

# **PROJECT REPORT**

## **A STUDY TO ASSESS THE ASSOCIATION BETWEEN PERCEIVED PATERNAL PARENTING STYLE AND RESILIENCE AMONG YOUNG ADULTS**

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## CERTIFICATE

This is to certify that the project report entitled, "A STUDY TO ASSESS THE ASSOCIATION BETWEEN PERCEIVED PATERNAL PARENTING STYLE AND RESILIENCE AMONG YOUNG ADULTS", is a bonafide record submitted by Ms. MADHURI RAJKUMAR, Reg.no. SB19PSY020, in partial fulfillment for the award of the Degree of Bachelor of Psychology during the academic year 2019-2022.



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## DECLARATION

I, MADHURI RAJKUMAR, hereby declare that the study presented in the dissertation entitled, "A STUDY TO ASSESS THE ASSOCIATION BETWEEN PERCEIVED PATERNAL PARENTING STYLE AND RESILIENCE AMONG YOUNG ADULTS", which is submitted to the Department of Psychology, St. Teresa's College, Ernakulam is a bonafide record of the research work carried out by us, under the supervision and guidance of Ms. Vishnupriya V, 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.

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## **ABSTRACT**

**Project Title: A STUDY TO ASSESS THE ASSOCIATION BETWEEN PERCEIVED PATERNAL PARENTING STYLE AND RESILIENCE AMONG YOUNG ADULTS**

**Research Focus: YOUNG ADULTS IN AN INDIAN POPULATION**

Although several studies have been done on the maternal influence on the child's ego-resilience, there is very little literature on the role of the father in the psychological development of the child. Parenting styles have a significant influence on the child's ability to react to various situations as they grow up. Baumrind (1970) identifies five different parental styles, namely, the authoritarian, the permissive, the authoritative, the traditional and the neglectful, based on two dimensions---parental demandingness and parental responsiveness. Three of these styles (authoritative, authoritarian and permissive) were chosen for the purpose of this study. In order to measure D. Baumrind's parental authority prototypes, we used the Parental Authority Questionnaire, a 30-item-per-parent questionnaire with scores derived from the children's phenomenological appraisal of their parents' authority style. The Brief Resilience Scale measures resilience in its original and most basic meaning: the ability to bounce back from difficult situations (Agnes, 2005). It consists of 6 items and is self-report in nature. Data collection was performed through a questionnaire combining the 2 measures on a random sample of 200 participants between ages 18 to 35. The Chi-Square test, Spearman's Correlation method and Mann-Whitney U-test were used to for statistical analysis. Results reveal no significant association between paternal parenting style and resilience at 0.05 level of significance

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**CHAPTER I**  
**INTRODUCTION**

## **INTRODUCTION**

Parental behavior is one of the primary external factors that determine the status of the child's mental health through adolescence and adulthood. In fact, positive parental behaviour has been shown to correlate positively with the child's mental health (Roosa, Wolchik and Sandler, 1997) and contribute significantly to the self-esteem of the growing individual. Beyond simply being a positive influence, the style of parenting, which is the set of attitudes and beliefs used in parenting, also affects the child's psychological and behavioral adjustment in life. The aim of our study is to understand whether parenting styles, specifically the father's, is a predictor of resilience in children. Mothers and fathers play different roles in the development of a child; traditionally, mothers are more involved in the daily lives of the child, while fathers provide material support and play a role in influencing the child's gender role. Nowadays, both parents share more or less equal roles in parenting. Paternal involvement in the child's life is associated with their healthy development. In this study, we focus on resilience as an important outcome of an individual's relationship with their fathers. Resilience is the process of, capacity for, or outcome of, successful adaptation despite challenging or threatening circumstances (Sandler, Wolchik, Mackinnon, Ayers and Roosa 1997).

### **1.1 BACKGROUND OF THE STUDY**

As psychology students, we study human behavior and cognitive function, in particular, personality. The personality of an individual is a unique combination of qualities and characteristics that differentiates one individual from another. One particular trait can have an influence over multiple others and one such trait is 'resilience', the ability to bounce back from adversities. This encompasses attributes like self-compassion, emotional awareness and regulation, survivor mentality and so on. There are numerous ways in which this trait develops in a person, however, the root lies in social support and the primary source is the parents and the kind of bond and support extended on their part. This brought us to parenting styles. The practice of parenting a child is viewed differently by individuals and has changed

significantly over time. Nowadays, there is much importance given to the kind of parenting engaged in, in order to create a strong and healthy future for our society.

It is undeniable that both parents have a significant impact on the child, whether or not they chose to be involved. However, most of the burden of child-raising is placed on the mother. Whether a child is successful or not, it is the mother's parenting style and capabilities that get questioned. The father's role is limited to being the breadwinner. Hence, when given an opportunity to do research as part of our degree, we decided to focus on the impact of paternal parenting on the development of a crucial part of personality, the resilience of an individual (Kathy Watson, 2006). Even while going through literature on the topic, there were very limited information available on the role of a father in building the resilience of the child.

## **1.2 PROBLEM STATEMENT**

To understand whether resilience is associated with paternal parenting style among young adults between ages 18 to 35.

## **1.3 NEED AND SIGNIFICANCE OF THE STUDY**

Difficulties and setbacks are fundamental to life. It allows an individual to gain insight, understand themselves, others, and their surroundings and is an integral part of learning and growing as a person. Changes in the modern era have aimed to make life comfortable but the number of people stressed and burned out is drastically higher than those in the past. In such a situation, there need to be much effort put into preparing a person to face these stressors of life. This basic quality of being able to maintain peace with oneself and others in the face of hurdles and finding a way out of it is what is termed 'resilience'. This particular trait is not innate. It is the result of various biological, social and other protective factors. One of the most significant factors is parenting. Parents differ drastically in their views on parenting a child and this is reflected in their style of parenting. There are said to be five different parenting styles but this is condensed to three. One needs to identify the best kind of parenting style so that there will be more awareness for people everywhere. The amount of materialistic goods that can be given to make a child's life better is bounded and often has

limited impact. However, qualities like resilience that lasts throughout one's life equips them to face their life and the problems that come with it.

#### **1.4 SCOPE OF THE STUDY**

The current study examines how paternal parenting style is a successful predictor of resilience in participants. Positive parental behavior has proven to positively correlate with a child's mental health (Roosa, Wolchik and Sandler, 1997). The aims and beliefs with which a parent raises their child, also known as parenting style, has a significant impact on the child's psychological adjustment and well-being. According to Diana Baumrind (1971), there are five parenting styles, however, for the purpose of this study we will be looking at three--- authoritarian, authoritative and permissive. The father plays a significant role as the main contributor to the child's sense of security and as a provider of material support. They also influence the child's perception of their gender identity. The study aims to understand the role a father's parenting style, as perceived by the participants, plays on the development of resilience, which is the process of, capacity for, or outcome of, successful adaptation despite challenging or threatening circumstances (Sandler, Wolchik, Mackinnon, Ayers and Roosa 1997). In our study, we examine resilience as the ability to bounce back from stressful situations.

We employ a 36-item questionnaire, which includes the Parental Authority Scale and the Brief Resilience Scale, to 200 participants ranging from 18 to 35 years of age. Our primary data collection is through snowball sampling via a Google form. The cross-sectional study will continue till we have enough data to make inferences about the relationship between perceived paternal parenting style and resilience.

Through the study, we have the opportunity to investigate the literature done by various researchers on the role of parents in the development of various personal characteristics of the child such as resilience and coping. Our research will give us a better understanding of the current trend of parenting among young adults---traditionally, Indian parents were stereotyped as 'authoritarians'; however, there have been changes to this perception as a result of modern parenting where both parents play a complementary role in child-rearing. We will explore the need for a more rational and positive style of parenting for the psychological adjustment of the child as well as whether gender will play a role on the impact

of these parenting styles on the child. Finally, our study provides a theoretical framework to educate parents and guide them to reflect on and critique their own parenting styles and focus on practical applications of positive parenting to improve their child's resilience and well-being.

## **1.5 OBJECTIVES OF THE STUDY**

- To understand the relationship between resilience and paternal parenting style
- To find out whether resilience is dependent on paternal parenting style.
- To explore whether resilience is different between males and females in the study.

## **1.6 LIMITATIONS OF THE STUDY**

Our study has some limitations within which our findings need to be interpreted carefully. Some limitations of the study are mentioned below.

1. Firstly, the results of this study may not be completely generalizable as the sample was restricted to 200 participants and this may affect the understanding of significant relationships in the data.
2. Secondly, there is a lack of previous research studies on our research objectives and therefore, very little theoretical foundation to the exploration of our hypothesis.
3. Thirdly, since our primary data collection mode is through a Google form, in an uncontrolled setting, participants may not sincerely answer all the questions due to factors like time constraints, fatigue, boredom, etc., or give accurate responses that reflect their perceptions of the variables in the study.
4. Finally, as the results are specific to an Indian population, this study does not apply to other cultural settings nor investigate their impact on the variables.

Studies examining the role of the father's involvement in the child's mental health are plenty; but our study aims to zero in on two specific variables, through our analysis of previous research---parenting style and resilience. To achieve our research objectives, we have made our questionnaire concise and viable with 36 items that are direct, easy to read and interesting to answer.

**CHAPTER II**  
**REVIEW OF LITERATURE**

## **REVIEW OF LITERATURE**

### **2.1 LITERATURE REVIEW**

#### Parenting Style

Parenting style is a constellation of parents' attitudes and behaviours toward children and an emotional climate in which the parent's behaviours are expressed (Darling and Setinberg, 1993). Xinwen Bi, Yiqun Yang, Hailei Li, Meiping Wang, Wenxin Zhang and Kirby Deater-Deckard (2018) investigated the associations between parenting styles and parent-adolescent relationship factors and explored whether adolescent gender moderated these factors.

According to results, for adolescent's expectation for behavioural autonomy, the main effect of parenting style was significant; adolescents of authoritative parents reported the lower level of expectation for behavioural autonomy compared to other parenting styles. In this study done by Farahnaz Mirzaei and Hasanali Kadivarzane (2013), a correlational and cross sectional analysis was done to investigate the relationship between parenting styles and hardiness in high school. It is well established in the psychological world that parents play a critical role in children's psychological and behavioural well-being. The parental climate in which a child grows up influences the way in which children mobilise their competencies to cope with difficult situations (Punamaki, Quota & El-Sarraj, 2001). According to the results of the correlational analysis, there is a negative and significant relationship between hardiness and parenting style, i.e. as hardiness increases, parenting style is reduced. However, another finding of this research is that hardiness has a positive correlation with authoritarian parenting style. Several studies have shown that attention from parents and positive parenting reduces adolescents' problem behaviours such as delinquency and substance abuse. This study also highlights the importance of congruent parenting of both parents for the child's internal development. A confounding variable may be the degree of mothers' participation and equal parenting, which needs to be investigated further.

The research was done by Samiullah Sarwar (2016) published in the Journal of Education and Educational Development determined the influence of parents and their parenting styles. The analysis of the literature reveals that the authoritarian parenting style is more appropriate for young children to prevent them from delinquency since such parents focus on limiting the child's autonomy along with the parent-child relationship. Natasha Kritzas and Adelene Ann Grobler (2005) investigated the relationship between perceived parenting styles and resilience in adolescence. Adolescence is a particularly stressful period of development where developmental changes related to coping occur against various types of stressors. The research indicated a significant negative correlation between a mother's and a father's authoritative style and dysfunctional coping strategies in female and male adolescents. The study also confirmed the findings that positive parenting behaviour is an external factor that correlates positively with the adolescent's resilience. Derya Sari Cenk and Ayhan Demir (2015) investigated the optimism levels of Turkish adolescents aged between 14 and 18 and their relation with parenting style, gender and academic achievement. According to the results of the current study, a parent's warmth, acceptance and supportiveness is more effective on a child's optimism level than strict control, coercion or complete permissiveness.

Larry A. Hjelle, Elizabeth A. Busch and John E. Warren (1996) explored the relationship between two cognitive personality constructs---explanatory style and dispositional optimism--and self-reported maternal and paternal parenting behaviour. The results of the self-report experiment showed that dispositional pessimism was associated with self-reports of mothers as having been hostile, neglectful, and rejecting. P Manzeske and Anne Dopkins Stright (2009) examined the relations between maternal parenting styles and young adults' emotional regulation with participants from a large Midwestern university. Results showed that for highly warm and behaviourally controlling, and averagely psychologically controlling mothers, their children had moderate emotional regulation; maternal behavioral and psychological control and young adult emotion regulation were negatively correlated. Sahitya, S. M. Manohari and Raman Vijaya (2019) investigated the association between parenting styles and children's development in India. The study conducted by Masayo Uji, Ayuko Sakamoto, Keiichiro Adachi and Toshinori Kitamura (2013) investigated the validity and reliability of the Japanese version of the Parental Authority Questionnaire (PAQ) and examine whether children's later mental health is influenced by the way parental authority is exercised. The results of the study confirmed the three-factor structure of the J-PAQ. Maternal authoritative parenting decreased risk to self and others. The results of the study

confirmed the three-factor structure of the J-PAQ. Maternal authoritative parenting decreased risk to self and others. The results of the experiment show that Baumrind's authoritative parenting style could negatively predict early maladaptive schemas in the area of rejection or disconnection; authoritarian parenting style was found to be a good predictor of schemas in the areas of other-direction and rejection/disconnection. The study conducted by Nancy Eisenberg, Lei Chang, Yue Ma and Xiaouri Huang (2009) examined the relations of authoritative parenting and corporal punishment to Chinese first and second graders' effortful control (EC), impulsivity, ego resilience, and maladjustment, as well as mediating relations. The results of the study show that the relationship between the variables is similar in the US and in China, e.g. the relation of parenting to children's ego resilience was mediated by EC (effortful control) and/or impulsivity, and ego resilience mediated the relations of EC and impulsivity to internalizing problems.

### Resilience

Mary Karapetian Alvord and Judy Johnson Grados (2005) wrote on *Enhancing Resilience in Children: A Proactive Approach*. There is still much debate as to what behaviour accounts for the term resilience. Some of the most important contributing factors includes the nature of individuals, families and culture. There exist protective factors that help people deal more effectively with stressful events and mitigate risks in families and communities. Individuals high in resilience are most likely those who take an active part in overcoming difficulties. Such individuals also have the ability to adapt quickly according to the situation. The Alvord-Baker social skills group model uses the protective factors and provides a practical, proactive, cognitive-behavioural approach to enhance resilience in children. These procedures can be introduced by clinicians, along with the active participation of the children and their parents, resulting in an integrated approach that helps develop and enhance resilience. The progress made in this kind of study needs to be periodically revised due to the dynamic nature of the environmental and individual factors.

Odin Hjemdal, Patrick A. Vogel, Stian Solem, Kristen Hagen and Tore C. Stiles (2010) conducted a study on *The Relationship between Resilience and Levels of Anxiety, Depression, and Obsessive-Compulsive Symptoms in Adolescents*. Mental disorders are likely to be caused by multiple risk factors and processes rather than singular causes. Thus,

the identification of a causal risk factor will contribute to elucidating only one aspect of a more complex matrix of causes. Condition like Obsessive Compulsive Disorder stands out from the usual emotional disorders due to the absence of a clear antecedent. Depressive and anxiety symptoms on the other hand are related to internalizing problems. The results from the current study illustrates how a measure of resilience may facilitate understanding of the relation between level of psychopathological symptoms and protective factors. The presence of protective factors such as the availability of sources of social support outside the family, as well as perceived levels of family cohesion, etc. is associated with lower levels of stress and psychiatric symptoms. For the total resilience score, there were no gender differences, but there were, however, it did exist for three of the subscales of resilience.

Linda C. Theron and David R. Donald (2011) elaborated on educational psychology and developing context (A rejoinder to Toland and Cardigan). The resilience theory argues that it's not the nature of adversity that is most important, rather how we deal with it. The works of Tolland, Carrigan and more has brought light to the fact that resilience is rooted in complex and dynamic processes. This includes 'basic human adaptational systems' (Masten 2001). It could include numerous systems like intelligence, self- regulation, attachment, meaning- making, etc, depending not only on the individual factors but also environmental factors such as the social context. This implies that it is not only the child as an individual entity that is at fault when resilience isn't achieved but also the social factors like the school, teachers, family, culture etc. that leads to the issue. Hence, educational psychologists are urged to focus more on the 'social ecology of resilience'. Bullying refers to aggressive goal-directed behaviour that harms another individual within the context of a power imbalance. It takes various forms such as name calling, hitting, isolation, spreading humiliating rumours and sending insulting messages by phone. Maria Sapounaa and Dieter Wolke studied (2013) explored Resilience to bullying victimization: The role of individual, family and peer characteristics. The influence of family relationships on the long- term outcome of student bully victims has only been studied recently. The current study revealed significant gender differences emerged for depression, delinquency, emotional and behavioural resilience, self-esteem, sibling victimization and parental conflict. Results indicated that adolescents who experienced no or low levels of conflict with their parents were more likely to report low levels of depression and delinquency following bullying victimization.

There are many views that define resilience but the most accepted one is that resilience is not a personal or innate characteristics, rather a process revealed as a result of interaction of several factors in case of one's experiences in difficulty. Various factors associated with this quality includes family, school and the environment where the individual lives. Emine Erdogana , Oznur Ozdoganb and Mehmet Erdogan (2014) devised the following study- University Students' Resilience Level: The Effect of Gender and Faculty- to assess university students resilience level and to reveal the association of this level with faculty type and gender. Overall, it was found that the effect of faculty type on resilience was not significant. But faculty affect was only significant for the subs-scale of leadership in favour of the students in the faculty of education. On the other hand, the effect of gender on resilience was statistically significant in favour of male students. Elham Atighi , Atefeh Atighi and Iman Atighi (2015) explored on the resilience of adolescent girls based on parenting styles. A resilient person can effectively deal with adversities, be it mental, emotional or physical, and quickly return to pre- crisis state. This is key to the understanding of other psychological factors like motivation and emotions. It is a quality of much significance especially during adolescence, a period of much turmoil. Family setting and parenting styles exerts a great influence on the development of reliance in children. The present study takes a correlative-descriptive approach. It was concluded that there is a significant and positive relation between resiliency and authoritative parenting style. The authoritative parenting style involves setting reasonable expectations of the child while also listening to the child, showing kindness and friendliness, and encourages participation in family decision making. This kind of parenting style is considered most effective. The strictness and authority shown are usually judged as appropriate and requires even by the children. The adolescents learn to inhibit their behaviour by the healthy boundaries set by parents, not falling into the influence of peers. Additionally, authoritative parenting style has been found to have a negative relation with personality disorders. Nicholas A. Livingston, Nicholas C. Heck, Annesa Flentje, Hillary Gleason, Kathryn M. Oost, and Bryan N. Cochran (2015) investigated on Sexual Minority Stress and Suicide Risk: Identifying Resilience through Personality Profile Analysis. A sexual minority is a group whose sexual identity, orientation or practices differ from the majority of the surrounding society. Suicide is the third leading cause of death among adolescents and young adults within the United States, with the sexual minority being much more susceptible. This is linked to the experience of stressors like victimization, concealment, etc. this leads to psychological and behavioural mechanisms, such as social

isolation, emotion regulation (e.g., coping, rumination), and cognitive processes (e.g., hopelessness, pessimism). This strengthens the relation between minority stressors and negative outcomes. Sexual minority-based victimization is emphasized in the current study. The results indicated that individuals of sexual minority identified as possessing an adaptive personality profile were more resilient in the face of victimization as it relates to the likelihood of attempting suicide. It was also demonstrated that resilience (e.g., flexibility and social aptitude) among the younger population is associated with lower neuroticism and higher agreeableness, conscientiousness, extraversion, and openness to experience.

Adolescence is referred to as a difficult or a crucial stage because it is a stage of transformation, both in physical and psychological development. The teenagers are required to overcome multiple transformations so a vital trait during this time is Resilience or the ability to bounce back during or after difficult times. This enables them to manage and learn from experiences. Empathy is a quality that undergoes extensive development during this period. It teaches them to reflect, observe and think about their own behaviour which enables them to appreciate the feelings of others. Seema Vinayak and Jotika Judge (2018) investigated on how Resilience and Empathy are Predictors of Psychological Wellbeing among Adolescents. One of the objectives of the current study was to find the relationship between resilience, empathy and psychological well-being. It was observed that empathy and resilience showed a positive relation to psychological wellness whereas, resilience and empathy have the higher correlation as compared to their correlations with psychological well-being. Additionally, gender differences were found on resilience and empathy while no gender difference exists on psychological well- being.

The presence of a chronic illness is known to be extremely stressful, not just for the patient, but also the people surrounding the individual, especially the family. One study by Maria Calpes, Anne Marie Martin, Caroline Dalton, Lynne Maresh, Eileen Savage, George Knafl and Marcia Van Riper (2018) examined adaptation and resilience in families of individuals with down syndrome living in Ireland. This condition is a genetic disorder characterised intellectual disability, loss of cognitive functions and distinct physical anomalies. Results indicated that such families can attain resilience. There were several crucial factors associated with the development. These included things like effective communication, family hardiness, etc. With timely interventions, these families could lead a productive life. Resilience refers to the ability

to bounce back from adversity or any sort of negative emotional experience. Optimism is the belief that the future holds positive outcomes. It contributes to resilience and is key to how individuals adapt to stressful events. When confronting challenges, optimists show more resilience, even if progress is difficult and slow. There is a reciprocal relationship between these two, i.e., optimism leads to resilience and resilience results in more optimism.

### Resilience and Parenting Style

The interaction between a child and his family plays a significant role in the development of various aspects of personality. More importantly, the child's perception of the family member's behaviour and actions played a significant role in various aspects of their behaviour. Jiwon Cho, Jung Hee Ha and Juliet Jue (2020) explored on the difference between mother's and children's perception of parenting style and its influence. It was observed that the mothers perceived themselves to be more rational and affectionate than did the child. Mothers of these children had significantly higher rates of depression and low resilience. The study conducted by Hamidreza Zakeri, Bahram Jowkar, and Maryam Razmjooe (2010) investigated the relationship between parenting styles and resilience on 350 college students. The results of the present study showed there was a positive and significant correlation between acceptance-involvement parenting style and resilience. Kathryn E. Williams, Joseph Ciarrochi, Patrick C. L. Heaven (2012) examined the longitudinal relationships between perceived parenting style and psychological flexibility among students in a self-report manner. The study also showed that mother and father variables did not differ in how they predicted psychological flexibility. A study by Elhalm Atighi, Atefeh Atighi and Iman Atighi (2015) looked into predicting psychological resilience in girls based on the parenting styles used. Resiliency is an especially important factor when it comes to maintaining a proper balance in the face of stressful circumstances. Family plays a critical role in the development of resilience in each child. Research showed positive correlation between parenting style and resilience in both authoritative and authoritarian parenting style but an inverse relation for permissive parenting style.

## **2.2 RESEARCH GAP**

The current study uses chi-square test and correlative technique, both of which are used to check for the existence of an association between the two variables. Personality traits like resilience are known to be influenced by multiple other extraneous factors like environmental

experiences. Personal qualities like the need for acceptance, the closeness of the child to parents, family cohesiveness, etc. can affect the outcome. Previous research has not tried to understand how these variables may relate to an Indian population, where there is may be cultural factors affecting the relationship between the themes under study. There is also very little research on paternal parenting style as opposed to maternal parenting style and their impact on the psychological well-being and resilience of the child.

The study focuses exclusively on the effect of perceived paternal parenting style on the resilience of a child. It is not possible to predict which parent plays a greater role in the development of a child, in the current context.

**CHAPTER III**  
**THEORETICAL FRAMEWORK**

## **THEORETICAL FRAMEWORK**

Through this study we will be investigating the impact of Baumrind's parenting styles on the emotional resiliency among young adults between the ages 18 and 35. The aims and beliefs with which a parent raises their child, also known as parenting style, has a significant impact on the child's psychological adjustment and well-being. According to Baumrind (1971), there are three types of parenting styles----an authoritarian parent is low in responsiveness and high in demandingness – is disciplinarian, strict and limits the child's autonomy, a permissive parent is high in responsiveness and high in demandingness – imposes no rules and regulations on their child's behaviour, while an authoritative parent is demanding but also equally receptive to the child's needs. Resilience is examined not just as the ability to recover from illness, but as the ability to bounce back from difficult situations. We employ a 36-item questionnaire, which includes the Parental Authority Scale and the Brief Resilience Scale, to 200 participants ranging from 16 to 50 years of age. Our primary data collection is through snowball sampling via a Google form. The cross-sectional study will continue till we have enough data to make inferences about the correlational relationship between perceived paternal parenting style and resilience.

### **3.1 PARENTING STYLES**

A parenting style is a psychological concept representing fixed strategies that parents use in raising their children. The quality of parenting can be more essential than the quantity of time spent with the child. For instance, the parent may be engaging in a different activity and not demonstrating enough interest in the child. Parenting styles are the representation of how parents respond to and make demands on their children. Parenting practices are specific behaviours, while parenting styles represent broader patterns of parenting practices. There are various theories and opinions on the best ways to rear children, as well as differing levels of

time and effort that parents are willing to invest. Parents' styles reflect attitudes toward discipline and parental responsibilities, as well as establish expectations for children. These are conveyed through parental body language, tone of voice, emotional displays, and quality of attention, in addition to the content of what parents say to their children and their overall behavior toward them. Tracing the conceptual development of parenting styles research, Darling and Steinberg (1993) suggest that parenting styles ought to be considered within the context of how parents' behaviors and practices impact child development. Such impact is a function of parents' values and socialization goals, their attitudes toward children, and their specific parenting practices. Although not typically described using the framework of parent-child relationships, clearly parenting styles have a direct impact on such relationships as illustrated by the following descriptions of parenting styles and their effects on child behavior.

According to Harari (2005), psychologists endorse the concept that parenting is an essential component in fostering children's growth and development. Parents are expected to offer responsible caregiving as well as be invested and committed throughout their children's lives (Baumrind & Thompson, 2002). According to Baumrind, parenting style can be seen varying along two orthogonal dimensions of demandingness and responsiveness. When crossed, these two dimensions yield four parenting styles:

- Authoritative - responsible and demanding
- Authoritarian - demanding but not responsive
- Permissive - responsive but not demanding
- Rejecting-neglecting - neither demanding nor responsive

Based on the review of the literature, authoritative parenting styles have been associated with many successful child developmental outcomes. Permissive and authoritarian parenting styles have not been found to have these same positive effects on child outcomes.

### **3.2 RESILIENCE**

The APA defines resilience as the process of adapting well in the face of trauma or tragedy, threats, or other significant sources of stress (Southwick et al., 2014). It is what people call 'bouncing back.

This does not mean that a resilient person doesn't feel the same level of emotion as any regular person. It simply means that they have the capacity to deal with problems more effectively and get back on time quicker than the average person, despite the troubles they go through. Problems are faced head-on.

There are several qualities that every resilient person has. These are:

1. Self-compassion- this refers to the sympathy and understanding one shows themselves. Although many might consider this as something common, this is something that is hard to see these days. Especially with the increasing use of social media, people find it easy to undermine themselves and their values. Constant comparison with unrealistic standards makes it harder to appreciate oneself.
2. Social support- resilient people understand the importance of having a social support group. This may be a small circle but the bond is very strong and more than enough to give them a feeling of security and belongingness, especially during the time of a crisis.
3. Effective emotional regulation- most people struggle to contain their emotions during stressful times. Resilient people also go through the same emotions but they possess the understanding that these feelings are only temporary and it will pass.
4. Feeling of control- individuals high in resilience have a strong locus of control. They act on the belief that it is their actions that will determine their future.
5. Problem-solving skills- a resilient person looks at problems in an objective manner, making sure they find rational solutions to deal with their issues. They rarely have emotional outbursts.
6. A survivor mentality - this frame of mind empowers an individual, making them focus on surviving a dreaded situation rather than becoming a victim. Our resilience changes over time and with the situation. It is often various situations that shape it. There will be instances in which individuals feel like they are the only ones being left behind and other times when people manage to surprise themselves with how well they manage a difficult situation. There are various kinds of resilience a person requires while dealing with stressors. These include:
  - Physical resilience- refers to how effectively the body can adapt to changes and also includes its ability to heal from injuries, physical demands, etc. This is the easiest to build up for most people as it comes with a healthy lifestyle.

- Emotional resilience- involves the ability to regulate one's emotions at a stressful time. It is quite difficult to maintain one's peace at a stressful time. A person high in this finds it possible to maintain an optimistic view of life. They are aware of their innermost thoughts and feelings and hence find it easy to predict and control the flow of emotions.
- Mental resilience- refers to the capacity to understand uncertain situations and adapt quickly to change. They use logic to make sense of their situation and use isn't hesitant to seek help If required.
- Social/ community resilience - refers to the ability of a group to recover from stressful situations. This includes the ability to seek and provide assistance for those in need. For instance, when a community comes together to restore houses and previous living conditions after a tornado strikes.

### **3.3 THEORIES**

#### Diana Baumrind's Parenting Styles:

In her research, Diana Baumrind found what she considered to be the four basic elements that could help shape successful parenting: responsiveness vs. unresponsiveness and demanding vs. undemanding. Parental responsiveness refers to the degree to which the parent responds to the child's needs in a supportive and accepting manner. Parental demandingness refers to the rules which the parent has in place for their child's behaviour, the expectations for their children to comply with these rules, and the level of repercussions that follow if those rules are broken. Through her studies Baumrind identified three initial parenting styles: authoritative parenting, authoritarian parenting and permissive parenting. Maccoby and Martin expanded upon Baumrind's three original parenting styles by placing parenting styles into two distinct categories: demanding and undemanding.

#### Bowlby's Attachment theory:

Attachment is the strong, affectionate tie we have with special people in our lives that leads us to experience pleasure and joy when we interact with them and to be comforted by their

nearness in times of stress. According to Bowlby, the infant's relationship with the parent begins as a set of innate signals that call the adult to the baby's side. Over time, a true affectionate bond forms, supported by new emotional and cognitive capacities as well as by a history of warm, sensitive care. Attachment develops in four phases: pre-attachment, attachment-in-the-making, clear-cut attachment and formation of a reciprocal relationship. There are four main types of attachment: secure, insecure, resistant, and disorganized.

#### Dr Norman Garmezy's Resilience Theory:

Garmezy defines resilience as a function that reflects the capacity to recover and maintain adaptive behavior that may follow initial retreat or incapacity upon initiating a stressful event. He discards the earlier held view that considered resilience a quality that made individuals resistant to the effect of stress. He also insisted that the presence of resilience didn't imply that someone is superior to another.

Various factors were said to play a role in the development of this trait. The key factors include: Individual factors- the overall personality and temperament of an individual determines the resilience shown in the face of adversity. The unique blend of traits such as optimism, problem-solving skills, objectivity, etc, determines how well one is equipped to face challenges.

- Familial factors- includes the level of cohesion, support, love, and understanding shown among family members.
- Support factors- includes support given to an individual, outside his/ her family. This commonly includes friends, teachers, coaches, religious groups, etc.

#### Michael Rutter Theory:

Rutter defined resilience as, "An interactive concept that is concerned with the combination of serious risk experiences and a relatively positive psychological outcome despite those experiences". According to this view, it is not simply the psychological factors that determine a person's ability to cope with the challenges of life, rather it is the availability of resources needed to overcome a particular situation. An individual cannot be resilient while facing different types of problems. People have the tools to adapt to some situations and not others. Resilience is determined by the nature of a crisis and the resources possessed.

**CHAPTER IV**  
**RESEARCH AND METHODOLOGY**

## **RESEARCH AND METHODOLOGY**

A research methodology involves specific techniques adopted in the research process to collect, organize and evaluate data. It is used to verify a theory and test its application along a specific set of academic standards. It describes the tools and measures used to gather data for the topic under study.

This chapter provides a description of the objectives of the study, the hypothesis, the research design, sources of data collection, method of data collection, sample size and data analysis method.

### **4.1 OBJECTIVES**

- The main objectives of the study are to find the relationship between perceived paternal parenting style and resilience among young adults, and understand whether resilience is dependent on paternal parenting style.
- The secondary objective is to investigate whether resilience is distributed differently between males and females in the study.

### **4.2 HYPOTHESIS**

1. Resilience is dependent of Paternal Parenting Style
2. There is a relationship between Paternal Parenting Style and Resilience among the participants
3. There is a significant difference in gender between males and females

### **4.3 RESEARCH DESIGN**

The research design used in this study is descriptive and correlational research, which is a type of non-experimental research method where a researcher observes two/more variables in order to understand the relationship between them without any influence from extraneous variables. However, it does not test the cause-effect relationship between the variables. It is ideal for gathering data quickly and generalizing the findings to real-life situations.

### **4.4 SOURCE OF DATA**

The data collected is primary in nature. The study procedure consisted of collecting data by the way of online survey.

### **4.5 SAMPLE DESIGN**

The sample under consideration covers 200 individuals in the age range 18-35.

### **4.6 SAMPLE SIZE**

A sample size of 200 young adults were chosen through non-probability convenient sampling from readily available population.

### **4.7 SAMPLING METHOD**

Convenience sampling method, which is a form of non-probability sampling method, focuses on collecting primary data from participants who are readily accessible to the researchers, i.e., researchers can subjectively select people at random who would be happy to participate in the research. The sample can be found anywhere---at malls, schools, online communities, etc. This is a useful technique for pilot testing and hypothesis generation, with its advantages being that it can speed up the research process and the researcher does not have to invest too many resources to collect the sample.

## **4.8 METHOD OF DATA COLLECTION**

For the purpose of our research, we created a Google form of our questionnaire, which was circulated to our target population who were conveniently accessed online. A sample of 200 participants including male and female were collected from young adults in the Indian population between ages 18 and 35. The sample was selected on the basis of the inclusion-exclusion criteria.

Inclusion criteria for the sample:

1. Individuals within the age and of 18 and 35
2. Individuals who are Indian in nationality
3. Individuals who have knowledge of English

Exclusion criteria for the sample:

1. Individuals above the age of 35 and below the age of 18.
2. Individuals outside of India
3. People with no knowledge of English

## **4.9 DRAFTING QUESTIONNAIRE**

The online survey included two parts: The Parental Authority Questionnaire and the Brief Resilience Scale.

Scales:

### Parental Authority Questionnaire (Parenting Style)

Baumrind (1971) proposed three distinct patterns of parental authority (permissiveness, authoritarianism, and authoritative) and measured these parenting styles through interviews with parents and their children and through observations of parents interacting with their children. Two forms of the questionnaire were constructed to evaluate the parental authority of mothers and of fathers, 30 items each. The results of these studies showed the PAQ to have highly respectable measures of reliability and validity. The PAQ should be useful for assessing the parental authority exercised by both mothers and fathers and it is appropriate for both females and males who are older adolescents or young adults. The PAQ

has three subscales: permissive (P: items 1, 6, 10, 13, 14, 17, 19, 21, 24 and 28), authoritarian (A: items 2, 3, 7, 9, 12, 16, 18, 25, 26 and 29), and authoritative/flexible (F: items 4, 5, 8, 11, 15, 20, 22, 23, 27, and 30). Mother and father forms of the assessment are identical except for references to gender. The PAQ is scored easily by summing the individual items to comprise the subscale scores. Scores on each subscale range from 10 to 50.

#### Brief Resilience Scale (Resilience)

The brief resilience scale (BRS) was created to assess the ability to bounce back or recover from stress. The 6 item scale was developed to assess a unitary construct of resilience, including both positively and negatively worded items. The possible score range on the BRS is from 1 (low resilience) to 5 (high resilience). Items 1, 3, and 5 are positively worded, and items 2, 4, and 6 are negatively worded. The BRS is scored by reverse coding items 2, 4, and 6 and finding the mean of the six items. To calculate the score, add the responses varying from 1-5 for all six items giving a range from 6-30---then divide the total sum by the total number of questions answered.

### **4.10 DATA ANALYSIS TECHNIQUE**

The data collected through the questionnaire was analysed using the IBM SPSS ver. 25.0. The Pearson's Chi-Square Test & Spearman's Correlation Coefficient was used to examine the association between paternal parenting style and resilience. The Chi-Square Test of Independence determines whether there is an association between categorical variables (i.e., whether the variables are independent or related). It is a nonparametric test. This test utilizes a contingency table to analyse the data. A contingency table (also known as a cross-tabulation, crosstab, or two-way table) is an arrangement in which data is classified according to two categorical variables. The categories for one variable appear in the rows, and the categories for the other variable appear in columns. Each variable must have two or more categories. Each cell reflects the total count of cases for a specific pair of categories. Additionally, the Chi-Square Test of Independence only assesses associations between categorical variables, and cannot provide any inferences about causation.

The Spearman rank-order correlation coefficient (Spearman's correlation, for short) is a nonparametric measure of the strength and direction of association that exists between two variables measured on at least an ordinal scale. The test is used for either ordinal variables or

for continuous data that has failed the assumptions necessary for conducting the Pearson's product-moment correlation. Your two variables should be measured on an ordinal, interval or ratio scale. A monotonic relationship exists when either the variables increase in value together, or as one variable value increases, the other variable value decreases. It is also worth noting that a Spearman's correlation can be used when your two variables are not normally distributed.

Finally, the Mann-Whitney U-Test was conducted to investigate the distribution of resilience across categories of gender. In statistics, the Mann-Whitney U test is a nonparametric test of the hypothesis that a variable is distributed equally over two categories of a 2<sup>nd</sup> variable.

**CHAPTER V**  
**DATA ANALYSIS**

## DATA ANALYSIS

Analysis and interpretation are crucial steps of any research program. It is the process by which we make sense and meaning of the data collected and determine the conclusions, significance and implications of the findings.

Table 1

Normality testing of the variables Parenting Style and Resilience

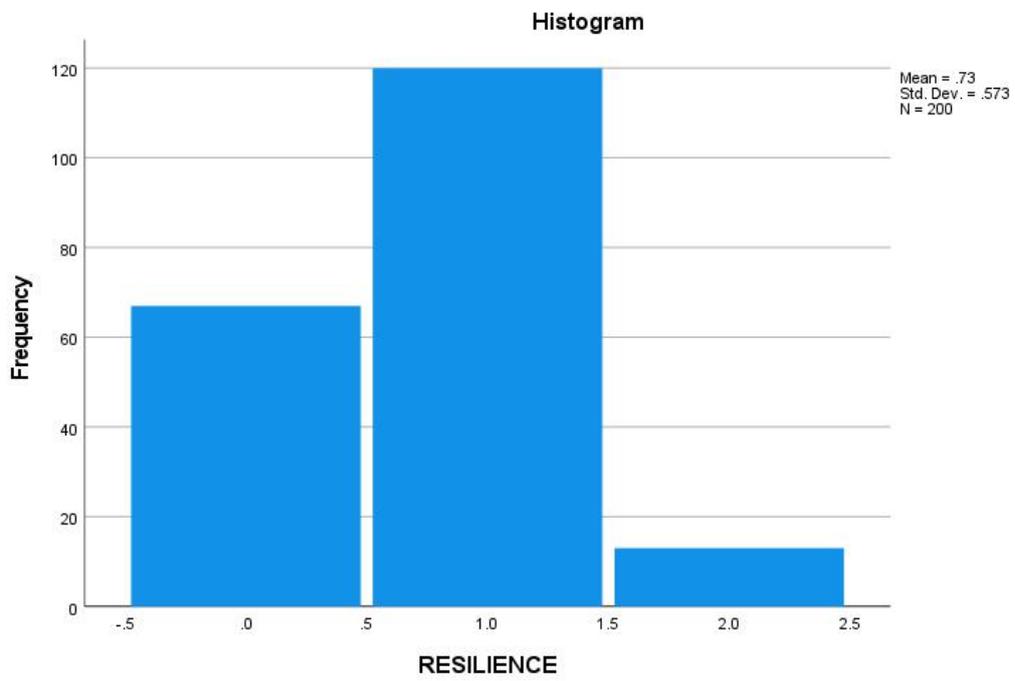
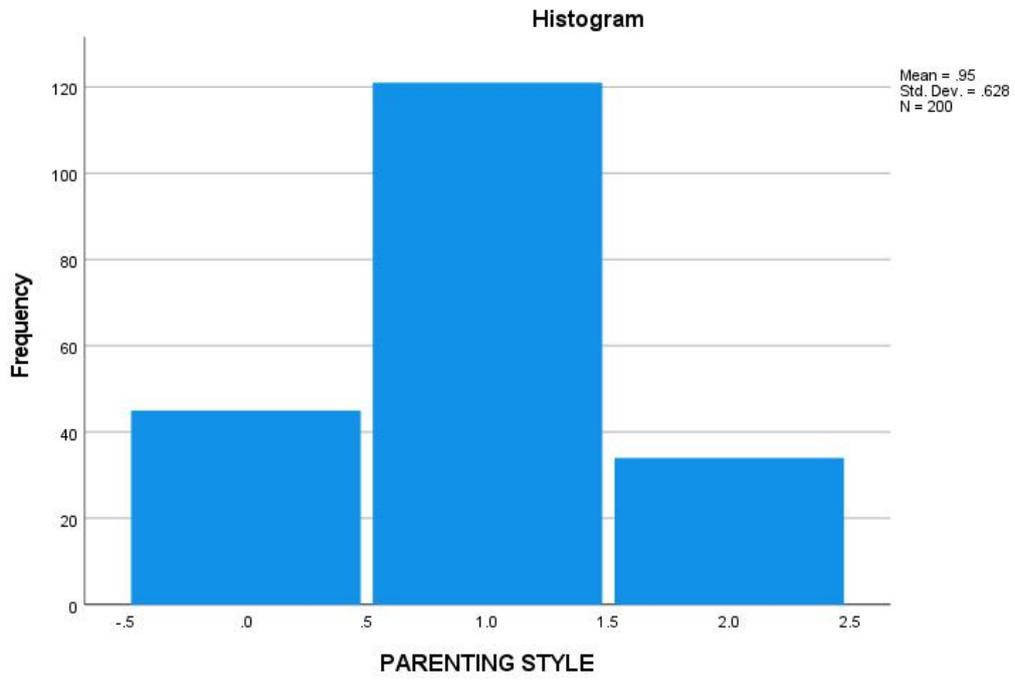
### Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
PARENTING STYLE	200	100.0%	0	0.0%	200	100.0%
RESILIENCE	200	100.0%	0	0.0%	200	100.0%

### Test of Normality

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
PARENTING STYLE	.310	200	<.001	.780	200	<.001
RESILIENCE	.346	200	<.001	.737	200	<.001

a. Lilliefors Significance Correction



Since the p value for Parenting Style and Resilience is <.001 which turns out to be much less than significance level (0.05) in the Kolmogorov-Smirnov test for Normality, it is concluded that the variables used in this study do not have a normal distribution (as evident from the histograms of each).

Table 2 & 3

Pearson’s Chi-Square Statistic between paternal parenting style and resilience in the participants.

**Chi-Square Tests**

Pearson Chi-Square	3.806 <sup>a</sup>	4	.433
Likelihood Ratio	3.600	4	.463
N of Valid Cases	200		

a. 2 cells (22.2%) have expected count less than 5. The minimum expected count is 2.21.

