	a little	or disagree	a little	Agree

I am someone who...

1. _____ Is talkative
2. _____ Tends to find fault with others
3. _____ Does a thorough job
4. _____ Is depressed, blue
5. _____ Is original, comes up with new ideas
6. _____ Is reserved
7. _____ Is helpful and unselfish with others
8. _____ Can be somewhat careless
9. _____ Is relaxed, handles stress well.
10. _____ Is curious about many different things

11. _____ Is full of energy
12. _____ Starts quarrels with others
13. _____ Is a reliable worker
14. _____ Can be tense
15. _____ Is ingenious, a deep thinker
16. _____ Generates a lot of enthusiasm
17. _____ Has a forgiving nature
18. _____ Tends to be disorganized
19. _____ Worries a lot
20. _____ Has an active imagination
21. _____ Tends to be quiet
22. _____ Is generally trusting
23. _____ Tends to be lazy
24. _____ Is emotionally stable, not easily upset
25. _____ Is inventive
26. _____ Has an assertive personality
27. _____ Can be cold and aloof
28. _____ Perseveres until the task is finished
29. _____ Can be moody

30. _____ Values artistic, aesthetic experiences
31. _____ Is sometimes shy, inhibited
32. _____ Is considerate and kind to almost everyone
33. _____ Does things efficiently
34. _____ Remains calm in tense situations
35. _____ Prefers work that is routine
36. _____ Is outgoing, sociable
37. _____ Is sometimes rude to others
38. _____ Makes plans and follows through with them
39. _____ Gets nervous easily
40. _____ Likes to reflect, play with ideas
41. _____ Has few artistic interests
42. _____ Likes to cooperate with others
43. _____ Is easily distracted
44. _____ Is sophisticated in art, music, or literature

APPENDIX C

THE ROSENBERG SELF-ESTEEM SCALE

The Rosenberg Self-Esteem Scale is a 10-item self-report measure of global self-esteem. There are four responses to each statement. Please indicate how strongly you agree or disagree with each statement.

Strongly Agree	Agree	Disagree	Strongly disagree
-----------------------	--------------	-----------------	--------------------------

1. On the whole, I am satisfied with myself.
2. At times I think I am no good at all.
3. I feel that I have a number of good qualities.
4. I am able to do things as well as most other people.
5. I feel I do not have much to be proud of.
6. I certainly feel useless at times.
7. I feel that I'm a person of worth, at least on an equal plane with others.
8. I wish I could have more respect for myself.
9. All in all, I am inclined to feel that I am a failure.
10. I take a positive attitude toward myself.

APPENDIX D

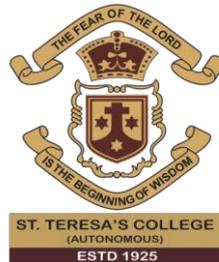
SATISFACTION WITH LIFE SCALE

The Satisfaction With Life Scale (“SWLS”) is an instrument developed to measure an individual's perceived satisfaction with life. There are seven responses to each statement. Please indicate how strongly you agree or disagree with each statement.

7	6	5	4	3	2	1
Strongly	Agree	Slightly	Neither	Slightly	Disagree	Strongly
Agree		Agree	Agree nor	Disagree		disagree
			disagree			

1. In most ways my life is close to my ideal_____
2. The conditions of my life are excellent_____
3. I am satisfied with my life_____
4. So far I have gotten the important things I want in life_____
5. If I could live my life over, I would change almost nothing_____

**ST. TERESA'S COLLEGE (AUTONOMOUS)
ERNAKULAM**



**FINAL YEAR B.Sc PHYSICS
PROJECT REPORT
2021-22**

**STUDY OF LISSAJOUS PATTERNS USING OSCILLOSCOPE AND
PENDULUM METHOD**

PROJECT REPORT

Submitted by

ALICIA MARIYAM BOBBY

Register No: AB19PHY002

Under the guidance of

Dr. MARY VINAYA

Submitted to,

Mahatma Gandhi University, Kottayam

In partial fulfilment of the requirement for the Award of
BACHELOR'S DEGREE OF SCIENCE IN PHYSICS



St. TERESA'S COLLEGE (AUTONOMOUS)

ERNAKULAM, KOCHI-682021

ST. TERESA'S COLLEGE (AUTONOMOUS)

ERNAKULAM



CERTIFICATE

This is to certify that the project report entitled " **STUDY OF LISSAJOUS PATTERNS USING OSCILLOSCOPE AND PENDULUM METHOD** " is a bonafide work by **Alicia Mariyam Bobby**, St. Teresa's College Ernakulam, under my supervision at the Department of Physics, St. Teresa's College, Ernakulam for the partial fulfilment of the award of Degree Of Bachelor of Science in Physics during the academic year 2020-21 The work presented in this dissertation has not been submitted for any other degree in this or any other university.

Supervising Guide

Priya
for Dr. Mary Vinaya

Head of the Department

Priya
Dr. Priya Parvathi Ameena Jose

1. Examiner 1:

Amjirathu

2. Examiner 2:



Place: Ernakulam

Date: 9/5/2022

ST. TERESA'S COLLEGE (AUTONOMOUS)

ERNAKULAM



B.Sc PHYSICS

PROJECT REPORT

Name: ALICIA MARIYAM BOBBY

Register Number: AB19PHY002

Year of Work: 2021-2022

This is to certify that this project work entitled " **STUDY OF LISSAJOUS PATTERNS USING OSCILLOSCOPE AND PENDULUM METHOD** " is a bonafide work by Alicia Mariyam Bobby, St. Teresa's College Ernakulam.

Staff Member in-charge

Head of the Department

Priya
for **Dr. Mary Vinaya**

Priya
Dr. Priya Parvathi Ameena Jose

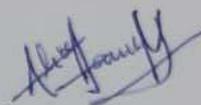
Submitted for the University Examination held at St. Teresa's College, Ernakulam.

Date: 9/5/2022

Examiner

DECLARATION

I, Alicia Mariyam Bobby (Register No: AB19PHY002), final year B.Sc. Physics student, Department of Physics, St. Teresa's College, Ernakulam, do hereby declare that the project work entitled " **STUDY OF LISSAJOUS PATTERNS USING OSCILLOSCOPE AND PENDULUM METHOD** " has been originally carried out under the guidance and supervision of Dr. Mary Vinaya, Professor, Department of Physics, St. Teresa's College (Autonomous), Ernakulam, in partial fulfilment for the award of the Degree of Bachelor of Physics. I further declare that this project is not partially or wholly submitted for any other purpose and the data included in the project is collected from various sources and are true to the best of my knowledge.



Alicia Mariyam Bobby

Place: Ernakulam

Date: 9/5/2022.

**STUDY OF LISSAJOUS PATTERNS USING OSCILLOSCOPE AND
PENDULUM METHODS**

ACKNOWLEDGMENT

I am bringing out this project report with immense pleasure and sense of satisfaction. I would like to express our sincere gratitude to Dr. Mary Vinaya, our project in-charge, for guiding for her valuable inputs and guidance.

I would also like to extend my sincere thanks to all the faculty members of the Physics Department, non-teaching staff and our friends for their valuable suggestions and support. Above all, I thank God Almighty for showering abundant blessings upon me to get through this project.

Alicia Mariyam Bobby

ABSTRACT

Any of an infinite variety of curves formed by combining two mutually perpendicular simple harmonic motions, commonly exhibited by the oscilloscope, and used in studying frequency, amplitude, and phase relations of harmonic variables are called Lissajous Figures. They merge mathematical elegance, engineering applications, and artistic possibilities. Initially investigated by Nathaniel Bowditch in 1815 who created these figures using a harmonograph, its practical application and analysis was done in 1857 by Jules Antoine Lissajous (for whom they are named), a professor of mathematics at the Lycée Saint-Louis in Paris.

Here we see how Lissajous figures differ from the patterns created by a harmonograph and how they are used to assess the frequency relation between sinusoidal waves producing the patterns. Although such differences can be measured numerically, the Lissajous figure makes it easy to do a visual real-time observation of the phase relationship and subtle changes in it between the left and right channels of a stereo audio signal. This is done by connecting the signal at the input of the linear channel to the scope's X-input and the output to the Y-input, the static input/output phase and amplitude relationship are visible. Any changes will be seen as well.

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CHAPTER 1

INTRODUCTION

Lissajous patterns are formed when you combine periodic waves moving back and forth with periodic waves moving up and down. This exhibit does this electronically allowing the visitor to control the frequency of the X and Y motions independently. The resulting pattern can be observed on an oscilloscope and viewed on moving speakers. If the frequencies are high enough, the speakers produce sound. The combination of tones can be correlated with the scope pictures.

The oscilloscope can measure voltage, frequency, and phase angle. Two-channel measurements are very useful and are presented. We also can get Lissajous figures in oscilloscope other than to get the waveform figures.

In electronic applications we can generate Lissajous patterns by applying different signals to the horizontal and vertical inputs of an oscilloscope. This technique was often used to measure unknown frequencies before the invention of frequency meters. A signal of known frequency was applied to the vertical input. The resulting pattern was a function of the ratio of the two frequencies.

A Lissajous figure is produced by taking two sine waves and displaying them at right angles to each other. This can be easily done on an oscilloscope in XY mode. If the oscilloscope has the x-versus-y capability, one can apply one signal to the vertical deflection plates while applying a second signal to the horizontal deflection plates. The horizontal sweep section is automatically disengaged at this time. The resulting waveform is called Lissajous figure. This mode can be used to measure phase or frequency relationships between two signals.

1.1 Lissajous Figure Use

The Lissajous figures uses mainly consists of measurement of the frequency and measurement of the phase difference. The Lissajous figure is of high importance in physics in order to study the sinusoidal waves. The Lissajous figures are mainly used in analogue electronics to analyse the intersection of two or more sinusoidal wave constructing loops which are also known as Lissajous knots in general. They are the shapes created when the x-coordinate of a curve is described by one sine wave, and the y-coordinate is described by another sine wave. By adjusting the frequency of each wave, the phase between them, and their relative amplitudes, interesting patterns emerge.

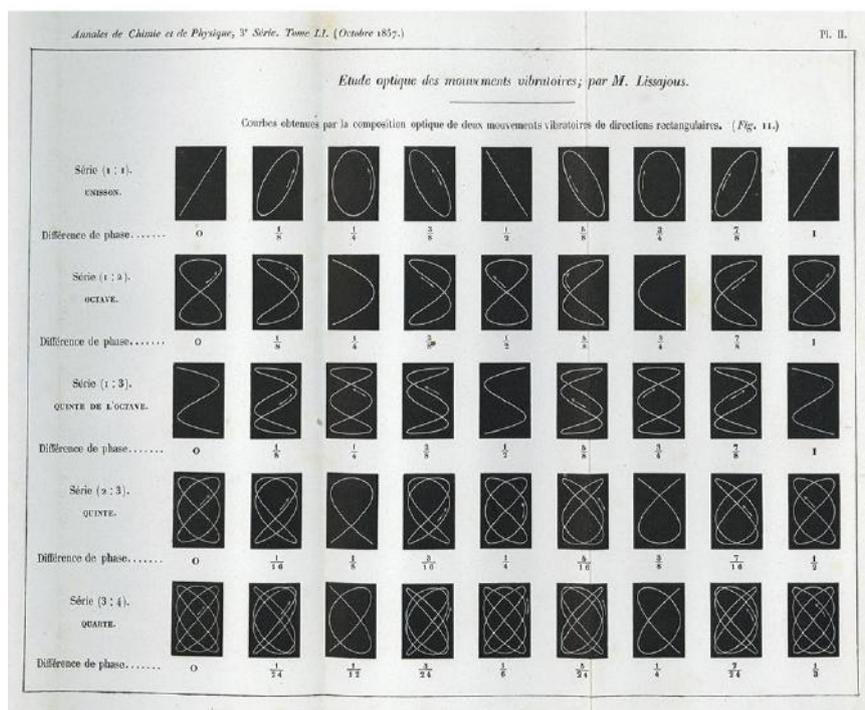
CHAPTER 2

LITERATURE SURVEY

Jules Antoine Lissajous (1822–1880) became known to the scientific society with his analysis on “Lissajous figures”—patterns formed when two vibrations along perpendicular lines are superimposed. Lissajous entered the École Normale Supérieure in 1841 and later became professor of physics at the Lycée Saint-Louis in Paris, where he studied vibrations and sound.

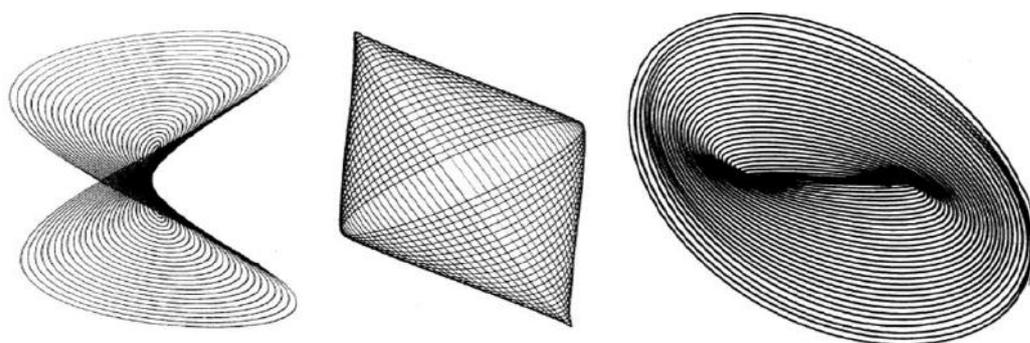
Like some other physicists of his time, Lissajous was interested in demonstrations of vibration that did not depend on the sense of hearing. His most important research, first described in 1855, was the invention of a way to study acoustic vibrations by reflecting a light beam from the vibrating object onto a screen. Lissajous produced two kinds of luminous curves. In the first kind, light is reflected from a tuning fork (to which a small mirror is attached), and then from a large mirror that is rotated rapidly. The second kind of curve, named the 'Lissajous figure,' is more useful. The light beam is successively reflected from mirrors on two forks that are vibrating about mutually perpendicular axes. Persistence of vision causes various curves, whose shapes depend on the relative frequency, phase, and amplitude of the forks' vibrations. If one of the forks is a standard, the form of the curve enables an estimate of the parameters of the other. As Lissajous said, they enable one to study beats (the ellipses rotate as the phase difference changes). 'Lissajous figures' have been, and still are, important in this respect

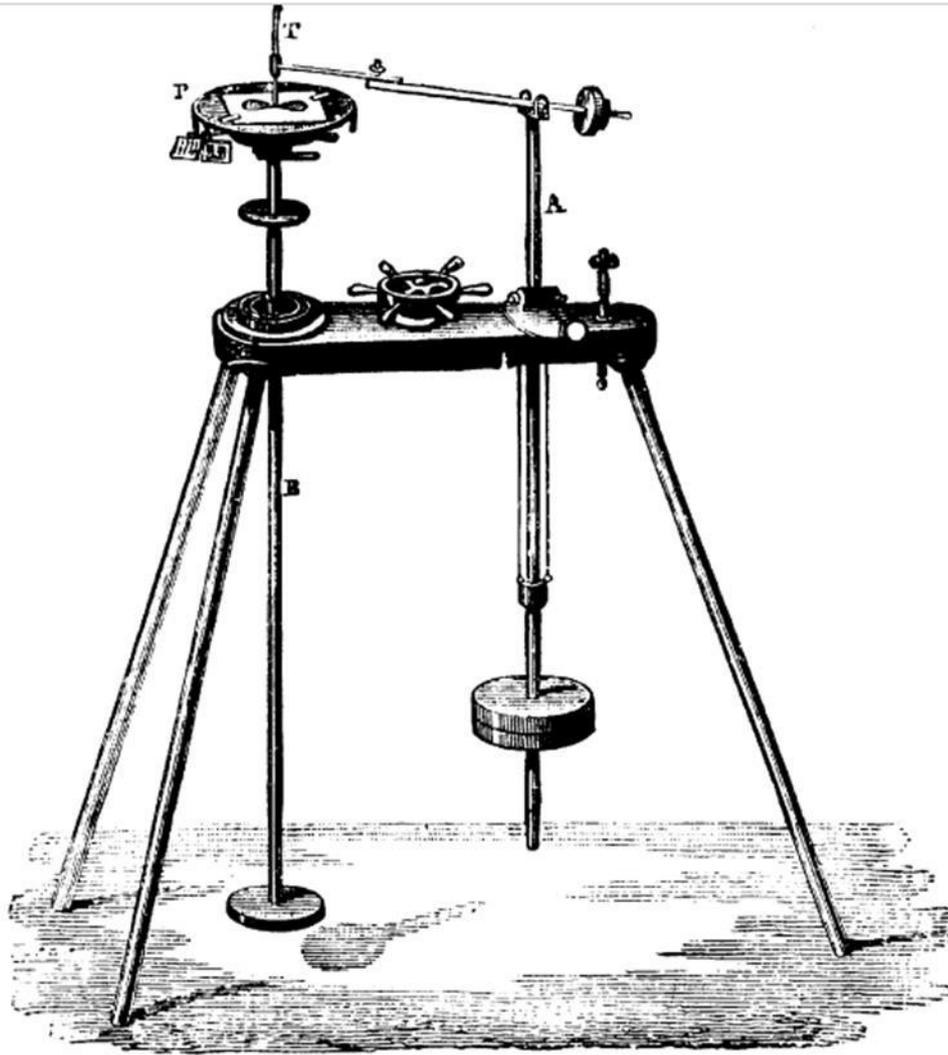
In 1857, he published "Mémoire sur l'Étude optique des mouvements vibratoires," *Annales de chimie et de physique*, 3rd series, 51 (1857) 147-232, 2 folding plates. Lissajous's paper on his optical method of studying vibration gave rise to the widely used "Lissajous figures," or Lissajous curves defined mathematically as curves in the xy plane generated by the functions $y = a \sin (w_1t + q_1)$ and $x = b \sin (w_2t + q_2)$ where w_1 and w_2 are small integers.



Lissajous figures from Lissajous's original publication on the subject.

Lissajous' work was praised by his contemporaries and discussed by the physicists John Tyndall (1820–1893) and Lord Rayleigh (John William Strutt, 1842–1919) in their classical treatises on acoustics. In 1873 he was awarded the prestigious Lacaze Prize for his “beautiful experiments,” and his method was exhibited at the Paris Universal Exposition in 1867. But apparently nothing is new under the sun: Lissajous' figures had been discovered long before by the self-taught American scientist Nathaniel Bowditch (1773–1838). Bowditch also wrote many scientific papers, one of which, on the motion of a pendulum swinging simultaneously about two axes at right angles (to illustrate the apparent motion of the Earth as viewed from the Moon), described the so-called Bowditch curves (better known as the Lissajous figures, after the man who later studied them in detail). He produced these patterns in 1815 with a compound pendulum.





A variation of this device, in which the motion of two pendulums is combined and traced on paper by means of a pen attached to one of the pendulums, became a popular nineteenth-century science demonstration.

The ensuing figures were called “harmonograms,” and their incredible variety never failed to impress the spectators. The novelty of Lissajous’ method was that it departed from mechanical devices and relied instead on the much more efficient agent of light. In this he was a visionary, foretelling our modern electronic era.

CHAPTER 3

LISSAJOUS PATTERN

A Lissajous figure is produced by taking two sine waves and displaying them at right angles to each other. This is easily done on an oscilloscope in XY mode. If the oscilloscope has the x-versus-y capability, one can apply one signal to the vertical deflection plates while applying a second signal to the horizontal deflection plates. The horizontal sweep section is automatically disengaged at this time. The resulting waveform is called Lissajous figure. This mode can be used to measure phase or frequency relationships between two signals.

When the two sine waves are of equal frequency and in-phase, a diagonal line to the right will be produced. When the two sine waves are of equal frequency and 180 degrees out-of-phase a diagonal line to the left will be produced. When the two sine waves are of equal frequency and 90 degrees out-of-phase a circle will be produced. When the horizontal and vertical sine wave frequencies differ by a fixed amount, this is equivalent to constantly rotating the phase between them.

3.1 Phase Measurements Using Lissajous Figures

Lissajous figures are sometimes used for the measurement of phase. Lissajous figures are produced in an oscilloscope by connecting one signal to the vertical trace and the other to the horizontal trace. If the ratio of the first frequency to the second is a rational number, then a closed curve will be observed on the CRO. If the two frequencies are unrelated, then there will be only a patch of light observed because of the persistence of the oscilloscope screen.

If the two signals have the same frequency, then the Lissajous figure will assume the shape of an ellipse. The ellipse's shape will vary according to the phase difference between the two signals, and according to the ratio of the amplitude of the two signals.

For few Lissajous figures based on their shape, we can directly tell the phase difference between the two sinusoidal signals.

- If the Lissajous figure is a straight line with an inclination of 45° with positive x-axis, then the phase difference between the two sinusoidal signals will be 0° . That means, there is no phase difference between those two sinusoidal signals.
- If the Lissajous figure is a straight line with an inclination of 135° with positive x-axis, then the phase difference between the two sinusoidal signals will be 180° . That means, those two sinusoidal signals are out of phase.

- If the Lissajous figure is in circular shape, then the phase difference between the two sinusoidal signals will be 90° or 270° .

We can calculate the phase difference between the two sinusoidal signals by using formulae, when the Lissajous figures are of elliptical shape.

- If the major axis of an elliptical shape Lissajous figure having an inclination angle lies between 0° and 90° with positive x-axis, then the phase difference between the two sinusoidal signals will be.

$$\phi = \sin^{-1} \frac{x_1}{x_2} = \sin^{-1} \frac{y_1}{y_2}$$

If the major axis of an elliptical shape Lissajous figure having an inclination angle lies between 90° and 180° with positive x-axis, then the phase difference between the two sinusoidal signals will be

$$\phi = 180 - \sin^{-1} \frac{x_1}{x_2} = 180 - \sin^{-1} \frac{y_1}{y_2}$$

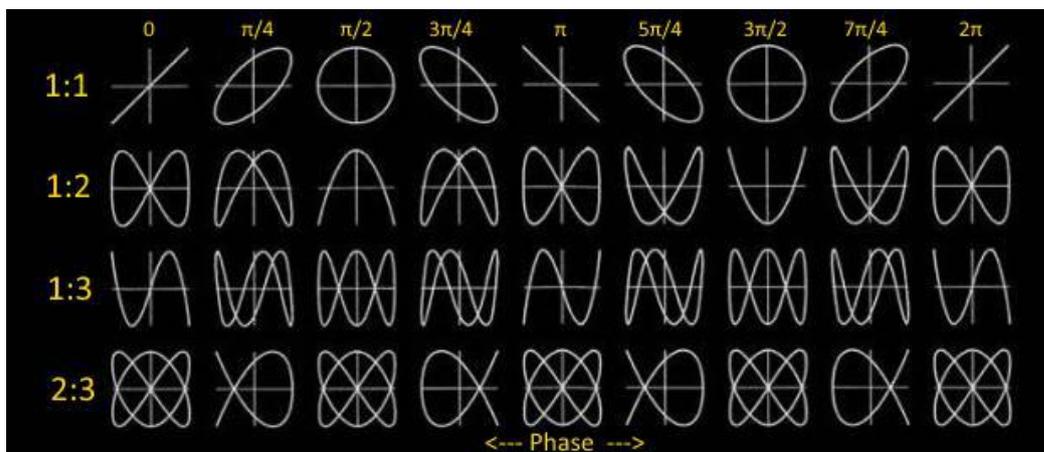
Where,

x_1 is the distance from the origin to the point on x-axis, where the elliptical shape Lissajous figure intersects.

x_2 is the distance from the origin to the vertical tangent of elliptical shape Lissajous figure.

y_1 is the distance from the origin to the point on y-axis, where the elliptical shape Lissajous figure intersects.

y_2 is the distance from the origin to the horizontal tangent of elliptical shape Lissajous figure



3.2 Frequency Measurements Using Lissajous Figures

Lissajous figure will be displayed on the screen, when the sinusoidal signals are applied to both horizontal & vertical deflection plates of CRO. We can apply the sinusoidal signal, which has standard known frequency to the horizontal deflection plates of CRO. Similarly, apply the sinusoidal signal, whose frequency is unknown to the vertical deflection plates of CRO

Let, f_H and f_V be the frequencies of sinusoidal signals, which are applied to the horizontal & vertical deflection plates of CRO respectively. The relationship between f_H and f_V can be mathematically represented as below.

$$f_V/f_H = n_H/n_V$$

From above relation, we will get the frequency of sinusoidal signal, which is applied to the vertical deflection plates of CRO as

$$f_V = (n_H/n_V) f_H \quad \text{---(1)}$$

Where,

n_H is the number of horizontal tangencies and

n_V is the number of vertical tangencies.