**Parenting Style \* Resilience Crosstabulation**

			Resilience			
			H	L	N	Total
Parenting Style	AN	Count	2	13	19	34
		Expected Count	2.2	11.4	20.4	34.0
	AV	Count	6	37	78	121
		Expected Count	7.9	40.5	72.6	121.0
		Count				
		Expected Count				

P	Count	5	17	23	45
	Expected	2.9	15.1	27.0	45.0
Total	Count	13	67	120	200
	Expected	13.0	67.0	120.0	200.0
	Count				

The Pearson Chi-square coefficient was computed to assess the association between paternal parenting style and resilience. Authoritative parenting style seems to have the highest association with normal level of resilience in the participants and does not relate significantly to high levels of resilience. Permissive style seems to have a higher association with normal level of resilience while authoritarian style seems to have more or less similar association with low and normal levels of resilience. Although individual category results are such, since the Chi-square statistic (3.806) is much greater than the designated alpha level (0.05), the hypothesis (that parenting style is dependent of resilience) is rejected.

Note: for the Chi-square test to be fully accurate, less than 20 per cent of cells must have an expected count of at least 5. Since there are two counts with score less than 5, further alternatives, like collecting larger sample, may be considered. In this case, the likelihood ratio was checked to ascertain whether the hypothesis can be accepted. Since its values (.463) is much bigger than designated alpha value (0.05), the hypothesis can be rejected with confidence.

### Table 3

Spearman's Correlation Coefficient between paternal parenting style and resilience in the participants.

### **Correlations**

PARENTING STYLE | RESILIENCE

Spearman's rho	PARENTING STYLE	Correlation	1.000	-.018
		Coefficient		
		Sig. (2-tailed)	.	.796
		N	200	200
	RESILIENCE	Correlation	-.018	1.000
		Coefficient		
		Sig. (2-tailed)	.796	.
		N	200	200

The Spearman correlation coefficient was computed to assess the strength of the relationship between paternal parenting style and resilience. There seems to be a negative correlation between these two variables at .05 significance level (2 – tailed), however, since the p-value (.796) is greater than alpha value (0.05), the hypothesis is rejected, i.e., it is concluded that there is no relationship between perceived paternal parenting style and resilience. In a similar study done by Dr Manju Gera & Jasjit Kaur (2015) to study resilience and parenting styles, the results revealed an insignificant correlation between parenting style and resilience.

Table 4

The Mann-Whitney U Test was conducted to investigate the distribution of resilience across categories of gender.

	Test	Sig. <sup>a,b</sup>
1	Independent-Samples Median Test	.219
2	Independent-Samples Mann-Whitney U Test	.131

Since asymptotic significance is less than 0.05, the hypothesis (the distribution of resilience score is not the same across male and female genders) is rejected. In the study done by Dr Manju Gera & Jasjit Kaur (2015) to study resilience and parenting styles, it was found that there was no significant difference between resilience of male and female populations.

**CHAPTER VI**  
**FINDINGS**

## FINDINGS

The aim of the study is to understand whether parenting styles, specifically the father's, has a relationship with resilience in young adults in India between ages 18 and 35. Mothers and fathers play different roles in the development of a child; traditionally, mothers are more involved in the daily lives of the child, while fathers provide material support and play a role in influencing the child's gender role. Nowadays, both parents share more or less equal roles in parenting. Paternal involvement in the child's life is associated with their healthy development. In this study, we focus on resilience as an important outcome of an individual's relationship with their fathers. Resilience is the process of, capacity for, or outcome of, successful adaptation despite challenging or threatening circumstances (Sandler, Wolchik, Mackinnon, Ayers and Roosa 1997).

In order to measure D. Baumrind's parental styles prototypes, the Parental Authority Questionnaire, a 30-item-per-parent questionnaire with scores derived from the children's phenomenological appraisal of their parents' parenting style, was used. The Brief Resilience Scale measures resilience in its original and most basic meaning: the ability to bounce back from difficult situations (Agnes, 2005). It consists of 6 items and is self-report in nature. Data collection was performed from 200 participants through convenience sampling via Google by combining the 2 measures.

First, normality testing was conducted to see if the variables are normally distributed over the population. The Kolmogorov-Smirnova coefficient was 0.310 for Parenting Styles and 0.346 for resilience. Since the p value for Parenting Style and Resilience is  $<.001$  which turns out to be much less than significance level (0.05) in the Kolmogorov-Smirnov test for Normality, it is concluded that the variables used in this study do not have a normal distribution, therefore, non-parametric testing was used for our study.

Results from the Chi-Square Test for Independence reveal no significant association between resilience and parenting style. Since the Chi-square statistic (3.806) is much greater than the designated alpha level (0.05), the hypothesis is rejected. Resilience is independent of paternal parenting style. Based on the data analysed, high resilience is less frequently associated with all three types of parenting. The expected count for people with High Resilience and Authoritarian Parenting Style is 2.2, which is greater than the observed count (2). For people

with Low Resilience and Authoritarian Parenting Style, the E.C (11.4) is lesser than observed count (13). For people with Normal Resilience and Authoritarian Parenting Style, the E.C (20.4) is greater than observed count (19). The expected count for people with High Resilience and Authoritative Parenting Style is 7.9, which is greater than the observed count (6). For people with Low Resilience and Authoritative Parenting Style, the E.C (40.5) is greater than observed count (37). For people with Normal Resilience and Authoritative Parenting Style, the E.C (72.6) is greater than observed count (78). The expected count for people with High Resilience and Permissive Parenting Style is 2.9, which is lesser than the observed count (5). For people with Low Resilience and Permissive Parenting Style, the E.C (15.1) is lesser than observed count (17). For people with Normal Resilience and Permissive Parenting Style, the E.C (27) is greater than observed count (23). Authoritative style has the highest 'normal' level of resilience according to Chi-square test. Since the Chi-square coefficient is significantly higher than the alpha value (0.05), the hypothesis that resilience is dependent of parenting style is rejected.

A Spearman's correlational analysis was also done to measure the strength of the relationship between the two variables, if any. There seems to be a negative correlation between these two variables at .05 significance level (2 – tailed), however, since the p-value (.796) is greater than alpha value (0.05), the hypothesis is rejected. There is no relationship between perceived paternal parenting style and resilience.

The Mann-Whitney U Test was conducted to investigate the distribution of resilience across categories of gender. The significance level is .050 and the asymptotic significance was displayed as .131. Since asymptotic significance is less than 0.05, the hypothesis, i.e., the distribution of resilience score is not the same across categories of Gender, is rejected. In the study done by Dr Manju Gera & Jasjit Kaur (2015) to study resilience and parenting styles, it was found that there was no significant difference between resilience of male and female populations

Previous studies like the one done by Kathryn E. Williams, Joseph Ciarrochi, Patrick C. L. Heaven (2012) that examined the longitudinal relationships between perceived parenting style and psychological flexibility among students in a self-report manner showed that mother and father variables did not differ in how they predicted psychological flexibility. A study by

Elhalm Atighi, Atefeh Atighi and Iman Atighi (2015) looked into predicting psychological resilience based on the parenting styles used. Research showed positive correlation between parenting style and resilience in both authoritative and authoritarian parenting style but an inverse relation for permissive parenting style. The findings of the study are different from previous studies conducted on parenting style and resilience, taking into consideration that this study was conducted on an unequally distributed, Indian population where a phenomenological appraisal of paternal parenting style as opposed to maternal style (which is more popularly associated with the mental development of the child) was done, hence the results may be a result of the influence of factors outside our two variables.

**CHAPTER VII**  
**RECOMMENDATIONS**

## RECOMMENDATIONS

Resilience, or the ability to bounce back, is a personality trait that has been linked to parenting styles in multiple studies. In particular, Baumrind's parenting styles were used to categorize the nature of parenting beliefs, attitudes and behaviour into three- permissive, authoritarian and authoritative. Most studies have concluded that the authoritative parenting style is linked to higher levels of resilience in children. The current study focuses exclusively on the Indian population. Findings of the same indicate that there is no significant association between paternal parenting styles and resilience in the chosen sample. More research is needed on the topic to arrive at a reliable conclusion. Studies relating to the impact of parenting styles, especially on the development of resilience in a child, are extremely limited in the Indian context. Most of the available information focuses exclusively on the role of maternal parenting style. Traditionally, caring for a child is considered to be the responsibility of mothers. However, the role of fathers in the development of a child is of equal importance.

Qualitative research needs to be undertaken in order to explore the complexities of this topic. The personality traits of an individual cannot be taken apart and studied independently. One trait is related to another, hence a holistic approach needs to be employed. Resilience is a trait that is also significantly moulded by one's environment, so factors like major life events, socio-economic status, chronic illnesses in the family, living conditions, etc., need to be taken into consideration while studying the resilience of children. Additionally, children have varying degrees of attachment to the father and mother. That in itself could determine the impact of the parent's behaviour on traits like resilience.

**CHAPTER VIII**

**CONCLUSION**

## **CONCLUSION**

The study at hand was conducted to understand the role of perceived paternal style as a predictor of resilience in young adults between ages 18 and 35. The main variables studied include parenting style - permissive, authoritarian & authoritative, and resilience. The objective of the study was to use paternal parenting style as a predictor of resilience in children. The Parental Authority Scale and the Brief Resilience Scale were used to measure the same. Both were filled out by young adults on the basis of a phenomenological appraisal of their father's parenting style. The data was obtained through snowball sampling via a Google form. Since the variables were not normally distributed, data was analysed using the Chi-square test and Spearman's correlation coefficient. The results shows no significant relationship between any paternal parenting styles and high resilience in children. From the analysis, it can be concluded that resilience is independent of paternal parenting style among the participants.

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## **APPENDIX**

## APPENDICES

### APPENDIX I:

#### BAUMRIND'S PARENTAL AUTHORITY QUESTIONNAIRE

Please choose the options that best express your feelings regarding each item in the questionnaire.

1= strongly disagree

2= disagree

3= neither agree nor disagree

4= agree

5= strongly agree

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Items:

1. While I was growing up my father felt that in a well-run home the children should have their way in the family as often as the parents do.
2. Even if his children didn't agree with him, my father felt that it was for our own good if we were forced to conform to what he thought was right.
3. Whenever my father told me to do something as I was growing up, he expected me to do it immediately without asking any questions.
4. As I was growing up, once family policy had been established, my father discussed the reasoning behind the policy with the children in the family.
5. My father has always encouraged verbal give-and-take whenever I have felt that family rules and restrictions were unreasonable.
6. My father has always felt that his children need is to be free to make up their own minds and to do what they want to do, even if this does not agree with what their parents might want.

7. As I was growing up my father did not allow me to question any decision he had made.
8. As I was growing up my father directed the activities and decisions of the children in the family through reasoning and discipline.
9. My father has always felt that more force should be used by parents in order to get their children to behave the way they are supposed to.
10. As I was growing up my father did not feel that I needed to obey rules and regulations of behavior simply because someone in authority had established them.
11. As I was growing up, I knew what my father expected of me in my family, but I also felt free to discuss those expectations with my father when I felt that they were unreasonable.
12. My father felt that wise parents should teach their children early just who is boss in the family.
13. As I was growing up, my father seldom gave me expectations and guidelines for my behavior.
14. Most of the time as I was growing up my father did what the children in the family wanted when making family decisions.
15. As the children in my family were growing up, my father consistently gave us direction and guidance in rational and objective ways.
16. As I was growing up my father would get very upset if I tried to disagree with him.
17. My father feels that most problems in society would be solved if parents would not restrict their children's activities, decisions, and desires as they are growing up.
18. As I was growing up my father let me know what behavior he expected of me, and if I didn't meet those expectations, he punished me.
19. As I was growing up my father allowed me to decide most things for myself without a lot of direction from him.
20. As I was growing up my father took the children's opinions into consideration when making family decisions, but he would not decide for something simply because the children wanted it.
21. My father did not view himself as responsible for directing and guiding my behavior as I was growing up.
22. My father had clear standards of behavior for the children in our home as I was growing up, but he was willing to adjust those standards to the needs of each of the individual children in the family.

23. My father gave me direction for my behavior and activities as I was growing up and he expected me to follow his direction, but he was always willing to listen to my concerns and to discuss that direction with me.
24. As I was growing up my father allowed me to form my own point of view on family matters and he generally allowed me to decide for myself what I was going to do.
25. My father has always felt that most problems in society would be solved if we could get parents to strictly and forcibly deal with their children when they don't do what they are supposed to as they are growing up.
26. As I was growing up my father often told me exactly what he wanted me to do and how he expected me to do it.
27. As I was growing up my father gave me clear direction for my behaviors and activities, but he was also understanding when I disagreed with him.
28. As I was growing up my father did not direct the behaviors, activities, and desires of the children in the family.
29. As I was growing up I knew what my father expected of me in the family and he insisted that I conform to those expectations simply out of respect for his authority.
30. As I was growing up, if my father made a decision in the family that hurt me, he was willing to discuss that decision with me and to admit it if he had made a mistake.

## **APPENDIX II:**

### **BRIEF RESILIENCE SCALE**

Please choose the options that best express your feelings regarding each item in the questionnaire.

1= Strongly disagree

2= disagree

3= neutral

4= agree

5= strongly agree

S. NO	Items	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	I tend to bounce back quickly after hard times.	1	2	3	4	5
2	I have a hard time making it through stressful events.	5	4	3	2	1
3	It does not take me long to recover from a stressful event.	1	2	3	4	5
4	It is hard for me to snap back when something bad happens.	5	4	3	2	1
5	I usually come through difficult times with little trouble.	1	2	3	4	5
6	I tend to take a long time to get over setbacks in my life.	5	4	3	2	1

# **MULTIPLE SECURITY ANDROID CLOUD APPLICATION**

**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*

**Dona Dixon - SB19BCA006**

**&**

**Maggy Rose - SB19BCA011**

**III DC BCA (CLOUD TECHNOLOGY AND INFORMATION SECURITY  
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*Under the guidance of*

**Mrs. Neha Raju K**

**DEPARTMENT OF COMPUTER APPLICATIONS**

**MARCH 2022**

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**DEPARTMENT OF COMPUTER APPLICATIONS**

**MARCH 2022**

## DECLARATION

We, undersigned hereby declare that the project report, **Multiple Security Android Cloud Application**, submitted for partial fulfilment of the requirements for the award of degree of BCA St. Teresa's College (Autonomous), Ernakulam (Affiliated to Mahatma Gandhi University), Kerala is a bonafide work done by us under supervision of **Mrs. Neha Raju K.** 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

Dona Dixon - SB19BCA006

Maggy Rose - SB19BCA011

**ST. TERESAS COLLEGE (AUTONOMOUS), ERNAKULAM**  
**BCA (CLOUD TECHNOLOGY & INFORMATION SECURITY**  
**MANAGEMENT)**

**DEPARTMENT OF COMPUTER APPLICATIONS**



**CERTIFICATE**

This is to certify that the report entitled **Multiple Security Android Cloud Application** submitted by **Dona Dixon** and **Maggy Rose** 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.

**NEHA RAJU K**

**Internal Supervisor**



**For Head of the Department**

**External Supervisor**

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## **ABSTRACT**

The management of data while maintaining its utility and preservation of security scheme is a matter of concern for the cloud owner. In order to minimize the overhead at cloud service provider for applying security over each document and then transfer it to the client, we propose a layered architecture. This approach maintains security of the sensitive document and privacy of its data sensitivity. To make a balance between data security and utility, the proposed approach categorizes the data according to its sensitivity. Perseverance of various categories require different algorithmic schemes. We set up a cloud distributed android application environment where data is categorized into four levels of sensitivity: public, confidential, secret, top secret and a different approach has been used to preserve the security at each level. At the most sensitive layers i.e., secret and top-secret data, we made a provision to detect the faulty node that is responsible for data leakage and also introduces decoy technique to generate fake data of the original file, which will be delivered to the user if the behavior of the user is identified as the attacker. The original file will be securely stored by encrypting them using RSA algorithm.

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**LIST OF ABBREVIATIONS**

<b>SL NO.</b>	<b>ABBREVIATIONS</b>	<b>EXPANSION</b>
1	NCA	Native Cloud Application
2	RSA	Rivest-Shamir-Adleman
3	APK	Android Application Package
4	USB	Universal Serial Bus
5	SMS	Short Message Services
6	CPU	Central Processing Unit
7	API	Application Program Interface
8	OTP	One Time Password
9	DWT	Discrete Wavelet Transform
10	VM	Virtual Machine
11	QR	Quick Response
12	WT	Watermarking
13	AI	Artificial Intelligence
14	IP	Internet Protocol
15	.exe	Executable files
16	SLR	Systematic Literature Review

# CHAPTER - 1

## INTRODUCTION

In today's growing world, there is a need to share the information of the organization among various entities such as employees, business partners, customers, etc. With the emergence of cloud computing technology, connectivity enabled by the Internet is accomplished to allow the users having the potential to utilize the distributed and scalable computing environments. But this information can be attained by unauthorized access while transmitting the data or it can be intentionally or unintentionally leaked by the receiving party, and then it can be misused by some malicious entities. It can cause a serious threat to the organization's goodwill and reputation. Due to this reason, data security and leakage detection have become critical challenges for any organization. There is a need of mechanism that can preserve the security of the data being shared and can detect the malicious entity causing data leakage.

Though, from the year 2013, number of cloud users are projected to be increased from 2.4 billion to 3.6 billion in the year 2018. Hence, by the time, data availability has gradually gotten a hike that needs security and privacy. Maintaining the privacy is important to protect the data from leakage. According to a study, number of leaked sensitive data records had reached to 1.1 billion during the years 2011 to 2014. It has kept on increasing as the number of cloud users are increasing, also the malicious users. Thus, to cope up with increasing cyberattacks, cybersecurity requires an approach that can manage, secure and locate the malicious agents and activities.

Conversely, limiting the sharing of information in order to maintain security results in reduced data utility which may affect the performance of the organization. Security mechanism is applied over the whole data while transferring it to the cloud and then to the user which incurs high computational costs. When stronger security mechanism is applied to the whole data, it reduces data utility, processing speed and increases the overhead. If, no security mechanism is applied, then security and privacy can be compromised and there can be chances of data leakage and data misuse. To minimize the overhead while maintaining the data security and data utility, we propose a layer-based security and privacy architecture.

Traditional research has focused on transmitting the encrypted data from the owner to the cloud using layer-based architecture in the web environment. We enhance the traditional architectural behavior and provide a layer-based architecture in android cloud environment for securing the data that flows among three party system i.e., cloud, owner and client. The approach, we present in this paper, to preserve the data is related to maintain data utility issue while ensuring data security and also enable simple and easy access of data. Our solution to maintain privacy and security contributes in the following directions:

- The paper proposes a layer-based privacy and security architecture to preserve the cloud data confidentiality, when the data is shared among multiple entities. In order to reduce the computational overhead of applying security mechanism over the whole data, the stored data is categorized as per its level of confidentiality and then appropriate level of security is applied when the data is retrieved.

- Data utilization and security requirements may be quite different for different data. To make a balance between information utility and protection, the layer-based mechanism classifies the data in four categories named as Public, Confidential, Secret, Top Secret.
- At each layer, a different integrated combination of multiple technologies is utilized to fulfill the privacy and security requirements as per the data sensitivity. Each successive layer provides stronger security in addition to the security at the previous layer.
- Watermarking technique is utilized in case of secret and top-secret data to identify the leaker responsible for leaking the sensitive data. Furthermore, we adopt the message authentication scheme to verify the identified leaker in case of most critical data and decoy technique to generate fake data of the original file, which will be delivered to the user if the behavior of the user is identified as the attacker. The original file will be securely stored by encrypting them using RSA algorithm.

## 1.1 Android Cloud Applications

Android is a mobile operating system based on a modified version of the Linux kernel and other open-source software, designed primarily for touchscreen mobile devices such as smartphones and tablets. Android is developed by a consortium of developers known as the Open Handset Alliance and commercially sponsored by Google. It is free and open-source software.

Android App is a software designed to run on an Android device. The term also refers to an APK file which stands for Android package. This file is a Zip archive containing app code, resources, and meta information. Apps can be written in Kotlin, Java, and C++ or any such languages and are run inside Virtual Machine. The official development environment is Android Studio. Apps are normally distributed through app markets such as Google Play Store, so it is possible to enable installation from APK file or via USB connection in device settings.

A native cloud application (NCA) is a type of computer software that natively utilizes services and infrastructure from cloud computing providers such as Amazon EC2, Force.com, or Microsoft Azure.

## 1.2 Layer based architecture

A layer-based privacy and security architecture is used to preserve the cloud data confidentiality, when the data is shared among multiple entities. In order to reduce the computational overhead of applying security mechanism over the whole data, the stored data is categorized as per its level of confidentiality and then appropriate level of security is applied when the data is retrieved. Data utilization and security requirements may be quite different for different data. To make a balance between information utility and protection, the layer-based mechanism classifies the data in four categories named as Public, Confidential, Secret, Top Secret. At each layer, a different integrated combination of multiple technologies is utilized to fulfill the privacy and security requirements as per the data sensitivity. Each successive layer provides stronger security in addition to the security at the previous layer. Watermarking technique is utilized in case of secret and top-secret data to identify the leaker

responsible for leaking the sensitive data. Furthermore, we adopt the message authentication scheme to verify the identified leaker in case of most critical data.

### 1.3 RSA Algorithm

RSA (Rivest–Shamir–Adleman) is a public-key cryptosystem that is widely used for secure data transmission. It is also one of the oldest. The acronym "RSA" comes from the surnames of Ron Rivest, Adi Shamir and Leonard Adleman, who publicly described the algorithm in 1977. An equivalent system was developed secretly in 1973 at GCHQ (the British signals intelligence agency) by the English mathematician Clifford Cocks. That system was declassified in 1997.

In a public-key cryptosystem, the encryption key is public and distinct from the decryption key, which is kept secret (private). An RSA user creates and publishes a public key based on two large prime numbers, along with an auxiliary value. The prime numbers are kept secret. Messages can be encrypted by anyone, via the public key, but can only be decoded by someone who knows the prime numbers.

The security of RSA relies on the practical difficulty of factoring the product of two large prime numbers, the "factoring problem". Breaking RSA encryption is known as the RSA problem. Whether it is as difficult as the factoring problem is an open question. There are no published methods to defeat the system if a large enough key is used. RSA is a relatively slow algorithm. Because of this, it is not commonly used to directly encrypt user data. More often, RSA is used to transmit shared keys for symmetric-key cryptography, which are then used for bulk encryption–decryption.

### 1.4 Watermarking

A digital watermark is a kind of marker covertly embedded in a noise-tolerant signal such as audio, video or image data. It is typically used to identify ownership of the copyright of such signal. Watermarking is the process of hiding digital information in a carrier signal; the hidden information should, but does not need to, contain a relation to the carrier signal. Digital watermarks may be used to verify the authenticity or integrity of the carrier signal or to show the identity of its owners. It is prominently used for tracing copyright infringements and for banknote authentication.

Like traditional physical watermarks, digital watermarks are often only perceptible under certain conditions, e.g., after using some algorithm. If a digital watermark distorts the carrier signal in a way that it becomes easily perceivable, it may be considered less effective depending on its purpose. Traditional watermarks may be applied to visible media (like images or video), whereas in digital watermarking, the signal may be audio, pictures, video, texts or 3D models. A signal may carry several different watermarks at the same time. Unlike metadata that is added to the carrier signal, a digital watermark does not change the size of the carrier signal.

The needed properties of a digital watermark depend on the use case in which it is applied. For marking media files with copyright information, a digital watermark has to be rather

robust against modifications that can be applied to the carrier signal. Instead, if integrity has to be ensured, a fragile watermark would be applied.

Both steganography and digital watermarking employ steganographic techniques to embed data covertly in noisy signals. While steganography aims for imperceptibility to human senses, digital watermarking tries to control the robustness as top priority.



*Fig 3. 1. Watermarking*

Since a digital copy of data is the same as the original, digital watermarking is a passive protection tool. It just marks data, but does not degrade it or control access to the data.

One application of digital watermarking is source tracking. A watermark is embedded into a digital signal at each point of distribution. If a copy of the work is found later, then the watermark may be retrieved from the copy and the source of the distribution is known. This technique reportedly has been used to detect the source of illegally copied movies.

### **1.5 OTP Authentication**

A one-time password (OTP), also known as a one-time PIN, one-time authorization code (OTAC) or dynamic password, is a password that is valid for only one login session or transaction, on a computer system or other digital device. OTPs avoid several shortcomings that are associated with traditional (static) password-based authentication; a number of implementations also incorporate two-factor authentication by ensuring that the one-time password requires access to something a person has (such as a small keyring fob device with the OTP calculator built into it, or a smartcard or specific cellphone) as well as something a person knows (such as a PIN).

OTP generation algorithms typically make use of pseudo randomness or randomness to generate a shared key or seed, and cryptographic hash functions, which can be used to derive a value but are hard to reverse and therefore difficult for an attacker to obtain the data that was used for the hash. This is necessary because otherwise, it would be easy to predict future OTPs by observing previous ones.

OTPs have been discussed as a possible replacement for, as well as an enhancer to, traditional passwords. On the downside, OTPs can be intercepted or rerouted, and hard tokens can get lost, damaged, or stolen. Many systems that use OTPs do not securely implement them, and attackers can still learn the password through phishing attacks to impersonate the authorized user.

The most important advantage addressed by OTPs is that, in contrast to static passwords, they are not vulnerable to replay attacks. This means that a potential intruder who manages to record an OTP that was already used to log into a service or to conduct a transaction will not be able to use it, since it will no longer be valid. A second major advantage is that a user who uses the same (or similar) password for multiple systems, is not made vulnerable on all of them, if the password for one of these is gained by an attacker. A number of OTP systems also aim to ensure that a session cannot easily be intercepted or impersonated without knowledge of unpredictable data created during the previous session, thus reducing the attack surface further.

### 1.6 Decoy Technique

Decoy technique helps in generating on-demand bogus information and detects unauthorized access to information. Integrating decoy technology with user behavior profiling in the cloud can help in securing users' data by confusing the attacker with the decoy document.

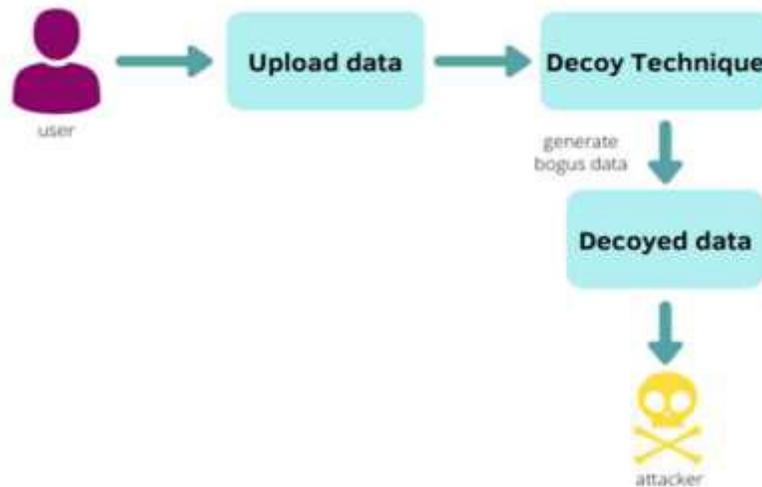


Fig 3. 2. Decoy Technique

## 1.7 Clever Cloud

Clever Cloud is a Platform as a Service, aiming at helping companies to ship way faster their web services in the cloud, with a pay-as-you-go pricing model. No infrastructure to manage, no system to update and no orchestrator to troubleshoot. clever Cloud operates its own hardware for better control, builds its own OS for greater performances, for the sake of sovereignty and above all security.



*Fig 3. 3. Clever Cloud*

## CHAPTER - 2

# LITERATURE SURVEY

The papers regarding Multiple Security in Cloud Application. 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.

“Layer-based Privacy and Security Architecture for Cloud Data Sharing”. Cloud distributed environment where data is categorized into four levels of sensitivity: public, confidential, secret, top secret and a different approach has been used to preserve the security at each level Traditional research has focused on transmitting the encrypted data from the owner to the cloud. We enhance the traditional architectural behavior and provide a layer-based architecture for securing the data that flows among three party system i.e., cloud, owner and client. In order to reduce the computational overhead of applying security mechanism over the whole data, the stored data is categorized as per its level of confidentiality and then appropriate level of security is applied when the data is retrieved. Data utilization and security requirements may be quite different for different data. To make a balance between information utility and protection, the layer-based mechanism classifies the data in four categories named as Public, Confidential, Secret, Top Secret. [1].

“Implementation of Security in a Healthcare Cloud using Decoy Technique and Fog Computing”. Using decoy technique to generate fake PHI data which will be delivered to the user if the behavior of the user is identified as the attacker. The authorized users can communicate with others over a secured channel using the key agreement protocol Healthcare professionals use Electronic Medical Records (EMR) including lab reports, X-rays, Computed Tomography (CT) scans, ultrasound, etc. of a patient. All this data is stored on the healthcare cloud, which provides services like maintenance and backup of the patients Personal Health Information (PHI). The healthcare cloud is constantly under the threat of data theft attacks which are the most serious forms of attacks. Hence the main goal of our system is to make these data theft attacks difficult for the attackers. To achieve this, we are using decoy technique to generate fake PHI data which will be delivered to the user if the behavior of the user is identified as the attacker. The authorized users can communicate with others over a secured channel using the key agreement protocol. The original PHI is securely stored by encrypting them using the blowfish algorithm. To make the data transfer smooth and efficient we are using fog computing, which will help in securing the data by keeping it at the edge. [2].

” Image Authentication Using QR Code Watermarking Approach Based on Image Segmentation”, 2021, [3] This paper proposes a new image authentication method that combines digital signatures and digital watermarking in the form of QR codes.

“A Robust video watermarking approach based on QR code”, 2021, This paper encodes the watermark into QR code and makes full use of the high fault tolerance of QR code, proposes a

watermark generating and decoding strategy based on the characteristics of QR code, which improves the robustness of the watermarking algorithm.[4]

” Improve Cloud Based IoT Architecture Layer Security”, 2021, It describes Internet of Things on data security. Combining the concept of Cloud based Internet of Thing architecture with different layers, the paper proposes different security issues and challenges in Internet of Things [4].

“A Review Paper on DES, AES, RSA Encryption Standards”,2020, It will sequentially list and review the said algorithms and clarify the relation between them. Such as the relation between the symmetric and asymmetric algorithm the one with secret key and the ones with key pairs [5].

” A Systematic Literature Review on Cloud Computing Security: Threats and Mitigation Strategies”, 2020, This systematic literature review (SLR) is aimed to review the existing research studies on cloud computing security, threats, and challenges [6].

” Design and implementation of an improved RSA algorithm”, 2020, It is a variant of RSA cryptosystem by reducing modules and private exponents in modular exponentiation. The experimental result shows that the speed of the decryption and signature has been substantially improved and the variant can be efficiently implemented in parallel [7].

Privacy preserving collaboration across multiple service providers to combat telecoms spam by in 2017, A system that aggregates the feedback scores reported by the collaborating TSPs without employing any trusted third-party system, while preserving the privacy of users and collaborators. They evaluate the system performance of privy using both the synthetic and real call detail records. They find that privy can correctly block spammers in a quicker time, as compared to standalone systems [8].

A hybrid solution for privacy preserving medical data sharing in the cloud environment, They investigates how the performance behaviors change when there are multiple clients accessing the cloud service simultaneously and how to make our solution applicable in the cloud with a large number of concurrences of medical data sharing and accessing.

Digital Watermarking Techniques for Security Applications by Sonam Tyagi, Harsh Vikram Singh Raghav the secret information is embedded into the actual information for protecting it from unauthorized use. By using this technique only authorized user can access the data. It may be classified into two domains that are spatial domain and frequency domain [9].

Privacy-Preserving Public Auditing for Secure Cloud Storage Utilizes the homomorphic linear authenticator and random masking to guarantee that the TPA would not learn any knowledge about the data content stored on the cloud server during the efficient auditing process, which not only eliminates the burden of cloud user from the tedious and possibly expensive auditing task, but also alleviates the users’ fear of their outsourced data leakage.

An Algorithm to Enhance Security in RSA. A modified algorithm for RSA with enhanced security. The security feature here is the elimination of  $n$  from the original RSA

algorithm. Instead, the newly generated replacement for  $n$  can be used in both the keys. The RSA algorithm is prone to mathematical factorization attacks. The algorithm that we presented in this paper eliminates this issue making the algorithm more secure with a slight increase of time complexity.

A pairing-free certificate-based proxy re encryption scheme for secure data sharing in public clouds, to assure the confidentiality of the sensitive data stored in public cloud storages, the data owners should encrypt their data before submitting them to the clouds.

OTP-Based Two-Factor Authentication Using Mobile Phones Presents a novel two-factor authentication scheme whereby a user's device produces multiples OTPs from an initial seed using the proposed production scheme. The initial seed is produced by the communications partners' unique parameters. Applying the many from one function to a certain seed removes the requirement of sending SMS-based OTPs to users, and reduces the restrictions caused by the SMS system [10].

Privacy Preserving Delegated Access Control in Public Clouds the data owner performs a coarse-grained encryption, whereas the cloud performs a fine-grained encryption on top of the owner encrypted data. Our approach is based on a privacy preserving attribute based key management scheme that protects the privacy of users while enforcing attribute based ACPs.

A survey on image encryption and decryption using blowfish & watermarking The blowfish algorithm is safe against unauthorized attack and runs faster than the popular accessible algorithms. For double protection, after the blowfish process, the encrypted image tends to go through a water marking process which is used to hide a secret or personal message to protect a products copyright or to demonstrate data integrity.

## CHAPTER - 3

# EXISTING SYSTEM

### 3.1. OVERVIEW

Traditional research has focused on transmitting the encrypted data from the owner to the cloud. We enhance the traditional architectural behavior and provide a layer-based architecture for securing the data that flows among three party system i.e., cloud, owner and client. The approach, we present in this paper, to preserve the data is related to maintain data utility issue while ensuring data security. Our solution to maintain privacy and security contributes in the following directions:

. In order to reduce the computational overhead of applying security mechanism over the whole data, the stored data is categorized as per its level of confidentiality and then appropriate level of security is applied when the data is retrieved. Data utilization and security requirements may be quite different for different data. To make a balance between information utility and protection, the layer-based mechanism classifies the data in four categories named as Public, Confidential, Secret, Top Secret.

At each layer, a different integrated combination of multiple technologies is utilized to fulfill the privacy and security requirements as per the data sensitivity. Each successive layer provides stronger security in addition to the security at the previous layer. Watermarking technique is utilized in case of secret and top-secret data to identify the leaker responsible for leaking the sensitive data. Furthermore, we adopt the message authentication scheme to verify the identified leaker in case of most critical data.

We evaluate the computation cost in terms of computation time required for processing the document at each layer. Furthermore, in the experimental evaluation, it has been represented that how the computation time can be reduced by effectively sharing the data.

### 3.2. ALGORITHM

#### Blowfish Algorithm

Blowfish is an encryption technique designed by Bruce Schneier in 1993 as an alternative to DES Encryption Technique. It is significantly faster than DES and provides a good encryption rate with no effective cryptanalysis technique found to date. It is one of the first, secure block cyphers not subject to any patents and hence freely available for anyone to use.

block Size: 64-bits

key Size: 32-bits to 448-bits variable size

number of subkeys: 18 [P-array]

number of rounds: 16

number of substitution boxes: 4 [each having 512 entries of 32-bits each]

Blowfish Encryption Algorithm:

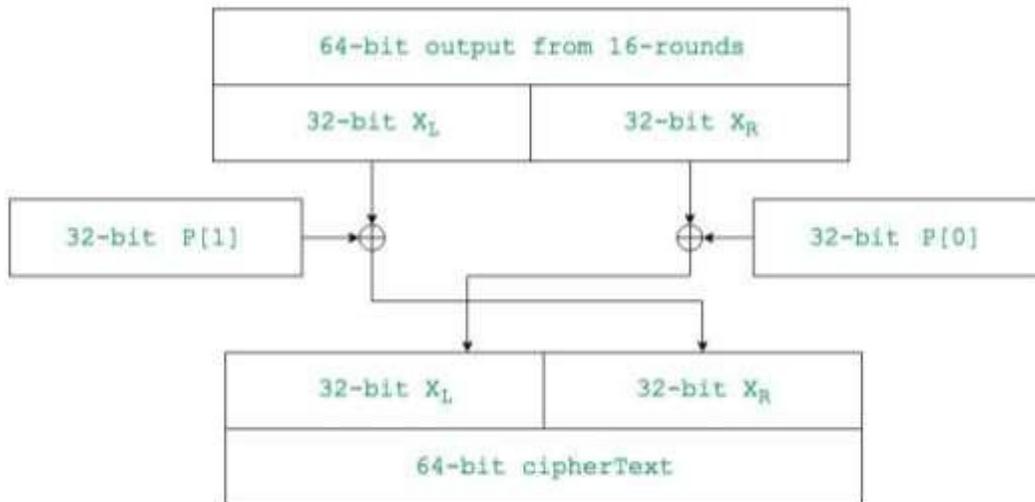


Fig 3. 4. Flowdiagram of post processing step.

The entire encryption process can be elaborated as:

Lets see each step one by one:

#### Step1: Generation of subkeys:

18 subkeys  $\{P[0] \dots P[17]\}$  are needed in both encryption as well as decryption process and the same subkeys are used for both the processes.

These 18 subkeys are stored in a P-array with each array element being a 32-bit entry.

It is initialized with the digits of pi(?).

The hexadecimal representation of each of the subkeys is given by:

$P[0] = "243f6a88"$

$P[1] = "85a308d3"$

.

.

.

$P[17] = "8979fb1b"$

Now each of the subkey is changed with respect to the input key as:

$P[0] = P[0] \text{ xor } 1\text{st } 32\text{-bits of input key}$

$P[1] = P[1] \text{ xor } 2\text{nd } 32\text{-bits of input key}$

.

.

.

$P[i] = P[i] \text{ xor } (i+1)\text{th } 32\text{-bits of input key}$

(roll over to 1st 32-bits depending on the key length)

.

.

.

$P[17] = P[17] \text{ xor } 18\text{th } 32\text{-bits of input key}$

(roll over to 1st 32-bits depending on key length)

The resultant P-array holds 18 subkeys that is used during the entire encryption process

## Step 2: Initialize Substitution Boxes:

4 Substitution boxes(S-boxes) are needed  $\{S[0] \dots S[4]\}$  in both encryption as well as decryption process with each S-box having 256 entries  $\{S[i][0] \dots S[i][255], 0 \leq i \leq 4\}$  where each entry is 32-bit.

It is initialized with the digits of pi(?) after initializing the P-array. You may find the s-boxes in [here!](#)

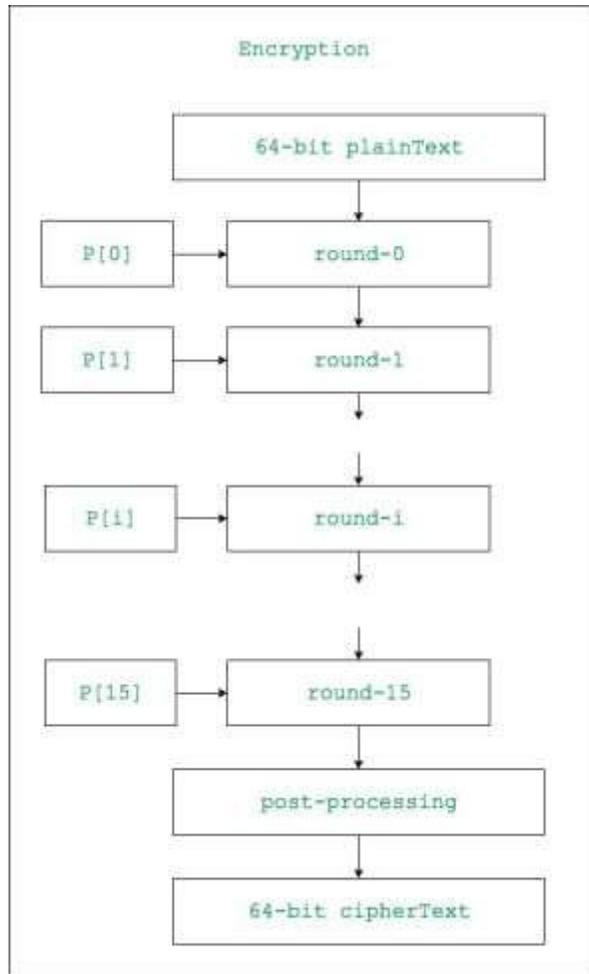


Fig 3.54. Flowdiagram of post processing step.

**Step 3: Encryption:**

The encryption function consists of two parts:

- a. Rounds: The encryption consists of 16 rounds with each round (R<sub>i</sub>) taking inputs the plain Text(P.T.) from previous round and corresponding subkey(P<sub>i</sub>). The description of each round is as follows:

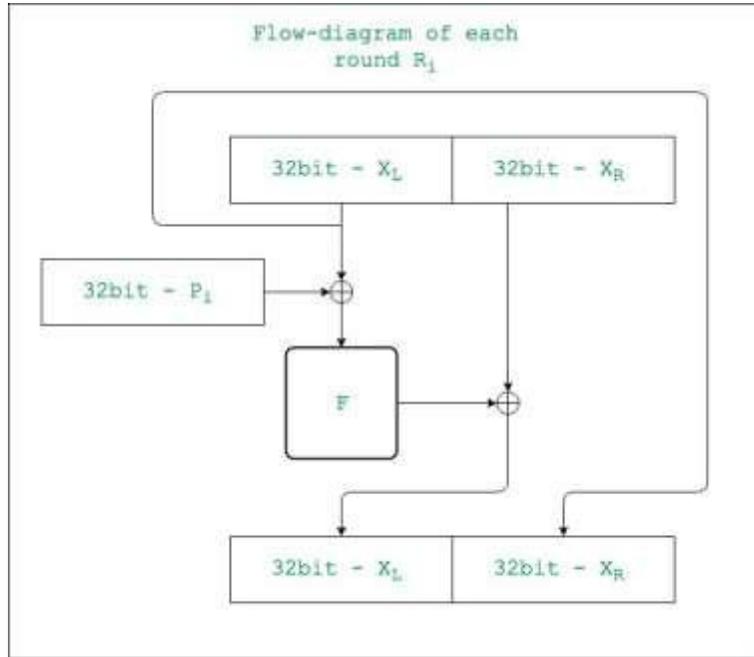


Fig 3. 6. Flow diagram of post processing step.

The description of the function "F" is as follows:  
 Here the function "add" is addition modulo  $2^{32}$ .

b. Post-processing: The output after the 16 rounds is processed as follows:

### QR Code Watermarking

The aim of the QR code watermarking technique proposed in this paper is to embed a QR code watermark within a cover image, and to be able to extract the watermark. Prior to embedding the watermark, bits in the encrypted watermark were scrambled using Arnold transform. The reason for this is to distribute the watermark data over the entire image. In practice, this effectively reduces localized errors in the extracted watermark, which may result from distortions to IW by an adversary. Algorithm 1 provides details of the steps involved in the embedding process. Algorithm 1 Embedding algorithm Input: A QR code, W, a cover image, I, and a key, K. Output: A watermarked image, IW

**Step 1.** Encrypt information in W by XORing the random bits in K with the modules in W to produce WE.

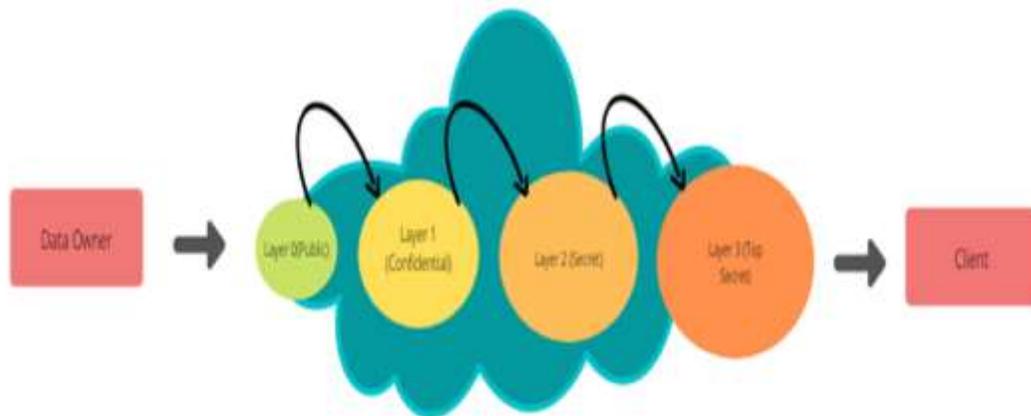
**Step 2.** Generate a chaotic image WT by scrambling the bits of the encrypted watermark WE using Arnold transform over a number of iterations.

**Step 3.** Convert I to IDW T by performing DWT to the desired level.

**Step 4.** Embed WT in a IDW T sub-band.

**Step 5.** Generate the watermarked image IW by inversing DWT.

### 3.3 FLOWCHART



*Fig 3.7. Flowchart of existing system*

### DRAWBACK

- Does not give the guarantee that data cannot be leaked by the receiving party, once the information is being passed to it.
- Blowfish Algorithm has the weakness in decryption process over the other algorithms in terms of time consumption.
- Blowfish algorithm can't provide authentication as well as non-repudiation as two people have the same key.

# CHAPTER -4

## PROPOSED SYSTEM

### 4.1 OVERVIEW

In today's emerging world, various organizations are shifting their data to the cloud because of a long list of its advantages. As more and more data is being stored in the cloud and shared among the users, it requires resistant security services and leakage detection mechanism. The proposed solutions in this field are grouped into four categories, i.e., access control mechanism, cryptography, watermarking and decoy technique. These solutions provide the security and privacy to data through access control mechanism. In access control mechanism, coalitions have been formed among data owners for distributing the data in a secure manner. To ensure the controlled transfer of data in a distributed environment while preserving well defined policies, usage control enforcement systems are given in cryptography, watermarking and decoy technique. With the help of decoy technique, illegal passing of sensitive information can be secured.

The paper proposes a layer-based privacy and security architecture to preserve the cloud data confidentiality, when the data is shared among multiple entities. In order to reduce the computational overhead of applying security mechanism over the whole data, the stored data is categorized as per its level of confidentiality and then appropriate level of security is applied when the data is retrieved. Data utilization and security requirements may be quite different for different data. To make a balance between information utility and protection, the layer-based mechanism classifies the data in four categories named as Public, Confidential, Secret, Top Secret.

At each layer, a different integrated combination of multiple technologies is utilized to fulfill the privacy and security requirements as per the data sensitivity. Each successive layer provides stronger security in addition to the security at the previous layer.

Watermarking technique is utilized in case of secret and top-secret data to identify the leaker responsible for leaking the sensitive data. Furthermore, we adopt the message authentication scheme to verify the identified leaker in case of most critical data and decoy technique to generate fake data of the original file, which will be delivered to the user if the behavior of the user is identified as the attacker. The original file will be securely stored by encrypting them using RSA algorithm.

### 4.2 ARCHITECTURE

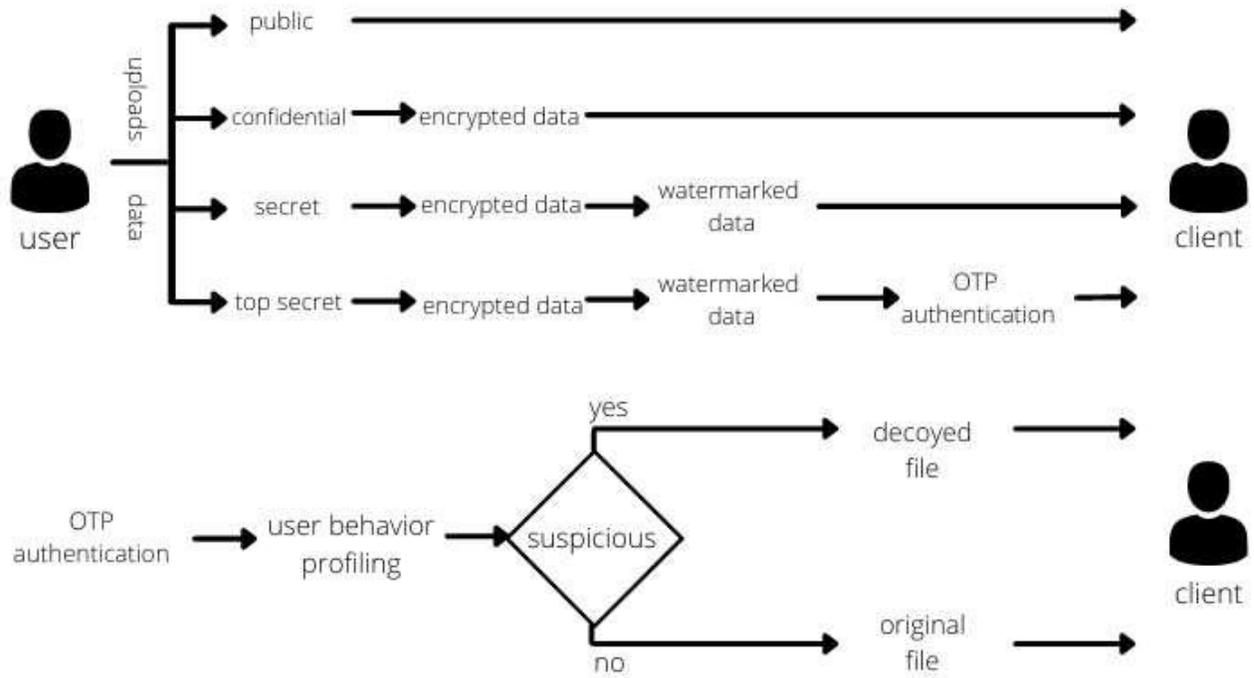


Fig 4.1. System architecture

## 4.3 SYSTEM WORKING

### Admin

**Step 1:** Open the website and login with admin credentials where he/she can add or manage employees, view feedback and files uploaded by the employees.

**Step 2:** To Add or manage employee, click on manage employee tab from admin homepage.

**Step 3:** To view files uploaded by the employees, click on view files tab from admin homepage.

**Step 4:** To view feedback given by the employees, click on view feedback tab from admin homepage.

**Step 5:** Click on logout tab to logout from the current session.

### Employees

**Step 1:** Open the application and setup the IP.

**Step 2:** Login with username and password.

**Step 3:** To upload files click on upload files button, choose the file to upload from gallery, choose the level (public, confidential, secret, top-secret) to which the file should be uploaded and name the file. To view the uploaded files click on view files button.

# **CHAPTER - 5**

## **SYSTEM REQUIREMENT SPECIFICATIONS**

### **5.1 SOFTWARE REQUIREMENTS**

- Coding Platform
- Android Applications
- Any Operating System (Windows)
- Clever Cloud

### **5.2 HARDWARE REQUIREMENTS**

5.3 6-8 GB RAM

5.4 Hard disk

5.5 Monitor

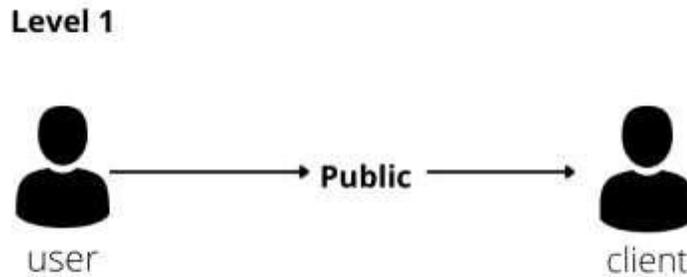
5.6 Keyboard

5.7 Mouse

# CHAPTER 6

## SYSTEM DESIGN ARCHITECTURE

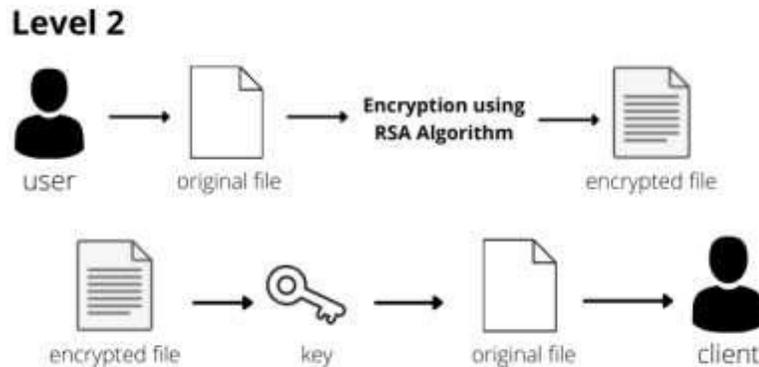
### Level 1



*Fig 6.1. Public*

Level 1 describes Public level, the uploaded file will be just stored. Anyone can access and view it. It can be treated as a public property.

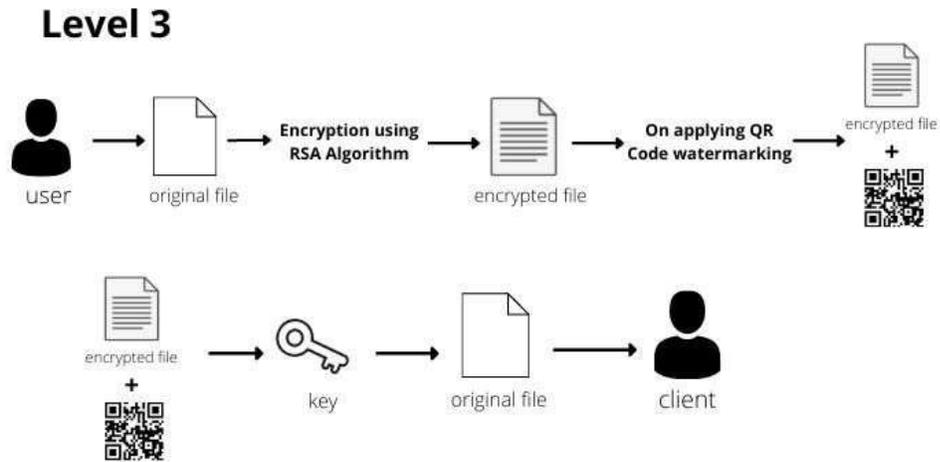
### Level 2:



*Fig 6.2. Confidential*

Level 2 Confidential level, the uploaded file will be stored by securing it with encryption. The algorithm used to encrypt the file is RSA algorithm. RSA is a public-key cryptosystem that is widely used for secure data transmission.

**Level 3:**



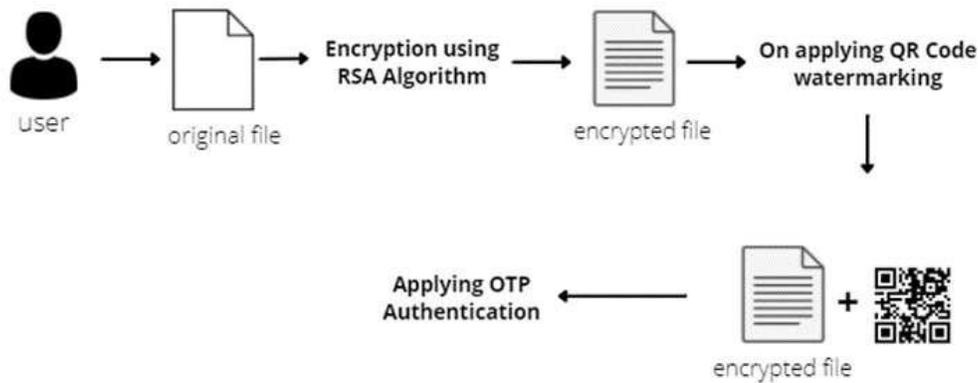
*Fig 6.3 Secret*

In secret level, the files are securely stored by providing them with QR Code watermarking along with RSA algorithm.

The aim of QR code watermarking approach, is to embed a QR code symbol within one of the DWT sub-bands of a digital image. Within the frequency domain, the strength of the embedded watermark can be adjusted based on the desired tradeoff between imperceptibility and robustness.

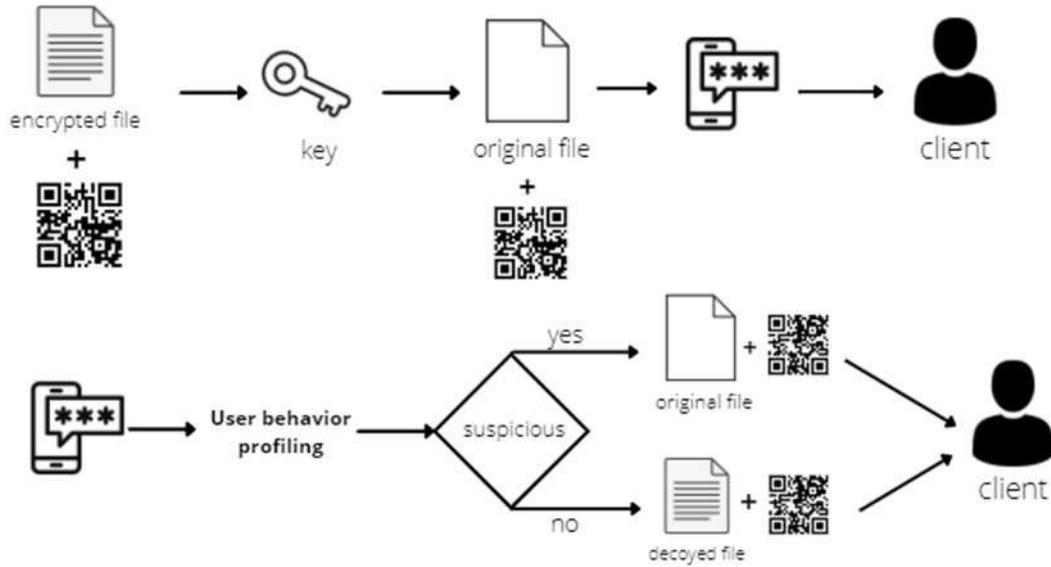
**Level 4:**

**Level 4**



*Fig 6.4. Top Secret*

In top secret level, the files are provided with OTP authentication and QR Code watermarking along with decoy technique and encryption using RSA Algorithm.



**Fig 6.5 Top Secret**

# CHAPTER 7

## MODULE DESCRIPTION

The system consists of four modules:

- ❖ **Module 1: Admin Login**
- ❖ **Module 2: Employee Registration**
- ❖ **Module 3: Employee Login**
- ❖ **Module 4: Uploading files and classification.**

### 7.1 MODULE 1: ADMIN LOGIN

Admin Login refers to the part in which the admin logs in to the website with the admin's login credentials. The admin is responsible for the management of the employees. He/she can view the uploaded files and feedback of the employees.

In this module the admin is able to login to his admin homepage by entering the admin username and password, which is 'admin' and 'admin' respectively. By entering the correct credentials, he/she would be directed to the admin homepage. The homepage comprises of 4 tabs:

- ❖ Manage employees
- ❖ View files
- ❖ View Feedback
- ❖ Logout

### 7.2 MODULE 2: EMPLOYEE REGISTRATION

Under the Manage Employees tab, the admin can add, delete and update Employees. The necessary details such as the employee's name, phone, place along with username and password has to be specified under the corresponding spaces.

After registering an employee, the particular employee will be provided with an email specifying that they are successfully registered along with their username and password. These details would be sent to the email id specified by the admin while filling the form.

With this Login credentials, the employee can login to their platform in the application. The email will also be comprised of some information's regarding the application, by which they could easily understand and use the application.

### 7.3 MODULE 3: EMPLOYEE LOGIN

In the application, before the employee logs in to their session, they should first set up their IP. After setting up their IP, they would be asked to login. There, the username and password provided in the mail should be used.

After logging in, the employee is given these options in their homepage:

- ❖ Edit Profile
- ❖ Upload Files
- ❖ Add Feedback

In Edit Profile session, the employee can edit their profile which was first given by the admin. In Upload Files, the user can view their uploaded files and can also add new files. In Add Feedback session, the employee can add their feedback on the application and its working.

### 7.4 MODULE 4: UPLOADING FILES AND CLASSIFICATION

In the upload files session from the employee home page, the employee can either view his/her files or add a new file. The employee can select the new file from gallery which needs to be stored securely in the application. After selecting which file to upload, they are asked to choose from which level of category they want to upload the file. The levels specified are the following:

❖ **Public:**

In Public level, the uploaded file will be just stored. Anyone can access and view it. It can be treated as a public property.

❖ **Confidential:**

In Confidential level, the uploaded file will be stored by securing it with encryption. The algorithm used to encrypt the file is RSA algorithm. RSA (Rivest–Shamir–Adleman) is a public-key cryptosystem that is widely used for secure data transmission. In a public-key cryptosystem, the encryption key is public and distinct from the decryption key, which is kept secret (private). An RSA user creates and publishes a public key based on two large prime numbers, along with an auxiliary value. The prime numbers are kept secret. Messages can be encrypted by anyone, via the public key, but can only be decoded by someone who knows the prime numbers. The security of RSA relies on the practical difficulty of factoring the product of two large prime numbers, the "factoring problem". Breaking RSA encryption is known as the RSA problem. Whether it is as difficult as the factoring problem is an open question. There are no published methods to defeat the system if a large enough key is used.

RSA is a relatively slow algorithm. Because of this, it is not commonly used to directly encrypt user data. More often, RSA is used to transmit shared keys for symmetric-key cryptography, which are then used for bulk encryption–decryption.

The RSA algorithm involves four steps: key generation, key distribution, encryption, and decryption.

A basic principle behind RSA is the observation that it is practical to find three very large positive integers  $e$ ,  $d$ , and  $n$ , such that with modular exponentiation for all integers  $m$  (with  $0 \leq m < n$ ) and that knowing  $e$  and  $n$ , or even  $m$ , it can be extremely difficult to find  $d$ . The triple bar ( $\equiv$ ) here denotes modular congruence. (In simple terms, modular congruence means that when you divide  $(me)d$  by  $n$  and divide  $m$  by  $n$ , each has the same remainder.)

In addition, for some operations it is convenient that the order of the two exponentiations can be changed and that this relation also implies

RSA involves a public key and a private key. The public key can be known by everyone and is used for encrypting messages. The intention is that messages encrypted with the public key can only be decrypted in a reasonable amount of time by using the private key. The public key is represented by the integers  $n$  and  $e$ , and the private key by the integer  $d$  (although  $n$  is also used during the decryption process, so it might be considered to be a part of the private key too).  $m$  represents the message (previously prepared with a certain technique explained below).

#### ❖ Secret

In secret level, the files are securely stored by providing them with QR Code watermarking along with RSA algorithm.

The aim of QR code watermarking approach, is to embed a QR code symbol within one of the DWT (Discrete Wavelet Transform) sub-bands of a digital image. Within the frequency domain, the strength of the embedded watermark can be adjusted based on the desired tradeoff between imperceptibility and robustness.

#### ❖ Top Secret

In top secret level, the files are provided with OTP authentication and QR Code watermarking along with decoy technique and encryption using RSA Algorithm.

## CHAPTER 8

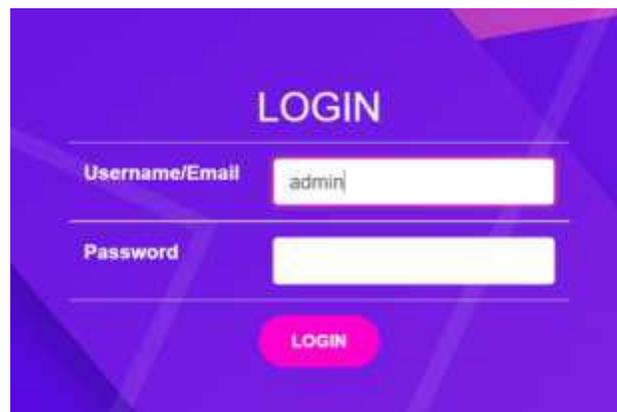
# IMPLEMENTATION

The admin interface part:

- The system is a website. There the admin can login with their login credentials.
- The website can access using the corresponding ip address and host address.

Under the Manage Employees tab, the admin can add, delete and update Employees. The necessary details such as the employee's name, phone, place along with username and password has to be specified under the corresponding spaces. After registering an employee, the particular employee will be provided with an email specifying that they are successfully registered along with their username and password. These details would be sent to the email id specified by the admin while filling the form. With this Login credentials, the employee can login to their platform in the application. The email will also be comprised of some information's regarding the application, by which they could easily understand and use the application.

**Step 1:** Open the website and login with admin credentials where he/she can add or manage employees, view feedback and files uploaded by the employees



*Fig 8.2. Login*

**Step 2:** To Add or manage employee, click on manage employee tab from admin homepage.

*Fig 8.2. Manage Employee*

**Step 3:** To view files uploaded by the employees, click on view files tab from admin homepage.

**Step 4:** To view feedback given by the employees, click on view feedback tab from admin homepage.

**Step 5:** Click on logout tab to logout from the current session.

Sl.no	File Name	File Type	File Path	Date
1	gsgs	Type1		2022-02-16
2	ysys	Type1		2022-02-16

*Fig 8.2. View Uploaded Files*



## View Feedback

Sl.no	Employee ID	Employee Name	Feedback	Date
1	21	Maggy	It is very nice.	10/12/2019
2	23	Maggy	It meant the world to me..	05/12/2021
3	24	Dona	It is wonderful	08/12/2021
4	21	Maggy	hi everyone	2022-02-01
5	21	Maggy	Niz app	2022-02-21

*Fig 8.2. View Feedback*

The Employee interface part:

- The employee interface is an application. The host and ip address of both the website and the application will be the same. It cannot be run unless their host and ip address is the same.

In the upload files session from the employee home page, the employee can either view his/her files or add a new file. The employee can select the new file from gallery which needs to be stored securely in the application. After selecting which file to upload, they are asked to choose from which level of category they want to upload the file

- **Step 1:** Open the application and setup the IP.
- **Step 2:** Login with username and password.

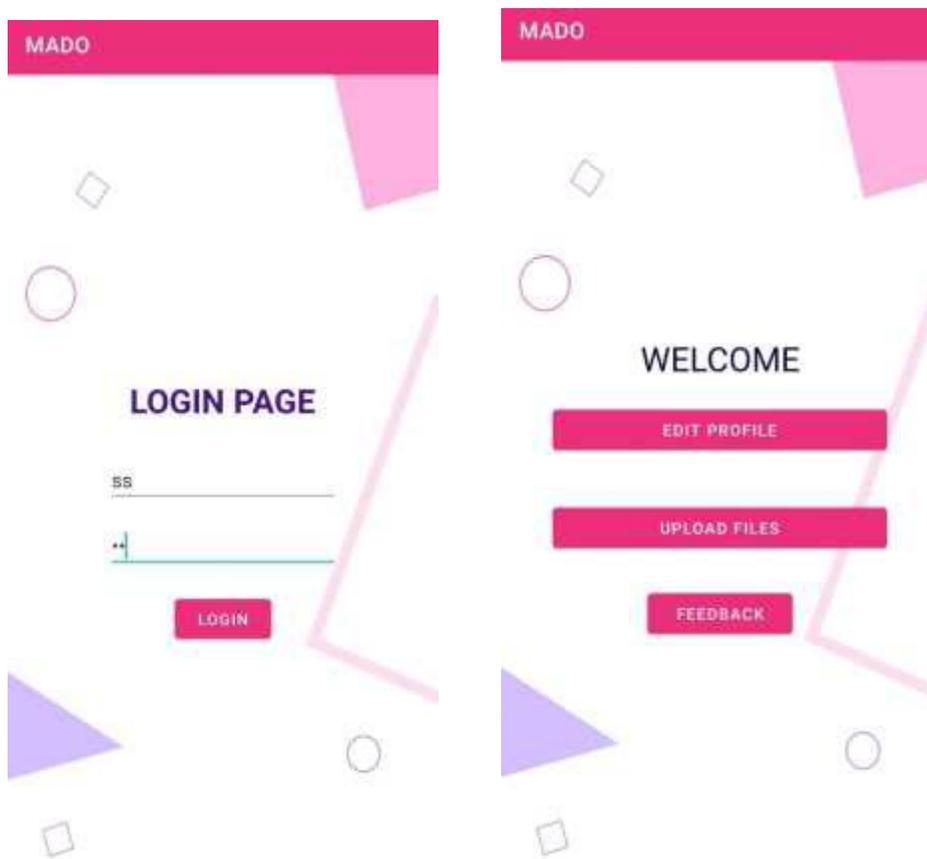


Fig 8.7. Login

In the application, before the employee logs in to their session, they should first set up their IP. After setting up their IP, they would be asked to login. There, the username and password provided in the mail should be used.

After logging in, the employee is given these options in their homepage:

- ❖ Edit Profile
- ❖ Upload Files
- ❖ Add Feedback

In Edit Profile session, the employee can edit their profile which was first given by the admin. In Upload Files, the user can view their uploaded files and can also add new files. In Add Feedback session, the employee can add their feedback on the application and its working.

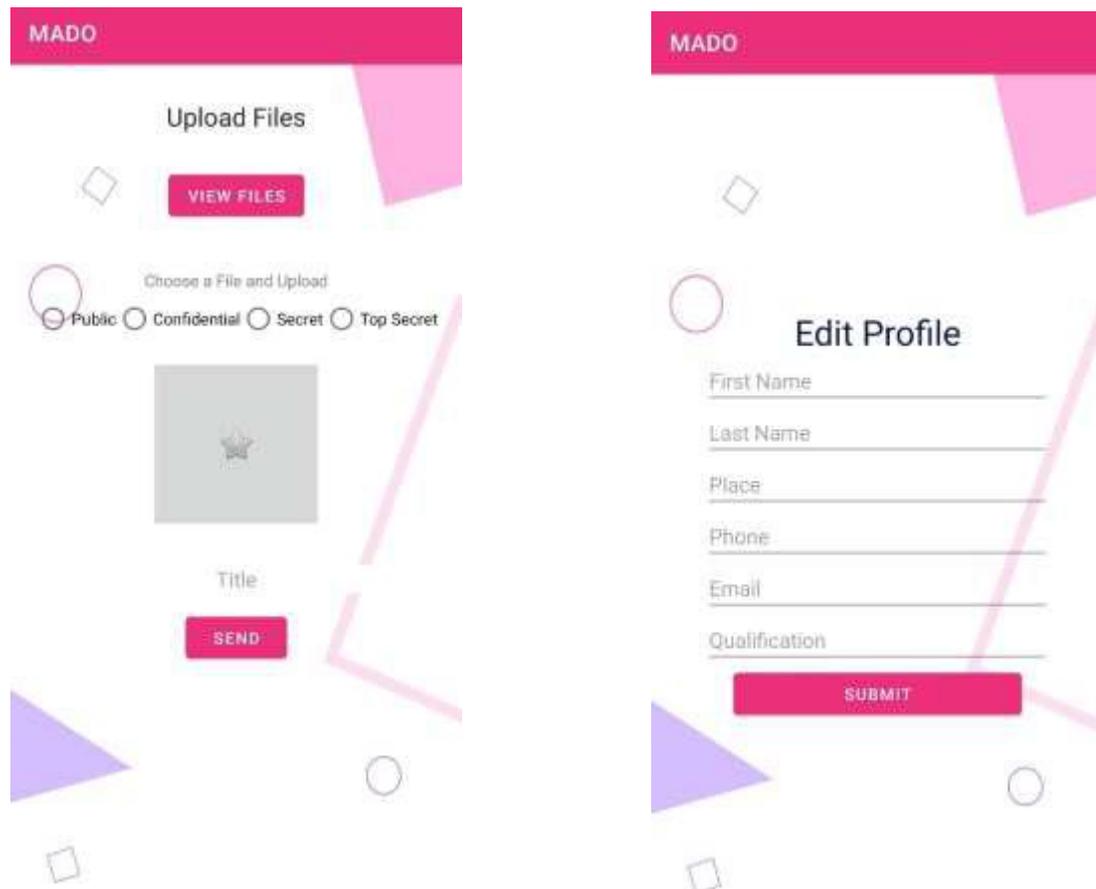
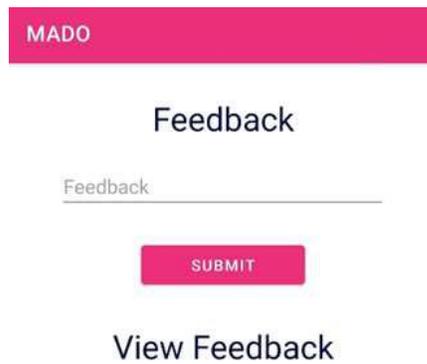


Fig 8.9. Application

**Step 3:** To upload files click on upload files button, choose the file to upload from gallery, choose the level (public, confidential, secret, top-secret) to which the file should be uploaded and name the file. To view the uploaded files click on view files button.



The screenshot shows a mobile application interface. At the top, there is a pink header bar with the text "MADO" in white. Below the header, the word "Feedback" is centered in a large, bold, black font. Underneath, there is a text input field with the placeholder text "Feedback" in a light gray font. Below the input field is a pink rectangular button with the word "SUBMIT" in white, uppercase letters. At the bottom of the form, the text "View Feedback" is centered in a bold, black font.

*Fig 8.9. Feedback*

## CHAPTER - 10

### CONCLUSION

In this paper, we propose a sensitivity based layered architecture that works for securing data and preserving its privacy in cloud environment. The proposed architecture reduces the overall overhead at the cloud service provider by implementing the layered based security mechanism. Considering the fact that data utility and security requirements may be quite different for different data, our adapt method maintains security and privacy at each layer differently while considering data utility. At each layer, hashing, encryption and watermarking schemes are innovatively and differently combined together to obtain a better balance between information security and utility. For the most sensitive data i.e. secret and top-secret data, the approach provides the mechanism to identify the malicious entities in the case of data leakage. As part of the protection of data mission in the cloud, this document focuses on protecting the user's original file within the cloud using decoy technique. For this purpose, another photo is maintained to provide to the intruder. That photo is kept secret. By default, the user accesses default image and the access to the original file is provided only after verifying the authenticity of the user. Thus, the original file is securely stored in the application and kept safe from intruders.

# CHAPTER - 11

## REFERENCE

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## CHAPTER 12

### APPENDIX

#### Source Code

```
from flask import *
from public import public
from admin import admin
from api import api

import smtplib
from email.mime.text import MIMEText
from flask_mail import Mail

app=Flask(__name__)
app.secret_key="project"

mail=Mail(app)
app.config['MAIL_SERVER']='smtp.gmail.com'
app.config['MAIL_PORT'] = 587
app.config['MAIL_USERNAME'] = 'madopvtltd@gmail.com'
app.config['MAIL_PASSWORD'] = 'maggydona5'
app.config['MAIL_USE_TLS'] = False
app.config['MAIL_USE_SSL'] = True

app.register_blueprint(public)
app.register_blueprint(admin,url_prefix='/admin')
app.register_blueprint(api,url_prefix='/api')

app.run(debug=True,port=5004)
```

#### #Android Upload File Source Code

```
public class FileUploadAsync extends
AsyncTask<Map, Void, String> {

    private String url;
    private HttpURLConnection con;
    private OutputStream os;
```

```

    private String delimiter = "--";
    private String boundary =
"SwA"+Long.toString(System.currentTi
meMillis())+"SwA";

    public JsonResponse json_response =
null;

    FileUploadAsync(String ur) {
        url = ur;
    }

    @Override
    protected String
doInBackground(Map... strings) {
        try {
            con = (URLConnection) (
new URL(url)).openConnection();
            con.setRequestMethod("POST");
            con.setDoInput(true);
            con.setDoOutput(true);

con.setRequestProperty("Connection",
"Keep-Alive");

con.setRequestProperty("Content-
Type", "multipart/form-data;
boundary=" + boundary);
            con.connect();
            os = con.getOutputStream();

            Iterator it =
strings[0].entrySet().iterator();
            while (it.hasNext()) {
                Map.Entry pair = (Map.Entry)
it.next();
                if
(pair.getKey().toString().equals("image"
)) {

addFilePart(pair.getKey().toString(),
"abc.jpg", (byte[]) pair.getValue());

```

```

        }
        else {

addFormPart(pair.getKey().toString(),
new String((byte[]) pair.getValue()));
        }
    }

        finishMultipart();
        return getResponse();
    } catch (Exception e) {
        Log.v("+++++",
e.toString());
    }
    return "";
}

    public void addFilePart(String
paramName, String fileName, byte[]
data) throws Exception {
        os.write( (delimiter + boundary +
"\r\n").getBytes());
        os.write( ("Content-Disposition:
form-data; name=\"" + paramName +
\""; filename=\"" + fileName + "\"\r\n"
).getBytes());
        os.write( ("Content-Type:
application/octet-stream\r\n"
).getBytes());
        os.write( ("Content-Transfer-
Encoding: binary\r\n" ).getBytes());
        os.write("\r\n".getBytes());

        os.write(data);

        os.write("\r\n".getBytes());
    }

    public void addFormPart(String
paramName, String value) throws
Exception {
        writeParamData(paramName,

```

```

value);
    }

    private void writeParamData(String
paramName, String value) throws
Exception {
        os.write( (delimiter + boundary +
"\r\n").getBytes());
        os.write( "Content-Type:
text/plain\r\n".getBytes());
        os.write( ("Content-Disposition:
form-data; name=\"" + paramName +
"\r\n").getBytes());
        os.write( ("\r\n" + value +
"\r\n").getBytes());
    }

    public void finishMultipart() throws
Exception {
        os.write( (delimiter + boundary +
delimiter + "\r\n").getBytes());
    }

    public String getResponse() throws
Exception {
        InputStream is =
con.getInputStream();
        byte[] b1 = new byte[1024];
        StringBuffer buffer = new
StringBuffer();

        while ( is.read(b1) != -1)
            buffer.append(new String(b1));

        con.disconnect();

        return buffer.toString();
    }

    @Override
    protected void onPostExecute(String
s) {

```

```
super.onPostExecute(s);
try {
    JSONObject jo = new
JSONObject(s);
    json_response.response(jo);
} catch (JSONException e) {
    e.printStackTrace();
}
}
```



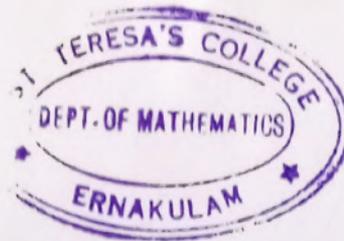
## CERTIFICATE

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. **MALAVIKA JAIN** 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

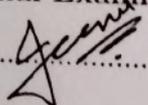
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**External Examiners**

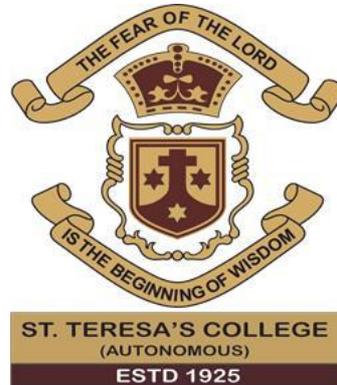
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# **OBSTACLE DETECTION DEVICE FOR VISUALLY IMPAIRED**

**ST.TERESA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**

*(Affiliated to Mahatma Gandhi University, Kottayam)*



## **PROJECT REPORT**

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

**BCA (CLOUD TECHNOLOGY AND INFORMATION  
SECURITY MANAGEMENT)**

*By*

**Manaal Kalam- SB19BCA012**

**&**

**Megha John- SB19BCA014**

**III DC BCA (CLOUD TECHNOLOGY AND INFORMATION SECURITY  
MANAGEMENT)**

*Under the guidance of*

**Ms. Neha Raju K**

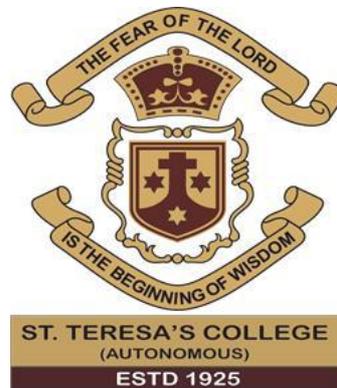
**DEPARTMENT OF COMPUTER APPLICATIONS**

**MARCH 2022**

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MANAGEMENT)**

*Under the guidance of*

**Ms. Neha Raju K**

**DEPARTMENT OF COMPUTER APPLICATIONS**

**MARCH 2022**

## DECLARATION

We, undersigned hereby declare that the project report, **Obstacle detection device for visually impaired**, submitted for partial fulfillment of the requirements for the award of degree of BCA St. Teresa's College (Autonomous), Ernakulam (Affiliated to Mahatma Gandhi University), Kerala is a bonafide work done by us under supervision of **Ms. Neha Raju K.** 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

Manaal Kalam-SB19BCA012

Megha John-SB19BCA014

**OBSTACLE DETECTION DEVICE FOR VISUALLY IMPAIRED**  
**ST. TERESA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**BCA (CLOUD TECHNOLOGY & INFORMATION SECURITY**  
**MANAGEMENT)**  
**DEPARTMENT OF COMPUTER APPLICATIONS**



**CERTIFICATE**

This is to certify that the report entitled **Obstacle detection device for visually impaired** submitted by **Megha John and Manaal Kalam** to St. Teresa's College, Cochin in partial fulfillment 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.

*for*  
*Neelav*  
*17/12/22*  
**NEHA RAJU K**

**Internal Supervisor**



**RAJI S PILLAI**

*for* **Head of the Department**

*for*  
*4/4/22*  
**External Supervisor**

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We convey our hearty thanks to our parents for the moral support, suggestion and encouragement.

## **ABSTRACT**

The paper, a stick guide model is represented for visually impaired persons to guide in their way, which consists of an IR sensor and an accelerometer along with a Bluetooth module. The stick is smart stick that will make the visually impaired persons guide their way.

The IR sensor embedded in the stick will detect obstacles and give a buzzer notification which will help the blind user to avoid the obstacles in his way. There is an accelerometer in the stick which will detect the fall of the blind user and send a character to the android device through Bluetooth module. From this android device after receiving the character corresponding to the fall of the user a text message will be sent to the parent or caretaker along with the location details of the blind user. The emergency button embedded in the stick will provide the provision to send emergency text messages to relatives or to caretaker.

For finding the stick using the android app the blind user can press a button in the app and the buzzer in the stick will turn on.

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**LIST OF ABBREVIATIONS**

<b>SL NO</b>	<b>ABBREVIATION</b>	<b>FULL FORM</b>
1	IoT	Internet of Things
2	IP	Internet Protocol
3	IR	InfraRed
4	LED	Light Emitting Diode
5	RAM	Random Access Memory

# CHAPTER 1

## INTRODUCTION

In this modern world, people live their lives happily. The daily needs can be satisfied with the help of modern environment. People with any defects can be solved and it does not have more pain to their regular life. But blindness is one of the problems. Due to that they lack their happiness.

The major sensory organ of a person is their eyes. One glimpse around us is enough to make us realize how visual is most of the information in our environment. Timetables in train stations, signs indicating the right way or potential danger, a billboard advertising a new product in the market, these are all the visual types of information we all come across in our daily life. Most of this information is inaccessible for the blind and the visually impaired, inhibiting their independence, since access to information signifies autonomy.

Dealing with sight loss, already, is a challenge in itself. The lack of emotional support at diagnosis centers, the limited accessibility to activities and information, the societal stigma and the lack of unemployment, are all factors frequently leading blind or low vision individuals in isolation. This last point illustrates how the problem for the visually impaired is not their blindness or lower vision in itself but their segregation from anyone else.

Being blind in a world suited for the sighted, it means there will be multiple normal mishaps. Stumbling upon an office chair that wasn't neatly tucked under the desk or knocking a glass off the table because it was left right on the edge, are small accidents that can happen and that's okay. However, such mishaps tend to be perceived by sighted individuals as the inability of the visually impaired to perform tasks, while, in reality, they stem from the inaccessibility of our world. Blindness or low vision does not indicate the intelligence of the individual nor how sad their life is. Just because the sighted cannot imagine their world without vision does not mean that the visually impaired have a sad or unhappy life because of their visual condition.

## **1.1 INTERNET OF THINGS (IoT)**

An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices -- for instance, to set them up, give them instructions or access the data.

The internet of things helps people live and work smarter, as well as gain complete control over their lives. In addition to offering smart devices to automate homes, IoT is essential to business. IoT provides businesses with a real-time look into how their systems really work, delivering insights into everything from the performance of machines to supply chain and logistics operations.

As such, IoT is one of the most important technologies of everyday life, and it will continue to pick up steam as more businesses realize the potential of connected devices to keep them competitive.

## **1.2 ANDROID APPLICATIONS**

Android is an open-source software stack that includes the operating system, middleware, and built-in mobile applications based on a modified version of Linux that device vendors can further customize to differentiate their products.

Android is a mobile operating system based on a modified version of the Linux kernel and other open source software, designed primarily for touchscreen mobile devices such as smartphones and tablets. Android is developed by a consortium of developers known as the Open Handset Alliance and commercially sponsored by Google. It is free and open source software. Android App is a software designed to run on an Android device. The term also refers to an APK file which stands for Android package. This file is a Zip archive containing app code, resources, and meta information. Apps can be written in Kotlin, Java, and C++ or any

such languages and are run inside Virtual Machine. The official development environment is Android Studio. Apps are normally distributed through app markets such as Google Play Store, so it is possible to enable installation from an APK file or via USB connection in device settings.

According to a recent survey it is found that more than 2000 malware applications are launched per day by different android markets. As in our view google playstore is the best and trustable market for the android applications. But it is in fact that there are no stable mechanisms to detect such a number of those new malwares. So as the first step google introduced a service named Bouncer. Bouncer is a service to detect malware in every application submitted in google play store. If an application is seen as malicious it is rejected from the store and the developers account, all the accounts from that IP address will be automatically banned. According to google it has been found that there is a 40% decrease in malware attack.

## CHAPTER 2

### LITERATURE SURVEY

There are some papers based on the iot based obstacle detection. These papers helped us to learn and understand things more deeply. It 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.

Arduino Powered Obstacles Avoidance for Visually Impaired Person(2018) by Ms. A. Aruna1 , Ms.Y.Bibisha Mol, Ms.G.Delcy and Dr.N.Muthukumar. The paper introduces a concept which is a shoe module. Normally human beings use shoes for their daily life . In general, blind people want support to walk. So, they wear shoes and have a cane. An Arduino board is attached to the shoe and in the cane. If any obstacle is present in front of the visually impaired person it can be detected by the shoe with the help of Arduino and if any staircase or other natural activities like running of water or any stagnant water present in front of the blind person ,it can be detected by the cane with the help of ultrasonic or TSOP sensors[1].