Two lines are drawn, one vertical and one horizontal so that they do not pass through any intersection on Lissajous pattern. Then the number of intersections of the horizontal and vertical lines with the Lissajous patterns and counted separately. So after finding the tangencies if we know we can easily calculate the unknown frequency applied to vertical plate.

By substituting the values of n_H , n_V and f_H in (1), we will get the value of f_V , i.e. the frequency of sinusoidal signal that is applied to the vertical deflection plates of CRO.

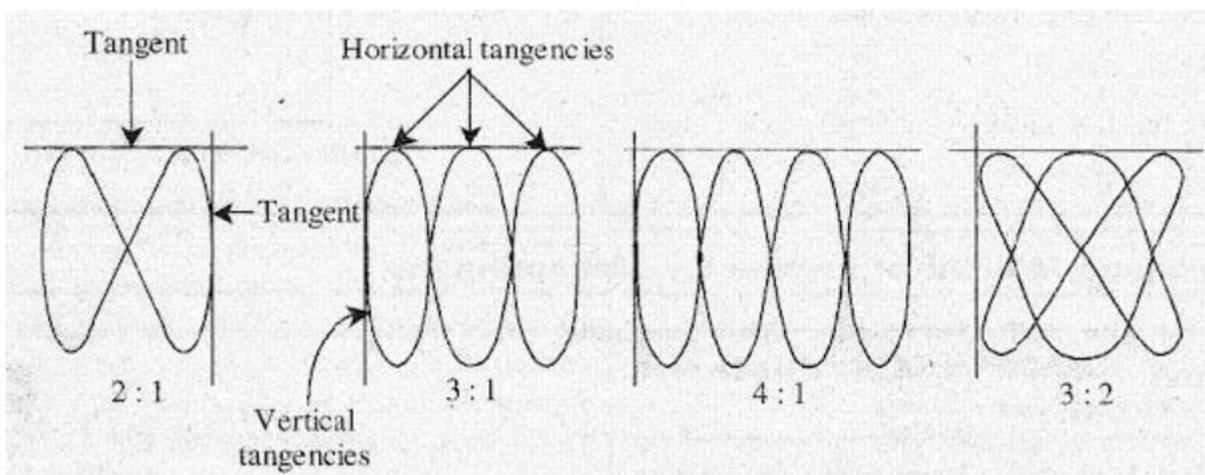


fig 6.2 Lissajous patterns allowing different frequencies ratios

All electronic circuits in the oscilloscope like attenuators, time base generators, amplifiers cause some amount of time delay while transmitting signal voltage to deflection plates. We also know that horizontal signal is initiated or triggered by some portion of output signal applied to vertical plates of CRT. So the delay line is used to delay the signal for some time in the vertical section of CRT.

3.3 Lissajous Figures Using Compound Pendulum

A device consisting of two coupled pendula, usually oscillating at right angles to each other, which are attached to a pen. The resulting motion can produce beautiful, complicated curves which eventually terminate in a point as the motion of the pendula is damped by friction. In the absence of friction (and for small displacements so that the general pendulum equations of motion become simple harmonic motion), the figures produced by a harmonograph would be Lissajous curves.

Lissajous curves are a special case of the harmonograph with damping constants $\beta_1=\beta_2=0$.

The compound pendulum may be made to swing in two different planes and to swing with two different periods. One plane of swing is fixed and is determined by the supporting of the two cords. The other plane of swing may be made anything desired by the operator but is usually made to swing at right angles to the upper plane. The period of the swing of the lower pendulum and the upper pendulum depends upon the location of the movable collar. The periods of the two swings may thus be adjusted to any desired ratio. some very interesting patterns may be obtained which illustrate the result of combining two harmonic motions of different periods.

CHAPTER 4

EXPERIMENT

4.1 LISSAJOUS PATTERNS USING PENDULUM METHOD

We attempt to create Lissajous patterns using a compound pendulum and an LED light source. Different patterns can be obtained by varying the length of the 2 parts of the pendulum.

APPARATUS:

LED light source

Transparent wire (fishing line)

A small weight

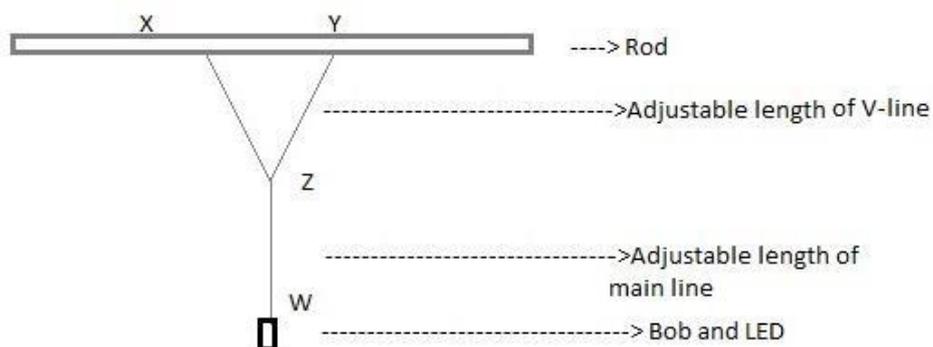
A long rod to hang the pendulum

Camera with adjustable shutter speed

Tripod stand

PROCEDURE

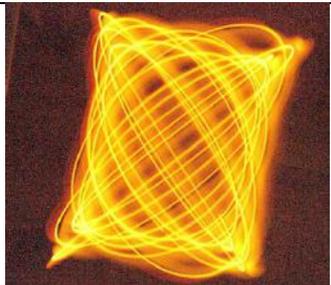
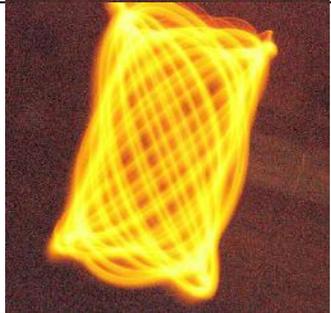
The long rod is set up firmly and from two measured points, the wire or line is attached and brought to meet in the middle in the form of a V. From the tip of the V, the main length of the pendulum is attached. At the tip of this line, the LED, attached to a suitable weight (which will not be changed for the duration of the experiment) is strung on. A tripod stand is used to position the camera above the pendulum in such a way that it can capture the movement of the pendulum without anything else coming into its field of view. The shutter speed of the camera is set to 30 seconds and focussed as required. The length of the upper region of the pendulum as well as that of the line attached to the bob is measured in advance. The pendulum is set into circular motion and the camera is used to capture the long exposure shot and the pattern is recorded. The process is repeated by varying the lengths of the upper portion of the pendulum as well as that of the main line. The patterns are compared to the ones obtained using an oscilloscope.

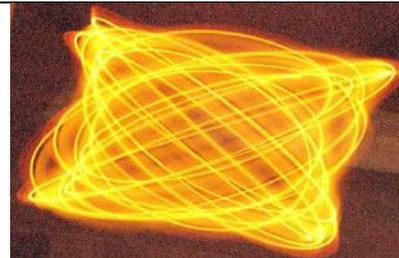
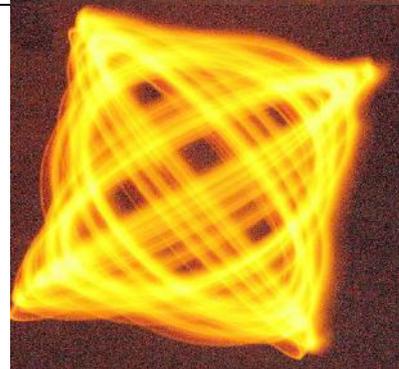
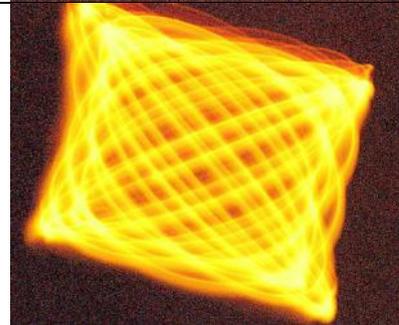
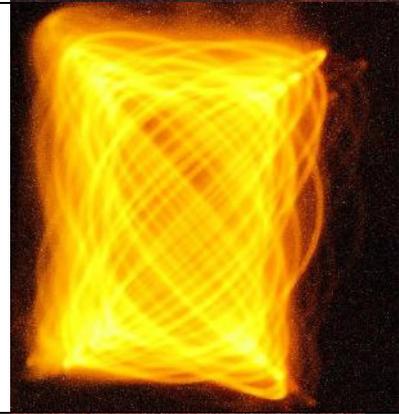
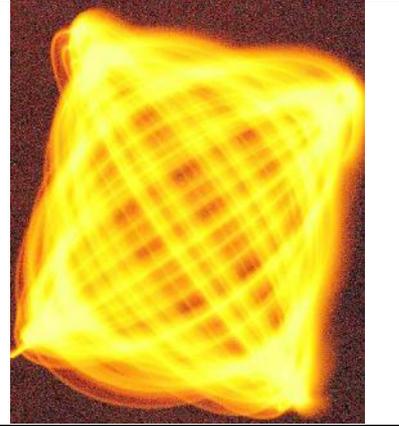


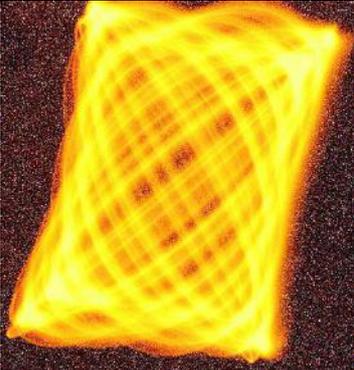
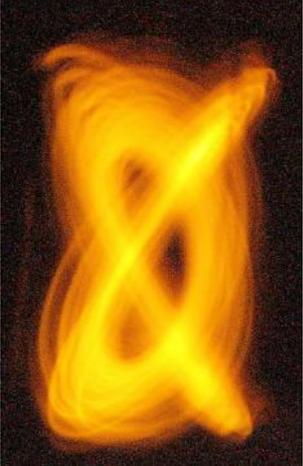
PRECAUTIONS

- The wire used must be transparent so that it doesn't obstruct the camera.
- The rod and tripod must be kept steady.
- The room in which the experiment is done must be kept dark to get a more accurate patterns.
- Take care to set the pendulum in almost the same motion (without excessive force and from same position as much as possible).

OBSERVATIONS

Length of V Pendulum A (cm)	Length of Main line B (cm)	Ratio A:B	Obtained pattern
50	100	1:2	
50	80	5:8	

30	100	3:10		
30	80	3:8		
30	60	1:2		
30	20	3:2		
20	100	1:5		

20	80	1:4	
20	20	1:1	

4.2 FREQUENCY MEASUREMENT USING LISSAJOUS FIGURES

We attempt to create Lissajous Patterns using oscilloscope and verify the theory relating the frequency ratio to the ratio of number of vertical and horizontal tangents.

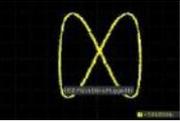
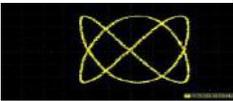
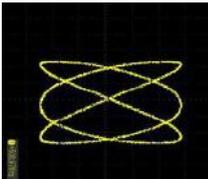
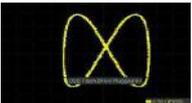
APPARATUS

1. Two signal generators
2. Oscilloscope

PROCEDURE

Two signal generators are used and they are connected to the vertical and horizontal traces of the oscilloscope. The signal voltage is set at 4V peak-to-peak. Vary the frequency of the generators until a closed pattern occurs on the scope. This pattern is recorded. The number of vertical and horizontal tangencies and their ratio as well as frequency ratio of the generators is calculated (vertical tangencies are points where the figure is tangent to the vertical axis. Similar for horizontal). Procedure is repeated for other frequency values and experiment is used to verify the theory.

OBSERVATIONS

Lissajous Figure	No. Of Vertical Tangencies n_H	No. Of Horizontal Tangencies n_V	n_H/n_V	Frequency of Generator 1 (Hz) f_V	Frequency of Generator 2 (Hz) f_H	f_V/f_H
	1	2	1:2	1	2	1:2
	2	3	2:3	1	1.5	2:3
	3	2	3:2	3	2	3:2
	1	2	1:2	0.5	1	1:2
	1	4	1:4	0.5	2	1:4

CHAPTER 5

CONCLUSIONS

Lissajous patterns are the shapes created when the x-coordinate of a curve is described by one sine wave, and the y-coordinate is described by another sine wave. By adjusting the frequency of each wave, the phase between them, and their relative amplitudes, interesting patterns emerge. They can be created using oscilloscopes and compound pendulums.

Lissajous pattern can be obtained using a swinging pendulum. The use of 2 strands of string gives the pendulum a more dynamic motion owing to the altered time periods as it moves on two perpendicular axes at the same time. Since the light lines are not distinct enough and is harder to align along a line, accurate frequency calculation using this method is not recommendable.

From the second experiment, we verified that the ratio of number of vertical tangencies to number of horizontal tangencies are equal to ratio of the two input frequencies. So we can conclude that Lissajous Figures are affected by the ratio of the two input frequencies. This implies that Lissajous figures provide a way to find an unknown frequency. Additionally, it was seen that for high frequency input, the given pattern moves faster. And so, Lissajous Figure also depends on value of frequency input.

CHAPTER 6

APPLICATION OF LISSAJOUS FIGURES

Lissajous figures are used for real-time analysis of the phase relationship between the left and right channels of a stereo audio signal. A Lissajous curve is used in experimental tests to determine if a device may be properly categorized as a memristor. It is also used to compare two different electrical signals: a known reference signal and a signal to be tested.

Creation of simple Lissajous figures during rewarming for bypass runs may be an additional helpful tool in root cause analysis of patient death/morbidity due to unexplained organ failure post major aortic surgery, when surgery, perfusion, and anesthesia seem faultless. A simple graphical representation of the large amounts of electronic perfusion data on mixed venous saturation and temperature that is generated during prolonged cases may aid analysis. “Unknown” reasons for death/morbidity usually relate to organ ischemia and inflammation. The introduction of electronic data management (EDM) systems enables accurate and detailed collection of perfusion information. Prior to this, recorded information was infrequent and subjected to error and bias by clinicians. Electronic acquisition systems make it possible to capture hundreds of variables as frequently as every 20 seconds with great accuracy. Nasopharyngeal temperature and mixed venous oxygen saturations are plotted to potentially identify organ ischemia which may help to explain why some deaths/morbidities occur.

Lissajous figures were sometimes displayed on oscilloscopes meant to simulate high-tech equipment in science-fiction TV shows and movies in the 1960s and 1970s. They are sometimes used in graphic design as logos.

Examples include:

- The Lincoln Laboratory at MIT ($a = 3, b = 4, \delta = \pi/2$)
- Disney's Movies Anywhere streaming video application uses a stylized version of the curve

- Facebook's rebrand into Meta Platforms is also a Lissajous Curve, echoing the shape of a capital letter M ($a = 1$, $b = -2$, $\delta = \pi/20$)



The Dadaist artist Max Ernst painted Lissajous figures directly by swinging a punctured bucket of paint over a canvas. Interesting patterns can be made using light, paint and sand which reveal the elegance and artistry of these mathematical equations.

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SECURE DATA- A HYBRID CRYPTOGRAPHIC TECHNIQUE TO SECURE DATA ON CLOUD

**ST. TERESA'S COLLEGE (AUTONOMOUS)
AFFILIATED TO MAHATMA GANDHI UNIVERSITY**



In partial fulfilment of the requirements for the award of the degree of

**BCA
(CLOUD TECHNOLOGY AND INFORMATION SECURITY
MANAGEMENT)**

By
**Alint Saji - SB19BCA002
&
Niveda P - SB19BCA015**

**III DC BCA (CLOUD TECHNOLOGY AND INFORMATION SECURITY
MANAGEMENT)**

Under the guidance of
Mrs. Veena Antony

**DEPARTMENT OF COMPUTER APPLICATIONS
MARCH 2022**

DECLARATION

We, undersigned, hereby declare that the project report, “**SECURE DATA- A HYBRID CRYPTOGRAPHIC TECHNIQUE TO SECURE DATA ON CLOUD**”, submitted for partial fulfilment of the requirements for the award of the degree of BCA (Cloud Technology and Information Security Management) at St. Teresa’s College (Autonomous), Ernakulam (Affiliated to Mahatma Gandhi University), Kerala, is a bonafide work done by us under the supervision of Mrs. Veena Antony. This submission represents our ideas in our own words and where ideas or words of others have not been included. We have adequately and accurately cited and referenced the original sources. We also declare that we have adhered to the ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma, or similar title of any other University.

Ernakulam
March 2022

Alint Saji-SB19BCA002
Niveda P-SB19BCA015

ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM
BCA (CLOUD TECHNOLOGY AND INFORMATION SECURITY
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DEPARTMENT OF COMPUTER APPLICATIONS



CERTIFICATE

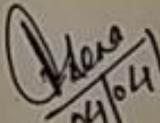
This is to certify that the report entitled "SECURE DATA- A HYBRID CRYPTOGRAPHIC TECHNIQUE TO SECURE DATA ON CLOUD", submitted by Alint Saji to the Mahatma Gandhi University in partial fulfillment of the requirements for the award of the Degree of BCA (Cloud Computing and Information Security management) is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.



RAJI S PILLAI

Head of the department

For


04/04/22
VEENA ANTONY
Internal Supervisor


4/4/22
External Supervisor

ACKNOWLEDGEMENT

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We convey our hearty thanks to our parents for the moral support, suggestion, and encouragement.

ABSTRACT

Cloud computing is the provisioning of sharing information and resources that are delivered as a service to end-users over the internet on-demand. Thus cloud enables users to access their data from any geographical location at any time and also has brought benefits in the form of online storage services. But with cloud storage comes security risks and data leak possibilities. Hence data security is a very important component of cloud storage. This Security concern can be solved using various ways, the most commonly used techniques are cryptography and steganography. But sometimes a single technique or algorithm alone cannot provide high-level security.

The “Secure Data” system proposes using a hybrid Cryptographic technique to provide extra security to the cloud. The system consists of 3 types of users i.e Admin, User & Owner. The Admin and Owner will have permission to upload the files(images, videos, audios, pdf, word file, ppts). The Admin or Owner uploads a file to the portal, it gets encrypted using the Blowfish algorithm & its key gets encrypted using the public key Elliptical curve cryptographic algorithm. The user can then download their files from the cloud through the portal by performing a Two-Factor Authentication and following the reverse process of encryption, which results in the file getting decrypted. The user can then download it to their local computer.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL BACKGROUND

Ensuring data security is crucial if you are to remain compliant against the increasing data security regulations, as well as ensuring that you maintain a good relationship with your customers and prospects. Data security concerns the protection of data from accidental or intentional but unauthorized modification, destruction, or disclosure through the use of physical security, administrative controls, logical controls, and other safeguards to limit accessibility. Data security includes data encryption, tokenization, and key management practices that protect data across all applications and platforms.

1.2 INFORMATION SECURITY

Information Security is the practice of preventing unauthorised access, use, disclosure, disruption, modification, inspection, recording, or destruction of information. Information can be physical or electronic. Information can be anything, say your profile on social media, your data on mobile phone, your biometrics, etc. Thus, Information Security spans so many research areas like Cryptography, Mobile Computing, Cyber Forensics, online social media, etc.

Information security principles

The basic components of information security are most often summed up by the so-called CIA triad: **confidentiality, integrity, and availability.**



Fig 1.1 CIA Triad

1.2.1. Confidentiality

Confidentiality is perhaps the element of the triad that most immediately comes to mind when you think of information security. Data is confidential when only those people who are authorised to access it can do so; to ensure confidentiality, you need to be able to identify who is trying to access data and block attempts by those without authorization. Passwords, encryption, authentication, and defence against penetration attacks are all techniques designed to ensure confidentiality.

Examples of data with high confidentiality concerns include:

- Social Security numbers, which must remain confidential to prevent identity theft.
- passwords, which must remain confidential to protect systems and accounts.

Consider the following when managing data confidentiality:

- To whom data can be disclosed
- Whether laws, regulations, or contracts require data to remain confidential
- Whether data may only be used or released under certain conditions
- Whether data is sensitive by nature and would have a negative impact if disclosed
- Whether data would be valuable to those who aren't permitted to have it (e.g., hackers)

A good example of methods used to ensure confidentiality is requiring an account number or routing number when banking online. Data encryption is another common method of ensuring confidentiality. User IDs and passwords constitute a standard procedure; two-factor authentication (2FA) is becoming the norm. Other options include Biometric verification and security tokens, key fobs or soft tokens. In addition, users can take precautions to minimise the number of places where information appears and the number of times it is actually transmitted to complete a required transaction. Extra measures might be taken in the case of extremely sensitive documents, such as storing only on air-gapped computers, disconnected storage devices or, for highly sensitive information, in hard-copy form only.

1.2.2.Integrity

Integrity means maintaining data in its correct state and preventing it from being improperly modified, either by accident or maliciously. Many of the techniques that ensure confidentiality will also protect data integrity, but there are other tools that help provide a defence of integrity in depth: checksums can help you verify data integrity, for instance, and version control software and frequent backups can help you restore data to a correct state if need be. Integrity also covers the concept of non-repudiation.

Data integrity can be compromised through human error or, worse yet, through malicious acts. Data that's accidentally altered during the transfer from one device to another, for example, can be compromised, or even destroyed by hackers.

Common threats that can alter the state of data integrity include:

- Human error
- Unintended transfer errors
- Misconfigurations and security errors
- Malware, insider threats, and cyberattacks
- Compromised hardware

To preserve data integrity and minimize risk following steps can be followed:

1. **Validate Input:** When your data set is supplied by a known or unknown source (an end user, another application, a malicious user, or any number of other sources) you should require input validation. That data should be verified and validated to ensure that the input is accurate.
2. **Validate Data:** It's critical to certify that your data processes haven't been corrupted. Identify specifications and key attributes that are important to your organisation before you validate the data.
3. **Remove Duplicate Data:** Sensitive data from a secure database can easily find a home on a document, spreadsheet, email, or in shared folders where employees without proper access can see it. It's prudent to clean up stray data and remove duplicates.

1.2.3.Availability

Availability is the mirror image of confidentiality: while you need to make sure that your data can't be accessed by unauthorised users, you also need to ensure that it *can* be accessed by those who have the proper permissions. Ensuring data availability means matching network and computing resources to the volume of data access you expect and implementing a good backup policy for disaster recovery purposes.

Availability countermeasures to protect system availability are as far-ranging as the threats to availability. Systems that have a high requirement for continuous uptime should have significant hardware redundancy with backup servers and data storage immediately available. For large, enterprise systems it is common to have redundant systems in separate physical locations. Software tools should be in place to monitor system performance and network traffic. Countermeasures to protect against DoS attacks include firewalls and routers.

The key to ensuring data availability is often in how you store it. The following are techniques you can use to keep your data online.