The proposed work includes the design of a lightweight adaptable cane with multiple sensors connected to an Arduino board, along with a handle head and sticks elongator. A conventional white cane forms the main base frame of the device, ultrasonic and infrared sensors are mounted at appropriate locations to detect obstacles and it can scan a predetermined area, both known and unknown locations around blind by emitting-reflecting waves with the help of that blind stick. The equipped sensors send signals to an Arduino programmed board, which communicates with the alarm unit that comprises a buzzer and vibrator[2] .

The device is a kind of the white cane to help blind people to scan their surroundings for obstacles or orientation marks. This device is equipped with an ultrasonic sensor, a water sensor, and a pulse heart sensor that will be mounted on a white cane to determine changes in the environment. Ultrasonic sensors are used to detect obstacles in front of it by utilizing ultrasonic wave reflection, water detection sensors to find out if there is a puddle or flooded ahead[3].

The proposed VI (Visually Impaired) Assistant System is developed to assist the visually impaired people with four modules which are obstacle recognition, obstacle avoidance, indoor and outdoor navigation, and real-time location sharing. The proposed system is a combination of smart glove and smart-phone application which works fine in the low light level also. The smart-phone-based obstacle and object detection is used to detect various objects in the surrounding[4].

Every person wants to be self-reliant even if he is a visually impaired person .This paper offers a system that helps these people. The system includes three Ultrasonic Sonar sensors, three Passive Infrared sensors (PIR sensor), raspberry pi, SD card, vibrator and headphones. All equipment is built into a mobile cane. The PIR sensors allow the proposed system to detect movable obstacles like walking people, vehicles etc around the user in the left, the right and the front[5].

The device is a kind of the white cane to help blind people to scan their surroundings for obstacles or orientation marks. This device is equipped with an ultrasonic sensor, a water sensor, and a pulse heart sensor that will be mounted on a white cane to determine changes in the environment. Ultrasonic sensors are used to detect obstacles in front of it by utilizing ultrasonic wave reflection, water detection sensors to find out if there is a puddle or flooded ahead[6]

The proposed smart cane is designed with obstacle detection module, heat detection, water detection, light detection, pit and staircase detection using InfraRed (IR) sensor, GPS (Global Positioning System), and GSM(Global System for Mobile) which helps them to accomplish his/her daily tasks with ease. The obstacle detection module uses ultrasonic range along with a camera to detect the obstacles which intimates that the obstacle is detected[7]

Smart cane for assisting visually impaired people " to overcome the problems they face in their daily life. The device is a low cost and lightweight system that processes signals and alerts the visually impaired over any obstacle, potholes or water puddles through different beeping patterns. It senses the light intensity of the environment and illuminates the LED accordingly. These are accomplished by incorporating two ultrasonic sensors, a moisture sensor and a LDR sensor along with an Arduino Nano micro-controller. These are placed at specific positions of the cane for efficient guidance. Moreover, a GSM module is also added to the system so that

the visually impaired person can send a message to the emergency contact number in case of distress[8].

The paper describes the use of Arduino on ultrasonic blind walking stick. The blind handle is safer for a person to walk. The bar senses the item before the individual and provides the consumer with a vibrational answer or on demand[9].

The paper describes a real-time system which makes use of the ultrasonic sensor, camera, and smartphone for detection, recognition and processing of objects that hinders the path of a visually impaired person. Ultrasonic sensors detect and measure the distance of obstacles while image captured from a camera is used for object recognition. The output given to the user is in the form of vibration and audio. The intensity of the output depends on the distance of an object from the user.[10]

## CHAPTER 3

# EXISTING SYSTEM

### 3.1 OVERVIEW

Shoe module consists of an ultrasonic sensor which helps to detect the obstacle in front of the user. The Nordic radio frequency is used to receive the signal from the obstacle and it is given to the buzzer. Cane is also used in our method which is also used to detect the obstacle by ultrasonic sensor and TSOP sensor and the raindrop that is the stagnant water can be detected by using rain drop detector and NRF receiver is used to get the signal from the shoe and finally the vibration motor gets vibrated and the buzzer gives alert to the blind person.

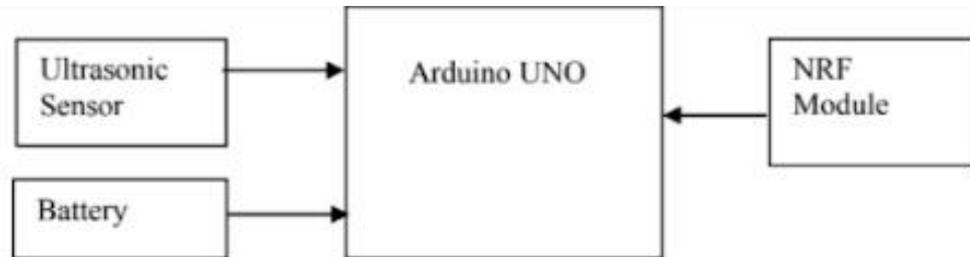
In this project we have the proposed idea that we have two modules. One is the shoe module and the other one is the cane module. Cane module is the primary module and shoe module is the secondary module two have combined these two modules. The NRF module can easily transmit the signal. Our system has been used to detect the water by the rain drop detector and other obstacles like staircase detection can be identified.

Ultrasonic sensors generate a pulse continuously if any obstacle is present in front of the sensor then the signal is given to the cane. Simultaneously the buzzer sound is produced. Ultrasonic sensor generates the pulse continuously along with the TSOP sensor sensing. The time delay between the ultrasonic sensor and TSOP sensor is identified as Staircase. Then the buzzer sound is produced and the vibration motor gives alert to visually impaired persons. If a drop of water is detected by the water drop sensor ,then the buzzer sound is given to blind person. If it is not detected then the above detection process will be continued.

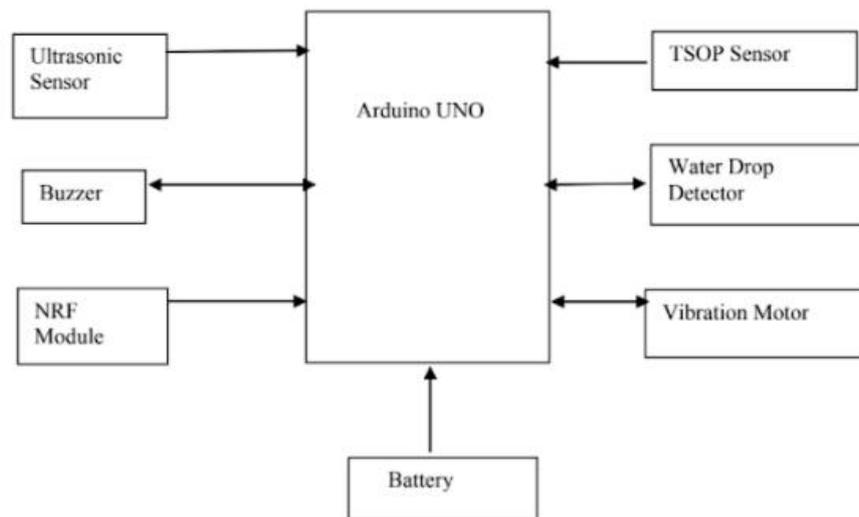
In Shoe Module ultrasonic waves are coming out of it continuously. If any obstacle is present in front of the shoe, the ultrasonic sensor senses the signal and transmits it to the NRF module. Then the NRF transmitters transmit the signal to the NRF receiver which is placed in the cane.

Cane receives the NRF signal, automatically it sends the signal to the buzzer and it will turn on along with the buzzer sound, and the vibration motor gives its own vibration alert to the visually impaired person. TSOP sensor is placed in the bottom of the cane it transmit the signal simultaneously with ultrasonic waves. If any staircase is found in front of the sensor it gives alert to the blind people by giving continues buzzer sound along with the vibration alert.

### 3.2 BLOCK DIAGRAM



**fig 3.1** block diagram of existing system cane module



**fig 3.2** block diagram of existing system shoe module

### 3.3 DRAWBACKS

Although the system works successfully, it has some drawbacks. This system cannot help or protect the person in case of unforeseen emergencies like if the person feels uneasy at some point of time.

# CHAPTER 4

## PROPOSED SYSTEM

### 4.1 Overview

Obstacle detection and warning can improve the mobility as well as the safety of visually impaired people specially in unfamiliar environments. For this, firstly, obstacles are detected and localized and then the information of the obstacles will be sent to the visually impaired people by using different modalities such as voice, tactile, vibration.

This proposed methodology is designed to create a smart blind stick for visually disabled person. They rely upon their families for portability and guidance. Their versatility contradicts them from associating with individuals and social exercises. Before, various frameworks are structured with restrictions without a strong comprehension of the any visual observation. Analysts have gone through the decades to build up an insightful and shrewd stick to help and caution outwardly weakened people from obstructions and give data about their area. People who can't see may face many difficulties to connect to the environment. It's very difficult for a blind people to detect the obstacles in front of them unless and until the stick touches it. With a normal stick, they will use tap method in which stick is continuously tapped on the ground continuously to find the optical nearby but it is not sufficient. This is the reason why they are dependent on their family or people nearby.

#### *Summarizing our system*

1. The system detects obstacles that are in front of them
2. The system has an accelerometer that will detect fall
3. The system has emergency button that the person can use in case he/she has an emergency.
4. It has a button that can be used if the person misplaces the system

The Project proposing is a smart guide stick.

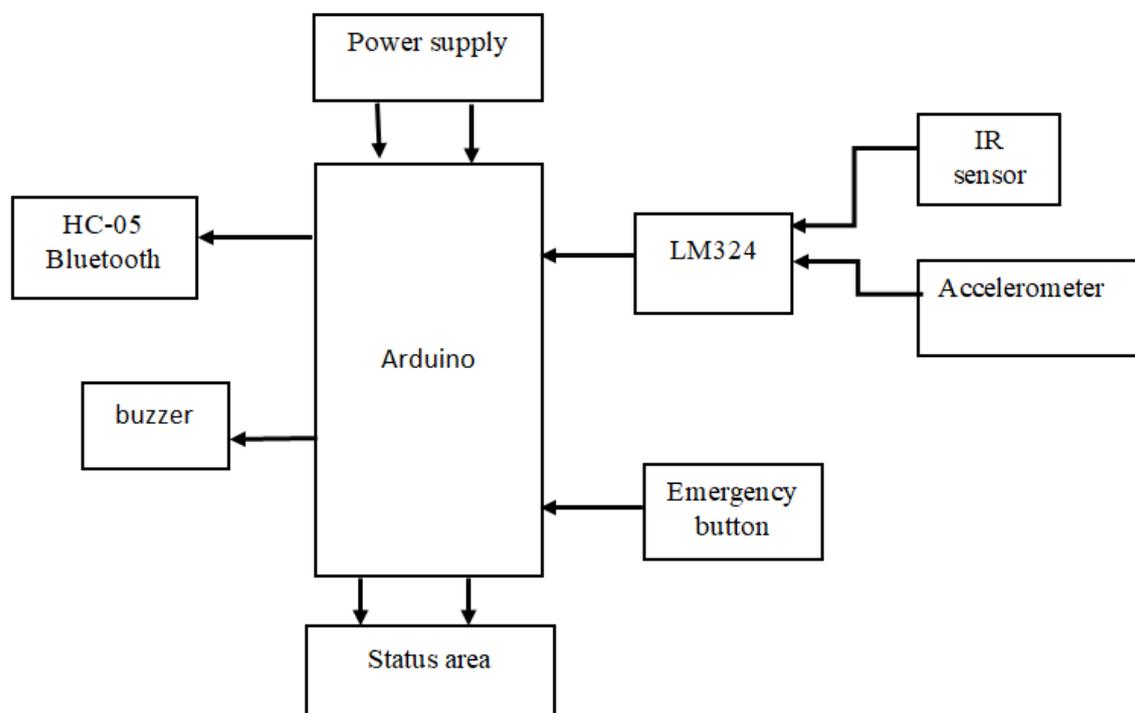
The IR sensor embedded in the stick will detect obstacles and notify the user to avoid the obstacles in his way , using a vibrator motor .

There is an accelerometer in stick which will detect fall of the blind user

The emergency button embedded in the stick will provide the provision to send emergency text message to relative or to caretaker.

For finding the stick using the android app the blind user can press a button in the app and the buzzer in the stick will turn on

## 4.2 BLOCK DIAGRAM



**fig 4.1** block diagram of proposed system

**The components are mentioned below:**

### a. Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the

microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

#### **b. IR Sensor**

An infrared sensor (IR sensor) is a radiation-sensitive optoelectronic component with a spectral sensitivity in the infrared wavelength range 780 nm ... 50  $\mu$ m. IR sensors are now widely used in motion detectors, which are used in building services to switch on lamps or in alarm systems to detect unwelcome guests. In a defined angle range, the sensor elements detect the heat radiation (infrared radiation) that changes over time and space due to the movement of people.

#### **c. Accelerometer -ADXL335**

An accelerometer is an electronic sensor that measures the acceleration forces acting on an object, in order to determine the object's position in space and monitor the object's movement. Acceleration, which is a vector quantity, is the rate of change of an object's velocity (velocity being the displacement of the object divided by the change in time). Here the accelerometer is used to detect the fall of the person.

#### **d. HC-05 Bluetooth Module**

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC.

#### **e. Buzzer**

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

#### **f. LM324**

LM324 is a comparator IC. Comparator circuit compares two voltages and outputs either a 1 (the voltage at the plus side; VDD in the illustration) or a 0 (the voltage at the negative side) to indicate which is larger. Comparators are often used, for example, to check whether an input has reached some predetermined value.

Here, it is used to convert analog signals to digital signals.

**g. Status Area**

Status area will have three LED's

- i Red LED-To check if the power supply is sufficiently reaching the board.
- ii Status LED-To check if the program in the arduino is running correctly.
- iii Data LED- To check the flow of data.

**h. Emergency Button**

This button is used so that the person can notify the caretaker or his/her parents in case of an emergency.

# CHAPTER 5

## SYSTEM REQUIREMENTS

### 5.1 SOFTWARE REQUIREMENTS

- Coding platform
- Android application
- Any operating systems (windows, Linux....etc)

### 5.2 HARDWARE REQUIREMENTS

- 8GB RAM
- Hard Disk
- i3 processor
- Monitor
- Keyboard
- Mouse
- IR sensor
- Accelerometer
- Buzzer
- Vibrator
- Bluetooth module
- Touch sensor

## CHAPTER 6

### MODULE DESCRIPTION

**This System consists of 3 Modules:**

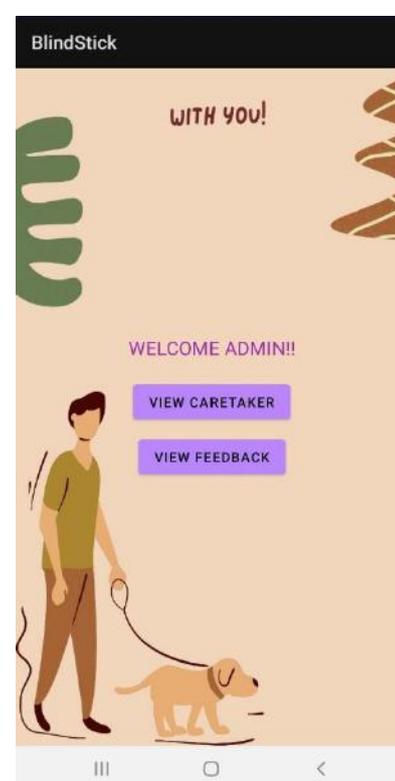
- **Module 1:** Admin
- **Module 2:** Caretaker
- **Module 3:** Blind

#### 6.1 MODULE 1: ADMIN

Admin has the highest authority in our system. They view and manage user permissions. They have whole control of the system and can also manage both caretaker and blind. They can enter using the username and password. The admin can add or remove the caretaker and also view the feedbacks that is given by the caretakers.



**fig 6.1.1** login



**fig 6.1.2** welcome page



**Fig 6.1.3** view caretaker.



**Fig 6.1.4** view feedback

## 6.2 MODULE 2: CARETAKER

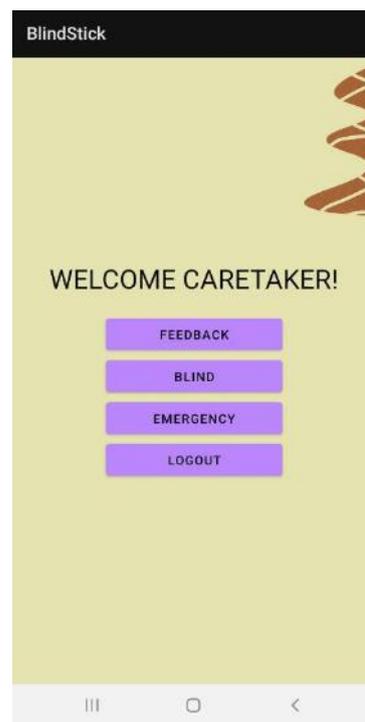
He is the one that gives physical or emotional care and support and serves as caretaker to the younger children but in this context it is a person that supports and takes care of the visually impaired. It is possible to either register the caretaker or login as one. When logged in as a caretaker viewing any emergencies, giving feedbacks, view and track location in case of emergency can be done. The number registered as the caretaker is where the SMS is sent to.



**Fig 6.2.1 Register**



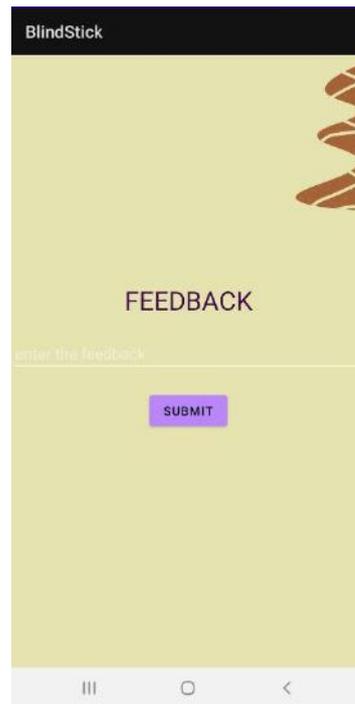
**Fig 6.2.2 Login**



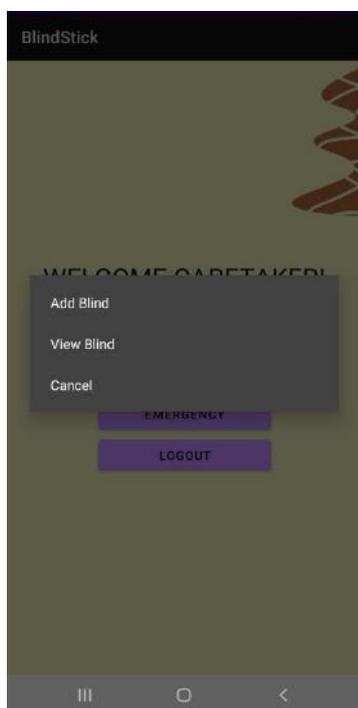
**fig 6.2.3 Home page**



**fig 6.2.4** View Emergency



**Fig 6.2.5** Add Feedback



**fig 6.2.6** Manage Blind



**fig 6.2.7** view emergency

### 6.3 MODULE 3: BLIND

When logged in as blind the initially we will have to connect to the Bluetooth module that is present in the stick. This way we connect the android phone to the stick which is important since in case of any emergency when the emergency button is pressed a character is sent to the android application via Bluetooth which will in turn send an emergency notification along with the GPS location to the caretaker. In case of unforeseen situations also the same above mentioned process takes place.



**Fig6.3.1** Register



**fig 6.3.2** Welcome Page

## CHAPTER 7

### IMPLEMENTATION

The system proposed is a smart stick that helps the visually impaired guide their way and detect any obstacles in front of them. It is a known fact that visually impaired people are the ones that struggle's the most. They always need someone to guide them and take care of them. And in case of an emergency in the absence of any caretaker they cannot ask for help.

The developed android application is installed in the phone. Firstly the registered blind should log in to the application using username and password with the help of the admin or the caretaker. We are then prompted to the welcome page. In the welcome page by choosing Bluetooth it connects the phone to our device using HC05 Bluetooth module present in the device. Once the blind is logged in and it connects to the bluetooth it remains running in the background. This is also done with the help of the admin or caretaker.

The stick basically detects any obstacles in front of them and the signal is send to both the buzzer and vibrator. This is done using IR sensor. It also has an accelermeter that detects the fall. When the person trips and fall down the accelerometer detects it and sends a character to the phone through the Bluetooth module. This character on reaching the phone automatically sends a SMS to the registered caretaker along with the GPS location. In case of emergency, for instance the blind feels uneasy or dizzy then another corresponding character is send to the phone and an emergency message is sent to the caretakers phone.

All of this is possible only if the stick is with the blind. In case the blind misplaces it, He/ She can use the phone to press the switch which will in turn activate the buzzer. The volume button in our phone is the switch that is pressed to turn on the buzzer.

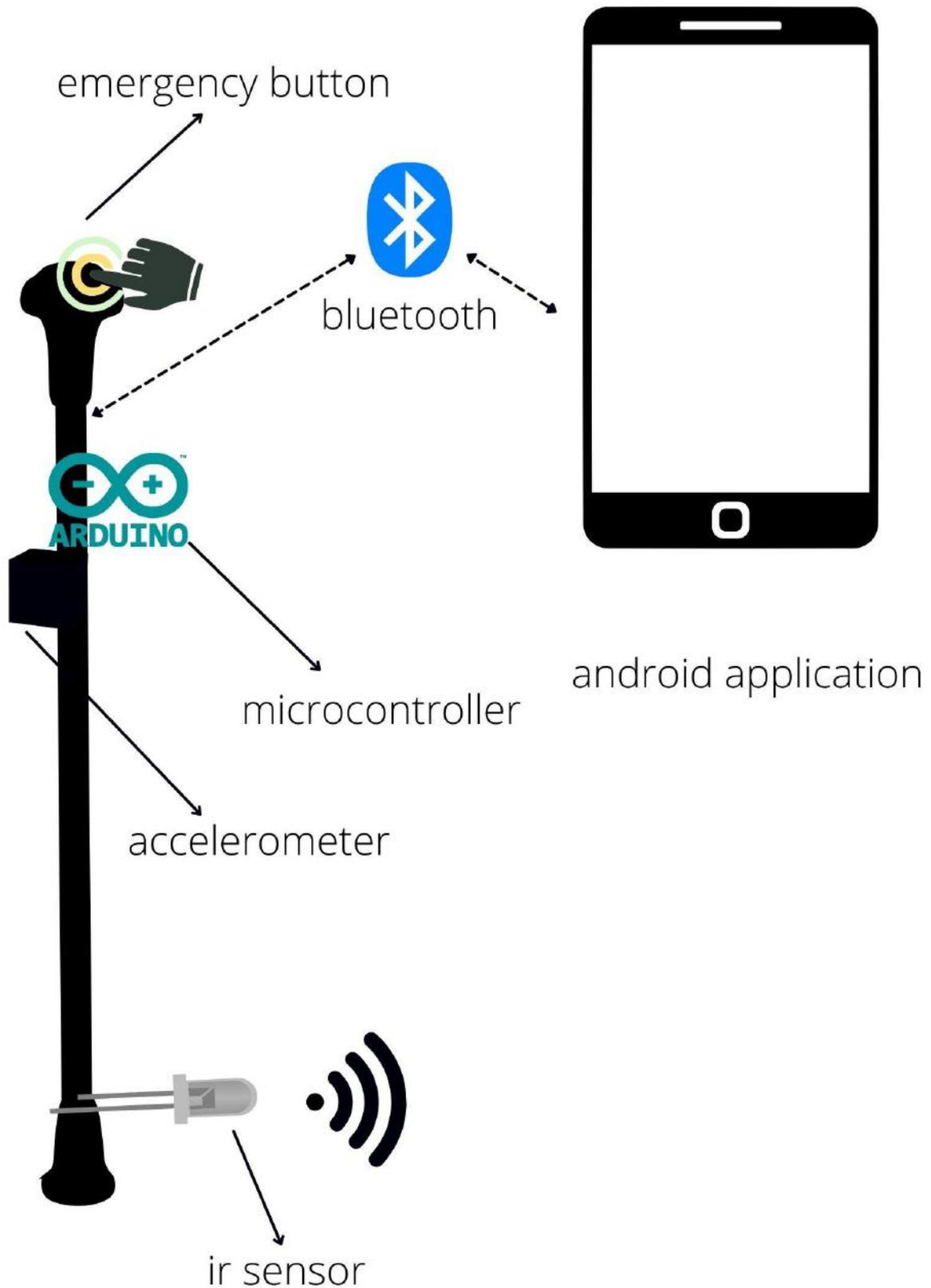


fig 7.1 smart stick

## CHAPTER 8

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## APPENDIX

### api.py

```
@api.route('/CaretakerViewlocation')
```

```
def CaretakerViewlocation():
```

```
    data={ }
```

```
    id=request.args['id']
```

```
    q="select * from location where blind_id='%s'" %(id)
```

```
    res=select(q)
```

```
    if res:
```

```
        data['status']="success"
```

```
        data['data']=res
```

```
    else:
```

```
        data['status']="failed"
```

```
    data['method']="CaretakerViewlocation"
```

```
    return demjson.encode(data)
```

```
@api.route('/CaretakerViewemergency')
```

```
def CaretakerViewemergency():
```

```
    data={ }
```

```
    id=request.args['id']
```

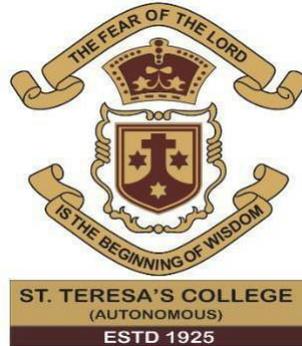
```
    q="select * from emergency inner join blind using(blind_id) where  
    caretaker_id=(select caretaker_id from caretaker where login_id='%s')" %(id)
```

```
    res=select(q)
```

```
    if res:
```

```
        data['status']="success"  
  
        data['data']=res  
  
    else:  
  
        data['status']="failed"  
  
    data['method']="CaretakerViewemergency"  
  
    return demjson.encode(data)
```

**THE ART OF BECOMING: A STUDY OF THE FILM  
NOMADLAND THROUGH THE THEORETICAL LENS  
OF NOMADIC HUMANITIES**



*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 “The Art of Becoming: A Study of the Film *Nomadland* through the Theoretical Lens of Nomadic Humanities.” is the record of bona fide work done by me under the guidance and supervision of Ms. Vinitha John, Assistant Professor, Department of English.

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March 2022

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## **CERTIFICATE**

I hereby declare that this project entitled “The Art of Becoming: A Study of the Film *Nomadland* through the Theoretical Lens of Nomadic Humanities.” by Maria Anto Padinjarekara is a record of bona fide work carried out by her under my supervision and guidance.

Ms. Vinitha John

Department of English

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St Teresa’s College (Autonomous)

March 2022

Ernakulam

**An Abstract of the Project entitled**

**The Art of Becoming: A Study of the Film *Nomadland* through the Theoretical Lens of Nomadic Humanities.**

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**March 2022**

**Supervising Teacher: Ms. Vinitha John**

A nomad is someone who dares to explore creation in all its nuances. Their stories are a reflection of their trailblazing legacy of self-discovery and forbearance. Tucked away in the center of boondocks, all they carry within themselves is a passion to globe-trot in their vans. The Project titled, “The Art of Becoming: A Study of the Film *Nomadland* through the Theoretical Lens of Nomadic Humanities” is an attempt to probe into the makeshift communities of vagrants, the female protagonist’s existential crises and the becoming woman nomad’s mellow juxtaposition next to the natural world, perusing the works of philosophers, John Dewey and Rosi Braidotti. The fulcrum of this work is to figure out their remarkable livelihood following the footfalls of Fern, an amateur rover in her sixties forging intrinsic social connections, within the theoretical fabric. The theory applied to sift this pattern is ‘Nomadic Humanities’. Another term that will be briefly looked at from the theoretical perspective is Jacques Derrida’s ‘Phallogocentrism’ and how nomadic women dislodge this idea, onwards and upwards.

## **ACKNOWLEDGEMENT**

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Maria Anto Padinjarekara

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## Introduction

When things seem bleak, strut out of the place and hit the road. This is basically what nomads do; they redefined the traditional concept of a home. The 2021 Oscar contender *Nomadland*, won the hearts of citizens globally, with its genuine portrayal of American life in the Midwest. The writer and director of the movie, Chloé Zhao was proclaimed the first woman of colour to seize the Academy award for her impeccable direction, projecting a vibrant cast comprising real-life nomads. Her works mostly encapsulate self exploratory journeys of identifying with the microcosm of the living world. Indeed, the tale of a nomad is one such genre: the protagonist of the film, Fern, is an amateur globetrotter who deliberately chooses the life of a maverick, an uncommon sphere for a woman to thrive in. The other feminine actors seem to embody a spirit like that of Fern's, resolute to create their existence on earth symbolic. They customize their vans in order to fit their purpose, park and travel before the light breaks in through the clouds. The Rubber Tramp Rendezvous curated by a veteran nomad, Bob Wells [chief of the tribe] is where the community of van dwellers gather to get steeped in the lessons to become a successful nomad. All of those who have come here not to dominate, nevertheless be all ears to the emotional rollercoasters of fellow nomads from different parts of the U.S, seem to be torn between the acknowledgement of suffering self and suffering others.

Various theories have been formulated with regard to the life of nomads in order to trace their external situation and cross-cultural interactions, history and patterns of movement plus the factors influencing their decision to eke out the life of a pioneer. The incipient journey to becoming nomad requires understanding of various impediments that are likely to cross in the form of familial ties, relationships and loneliness, as revealed through Fern's lens. However,

what adds a silver lining to their otherwise dull episode is the interaction with the campers who have similar stories to confide in.

This work of reality-cum-fiction holds a legion of themes, ranging from identity and existential crises, capitalist hegemony in the modern world, social commitment, fraternity, globalization to the resplendent aura of Mother Earth. The philosophers, John Dewey and Rosi Braidotti are whose lines, that will be taken into account in the forthcoming chapter one of this project. Dewey deems man as a creature who is overwhelmed by the munificence of nature; he wittingly focusses on the juxtaposition of history with science and geography. Braidotti looks at coexistence as an ideal means of survival and goes on further to put forth the benefits of heteronomy, advocating for a multifaceted approach, where dominant categories wane and minorities emerge. Right after analyzing the term 'Phallogocentrism' coined by Jacques Derrida, the other post-structuralists took a chance to lend a feminine transition to this concept by preferring the more mobilized nomadic women over the highly indolent sedentary category of females. The thoughts of Catharine.R.Simpson have contributed significantly to a more accurate representation of their studies by elucidating types of nomads that are forged over decades.

Here, the first chapter named 'Nomadic Studies: A Conceptual Framework' explores ideas of home geography, essence of a thinking mind, post-humanist practices and the unconventional modes of becoming a woman nomad et al. posited by acclaimed reformers such as Dewey, Derrida and Braidotti. The second chapter titled 'Highlighting the Transition and Discovery in *Nomadland*' gives a brief outline of the nomadic life of the protagonist within the theoretical framework. The third chapter, 'American Homecoming: Woman Returns to Nature' is written in the form of a realism infused ode to the magnificent nature. It ends on a grateful

note, because this motion picture could not have been recognized as what it stands for today, should it be without the long stretched landscapes, shot within the natural environment.

## Chapter 1

### Nomadic Theories: A Conceptual Framework

The term 'Nomad' is worldwide acknowledged and understood as a fellow traveller with no permanent abode or place of residence, building intricate relations within nature as a whole, through purposeful interactions. A study of historical patterns of these movements constitutes 'Nomadic'. This act of unbridled motion can be carefully looked at as flows of exile, mass mobility as well as compelled dislocation from territories or more specifically, as diaspora. A much formulaic definition of Nomadic Humanities was put forward by Helen Small in her 2013 book, *The Value of the Humanities*, as the "study of the meaning-making practices of human culture, past and present, focusing on interpretation and critical evaluation" (Small 4). What makes the life of nomads extraordinary is the farrago of movements that inadvertently create a juxtaposition of individual symmetries, languages, cultures, creeds, cobwebs, ideas and landscapes. Their living conditions can alter, similar to that of a savage minimalist to adequacy. According to Catharine. R. Simpson, four types of nomads have been discovered so far. One is the modern nomad, occupying the higher echelons of class structure such as woman trailblazers. The second category of travellers is the self-aware explorers on the lookout for specks of stardust and adventure. Further, the third type comprising gap-year students and a concluding fourth of this series are the older folks voyaging in gigantic traveller buses, uber cool turbos and snazzy mule vehicles. In a more rigorous tone, James Clifford addresses them as "post modern primitivist figures".

A fourteenth century Arab sociologist, Ibn Khaldûn's theory of relation between "Bedouin civilization" and "sedentary people", served as a pathway for nomadic studies.

This Arab sociologist and philosopher is the versatile founder of a myriad of proto-disciplinary areas in the field of humanities. A detailed study of Nomadic Humanities can possibly do justice to the history of wanderers, their cultures and practices. Spaciously performed, Nomadic Humanities takes up prosaic processes and complex meanings of alluring movements within the nomadic sphere, as established in arts [visual arts and literature], letters, sciences and a plethora of languages at a planetary level. The two theorists, John Dewey and Rosi Braidotti, provide a more theoretical framework for an ideal representation of nomadic humanities. The texts they wrote differ in context, ideology, genre and perspective.

Two pivotal doctrines for a better understanding of nomadic humanities are woven intricately in Dewey's *Democracy and Education: An Introduction to the Philosophy of Education*. First and foremost, he points to the notion of thinking that pushes homo sapiens forward; secondly he draws attention to the essence of the thinking mind. The shared interests that are laid out and communicated between individual beings measure the worth of any social life. He starkly remarks two viruses that impede processes of thinking, visualizing, sharing and educating, one of which is the staunch division of life into bricks of dualities and a second contagion of the fixity of habit that had snowballed into an even more bigger laid back thing over the years; as humans becoming increasingly allergic to change, evolution, "the uncertain and the unknown" (Simpson). Dewey advocates for us to move forward with a cross-curricular approach that predominantly focuses on the juncture of three major disciplines- history, geography and science. His thought considers man as someone who benefits from the prolificacy of nature and whose actions are in continuous alignment with nature's movements. Another great idea Dewey brings to notice is the notion of home geography, considering home as an initial point from where man decides to step out into the wild.

A striking resemblance between the definitions of humanities and humanism can be mystifying at one glance. The two differ from each other in terms of its study of the human, where the latter emphasizes the consolidated belief in the human abilities. A Deweyite language acted as a prompt to discover three extensive capacities of global citizens: To start with, a nudge to broaden consciousness; furthermore an ability to picture oneself as a fellow member of a large heterogeneous system or nation; ultimately, the capacity to read a chronicle of the life of a different man. With that, Dewey anticipates us to think, act and expand our consciousness in a way that cultivates more discipline as well as meaning to this realm.

A much pluralistic theorist discovering the posthuman-self angle of a nomad is Rosi Braidotti. She speaks of 'problems' rather than an individual problem. According to Braidotti, the problem with philosophy is to figure out the meaning as we unfold or determine the actual that lies beneath the surface. As Bradotti pens down in her book *Nomadic Theory*, in the same moment, it [new situation] can auxiliarily leave us all the more excited and depleted. This concept is said to have a thundering effect on readers. Thus, it calls for a more logical reason to analyze it and an imaginative incentive to carry it forward. Nomadic politics examine the significance of becoming democratic to bring in discussions, conversations and negotiations, in a way that focuses on listening rather than establishing a form of control. One well suited example of coercion is keeping "Me" and "Us" in the center of things, that being at variance with "Not me" and "Not us" placed at the periphery. A responsibility of singularity is to accept the singularity of others and their own voices. The nomadic subject that she puts forth entails a theory of human persona to seek, utilize and exploit. It is also defamiliarized and is made to stand discrete from what is labelled ordinary or known. Braidotti refers to two terms that are already in the domain, anthropocene and posthuman which are in sequence with each other. The

Anthropocene mirrors the trait of a human being to lord over other living components in an ecosystem, whereas the post human self has its roots in early modern humanism. Post human subjectivity reforms humanistic practices and brings in diversity with a giant call for heteronomy and multi-faced relationality instead of autonomy and self-referential purity. The nomadic subject of Braidotti claims those humans who deliberately go in the direction of posthuman will endure and flourish. Such a journey requires thinking a great deal even more than a clear picture of thought. The process of thinking itself can put someone in agony, while introducing them to the impending chaos of life. This blitz on the brain may invite strain and strife. Braidotti further makes a clear cut suggestion that those who have suffered pain and agony are more than equipped to lead on an ethical transfiguration and are supposed to be the experimental spirits of change. A marginalized man or woman, whoever it be, is considered no deficit but a guardianship of truths. Additionally what is written in Braidotti's *Nomadic Theory* describes a process of becoming, in general. The fulcrum of Nomadic theory posits an entity that foregrounds change and motion rather than a lack of movement. This idea of mobility and of becoming is offered via a more exclusive way of becoming-vagabond, becoming molecular or woman or even a beast that represents a blithe faction consisting of minority groups. Majority is no longer visible; thanks to their monotonous patterns of existence barring creativity. Here, the so-called dominant group forming a majority is basking in self-immortalization. A much wider outlook on this matter implies that experimental minorities encompassing women, blacks, plants, molecules and other physical entities are said to have an edge over the dominant because of their ability to serve as initial points for empowering practices in the art of becoming. This evolution process happens within a region of closure, where humans as individuals can connect with, based on their own personal lives. Such alliances with positive forces, within the local environment

could bring in "common actualization of alternative modes of relations and affective connection" (Braidotti 30). A liberation of the thinking motif from the clutches of duality calls for a dissipation of gender discriminatory sexed identities or sexed notions for that matter.

Phallogocentrism is a term coined by the French philosopher, Jacques Derrida; while separating it into two components, we derive phallus which means masculine and centric i.e. in or at the center. As per definitions, the neologism [Phallogocentrism] places the masculine at the core of the social world and considers the subdued part, feminine as other. Therefore, becoming woman is the first step to dislodge this theory of subservience and the disposition of women folk as sexual aberrants with regard to Western ideological thought. What Deleuze, Derrida and other post-structuralists focussed was to bring about a feminist spin in the peculiar images of minority; opting molecular or nomadic women over the crowded majority of sedentary or molar women operating the structural domain of Phallogocentrism. Thus, the unsymmetrical process of becoming a woman is an internally diversified movement, although with a chunk of common. This commonality coerces the men, women, meek and old and blacks to become unified with a purpose to dismantle the familiar grounds that made them a dichotomously opposed category. The distinct line of becoming molecular "is not only a spatial but also a temporal phenomenon" (31). Time as a nonlinear phenomenon looks at contemplating skillfully the memory and its relation with imagination. A closer look at trauma, bruises and agony would provide a better understanding of negative memories. These become the solid foundation of the consciousness pertaining to ancient marginalized communities, archived in their memory. This "oppositional consciousness" (32) is assembled by the wound and despondency imprinted on them [marginalized] over these ages, acting as the building blocks of nomadic theory and its practical application.

What seriously counts here is not to restrict this path to a sheer matter of role reversal. "The point is to go beyond the logic of reversibility" (Braidotti 43). The becoming woman nomad is thus a series of transformative politics, oriented toward a more inclusive and gender-free becoming.

## Chapter 2

### Highlighting the Transition and Discovery in *Nomadland*

The film 'Nomadland', directed by Chloe Zhao is adapted from Jessica Bruder's award winning book *Nomadland: Surviving America in the Twenty-First Century*. A gripping journey of self-realization, written in the form of a mournful elegy, it casts a special focus on American landscapes and the extraordinary lives of ordinary Americans. The heroine of the movie, Fern is a willed woman in her sixties who refuses to succumb to the traumas that fate puts her in; the character played by the most sought after lady American actress, Frances Louise McDormand. Throughout the length of the movie, Fern is introduced to several characters that live a similar life to that of hers. The fictional center, leading the life of a nomad, encounters a slew of hardships that test her mettle. A surprising fact to be noted is that the other characters who play nomad in the movie are real-life non-actors. Considering the background of Fern, she has had lost almost everything precious in her life. The loss of loved ones seems to alter every atom and cell in her body; internally a transformation occurs that is visible over the course of the movie.

Set in 2012, it follows the path of a widowed woman who had to relinquish all her past souvenirs, a small town built of love and a job that gave her much contentment. Diving deep into what made their lives miserable and threw them out into the wilderness would eventually direct fellow folks to the recession that took place during 2007-08. On the 31st of January, 2011 U.S Gypsum Corporation shut down its plant situated in the local town of Empire due to a curtailed demand for sheetrock. The town's zip code was terminated a few months following the mine's closing. As Fern's grief was dwindling, another tragedy pummelled her. What then came as a giant blow to the woman was her husband's tragic demise. Before she could entirely figure out

the grief she was in, Fern gathers her belongings, packs up her stuff, operates her van [which she admiringly calls 'vanguard'] and sets off on a road trip. In a moonlit light, Fern alone in her car driving, sings an old rhyme. Anybody who hearkens her will probably feel like she was spreading mellow Christmas vibes; albeit the background tune is not attuned to the joyfulness that she emits. As she drives the car, the places seem to go backward, in reverse. This shows a possible connotation of her mind's tendency to go back to the place which she considered home. The ability of the protagonist to move forward rather than remain stuck is exemplary. She is receptive to change and her resilient nature taught her to always look up however dark the situation may seem for a wanderer like her. Fern is one of the victims of laissez faire capitalism. Although capitalism had been the unique cause of the shutdown of Empire, the plot does not probe heavily into the dark side of it and increase the chances of it [movie] being called a social commentary.

From time to time, she picks up seasonal jobs. Her temporary job at Amazon Fulfillment Centre [a seasonal program for nomadic RV'ers] did not bring her much fortune other than meet her basic needs. The bright side is that she gets acquainted with many others at her job, which gives her comfort. Good camaraderies are a cure for broken souls.

A tattooed lady shares a statement that means the most to her: "Home, is it just a word? Or is it something that you carry within you" (*Nomadland* 00:06:26). According to Fern, her home is where she and her partner live in harmony. Externally he's no more, though he stays alive in her heart. Her home is her van for that matter. Fern ensues to live her life in a sober state of manner, accepting the true realities of existence. When a kid from her erstwhile neighborhood asks whether she was homeless, she retorts in a mild and succinct way, "No, I am not homeless. I am just houseless" (00:10:13). According to Fern, the two are explicitly different.

One of her best friends, who is also her co-worker at the Amazon warehouse, introduces Fern to Bob Well's "Rubber Tramp Rendezvous" (*Nomadland* 00:12:31), a heterogeneous community of wanderers in Quartzsite, Arizona. Bob, an oral campaigner for veteran van dwellers, aims for the freedom and goodwill of senior nomads. People from diverse environments convene to share their stories, cultivate empathy and support each other through subtle acts of kindness and recognition. Though initially Fern disagreed with the idea of going to a RV camp for guarded personal behaviour, she then hops on to experience life in a way that is far from ordinary. She actively gets involved in the camp activities, dances in a bar gently with a man named Dave and is always up for a bit of a knees-up with other nomads. She is genuinely joyous in open spaces and enclosed chambers, more or less, sounds harrowing for her. An epitome of strength, hardwork and dedication is Fern's jovial workmate, Linda May. A major portion of her life was dedicated to raising her two children. When she had looked back once, she felt miserable that her life was nothing but a series of struggles. When she got to a really low point, she thought of saying goodbye to the world, because she had none to accompany. But then one sweet stare at her loyal dogs.. she decided to wait.

At the camp, Bob Wells, the RV [recreational vehicle] Guru speaks of "the tyranny of the dollar" (00:18:49). In Bob's words, the worker community accepted and embraced the capitalist regime and thus developed a fixity of habit that is difficult to break or emerge out of. He comes up with an "analogy of a workhorse" (00:19:04), where the equine toils itself to death instead of being sent to pastures. This comparison is made so as to interpret the global elites' monopoly over its highly skilled labourers. During the campfire, fellow participants of the annual gathering sit down to unwind and hearken. The stories they listen to forms a sort of connection that these members did not feel to have developed earlier. Each of them instinctively forges a bond

garlanded with love, empathy and understanding. As in the case of Bob Wells, he speaks with much passion to his community members like a pioneer speaking to big mobs on exciting adventures, he teaches them "Ten Commandments of Stealth Parking" (*Nomadland* 00:24:56) and is even kind enough to demonstrate some stages of it. Amid the discussion, an old woman opens up: "I love this lifestyle of freedom, beauty and connection to the earth" (00:25:23-25). Unlike most people would think, RV'ers never felt like wasting their time in these terrible boondocks; they were mindful of their experiences, thoughts and even the slightest occupations that they performed. Only little joys mattered to them such as cracking jokes, working together as mates, sharing food and beverages, building comradeship and partaking in trading cool stuff to other van dwellers. (see figure 1). Fern thrives in her solitude, also she interacts with other nomads. She finds a good friend in the character Dave, which is enacted by the immensely popular David Strathairn. They like each other, but face an impediment to express it lucidly.



Fig. 1. A citation image from "Frances McDormand and the travelers of 'Nomadland', the Oscar best picture winner." *latimes*, 25 Apr. 2021,

[www.latimes.com/entertainment-arts/movies/story/2021-04-25/oscars-2021-nomadland-best-picture?\\_amp=true](http://www.latimes.com/entertainment-arts/movies/story/2021-04-25/oscars-2021-nomadland-best-picture?_amp=true).

Fern is like fluid in a can, subtly showing her ability to adapt and take shape effortlessly. Also, it is evident that the companionship with fellow RV'ers saves her in situations where she was not prepared beforehand; an instance when her tire gets blown in a desert land. Swankie comes to her rescue by giving her a ride to town and even rebukes her for not having a spare or any strict back up plan. Swankie is a cancer battler. Although she got cancer removed from her lung, the doctors informed that her death could take place anytime, in seven to eight months. Fern feels sorry for Swankie and expresses her solicitude, while Swankie does not do the 'self-pity' instead she reveals the buoyancy to visit her place holding sweet memories of the past. Swankie further shares some insights that she gained from a book "Final Exit by Mr. Death" (*Nomadland* 00:38:37-41). The woman regards it as a recipe for a fulfilling ending. Swankie converses with Fern, like that of a philosopher does with a student; her life serves as an inspiration for Fern to do the things that she would like to get done before she gives up the ghost. Swankie's hard core love for rocks is revealed in her arduous desire to explain to Fern, the profile of each stone in her hand. Also, the nomad fantasizes her dream burial with friends gathered, tossing a rock each into the fire comes to fruition in the latter part of the movie. This echoes an idea that ultimately your desires will be fulfilled. On nights where she does not have anything worthwhile to carry out, Fern sits in her tightly packed van, takes out an old album that walks her down the memory lane with her husband and loved ones. The song played in the background acts as a window to her past. Her grief here is not apparent; in a sense she hides it behind her smile. She skims through all the pictures as a sort of reliving all those tiny magical moments. Fern reminisces about her husband Bo whom she loved big time and whose death she still cannot

process. She speaks with Swankie of his final days in a hospital chamber and expresses her remorse of not letting him go sooner without putting him in much torment. Still and all, Swankie had a different story to tell from Bo's perspective that he would have wanted to spend a few more hours with Fern. Fern actually gave her entire life to Bo that when he departed to another world, it created a void in her soul, even Dave was not able to fill. Fern finds a boon companion in Dave, who is unravelled in a later segment of the movie. Her work as a camp host, tagging along with Linda helps her develop some esprit de corps with the denizens of the camp. Fern addresses themselves humorously "We be the Bitches of Badlands" (*Nomadland* 00:48:11-13) for the reason they work in these terrible boondocks where there is hardly any vegetation. They take simple precautions like wearing gloves to inhibit any microvirus creeping into their systems. In a later sequence of all the main characters in a resto bar, Linda speaks of her long stayed dream of building an earthship with zero harm to the environment. She describes it as a fully self-sufficient abode built out of round automobile tires, cylindrical bottles and cans. Calling it an exquisite piece of handmade art, she thinks of giving it to her grandchildren as sort of some legacy that she could leave behind. Linda looks serious about her goals; she conjures up building her own small sustainable empire with the limited resources in her stock. The fact that her earthship will be an environmentally-friendly establishment adds a feather to her cap. Furthermore, Linda articulates her belief of how this structure will remain rock solid for eons to come, transcending the sheer existence of her colleagues and companions. Dave's and Fern's relationship seem to take roots in compassion. This comes after Dave feels sorry for breaking a couple of Fern's most cherished dishes, possibly her family's. The way she mends the torn components of the plate back to its initial state can be understood as a means of fixing her own broken heart. Another interpretation of Fern fixing shattered pieces is analyzed by

comprehending the methodology of Japanese art, Kintsugi. Here, the shattered components are her past memories which she tries not to brood over, plus her inner instinct to make new colourful memories which are devoid of agonies from the bygone times. Sometimes, a meager household item could contain stories of people.

When Dave gets a temperature, Fern goes the extra mile to make him cure of his illness. Fern and Dave seem to have a perfect bond, even though it does not end in a romantic relationship. All their visits to national parks, toil at restaurants, cooking food together, loosening up after a long day at work and skywatch practicing; they seem to be getting along very well. Just like a missing piece of jigsaw, Fern fits effortlessly into the mostly male nomadic community. Fern had seen the world more than any other rookie nomad via her escapades. When Dave's only son, James, on his one visit to the restaurant, tells her that the place where they work is awful, Fern's reply was that she could think of worse places. They are places which she solely had been too doing odd jobs, which was pretty rough for a human soul to survive. According to Fern, she accepts both good and bad and does every job with an undying hope that her situation will get better and she will become a greater nomad. Even otherwise, she still manages to go with the flow and not complain about the roadblocks that she encounters all through her exploratory odyssey.

James seems to be non-appreciative of his father's cooking expertise and slightly ignorant of his emotional turmoil because Dave stays farther away from his family. The man wants his father to spend time with him and his family. Fern finds Dave to be up with something; he shares it with Fern, the arrival of his grandchild. Dave confesses that he has not been a good father to James; however Fern asks him to go and "be a grandfather" (*Nomadland* 01:04:05). Fern plays the role of a guardian in Dave's story; she gives him sound advice but does not want obviously to

interfere in his personal affair. The central protagonist's constant tendency to remain companionless is demonstrated in several divisions of the film.

Fern looks insignificant when juxtaposed against the vastness of the landscape. When she hits the road, she is opened to a world of opportunities to deny or leap into. She is self protective and her decisions are more or less made upon some prescribed rules laid down by Empire town. She establishes an invisible boundary around her and lives inside her circumscribed zone, where Bo and herself only exist. Amidst fellow employees at job, she seems to carve out a niche for herself; training oneself to be more capable and employable. Exercising freedom unapologetically makes her do things that are least done by woman nomads like peeing on the roadside. A true nomad at her core, Fern seems to embody her challenges with utmost grace.



Fig. 2. A citation image from "Nomadland van." *Indiewire*, 12 Apr. 2021, [www.indiewire.com/2021/04/nomadland-cinematography-joshua-james-richards-1234629742/amp/](https://www.indiewire.com/2021/04/nomadland-cinematography-joshua-james-richards-1234629742/amp/).

Not much is revealed about the significance of "vanguard", her vehicle in the film. Although feebly discussed, vanguard functions as a pivotal key in establishing Fern and what she represents. A fair amount of her life happens within the constricted walls of vanguard, which she

calls her home. The name even symbolizes something, "camper for protection" (see figure 2). Fern holds it dear to her heart and is not ready to sell the van at any point. To repair the van, she needs a good sum of money. It is during this tough time, the woman nomad calls on Dolly, her only womb sharer. Despite the fact that they come from the same womb, their outlook on worldly wishes are at loggerheads. Dolly is more oriented towards family and kin whereas Fern always wished to stay detached from the doting crowd. At her sister's abode, she gets introduced to George's [Dolly's husband] friend Jim. Soon, Fern fits seamlessly into the picture; she takes the credit of her sister's love story for she was the mutual between Dolly and George. Later in an afternoon conversation, the men speak of their real estate business graphs which seem to disappoint Fern. She is part of the above- the-poverty line working class sector. Men had their conversations around how housing markets crumbled in the economic downturn of 2008 and how they could have weaselled out of their estate dealings with the public. Fern disagrees with the idea of manipulating the public into investing their entire fortune to buy some homestead they possibly cannot afford. A bold woman by circumstances, she stands up for what she firmly believes is forthright, even if it means to stand alone. Dolly soothes Fern with her words of nomadic appreciation, calling her a trailblazer for choosing a different path, thereby keeping up the American tradition. Fern is a pioneer in this field of becoming a full-time nomad, not everybody has the courage to live a life, soaked in adventures and unknown paths. That night, Dolly and Fern engage in on a very deep meaningful conversation in which Dolly invites Fern to live with them. Fern, on the other side, feels perturbed with the thought of living in a permanent space. Her life is outside the living space. More or less, she feels thwarted in a closed cubicle, hardly any room for her to breathe. A better and more crucial insight into Fern looks to be laid out by Dolly; what kind of a character is Fern's in the movie is subtly unravelled when Dolly

imagines how desperately her soul sister wanted to escape home that as soon as the time came, she left the town. Marrying her beau and moving in with him [Bo] who she had only known for a while was the other exploit Fern chose to embark upon in her adulthood. Dolly slowly peels out the many layers of Fern as a child. Although her strange disposition wired relatives into believing that she was anomalous, Dolly deemed her as a doughty individual and loved her to pieces because she [Fern] was the only person who seemed to have figured her sister out so profoundly before anybody. Dolly felt like by leaving, Fern has left a void in her, like Bo's death did for her sister.

On her way through the boundless desert, she runs across a nomad in his twenties. He was sitting by a fire, getting warm and cozy with a cigarette. They understand that they have met before at Quartzite, Arizona where she worked as a camp host. Fern has lent this man a lighter once. As a gentle form of gratitude gesture, he thankfully repays her with an adorable dinosaur stone which she accepts with smiles. The guy has a family and a girlfriend, whom he writes letters to. Fern dedicates a song cue for the chap and chants her wedding vow in a soulful rhythm; the lines she utter brims with heartfelt reflections on life and memories which are bound to add meaning to people's lives. A gaze at Fern's photo collection of her blissful childhood is sure to go in sync with her soulful disposition and the tune emerging in the background to provide a broader interpretation of its lyrics. "So long lives this and this gives life to thee" (*Nomadland* 01:20:39).

Dave appreciates Fern's archetype of a human being and he wishes for her to stay longer with him. Fern is not a character who can hold onto a domestic life and live as someone's counterpart. She has her nomadic traits that she further would like to explore. At night, when everybody sleeps peacefully, Fern comes out of the homestead and sleeps in her van. Van and

Fern are inseparable and it repeatedly reassures the fact that her whole life is carried within herself and in vanguard. Fern abruptly decides to skedaddle from Dave's place without bidding adieu to him and his family. She drives her van and resumes her journey of solitude, of finding self and of becoming nomad. She camouflages with the natural landscape of water, tunnels, rocks, rivers and terrains; co-existing with animals and other creatures; a nearly perfect position for nomads to be free from external concerns.

In a final word with Bob, she articulates her reason for staying in the Empire even after Bo's demise. She quotes her father's words, "What remembered lives" (*Nomadland* 01:35:58). She thinks of Bo more frequently than herself, thus she presumes that he is with her, not physically but imaginatively. Meanwhile, Bob recollects his son who died in a suicide, who now would have been a thirty three year old. He breaks down everytime he gets reminded of the fact that his son is no longer alive. Speaking of which, he serves as a living inspiration for many nomads who do not have much to look forward to in life. Bob grieved his son's death for a long time, however he did not give up on life. He still managed to find a break in the cloud by helping others find their purposes, honouring his son's long forgotten life.

The film almost comes to an end when Fern reaches the Empire town. The part where the movie ends is its actual beginning, Fern becoming the real life essence of a nomad. It can be read as a cyclical narrative. "See you down the road" (01:37:59) is very much what nomads say instead of a final goodbye. In reality, there is no ultimate cheerio; fellow RV'ers part their ways only to see again. Fern's journey of becoming a woman nomad thus, is a process of recuperating from the poignant memories of the past and creating new gay memories to be cherished.

## Chapter 3

### American Homecoming: Woman Returns to Nature

The endless dimensions of American topography are captured incredibly in the film. Fern's state of mind is presented via the space surrounding her. Initially she lacks confidence in her journey of becoming a woman nomad and what was environing her also appeared dull and lifeless like arid regions, a combination of a single colour. At a later stage, when she progresses and goes totally into loving her nomadic lifestyle, a myriad of colours turns out to be the visual. The scenery appears unique and vibrant just as her jubilant mind. Nature seems to be evolving in tandem with the rise and setting of the sun, albeit the background with the same series of photographs repeated on a loop. Therefore, the environment acts as a harbinger of change which will inevitably transform the subtlety of the protagonist into something more intense. The longshots capturing larger creations in *Nomadland* are significant for it paints the whole naked world in vibrant and delicate hues; further showing the nomad's ingenuity to breathe a colourful life.

Fern herself becoming the very embodiment of the natural world, within the formidable universe, is determined to tide over any crisis under its wing. She finds solace in the beauty and tranquillity of the landscape when she feels overwhelmed. Standing in the juncture of past and present and hands laid out to an optimistic future; she believes in the prowess of the prodigious yet spatially finite universe. The bountiful earth gives in plenty and humans seize every bit of what this serene place has to offer. Fern deems herself as a small trace of existence in this organic realm of richness, sharing her region with a magnificent variety of wild plants, beasts and other living organisms. Fern's companionship with *homo sapiens* goes a long way when van

dwellers come together to interact and recoup, pursuing freedom en masse. Their cultural differences make them distinct human beings, each one occupying a small fraction of a larger heterogeneous community.

Man and nature union is a wonderful theme to be analyzed; men in alignment with nature are likely to overcome any heartbreak. Nature protects him like a toddler in her arms and prepares him for any forthcoming apocalypse that has the power to transform his life. Fern surrenders her tribulations into the mighty hands of Mother Earth. Towering trees, cold winds and gorgeous sundown gigs seem to bring out the goodness in the character played by Dormand. As nature turns out to be the magnanimous giver in Fern's episode, her whole journey revolves around being in tune with the elements of the natural world. Even to meet up with her loved ones, she prefers to stay out rather than stay in. In Dolly's words, it is remarked that Fern finds her existence in the badlands intriguing and always liked to remain outdoors. She is a one of a kind woman nomad who is fated to pull off an impromptu existential crisis, basking in the succour and nourishment nature showers her with. The poetry "But thy eternal summer shall not fade" (*Nomadland* 01:20:13-15), subtly shows her potential to keep the lamp burning amidst burgeoning darkness. The summer spent as a camp host alongside the workmate- turned- friend Linda was a bit of a knees-up for Fern; doing spa sessions, driving automobiles and fixing equipment were all the more fun and it did help her live with both passion and kindness alike. From the scene shot at the Badlands National Park situated in South Dakota, depicts Fern swirling through the rocks separated from other tourists; it is very much comprehensible that she finally feels like herself in this journey of finding purpose. The woman discovers joy in letting loose and going in with the flow of nature rather than forcing a schedule. This new situation encourages her to experience and explore in the exact same moment.

Along the highways, Fern gets engrossed in the sheer beauty of cotton candy skies and pasture lands which gives her a push to move forward. The nomads neither settle at one place nor in motion all the time; their paths vary with altered seasons, sometimes they overlap, sometimes they do not; but down the road, they are all hopeful that they will see each other to tell more stories. On the bright side, they are content with adequacy and are visibly careful of their belongings. What is considered trivial to a few are treated as precious by these rolling stones. In close propinquity with the natural world, they act like the flowers that open with the sun. The light they are continually seeking is found in the wilderness. Naturalism is depicted deliciously in numerous sequences of the film. No overstatement is figuratively established in the way their living conditions are portrayed, which well complies with the fact that most of the supporting actors are nomads themselves outside the Hollywood sphere. They do not enact the roles that they play, instead live their lives out, so that the world could resonate with their truths rather than think of it as an aberration. Throughout the film, the characters seem to get hold of our hands, take us through their journey and via catharsis gently water our passions. As soon as the movie ends, there is this feeling of resumption when Fern steps out of her home leaving the Empire [home and memories] forever and weightlessly glides into the tender arms of Mamma Earth, just like a child reclaiming her long lost mother. The film parlous challenges the concept of an abode; is it something built out of bricks and cement or is it a substance of love, warmth and affinity that we encounter in the most unforeseen regions of the ecosystem.

Moreover, she is a woman and nature too is a woman. When they conjoin, they form a single indomitable spirit which no power can surpass, figuratively. The molecular minority of nomadic women turns out to be all the more invincible; their eyes open to the wonders of the natural world. A pioneer capable of doing much more than being an unconventional nomad, she

is ready to take up the responsibilities of her new existence and live a life of dignity and blithe solitude. Well, they are certain to dominate the globe in the next few centuries. Her world is nudged to broaden horizons for her wings to stretch to its highest potential. Consequently, her home becomes a universal symbol transcending all racial, ethnic, cultural and linguistic geographical barriers. Hence, as original as it may sound, her journey to the unknown is a deeply affecting series yet to be tabled.

Additionally, the plot intends to strike a fine line between fiction and reality by its unique action formula. People, places and structures included in it are all existing and real. And thus, it wins in representing everything honest, radical and enriching to humanity.

## Conclusion

The illustrious Frances McDormand starrer *Nomadland* documents the journey of Fern, a tenacious widowed woman who embraces the nomadic way of living after the tragic impromptu demise of her husband. The illuminated character was brought out by the writer and director of the film, Chloé Zhao who got inspired by the honest-to-goodness, wholesome life of fleeing Americans as presented in one of Jessica Bruders' books. Fern, as the quintessential becoming nomad, takes up the singledom with effortless grace and steps into the magnificent realm of coexistence. With a heart that brims with tenderness and a mind that sieves, she travels in the direction of vast roads, timeless mountain cliffs and sandy beige deserts. "She is part of a long tradition of US heroes and adventurers who, as Huckleberry Finn put it, decide "to light out for the territory," and leave ordinary life behind" (James). Their extraordinary lives speak volumes about the mould breaking individuals of American society who were pioneers in discovering a path of their own, left their homelands to create a convoluted legacy that ought to be difficult to eradicate.

The communion with nature transformed her suffering into a beautiful work of aesthetics with the panorama of gorgeous purple hued skies serving its backdrop. Her empathy for the living world subtly demonstrates the fundamental goodness that lightens her soul. This beauty of her inner realm camouflages with the breathtaking landscape enveloping the woman, which makes her the very embodiment of Mamma Earth. Therefore, her movements are intertwined with the realistic and fantastical elements of the natural world. Nature and Fern are no separate entities; they are like shimmering constellations in the night sky, each forming a part of the whole nine yards i.e. the Universe.

Fern magically coasts along with a renewed hope of becoming her best possible version of a gypsy, untied to past human bonds. Perhaps the journey of becoming a wanderer is not

about becoming anything, may be unbecoming all the things that one were. Her new union is certain to bring her warmth, solace, extreme peace and a living with a purpose. Perhaps, her loneliness has transfigured into something more concrete; akin to freedom and resilience. A bonafide nomad whose unflinching desire is to while away hours in a locale where men, beasts, birds and butterflies are humbled to breathe life into an earthy space of fragile hues.

Over and above, *Nomadland* stirringly made us reconsider the concept of a home and the motive of extravagance. Without a doubt, call them trailblazers, ready to leave a trail for all those who are yet to pursue their individual paths. Their epic stories will serve as dollops of advice for younger generations to break their cocoons and create a marvellous saga. In addition, their stories would not end with a final goodbye, but progresses to witness new enthralling domains and build astounding earthships similar to that of Linda May's.

As a final conclusion to this extremely singular chronicle of a nomadic woman, it ought to include the kaleidoscopic nuances of multiple women's perspectives. Further scope of this research may be attributed to this very notion: Can an awakening feminist seek geographic expedition? As Braidotti expressed in her book *Nomadic Theory* that this journey of becoming should not be attenuated to a mere upsetting of roles, but to look beyond what is visible, seek beyond what is sought and to comprehend more than what is allowed to be acknowledged through the hypothesis of reversibility. Ergo, in a nutshell, the film has triumphantly reproduced the essential aspects of nomadic existence and the utility of movement in the most convincing form and detail, shedding away all the superfluous.

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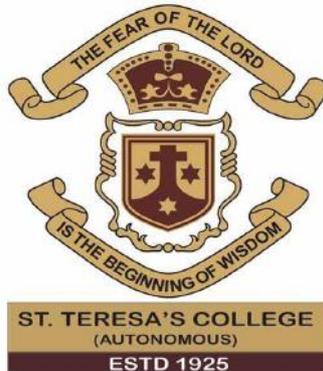
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**DEFINING CRIME: A READING OF COLLIN'S *THE HUNGER GAMES*  
THROUGH THE LENS OF RADICAL CRIMINOLOGY**



*Project submitted to St. Teresa's College (Autonomous) in partial fulfilment of the  
requirement for the degree of BACHELOR OF ARTS in  
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**MARCH 2022**

## DECLARATION

I hereby declare that this project titled ‘Defining Crime: A Reading of Collin’s *The Hunger Games* Through the Lens of Radical Criminology’ is the record of bonafide work done by me under the guidance and supervision of Dr. Jisha John, Assistant Professor, Department of English.

ERNAKULAM

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## CERTIFICATE

I hereby declare that this project titled ‘Defining Crime: A Reading of Collin’s *The Hunger Games* Through the Lens of Radical Criminology’ by Maria Elsa is a record of bonafide work carried out by her under my guidance and supervision.

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**Defining Crime: A Reading of Collin's *The Hunger Games* Through the Lens of  
Radical Criminology**

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The connection between literature and criminology is undeniable, and yet for too long, those studying crime and literature have either failed to see it or dismissed it as irrelevant. The project aims to establish the relationship between radical criminology and literature by analysing the novel '*The Hunger Games*' and discussing pertaining issues such as human rights violations and illegal domestic surveillance.

The project undertaken includes three chapters. Chapter one, titled 'Crime, Society, and the Powerful: A Theoretical Framework' is a close study of the main concepts of radical criminology as well as the limits of its usage. Chapter two, titled 'Demystifying Crime in *The Hunger Games*' is the application of the main concepts of radical criminology to the fictional and realistic settings of the novel. It undertakes a thorough analysis of the various "crimes" committed by the various characters in *The Hunger Games* and their perceptions of what is a 'crime' and what isn't. Chapter three, titled '*The Hunger Games*: Crime Against Humanity' focuses on the interpretation and representation of violence and power in the novel. It also attempts to bring the limitations of criminology into the limelight through the exploration of the fictional legacy left behind by Suzanne Collins. The conclusion chapter effectively summarises and reflects on the thesis.

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## INTRODUCTION

Crime has become one of the main issues that has been increasing in India. The term "crime" comes from the Latin word 'crimen', meaning 'offence' and also 'wrong-doer'. It is defined as an act or omission that is illegal and is punishable by imprisonment or a fine. According to Emile Durkheim, a certain amount of crime contributes to the well-being of a society. It helps people prepare for the change if the change is going to occur because of deviance (81). Many people break laws so that they can survive in society. However, several criminologists have suggested that the key to understanding a criminal offence is to focus on the fundamental attributes of all criminal behaviour rather than on specific criminal acts. Instead of trying to differentiate crimes, we need to identify what it is they all have in common. We also need to understand that the society that we live in may define crime from a different perspective. (Burke)

For too long, those studying crime and literature have either dismissed the connection between literature and crime or failed to see it at all. The criminology, psychiatric, sociological, or psychological fields are usually aligned with the phenomenon of crime. Rarely have we made a connection between the phenomenon of crime and other unrelated academic areas, such as literature (Dow). In his work, Curt Bartol writes, "Over the years, sociology, psychology, and psychiatry have dominated the study of crime-disciplines, but other disciplines are getting more involved (4). We also need to look into the ideas put forward by Julie Harrower in her work '*Applying Psychology to Crime*', in which she stresses: "Criminology attempts to integrate the potential contributions of a wide range of disciplines to study criminal behaviour and legal issues"(1). Both of these ideas are true, especially in terms of the literary field. As it is becoming more actively involved, homicide is a subject frequently studied and critiqued.

Throughout the centuries, there have been various attempts made to enter a criminal's mind and to discover what lies beneath. In his work '*Retreat into the Mind: Victorian Poetry*

*and the Rise of Psychiatry*', Faas writes, "murder, or the attempt at it, is the second most stereotypical event in the history of English literature" (154). Literature often depends on crime for a good story, and it yields important insights about crime. Many of the greatest books ever written involve crime, and this sheds light on the writer's need for a special tension, which helps in the story's action and the character's development. What's better than a plot that involves the violation of natural law? Some literary works dealing with the identification of the mental processes of a criminal have been so insightful that crime experts have applied them to some high-profile cases. Some of the most famous depictions of crime in literature are in Hamlet, Macbeth, and Othello. Thomas De Quincey, an English literary critic, wrote an essay titled '*On the Knocking at the Gate in Macbeth*' in 1823, in which he argued that murder is a topic worthy of psychological analysis. Shakespeare was praised for his depiction of murder in the essay. He compared the real-life serial killer John William to the Shakespearean character Macbeth. He said that John Williams was a genius and a great artist and felt that murders committed by John William were worth analysing, just like the works of William Shakespeare.

In 1946, George Orwell wrote an essay called '*Decline of English Murders*', in which he criticised the lack of thought-provoking murders during his time. He put forward the fact that real-life murders play in the imaginations of novelists, playwrights, and poets. Similarly, in 1925, Thomas Hardy saw a woman hanged in revenge for the murder of her husband in Victorian Dorset. The novelist was haunted by this incident for the rest of his life. He said, "I remember what a fine figure she showed against the sky as she hung in the misty rain and how the tight black silk set off her shape as she wheeled half-round and back." (Wilson 38). The woman engraved in his memory was Elizabeth Martha Brown, hanged on August 9th, 1856, for the murder of her husband. Later, he wrote '*Tess of the D'Urbervilles*', in which the main character resembles Elizabeth Martha Brown.

Radical criminology is based on Karl Marx ideas that the upper class can maintain their power and privilege through exploitation and oppression of the lower classes. The structure of society allows the elites to decide what constitutes a crime and what punishment should be. Thus, we often see people who are not from the upper-class committing crimes. According to radical criminologists, we should stop focusing on individual offenders because doing so hides the larger picture of what is happening. When non-radical criminologists and the public focus on a single person and their punishment, they are basically letting the wealthy elite get away with their crime. Radical criminology wants us to consider the relationship between the powerful and the powerless in society, as well as how this relates to the creation and application of checks on deviant behaviour via the use of different rules and laws. Further, he wants us to think about why power is used, the abuse that power creates, and why the people suffering in these situations don't get any attention or help. Karl Marx's (1818–1883) works assisted in the development of radical criminology. In his works, Marx used to refer to the criminal underclass as the "Lumpenproletariat" ("Lumpenproletariat"). Karl Marx saw the Lumpenproletariat as a stumbling block to the inevitable socialist revolution because they were incapable of developing any kind of class consciousness or any kind of positive bond with their community or neighbours, and thus incapable of contributing meaningfully to the good. Since his death, Marxist thinkers have developed his theory and have a different view of the criminal underclass today. Some saw them as the leaders of the revolution and as members of working-class society who were being pushed to the verge by a powerful system. The birth of Marxist criminology can be traced back to the work of Richard Quinney. He argued that the purpose of the criminal justice system was not to create society but to enforce the will of the powerful (Quinney 23). The criminal justice system is used as a tool to subdue the revolution. We have to consider crime in terms of the presence or absence of power in a moment, rather than good behaviour and bad people. "What if a robbery occurs and the victim is from a privileged class?" If they

were, the system would try to move Heaven and Earth to find justice. “Was the person who robbed, a member of the privileged class?” If not, they have to deal with the consequences of the criminal justice system. Today’s radical criminology challenges us to consider crimes committed by the powerful as well as how powerful people use their positions of authority to construct and enforce narratives about the “true” problem of crime in society to diverge from their own wrongdoing. This involves focusing on white-collar crime, state and political crime, human rights violations, and the general ways in which the system oppresses those who do not hold power.

In 2008, *The Hunger Games*, a dystopian young adult novel, took the world of literature by storm, as author Susan Collins invited readers to imagine a North America where children are forced to fight. The novel tells the story of Panem, which is divided into thirteen districts. District 12 is now known as "Seam" and is where the main character, Katniss Everdeen, lives with her mother and younger sister. She saves Prim from reaping and takes her place as a contestant in the Hunger Games, a televised fight of twenty-four children. The male tribute from Seam is Peeta Mellark, a baker’s son who acts as Katniss’s friend, enemy, and love interest. With the help of Peeta and mentor Haymitch Abernathy, Katniss starts a revolution against the Capitol of Panem.

*The Hunger Games* is a book about love, hunger, oppression, and the consequences of war. However, it is also about conflict based on a fascist dictatorship that is capitalistic, and the military-industrial complex which is extremely powerful. Another reason I chose this book to work on my thesis is because Suzanne Collins said that *The Hunger Games* was inspired by switching channels between reality TV shows and the Iraq War, but I strongly felt that this book was inspired by her real-life experience of being the daughter of a soldier who fought in the Vietnam War. She has the experience of being a helpless spectator waiting to hear from her father and has also witnessed how media coverage has turned the war into a different type of

"reality show" ("Suzanne Collins on the Vietnam War Stories Behind the Hunger Games and Year of the Jungle" 03:15–05:21). Thus, connecting it with the idea that real-life murders play in the imaginations of novelists, playwrights, and poets, put forward by George Orwell, I find this to be a perfect book to work on my thesis.

The project undertaken includes three chapters. Chapter one, titled 'Crime, Society, and the Powerful: A Theoretical Framework' is a close study of the main concepts of radical criminology as well as the limits of its usage. Chapter two, titled 'Demystifying Crime in *The Hunger Games*' is the application of the main concepts of radical criminology to the fictional and realistic settings of the novel. It undertakes a thorough analysis of the various "crimes" committed by the various characters in *The Hunger Games* and their perceptions of what is a 'crime' and what isn't. Chapter three, titled '*The Hunger Games*: Crime Against Humanity' focuses on the interpretation and representation of violence and power in the novel. It also attempts to bring the limitations of criminology into the limelight through the exploration of the fictional legacy left behind by Suzanne Collins. The conclusion chapter effectively summarises and reflects on the thesis.

## **Chapter 1**

### **Crime, Society, and the Powerful: A Theoretical Framework**

In their work, '*General Theory of Crime*', Gottfredson and Hirschi define crime as an act of force or fraud undertaken in pursuit of self-interest (2). Crime is considered a form of anti-social behaviour. However, several criminologists believe that the key to understanding a crime is to focus on the fundamental attributes of criminal behaviour rather than the specific criminal acts. Instead of trying to differentiate specific criminal acts, there is an existing need to start identifying what criminal acts have in common.

Keeping in mind the fact that the society we live in defines crime from a different point of view, radical theorists have developed various theories. According to them, laws are created to benefit the rich and powerful while hurting the general population. The government and rich people use their ability to build and enforce laws to distract other people from their wrongdoings. The system of justice oppresses those who are not in power, and crimes that challenge the social, economic, and political order are referred to as "terrorism" because the elites decide what is right and wrong.

Radical theories encompass not only social class, but race, ethnicity, and gender as well. The seminal work in this field, '*The New Criminology*', by Taylor, Walton, and Young, was based on Marxist material. It was an attempt to link the concerns of labelling theory with Marxism. This work remained influential because it was one of the first attempts to deviate from the dominant form of criminology. The dominant form of that time was concerned with the behaviour of the criminal, looking for the cause of crime within the individual. Taylor et al. not only offered a thoroughgoing critique of criminology, but also tried to offer a theoretical perspective to replace the focus on individuals with a focus on the social construction of crime. They offered a theory combining labelling theory with Marxism as a means of retaining

concern with the value of individual meaning and action alongside the power of state agencies to control and define. Let's look into this framework in a little more detail.

According to the ideas put forward by Taylor et al. in their work '*The New Criminology*', in order to analyse a crime, we have to take a look at a variety of factors in order to evaluate people's motivations to commit crime or deviance. First, it examines the wider origins of deviant acts. Taylor et al. are referring to societal power structures and social inequality, and questions such as how equal society was and whether there was a motivation for deviant behaviour were raised. The second factor to consider is the immediate origins of the deviant act. This refers to the particular circumstances that led to the crime. In other words, how and why do individuals choose to respond to their structural location in the way that they do? The third factor is the act itself. People may decide to behave in a particular way, but may, for various reasons, choose not to do so, or their choices may become modified in the process of interaction. The fourth factor is the immediate origins of social reaction. It's important to understand that people behave in a range of different ways, some of which may be labelled as deviant, while others may not. It also refers to the reactions of those connected to the individual; how they react to the individual's deviant actions. This connects us to the fifth factor; how does the rest of society react? Professionals working in the criminal justice agencies as well as other people significant to the offenders will be part of the wider audience. Their response to different behaviour needs an understanding of what Taylor et al. call a "political economy" of social reaction, and the final consideration is whether the impact of this behaviour on an individual's future conduct will be labelled as a deviant behaviour impact on that person's future. Will the act become a master status, and if so, how will that impact further acts of deviance? (Walklate 32-33)

Radical criminology, in particular, encouraged an understanding of the law and the process of its implementation as a much more differentiated concept. It also encouraged

criminologists to think more carefully about the role of the state in the criminalization process. As a result of the emphasis that radical theories placed on understanding the process of criminalization, it certainly laid the foundation for later theoretical developments like critical criminology, which focuses particularly on the differing ways in which the power associated with the political economy of the state asserts itself. It is evident that the notion of the criminality of the state shifts the criminological agenda away from seeing society as essentially consensual and towards seeing it as essentially rooted in conflict. This fundamental shift not only locates the explanation of crime squarely in the social domain, but also centres the practices of the powerful, both the seen and the unseen, as legitimate concerns for the criminological agenda. Thus, no one knows the answer to the question of what constitutes a crime or punishment (Walklate 32-37).

In societies such as Africa, America, and India, those who make and administer criminal laws have ideological and material interests that conflict with the aims of most people. They don't consider the crimes of the powerful to be crimes, but rather wealth-creation and business. Their oppressive activities are less severely punished. In conventional criminology, crime is defined one-sidedly as the exclusive grief of that state, unleashed by a selfish individual or group. This is different from what is known as "personal justice," in which the wronged individual relies on self-help, kinship, or community assistance for the enforcement of retribution or reparation.

Women are relatively ignored in conventional criminology. The attempt to go beyond the traditional focus of conventional criminology is done by focusing on the feminist issues in the novel. Earlier, women were socialized into embracing the social norm that they are gentle and caring. They were limited in their crime scenarios as they were usually engaged in taking care of their children. Today, feminists try to achieve gender equality and the empowerment of women.

A sub theory of the radical theory is the “Radical theory of Feminist Criminology”. According to radical feminist theorists, women commit crimes due to oppression by the patriarchal society. In Pat Carlen’s *‘Women, Crime, and Poverty’* (1988), she examined criminality using a control theory approach, suggesting women were controlled by society. She proposed that female criminality was the result of women rejecting socially-approved pathways. Carlen outlined two ways in which women are expected to conform to societal norms: class and gender. Rejection of these norms leads to female criminality and deviance. Another topic that feminists have been looking into is ‘juvenile crime’. According to them, young people disproportionately commit juvenile crimes. Feminist theorists and others have examined why this is the case. Talcott Parsons (1964) purported that masculinity was internalised by young people during adolescence, which led to boys engaging in more delinquent behaviour than girls. The idea of masculinity may make young people more likely to commit crime. Being tough, powerful, aggressive, daring, and competitive became a way for them to express their masculinity.

## **Chapter 2**

### **Demystifying Crime in *The Hunger Games***

*"Most criminals are not born; they are made...What the state truly punishes in a criminal is frequently its own neglect, its own failure to perform its duty to the citizen. "*

*-William Randolph Hearst*

In their work, '*General Theory of Crime*', Gottfredson and Hirschi define crime as an act of force or fraud undertaken in pursuit of self-interest (2). Crime is considered a form of anti-social behaviour. However, several criminologists believe that the key to understanding a crime is to focus on the fundamental attributes of criminal behaviour rather than the specific criminal acts. Instead of trying to differentiate specific criminal acts, there is an existing need to start identifying what criminal acts have in common.

*The Hunger Games* is a young adult novel by Suzanne Collins that deals with a society in which young people have to fight to the death until there is only one "Victor". The purpose of the Games is to remind people of Panem about the power of the government. This Game has constantly reminded people about the ability of the government to destroy anyone who defies their laws. The novel tells us the story of a future post-apocalyptic North America, now called Panem. Katniss Everdeen lives with her mother and eleven-year-old sister, Prim, in District 12, or "Seam". She saves Prim from the Hunger Games, a televised fight between twenty-four children, by taking her place as a "tribute," or contestant in the Games. The male tribute from her district is Peeta Mellark, who acts first as friend, enemy, and love interest to propel the violent story through the Games. Later in the novel, with the help of Peeta and mentor Haymitch Abernathy, Katniss starts a revolution against the Capitol of Panem.

In the novel, multiple perspectives of crime and violence are present: as punishment, a reminder of forced obedience, a general fascination with death, and many others. The primary reason for the Capitol to organise the Hunger Games was to punish the uprising. However, this

changed from punishment to embracement of the power over the districts and their residents. The Hunger Games become part of the culture of the Capitol, and residents can feel passionate about who they want to win while maintaining distance between themselves and the tributes. "The real sport of the Hunger Games is watching the tributes kill one another" (Collins 177). The word "tribute" in the novel refers to the children offered as payment to the Capitol. In ancient and medieval times, it was common for a powerful state to force some tributary entity to hand over children as servants or to sacrifice them. By doing so, the rich and powerful state remains in power and dominates over the less powerful states. In Panem, parents have to give up their children. This act forces them to acknowledge their humiliation in the matter. They stand helpless in front of such a cruel act, and there is nothing the people can do to stop it. The ritualistic acknowledgement of power and powerlessness between the Capitol and the districts highlights each party's role in the government system: the districts serve the Capitol. The residents of Panem were humiliated by sacrificing their sons and daughters to the Games. Thus, we can conclude that life is terrible for the people of districts, especially for the poor in the outskirts of Districts. For many families, young men and women are the primary caretakers of the family and are responsible for feeding them. For example, Katniss and Gale are the primary caretakers of their families. Katniss gets food for her family through illegal hunting and has no qualms about killing animals, which she later sells on the Hob or black market in exchange for bread or any other food item. Whereas Gale is a miner, he spends most of his time mining and hunting for his family. During the reaping, these young citizens struggle to find alternative solutions to help their families. If selected as tributes, they are well aware that their families would die of starvation. Thus, Gale and Katniss promise each other to take care of their families if one of them has to go.

According to radical criminologists, laws benefit the rich and powerful while hurting the general population. The government and rich people use their ability to build and enforce

laws to distract other people from their wrongdoings. The system of justice oppresses those who are not in power, and crimes that challenge the social, economic, and political order are referred to as “terrorism” because the elites decide what is right and wrong. Criminology was encouraged to think about the state's role in the process of criminalization. As a result, it laid the foundation for later theoretical developments like critical criminology, which focuses on the differing ways in which the power associated with the political economy of the state asserts itself. The idea of the criminality of the state makes the criminological agenda shift away from seeing society as consensual and towards seeing it as essentially rooted in conflict. This fundamental shift locates the explanation of crime in the social domain, as well as the practices of the powerful, both visible and invisible, as legitimate concerns for the criminological agenda. Thus, no one knows the answer to the question of what constitutes a crime or punishment.

The first three chapters of the novel introduce us to some major characters in *The Hunger Games*, notably Katniss, Peeta, Haymitch, Gale, and Prim. Now, let us take a look at the creation of Panem. The rising sea levels and severe storms caused by global warming have led to the destruction around the world. There was widespread food shortage, and the government of Panem rose after North America collapsed. Panem is a fictional country with 13 districts and a Capitol. Under the repressive rule of the Capitol, each of the twelve districts had to provide for the entire nation. These districts did not have a say in the government. Massive electric barriers divided them, and thus, each district had its own culture. Then came the “Dark Days,” which occurred because of the rebellion against the practices of the Capitol. However, it ended when the Capitol defeated all twelve districts and destroyed district 13. After the war ended, they showed their true power and created “The Hunger Games” as a punishment for treason. The Games are an annual event in which two “tributes” are chosen from each of the twelve districts at the “Reaping” and transported to the Capitol to partake in the Hunger

Games, where they will battle to the death until one tribute survives. The Capitol asked people to celebrate reaping like a festival, but it is clear from the pain and fear experienced by the families how much more painful it is for the districts to follow its practices. While the rest celebrate out of relief, at least two families grieve for their children and try to figure out how to survive the next few weeks. The people in the districts are powerless to stop the practice of reaping. They are eligible to reap as soon as they reach the age of twelve. That year, they have to enter their name once. At thirteen, they enter their name twice. And so on until they reach the age of eighteen, the final year of eligibility (Collins 12). This practice makes the condition of the poor even worse. Capital provided the poor with an additional option to add their names more than once for "tesserae". Each of these are worth a year grain and oil supply for one person. Since Katniss belonged to District 12, she had to enter her name multiple times to support her family. Thus, at sixteen, Katniss had her name entered twenty times. Gale, her best friend, had his name entered forty-two times. Whereas Madge, daughter of the mayor, had never been at risk. She did not require tesserae, so her chances of being drawn are low compared to the rest of the Seam or District 12 residents (Collins 12).

Although Panem is a single country, there is an imperial relationship between the Capitol and the districts. This country has an economic and political relationship quite similar to that of coloniser and colonised. The colonising nation usually gains the resources they need to support their standard of living, leaving a few of their resources that the colonized populations could use, all in return for the "civilising" influence and "protection" of the colonisers. Similarly, in Panem, each district was required to contribute to various industries that provided for the entire nation. For example, mining was the main occupation for District 12 while fishing was the main occupation for District 1, technology was the main occupation for District 3. Meantime, the residents of the Capitol remain rich. Their sense of fashion and style was outrageous, and it was common for them to have plastic surgery. They wore wigs in

colours, dyed their bodies in bright colours, and inked their skin with decorative patterns. They even have this weird medicine that causes them to vomit, giving them enough room to have more food.