Data Redundancy: It is important to store backups of your data in a separate location, or in a distributed network. This ensures that if a storage component degrades or fails, you won't lose the data permanently. You should frequently update your backups so you can restore the most recent versions of your data.

Data Loss Prevention Tools: Data Loss Prevention (DLP) tools help mitigate against data breaches and physical damage to your data centre. They leverage cloud-based or third-party secure storage to prevent data loss. Some DLP tools include features such as monitoring, threat blocking, and forensic analysis.

Erasur Coding: Object storage uses advanced erasure coding to ensure that data is always available. Erasure coding combines data with parity information and then splits or "shards" it and distributes it across the storage environment. This protects against component failure as you only need a subset of the shards to restore the data.

1.3 CLOUD COMPUTING

Cloud Computing refers to manipulating, configuring, and accessing the hardware and software resources remotely. It offers online data storage, infrastructure, and application. Cloud computing offers platform independence, as the software is not required to be installed locally on the PC. Hence, Cloud Computing is making our business applications mobile and collaborative.



Fig 1.2.Cloud Computing

There are certain services and models working behind the scenes making cloud computing feasible and accessible to end users. Following are the working models for cloud computing:

- Deployment Models
- Service Models

1.3.1 Deployment Models

Deployment models define the type of access to the cloud, Cloud can have any of the four types of access: Public, Private, Hybrid, and Community.



Fig 1.3 .Deployment Models

Public Cloud

Provisioned for open use by any consumer (e.g., business, academic, government). The cloud infrastructure may be owned, managed, and operated by the consumer, a third party, or a combination of them. It exists on the premises of the cloud provider.

Private Cloud

Provisioned for exclusive use by a single consumer. The cloud infrastructure may be owned, managed, and operated by the consumer, a third party, or some combination of them, and it may exist on or off-premises.

Community Cloud

Provisioned for exclusive use by a specific community of consumers from organisations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). The cloud infrastructure may be owned, managed, and operated by one or more of the organisations in the community, a third party, or some combination of them, and it may exist on or off-premises.

Hybrid Cloud

A composition of two or more distinct cloud deployment models (i.e., private, community, public) that remain unique entities, but are bound together by standardised or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).

1.3.2 Service Models

Cloud computing is based on service models. These are categorised into three basic service models which are -

- Infrastructure-as-a-Service (IaaS)
- Platform-as-a-Service (PaaS)
- Software-as-a-Service (SaaS)

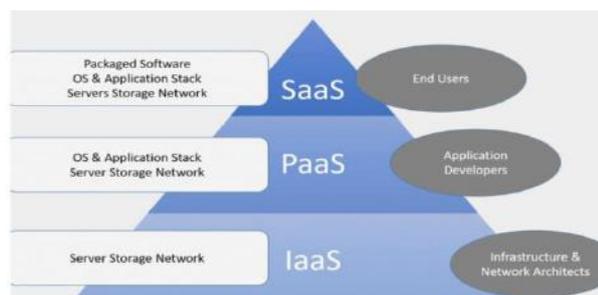


Fig 1.4 .Cloud Service Models

Infrastructure-as-a-Service (IaaS)

Infrastructure as a service offers a standardised way of acquiring computing capabilities on demand and over the web. Such resources include storage facilities, networks, processing power, and virtual private servers. These are charged under a “pay as you go” model .In this service model, customers do not need to manage infrastructure, it is up to the provider to guarantee the contracted number of resources and availability.

Platform-as-a-Service (PaaS)

Platform as a Service is halfway between Infrastructure as a Service (IaaS) and Software as a Service (SaaS). It offers access to a cloud-based environment in which users can build and deliver applications without the need of installing and working with IDEs which are often very expensive. Additionally, users can often customise the features they want to be included with their subscription.

Software-as-a-Service (SaaS)

Software as a Service offers applications that are accessed over the web and are not managed by your company, but by the software provider. This relieves your organisation from the constant pressure of software maintenance, infrastructure management, network security, data availability, and all the other operational issues involved with keeping applications up and running.

1.4 CRYPTOGRAPHY

Cryptography, or cryptology, is the practice and study of techniques for secure communication in the presence of adversarial behaviour. More generally, cryptography is about constructing and analysing protocols that prevent third parties or the public from reading private messages; various aspects in information security such as data confidentiality, data integrity, authentication, and non-repudiation are central to modern cryptography.

Modern cryptography is the cornerstone of computer and communications security. Its foundation is based on various concepts of mathematics such as number theory, computational-complexity theory, and probability theory. Modern cryptography concerns itself with the following four objectives:

- **Confidentiality:** The information cannot be understood by anyone for whom it was unintended.
- **Integrity:** The information cannot be altered in storage or transit between sender and intended receiver without the alteration being detected.
- **Non-repudiation:** The creator/sender of the information cannot deny at a later stage their intentions in the creation or transmission of the information.
- **Authentication:** The sender and receiver can confirm each other's identity and the origin/destination of the information.

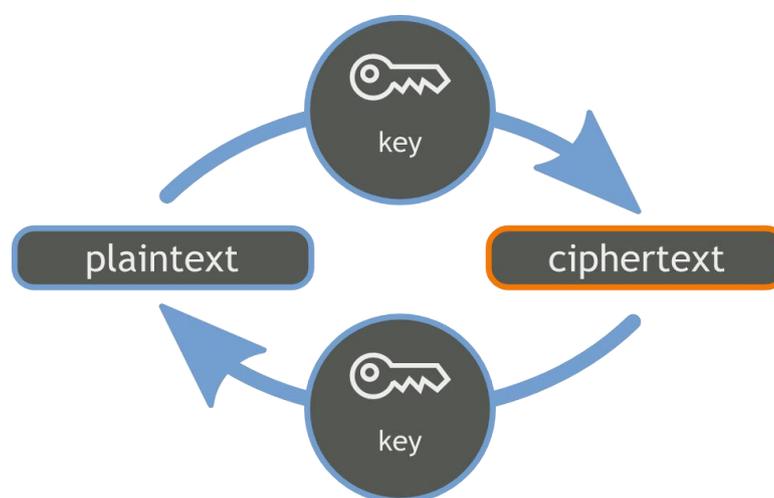


Fig 1.5 .Cryptography

The terminology used in cryptography is given below:

- 1. Plaintext:** The original message or data that is fed into the algorithm as input is called plaintext.
- 2. Encryption algorithm:** The encryption algorithm is the algorithm that performs various substitutions and transformations on the plaintext. Encryption is the process of changing plaintext into cipher text.
- 3. Ciphertext:** Ciphertext is the encrypted form of the message. It is the scrambled message produced as output. It depends upon the plaintext and the key.
- 4. Decryption algorithm:** The process of changing Ciphertext into plaintext is known as decryption. Decryption algorithm is essentially the encryption algorithm run in reverse. It takes the Ciphertext and the key and produces the original plaintext.
- 5. Key:** It also acts as input to the encryption algorithm. The exact substitutions and transformations performed by the algorithm depend on the key. Thus, a key is a number or a set of numbers that the algorithm uses to perform encryption and decryption.

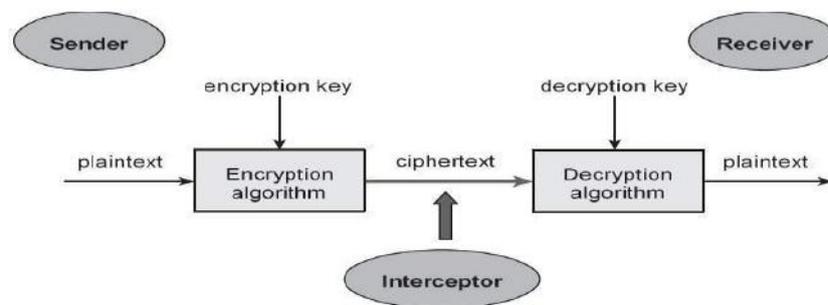


Fig 1.6 .Encryption-Decryption process

1.4.1.Types of Cryptography:

In general, there are three types of cryptography:

- 1. Symmetric Key Cryptography:** It is an encryption system where the sender and receiver of a message use a single common key to encrypt and decrypt messages. Symmetric Key Systems are faster and simpler but the problem is that sender and receiver have to somehow exchange keys in a secure manner. The most popular symmetric key cryptography system is Data Encryption System(DES).

2. **Hash Functions:** There is no usage of any key in this algorithm. A hash value with fixed length is calculated as per the plain text which makes it impossible for contents of plain text to be recovered. Many operating systems use hash functions to encrypt passwords.
3. **Asymmetric Key Cryptography:** Under this system a pair of keys is used to encrypt and decrypt information. A public key is used for encryption and a private key is used for decryption. Public keys and Private keys are different. Even if the public key is known by everyone, the intended receiver can only decode it because he alone knows the private key.

1.4.2.HYBRID CRYPTOGRAPHY

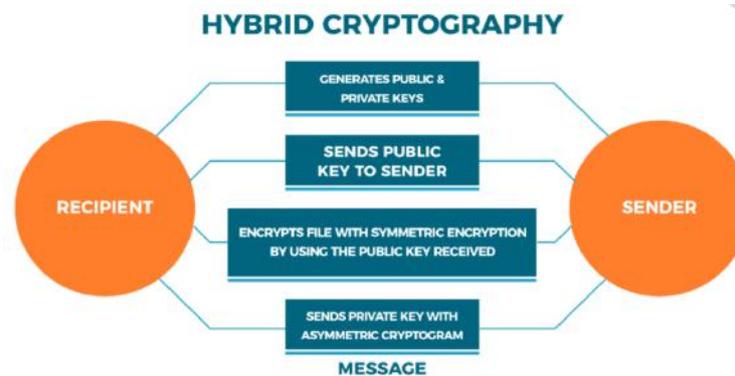


Fig 1.7 .Hybrid Cryptography

Hybrid cryptography is a mode of encryption that merges two or more encryption systems. It incorporates a combination of asymmetric and symmetric encryption to derive benefit from the strengths of each. The approach takes advantage of public-key cryptography for sharing keys and the speed of the symmetric encryption for encrypting messages.

A hybrid encryption scheme combines the ease of use of an asymmetric encryption scheme with the effectiveness of a symmetric encryption technique. To encrypt a message first generate a symmetric key and then encrypt the data. Then the person to whom we wish to send the message will share her public key and keep the private key a secret. After this, encrypt the symmetric key using the public key of the receiver and send the encrypted symmetric key to the receiver. To decrypt a message the receiver decrypts the encrypted symmetric key using her private key and gets the symmetric key needed for decryption and then the receiver uses the decrypted symmetric key to decrypt the message.

ADVANTAGES:

- Provides a high level of security Hybrid encryption is a combination of symmetric encryption and asymmetric encryption so it provides high security as compared to other techniques.
- Transmission of data becomes secure. Just as data security is ensured on all devices, encrypting data also provides security benefits during transmission.

1.4.3.ELLIPTIC KEY CRYPTOGRAPHY

Elliptic curve cryptography (ECC) is a public key encryption technique based on elliptic curve theory that can be used to create faster, smaller, and more efficient cryptographic keys. ECC generates keys through the properties of the elliptic curve equation instead of the traditional method of generation as the product of very large prime numbers.

The technology can be used in conjunction with most public key encryption methods, such as RSA, and Diffie-Hellman. Because ECC helps to establish equivalent security with lower computing power and battery resource usage, it is becoming widely used for mobile applications.

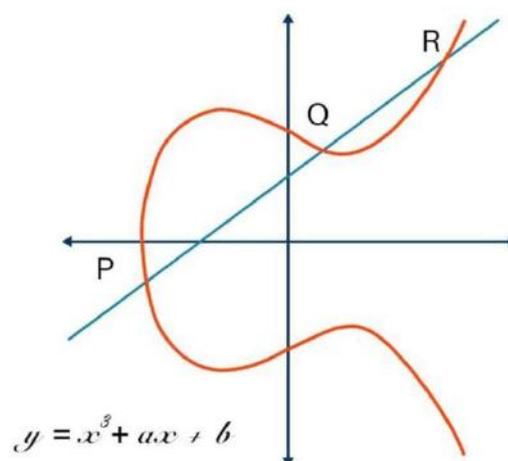


Fig 1.8 .Elliptic Curve Cryptography

Why is ECC important?

Size is a major factor in the importance of elliptic curve cryptography. For keys of the same size, solving for an elliptic curve discrete logarithm is significantly harder than factoring, which is how RSA encryption keys work.

To put things into perspective, according to a Universal Security study, breaking a 228-bit RSA key would take less energy than what is needed to boil a teaspoon of water. Alternatively, breaking a 228-bit ECC key would require more energy than it would take to boil all the water on earth.

Therefore, having the ability to significantly reduce the size of these keys can serve very useful for devices which have less computational power.

1.4.4.BLOWFISH ALGORITHM

Blowfish is a symmetric block cipher that can be effectively used for encryption and safeguarding of data. It takes a variable-length key, from 32 bits to 448 bits. Blowfish was designed in 1993 by Bruce Schneier as a fast, free alternative to existing encryption algorithms. Blowfish is unpatented and licence-free, and is available free for all uses. Blowfish Algorithm is a Feistel Network, iterating a simple encryption function 16 times. The block size is 64 bits, and the key can be any length up to 448 bits. Although there is a complex initialization phase required before any encryption can take place, the actual encryption of data is very efficient on large microprocessors. Blowfish is designed to have the following characteristics:

Fast: Blowfish encrypts data on 32-bit microprocessors at a rate of 18 clock cycles per byte.

Compact: Blowfish can run in less than 5k of memory.

Simple: Blowfish's simple structure is easy to implement and eases the task of determining the strength of the algorithm.

Variably Secure: The key length is variable and can be as long as 448 bits. This allows a trade-off between higher speed and higher security.

1.5 PROBLEM DEFINITION

In this digital world, data is stored in the Internet in various forms, various devices and in various parts of the world. The current data protection systems, such as in the form of texts, documents and media files are secured with basic encryption techniques and a single encryption technique is used. Encryption is a strong but old standard for securing data. There are several encryption techniques that have been ruling in the world of computer science. The main worry of using a single encryption technique is that it is easily breakable. So, a single encryption is not sufficient for the protection of sensitive data of individuals. Hybrid encryption comes into the scene. Hybrid encryption is a mode of encryption that merges two or more encryption systems. It incorporates a combination of asymmetric and symmetric encryption to benefit from the strengths of each form of encryption. These strengths are respectively defined as speed and security.

Hybrid encryption is considered a highly secure type of encryption as long as the public and private keys are fully secure.

1.6 OBJECTIVES

The main objective of this project is to safely store and secure files of an individual in a system. The present situation brought out the need for implementing more than one cryptographic algorithm. Thus, the concept of providing a file storage system, secured with the combination of multiple cryptographic algorithms was introduced. This technique is known as Hybrid Cryptography. The Blowfish algorithm and the Elliptic key cryptography (ECC) algorithm is used. This system is implemented for a secure document upload and download for users, who have registered in the system. The system also authenticates the identity of the person. It is performed before giving the user access to the files stored on the cloud.

CHAPTER 2

LITERATURE SURVEY

A technique combining multiple cryptographic algorithms of symmetric key and steganography for providing extra security to data. File during encryption is split into three parts. These individual parts of the file will be encrypted using different encryption algorithms simultaneously with the help of the multithreading technique. The key information is inserted into an image using the LSB technique. This helped to accomplish better data integrity, high security, low delay, authentication, and confidentiality. However, the key management was not securely performed and the system used only symmetric cryptographic algorithms. The idea of using public-key cryptographic techniques to avoid any attack during the transmission of data was also proposed.[1]

A hybrid cryptography algorithm is proposed in order to achieve confidentiality and increase security in the communications taking place over the internet. The paper also focuses on the time taken for the encryption and decryption process so that the algorithm is not CPU exhaustive. The algorithms used are- RSA and Diffie-Hellman where the Diffie-Hellman acts as a secure key transmission agent for the RSA and the RSA accounts for the security of the message. The paper also mentions how ECC could be used in place of RSA which would lead to a reduction in the key size and greater security hence it would also result in less bandwidth being consumed in message transmission i.e., reduced cost of communication, in their future works.[2]

Block cipher symmetric key cryptography plays a significant part in data security systems. This paper offers a comparison among the commonly used symmetric key cryptography algorithms: DES (Data Encryption Standard), Blowfish, TDES (Triple Data Encryption Standard), PRESENT, KLEIN. The comparison of algorithms is performed based on Attacks, key size, and block size and provides state-of-the-art results in their field. The results showed that the Blowfish algorithm has a very high-security level due to its key size; it is very active against linear and differential attacks.[3]

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A system using a combination of cloud computing and steganography in mobile. In this model, the user will select an image, after that enter the data and the keys as the input. Now this input will be used by the steganography application, which is installed on the user's mobile device. The steganography application converts the inputs and produces a stego image to be accumulated on the cloud. The major drawback of the system was that it could work only with a limited amount of data. It also proposed the idea of using various encryption techniques to provide better security.[5]

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An analysis performed on a hybrid cryptographic system of ECC & Blowfish showed that the hybrid algorithm is safe than using a single algorithm but among the hybrid system made using Blowfish and ECC algorithm with different key size Blowfish- ECC with key size 448 bit has better performance in terms of throughput whereas the Blowfish-ECC with the key size 192 is found to have better performance in terms of Execution time, decryption time and Encryption time.[7]

A study of hybrid cryptography was performed from 2015 to early 2019. Papers related to the problem were searched and about 20 were considered on the basis of filtering in this study. Of these, eight (8) are based on a user-friendly tabular survey and 12 are in-depth surveys. The main aim of this review paper is to provide more and more information to the new researchers, students in this field of hybrid

cryptography, and those also inexperienced in cryptography. A study of a lot of combinations was performed which showed that a combination of DSA, AES, and Steganography had a weakness of time complexity being high because it is a one-by-one process. Whereas a combination of AES, RC6, Blowfish- AES, DES, Blowfish provide low delay for data encode decode but provides low security. A combination of Blowfish and SRNN public key- SRNN increases the time performance. Also mentions about the use of ECC algorithm is used for protecting secret keys which is the highest secure public-key algorithm.[8]

The paper presented a review on Elliptical Curve cryptography. The characteristics such as encryption, decryption, key generation, power consumption, etc...were studied in detail. During his analysis, he observed that compared to the rest of the cryptographic techniques. In the analysis of cloud storage security, it is discovered that hybrid cryptography is better poised to ensure the attainment of security techniques for data protection that have been accepted universally in the field of information security. [9]

A secure method of hiding messages using combinations of ECC & Blowfish algorithms. Here an image is taken as the cover image and it is stream ciphered to get the Most Significant Bit. The message is encrypted using an ECC algorithm and then it is stored in the image. The image is then encrypted using the blowfish algorithm. The paper showed that ECC was difficult to crack and the encryption and decryption time required is comparatively slower when compared to other algorithms. The blowfish algorithm was used to improve the speed up of encryption and decryption so that large files also can be communicated on the network in a secure and efficient way.[10]

CHAPTER 3

EXISTING SYSTEM

Different methods for securely storing files in the cloud using a hybrid cryptography algorithm have been presented. In the existing system, the user can store the file safely in online cloud storage as these files will be stored in encrypted form in the cloud and only the authorised user has access to their files.

The system uses 3DES (Triple Data Encryption Standard), RC6 (Rivest Cipher 6), and AES (Advanced Encryption Standard), to provide security to data. LSB steganography (LSB – Least Significant Bit) technique is used to securely store the key information. Key information will contain the information regarding the encrypted part of the file, the algorithm, and the key for the algorithm. File during encryption is split into three parts. These individual parts of the file will be encrypted using different encryption algorithms simultaneously with the help of the multithreading technique. The key information is inserted into an image using the LSB technique.

Though the system provides an extra layer of security to files it's a time-consuming process and requires more storage. The algorithms used here are symmetric cryptographic algorithms. The key information is stored in the profile picture which is not secure and vulnerable to attack. No authentication procedures other than the login credentials are used to verify the user. Login credentials are more vulnerable to hacking methods such as brute-force, eavesdropping, etc.

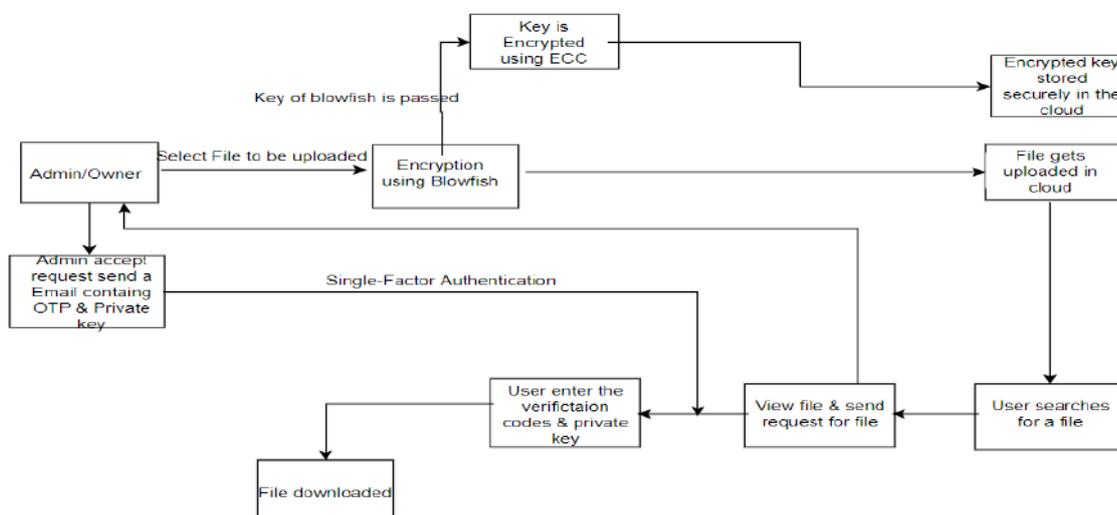


Fig.3.1 .Existing system model

CHAPTER 4

PROPOSED SYSTEM

The existing system implemented to secure data on the cloud is using a hybrid cryptographic method using various symmetric cryptographic algorithms. Though this system provides security to data stored when compared to the use of asymmetric cryptography the later proves to be more effective and difficult to crack. So here the proposed system is a combination of symmetric and an asymmetric cryptographic algorithm i.e., a combination of ECC & Blowfish algorithms.

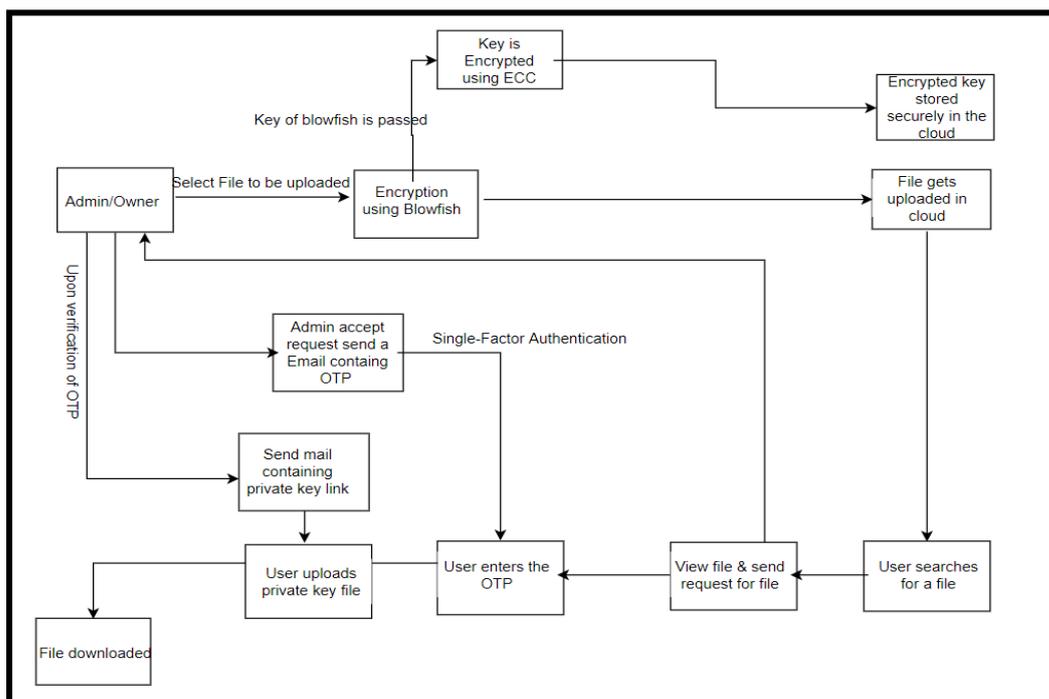


Fig.4.1 .Proposed System

The system also introduces a single-factor authentication technique to provide extra security. The authentication at the login verifies the user is valid but still there exists a chance that an intruder could login to the system using stolen or hacked credentials. Hence to make sure that the valuable information is received only by the right person a second stage of authentication is performed before giving the user access to the files stored on the cloud. In this stage an OTP is sent to the user, through mail. The user has to enter this OTP & the system checks for the match. If the match is found another mail containing the private key link is sent to the user’s mail-id. By uploading the private key, the user successfully completes the authentication, and the decrypted file will get downloaded.

Additionally in order to make sure that the files have not been modified /altered a hash of the file is created when the file is uploaded to the cloud. Whenever the hash value is changed the file's status changes to Invalid.

The combination of ECC & Blowfish was used since many studies showed that a combination of these algorithms has proved to be more effective when compared to others provides an equal security level with a smaller key size when compared with other public-key cryptosystems, thereby reducing processing overhead and storage. ECC also provides a methodology for obtaining high-speed, efficient, and scalable implementation of protocols for authentication and key agreement. Attacks on groups of elliptic curves are weaker than other available algorithm attacks. It supports very fast key generation. The Blowfish algorithm also has a lesser number of operations to complete compared to other encryption algorithms. Blowfish generates a really large key, and this alone is a huge benefit to security. With the increase in speed of computer processing, Blowfish is able to create a much longer key so that it is much more difficult to try to hack the key value. ECC suffers the disadvantage of low throughput that limits its compatibility to LTE connections. On the other hand, Blowfish offers higher throughput than other algorithms. Hybrid cryptography consisting of Blowfish and ECC guarantees less overhead, better execution of encryption processes, and higher throughputs.

CHAPTER 5

SYSTEM REQUIREMENTS

5.1 SOFTWARE REQUIREMENTS

- i. Front end: HTML, CSS
- ii. Back end:
 - ❖ Back-end Database : MySQL
 - ❖ Back-end Scripting : PHP
 - ❖ Back-end Server : Xampp,Apache
- iii. Operating System:
 - ❖ Client: Windows 10

5.2 HARDWARE REQUIREMENTS

- i. System
 - ❖ Windows 10 PC/ Laptop
 - ❖ RAM : 4 GB
 - ❖ System-type : 64-bit
 - ❖ Network Connectivity

CHAPTER 6 SYSTEM DESIGN ARCHITECTURE

6.1.ADMIN LEVEL FUNCTIONS

The system provides several functions for the admin to perform. Each component is connected to the main database of the system. The functions are:

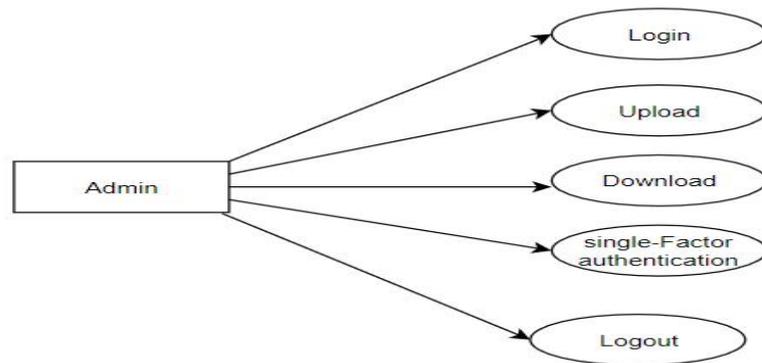


Fig.6.1 Admin Level Functions

6.2.USER LEVEL FUNCTIONS

The system provides several functions for the user to perform. Each component is connected to the main database of the system. The functions are:

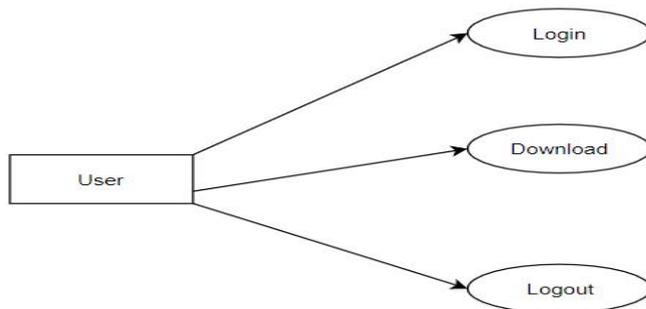


Fig.6.2.User Level Functions

6.3.OWNER LEVEL FUNCTIONS

The system provides several functions for the Owner to perform. Each component is connected to the main database of the system. The functions are:

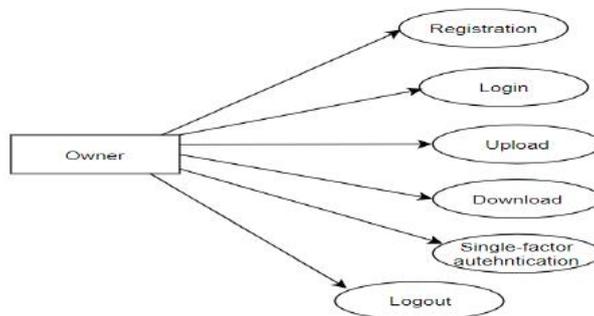


Fig.6.3.Owner Level Functions

6.4.USER/ OWNER REGISTRATION

New users and owners can create an account on the registration page. A user/owner can register or sign in by providing the necessary credentials like username, password etc in the registration/login page. After the registration, an account for the user is successfully created by the system.



Fig.6.4 Registration

6.5.USER/OWNER LOGIN

The registered users/owner/admin can log in or sign up to the system. In order to log in/signup, the user/owner/admin needs to give the necessary credentials like the username and password. Upon successful entry of the details, the user is logged in to the system where the user can access the various resources present in it.



Fig.6.5 login

6.6.UPLOADING FILES INTO THE SYSTEM

Admin & Owner have upload permission. Different types of files such as pdf, ppt, audio, video, etc can be uploaded. The file selected gets encrypted using a Blowfish algorithm. The encrypted file gets stored in the cloud and the key of the Blowfish algorithm is passed for the 2nd stage of encryption performed using the ECC algorithm. Once the 2nd stage of encryption is completed the key is also stored in the cloud.

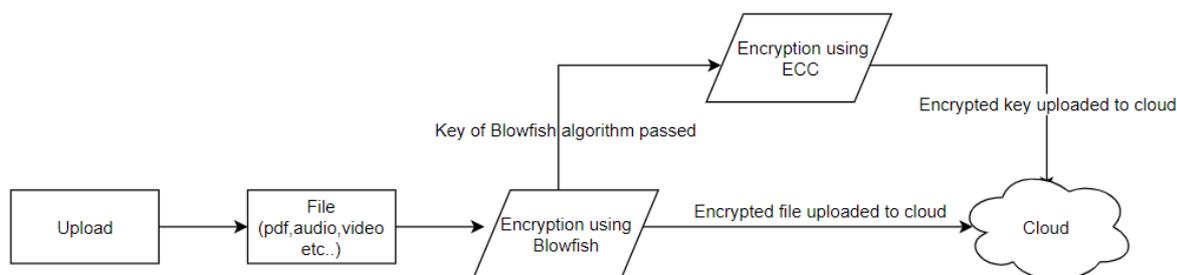


Fig.6.6.File Upload

6.7.DOWNLOADING FILES FROM THE SYSTEM

The user requests a file. The admin/owner has to accept or reject the request. Once it’s accepted the user has to click on “view the file”. The user will then receive mail with a 4-digit number and a file containing the private key . The user has to enter the code received and upload the private key file. If the code entered and private key match with the values stored in database the file gets decoded

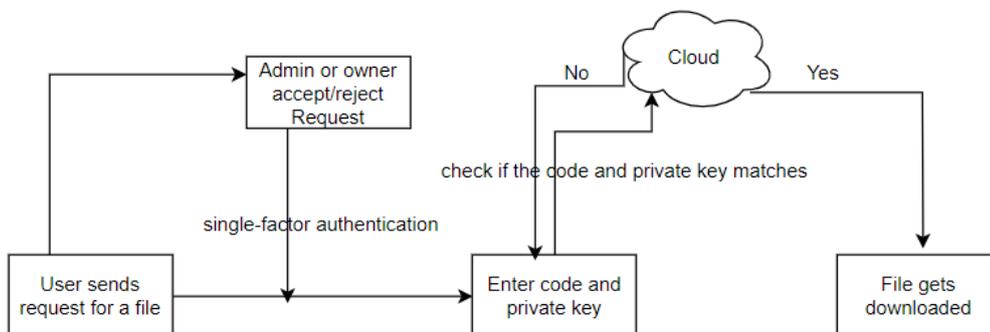


Fig.6.7.File Download

CHAPTER 7

MODULE DESCRIPTION

The “Secure Data” System consists of 4 modules:

- 1.Registration & login**
- 2.Blowfish Encryption**
- 3.ECC Encryption**
- 4.Decryption**

7.1.Module 1: Registration & Login

This section includes the front-end of the “SECURE DATA- A HYBRID CRYPTOGRAPHIC TECHNIQUE TO SECURE DATA ON CLOUD”. The front end consists of a login page, registration page and dashboard. There are three types of accounts that can be created with different levels of access. They are admin, owner and user. The admin has the topmost level of privilege which is set by default with the ability to upload/download files and accept/reject requests. The owner once approved by the admin has the privilege to upload/download files and accept/reject requests. The users can only request for the files they want to download. The users once registered, can login to their respective accounts. After login they are directed to their user dashboard where various options like file search view requests are available.

7.2.Module 2: Blowfish Encryption

The admin and the owner have the privilege to upload files. They can download their public key from the dashboard which is required to upload the files. In the file upload section, they can enter the file name and upload the file. The public key file also needs to be uploaded. A random blowfish security key will be generated automatically which can be manually modified as well. Once submitted, the file gets encrypted using the blowfish algorithm. Blowfish is a symmetric encryption algorithm, meaning that it uses the same secret key to both encrypt and decrypt messages. Blowfish is also a block cipher, meaning that it divides a message up into fixed-length blocks during encryption and decryption. The block length for Blowfish is 64 bits; messages that aren't a multiple of eight bytes in size must be padded.

1. **Block Size:** 64-bits
2. **key Size:** 32-bits to 448-bits variable size
3. **number of subkeys:** 18 [P-array]
4. **number of rounds:** 16
5. **number of substitution boxes:** 4 [each having 512 entries of 32-bits each]

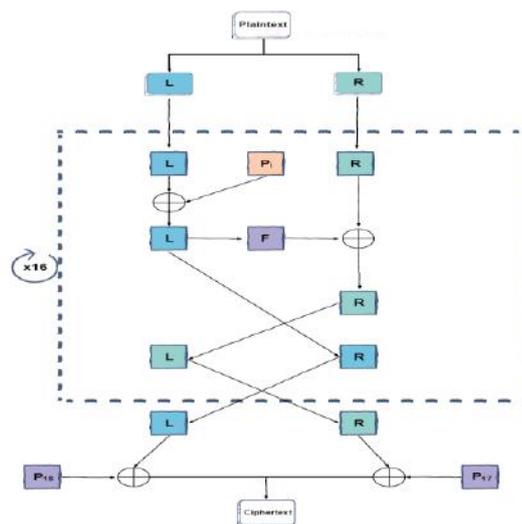


Fig 7.1. Blowfish Algorithm in diagrammatic form

The diagram above provides a high-level overview of how the Blowfish algorithm works. Since Blowfish makes use of an SP network, the first step is to initiate the substitution box (S-box) and permutation box (Pbox). The Pbox entries are shown as the P_i in the diagram above. There is a total of 18 Pbox entries. Next, we split our 64-bit plaintext into two equal blocks, L and R.

Next, we enter an encryption loop that runs 16 times. The following steps take place in each loop:

1. We XOR L with P_i , where I depend on the loop's current iteration.
2. We then XOR R with F, which is a function of L that makes use of the S-box split into 4 blocks. The overview of the F function is shown in the image below.

3. Finally, L and R are swapped before the loop enters its next iteration.

After the loop finishes, L and R are swapped once more. Next, we make use of our last two unused Pbox entries by XORing R with P_{17} and L with P_{18} . Finally, we combine L and R to retrieve the ciphertext.

7.3.Module 3: ECC Encryption

The key of the blowfish encryption is again encrypted using the Elliptic key cryptography(ECC) algorithm. An elliptic curve is the set of points that satisfy a specific mathematical equation. The equation for an elliptic curve looks like this $y^2=x^3+ax+b$. Multiplying a point on the curve by a number will produce another point on the curve, but it is very difficult to find what number was used, even if you know the original point and the result. Equations based on elliptic curves have a characteristic that is very valuable for cryptographic purposes: they are relatively easy to perform, and extremely difficult to reverse. With ECC, you can use smaller keys to get the same levels of security. After encryption, the key is stored securely.

ECC Working:

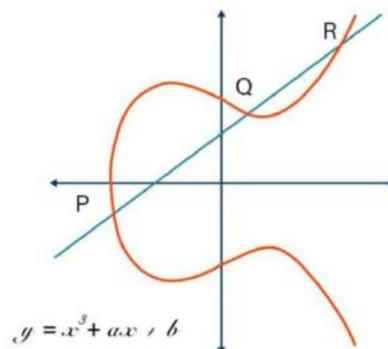


Fig 7.2.ECC Algorithm example diagram

First encode the message M into a point in the Elliptic Curve. Let the point be P_m [Now this point is encrypted]. For encryption choose a random positive integer k . The Cipher Text will be $C_m = \{ kG, P_m + kP_B \}$, for encryption public key of B used (ie Bob's). This point will be sent to the receiver.

For decryption, multiply 1st point in the pair $(kG, P_m + kP_B)$ with the receiver's secret key. ie: $kG \times n_B$
 à For decryption, private key of B used, ie Bob's) Then subtract it from second point/coordinate in the pair ie $P_m + kP_B - kG \times n_B$ [We know $P_B = n_B \times G$] So, $P_m + kP_B - kP_B$. It is equal to the P_m ie Original Message. So, receiver got the same point.

7.4.Module 4: Decryption

The user can search for the files they want to download. All the available files will be displayed when the file search option is clicked. Users can click on the request button side by the file name which sends the request to the owner and admin. Once the admin/ owner approves the request, the user can download the file from the view requests window where the status of the file will appear as approved with the option to view the file.

The user when clicks on it is redirected to a page where they need to upload their public key. At the same time the user receives mail with an OTP and a text file containing the private key. The user needs to enter the OTP and has to upload the private key file. This assures that extra level of security is provided so that the file does not reach wrong hands who don't have the authority to acquire it. Once the OTP and private key are verified the file gets decrypted and can be downloaded.

CHAPTER 8

IMPLEMENTATION

Implementing “**SECURE DATA- A HYBRID CRYPTOGRAPHIC TECHNIQUE TO SECURE DATA ON CLOUD**” will strengthen the security of data, as two cryptographic techniques namely Blowfish and elliptical curve cryptography are used. It will provide a secure way of storing and sharing data.

A user needs to first create an account to use Secure Data. There are three types of account namely, admin, owner and user. Each account has different privileges with admin being the most privileged, then owner and lastly user. The registration involves users to enter personal details in the registration page. Once registered, the users can log in into their personal accounts by providing the username and password given at the time of registration.

After login, the users will be directed to their dashboard. The dashboard will display all the resources provided by SECURE DATA. When an admin logs in, the dashboard will display options like view user (contains the list of users), view upload (contains the list of files uploaded), view requests (contains the list of file access requests), file upload (for uploading files), download key (to download the public key), log out(to sign out of the system). The owner has similar options except for option, view user, which only the admin has the privilege to access. Whereas when a user logs into the system, the dashboard will only display the options like file search(which displays the list of available files that can be requested for access), view requests (displays the status of the requested files) and logout.

Download key page displays the option click to download, which upon clicking will download the public key file. In the file upload page, the user can upload any type of files like image, text, audio, video,pdf etc. The user needs to give the file name and upload the file that needs to be uploaded as well as the public key file. A random blowfish key will be generated, which can be manually modified as well. The key of the Blowfish is then encrypted using ECC algorithm, which is performed in the background. The page will also display the option of view all, which displays the list of files that has already been uploaded with the option to delete it as well. Once all the necessary fields and files are entered and uploaded, the user can click submit, upon which the file will be encrypted using the blowfish algorithm.

The view user page, which is only available for the admin, displays the list of users registered in SECURE DATA. It displays all the details of the users like their personal details as well as the status.

The view upload page displays the list of files uploaded in the system and their details. The files which are once approved for access don't have to be requested again.

The view request page displays the list of users, the files they have requested for access, date of request and the owner of the file. The admin or the owner have the privilege to accept the request upon which the user will be able to access the files. They can also revoke the access by clicking reject under the status.

Whereas the view user option in the user dashboard gives the list of files the user has requested with their details as well as the status of the request, i.e. whether the request is accepted or rejected. If accepted, the user can click to view which will then redirect the user to another page.

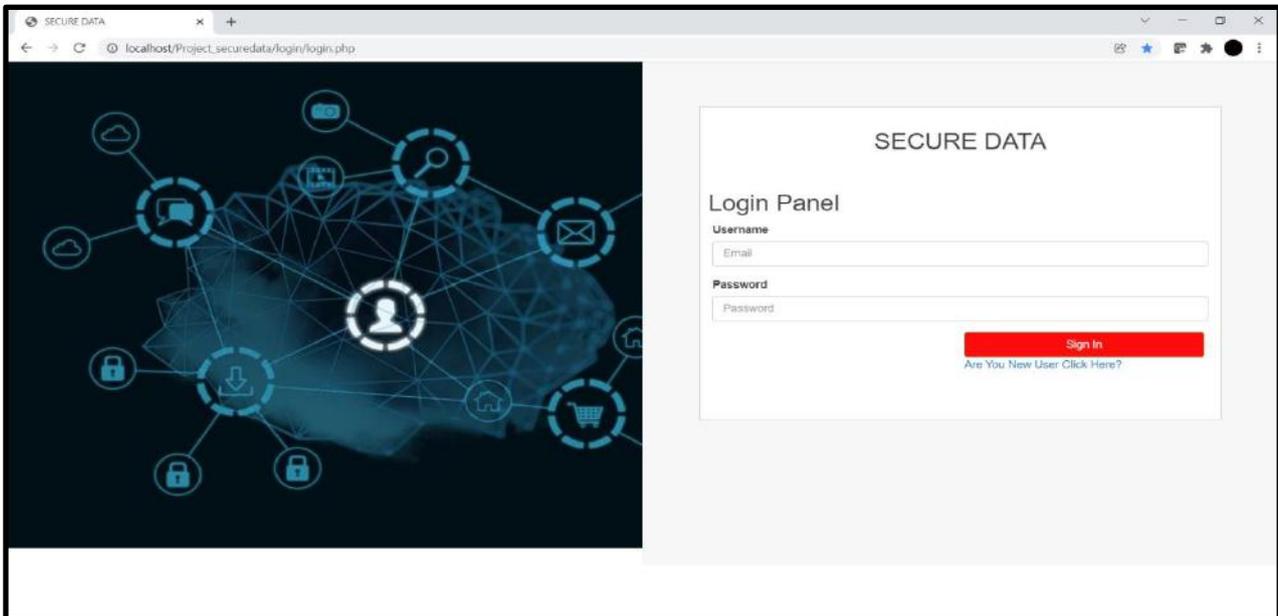
The file search option in the user dashboard gives the list of files available with their details. The user can request the files they want to access. The files already requested will appear as requested.

The users can download the files which are approved by the admin or the owner. When the owner clicks on “click to view”, the page redirects the user to another page where the user needs to enter the OTP, which is sent to their registered email. Once the user successfully enters the OTP, the user will receive another email containing the private key file. The user needs to upload the private key file, upon which the decrypted file gets downloaded.

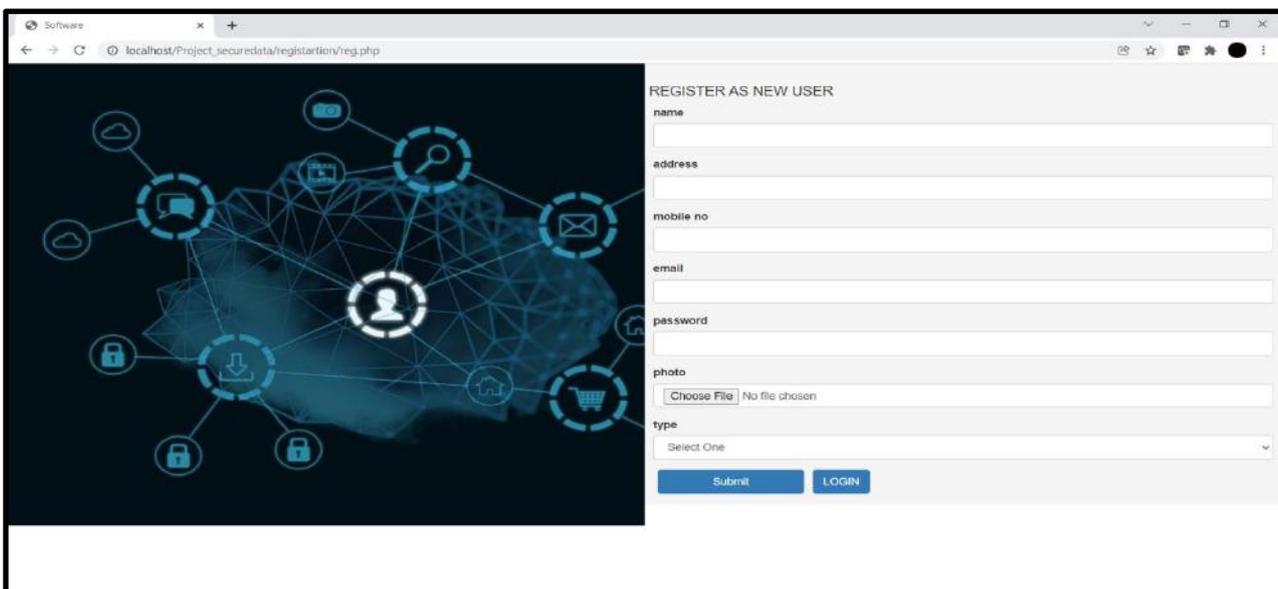
The system created works in a way where the laptop is acting as the cloud environment. But to set up the system in an actual cloud environment the following steps should be used. The first step is to purchase a domain and space. The domain and space are then connected. Once connected the next step is to install a server. A database should also be created. Now upload the codes to the space and connect the database and code. The system will be successfully hosted in the cloud.

STEPS TO USE THE SYSTEM:

1. The secure data login page displays the options to sign in. The already registered users can sign in using their username and password.