Throughout the novel, Suzanne Collins uses words and images in readers heads to manipulate their emotions and offer different perspectives. At the beginning of the game, readers see Katniss as the protagonist and the enemy tributes as the immediate antagonists. However, the real antagonist to fight against is the Capitol, specifically the Gamemakers and the president of Panem. Even, Katniss appears to struggle with this idea, as she is too preoccupied with the fight with other tributes. That is, until the end of the games when it's announced that only one tribute from the same district can come out alive. At this moment, Katniss realises that the Capitol is the true enemy to fight. She realises that "without a victor, the whole thing would blow up in the Gamemakers' faces." They'd have failed the Capitol. It might even be executed, slowly and painfully, while the cameras broadcast it to every screen in the country "(Collins 344). With a determination to make a stand against the Capitol, Katniss asks Peeta to eat poisonous berries with her. Unlike the outskirts like District 12, some wealthier districts see the Games as a way to honour and serve the Capitol, and they illegally train their youth to be the strong tributes. These districts see the Hunger Games as less of a punishment and more of a way to prove their worth to the Capitol and receive the best treatment. On the outskirts, the poor districts struggle with disease and starvation. They are involved in various illegal activities to stay alive. For the tributes, the fantasy of the food and costumes will overshadow the dark reality of the games if they allow it. Katniss doesn't want to be distracted by this. She knew that the game had changed from punishment to an entertainment source for people in the Capitol.

According to the ideas put forward by Taylor et al. in their work '*The New Criminology*'. To understand crime, we have to take a look at a variety of factors to evaluate

the motivation of an individual to commit a crime or deviance. First, it examines the wider origins of deviant acts. It refers to societal power structures and social inequality. *The Hunger Games* novel introduces us to Pamen, a fictional country. It constitutes twelve districts and a Capitol. The Capitol and the districts have a relationship that is quite similar to that of the coloniser and the colonised. Let's take the example of British India. There was uncertainty that existed amongst the people under British rule. People were struggling to survive and started to take part in crimes. But these crimes were considered social crimes and not acts of survival or rebellion (Das 205–07). Similarly, in *The Hunger Games*, we have a sixteen-year-old named Katniss. She relies on hunting and other deviant practices to provide for her family. She could never have the proper living conditions that other people in her district had because she was from the poor outskirts of District 12. The second factor to consider is the immediate origins of the deviant act. This refers to the particular circumstances that led to the crime. In the novel, Katniss resorts to illegal means to provide for her family. At eleven, her father died in a mining accident and her mother fell into depression. Since then, she tried to sell off their old clothes, looked into the garbage of the houses in the town square, and was involved in forgeries and illegal hunting. Her circumstances compelled her to live unconventionally. Katniss never cared about what other people thought of her deviant behaviour, and she did not have anyone to correct her. The third factor is the act itself. People may choose to behave in a particular way, but may, for various reasons, choose not to do so, or their choices may become modified in the process of interaction. The fourth factor is the immediate origins of social reaction. It's important to understand that people behave in a range of different ways, some of which may be labelled as deviant, while others may not. It also refers to the reactions of those connected to the individual; how they react to the individual's deviant actions. This connects us to the fifth factor; how does the rest of society react? Professionals working in the criminal justice agencies and other people significant to the offenders are part of the wider audience. Their response to

different behaviour needs an understanding of what Taylor et al. call a “political economy” of social reaction, and the final consideration is whether the impact of this behaviour on an individual's future conduct will be labelled as a deviant behaviour impact on that person's future. Will the act become a master status, and if so, how will that impact further acts of deviance?

The novel presents the reader with many situations in which Katniss protests against the unfair practices of the Capitol, then sometimes readers are exposed to characters' reactions to violence even before the Games start. One day while hunting in the woods, Katniss has the option to save a girl from falling victim to the Capitol. But she never tried to reach out and help that girl. She meets the girl again while training for the games. Katniss regrets her decision to not stand up for the girl and feels that her actions did not differ from those of the Capitol. Katniss recognises how her passivity in that event is like how citizens of Panem watch the Games: “That I let the Capitol kill the boy and mutilate her without lifting a finger.” Just like I was watching the games” (Collins 85). After seeing the girl in the Capitol for the second time, Katniss had to refocus herself into the mindset of a tribute in the Games, participating in the ordeal of the Capitol for its Districts, and the pleasure that citizens feel in watching the murders. She knew that this event, though not part of the games, still influences the relationship between the Capitol and the districts. She realises that the guilt for the deaths of people around them is diverted towards them when in reality it is the Capitol who commits the sin. She is a product of her dystopian environment. Katniss was the primary caretaker of her family. She started hunting at a very young age and has killed many animals to provide for her family. During her time at the Hunger Games, her hunting and survival skills helped her. She has constantly seen people dying of starvation, and also, the televised reality show of the Hunger Games was not much help in adding to her emotions. As a result of her constant exposure to death, she becomes emotionless when describing the scenes of human suffering and deaths she witnesses in real

life. She treated death as something consistent in nature and part of her environment. Not just Katniss, but most people around her feel the same. For example, Gale pointed out that hunting a human wouldn't be difficult for Katniss. He further reassures Katniss that she is a hunter and that there is no difference between hunting animals in the woods and people in the games. On the other hand, Katniss argues that other tributes are more than just defenceless animals. Gale immediately faces the facts. He knows that the Games will involve killing, so he knew that Katniss will have to change her morals to survive the game.

"Katniss, it's just hunting. You're the best hunter I know," says Gale.

"It's not just hunting. They're armed. They think, "I say."

"So do you. And you've had more practice. "Real practice," he says. "You know how to kill."

"Not people!" I say.

"How different can it be, really?" says Gale grimly.

The awful thing is that if I can forget they're people, it will be no different at all. (Collins 40)

Again, Katniss thinks about the future and reality of the games and sees herself in them. She acknowledges it is disgusting but also states that she can overcome it. The idea of hunting animals being the same as hunting humans is harsh. Even though taking part in murder is a ritualised occurrence in Panem, it gives us a sense of unease because, in our world, mass murder enforced by the government and carried out by children is taboo. But there's nothing that we, as readers, can do. We are as helpless as Katniss. She must kill to survive. Gale is right: killing other tributes for survival does not differ from killing animals for food. In both these scenarios, survival is the key.

In short, it is clear from the novel that Katniss resorts to illegal means to provide for her family. Being desperate for survival, she decides to illegally hunt animals in the forbidden area of the district to then sell them in the Hob or the black market that operates in an abandoned warehouse that once held coal. She did not have anyone to provide any consolation or

sympathy. This lack of emotional bonding steered her towards deviant acts. Katniss took up non-conventional ways to move on with her life after her mother failed to provide a traditional way of living. Also, Katniss is a victim of unfair practises made by the Capitol. After the “Dark Days”, the Capitol took control over Panem and people of the districts were constantly monitored by the Capitol. Poverty and starvation flourished in District 12.

As a result, the people became emotionless when describing the scenes of human suffering and deaths. Pain and sufferings were treated as part of their environment rather than as a crime or abnormality. All they cared was about survival. Thus, Katniss received no social support that could help her steer away from engaging in criminal activities. Even her friend, Gale, encouraged her in illegal hunting. Both of them went together to the prohibited area to hunt. Instead of advising Katniss of the dangers of their acts, Gale was also steered towards it.

### **Chapter 3**

#### ***The Hunger Games: Crime Against Humanity***

*“The nature of the criminal justice system has changed. It is no longer primarily concerned with the prevention and punishment of crime, but rather with the management and control of the dispossessed.”*

*- Michelle Alexander, The New Jim Crow: Mass Incarceration in the Age of Colour Blindness*

One of the notable choices made by Suzanne Collins in the novel is the names of the residents of the Capitol. Most of the residents of the Capitol are named after the Romans, for example, Cinna, Plutarch, Octavia, and Flavius. Collins brought in ancient Roman history to provide a foundation for the Capitol. Even the name of the county, “Panem”, is derived from the late Roman Empire’s practice of using bread as a tool to keep people placated and compliant. In his work ‘*Satires*’, Juvenal derived this and vilified the abrogation of political responsibilities of the Roman citizens in favour of wheat and costly entertainment. This savage practice by Roman citizens is quite similar to what the Capitol has been doing in Panem. The justice system in Panem maintained and encouraged a visible class of criminals. This kind of criminal justice system benefited the rich, as they could use cheap unskilled labour to do the work for them in return for their protection and guidance. Each of the twelve districts was required to contribute to various industries that provided for the entire nation. For example, mining was the main occupation for District 12, while fishing was the main occupation for District 1 and technology for District 3. In District 12, black markets and hunting are illegal. Thus, most people in the district see their justice system as ridiculous or arbitrary. Many people even had to break the laws imposed to make sure that they don't die of starvation. Often, they were also given harsh punishments for going outside the electric fence or breaking other laws. But they had no other choice. It was either waiting to die of starvation or finding an alternative solution to live.

In the novel, multiple perspectives of crime and violence are present: as punishment, a reminder of forced obedience, a general fascination with death, and many others. The primary reason for the Capitol to conduct the Hunger Games was to punish the uprising. However, this changed from punishment to the ultimate form of entertainment. Former game arenas are being used as “historic sites”, but not to educate the people of the districts. Instead, for a month, rewatch the Games, visiting the catacombs, visiting the sites where the deaths took place, and you can even take part in re-enactments (Collins 114). These “historic sites” are used as an additional warning to the districts and serve other purposes. The sites are used to show how the Capitol has created more than just a reality television show. They have built a new culture, encouraging Capitol residents and district citizens to fully embrace this form of entertainment in every aspect of their lives. Instead of providing resources for their starving citizens in the districts, the Capitol opts to cater primarily to the people living in the city giving them the opportunity to go on vacation and enjoy entertaining horror of the games. Even after the annual Games are over, the Capitol encourages its citizens to continue the abnormal obsession they have with the games by creating a historical vacation destination that makes the games appear less traumatising and more fictionalized. The complicated pleasure that residents derive from the games causes them to obsess over the games, even when the games are not officially held. The suffering tributes undergo during the games fuel the excitement of the Capitol residents. People in the Capitol feel a small connection to the tributes, and they act as if they know them, even though they will see them die and will probably never see them as anything other than a product of the Games.

The people of Panem are not allowed their basic human rights, such as the right to live, freedom from slavery, the right to privacy, etc. The government constantly monitors the action and speech of its citizens. During the Games, the tributes had a GPS tracking device implanted in their arms. Besides constant tracking of their location and movements. These tributes are

monitored and recorded using hidden cameras. This is done to ensure that the viewers of the games do not miss any of the action. However, these cameras also allow the game makers to introduce new dangers or obstacles, direct tributes towards or away from other areas, or otherwise direct or influence the outcome of the games. There is significant implicit use of surveillance cameras in the Capitol and the outer districts. When riots and other types of internal discontent arose in the districts, Katniss got a glimpse of the Capitol's video footage of the events while she was on the train to the Capitol. Because these cameras were practically invisible, the residents were unaware of the fact that they were being watched over. In Chapter 1 of the novel, we witness Katniss dismissing the idea of fleeing from District 12, claiming that the Peacekeepers would catch them. In the 74th Hunger Games competition, Katniss and Peeta manipulated Seneca Crane, the head Game-maker, into allowing two victors by pretending to be in love with one another. Katniss believes that the deception will end and that they will return to their previous lives, but this proves impossible. In Panem, Hunger Games winners are akin to reality television stars. They are also obligated to the Capitol, and they expect the Victors to serve as mentors to the tributes from their home districts in all the future Hunger Games, just as Haymitch did for them. Katniss believes that their deception will eventually be left behind, but she was wrong. The story of their "star-crossed love" became a new form of entertainment. By surviving the game, Katniss and Peeta's social roles have been irrevocably changed. This is true for all the winners, but it is especially true for them because there had never been two winners before, together with the fascinating story of their doomed love. Although their plan to return to normal life failed, several of the districts misinterpreted their strategy of portraying themselves as star-crossed lovers as an act of rebellion against the Capitol. The rising rebellion in the nation disturbed President Snow. He threatens Katniss with District 12. He warns her that unless they can persuade the district and President Snow of their true love, they will be able to wipe out District 12. Furthermore, he further confronts Katniss

by showing her a surveillance film of her and Gale kissing, to impress upon her the importance of a convincing portrayal of love. This leads to a fair conclusion that at least Katniss, if not all of District 12, is under extensive surveillance. The Capitol's Peacekeepers, deployed in the outlying districts, constitute the last example of illegal domestic monitoring combined with the abrogation of civil liberties. We have seen them examining the homes of district residents for contraband without a warrant or any other form of authorization. We also saw the Peacekeepers taking and destroying property. They detain and take into custody many district residents during their crackdowns on black market gatherings and other kinds of political dissidence, again providing no official authorization. These Peacekeepers brutally punished many of these detainees.

The extreme violation of human rights comes at the end of *Catching Fire*. After the successful infiltration of the Capitol, the rebels, along with Katniss, escape to District 13. President Snow destroys District 12 and now it is reduced to ashes and bones as a punishment for the rebel's actions. It was not the first time the Capitol had taken such action. They have destroyed District 13, which brought an end to the Dark Days and the beginning of the Hunger Games Era. As another example, we have Peeta. In the aftermath of the 75th Hunger Games, the rebels were successful in rescuing Katniss, but they left Peeta behind in the custody of the Capitol. During his detention, Peeta had undergone a brainwashing technique that caused him to assault Katniss. Peeta is only one of many individuals who have been victims of the Capitol. The Hunger Games are themselves an egregious example of human rights violations. The Capitol mandates a lottery and, with the Peacekeepers, oversees the game. They select 24 teenagers and put them into a combat arena where these children fight each other until there should be only one survivor. They would hail the winner as the victor for that year, and they would have to continue being the mentor for the rest of their lives, like Haymitch Abernathy and Mags Flanagan. As for Katniss, after becoming a victor, they provided her family with

better living conditions, but she was not happy. She had to suffer from constant panic attacks and nightmares from a traumatic experience in the Hunger Games, and yet again, during the 75th Hunger Games, she had to take part in the Games because the Capitol wanted her to. A violation of the rules in the Game endangers not only the tributes, but also their families, friends, and co-workers. None of the characters is more aware of this than Haymitch, who won the 50th Hunger Games competition by unexpectedly manipulating the force-field around the gaming arena, forcing a weapon thrown at him to bounce back and hit the last remaining tribute. A few weeks after the games ended, the Capitol assassinated his mother, younger brother, and girlfriend as punishment for his strategy. Even Capitol residents and Gamemakers faced retaliation from the state. After the conclusion of the 74th Hunger Game, in which both Katniss and Peeta are declared the winners, the President Snow imprisons Seneca Crane-the Head of Gamemakers -in a room with only a bowl of poisonous berries as punishment. There is no doubt that he was executed as a punishment for his failure.

Women are relatively ignored in conventional criminology. An attempt to go beyond the traditional focus of conventional criminology is made by focusing on the feminist issues in the novel. Today, feminists try to achieve gender equality and the empowerment of women. In Pat Carlen's "Women, Crime, and Poverty" (1988), she examined criminality using a control theory approach, suggesting women were controlled by society. She proposed that female criminality was the result of women rejecting socially-approved pathways. Carlen outlined two ways in which women are expected to conform to societal norms: class and gender. Rejection of these norms leads to female criminality and deviance. In this case, Katniss had no social support that could help her avoid engaging in criminal activities. Her circumstances never allowed her to have the life she wanted. The only time she enjoyed life was when she had her father with her. Her father was her role model. He took time off from his busy schedule to be with her and teach her hunting. He even made a bow for her. After his death, she was expected

to face the reality of life. Instead of embracing the social norm allotted to her, she dared to take up the role of her father and was willing to engage in crimes like hunting outside the fence and selling the products to the black market in exchange for food for her family. Katniss's willingness to engage in criminal activities can also be interpreted as a way of trying to cope with the strain she lives under. She was also encouraged by her only friend, Gale, to continue hunting, as they both knew if they stopped, their family would die of starvation. Another courageous deviance performed by Katniss is when both Katniss and Peeta almost eat the poisonous berries, which was considered the ultimate rebellious move. She took the risk to prove her point that something must be done to stop the cruel practices of the Capitol. Katniss knew that they would not have both of them dead, as that would mean thousands of dollars lost in bets placed on who would win, and it would also defeat the purpose of the Hunger Games: to entertain the audience with the survival of one sole winner. This deviant behaviour forced the Gamemakers to create a new set of rules that were never seen before.

Another topic that feminists have been looking into is juvenile crime. According to them, young people disproportionately commit juvenile crimes. Feminist theorists and others have examined why this is so. Talcott Parsons (1964) purported that masculinity was internalised by young people during adolescence, which led to boys engaging in more delinquent behaviour than girls. The idea of masculinity can make young people more likely to commit crime. Being tough, powerful, aggressive, daring, and competitive became a way for them to express their masculinity. This can be seen in *The Hunger Games* with Gale's willingness to participate in risky behaviours. Some of these behaviours include Gale's suggestion to run away from District 12 and how he believes that everyone should start a riot to stop the Hunger Games.

## CONCLUSION

What makes the novel *The Hunger Games* more remarkable is probably not just the enlightenment and awareness it endows, but also the way it tries to bridge the gap between criminology and literature. Furthermore, it discusses the conflict based on a fascist dictatorship that is capitalistic and the military-industrial complex which is extremely powerful. Through the novel, Suzanne Collins creates a new world that allows readers to acknowledge the manipulation and unfair practises of the Capitol and how the Capitol uses violence to control its citizens. The Games are, without doubt, a savage and ritualistic platform that allows the Capitol to remind and punish the districts and their people of the horrors of rebellion after the "Dark Days". But at the same time, it became a source of entertainment for Capitol citizens. They took pleasure in seeing the tribute's pain and misery. The Capitol encourages its citizens to continue the pathological obsession they have with the games by creating "historical sites" that make the games appear less traumatising and more fictionalised. By shedding light on the attempts made by the Capitol to hold on to their power, this novel successfully arrests our attention and calls for a conscious examination of the way we see crime and criminals.

The novel and its accompanying dramatization mark in bold the claims made by radical criminologists about how the upper class can maintain their power and privilege through exploitation and oppression of the lower classes. By providing evidence of contemporary issues like how the structure of society allows the elites to decide what makes up a crime and what punishment should be, we often see people who are not from the upper-class committing crimes, etc. This further serves to highlight the profound role and impact of the government and other justice systems in hiding the larger picture of what is happening in our society. When non-radical criminologists and the public focus on an individual level, they let the wealthy elite

get away with their crime. This is clearly what happens with Panem. Those who live in the Capitol are the wealthy elite. These elites control the whole of Panem through illegal domestic surveillance, severe punishments, and, last but not least, the Hunger Games.

From the analysis of the novel against the backdrop of the theories discussed, it can be concluded that human thoughts and actions can be manipulated socio structurally and that this can only be challenged effectively through a revolutionary transformation. It also offered a wide-ranging critique of the dominant form of criminology. This dominant form was concerned with criminal behaviour and the causes of criminal behaviour within individuals. Here, *The Hunger Games* novel makes a very useful illustration of radical crime. For example, the Capitol uses the media to serve as its mouthpiece and as a source of dissemination of propaganda. Finally, the whippings, beatings, kidnappings, and ritualistic executions of Panem residents are some other examples of radical crimes.

It also becomes inevitable to conclude that literature, like all other fields of study that have come before, holds the power to change the way we view the world. As far as the novel is concerned, we can't deny the fact that the rise of Panem is not far away from reality. The rich in our world continue to be richer and capitalistic, whereas the poor remain under the oppression of the privileged class. Criminal justice continues to benefit the privileged, and thus, we often see people who are not from the upper-class committing crimes. Hence, what makes up a crime is a notion that is constantly deliberated upon in this world of reality.

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**CONSTRUCTION & CHARACTERISATION OF**  
**SOLAR MOBILE CHARGER**

**PROJECT REPORT**

Submitted by

**MARIA ROSE MOL**  
**Register No: AB19PHY017**

Under the guidance of  
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**Department of Physics, St. Teresa's College (Autonomous), Ernakulam**  
**Kochi-682011**

Submitted to the  
**Mahatma Gandhi University, Kottayam**

*In partial fulfilment of the requirements for the Award of*  
**BACHELOR'S DEGREE OF SCIENCE IN PHYSICS**



**ST. TERESA'S COLLEGE (AUTONOMOUS)**  
**ERNAKULAM, KOCHI-682011**

**ST. TERESA'S COLLEGE (AUTONOMOUS)  
ERNAKULAM**



**CERTIFICATE**

This is to certify that the project report entitled '**CONSTRUCTION & CHARACTERISATION OF SOLAR MOBILE CHARGER**' is an authentic work done by MARIA ROSE MOL, St. Teresa's College, Ernakulam, under my supervision at the 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 2021-2022. 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: 9/05/2022

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B.Sc. PHYSICS  
PROJECT REPORT

Name : MARIA ROSE MOL

Register Number : AB19PHY017

Year Of Work : 2021-2022

This is to certify that this project entitled '**CONSTRUCTION & CHARACTERISATION OF SOLAR MOBILE CHARGER**' is an authentic work done by MARIA ROSE MOL.

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submitted for the University examination held at St. Teresa's College, Ernakulam

DATE: 9/05/2022



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3

## DECLARATION

I, MARIA ROSE MOL, final year B.Sc. Physics student, Department of Physics, St. Teresa's College, Ernakulam do hereby declare that the project work entitled 'CONSTRUCTION & CHARACTERISATION OF SOLAR MOBILE CHARGER' has been originally carried out under the guidance and supervision of Ms. MINU PIUS, Assistant Professor, St. Teresa's College (Autonomous), Ernakulam in partial fulfillment for the award of the degree of Bachelor of Physics. We further declare that this project is not partially or wholly submitted for any other purpose and the data included in the project is true to the best of our knowledge.

Place : Ernakulam

Date : 9/05/2022

MARIA ROSE MOL

CONSTRUCTION & CHARACTERISATION  
OF  
SOLAR MOBILE CHARGER

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## ABSTRACT

Mobile phones have become an indispensable part in human being's everyday life. But the availability of power for its charging is under question. Therefore, we attempted to construct a solar mobile charger powered by a solar panel. In solar mobile chargers, solar energy is used for the generation of voltage required to charge the mobile battery. Since, solar energy is one of the main sources of renewable energy, thus the abundance of solar energy can be guaranteed everywhere. In this work, we assembled a solar mobile charger and determined its efficiency, fill factor, and other key parameters from V-I characteristics. The performance of the panel is analysed by comparing its charging time upto 1% under AC mains and under direct sunlight. The charging of mobile phones is investigated for different tilt angles and intensities of light.

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# CHAPTER I

## 1.1 INTRODUCTION

Energy has always been closely linked to man's economic growth and development. Global energy demand is accelerating almost daily, resulting in an energy crisis and environmental pollution. The present strategies for development focused on rapid economic growth, have used energy utilisation as an index of economic development. This index however does not take into account the adverse long term effects of excessive energy utilization on society. Energy crisis is a broad and complex topic. Its overuse has resulted in depletion of natural resources and the higher consumption rates have severe effects on our environment. It's high time that we switch to cleaner and more efficient energy resources.

### **1.1.1 Renewable Resources**

Renewable energy resources are necessary and needed for the following reasons:

Renewable energy is reliable and plentiful and will be cheap once technology and infrastructure improves. Conventional sources cause pollution and degrade the environment whereas renewable energy produces only minute levels of carbon emissions and therefore helps combat climate change caused by fossil fuel usage. Energy efficiency and renewable energy policies can reduce the demand for and supply of energy generated from fossil fuels (natural gas, oil, and coal fired power plants). Geothermal energy, nuclear power, tidal and wave power, biogas, biomass energy, solar thermal electric power, photovoltaic energy, solar energy, hydroelectric power, are some of the widely used renewable sources of energy. Out of

them Windmills, Solar energy, Hydro-electric power has been widely used for generating electricity.

The transition to an energy system based on renewable technologies will have very positive economic consequences on the global economy and development.

### **1.1.2 Solar Energy**

Radiation from the sun is a source of energy suitable for initiating chemical reactions, production of heat and generation of electricity. In one hour, the sun pours as much energy onto the earth as we use in the whole year. If it were possible to harness this colossal quantum of energy, humanity would need no other source. It has the potential to satisfy all of our future energy needs. It's inexhaustible and Non-polluting. Solar radiation can be converted either into thermal energy (heat) or into electrical energy, though the former is easier to accomplish.

Some of the common devices used to capture solar energy and convert it into thermal energy are flat plate collectors, solar ponds and solar ovens. Solar radiation may be directly converted into electricity by photovoltaic cells. There are different types of photovoltaic cells.

In our project, we have made a humble effort to construct a mobile charger powered by solar energy using polycrystalline solar panels of 10W(reference panel) and of 1.3W.

## 1.2 THEORY

A solar cell is an electrical device that converts light energy into electrical energy through photovoltaic effect. It's basically a p-n junction diode although its construction is a bit different from that of conventional p-n junction diodes. A solar cell is composed of two types of semiconductors- n-type and p-type.

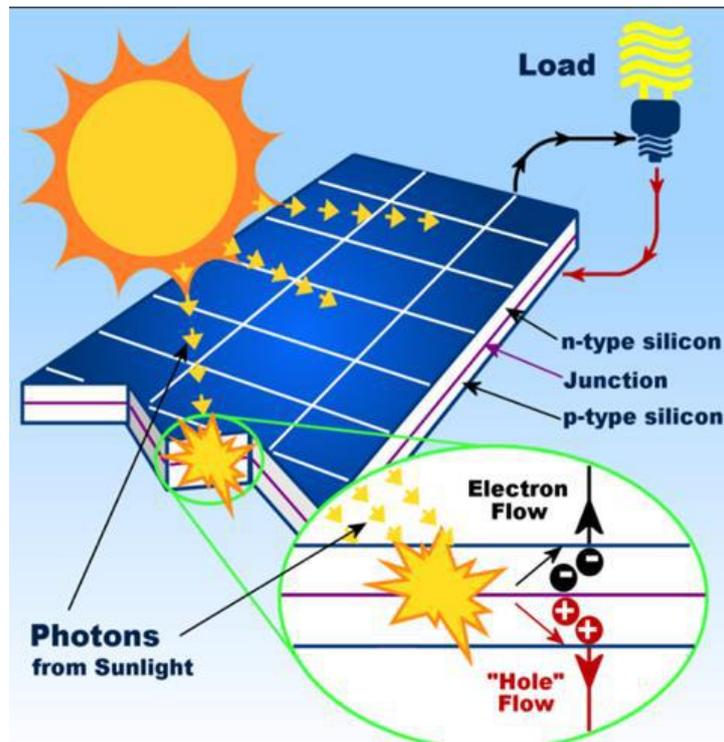
n-type semiconductor is formed by doping an intrinsic semiconductor with group V elements like phosphorus. These semiconductors have an excess of electrons and hence electrons are the majority carriers.

p-type semiconductor is formed by doping an intrinsic semiconductor with group III elements like Boron. These semiconductors have an excess of holes (vacancies due to lack of valence electrons) and hence holes are the majority charge carriers.

A very thin layer of p-type semiconductor is grown on a relatively thicker n-type semiconductor.

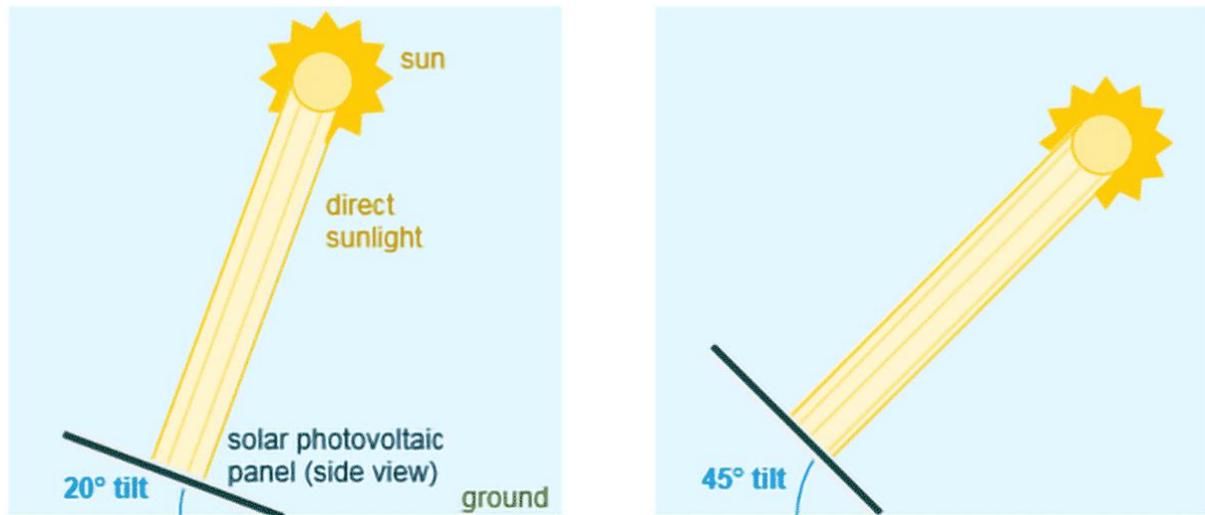
At the junction of the two layers, the electrons in the n-side move into the holes in the p-side. As a result at the junction a depletion layer is formed. It's so called because the region has no mobile charge carriers due to electron hole recombination.

On the p-side of the junction there are immobile negative ions and on the n-side of the junction there are positive immobile ions. These oppositely charged ions create an internal electric field that prevents electrons in the n-type layer from filling holes in the p-type layer. Hence a barrier potential is formed across the junction.



**Fig 1.1 working of a solar cell**

When light strikes the surface of the cell, electrons are ejected which is accompanied by the formation of holes. The electric field across the junction will move electrons to the n-type layer and holes to the p-type layer. Two charges build up on the opposite side of the junction, and hence we have a potential difference across the junction. If the n-type and p-type layers are connected with a metallic wire, the electrons will travel from n-type layer to p-type layer by crossing the depletion layer and then go through the external wire back to n-type layer, creating a flow of electricity. The more light that shines, the more electrons are ejected and the more current flows.



**Fig 1.2 tilt angle**

Solar panels work best when they face directly into the sun. But that task is complicated by the fact that the sun moves across the sky throughout the day. **Tilt angle** is the angle between the horizontal plane(ground) and the solar panel. The optimum tilt angle for maximum efficiency will depend on latitudes, seasons, etc.

There are a variety of solar cells. The three commonly used are mono crystalline, polycrystalline and thin film solar cells.

### **1.2.1 Mono crystalline solar cell**

The cell is composed of a single crystal, the electrons that generate a flow of electricity have more room to move. Mono crystalline solar panels (mono-SI) are a pure type of solar panel made from mono crystalline silicon. They have a uniform dark appearance with rounded edges that make them easily recognizable. The purity of the silicon enables high efficiency rates, some reaching above 20%. These panels tend to be less affected by high temperatures compared to polycrystalline panels. These cells are longer

lasting and space efficient. For these reasons they also tend to be the most expensive.

### **1.2.2 Polycrystalline solar cells**

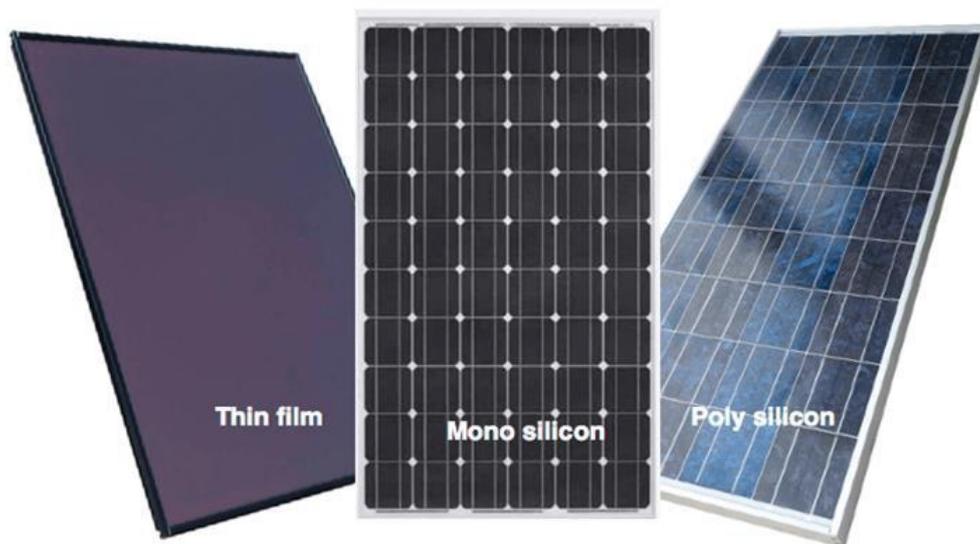
Polycrystalline solar panels are more eco-friendly than monocrystalline solar panels as they do not require individual shaping and placement of each crystal and most of the silicon is utilized during production. So, very less waste is produced. The acceptable maximum temperature of polycrystalline solar panels is 85 °C while the acceptable minimum temperature is -40 °C. Polycrystalline solar panels have lower heat tolerance than monocrystalline panels. So, at higher temperatures, these solar panels have lower efficiency than others.

These panels have high power density. They come with a structural frame of their own which makes mounting cheaper and simpler. Polycrystalline panels are suitable for roof mounted arrays. They are used in large solar farms to harness the power of the sun and supply electricity to nearby areas. They are used in standalone or self-powered devices such as traffic lights in remote areas, off-grid households, etc.

### **1.2.3 Thin film solar cells**

They are very economical, require less material, contain no toxic components, generate less waste, and are very easy to manufacture. There are 3 types of solar Thin-Film cells: Amorphous silicon thin film, cadmium telluride thin film, copper indium gallium selenide.

They are more flexible and lightweight than the other types making them perfect to be used in portable devices. Thin-Film solar panels are less efficient and have lower power capacities than mono and polycrystalline solar cell types. The efficiency of the Thin-Film system varies depending on the type of PV material used in the cells but in general they tend to have efficiencies around 7% and up to 18%. Thin-Film solar panels have a better temperature coefficient than silicon-based panels. Meaning that they are less affected by high temperatures and will lose only a small portion of their performance when it gets too hot.



**Fig 1.3 types of solar cells**

## 1.2.4 V-I Characteristics of A Solar Cell

The voltage current relation in a solar cell is given below:

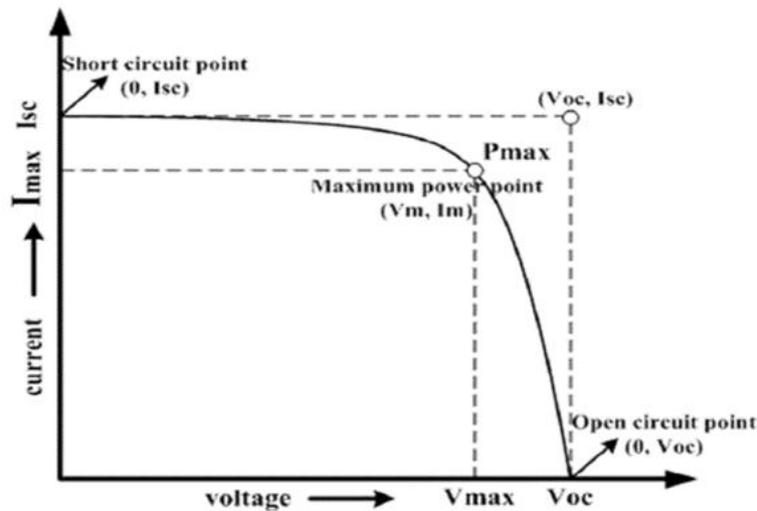


Fig 1.4 V-I characteristics

- $I_{sc}$  is the short circuit current and it is measured by short circuiting the terminals.
- $V_{oc}$  is the open circuit voltage and it is measured when no load is connected.
- $I_{max}$  is maximum current.
- $V_{max}$  is maximum voltage and it occurs at the bend of the characteristic curve.
- $P_{max}$  is maximum power.

$$P_{max} = I_{max} \times V_{max}$$

- Fill Factor (FF)

The fill factor gives an idea of the maximum output withdrawn from the solar cell for a given  $V_{oc}$  and  $I_{sc}$ . Mathematically it is given by the equation given below. The value of FF under ideal conditions

is unity. Deviations from the ideal gas values are due to defects and contact resistance. The lower the value of FF, the less sharp will be the V-I curve. For a silicon solar cell, the maximum value of FF is 0.88.

$$\begin{aligned} \text{FF} &= \frac{I_{max} \times V_{max}}{V_{oc} \times I_{sc}} \\ &= \frac{P_{max}}{V_{oc} \times I_{sc}} \end{aligned}$$

- Efficiency:

Solar cell power conversion efficiency given as

$$\eta_{cc} = \frac{P_{max}}{P_{in}}$$

# CHAPTER II

## 2.1 COMPONENTS

### 2.1.1 Polycrystalline solar panel-7V

Polycrystalline or Multi crystalline solar panels are solar panels that consist of several crystals of silicon in a single PV cell. Panels absorb energy from the sun and convert it into electricity. This panel has a voltage of 7V.

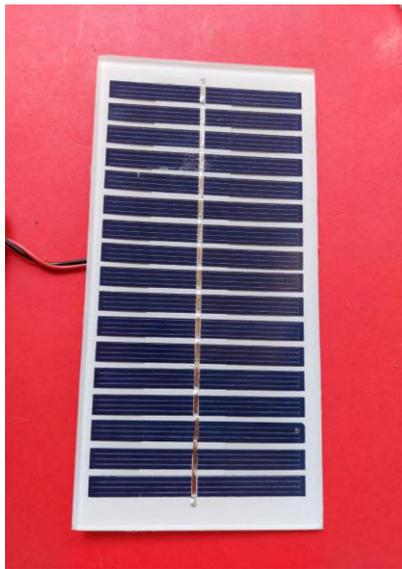
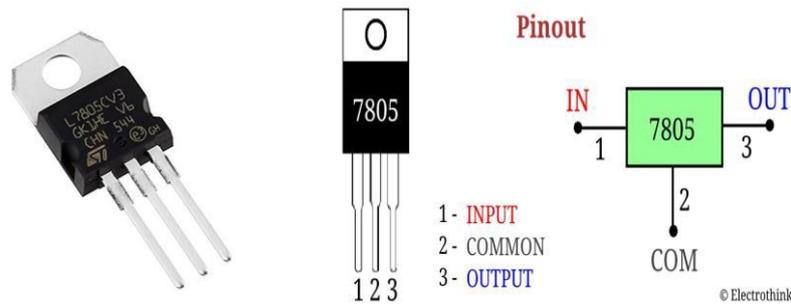


Figure 2.1.1 solar cell

### 2.1.2 IC7805

IC7805 is a 5V voltage regulator that restricts the output voltage to 5V for various ranges of input voltages. It acts as an excellent component against input voltage fluctuations for circuits, and provides an additional safety to the circuitry. It is inexpensive, easily available and very much commonly used. With few capacitors this IC can build a pretty solid and reliable voltage regulator in no time.



**Figure 2.1.2 Voltage regulator - IC7805**

### 2.1.3 Capacitors

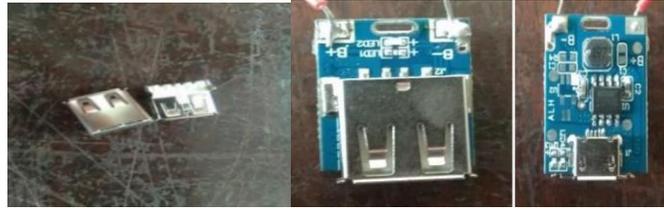
A capacitor is a device that stores electrical energy in an electric field. It is a passive electronic component with two terminals. We use 100 $\mu$ F capacitors for constructing solar mobile chargers. The capacitor is used to suppress the mini voltage spikes inside the phone. It helps keep the voltage constant when it is fluctuating up and down at times. When the phone is almost about to discharge, the capacitor helps in providing a boost power to the mobile phone for a short duration of time.



**Figure 2.1.3 capacitor 100 $\mu$ F**

### 2.1.4 USB module

USB stands for Universal Serial Bus. USB port allows USB devices to be connected to each other with and transfer digital data over USB cables. They can also supply power across the cable to devices that need it.



**Figure 2.1.4 USB Port Printed USB Port**

## **2.1.5 Multi-meter**

Multimeter is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter can measure voltage, current, and resistance. Analog multimeters use a microammeter with a moving pointer to display readings. Digital multimeters have a numeric display, and may also show a graphical bar representing the measured value. Digital multimeters are now far more common due to their lower cost and greater precision.



**Figure 2.1.5 digital Multimeter**

## **2.1.6 Soldering device**

The basic purpose of a soldering iron is to create a bond between two workpieces using electronically heated soft metal. The soldering iron supplies heat to the soldering tip, which is used to melt the solder. The melted solder forms a bond in the joint between two work pieces. 18 Solder is made up of soft metal alloys, usually composed of a combination of different materials. Typically, this includes a low percentage of a soft metal alloy (such as zinc or copper) and a high percentage of tin. Tin is also a

relatively soft metal, but it helps make the bond between the workpieces stronger. Another major component of solder is flux. Flux is a chemical agent that comes in gel form which is used as a catalyst for soldering. It is used to transfer the heat from the soldering iron to the metal so that the solder can form a chemical bond with the metal.



**Figure 2.1.6 Soldering device and Soldering iron**

### **2.1.7 Intensity metre**

A lux metre is a device for measuring brightness, specifically, the intensity with which the brightness appears to the human eye. A lux metre works by using a photocell to capture light. The metre then converts this light to an electrical current, and measuring this current allows the device to calculate the lux value of the light it captured.

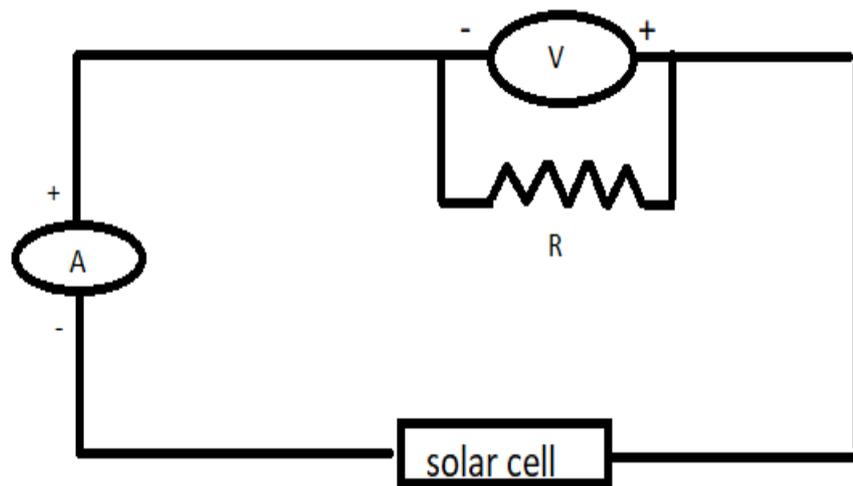


**Figure 2.1.7 intensity metre**

# CHAPTER III

In this chapter, the details of the experiment such as the construction of the solar mobile charger and its performance analysis are discussed.