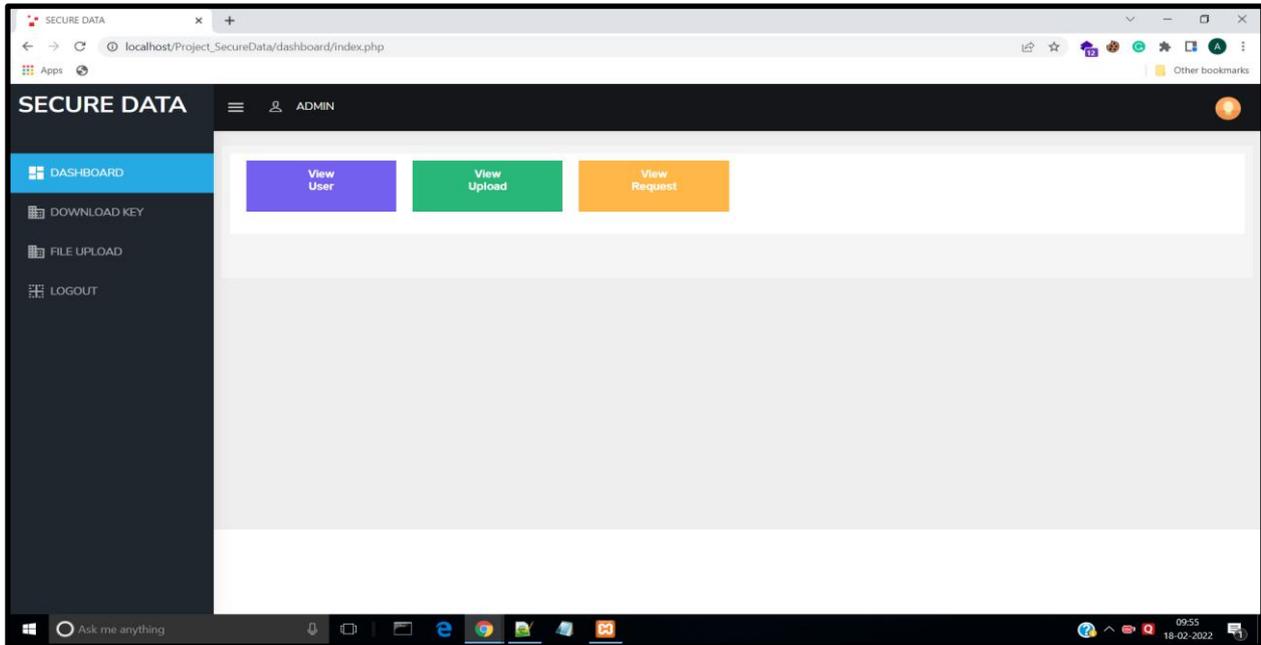
2. A new user should register themselves by clicking on the option “Are you a new user here?”, which upon clicking will take the user to the registration page.



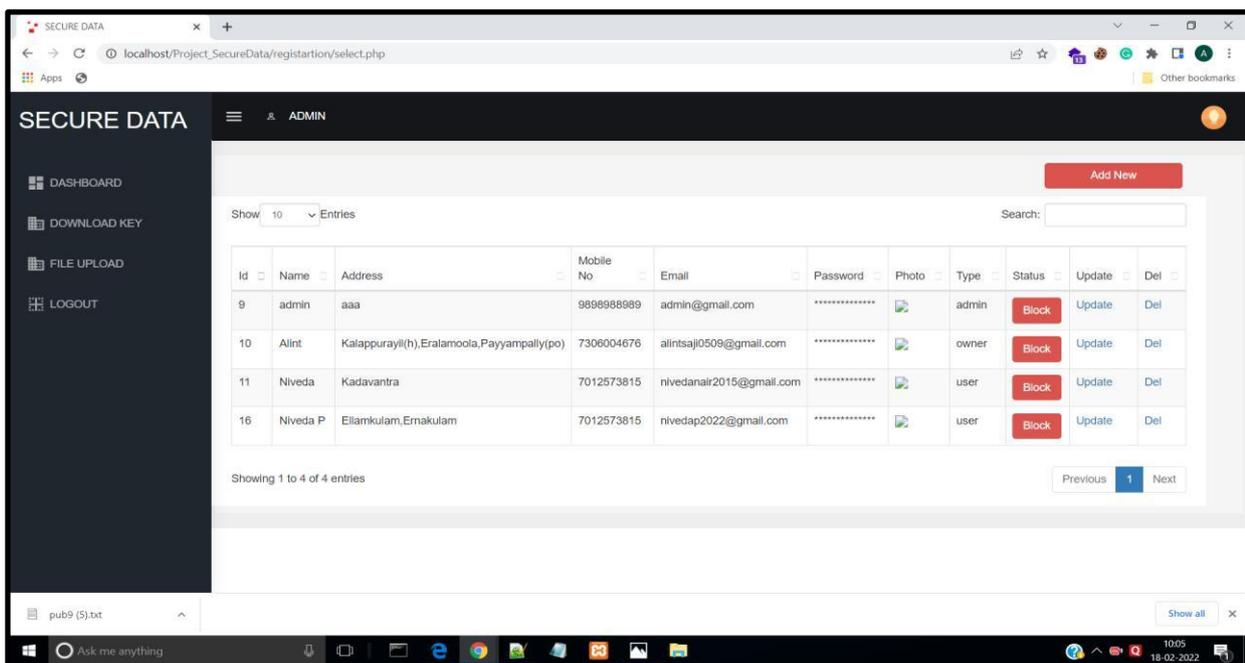
The new user needs to enter their personal details such as name, address, mobile number, email, password, photo of the user, and select the type of user you are from the drop-down menu.

ADMIN

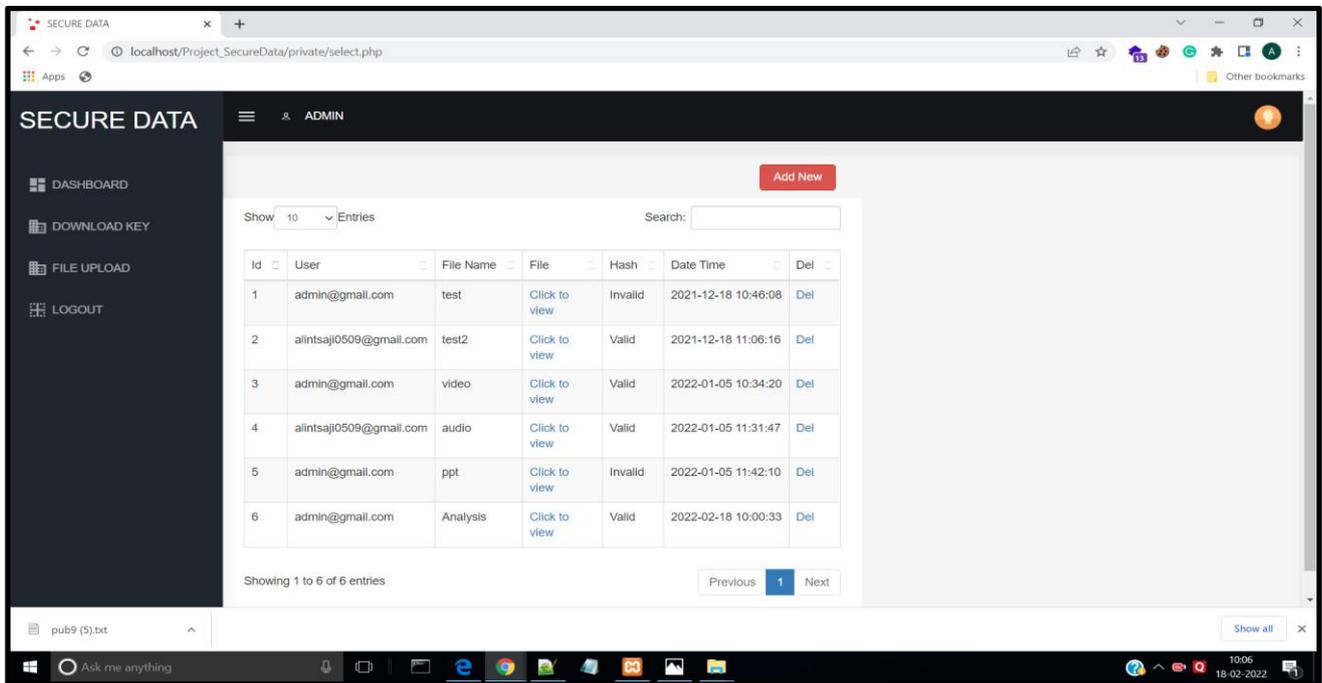
1. On successful login, the dashboard is opened which displays following options.



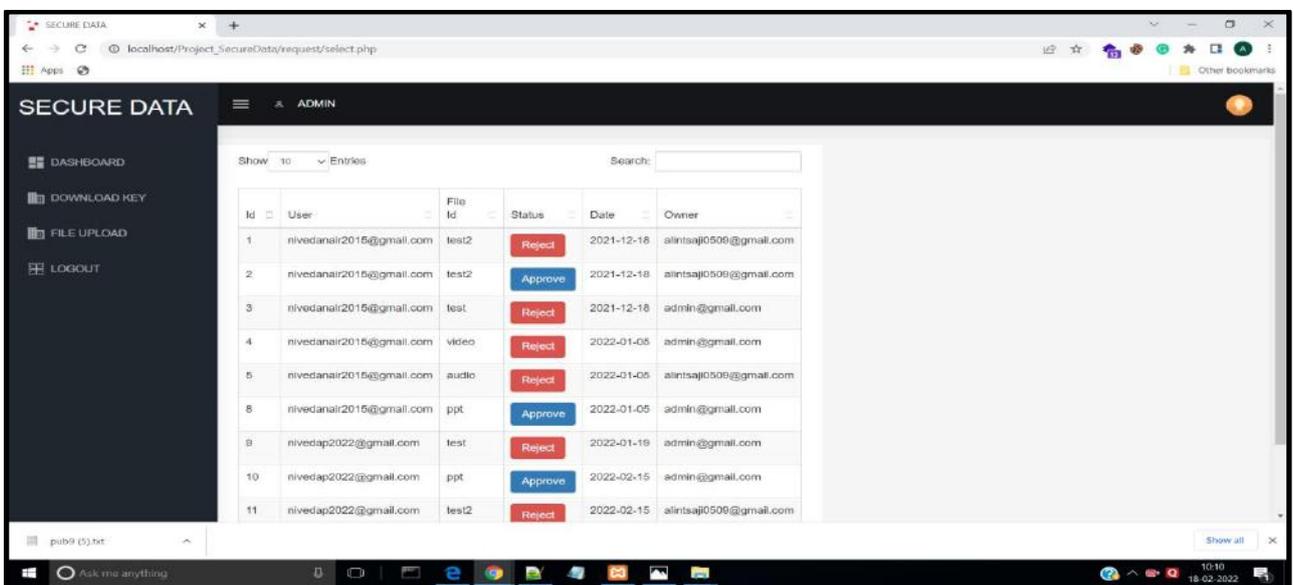
2. The view user option displays the list of users/owners who have registered in Secure Data. The admin is given the privilege to approve or block a user/owner. The owner/user will be unable to login until the admin approves them.



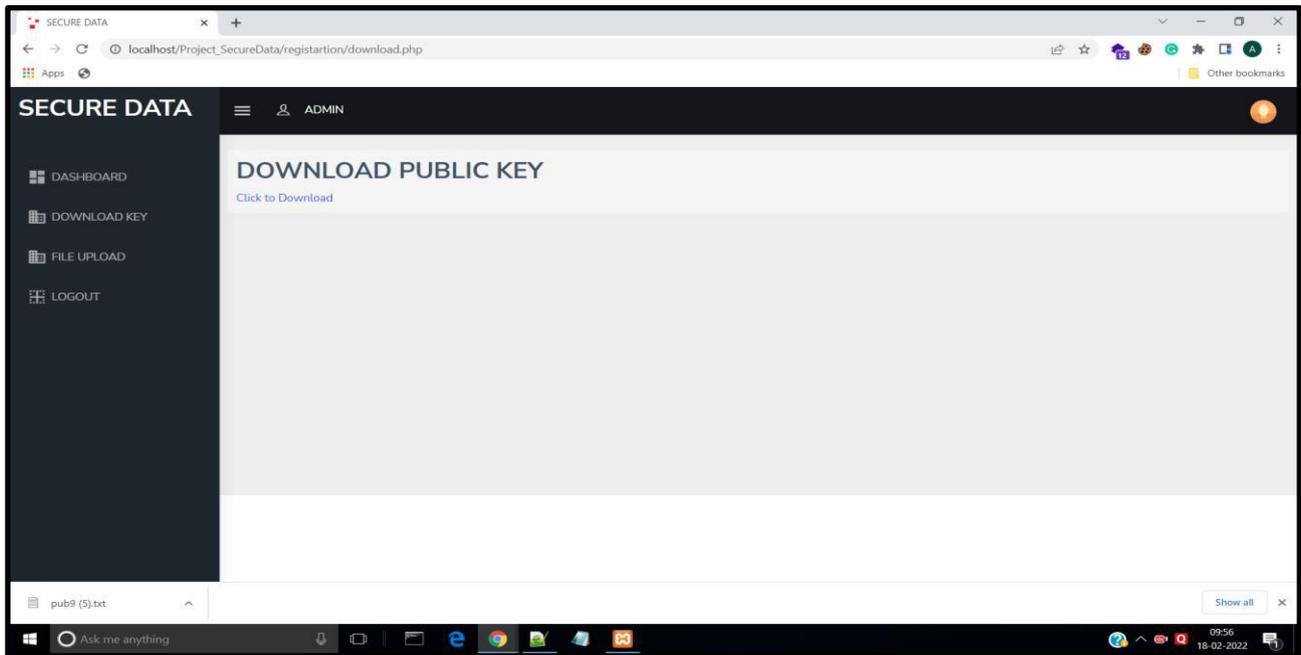
- The “View Uploads” options displays the list of files uploaded to the cloud along with details such as email-id of the owner of the file, filename, file, an hash value of the file ,which is generated during the upload to ensure the integrity is maintained ,date and time of upload and delete option.



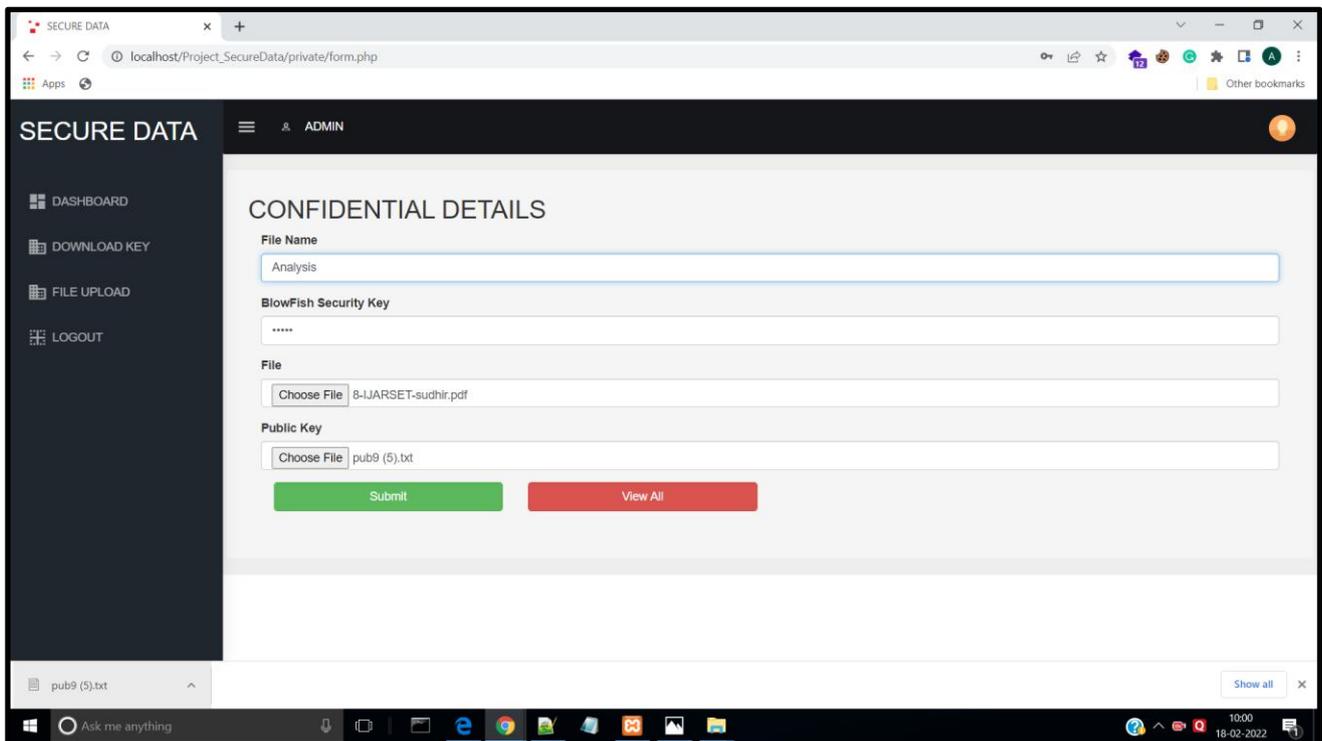
- The “View Request” Option displays the requests received from various users for the file. The admin can choose to approve or block the user.



- Admin can upload files to the file upload page. Before uploading the file, the admin needs to download the public key from the download key page by clicking “click to download”.

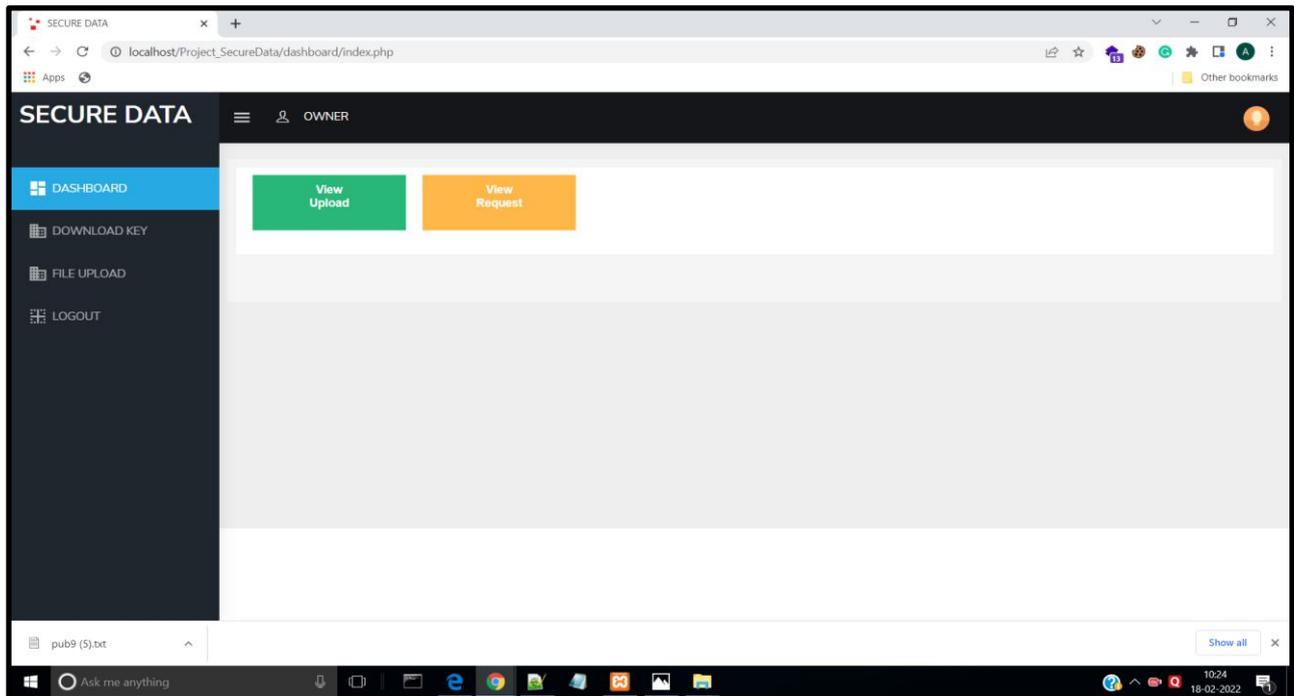


- The user needs to enter details like file name, and upload the file that needs to be uploaded and the public key. A blowfish key will be randomly generated which can be manually modified as well. And finally, click submit.

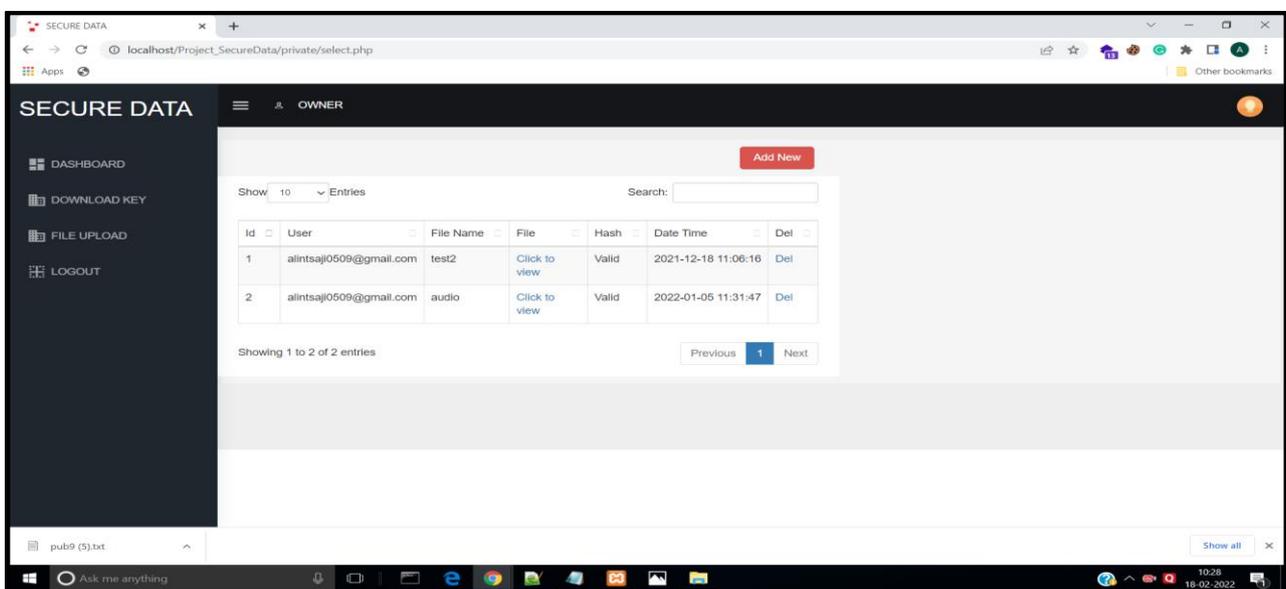


OWNER

1. The owner on successful login has the following options

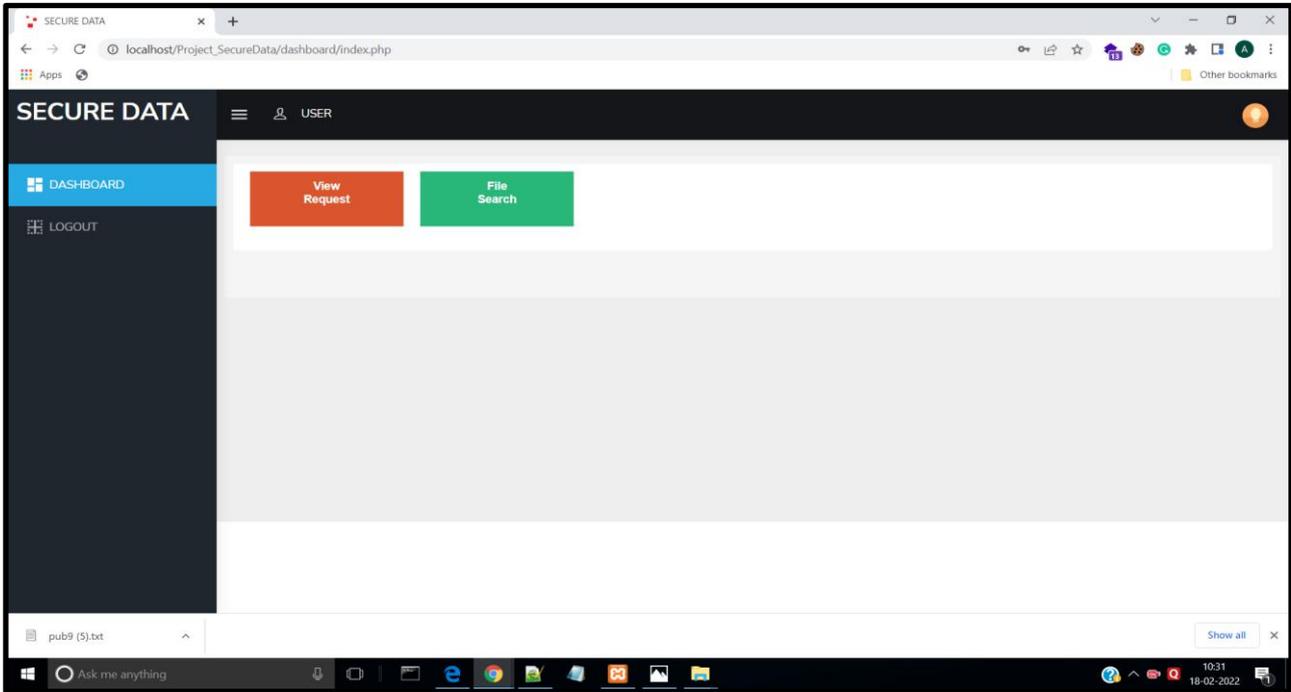


The view upload , View Request, file upload works in the same way as in the admin account. The only difference is that in the view upload option of admin the admin is able to view the files uploaded by both owners and admin. Whereas the owner can view only the files uploaded by them. Any type of file, such as pdf,ppt,audio,video etc. can all be uploaded.

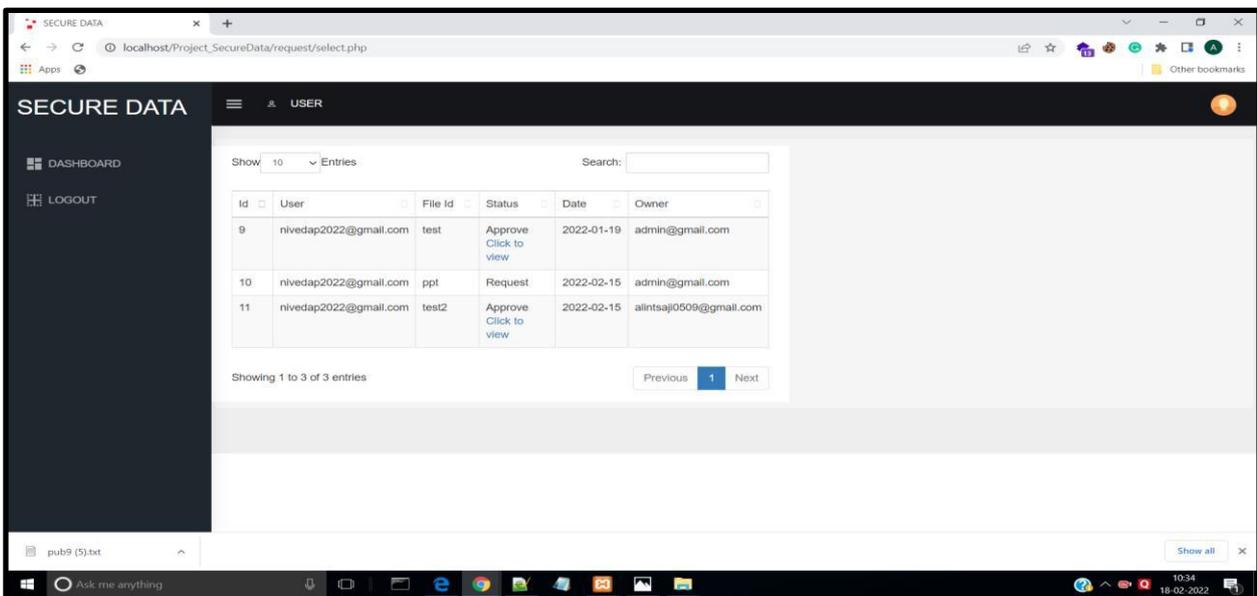


USER

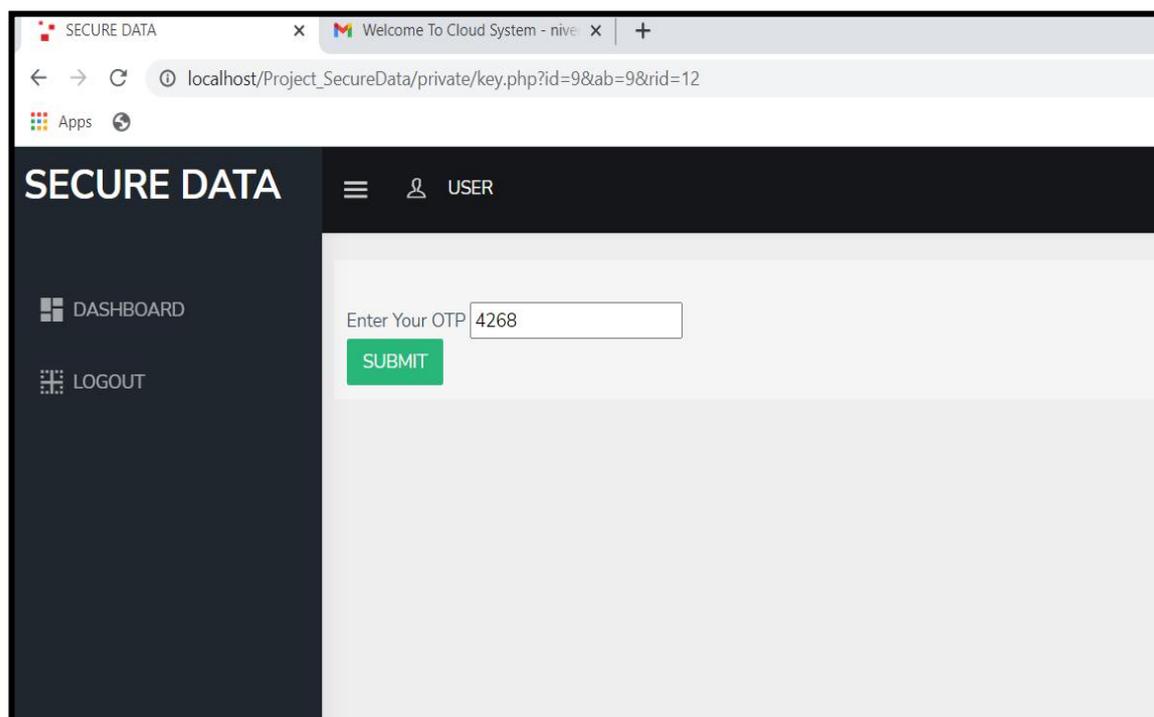
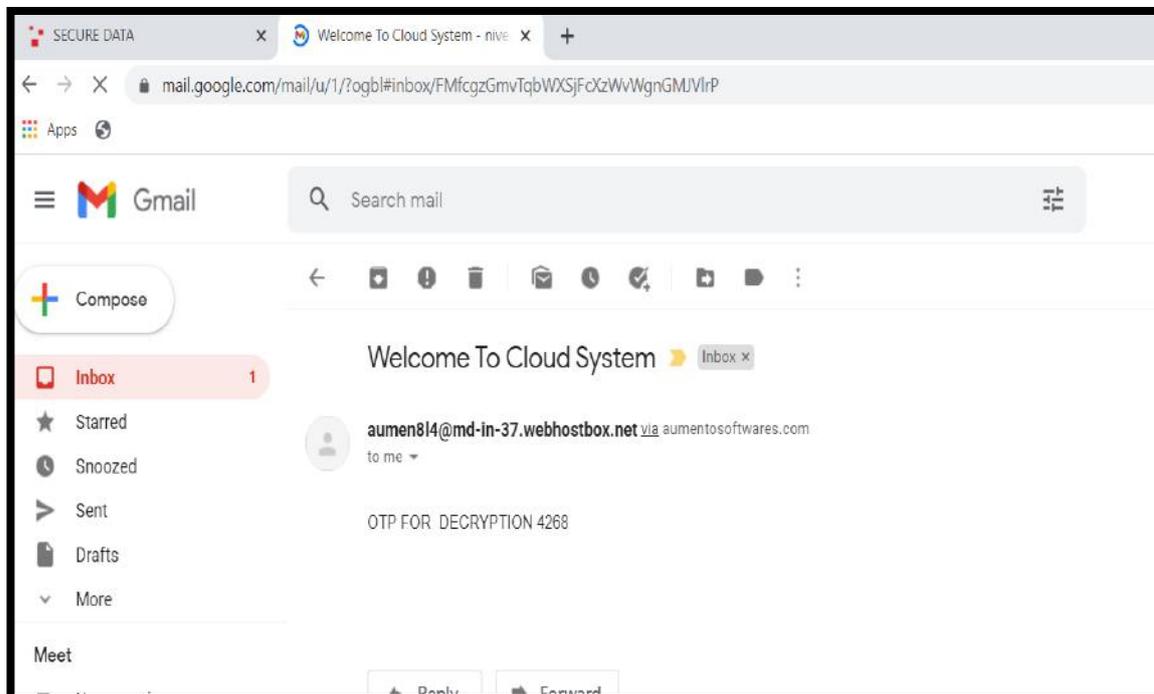
1. The user on successful login, has the following option.



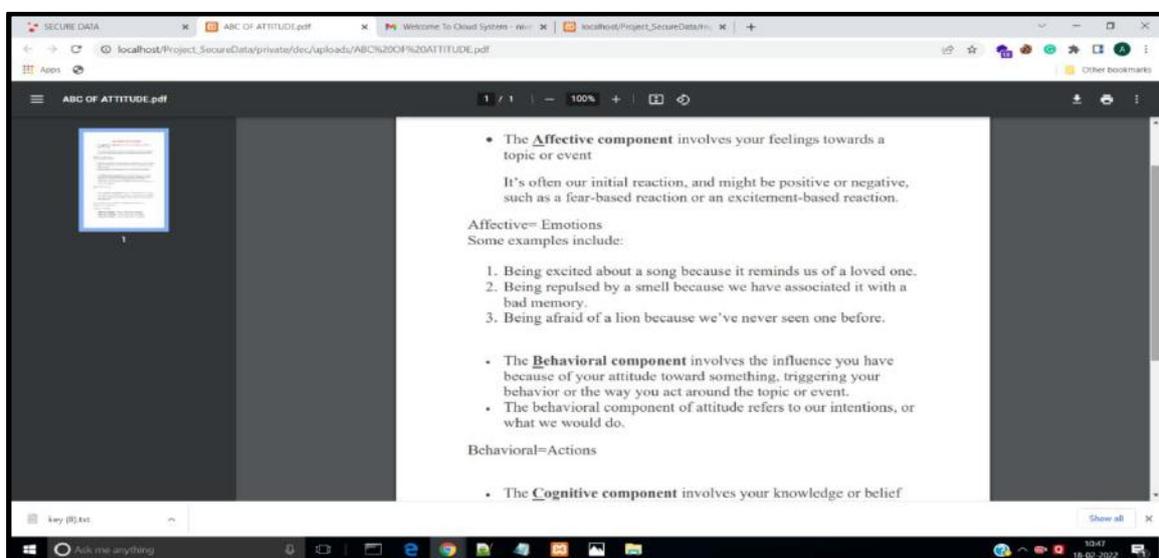
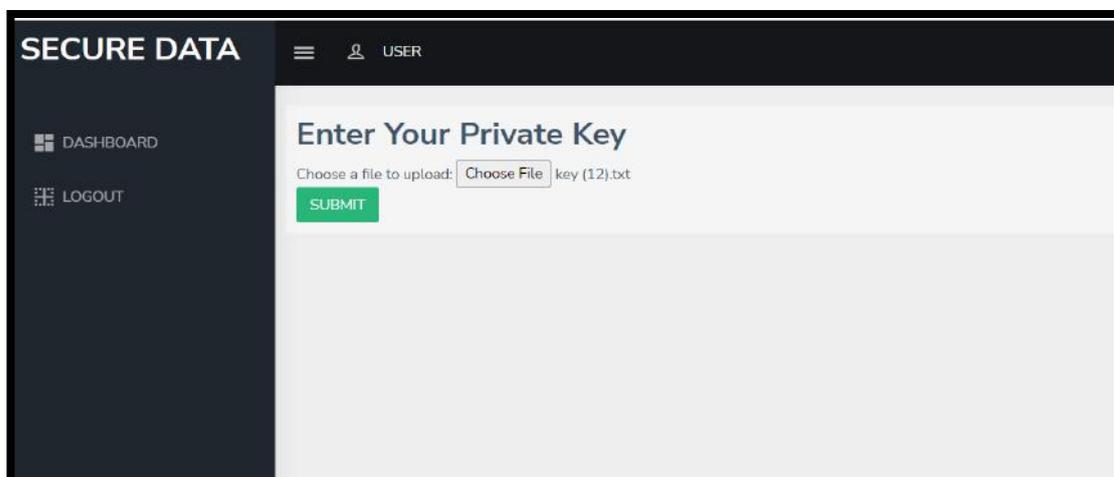
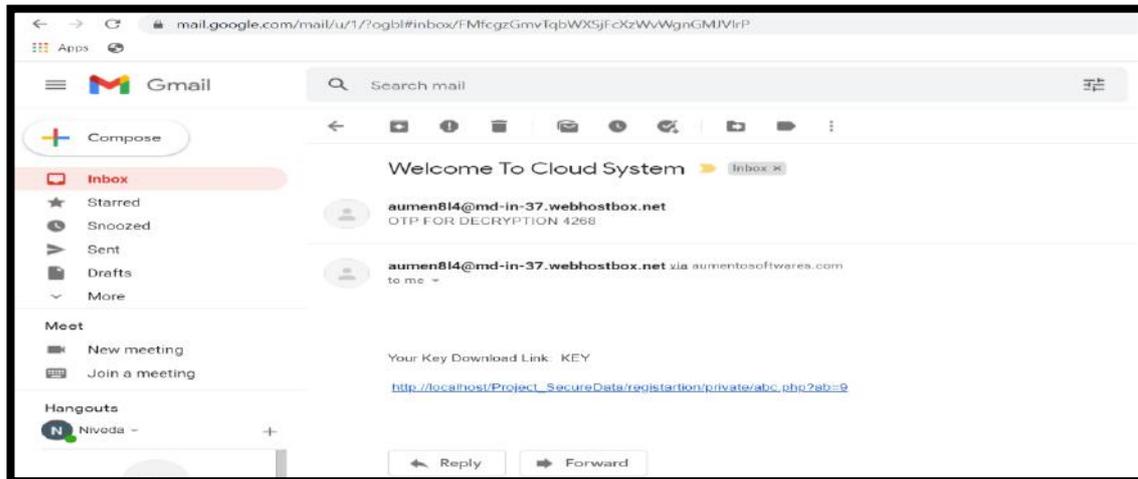
2. The “View Request” option helps the user to view the status of the already sent requests. If the request is accepted by the owner/admin then the view file option will be visible for the file in the status section.



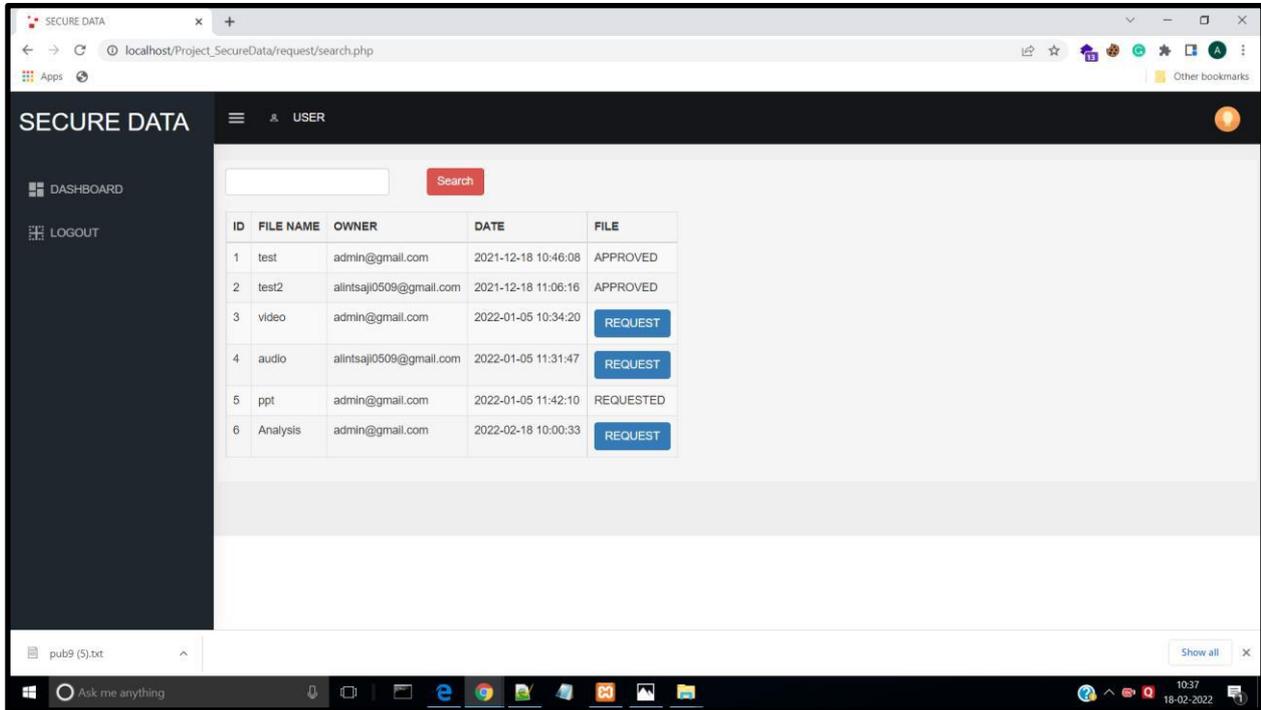
3. Clicking on the “Click to view “ options redirects to a new page asking to enter the OTP and upload Private key. Once the “Click to view “ is clicked, you will receive a mail in the registered mail-id containing the OTP .Upon successful verification of the OTP a second mail containing the private key link is sent to the user.



- 4. The private key is downloaded using the link received through the second mail. This key is then uploaded in the upload private key field to get the decrypted file.



- 5. The “File search” option displays the list of files uploaded to the cloud. It has an option “REQUEST”, clicking on which would send a request to the owner & admin. Once they have been approved, it will be reflected by replacing the “REQUEST” button with the status “APPROVED”.



CHAPTER 9

CONCLUSION

A novel approach to secure the data on cloud was proposed. The system uses a combination of symmetric and asymmetric key cryptographic algorithms namely Blowfish and Elliptic curve cryptography. Any type of file can be uploaded to the system like text,photo,video,pdf etc. The files are encrypted using the Blowfish and ECC algorithm before storing it in the cloud.

The system allows users to securely store their data in the cloud. It makes sure that only authorised users can access these files. The blowfish algorithm is used to encrypt the file and the key of the blowfish encryption is then again encrypted using the ECC algorithm. Blowfish generates a really large key, and this alone is a huge benefit to security. With the increase in speed of computer processing, blowfish is able to create a much longer key so that it is much more difficult to try to hack the key value. Whereas ECC provides an equal security level with a smaller key size when compared with other public-key cryptosystems, thereby reducing processing overhead and storage.

The recommendation for the proposed system for improvement is that the admin here has the overall control of the system, so if the admin account gets compromised it could lead to heavy data breach. Implementing methods which could provide an extra level of security system would be more beneficial.

The future scope of the application is to add an option to collect the user's valid identity proof during the registration which could be used for the admin to verify the user's identity and approve them as a valid user. The scope of using biometrics or enhanced 2 factor authentication mechanisms must be studied.

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- [12][https://en.wikipedia.org/wiki/Blowfish_\(cipher\)](https://en.wikipedia.org/wiki/Blowfish_(cipher))
- [13]https://en.wikipedia.org/wiki/Hybrid_cryptosystem

APPENDICES

SOURCE CODE

(i) Blowfish Encryption

```
<?php

$ip=$_SERVER['REMOTE_ADDR'];

$key = pack('H*', $password);

$key_size = strlen($key);

$filename2=$filename;

$plaintext =file_get_contents($filename2);

$iv_size = mcrypt_get_iv_size(MCRYPT_BLOWFISH, MCRYPT_MODE_CBC);

$iv = mcrypt_create_iv($iv_size, MCRYPT_RAND);

$ciphertext = mcrypt_encrypt(MCRYPT_BLOWFISH, $key,

                             $plaintext, MCRYPT_MODE_CBC, $iv);

$ciphertext = $iv . $ciphertext;

$ciphertext_base64 = base64_encode($ciphertext);

$filename3="enc/".$filename;

$myFile = "$filename3";

$fh = fopen($myFile, 'w') or die("can't open file");

$stringData = $ciphertext_base64;
```

```
fwrite($fh, $stringData);  
  
    fclose($fh);  
  
    $hash=hash_hmac_file('sha512', $filename3, 'secret');  
  
?>
```

(ii)ECC Encryption

```
<?php  
  
session_start();  
  
include("../connection.php");  
  
if(isset($_POST['submit']))  
  
{  
  
$paa="uploads/pub".$_SESSION['id'].".txt";  
  
if(move_uploaded_file($_FILES['publickey']['tmp_name'], $paa))  
  
{  
  
    //echo "aaaaaa";  
  
}  
  
$puss = fopen($paa, "r") or die("Unable to open file!");  
  
$sass=fread($puss,filesize($paa));  
  
fclose($puss);  
  
$password=$_REQUEST['password'];
```

```
function encrypt($data, $publicKey)
{
    openssl_public_encrypt($data, $encryptedData, $publicKey);
    return $encryptedData;
}

$msg=$_REQUEST['password'];

$public_file="../../registartion/public/pub".$_SESSION['id'].".txt";

$pub = fopen($public_file, "r") or die("Unable to open file!");

$a=fread($pub,filesize($public_file));

fclose($pub);

if($a!=$ass)
{
    echo"<script>window.location.replace('form.php?a=fail');</script>";
}

$strEncrypted = encrypt($msg,$a);

$ff=rand(1000,9999);

$password1 = "password/$ff.txt";

$fh = fopen($password1, 'w') or die("can't open file");

fwrite($fh, $strEncrypted);
```

```
fclose($fh);
```

```
$server_path = "uploads/"; //server path to folder
```

```
$target_path = $server_path.basename( $_FILES['file']['name']);
```

```
if(move_uploaded_file($_FILES['file']['tmp_name'], $target_path)) {
```

```
    $filename=$target_path;
```

```
    echo $filename . "<br>";
```

```
    include("step1.php");
```

```
    $ssql="INSERT INTO uploads(user,file_name,password,file_type,file,hash) VALUES  
($ _POST[user],'$ _POST[file_name]','$password1','$ _POST[file_type]','$filename','$hash)";
```

```
    echo "<br><br><br>".$ssql;
```

```
    $result=mysqli_query($con,$ssql);
```

```
    if($result)
```

```
    {
```

```
        echo"<script>window.location.replace('form.php?a=sucess');</script>";
```

```
    }
```

```
    else
```

```
    {
```

```
        echo"<script>window.location.replace('form.php?a=fail');</script>";
```

```
    } }
```

```
else{  
  
    echo"<script>window.location.replace('form.php?a=fail');</script>";  
  
}  
  
}  
  
else  
  
{  
  
    echo"<script>window.location.replace('form.php?a=fail');</script>";  
  
}  
  
>
```