### 3.1 V-I CHARACTERISTICS OF SOLAR CELL



**Fig 3.1 circuit diagram**

V-I characteristics stand for voltage-current characteristics of an electrical component or device. The V-I graph yields valuable information about the resistance and breaks down an electronic component. From the V-I characteristics  $I_{sc}$  is the short circuit current and it is measured by short

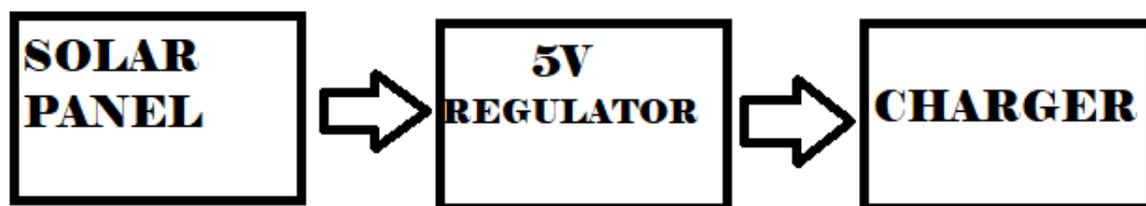
circuiting the terminals.  $V_{oc}$  is the open circuit voltage and is measured when no load is connected,  $P_m$  is the maximum power.  $I_m$  is the maximum current.  $V_m$  is maximum voltage and it occurs at the bend of the characteristics curve.

Connections are made as shown above in the diagram. The solar cell is connected in forward bias. Positive of the cell is connected to the positive of the voltmeter, and the negative of the cell is connected to the negative of the ammeter. A load resistance is connected across the voltmeter. The experiment is done by varying the values of resistance. In each step, take both ammeter and voltmeter readings. The cell is kept in maximum intensity position. A graph is plotted taking voltage along X-axis and current along Y-axis. The V-I characteristics parameters are determined from the graph.

## 3.2 SOLAR MOBILE CHARGER

The objective of this project is to make a mobile charger unit using a solar panel, determine V-I characteristics of the solar panel, deduce parameters such as fill factor, power density, determine optimum inclination for charging, and also compare time of charging under mercury vapour lamp and under direct sunlight. The block diagram for solar mobile charger is shown in Fig. 3.1.

### BLOCK DIAGRAM



**Figure 3.2 Block Diagram of Mobile Charger.**

Solar mobile charger consists of a panel and a fixed voltage Regulator. The solar panel is a voltage source, the output of which varies based on the intensity of sunlight falling on the solar panel. It works on the principle that when light falls on the solar cell, electron-hole pairs are created in the n-type emitter and in the p-type base. The generated electrons (from the base) and holes (from the emitter) then diffuse to the junction and are swept away by the electric field, thus producing current. Most cell phone charger's output voltage is between 5 and 12 volts. IC7805 is a voltage regulator IC which is used to provide a constant output voltage of 5V.

### 3.2.1 Circuit Diagram

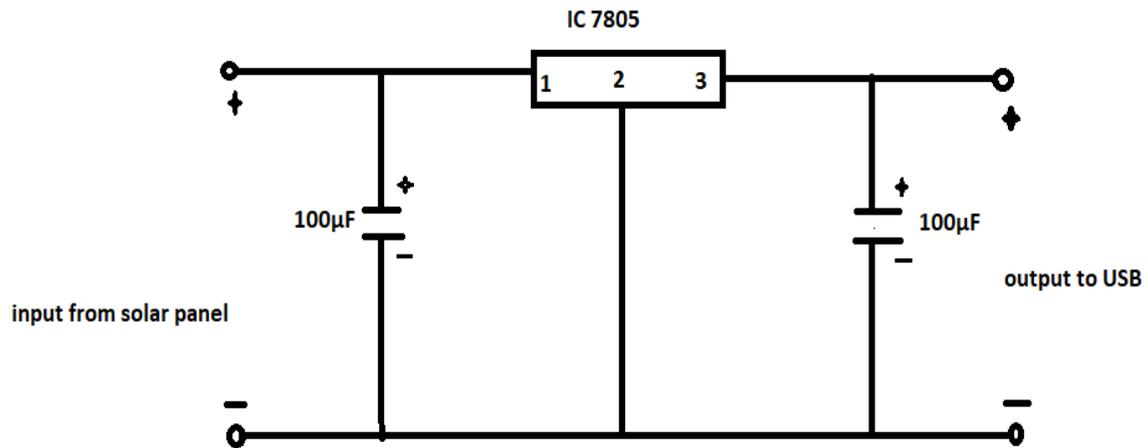


Figure 3.2.1 Basic circuit Diagram

This is the basic circuit diagram of a solar mobile charger. In the circuit IC7805 is connected to two 100µF capacitors. Input voltage is provided by the solar panel and output is taken from the USB port connected across the IC7805 and capacitor 100µF. Then the USB port is connected to the mobile phone.

### 3.2.2 Breadboard Connections

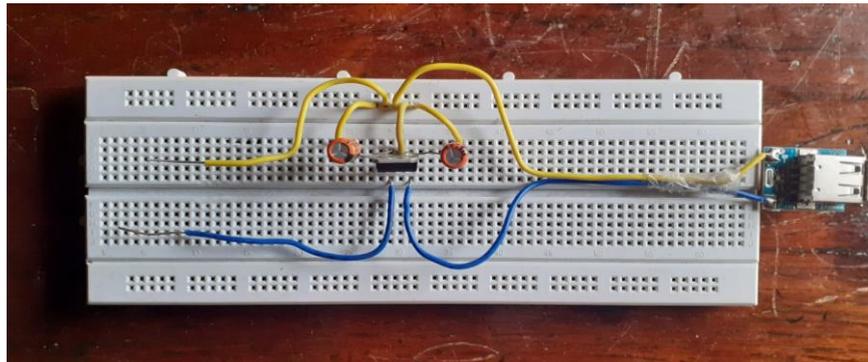


Figure 3.2.2

The preliminary basic circuit of the mobile charger is done in the breadboard. This is tested to ensure that it gives the sufficient voltage and current required for charging the mobile. Then this circuit is converted to a printed circuit board.

### 3.2.3 Mobile charger Printed Circuit Diagram

A printed circuit board (PCB) mechanically supports and electrically connects electrical or electronic components using conductive tracks or pads. Components are generally soldered onto the PCB to both electrically connect and mechanically fasten them to it. The basic mobile charger circuit is converted into PCB, since it is easier to handle than the connections done in the breadboard.

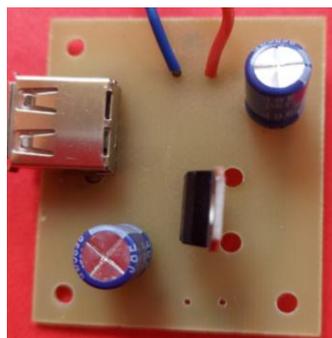
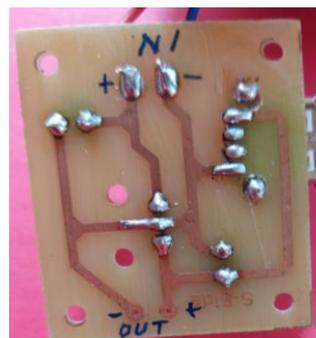
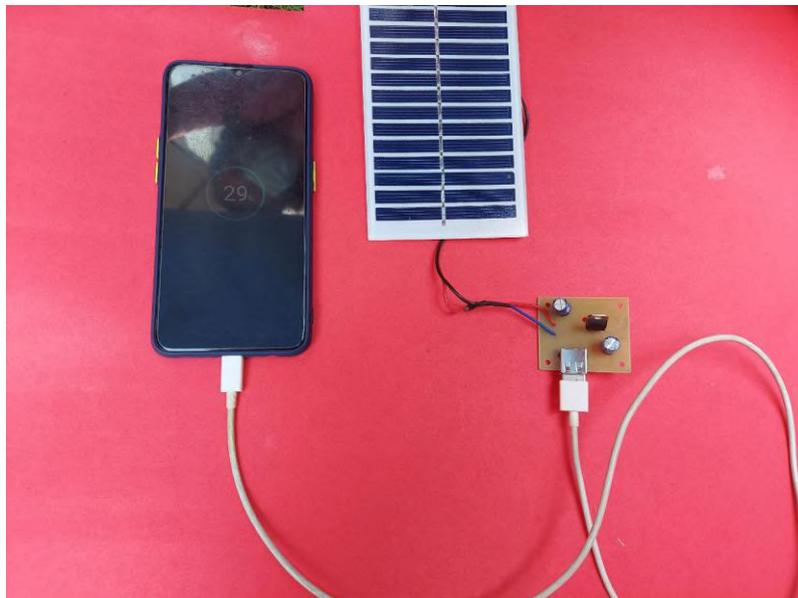
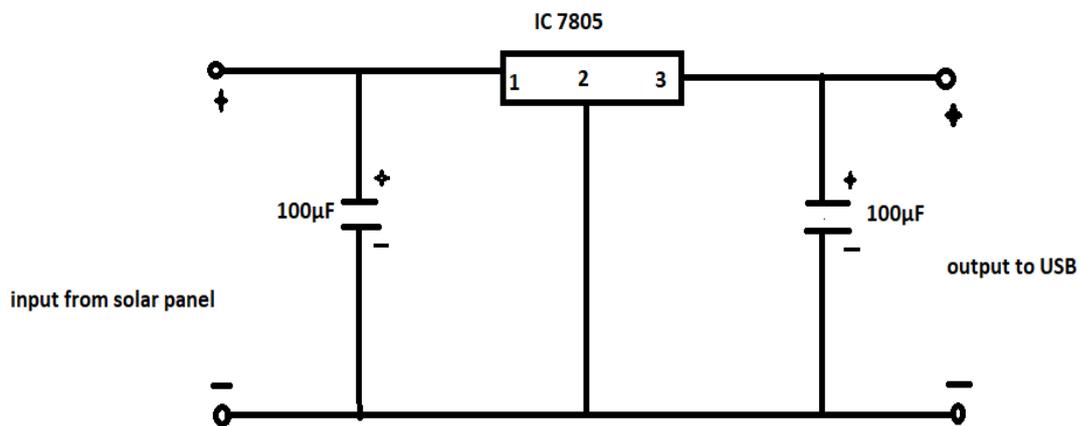


Figure 3.2.3 (A) PCB module



(B) PCB circuit board

### 3.3 CONNECTIONS AND WORKING



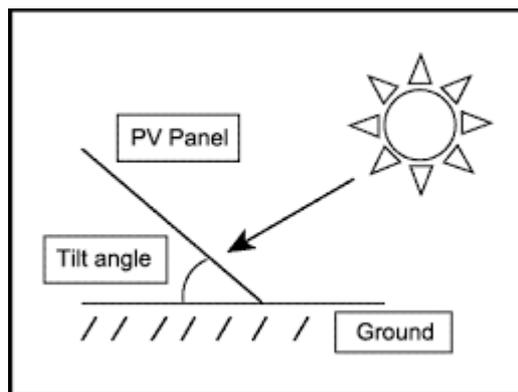
**Figure 3.3 Circuit Diagram**

The input terminal of IC7805 is connected to the positive terminal of a  $100\mu\text{F}$  capacitor. IC7805 will regulate the output voltage at 5V. The output terminal of IC7805 is connected to the positive terminal of the other capacitor  $100\mu\text{F}$ . The capacitor is used here to suppress the mini voltage spikes inside the phone. It helps keep the voltage constant when it is fluctuating up and down at times. When the phone is almost about to discharge, the capacitor helps in providing a boost power to the mobile

phone for a short duration of time. The negative terminals of these capacitors are grounded. The input voltage is supplied through the solar panel. Positive and negative terminals of the solar panel are connected across the corresponding terminals of the capacitor  $100\mu\text{F}$ . The output goes to the USB port. This USB port is connected to the mobile phone. Once connections are done, the sunlight is allowed to fall on the solar panel. This is then converted to electrical energy, the voltage corresponding to this energy is regulated using voltage regulator and capacitors and then it is used to charge the mobile device.

### 3.4 PROCEDURE

#### 3.4.1 Determination of tilt angle for maximum efficiency.



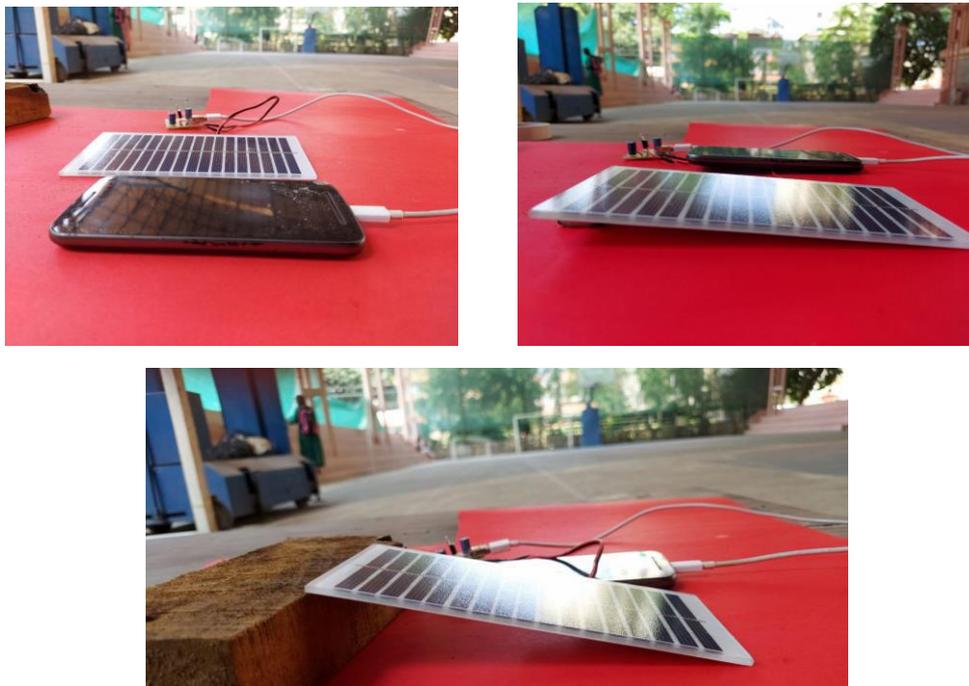
**Fig 3.4 Tilt angle**

Initially, the mobile phone is charged with the solar panel at 0 degree inclination to the ground. The time taken for charging the phone by 1% is noted.

The experiment is repeated for different tilt angles and in each case the time taken for charging the phone by 1% is noted.

Since the optimum tilt angle for the panel is dependent on seasonal variations we use a software to determine the optimum tilt angle at a particular latitude.

The time taken to charge the phone by 1% corresponding to the optimum tilt angle is also noted.



**Fig 3.4 solar panels at different tilt angles**

### **3.4.2 Mercury vapour lamp and Sun light comparison**

In order to understand how the intensity of the light affects the time taken for charging the phone, the experiment is done first using a mercury lamp and then by exposing the solar panel to sunlight. The time taken for charging the phone by 1% during each case is noted. The intensity of each of the sources are measured using a lux metre.

### **3.4.3 Charging and Discharging time in AC mains and solar panels of different power**

The mobile phone is charged using AC mains(5V), a reference solar panel of 10W and a solar panel of 1.3 W. The time taken for charging the phone by 1% is noted in each case. The time taken for discharging is also noted.

# CHAPTER IV

## 4.1 RESULTS AND DISCUSSIONS

### **4.1.1 V-I characteristics of solar cell and determination of efficiency, maximum power and fill factor.**

SI. NO	VOLTAGE (V)	CURRENT (A)
1.	5.32	0
2.	5.09	0.26
3.	5.03	0.27
4.	4.98	0.29
5.	4.94	0.30
6.	4.86	0.32
7.	4.75	0.34
8.	4.55	0.37
9.	4.18	0.40
10.	3.62	0.43
11.	2.86	0.46
12.	1.72	0.49
13.	1.60	0.5
14.	1.47	0.51
15.	0.916	0.55
16.	0.216	0.63
17.	0	0.64

Short circuit current,  $I_{sc} = 0.64 \text{ A}$

Open circuit voltage,  $V_{oc} = 5.32 \text{ V}$

Maximum current,  $I_{max} = 0.37 \text{ A}$

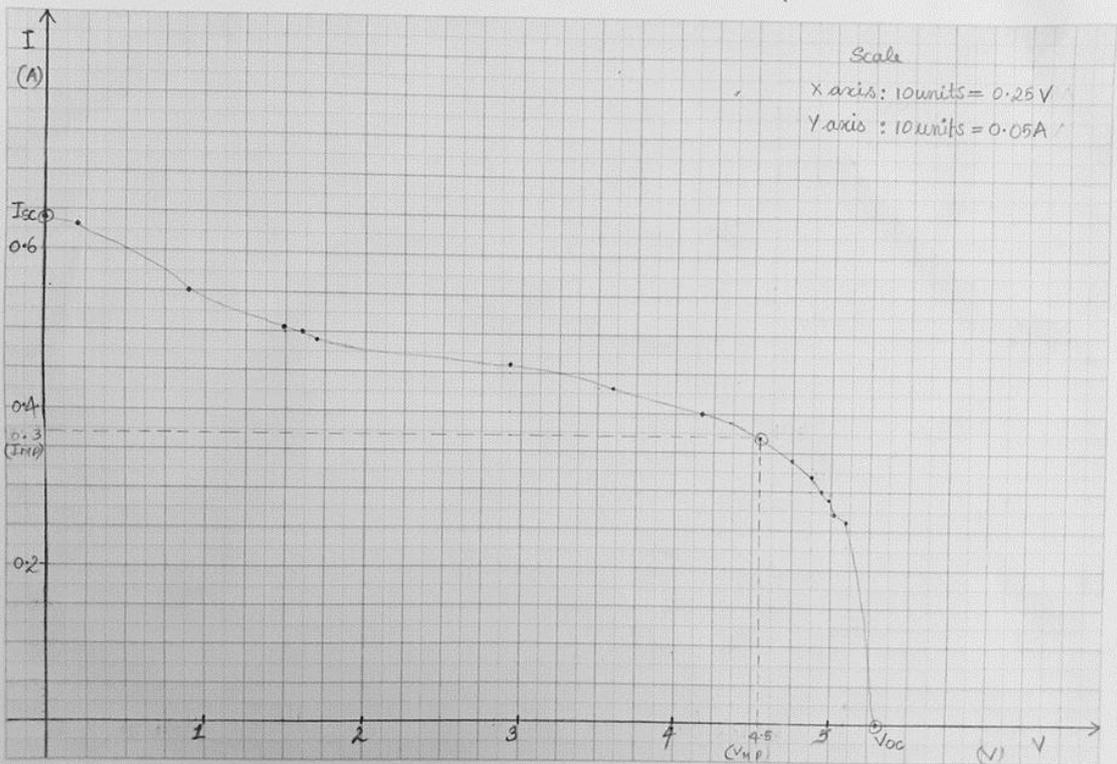
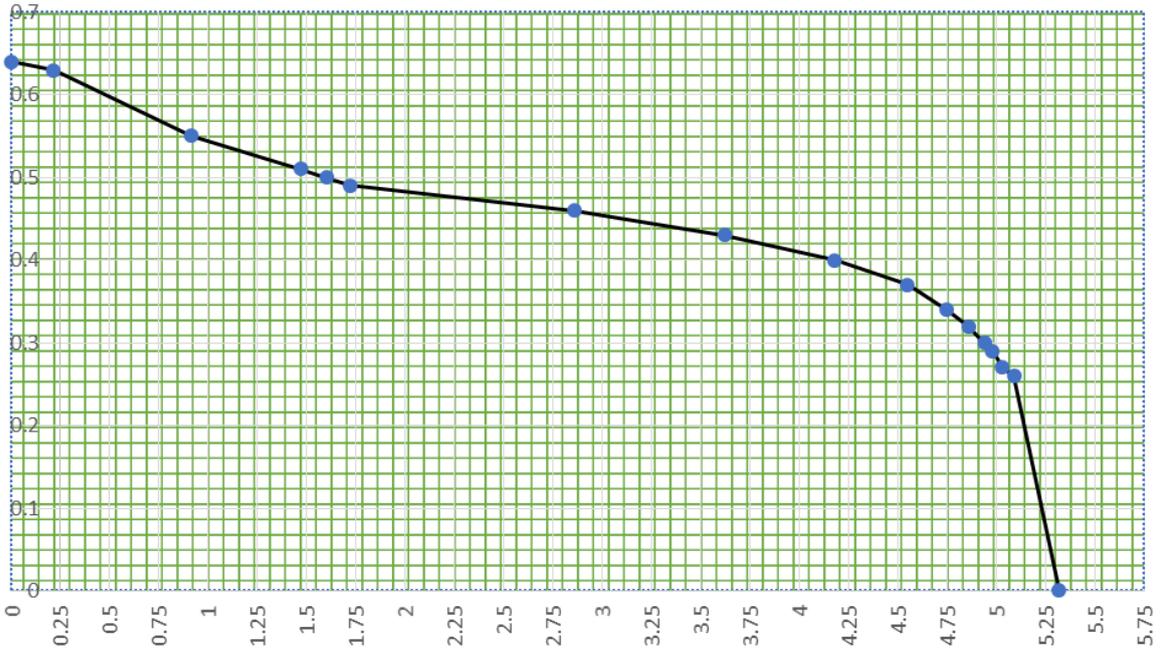
Maximum voltage,  $V_{max} = 4.55 \text{ V}$

Maximum Power,  $P_{max} = 4.55 \text{ V} \times 0.37 \text{ A} = 1.68 \text{ W}$

$$\text{Fill factor} = \frac{I_{max} \times V_{max}}{I_{sc} \times V_{oc}} = \frac{0.37 \times 4.55}{0.64 \times 5.32} = 49.4\%$$

$$\text{Efficiency} = \frac{P_{max}}{P_{in}} = \frac{1.68}{35} \times 100 = 4.8\%$$

V-I GRAPH



## 4.1.2 Determination of tilt angle for maximum efficiency

Date: 07/04/2022

Tilt angle obtained as per software: 3.2 degree

(Latitude: 9 deg 58 min 34 sec)



Vertical distance (cm)	Angle (degree)	Time taken for charging 1 %
0	0	33 min 22 sec
1	3.2	31 min 33 sec
3.7	12	35 min 40 sec
6.4	20	38 min 11 sec
8	26	44 min 25 sec
18	90	No charging

We get maximum efficiency for a tilt angle of 3.2 degree which is also the same according to the software.

### 4.1.3 Mercury vapour lamp and Sun light comparison

Angle of inclination: 0 degree

Power of mercury lamp: 35W

Intensity of the light from sodium vapour lamp as measured by a lux meter:  
7,600 lux

Intensity of sunlight as measured by the lux meter: 40,000 to 70,000 lux  
(during peak time)

<b>Source</b>	<b>Time taken for charging 1%</b>
<b>Sodium vapour lamp</b>	1 hr 13 min
<b>Sun</b>	31 min 33 sec

Hence higher the intensity, lesser the time taken for charging the phone.

#### **4.1.4 Charging and Discharging time in ac mains and solar panels of different power**

We successfully designed a solar mobile charger using IC 7805 and capacitors. Here, we have used a Motorola mobile phone having battery capacity 3500 mAh to determine charging and discharging time.

##### Reference solar panel

Power: 10W (voltage at maximum power 16.032 V and current at maximum power 0.640 A).

##### Solar panel 2

Power: 1.3W

Charging and discharging time of the above devices were measured and are tabulated in the table below.

<b>When mobile is connected to</b>	<b>Time taken for charging 1%</b>	<b>Time taken for charging 100%</b>	<b>Time taken for discharging 1%</b>	<b>Time taken for discharging 100%</b>
<b>AC main 5V, 1A</b>	1.41 minutes	2.35 hours	8.43 minutes	12.65 hours
<b>Solar panel 1 (Reference 10W)</b>	1.7 minutes	2.833 hours	8.43 minutes	12.65 hours
<b>Solar panel 2 (1.3W)</b>	31.55 minutes	52.58 hours	8.43 minutes	12.65 hours

## 4.2 ADVANTAGES AND DISADVANTAGES

### 4.2.1 Advantages:

- No pollution associated with it.
- It must last for a long time - solar panels last for over 30 years.
- No maintenance cost.
- Utilise renewable resources.
- Useful in remote areas and portable for travellers.
- Save electricity bill in the long run.
- No external power source required for charging.
- It can be used for all types of mobile phones and other gadgets too with a USB port as charging point.
- Solar mobile phone charger is compact in size and easy to carry around.

### 4.2.2 Disadvantages:

- Initial cost is high.
- Low efficiency and dependence of efficiency on tilt angle.
- Difficulties caused due to weather and also at night we will not get solar energy.
- Solar chargers have no capacity to store energy.

### 4.3 CONCLUSION

We have constructed a solar assisted mobile charger using a solar panel of 1.3W, IC7805 and capacitors. V-I characteristics of the solar panel were initially studied. A maximum power of 1.68W, efficiency of 4.8% and fill factor of 49.4% were determined. The tilt angle for maximum efficiency was found to be 3.2 degree. Charging and discharging time were noted and tabulated. Relation between intensity of light and time taken for charging was also found by charging the mobile phone in mercury vapour lamp and sunlight. Charging occurred in both cases, but faster charging was observed in sunlight.

From our project it was found that, using a solar panel of 1.3 W, it takes 31.55 minutes to charge a mobile phone by 1%. Hence, it takes a total of 52.58 hours for complete charging. So, the solar mobile charger takes more time for charging a mobile phone than direct electricity. For faster charging, the panel must be aligned at the optimum tilt angle and the charging must be done in the noon time because the rays from the sun are the strongest and give the brightest light at noon. We can improve the efficiency in charging by bringing modifications like increasing the panel power. Solar panels can be wired in parallel to increase the output current keeping the output voltage constant and hence faster charging. Climate is also important for the efficient working of the solar mobile charger. This issue can be tackled using a power bank set up. Also, the technology is advancing each second and there is a great future for the project.

#### 4.4 REFERENCES:

- Handbook of solar energy- G.N Tiwari, Arvind Tiwari, Shyam
- Solar photovoltaics(third edition)- Chetan Singh Solanki
- [www.slideshare.in](http://www.slideshare.in)

ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM



CERTIFICATE

This is to certify that the dissertation entitled, **INTERVAL GRAPHS, TOLERANCE GRAPHS- IT'S APPLICATIONS** is a bonafide record of the work done by Ms. **MARY IMELDA** 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.

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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 **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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Date: 27.05.2022



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## ACKNOWLEDGEMENTS

I must mention several individuals who encouraged me to carry this work. Their continuous invaluable knowledgeable guidance throughout the course of this study helped me to complete the work up to this stage

I am very grateful to my project guide (Dhanalakshmi O M) for the immense help during the period of work

In addition, very energetic and competitive atmosphere of the Department had much to do with this work. I acknowledge with thanks to faculty, teaching and non-teaching staff of the department and Colleagues.

I also very thankful to HoD for their valuable suggestions, critical examination of work during the progress.

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Date: 27-05-2022



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Project Report

On

**INTERVAL GRAPHS, TOLERANCE  
GRAPHS- IT'S APPLICATIONS**

*Submitted*

*in partial fulfilment of the requirements for the degree of*

**MASTER OF SCIENCE**

*in*

**MATHEMATICS**

*by*

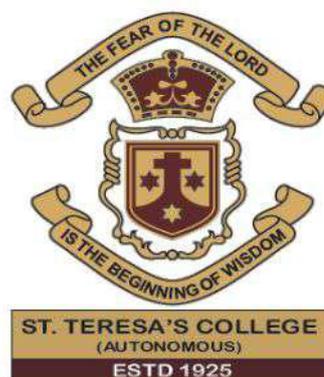
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(2020-2022)

*Under the Supervision of*

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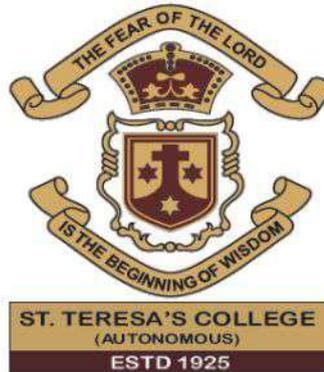
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**ERNAKULAM, KOCHI - 682011**

**APRIL 2022**

**ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM**



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# Chapter 1

## Introduction

---

In graph theory, an interval graph is an undirected graph formed from a set of intervals on the real line, with a vertex for each interval and an edge between vertices whose intervals intersect. It is the intersection graph of the intervals. Interval graphs have a variety of applications in various fields such as radio frequency allocation, VLSI architecture, temporary thinking in AI, storage allocation, used for modeling food webs, and studying planning problems etc. Also a compilation of intermediate graphs, called Tolerance graphs was introduced in 1982 by Columbus and Monma. Several uses are proposed in the fight against the COVID-19 epidemic since graphs appear as a natural tool in shaping the various problems associated with this global epidemic by slowing down the process of transmitting the virus. This method can be used to fight other epidemics as well. In this project, I've tried to emphasize the importance of interval graph by discussing it's properties and thus applications too and also solved a flight scheduling problem by finding out the minimum number of gates required in a day considering the timetable of departure flights of domestic as well as international schedules. It is done using the Mathematical Software named 'Sage-Math'.

## Chapter 2

# PRELIMINARIES

---

A Graph is an ordered pair  $(V,E)$  where  $V$  is the set of vertices and  $E$ , the set of edges connecting the vertices.

**Transitive Orientation:** Obeys the transitive property: if an edge  $ab$  is oriented from vertex  $a$  towards vertex  $b$ , and edge  $bc$  is oriented from  $b$  to  $c$ , then there is an edge  $ac$  and it is oriented from  $a$  to  $c$ .

**Intersection Graph:** An intersection graph  $G$  is an undirected graph formed from a family of sets  $S_i$ ,  $i = 0, 1, 2, \dots$  by creating one vertex  $v_i$  for each set  $S_i$ , and connecting two vertices  $v_i$  and  $v_j$  by an edge whenever the corresponding two sets have a nonempty intersection.

**Chord:** A cycle has a chord if there are a pair of vertices that are adjacent, but not along the cycle.

**Perfect Graphs:** In perfect graphs, chromatic number of every induced subgraphs equals the order of largest clique of that subgraph.

**Chromatic number:** Smallest number of colors needed to color a graph.

**Induced Subgraph:** Graph formed from a subset of vertices of the graph and all of the edges connecting pairs of vertices in that set.

**Clique:** A set  $C$  is a clique of the graph  $F$ , iff  $C$  is a subset of  $V(G)$  and  $u,v$  in  $C$  where  $u \neq v$  such that  $uv$  belongs to  $E(G)$ .

**Maximal Clique:** Clique that cannot be extended by adding in another vertex of the graph.

## 2.1 SageMath

Originator and Leader of Sage is William Stein, a mathematician at University of Washington. It was first released in 2005. SAGE- System for Algebra and Geometry Experimentation. Sage is a free, open source Mathematical software that supports research and teaching in algebra, geometry, number theory, cryptography etc... Both Sage development model and Sage technology itself is divided by the greatest emphasis on openness, community, cooperation and collaboration. The ultimate goal of Sage is to create a functional, free, open source different from Maple, Mathematica, Magma, and MATLAB. It builds on top of many existing open-source packages like NumPy, SciPy, Maxima, GAP, R(Statistics) and many more. Python programming language is the backbone of SageMath.

SageMath Operations:

\*Running SageMath: Type any SageMath command in the input box, and press Shift+Enter to see the result.

\*Graph(5): Build a graph on 5 vertices

\*Graph0:[1,2], 1:[2,3], 2:[3] is a graph 4 vertices, where vertex 0 is connected to 1,2; 1 is connected to 2,3; and 2 is connected to 3.

\*return: the result of the function is given by return.

## Chapter 3

# INTERVAL GRAPHS

---

### 3.1 Origin

In 1957, a Hungarian mathematician named Hajos introduced the Interval Graphs by examining the Intersection of Intervals. About the same time, the American biologist Seymour Benzer was looking at genetic problems, especially studying the structure of fragmented genes. In his 1959 paper, he speculated that the fragments were straightforward pieces, and he also asked about the interlocking structure of the intersection lines, and how they would pass. Hajos watched from time to time; Benzer was looking at genetics. Benzer initiated the study of intervals in his paper which included the study of structure of bacterial genes. At that time it was not clear whether the DNA of bacterial genes are linear or not, but Benzer's work was the basic in establishing the fact that the genes are linear. He obtained data on the overlap of fragments of the gene and showed the data consistent with linearity. Interval graph arise in connection with the restriction map that shows certain site's location on specific DNA.

### 3.2 Definition

Interval graphs are the Intersection graph of intervals on real line, where each vertex represents an interval and two vertices are adjacent if their corresponding intervals intersect.  $G=(V,I)$  is an Interval Graph, if we can associate a set of Intervals  $I=(I_1, \dots, I_n)$  on a line where  $V=(1, \dots, n)$

and two vertices,  $x$  and  $y$ , are linked by an edge if and only if their intervals have non empty intersection.

### 3.3 Properties of Interval Graphs

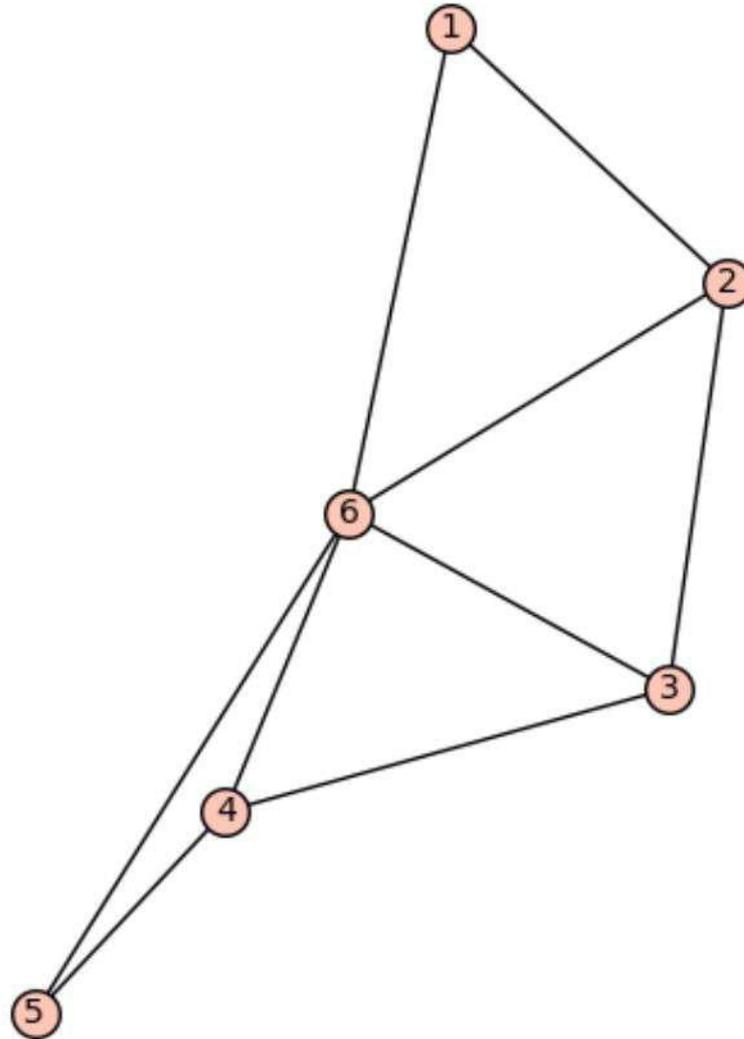


Figure 3.1: Interval Graph

#### 3.3.1 Chordal Graph Property

Interval Graphs are Chordal Graphs, that is every cycle of length greater than or equal to 4 will have a chord in it; which means there will be an edge connecting two vertices that are not consecutive in the cycle.

### 3.3.2 Perfect Elimination Scheme exist

A graph is an interval graph iff a perfect elimination scheme exist. If  $v_1, v_2, \dots, v_n$  are the vertices, then in perfect elimination scheme ; considering  $v_1$ , all the vertices that is adjacent to  $v_1$  will be connected each other. Then if we remove  $v_1$ , then again considering  $v_2$  all the vertices adjacent to  $v_2$  will be connected to each other and so on... We continue this until the remaining graph is empty.

### 3.3.3 co-TRO property

The complement of Interval Graph satisfies Transitive Orientation.

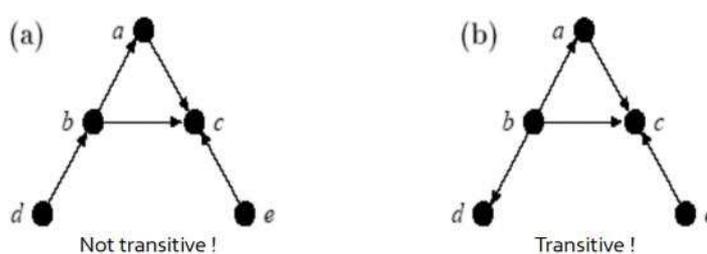


Figure 3.2: co-TRO property

### 3.3.4 Perfect Graphs

Interval graphs are perfect graphs. In perfect graph, chromatic number of the graph will be equal to its clique number.

### 3.3.5 Consecutive Ones Property

Consecutive ones property is an important property of the Interval graphs. From an interval graph(or Intersection graph), we can construct a binary matrix(with 0's and 1's) which is also called the clique matrix. This matrix is said to satisfy consecutive one's property for columns if its rows can be permuted in such a way that 1's in each column should occur consecutively.

## Chapter 4

# APPLICATIONS OF INTERVAL GRAPHS

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### 4.1 Grocery Shop Problem

Several People spend Saturday morning at a grocery shop. If 2 people are there at the same time, they can see each other. -Adam arrives at 9.00am and stays for 2 hours -Bob arrives at 9.45am -Carol arrives with Adam and leaves with Bob, before Adam is ready to leave. - Dave arrives as Adam is leaving and leaves at noon. -Ella spends the shortest amount of time, but she sees Adam, Bob, Carol, Dave. - Frank sees Adam, but not Bob How many people could Bob see at the grocery shop? Figure 4.2 is the Interval graph corresponding to the

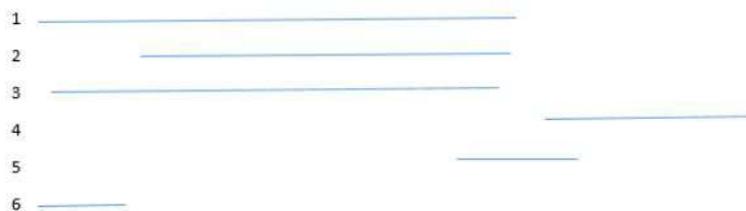


Figure 4.1: Grocery shop problem-Intersection graph

given problem. Here vertices represents each person (1-A,2-B,3-C,4-D,5-E,6-F) and the vertices are named from the starting letter of their names (A, B, C, D, E, and F) Figure 4.1 represents the Intersection Graph. From the figures, it is clear that, Bob could meet with 3 people at the grocery shop. This can also be considered as an application of

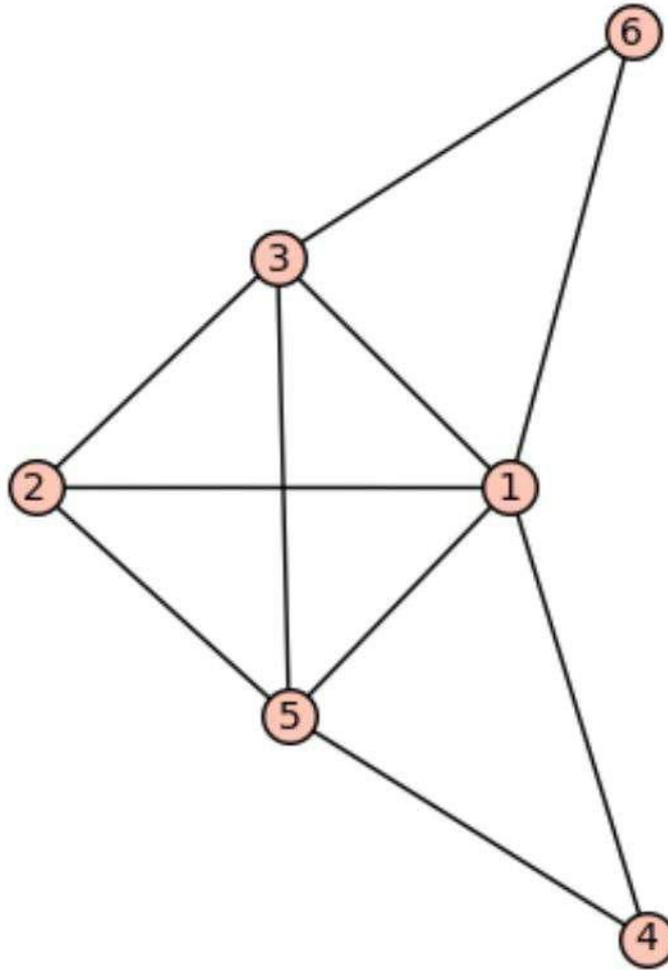


Figure 4.2: Grocery shop problem-Interval graph

the current pandemic situation. If we need to find the primary and secondary contacts of a person who may have affected with the virus, then it can easily be found from an interval graph.

## 4.2 Room Scheduling Problem

For a particular day, in a university there are a number of lectures scheduled and their time schedules are given as follows: Lecture a may go from 9:00 to 10:15, Lecture b may go from 10:00 to 12:00, etc.. (refer Fig 4.3) Conflicting lectures require different rooms; that is, when two time intervals overlap, we cannot schedule those lectures to the same room, as is the case for Lectures a and b. What is the minimum number of classrooms required to schedule the full set of lectures?

Figure 4.3 illustrates such a scheduling problem with six lectures.

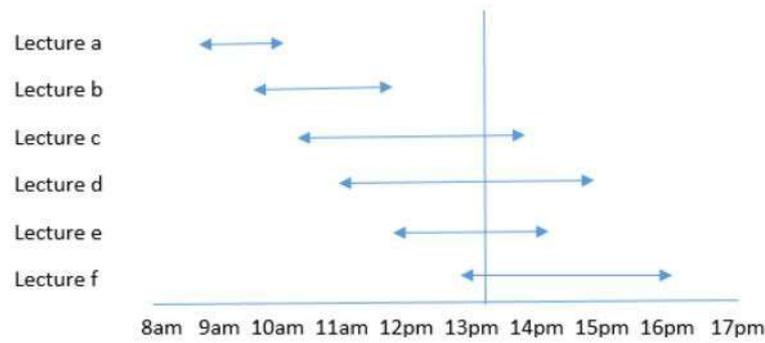


Figure 4.3: Room scheduling problem

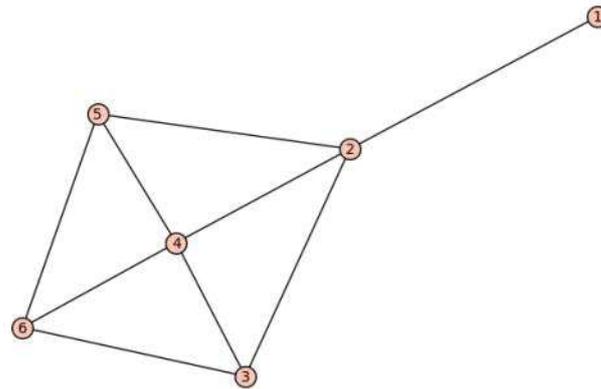


Figure (d)(lecture a=1,lecture b=2,lecture c=3, lecture d=4,lecture e=5,lecture f=6)

Figure 4.4: Room scheduling problem-Interval graph

Figure 4.4 shows the corresponding interval graph. The vertical cut at 13:15( figure 4.3) indicates a time when four classes are “alive” at the same moment, implying that we will need at least four classrooms. Also from the corresponding interval graph we can observe that the number of vertices of the maximum clique is 4. Hence the answer is 4.