(iii)Mail-1

```
<?php  
session_start();  
date_default_timezone_set('Asia/Calcutta');  
$otp_time=date("Y-m-d h:i:s");  
$ab=$_REQUEST['ab'];  
$url="https://alc-training.in/gateway.php";  
$email=$_SESSION['email'];  
  
$rand1=rand(1000,9999);  
$rand=$rand1;  
$subject="Welcome To Cloud System";  
$from_name="Secure File Sharing App";
```

```
$msg="
OTP FOR DECRYPTION $rand1
";
$message = urlencode($msg);
$ch = curl_init();
if (!$ch){die("Couldn't initialize a cURL
handle");} $ret = curl_setopt($ch,CURLOPT_URL,$url);
curl_setopt ($ch,CURLOPT_POST, 1);
curl_setopt($ch,
CURLOPT_SSL_VERIFYPEER, false);
curl_setopt($ch,CURLOPT_SSL_VERIFYHOST, 2);
curl_setopt
($ch,CURLOPT_POSTFIELDS,"email=$email&msg=$msg&subject=$subject&title=$title");
$ret = curl_setopt($ch, CURLOPT_RETURNTRANSFER, 1);
//If you are behind proxy then please uncomment below line and provide your proxyip with port.
// $ret = curl_setopt($ch, CURLOPT_PROXY, "PROXY IP ADDRESS:PORT");
$curlresponse = curl_exec($ch); //
if(curl_errno($ch))
echo 'curl error : '. curl_error($ch);
if (empty($ret)) {
die(curl_error($ch));
curl_close($ch); // close cURL
} else {
```

```
$info = curl_getinfo($ch);
```

```
curl_close($ch);
```

```
}
```

```
?>
```

iv)Mail-2

```
?php
```

```
session_start();
```

```
date_default_timezone_set('Asia/Calcutta');
```

```
$otp_time=date("Y-m-d h:i:s");
```

```
$ab=$_REQUEST['ab'];
```

```
$url="https://alc-training.in/gateway.php";
```

```
$email=$_SESSION['email'];
```

```
$subject="Welcome To Cloud System";
```

```
$from_name="Secure File Sharing App";
```

```
$msg="
```

```
Your Key Download Link: KEY
```

```
http://localhost/Project_SecureData/registartion/private/abc.php?ab=$ab
```

```
"; // HTML message
```

```
$message = urlencode($msg);
```

```
$ch = curl_init();
```

```
if (!$ch){die("Couldn't initialize a cURL
```

```
handle");} $ret = curl_setopt($ch,CURLOPT_URL,$url);
curl_setopt ($ch,CURLOPT_POST, 1);
curl_setopt($ch,
CURLOPT_SSL_VERIFYPEER, false);
curl_setopt($ch,CURLOPT_SSL_VERIFYHOST, 2);
curl_setopt
($ch,CURLOPT_POSTFIELDS,"email=$email&msg=$msg&subject=$subject&title=$title");
$ret = curl_setopt($ch, CURLOPT_RETURNTRANSFER, 1);
//If you are behind proxy then please uncomment below line and provide your proxyip with port.
// $ret = curl_setopt($ch, CURLOPT_PROXY, "PROXY IP ADDRESS:PORT");
$curlresponse = curl_exec($ch); //
if(curl_errno($ch))
echo 'curl error : '. curl_error($ch);
if (empty($ret)) {
die(curl_error($ch));
curl_close($ch); // close cURL
} else {
$info = curl_getinfo($ch);
curl_close($ch); // close cURL
//echo $curlresponse;
//header("location:contact.php") ;
}
?>
```

EFFECTS OF CUSTOMER PERCEPTION TOWARDS ECO – FRIENDLY BAGS

Project Report

Submitted by
ALIVIA GRACE MATHEWS (Reg. No. SB19BMS002)

Under the guidance of

Smt. Megha Mary Michael

In partial fulfilment of the requirements for award of the degree of
Bachelor of Management Studies (International Business)



St. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM
COLLEGE WITH POTENTIAL FOR EXCELLENCE

Nationally Re-Accredited at 'A⁺⁺' Level (NAAC Fourth Cycle)

March 2022

Valued by : 
09/05/22
Dr. Sr. Usha.A.A.

ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM, KOCHI – 682011



CERTIFICATE

This is to certify that the project entitled “A Study on the Effects of Customer Perception Towards Eco – Friendly Bags”, has been successfully completed by Ms. Alivia Grace Mathews, Reg. No.SB19BMS002, in partial fulfillment of the requirements for the award of degree of Bachelor of Management Studies in International Business, under my guidance during the academic years 2019-2022.

Date: 29/04/2022




Mrs. MEGHA MARY MICHAEL
INTERNAL FACULTY GUIDE

DECLARATION

I, Alivia Grace Mathews, Reg. No. SB19BMS002, hereby declare that this project work entitled "A Study on the Effect of Customer Perception Towards Eco – Friendly Bags" is my original work.

I further declare that this report is based on the information collected by me and has not previously been submitted to any other university or academic body.

Date: 29/04/2022

09/05/2022



ALIVIA GRACE MATHEWS

Reg. No. SB19BMS002

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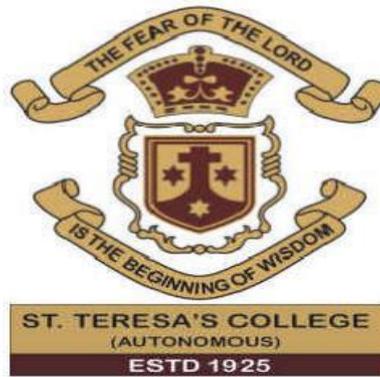
CERTIFICATE

This is to certify that the project report entitled, “A Study on the Effects of Customer Perception Towards Eco – Friendly Bags”, is a bonafide record submitted by Ms. Alivia Grace Mathews, Reg. No.SB19BMS002, in partial fulfillment of the requirements for the award of the Degree of Bachelor of Management Studies in International Business during the academic years 2019-2022.

Date: 29/04/2022

**Dr. LIZZY MATHEW
PRINCIPAL**

ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM, KOCHI – 682011



CERTIFICATE

This is to certify that the project entitled “A Study on the Effects of Customer Perception Towards Eco – Friendly Bags”, has been successfully completed by Ms. Alivia Grace Mathews, Reg. No.SB19BMS002, in partial fulfillment of the requirements for the award of degree of Bachelor of Management Studies in International Business, under my guidance during the academic years 2019-2022.

Date: 29/04/2022

**Mrs. MEGHA MARY MICHAEL
INTERNAL FACULTY GUIDE**

DECLARATION

I, Alivia Grace Mathews, Reg. No.SB19BMS002, hereby declare that this project work entitled “A Study on the Effect of Customer Perception Towards Eco – Friendly Bags” is my original work.

I further declare that this report is based on the information collected by me and has not previously been submitted to any other university or academic body.

Date: 29/04/2022

ALIVIA GRACE MATHEWS

Reg. No. SB19BMS002

ACKNOWLEDGEMENT

I would like to place on Project Report my debt of gratitude to those who helped me in the preparation of this project.

I extend my sincere gratitude to the Director of the college, Rev. Dr. Sr. Vinitha, the Principal of the college, Dr. Lizzy Mathew and all the faculty members of the Department of Management Studies for their overall guidance, inspiration and suggestions throughout my project work.

I take this opportunity to express my deep sense of gratitude and whole hearted thanks to the Head of Department, Mrs. Megha Mary Michael who was also my Project Guide for guiding me in all stages of this project, without whom this project would have been a distant reality.

I also wish to thank everyone who took their time to be a part of my research project.

Last but not the least, I extend my heartfelt thanks to my family, friends and everyone who have directly or indirectly helped me for completing the project in time and thereby making it a success.

Alivia Grace Mathews

EXECUTIVE SUMMARY

I am presenting this report on the customer perception towards eco-friendly bags.

It starts with the rationale behind preparing the report, objectives, significance of the study and the background of the industry.

All this research is then followed by a survey which reveals some facts about the customers awareness about environmental issues, their preference for the product and their satisfaction levels with the product.

The report has been concluded with the interpretation of the whole thing and the information collected is presented with the help of charts and diagrams.

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**THE EFFECTS OF CUSTOMER PERCEPTION TOWARDS
ECO FRIENDLY BAGS**

CHAPTER ONE
INTRODUCTION TO STUDY

1. INTRODUCTION TO STUDY

Many global and local problems are caused by single use plastic bags, including environmental damage climate change and pollution caused by their manufacture. Wildlife and other habitats are also affected from the discarded bags and degraded plastic fragments. It also causes damages to the human health by the indigestion of the of chemical compounds found on the plastic bags. Climate change has become a world-wide problem today and with the increasing levels of global pollution the number of people shifting to a more sustainable lifestyle has also expanded. Some of the population has shifted to using eco-friendly bags over plastic bags in order to reduce the amount of pollution discharged into the environment.

The ever-increasing global environmental degradation has led to health impacts. Evidence shows that primary cause of environmental degradation are human induced. Concerns over a sustainable future due to the problems and challenges facing today's environment has led to the formulation of intervention programmers and measure to compact the phenomenon accordingly. Besides these efforts, many have also modified their processes to conform to the green movement or green marketing.

Consumers on the other end are becoming aware of the environmental issues. This is exhibited in their changing attitudes towards the environment through the demand of eco -friendly products. The desire of consumers to purchase eco-friendly products and services is rising and many more are aware of environmental issues and consequently choose products that do not damage the environment over less environmentally friendly products even if they cost more.

Plastic pollution pervasive global environmental threat. More than 40 years of records show that there is debris in ocean samples. The results from the sample showed that there was approximately three times more plastic in the water from 1996 to 1990. This shows us the need for the switching from plastic bags to eco – friendly bags.

Eco bags are a clean, safe and environment friendly alternative to plastic bags. They are made out of hundred per cent biodegradable materials like natural fibers and other degradable materials. Eco bags can also bear a stronger load than conventional bags. Eco bags not only recycle materials that would be going into waste, they also eliminate the use of single use plastic bags that have proven to harm the environment. Made from petroleum, plastic bags fuel extraction of fossil resources. They also cause serious disposal problems. Plastic bags take centuries to break down in nature and burning them can release toxic chemicals into the environment. Non-toxic eco bags on the other hand, conserve the environment by harmlessly

biodegrading after numerous uses. As there is a rise in the environmental awareness among the public, customers are consciously making decisions to purchase products that are eco – friendly and do not harm the environment.

Customer perception can be a process in which a customer collects information on a particular brand or product and interprets the information to make a meaningful image about the particular product. It is defined as the probability of consumer readiness to purchase a product in the future. However, this is dependent on or influenced by several factors such as the buyer's characteristics, cultural factors and psychological factors. Customer perception and buying behaviour can also depend on their awareness about various issues.

1.2 STATEMENT OF PROBLEM

The government of India has imposed a ban on the use of single use plastic bags due to the increase in the rising levels of pollution caused by plastics dumped into the terrestrial and aquatic ecosystems. They have also banned the use of carry bags made of recycled plastic with less than 50 microns in thickness. Daily use products with plastic contents in it like cosmetics and toiletries, which contain microbeads and are not biodegradable has been banned. This study helps the government and companies to adapt eco – friendly shopping bags by understanding the customers perception towards eco – friendly bags.

1.3 LITERATURE REVIEW

Lombardo defined consumer preference as the set of assumptions that focus on consumer selections with results in different situations like happiness, satisfaction and utility. The entire consumer preference results in the best optimal choice. It allows a consumer to prioritize different bundles of goods according to their levels of utility, or their total level of satisfaction or dissatisfaction of consuming a good or service. It is very critical to understand that consumer preferences are not dependent upon consumer income or prices. Therefore, a consumer's ability to buy a product or service does not reflect the customers likes or dislikes.

By the definition provided by Rashid, green purchase intension is the probability and willingness of individuals to purchase a green product over other conventional products in their purchase considerations. Comparably, it is the willingness of an individual to consider and prefer the green products rather than a conventional or traditional product in the decision-making process.

According to Raines, consumer preference explains how a consumer ranks a collection of goods or services or prefers one collection to another. This definition states that consumers rank the goods based on the satisfaction and utility. In a study proposed by Park and Ha, green purchasing intention is an indicator of a subsequent behaviour in response to the purchase of green products. In another study posited by Follows and Jobbers, it states that the purchase intention can be translated into actual purchase behaviour on green products when the consumers believe that their effort on consumption of green products does bring a positive effect. From the above definitions, it can be deduced that a person's decision to purchase a product is strongly influenced by a variety of factors. These factors could be psychological, social, environmental and personal choices of an individual. Aman et al indicated that environmental knowledge and environmental concern both have a significant influence on the purchase intention of green products. Further, it was revealed that attitude also have a partial effect on the relationship between the environmental concern and green purchase intention.

Eco-friendly bags are the types of bags that can be reused and recycled. They are made out of materials that can be used over and over without causing any harm to the environment. The materials used to manufacture eco-friendly reusable bags usually come from waste that people don't use anymore. These materials can be put into good use by turning them into reusable eco-friendly bags. The materials acquired to manufacture the bags are taken through a process that converts them into a fabric that is reusable without creating any harm to the environment (O'neal, 2011).

Altaf mentioned that there are many individuals who have not realized the importance of eco-friendly bags. There are never-ending efforts around the world where people are diverting their efforts and actions towards all those things which are not harmful to the environment. Organizations are also taking a serious step towards protecting the environment by providing eco-friendly shopping bags to customers.

1.4 SIGNIFICANCE OF STUDY

The increasing use of plastic bags has a long-lasting impact on the environment. It can take around 15 to 1000 years to decompose during which it can cause the deaths of millions of wildlife species. Buying eco-friendly bags can contribute to saving the wildlife species from the consumption of plastic bags. The utilization of plastic-carrier-bags by consumers is a form of social change. In an article by Billy Kahora "A Plague of Plastic" describes how the massive volumes of plastic bags are a challenging situation in the world. Considering the large-scale

damaging effects of plastic bags, many countries, around the world have already prohibited the production and use of plastic bags by enacting parliamentary-legislations. However, the implementation of this complete ban on plastic bags has not been successful in many parts of the world.

Although there are many shopping bags made of natural fibers, their use is limited due to the consumer perception that plastic bags are more cheap or affordable when compared to eco-friendly bags. The failure to integrate social, economic and environmental policies and objectives can result in the weakening of a country's progress on poverty-reduction, increasing discrimination and consequently damaging the environment. Due to the inadequate collection of waste, the uncollected waste including the plastic waste is burned, buried or dumped haphazardly in unfit places. These waste disposal methods have serious and long-term consequences on the environment. Since, more than half of the world's population lives in cities, there has been an increase in the use of plastic bags which makes it critical for the effective management on the use of plastic bags in order to protecting the environment. Consumers find plastic bags to be free as they are given to the consumers in the form of a consumption cost by retailers and other supermarkets.

Studies have shown that the consumers perception and usage behaviour in respect with the government policies and implementation of recycling systems could be highly influential in reducing the eco impact of the plastic shopping bags. This survey, has mainly aimed at the customer perception towards eco-friendly bags and their willingness to reduce the consumption of plastic bags. Building up public awareness and motivation to reuse, reduce and recycle can help resolve the environmental problems to a great extent.

1.5 SCOPE OF STUDY

This study is mainly focused on understanding the different factors that affect the customer perception towards eco-friendly bags. Thus, this research helps to understand the customer preference for eco bags over plastic bags.

1.6 OBJECTIVES OF STUDY

The main objectives of this study are –

- To understand the customer preference for eco-friendly bags over plastic bags.
- To identify the relationship between environmental concerns and customer attitude towards purchasing eco-friendly bags.

- To understand the factors affecting consumer buying behaviours towards eco-friendly bags.

1.7 RESEARCH HYPOTHESIS

The following are the research hypothesis constructed for this study –

H1: There is a positive relationship between the satisfaction levels of consumers towards eco-friendly bags.

H2: There is a positive relationship between environmental concerns and customers attitudes towards purchasing eco-friendly bags.

H3: There is a positive relationship between consumers attitudes and purchasing intentions towards eco-friendly bags.

H4: There is a positive relationship between the consumer preference for eco-friendly bags over plastic bags.

1.8 METHODOLOGY

1.8.1 Data Collection

The two many types of data collection that are used by researchers are primary data and secondary data. Primary data collection is used to collect information's from the respondents through interviews, questionnaires, case studies. Secondary data collection is collecting the information's that are already existing, these include newspapers, journals, research papers of government, etc.

The tool used for this research was primary data collection to understand the customers perception through self – administered questionnaires. 5-point Likert scale using degrees of agreement was used to measure their responses.

Secondary data collection techniques were used to find out the industry profile of eco – friendly bags. It was also used in the introduction to study and literature review.

1.8.2 Data Sampling

1.8.2.1 Population

Population is a collection of the elements which has same or other characteristics in common. The number of elements in the population is the size of the population. In this survey, the

population comprises of the customers who use eco – friendly bags in Kerala.

1.8.2.2 Sample Size

The sample size taken for this study is 120 responses. Questionnaires were distributed to the respondents and enough time was given to fill the questionnaire.

1.8.2.3 Sampling Technique

The study uses convenience sampling technique which is a type of non - probability sampling technique. It involves selecting the sample population from a pool of conveniently available respondents.

1.8.3 Data Collection Techniques

The questionnaire is carefully designed to meet the requirements of the research. The questions are constructed using the various scales like nominal scale, ratio scale and Likert scale. The Likert scale questions help understand the customers satisfaction levels on using eco-friendly bags.

1.8.4 Data Analysis Technique

The entire data has been analysed using SPSS software package. The tools used for the analysis in SPSS are as follows:

- Cross Tabulation and Chi-square
- Percentage Analysis

1.9 LIMITATIONS OF THE STUDY

- Time constraints were one of the major limitations.
- The sample size is very small which makes it hard to understand the accuracy of the data provided.
- Many respondents were not cooperative with the research survey.

CHAPTER TWO
INDUSTRY ANALYSIS AND PRODUCT PROFILE

2.1 INDUSTRY PROFILE

As the prices of garments have dropped over the years, people started to buy more clothes and this led to the fashion industry adopting unhealthy production practices that has posed serious consequences on our health, the health of the environment and various species. This happens due to the increase in fast fashion where mass production of cheap and disposable clothing is made. The change in our lifestyle makes us to buy new products and try new trends, ignoring their effects on the environment. The fashion industry is the second largest polluter in the world after the oil industry. As the industry increases, the damages caused also increase. One of the main steps to help mitigate this problem is raising awareness and willingness to change.

The toxic waste produced from garments are directly dumped into the rivers which affects the aquatic ecosystems and pose a threat to the marine species. This waste contains toxic substances such as lead, mercury, arsenic, among others. The fashion industry is a major water consumer. Huge quantities of fresh water are used for the dyeing and finishing process and all the fashion products.

Synthetic fibers when washed release huge amounts of microfibers into the water, making their way to the oceans and other water bodies. Scientists have found that these microfibers are ingested by the small aquatic organisms which are then eaten by small fishes and then larger fishes. Studies have also shown that microfibers can release plastic contents into the air polluting the atmosphere.

Textiles has clearly become disposable. As a result, we generate more waste. Most of the apparels we use go into landfills or are burned which increases the environmental damages. Only 25% of these textile wastes are recycled.

Synthetic fibers such as polyester, plastic fibers, therefore non-biodegradable and can take up to 200 years to decompose. Synthetic fibers are used in 72% of our apparels.

The apparel industry accounts for 10% of global carbon emission. The global fashion industry is generating a lot of greenhouse gases due to the energy used during its production, manufacturing and transportation. Synthetic fibers used in most of our apparels are made from fossil fuel, making production much more energy intensive than with natural fibers. Most of the apparels are produced from countries that are essentially powered by coal.

The soil is a fundamental element of our ecosystem. We need healthy soil for food production but also to absorb CO₂. The massive, global degradation of soil is one of the main environmental issues our environment is currently facing. It presents a major threat to global food security and also contributes to global warming. The fashion industry plays a major part in degrading soil in different ways: overgrazing of pastures, degradation of the soil due to massive use of chemicals and deforestation caused by wood-based fibers like rayon.

Every year thousands of hectares of endangered and ancient forests are cut down and replaced by plantations of trees used to make wood-based fabrics. This loss of forests is threatening the ecosystem and indigenous communities.

2.2 PRODUCT ANALYSIS

Eco-friendly bags can be easy to use and store and they can also be reused and recycled many times. They don't pollute the environment or harm any species and they also get degraded into the environment without taking years to decompose. Plastic bags on the other hand cannot be reused and when disposed ends up in the oceans or landfills where they can take more than 1000 years to completely decompose, during this time period animals and birds consume these products which can pose a huge threat to them. Eco-bags are made of natural fibers that can be used for years and are sustainable. Eco friendly can be of different types, they are –

1. Canvas/Cotton bags: these bags are made of the soft fabric called cotton, those that are organically grown does not cause pollution but artificially grown cotton can use high levels of pesticides. Canvas bags can be available in conventional cotton, organic cotton or hemp. These bags can be recycled to make other bags as well.
2. Jute bag: these bags are made from one of the strongest natural fibers and are cheaper than normal plastic bags. They are durable and sustainable and the jute crop requires little water.
3. Bamboo bags: these bags are the most viable alternative for plastic bags. They are made from sustainable, renewable and biodegradable bamboo fiber.
4. Paper bags: these are bags that are made paper, usually from kraft paper. They can be made either from recyclable or non-recyclable fibers to meet the customer needs. Paper bags are commonly used as shopping carrier bags and for packing some consumer goods.

CHAPTER THREE
DATA ANALYSIS AND INTERPRETATION

3.0 RESULTS AND ANALYSIS

In this chapter of analysis, data collection and finding of the study are discussed, the descriptive information and statistical analysis produced by the collected survey are shown. The given data are statistically analysed with spss software program.

3.1 DEMOGRAPHIC DETAILS OF RESPONDENTS

The researcher has tried to study the demographic variables of the respondents.

	Demographic Characteristics	Number of Respondents	Percentage
Age	Below 18	8	6.70%
	18 - 25	86	71.70%
	26 - 30	5	4.20%
	30 above	21	17.50%
		120	100%
Gender	Female	94	78.30%
	Male	26	21.70%
		120	100%
Occupation	Student	88	73.30%
	Working	28	23.30%
	Unemployed	3	2.50%
	Retired	1	0.80%
		120	100%
Monthly Income	10000 - 40000	28	70%
	50000 - 90000	6	15%
	Above 100000	6	15%
		40	100%

Table 3.1(a): Shows Demographic Details of Respondents

The demographic details of respondents are shown in table 3.1(a). The summary of the table above shows that out of the 120 consumers majority of them, i.e., 72.70% belong to the age group of '18 – 25' and 78.30% are female and are also students based on their occupational level. Among the consumers who are employed 70% of them have a monthly income of '10000 – 40000'.

3.1(a) CUSTOMER EVALUATION OF ECO-FRIENDLY BAGS

Evaluate eco friendly bags in terms of the following factors.

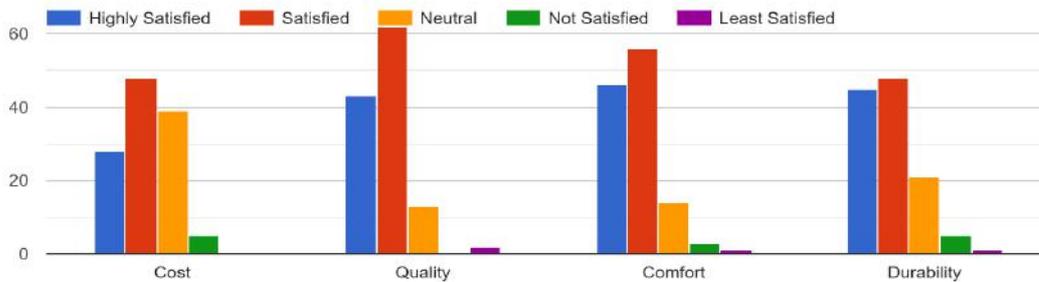


Fig 3.1(a): Bar graph showing the customer evaluation of eco-friendly bags in terms of cost, quality, comfort and durability

The graph shown in fig. 3.1(a) shows that most of the customers, i.e., 62% of the respondents are satisfied with the quality provided by eco-friendly bags. After quality, the respondents (56%) have voted for comfort while using eco-friendly bags. 48% of the respondents were satisfied with the cost and durability of eco-friendly bags. Cost and durability of eco-friendly bags has received the same amount of votes.

3.1(b): CUSTOMER DIFFICULTY IN MANAGING ECO BAGS DAILY

How often do you find eco bags difficult to manage in your daily life?
120 responses

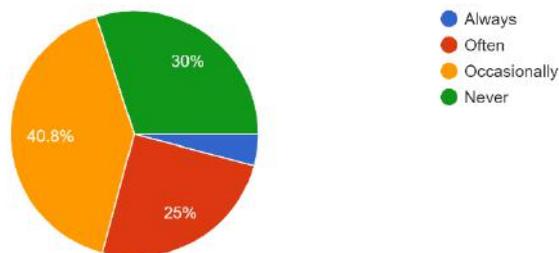


Fig. 3.1(b): Pie chart showing the difficulty of managing eco-friendly bags in daily life

The pie chart in fig. 3.1(b) shows that 40.8% of the respondents find it difficult to manage eco-friendly bags only occasionally. Only 30% of the respondents never found it difficult to manage eco-friendly bags in their daily life. 25% of the respondents found eco bags difficult to manage often and only 4.2% of the respondents found it difficult to handle always.

3.1(c): CUSTOMER POSSIBILITIES ON FINDING WAYS TO REUSE THE BAGS

How likely are you to find ways to reuse the bags?
120 responses

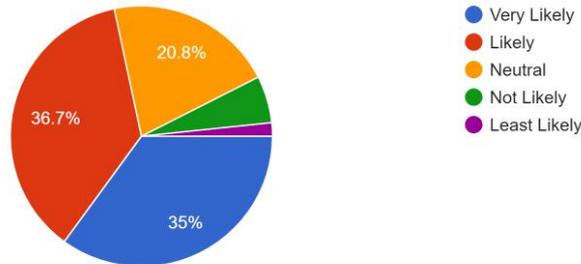


Table 3.1(c): Pie chart showing the possibilities of customers finding new ways to reuse the bags

The pie chart in fig. 3.1(c) shows that 36.7% of the respondents are likely to find ways to reuse the bags. While 35% of the respondents are most likely to find ways to reuse the bags, only 20.8% of the respondents are even-handed to finding new ways to reuse the eco-friendly bags. 5.8% of the respondents are not likely and only 1.7% of the respondents are least likely to find ways to reuse the bags.

3.2 HYPOTHESIS TESTING

H1: There is a positive relationship between the satisfaction levels of consumers towards eco-friendly bags.

Crosstab

Count

		Express your satisfaction for eco friendly bags over plastic bags in terms of : [Comfort]				Total
		Highly Satisfied	Satisfied	Neutral	Not Satisfied	
Do you prefer eco friendly bags over other bags?	Yes	55	32	8	1	96
	No	2	3	1	1	7
	Maybe	1	10	6	0	17
Total		58	45	15	2	120

Table 3.2.1.1 (a): Table shows the profile of customer preference for eco-friendly bags and their satisfaction based on comfort – Cross-Tabulation.

Table 3.2.1.1 (a) shows that higher the satisfaction of customers who use eco-friendly bags, higher is their preference for eco-friendly bags over the other bags. It also shows that 55% of the customers prefer eco-friendly bags over other bags and their satisfaction levels in terms of comfort is also high. The customers who didn't prefer eco-friendly bags over others and their satisfaction levels with eco-friendly bags were also low. And the number of customers who prefer both types of bags very neutral.

Chi-square test is used to verify the relationship between the customer preference and their satisfaction based on comfort for eco-friendly bags. The cross-tabulation is shown in the Table 3.2.1 (a) and the test of the relationship results is shown in Table 3.2.1.1 (b).

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	26.671 ^a	6	.000
Likelihood Ratio	24.248	6	.000
Linear-by-Linear Association	16.897	1	.000
N of Valid Cases	120		

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .12.

Table 3.2.1.1 (b): Shows the Chi-Square test of the relationship between customer preference for eco-friendly bags and their satisfaction based on comfort.

Analysis of the data using Chi-square test [Table 3.2.1.1 (b)] revealed that satisfaction based on comfort of customers using eco-friendly bags is significantly associated with their preference for the bag. Here the p value is .000 which is less than 0.05 so that it can be concluded that the null hypothesis got rejected. This means that the customer preference for eco-friendly bags contributes significantly to their satisfaction on their comfort level.

Crosstab

Count

		Express your satisfaction for eco friendly bags over plastic bags in terms of : [Sustainability]			Total
		Highly Satisfied	Satisfied	Neutral	
Do you prefer eco friendly bags over other bags?	Yes	56	32	8	96
	No	2	1	4	7
	Maybe	4	8	5	17
Total		62	41	17	120

Table 3.2.1.2 (a): Table shows the profile of customer preference for eco-friendly bags and their satisfaction based on sustainability – Cross-Tabulation.

Table 3.2.1.2 (a) shows that 56% of the customers prefer eco-friendly bags in terms of their satisfaction with sustainability. It shows that these customers are highly satisfied with the sustainability of the product. 4% of the customers felt that the sustainability of eco-friendly bags is neutral and hence they do not prefer eco bags. And the remaining customers prefer all types of bags and are satisfied with their sustainability.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	20.031 ^a	4	.000
Likelihood Ratio	16.701	4	.002
Linear-by-Linear Association	11.789	1	.001
N of Valid Cases	120		

a. 4 cells (44.4%) have expected count less than 5. The minimum expected count is .99.

Table 3.2.1.2 (b): Shows the Chi-Square test of the relationship between customer preference for eco-friendly bags and their satisfaction based on sustainability.

The data analysis used in table 3.2.1.2(b) is Chi-square test and it revealed that satisfaction based on sustainability of the eco-friendly bags is significantly associated with their preference for the product. Here the p value is .000 which is less than 0.05 so that it can be concluded that the null hypothesis got rejected. This means that the customer preference for eco-friendly bags contributes significantly to their satisfaction on the sustainability of eco-friendly bags.

Crosstab

Count

		Express your satisfaction for eco friendly bags over plastic bags in terms of : [Longevity]					Total
		Highly Satisfied	Satisfied	Neutral	Not Satisfied	Satisfied	
Do you prefer eco friendly bags over other bags?	Yes	48	32	14	0	2	96
	No	1	1	3	2	0	7
	Maybe	5	4	6	1	1	17
Total		54	37	23	3	3	120

Table 3.2.1.3 (a): Table shows the profile of customer preference for eco-friendly bags and their satisfaction based on longevity – Cross-Tabulation.

Table 3.2.1.3 (a) shows that 48% of the customers prefer eco-friendly bags in terms of their satisfaction for the longevity of the bags. It shows that these customers are highly satisfied with the longevity of the bag. The customers who didn't prefer eco-friendly bags over the other bags and their satisfaction levels with the longevity of the bags were also low. And the customers who prefer both types of bags were also neutral.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	32.668 ^a	8	.000
Likelihood Ratio	21.796	8	.005
Linear-by-Linear Association	9.436	1	.002
N of Valid Cases	120		

a. 10 cells (66.7%) have expected count less than 5. The minimum expected count is .18.

Table 3.2.1.3 (b): Shows the Chi-Square test of the relationship between customer preference for eco-friendly bags and their satisfaction based on sustainability.

The analysis of the data using Chi-square [Table 3.2.1.3 (b)] revealed that the satisfaction based on the longevity of the customers using eco-friendly bags is significantly associated with their preference for the product. Here the p value is .000 which is less than 0.05 so that it can be concluded that the null hypothesis got rejected. This means that the customer preference for eco-friendly bags contributes significantly to their satisfaction on the longevity of eco-friendly bags.

Crosstab

Count

		Express your satisfaction for eco friendly bags over plastic bags in terms of : [Multi - purpose]					Total
		Highly Satisfied	Satisfied	Neutral	Not Satisfied	Least Satisfied	
Do you prefer eco friendly bags over other bags?	Yes	50	31	13	1	1	96
	No	1	0	5	1	0	7
	Maybe	3	6	4	3	1	17
Total		54	37	22	5	2	120

Table 3.2.1.4 (a): Table shows the profile of customer preference for eco-friendly bags and their satisfaction based on multi-purpose – Cross-Tabulation.

Table 3.2.1.4 (a) shows that 50% of the customers prefer eco-friendly bags in terms of their satisfaction for the multi-purpose factor of the bags. It shows that these customers are highly

satisfied with the multi-purpose of the bag. The customers who didn't prefer eco-friendly bags over the other bags and their satisfaction levels with the multi-purpose of the bags were also low. And the customers who prefer both types of bags were also neutral.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	33.454 ^a	8	.000
Likelihood Ratio	28.848	8	.000
Linear-by-Linear Association	17.269	1	.000
N of Valid Cases	120		

a. 10 cells (66.7%) have expected count less than 5. The minimum expected count is .12.

Table 3.2.1.4 (b): Shows the Chi-Square test of the relationship between customer preference for eco-friendly bags and their satisfaction based on multi-purpose.

The analysis of the data using Chi-square [Table 3.2.1.4 (b)] revealed that the satisfaction based on the multi-purpose use of the eco-friendly bags of the customers is significantly associated with their preference for the product. Here the p value is .000 which is less than 0.05 so that it can be concluded that the null hypothesis got rejected. This means that the customer preference for eco-friendly bags contributes significantly to their satisfaction on the multi-purpose of eco-friendly bags.

H2: There is a positive relationship between the environmental concerns and customer attitudes towards purchasing eco-friendly bags.

How important do you think eco friendly bags are? * How likely do you think sustainable eco friendly bags have a positive influence on the environment? Crosstabulation

Count

		How likely do you think sustainable eco friendly bags have a positive influence on the environment?				Total
		Very Likely	Likely	Neutral	Least Likely	
How important do you think eco friendly bags are?	Very Important	59	14	0	0	73
	Important	15	22	3	0	40
	Neutral	1	3	2	0	6
	Least Important	0	0	0	1	1
Total		75	39	5	1	120

Table 3.2.2 (a): Table shows the profile of customer knowledge towards environmental concerns and their attitudes towards eco-friendly bags – Cross-Tabulation.

The table above shows that 59% of the customers think that sustainable eco-friendly bags have a positive influence on the environment which encourages them to think eco-friendly bags are important to sustain the health of the environment.

Here the independent sample is ‘How likely do you think sustainable eco-friendly bags have a positive influence on the environment’ and the dependent sample is ‘How important do you think eco-friendly bags are’.

Chi-square test is used to verify the relationship between the of customer knowledge towards environmental concerns and their attitudes towards eco-friendly bags. The cross-tabulation is shown in the Table 3.2.2 (a) and the test of the relationship results is shown in Table 3.2.2 (b).

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	157.070 ^a	9	.000
Likelihood Ratio	44.750	9	.000
Linear-by-Linear Association	40.418	1	.000
N of Valid Cases	120		

a. 12 cells (75.0%) have expected count less than 5. The minimum expected count is .01.

Table 3.2.2 (b): Shows the Chi-Square test of the relationship between customer knowledge towards environmental concerns and their attitudes towards eco-friendly bags.

Here the data generated in the Table 3.2.2 (b) shows that the relationship between the customer knowledge towards environmental concerns and their attitudes towards eco-friendly bags have a significant association. Here the null hypothesis is rejected as the value of p is .000 which is less than 0.05. This means that the customer knowledge towards environmental concerns is significantly associated with their attitudes towards purchasing eco-friendly bags.

H3: There is a positive relationship between consumers attitudes and purchasing intentions towards eco-friendly bags.

How often do you take cloth bags with you when you go shopping? * How likely are you to shop from a company that use eco friendly bags over plastic bags? Crosstabulation

Count		How likely are you to shop from a company that use eco friendly bags over plastic bags?				Total
		Very Likely	Likely	Not Likely	Least Likely	
How often do you take cloth bags with you when you go shopping?	Always	14	15	3	0	32
	Often	19	27	5	0	51
	Occasionally	6	18	4	1	29
	Never	3	2	2	1	8
Total		42	62	14	2	120

Table 3.2.3 (a): Table shows the profile of customer attitudes and purchasing intentions towards eco-friendly bags – Cross-Tabulation.

The table above shows that only 14% of the customers take eco-friendly shopping bags when they go for shopping and are likely to shop from a company that use eco-friendly bags over plastic bags. It shows that not many consumers prefer to shop from companies that provide eco bags over plastic bags.

Chi-square test is used to verify the relationship between the of customer knowledge towards environmental concerns and their attitudes towards eco-friendly bags.

The cross-tabulation is shown in the Table 3.2.3 (a) and the test of the relationship results is shown in Table 3.2.3 (b).

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.548 ^a	9	.139
Likelihood Ratio	11.642	9	.234
Linear-by-Linear Association	5.341	1	.021
N of Valid Cases	120		

a. 9 cells (56.3%) have expected count less than 5. The minimum expected count is .13.

Table 3.2.3 (b): Shows the Chi-Square test of the relationship between customer knowledge towards environmental concerns and their attitudes towards eco-friendly bags.

The data analysis used is Chi-square and it shows that there is no positive relationship between the customer knowledge towards environmental concerns and their attitudes towards eco-friendly bags. Here the null hypothesis has not been rejected because the value of p is not less than 0.05. This means that there is no positive relationship between the customer knowledge towards environmental concerns and their attitudes towards eco-friendly bags.

H4: There is a positive relationship between the consumer preference for eco-friendly bags over plastic bags.

How often do you take cloth bags with you when you go shopping? * Do you prefer eco friendly bags over other bags? Crosstabulation

Count		Do you prefer eco friendly bags over other bags?			Total
		Yes	No	Maybe	
How often do you take cloth bags with you when you go shopping?	Always	31	1	0	32
	Often	39	4	8	51
	Occasionally	20	1	8	29
	Never	6	1	1	8
Total		96	7	17	120

Table 3.2.4 (a): Table shows the profile of consumer preference for eco-friendly bags over plastic bags – Cross-Tabulation.

The table above shows that only 31% of the customers prefer eco-friendly bags over plastic bags. Majority of the customers often carry cloth bags with them when they go shopping. The independent sample is ‘Do you prefer eco-friendly bags over other bags and the dependent sample is ‘How often do you take cloth bags with you when you go shopping?’

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.651 ^a	6	.070
Likelihood Ratio	15.272	6	.018
Linear-by-Linear Association	6.567	1	.010
N of Valid Cases	120		

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .47.

Table 3.2.4 (b): Shows the Chi-Square test of the relationship between consumer preference for eco-friendly bags over plastic bags.

The data analysis used to verify the relationship between the customer preference for eco-friendly bags over plastic bags is Chi-square. In the Table 3.2.4 shows that there is no positive relationship between customer preference for eco-friendly bags over plastic bags. This is because the p value should be less than 0.05 for the null hypothesis to be rejected. This means that there is no positive relationship between the customer preference for eco-friendly bags over plastic bags.

CHAPTER FOUR
SUMMARY OF FINDINGS, SUGGESTIONS AND CONCLUSION

4.1 LIST OF FINDINGS

- i. Table 3.1 shows the demographic details of the respondents. These include the age, gender, occupation and monthly income of the respondents. There was a total of 120 respondents.
- ii. Table 3.1(a) shows the bar graph that evaluates the customer satisfaction of eco-friendly bags in terms of cost, quality, comfort and durability. The graph shows that majority of the respondents (62%) were satisfied with the quality provided by eco-friendly bags.
- iii. Table 3.1(b) shows the pie chart that indicates how often the customers find eco-friendly bags difficult to manage in daily life and majority, ie., 40.8% of the respondents found it difficult to manage only occasionally.
- iv. Table 3.1(c) shows the pie chart that indicates how likely the respondents are to find ways to reuse the eco-friendly bags and majority, ie., 36.7% of the respondents found it possible to reuse the bags in many ways.
- v. Table 3.2.1.1 (a) and (b) shows the positive relationship between the customer preference for eco-friendly bags and their satisfaction based on comfort. The null hypothesis for this relationship was rejected. It means there is a positive relationship between the customer preference and their satisfaction based on comfort of eco-friendly bags.
- vi. Table 3.2.1.2 (a) and (b) shows the positive relationship between the customer preference for eco-friendly bags and their satisfaction based on sustainability. The null hypothesis for this relationship was rejected. This means that there is a positive relationship between the customer preference for eco-friendly bags and their satisfaction for the sustainability of the eco bags.
- vii. Table 3.2.1.3 (a) and (b) shows the positive relationship between the customer preference for eco-friendly bags and their satisfaction based on longevity. The null hypothesis for this relationship was rejected. This means that there is a positive relationship between the customer preference for eco-friendly bags and their satisfaction for the longevity of the eco bags.
- viii. Table 3.2.1.4 (a) and (b) shows the positive relationship between the customer preference for eco-friendly bags and their satisfaction based on multi-purpose. The null hypothesis for this relationship was rejected. This means that there is a positive relationship between the customer preference for eco-friendly bags and their satisfaction for the multi-purpose use of the eco-friendly bags.
- ix. Table 3.2.2 (a) and (b) shows a positive relationship between the customer knowledge towards environmental concerns and customer attitudes towards eco-friendly bags. The null hypothesis for this relationship was rejected, which means that there is a positive relationship between the customer knowledge towards environmental concerns and customer attitudes towards eco-friendly bags.

- x. Table 3.2.3 (a) and (b) shows that there is no positive relationship between customer attitudes and their purchase intentions towards eco-friendly bags. Here, the null hypothesis was not rejected, which means that there is no positive relationship between the customer attitudes and their purchase intentions towards eco-friendly bags.
- xi. Table 3.2.4 (a) and (b) shows that there is no positive relationship between the customer preference for eco-friendly bags over plastic bags. The null hypothesis for this relationship was not rejected, which means that there is no positive relationship between the customer preference for eco-friendly bags over plastic bags.

4.2 SUGGESTIONS

- i. The study was conducted only in Kerala and the sampling used was convenience sampling. Future studies must take into research a larger scale of respondents and respondents of other geographical areas to reach more varied findings.
- ii. Future studies should also take a larger sample size and can focus on various dimensions to help explain the concepts better.
- iii. The variables adopted for the research are limited. More factors must be considered to find get varied results.
- iv. Since this research focuses only on eco-friendly bags, the results have been limited. Other green product categories can also be focused while doing the research.
- v. Producers must identify the target market by psychographic segmentation and taking right strategies and implementing those at right time.
- vi. Government should encourage current businesses to sell eco-friendly shopping bags and reduce the impact of plastic bags on the environment.
- vii. Government can help entrepreneurs to make a linkage with potential customers or the future generations. For this purpose, they can arrange exhibitions at schools and colleges, and seminars/workshops on the environmental benefits of eco-friendly bags and products. The government can also make a documentary or short – film on the environmental benefits of eco-friendly bags. Finally, they can also broadcast these records through print and electronic media.
- viii. Particularly, government should encourage all government, semi-government, autonomous organizations and institutions to be corporate customers of eco-friendly bags. It is a large market in the domestic market. All offices use seminar bags, gift items, decorative and stationary items, so they can easily buy and use green products in replace of artificial or plastic bags or gifts. Recently, many governments and corporates are using jute made green products.

4.3 CONCLUSION

In conclusion, this study has examined the purchase intentions of customers and their preference for eco-friendly bags. The customers satisfaction levels of the eco-friendly bags and their knowledge on environmental concerns. The finds demonstrated that the environmental knowledge and environmental concerns have a positive relationship with the customer attitudes. Purchasing eco-products are becoming an imperative to keep the planet alive and support people to sustain. Researchers have found that using eco-friendly bags and products can help in reducing climate change threats in the globe. Right now, customers are willing to pay more price for the products which are environment friendly like eco-friendly shopping bags.

Customers prefer eco-friendly products with quality. Marketers must focus on marketing high quality eco-friendly bags and products that satisfy customer needs and wants. Customer perception and attitudes need to be considered while manufacturing eco-friendly products that fulfil customer needs and also provide profits for the company.

Consumer attitudes also have a positive relationship with purchasing intentions towards eco-friendly bags. This paper has therefore highlighted and unveiled the relationships and made several important contributions to literature. Moreover, the data collected for the study support the research model and all the four hypotheses formulated. Consequently, the study's findings have provided worthy insights to stakeholders concerned.

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ANNEXURE

QUESTIONNAIRE

1. Age* (Mark only one circle)

- Below 18
- 18 – 25
- 26 – 30
- 30 above

2. Gender* (Mark only one circle)

- Female
- Male
- Prefer not to say

3. Occupation* (Mark only one circle)

- Student
- Working
- Unemployed
- Retired

4. Monthly Income level (If applicable, Mark only one circle)

- 10000 – 40000
- 50000 – 90000
- Above 100000

5. How likely do you think sustainable eco friendly bags have a positive influence on the environment? * (Mark only one circle)

- Very likely
- Likely
- Neutral
- Not likely
- Least likely

6. How important do you think eco-friendly bags are? * (Mark only one circle)

- Very important
- Important
- Neutral
- Not important
- Least important

7. How often do you take cloth bags with you when you go shopping? * (Mark only one circle)

- Always
- Often
- Occasionally
- Never

8. Do you prefer eco-friendly bags over other bags? * (Mark only one circle)

- Yes
- No
- Maybe

9. Express your satisfaction for eco-friendly bags over plastic bags in terms of: * (Tick the suitable box)

	Highly Satisfied	Satisfied	Neutral	Not Satisfied	Least Satisfied
Comfort					
Sustainability					
Longevity					
Multi-purpose					

10. Evaluate eco-friendly bags in terms of the following factors: * (Mark only one circle)

	Highly Satisfied	Satisfied	Neutral	Not Satisfied	Least Satisfied
Cost					
Quality					
Comfort					
Durability					

11. How often do you find eco-friendly bags difficult to manage in your daily life? * (Mark only one circle)

- Always
- Often
- Occasionally
- Never

12. How likely are you to find ways to reuse the bags? * (Mark only one circle)

- Very likely
- Likely
- Neutral
- Not likely
- Least likely

13. How likely are you to shop from a company that use eco-friendly bags over plastic bags?

- Very likely
- Likely
- Not likely
- Least likely

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एवं अनुसंधान संस्थान



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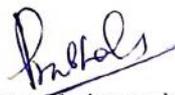
CERTIFICATE

This is to certify that this dissertation entitled “**Extraction and partial purification of β -amylase from sweet potato**” is a bonafide record of independent work carried out by Ms. **Alphine Thomas (Reg No: VM20FPT003)** M.Voc Food processing technology, St. Teresa’s College, Ernakulam during three month project work under the guidance and supervision of **Dr. Prabhakumari.C** of this Institute. It is further certified that she has independently reviewed the literature, performed all the tests, analyzed the results and critically discussed the findings in presented data.

This is in partial fulfillment of the requirements for the M.Voc Food processing technology of M.G University.

25-07.2022
Kollam




(Dr. Prabhakumari C.)
Dy. Principal Scientist

Dr. G. PRABHAKUMARI
Deputy Principal Scientist

Established by:



Accreditations & Approvals

- NABL as per ISO/IEC 17025 : 2017 in the fields of Chemical and Biological Testing (TC-6088)
- Bureau of Indian Standards (BIS) for Packaged Drinking Water Testing ● FSSAI notified Laboratory

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