### 4.3 Illustration of Consecutive Ones Property- Biological Application

Consider a hypothetical dataset with eight overlapping fragments (I1 to I8) as the intervals. Their pairwise overlap is considered and an adjacency matrix is constructed. Figure 4.5 shows the adjacency matrix where entry in the  $i$ th row and  $j$ th column is 1, if the vertices  $i$  and  $j$  are adjacent (fragments overlap) and 0 otherwise. The adjacency matrix is a square symmetric matrix. Figure 4.6 shows the corresponding intersection graph, called the interval graph. Each interval corresponds

1	1	2	3	4	5	6	7	8
2	1	1	0	0	0	0	0	0
3	1	1	1	1	1	1	0	0
4	0	1	1	1	1	0	0	0
5	0	1	1	1	1	1	0	0
6	0	1	0	1	1	1	0	0
7	0	0	0	0	1	0	1	1
8	0	0	0	0	0	0	1	1

**e.)Adjacency Matrix**

Figure 4.5: Adjacency matrix

to a vertex and two vertices  $u$  and  $v$  are connected with an edge if and only if the intervals  $u$  and  $v$  overlap. (This interval graph is constructed using SageMath) The corresponding ‘clique matrix’ for the figure 4.7

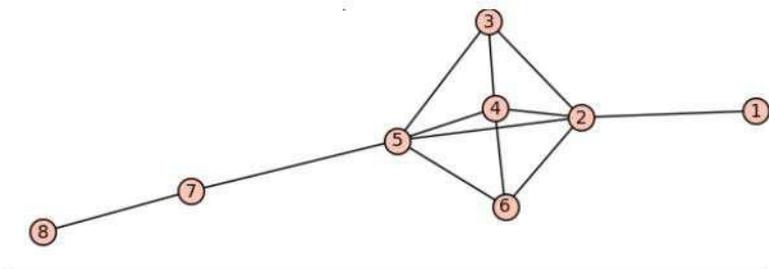


Figure 4.6: Interval graph

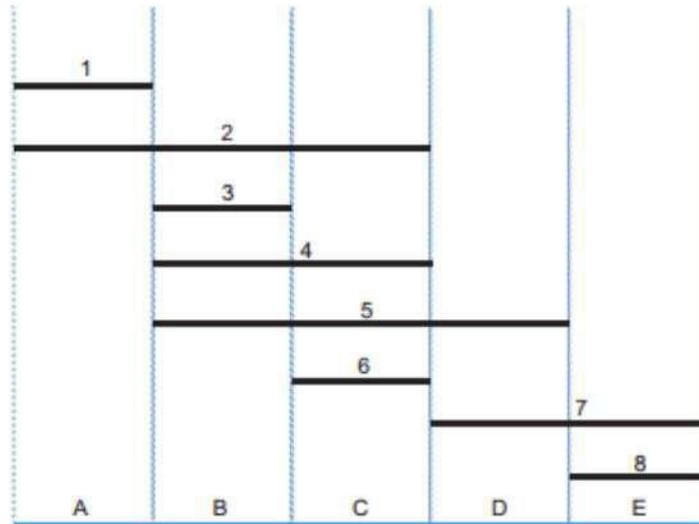


Figure 4.7: Intersection graph

is given below. This matrix makes it clear the consecutive ones property, that is 1's in each column occur consecutively. Considering figure 4.7, maximal cliques are A, B, C, D, E and they are ordered in a way. For example : the maximal cliques containing  $I_2$ (interval 2) are in an order, that is A, B, C. Similarly, that of  $I_5$  are B, C, D also occur in a



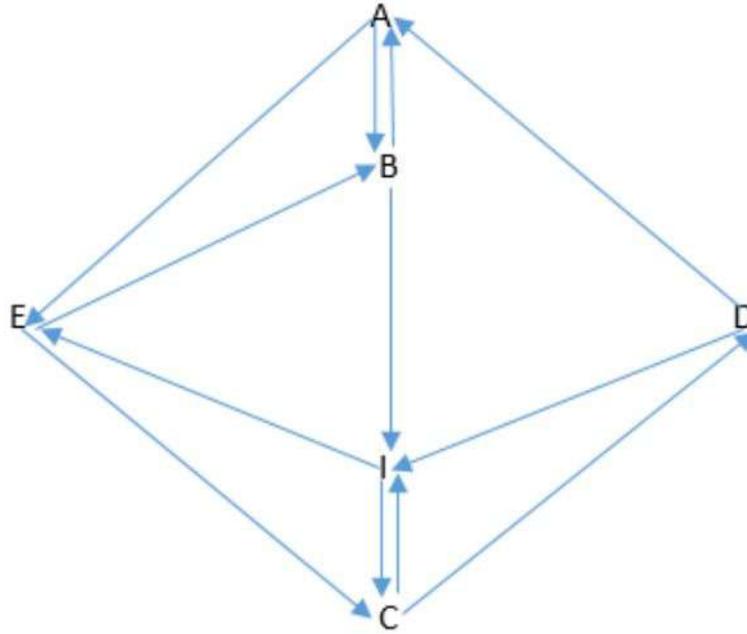


Figure 4.9: Berge Mystery Problem

told the truth, they were actually in the library at the same time. In the case of Ida and Eddie, however, maybe they were in the library or maybe not depending on whether Ida is the liar.

Solution using Interval Graph (property):

We can see a chordless cycle in Figure 4.9, cycle A, B, I, D suggest that one of these professors is a liar, because if all these people were telling the truth, we would be getting a contradiction with the property that the interval graph does not have a chordless cycle! This observation will help to solve the problem: Since Charlotte and Eddie did not participate in cycles A, B, I, D, they must have told the truth, because the liar is one of four in this cycle. But it is not the end of the cycle around here, for example, there is a large chordless cycle that goes everywhere around A, E, C, D, which means that Burt and Ida also told the truth. So now we are under two liars, Abe or Desmond. If Abe is a liar and Desmond is right, then A, B, I, D would remain a chordless 4-cycle since B and I are truthful. Therefore, Desmond is the liar.

## Chapter 5

# TOLERANCE GRAPH AND IT'S APPLICATIONS

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This class of graphs was introduced in 1982 by Martin Charles Golumbic and Clyde Monma at the 13th Southeastern Conference on Combinatorics, Graph Theory and Computing held at Boca Raton who used them to model scheduling problems in which the tasks to be modeled can share resources for limited amounts of time, also to generalise some of the well known applications of Interval graphs. A graph  $G = (V, E)$  is a tolerance graph if each vertex  $v$  in  $V$  can be assigned a closed interval  $I_v$  and a positive real value called tolerance  $t_v$ , such that  $xy$  belongs to  $E$  if and only if  $|I_x \cap I_y| \geq \min(t_x, t_y)$ .

A collection  $(I, t)$  of intervals and tolerances is called a tolerance representation.

If we restrict all the tolerances  $t_x$  to be equal to any fixed positive constant  $c$ , then we obtain exactly the class of interval graphs.

### 5.1 Different types of Tolerance Graphs

#### 5.1.1 Bounded and Unbounded Tolerance Graphs

A tolerance graph is bounded tolerance graph if it admits bounded tolerance representation and if otherwise it is unbounded. .

### 5.1.2 Proper Tolerance Graph

If a graph  $G$  has a tolerance representation such that no interval properly contains another interval, then  $G$  is called proper tolerance graph.

### 5.1.3 Unit Tolerance Graph

If graph  $G$  has a tolerance representation such that every interval is of unit length, then  $G$  is a unit tolerance graph.

## 5.2 Properties

An important property of Tolerance graphs are that they are perfect graphs. For any tolerance representation, any one or all of the following 5 properties are satisfied: a.)Tolerances are strictly positive b.)Tolerances are all distinct(except to that set to infinite) c.)The end points of Intervals are distinct d.)Intersection of the Intervals are non empty e.) Any tolerance which is larger than the length of its corresponding interval is set to be infinity; such a tolerance is called unbounded (mentioned above)

Regular Representation: Tolerance representation satisfying all the above 5 properties.

## 5.3 Application of Tolerance Graph

The following application of tolerance graph can be used to combat Covid-19 pandemic (or it is also applicable for other infectious diseases too), by limiting the spread of the disease. From 2020, this pandemic is causing terrible loss of lives and also it has a great impact on the economy of all over the world. Many measures are taken to fight this pandemic. Mathematics and computer science can also play an important role in this. Graphs appear as a natural tool in various problems related to the COVID-19 epidemic, making use of artificial intelligence; for example searching for infected contacts, to do other medical analyzes to understand the virus and the potential for disease, and, in general, to predict the dynamics of Covid-19 pandemic. Here in particular we will

be dealing with the application of Tolerance graph for the same. One of the most important things an epidemiologist can diagnose to reduce the spread of the virus is to determine events that can be called critical, which means many people can get infected at these events and hence they can give advice to minimise or restrict the number of participants in those events. This problem can be modeled as follows. Let  $G$  be the graph of their set of vertices corresponding to the set of intervals  $I = I_1, \dots, I_v$ . Each vertex represented by  $I_j = [s_j, e_j]$ , where  $s_j$  and  $e_j$  are initial time the person  $j$  get infected and the ending time of infection respectively. At each vertex, we add tolerance,  $t_i, i = 1, \dots, v$ .

### 5.3.1 Scheduling Flights

One of the real life problems that can be modeled with tolerance graphs is connected to flight schedule during the pandemic. I have considered application of the algorithm to the departure flights scheduled at the Cochin International Airport for August 23, 2021. The schedule was found at their website:

<https://cial.aero/flightstatus/status.aspx?type=DEPARTURElinkLvl1Id=8linkId=10>.

This airport has a rule that passengers use domestic flights must be at the gates 2 h before flight, and those for international flights 3 h earlier. To minimise the spread, it is needed to schedule flights  $a$  and  $b$  for different gates if period of time of the passengers in these two flights should be at the gate overlap for more than 30 min. Figure 5.1 gives the information of the timing of all the flights scheduled for a day (23 Aug 2021) in Cochin International Airport. If the flight is domestic, then let  $I_j = [s_j - 2, s_j]$  and  $I_j = [s_j - 3, s_j]$  if it is international, where  $s_j$  is the time of the flight  $j$  scheduled for the day. And let  $I = [I_1, \dots, I_x, I_{x+1}, \dots, I_{x+y}]$  be the set of intervals for each flight scheduled for the day with  $x$  domestic and  $y$  international flights. Each interval represents a vertex of the graph  $G$ . For each vertex, we add the tolerance,  $t_i, i = 1, \dots, v$ . The minimum number of gates that must be used is equal to the chromatic number of the corresponding tolerance graph (each color

corresponds to a gate). Corresponding computer program written in SageMath is given in figure 5.2. And its output is obtained is given in figure 5.3.

<u>Departure-Cochin International Airport, 23 Aug 2021</u>								
Flight	City	Time	I or D					
0	Doha	1.22	I		31	Delhi	8.40	D
1	Sharjah	3.18	I		32	Kolkata	8.47	D
2	Kuwait	3.31	I		33	Bangalore	9.34	D
3	Sharjah	3.46	I		34	Delhi	9.46	D
4	Doha	4.10	I		35	Delhi	9.40	D
5	Dubai	4.30	I		36	Mumbai	10.16	D
6	Dubai	5.30	I		37	Mumbai	11.30	D
7	Doha	8.12	I		38	Agatti Island	11.43	D
8	Muscat	8.23	I		39	Luoknow	12.27	D
9	Abu Dhabi	10.44	I		40	Ahmedabad	12.45	D
10	Male	9.27	I		41	Hyderabad	13.50	D
11	Male	10.26	I		42	Bangalore	14.05	D
12	Dubai	10.17	I		43	Chennai	14.43	D
13	Riyadh	11.28	I		44	Bangalore	15.31	D
14	Male	13.33	I		45	Bangalore	16.26	D
15	Male	13.48	I		46	Kolkata	17.15	D
16	Male	15.30	I		47	Mumbai	17.20	D
17	Dubai	16.02	I		48	Mumbai	17.26	D
18	Sharjah	16.10	I		49	Delhi	18.03	D
19	Sharjah	16.23	I		50	Chennai	18.12	D
20	Sharjah	20.03	I		51	Kannur	18.19	D
21	Dubai	19.03	I		52	Hyderabad	19.26	D
22	Sharjah	19.41	I		53	Delhi	19.30	D
23	Delhi	21.00	D		54	Delhi	19.30	D
24	Doha	21.15	I		55	Mumbai	19.54	D
25	Doha	23.32	I		56	Mumbai	20.01	D
26	Dubai	23.49	I		57	Bangalore	20.40	D
27	Hyderabad	5.15	D		58	Kolkata	21.16	D
28	Mumbai	6.13	D		59	Delhi	22.59	D
29	Indore/Bangalo	6.40	D		60	Delhi	23.26	D
30	Bangalore	7.33	D					

Figure 5.1: table

From figure 5.3 we obtain the following informations: The minimum number of gates required for 61 flights is 11. Furthermore the additional information obtained is that gate 0 is used for flights 4,28,32,37 etc...and so on. . .

```

intoll=[(22.22,1.22,0.3),(12.18,3.18,0.3),(12.31,3.31,0.3),(12.46,3.46,0.3),(1.10,4.10,0.3),(1.3
0,4.30,0.3),(2.30,5.30,0.3),(5.12,8.12,0.3),(5.23,8.23,0.3),(7.44,10.44,0.3),(6.27,9.27,0.3),(7.
26,10.26,0.3),(7.17,10.17,0.3),(8.28,11.28,0.3),(10.33,13.33,0.3),(10.48,13.48,0.3),(12.30,15
.30,0.3),(13.02,16.02,0.3),(13.10,16.10,0.3),(13.23,16.23,0.3),(17.03,20.03,0.3),(16.03,19.03
,0.3),(16.41,19.41,0.3),(19.00,21.00,0.2),(18.15,21.15,0.3),(20.32,23.32,0.3),(20.49,23.49,0.
3),(3.15,5.15,0.2),(4.13,6.13,0.2),(4.40,6.40,0.2),(5.33,7.33,0.2),(6.40,8.40,0.2),(6.47,8.47,0.
2),(7.34,9.34,0.2),(7.46,9.46,0.2),(7.40,9.40,0.2),(8.16,10.16,0.2),(9.30,11.30,0.2),(9.43,11.4
3,0.2),(10.27,12.27,0.2),(10.45,12.45,0.2),(11.50,13.50,0.2),(12.05,14.05,0.2),(12.43,14.43,0
.2),(13.31,15.31,0.2),(14.26,16.26,0.2),(15.15,17.15,0.2),(15.20,17.20,0.2),(15.26,17.26,0.2),
(16.03,18.03,0.2),(16.12,18.12,0.2),(16.19,18.19,0.2),(17.26,19.26,0.2),(17.30,19.30,0.2),(17
.30,19.30,0.2),(17.54,19.54,0.2),(18.01,20.01,0.2),(18.40,20.40,0.2),(19.16,21.16,0.2),(20.59
,22.59,0.2),(21.26,23.26,0.2)]

```

```

def schedule_flights(intoll):
    g=graphs.ToleranceGraph(intoll)
    from sage.graphs.graph_coloring import chromatic_number
    cronum=chromatic_number(g)
    from sage.graphs.graph_coloring import all_graph_colorings
    GraphColoring=all_graph_colorings(g,cronum)
    return[g,cronum,next(GraphColoring)]
schedule_flights(intoll)

```

Figure 5.2: SageMath input

```
[Graph on 61 vertices,
 11,
 {0: [4, 28, 32, 37, 16, 48, 52, 58, 60, 0, 1, 2, 3],
 1: [5, 29, 33, 38, 17, 20, 25],
 2: [6, 7, 36, 39, 43, 45, 50, 23],
 3: [27, 34, 30, 40, 18, 49, 24],
 4: [35, 14, 19, 51, 56, 26],
 5: [8, 13, 41, 44, 46, 53, 59],
 6: [9, 15, 47, 54],
 7: [10, 42, 21],
 8: [11, 22],
 9: [12, 55],
 10: [31, 57]}]
```

Figure 5.3: SageMath output

## Chapter 6

# CONCLUSION

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In various fields, graph theory has a diverse class of applications. It provides an approach to systematically testing the structure of given data and hence exploring connections between them by constructing graphs. In particular, Interval graphs along with its properties are used for wide variety of applications in many fields. Some of them are discussed here too. Interval graphs are an interesting case because biologists first developed them. Since Interval graphs are the generalization of Tolerance graphs, these applications are also valid to them. In this project, various applications of interval graphs are discussed and it gives a brief idea of the kind of real life situations in which interval graphs plays a major role. Several uses are proposed in the fight against the COVID-19 epidemic since graphs appear as a natural tool in shaping the various problems associated with this global epidemic by slowing down the process of transmitting the virus; grocery shop problem, room scheduling problem and flight scheduling problem are the examples.

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**ISOLATION, SCREENING AND CHARACTERIZATION OF PLANT  
GROWTH PROMOTING BACTERIA FROM RHIZOSPHERE  
ASSOCIATED WITH *IXORA COCCINEA***

A dissertation submitted in partial fulfilment of the requirement for degree of

**‘Master of Science’ in Botany**

By

**MARY OLIVIA ROBERT**

**REG NO: AM20BOT013**



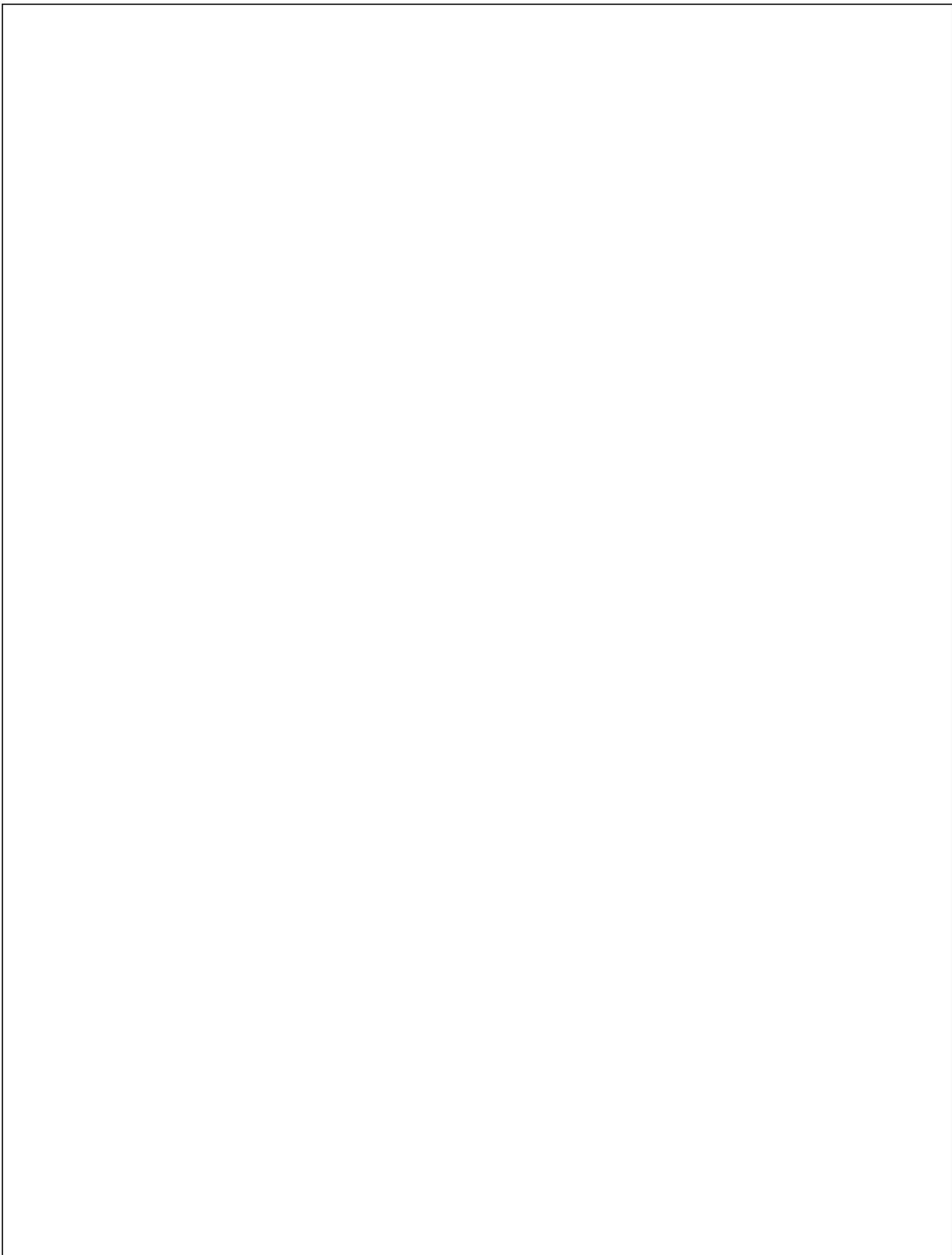
**DEPARTMENT OF BOTANY**

**ST.TERESA'S COLLEGE (AUTONOMOUS)**

**ERNAKULAM**

**KOCHI - 682011**

**2020 - 2022**



## CERTIFICATE

This is to certify that the dissertation titled, "ISOLATION, SCREENING AND CHARACTERIZATION OF PLANT GROWTH PROMOTING BACTERIA FROM RHIZOSPHERE ASSOCIATED WITH *IXORA COCCINEA*" is an authentic record of work carried out by MARY OLIVIA ROBERT under the supervision and guidance of Dr. ALPHONSA VIJAYA JOSEPH, Associate Professor, Department of Botany & Centre for Research, St. Teresa's College (Autonomous), Ernakulam in partial fulfilment of the requirement for the Master's Degree of Science in Botany.

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Ernakulam



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## INTRODUCTION

Soil is a dynamic living matrix and it is not only a critical resource in agricultural and food security but it is also towards maintenance of all life process (Gupta *et al.*, 2015). Soil is rich in microscopic life forms including bacteria, fungi, actinomycetes, protozoa and algae. Of these different microorganisms, bacteria are by far the most common. Bacteria fund over 95% of the soil microbial activities and dominate also in the level of abundance. This is as a result of their fast proliferation and ability to utilize wide range of carbon and nitrogen source as energy. It has been known for some time that the soil hosts a large number of bacteria (around  $10^8$  to  $10^9$  cells per gram of soil) and that the number of culturable bacterial cells in soil is generally only about 1% of the total number of cells present (Glick, 2012). Soil conditions like moisture, temperature, chemicals, etc., influences the type of bacteria and its number in the soil. Bacteria are generally not evenly distributed in soil. The concentration of bacteria that is found around the roots of plants i.e., in the rhizosphere, is typically much greater than in the rest of the soil.

Rhizosphere is the immediate region of plant root. Bacteria associated with the rhizosphere of plant is known as rhizobacteria. Rhizosphere into three separate parts, first the exorhizosphere relates to soil adherent to the root and those attached even after vigorous shaking, the second is rhizoplane which illustrate the thin layer of soil-root and thirdly an intercellular space in the root tissues inhabited by endophyte bacteria (endorhizosphere). These sites encourages healthy competition among organisms for more competency, saprophytic abilities and potential for enhancing plant growth. In addition to it, successful organisms multiply easily through a broad spectrum of actions as a result of high nutrient and carbon source, compete favorably with other microorganisms and poses tolerance to drought.

The rhizosphere is a host to diverse group of microorganisms that are influenced by rich source of nutrients obtained through the root exudates (Odoh, 2017). Plants select those bacteria contributing most to their fitness by releasing organic compounds through exudates creating a very selective environment where diversity is low. While these bacteria utilize the nutrients that are released from the host for their growth, they also secrete metabolites into the rhizosphere. Several of these metabolites can act as signaling compounds that are perceived by neighboring cells within the

same micro-colony, by cells of other bacteria that are present in the rhizosphere, or by root cells of the host plant (Gray & Smith, 2005).

Rhizosphere is one of the first steps in the pathogenesis of soil borne microorganisms. It is also crucial for the microbial inoculants used as biofertilizers, biocontrol agents, phytostimulators and bioremediators. *Pseudomonas* sp. is often used as model root colonizing bacteria.

Since the rhizosphere is very rich in nutrients, its associate bacteria (rhizobacteria) tend to develop a unique means of communication by enabling the effective selection of its mutual partner by creating host specificity and selective sensitive environment. Plant bacterial interaction in the rhizosphere are the determinants of plant health. It also aids in soil fertility. Regardless of the number of bacteria in a particular soil sample, the bacteria may affect plants in one of three ways i.e. beneficial, harmful, or neutral. However, the effect that a particular bacterium has on a plant can change as the conditions influencing it change.

Motile rhizobacteria may colonize the rhizosphere more profusely than the non-motile ones. This results in a better nutrient transformation. They also eliminate the harmful rhizobacteria and help in plant growth by niche exclusion. Induced systemic resistance is a mechanism by which PGPR control plant diseases through manipulation of host plant's physical and biochemical properties (Sivasakthi *et al.*, 2014).

The word PGPR was proposed by Kloepper *et al.*, (1980). It was coined for fluorescent *Pseudomonas*, a plant growth enhancer that fought against pathogens. Since then, the term has metamorphose and extended to include all rhizobacteria capable of directly enhancing plants growth (Kapulnik, 1981). Recently, it was used to include wide range of rhizobacteria that improve plant growth through different mechanisms. Bacteria that colonize plant roots and promote plant growth are referred to as plant growth-promoting rhizobacteria (PGPR). These include bacteria that are free-living and soil-borne, those that form specific symbiotic relationship with plants (e.g., *Rhizobia spp.* and *Frankia spp.*), bacterial endophytes that can colonize some or a portion of a plant's interior tissues, and cyanobacteria (formerly called blue-green algae).

Interaction of PGPR with the host plant is an intricate and interdependent relationship involving the two partners along with other abiotic characters. These microbes can promote plant growth by

regulating nutritional and hormonal balance, producing plant growth regulators, solubilizing nutrients and inducing resistance against plant pathogens. In addition to their interactions with plants, these microbes also show synergistic as well as antagonistic interactions with other microbes in the soil environment (Nadeem, 2014).

The genera of PGPR include *Azotobacter*, *Azospirillum*, *Acetobacter*, *Pseudomonas*, *Bacillus*, *Burkholderia*, *Caulobacter*, *Chromobacterium*, *Erwinia*, *Flavobacterium*, *Micrococcous* and *Serratia* etc. Direct use of microorganisms to promote plant growth and to control plant pest continues to be an area of rapidly expanding research.

A rhizobacterial strain is considered to be a putative PGPR if it possesses specific plant growth promoting traits and can enhance plant growth upon inoculation. An ideal PGPR strain should be highly rhizosphere-competent, eco-friendly and tolerant of physicochemical factors like heat, desiccation, radiations, and oxidants. It should colonize the plant roots in significant numbers upon inoculation, promote plant growth and exhibit a broad spectrum of action. It should be compatible with other bacteria in the rhizosphere and demonstrate better competitive skills over the existing rhizobacterial communities.

Plant growth promoting rhizobacteria can be classified into extracellular plant growth promoting rhizobacteria (ePGPR) and intracellular plant growth promoting rhizobacteria (iPGPR). The ePGPRs may exist in the rhizosphere, on the rhizoplane or in the spaces between the cells of root cortex while iPGPRs locate generally inside the specialized nodular structures of root cells. The bacterial genera such as *Agrobacterium*, *Arthrobacter*, *Azotobacter*, *Azospirillum*, *Bacillus*, *Burkholderia*, *Caulobacter*, *Chromobacterium*, *Erwinia*, *Flavobacterium*, *Micrococcous*, *Pseudomonas* and *Serratia* belongs to ePGPR. The iPGPR belongs to the family of Rhizobiaceae includes *Allorhizobium*, *Bradyrhizobium*, *Mesorhizobium* and *Rhizobium*, endophytes and *Frankia* species both of which can symbiotically fix atmospheric nitrogen with the higher plants.

Horticulture is one of the areas where agricultural technologies are widely and intensively used. Horticultural crops may grow both in the open and closed space such as greenhouse and tunnel, and there are several practical applications such as propagation with cuttings and grafting, pruning, and soilless culture; plant growth regulators that have little or no use with other agricultural crops were used largely in horticultural crop production. In addition, to make sure of sufficient plant

growth and development and high fruit yield and quality, these treatments should be inherited in horticultural production. Therefore, horticultural crops require more input than the other agricultural crops and sustainability maintenance is also quite significant. For these reasons, there is a need for different techniques that increase the input efficiency, and plant growth promoting rhizobacteria (PGPR) have proved to be a major tool. PGPR can affect on plant growth by production and release of secondary metabolites, lessening or preventing deleterious effects of phytopathogenic organisms in the rhizosphere and/or phyllosphere, and/or facilitating the availability and uptake of certain nutrients like N, P, and Fe from the root environment. In accordance with these action mechanisms, PGPR can be used for various purposes such as rooting of cutting, grafting union, fruit setting and thinning, lateral root formation, increasing tolerance against abiotic stress as well as growth, development, and biological control with root inoculation and or spraying (Esitken, 2011).

Most of the studies with PGPR are related to field crops. Nevertheless, in recent years, the use of PGPR in horticultural crops to promote plant growth, development, and yield has increased in various parts of the world. Several authors have reported that root inoculation and/or spraying with PGPR can result in increased germination, seedling emergence, and modified growth and yield of various horticultural crops.

PGPR are known to influence plant growth by various direct or indirect mechanisms. Direct mechanisms facilitate nutrient uptake or increase nutrient availability by nitrogen fixation, solubilization of mineral nutrients, mineralize organic compounds and production of phytohormones. Direct plant growth promotion include biofertilizer activity. Generally, plant growth promoting rhizobacteria promote plant growth directly by either often due to their ability for nutrient supply (nitrogen, phosphorus, potassium and essential minerals) or modulating plant hormone levels. These include:-

1. Nitrogen fixation
2. Phosphate solubilization
3. Phytohormone production

1. Nitrogen fixation:

Nitrogen is an essential element for all forms of life and it is the most vital nutrient for plant growth and productivity. Although the nitrogen presents 78 % of the atmosphere, it remains unavailable to the plants. No plant species is capable for fixing atmospheric dinitrogen into ammonia and expend it directly for its growth. Thus the atmospheric nitrogen is converted into plant utilizable forms by biological nitrogen fixation (BNF) which changes nitrogen to ammonia by nitrogen fixing microorganisms using a complex enzyme system known as nitrogenase. Plant growth promoting rhizobacteria have the ability to fix atmospheric nitrogen and provide it to plants by two mechanisms: symbiotic and non-symbiotic. Symbiotic nitrogen fixation is a mutualistic relationship between a microbe and the plant. The microbe first enters the root and later on form nodules in which nitrogen fixation occurs. Rhizobia are a vast group of rhizobacteria that have the ability to lay symbiotic interactions by the colonization and formation of root nodules with leguminous plants (Gupta *et al.*, 2015)

## 2. Phosphate solubilization:

Phosphorus is the most important key element in the nutrition of plants, next to nitrogen (N). It plays an important role in virtually all major metabolic processes in plant including photosynthesis, energy transfer, signal transduction, macromolecular biosynthesis and respiration [20]. It is abundantly available in soils in both organic and inorganic forms. Plants are unable to utilized phosphate because 95-99% phosphate present in the insoluble, immobilized, and precipitated form. Plants absorb phosphate only in two soluble forms, the monobasic ( $\text{H}_2\text{PO}_4$ ) and the dibasic ( $\text{HPO}_4^{2-}$ ) ions.

Plant growth promoting rhizobacteria present in the soil employ different strategies to make use of unavailable forms of phosphorus and in turn also help in making phosphorus available for plants to absorb. The main phosphate solubilization mechanisms employed by plant growth promoting rhizobacteria include:

- (1) Release of complexing or mineral dissolving compounds e.g. organic acid anions, protons, hydroxyl ions,  $\text{CO}_2$ ,
- (2) Liberation of extracellular enzymes (biochemical phosphate mineralization) and
- (3) The release of phosphate during substrate degradation (biological phosphate mineralization).

### 3. Phytohormone production:

A wide range of microorganisms found in the rhizosphere are able to produce substances that regulate plant growth and development. Plant growth promoting rhizobacteria produce phytohormones such as auxins, cytokinins, gibberellins and ethylene can affect cell proliferation in the root architecture by overproduction of lateral roots and root hairs with a subsequent increase of nutrient and water uptake

Indole Acetic Acid (IAA): Among plant growth regulators, indole acetic acid (IAA) is the most common natural auxin found in plants and its positive effect on root growth.

Cytokinins and gibberellins: Several plant growth promoting rhizobacteria *Azotobacter* sp., *Rhizobium* sp. etc. can produce cytokinins or gibberellins or both can produce either cytokinins or gibberellins or both for plant growth promotion plant growth promoting rhizobacteria produce lower cytokinin levels compared to phytopathogens.

Phytopathogenic microorganisms are a major and chronic threat to sustainable agriculture and ecosystem stability worldwide disturb the soil ecology, disrupt environment, degrade soil fertility and consequently show harmful effects on human health, along with contaminating ground water. PGPR is a promising sustainable and environmentally friendly approach to obtain sustainable fertility of the soil and plant growth indirectly. This approach takes inspire a wide range of exploitation of PGPR led to reducing the need for agrochemicals (fertilizers and pesticides) for improve soil fertility by a variety of mechanisms that via production of antibiotics, siderophores, HCN, hydrolytic enzymes etc. These accounts for the indirect plant growth promotion mechanisms activity or biopesticide activity.

The most intensively researched use of PGPR has been in agriculture and horticulture. Several PGPR formulations are currently available as commercial products for agricultural production. Recently developing areas of PGPR usage include forest regeneration and phytoremediation of contaminated soils. PGPR is also being used in green and sustainable agriculture in order to reduce the effect of chemical fertilizers, pesticides and insecticides (Jimtha *et al.*, 2020).

The success and commercialization of plant growth promoting rhizobacterial strains depend on the linkages between the scientific organizations and industries. Numerous work done showed

different stages in the process of commercialization include isolation of antagonist strains, screening, fermentation methods, mass production, formulation viability, toxicology, industrial linkages, quality control and field efficacy. Moreover, commercial success of PGPR strains requires economical and viable market demand, consistent and broad spectrum action, safety and stability, longer shelf life, low capital costs and easy availability of career materials (Gupta *et al.*, 2015)

## **OBJECTIVES OF THE STUDY**

- Isolation of bacteria from rhizosphere associated with *Ixora coccinea*
- Screening of the isolates for specific enzyme production.
- Screening of the isolates for plant growth promoting properties.
- Morphological characterization of screened isolates.
- Biochemical characterization of screened isolates.
- Molecular identification of screened isolates using PCR.

## REVIEW OF LITERATURE

Various groups of bacteria that are able to stimulate plant growth by a mechanisms of action are referred to as plant growth-promoting rhizobacteria or PGPR. They affect plant growth and development directly or indirectly either by releasing plant growth regulators (PGRs) or other biologically active substances. This causes an increase in the available nutrients, which increase nutrient uptake and reduces the negative effects of pathogenic microorganisms on plants. PGPRs have various types of effects, such as an increase in root growth and nutrient uptake, the stimulation of plant hormones, inhibition of the activity of plant pathogens, improvement of the soil structure, and mineralization of organic pollutants.

Bacteria are the most abundant microorganisms in the rhizosphere, it is highly probable that they influence the plants physiology to a greater extent, especially considering their competitiveness in root colonization (Sivasakthi *et al.*, 2014).

The word PGPR was proposed by Kloepper and associates (1980). It was coined for fluorescent *Pseudomonas*, a plant growth enhancer that fought against pathogens.

Nadeem and co-workers (2014) suggested that plant growth under stress conditions may be enhanced by the application of microbial inoculation including plant growth promoting rhizobacteria (PGPR) and mycorrhizal fungi. These microbes can promote plant growth by regulating nutritional and hormonal balance, producing plant growth regulators, solubilizing nutrients and inducing resistance against plant pathogens.

Plant growth promoting rhizobacteria (PGPR) are an important cluster of beneficial, root-colonizing bacteria thriving in the plant rhizosphere and bulk soil. They exhibit synergistic and antagonistic interactions with the soil micro biota and engage in an array of activities of ecological significance. They promote plant growth by facilitating biotic and abiotic stress tolerance and support the nutrition of host plants. Basu and colleagues (2021) also considered PGPR as an ecofriendly alternative to hazardous chemical fertilizers due to their active growth endorsing activities.

Gupta and colleagues (2015) plant growth promoting rhizobacteria promote plant growth directly by either often due to their ability for nutrient supply (nitrogen, phosphorus, potassium and essential minerals) or modulating plant hormone levels, or indirectly by decreasing the inhibitory

effects of various pathogens on plant growth and development in the forms of biocontrol agents, root colonizers, and environmental protectors.

Saharan and Nehra (2011) detailed on how the inoculation of crop plants with certain strains of PGPR at an early stage of development improves biomass production through direct effects on root and shoots growth. They also suggested that inoculation of ornamentals, forest trees, vegetables, and agricultural crops with PGPR may result in multiple effects on early-season plant growth, as seen in the enhancement of seedling germination, stand health, plant vigor, plant height, and shoot weight, nutrient content of shoot tissues, early bloom, chlorophyll content, and increased nodulation in legumes.

Odoh (2017) pointed out that plant growth promoting rhizobacteria (PGPR) involves the utilization of large array of soil bacteria to improve yield and plant growth. As free living and symbiotic rhizobacteria, PGPR colonizes extracellular and/or intracellular rhizoenvironment in search for carbon source while indirectly aiding plant growth. He also explained that the seeds or soil application of PGPRs inoculant enhances directly phosphates solubilization, atmospheric nitrogen fixation and secretion of plant hormones (indole acetic acid, gibberellins, cytokinins and ethylene) needed for growth and adaptation in stressed environment.

Wang and co-workers (2021) provided evidence of benefits when PGPR mixtures, rather than individuals, are used for protecting crops from various diseases, and underscore the critical determinant factors for successful use of PGPR mixtures. They also evaluated the challenges and limitations to achieving the desired outcomes from strain/species-rich bacterial assemblages, particularly in relation to their role for plant disease management. In addition, towards locating additive or synergistic outcomes, they highlight why and how the benefits conferred need to be categorized and quantified when different strains/species of PGPR are used in combinations.

The effect of, activators on selected soil properties, the experimental treatments including the application of the growth activators P energetic (K + P) and Azoter, which contains the bacteria *Azotobacter chroococcum*, *Azospirillum brasilense*, and *Bacillus megaterium*, before sowing or during vegetation were studied by Artyszak and Gosdowski (2021).

In addition, PGPR have been used for different purposes in horticultural crops, for instance, improving grafting union in grape (Kose *et al.*, 2005), fruit setting (Esitken *et al.*, 2006) and fruit thinning (Esitken *et al.*, 2009).

Altaf and colleagues (2019) explained the utilization of microorganism with the goal at enhancing nutrient availability for plants is a significant practice and is essential for agriculture. Besides, a sole PGPR not only performs as biological control agent but it performs multiple mode of actions. The rhizosphere, rhizoplane or the space pockets between the root cortex cells are the places where ePGPRs resides whereas iPGPRs resides generally in the peculiar nodule like structure of root cells. The genera of bacteria such as Serratia, Pseudomonas, Micrococcus, Flavobacterium, Erwinia, Chromobacterium, Caulobacter, Burkholderia, Bacillus, Azospirillum, Azotobacter, Arthrobacter and Agrobacterium belong to ePGPR.

PGPR affect plant growth by indirect mechanisms that involve suppression of bacterial, fungal, viral, and nematode pathogens. A lot of study showed that inoculation with PGPR resulted in significant yield increases in different crops, rooting of hardwood and semi-hardwood cuttings, increased germination and enhanced emergence of seeds under different conditions, promoted nutrient uptake of roots, total biomass of the plants, increased seed weight, induced early flowering, etc. (Kaymak, 2010).

Evidence the involvement of several chemical signals in controlling the associative symbiosis between plant growth-promoting rhizobacteria (PGPR) and roots was enunciated by Drogue and associates (2013). In this review, recent findings about the identification of signals involved in the interaction of plants with PGPR, and of PGPR with each other's, were presented.

In agricultural management practices, they are often included to minimize chemical inputs, increase productivity and restore the natural equilibrium in agro-ecological systems. Exchange of signals between plant roots and PGPR and how these relationships modulate plant abiotic stress responses by induced systemic resistance. (Jimtha *et al.*, 2020)

The steadily increasing potentiality of PGPR in agriculture was noted by Bhattacharyya and Jha (2011) and it is as it offers an attractive way to replace the use of chemical fertilizers, pesticides and other supplements. Growth promoting substances are likely to be produced in large quantities

by these rhizosphere microorganisms that influence indirectly on the overall morphology of the plants.

In the review article, Zhuang and coworkers (2007) explained the role of PGPR in bioremediation. Recently, the application of PGPR has been extended to remediate contaminated soils in association with plants. Of all the present contaminants, the profound impacts of organic and heavy metal pollutants have attracted worldwide attention.

The greatest benefit of seed treatment may be inhibition of slightly parasitic or nonparasitic but toxigenic microorganisms. The PGPR were antagonistic in vitro to most of these deleterious bacteria. The role of deleterious bacteria in depressing root growth is under study (Suslow *et al.*, 2008).

van Loon (2007) investigated on PGPR and came to the conclusion that the root-colonizing *Pseudomonas* bacteria have been shown to alter plant gene expression in roots and leaves to different extents, indicative of recognition of one or more bacterial determinants by specific plant receptors. Conversely, plants can alter root exudation and secrete compounds that interfere with quorum sensing (QS) regulation in the bacteria. Such two-way signaling resembles the interaction of root-nodulating *Rhizobia* with legumes and between mycorrhizal fungi and roots of the majority of plant species.

Beneduzi and colleagues (2012) the ability of bacterial siderophores and antibiotics to suppress phytopathogens could be of significant agronomic importance. Both mechanisms have essential functions in microbial antagonism but also are able to elicit induced resistance. Resistance-inducing and antagonistic rhizobacteria might be useful in formulating new inoculants, offering an attractive alternative of environmentally friendly biological control of plant disease and improving the cropping systems into which it can be most profitably applied.

In a study conducted by Dawwam and co-workers (2013), the results of in vitro assays showed that all isolates can produce IAA, while four isolates solubilized rock phosphate. These isolates having abilities for IAA production and phosphate solubilization were tested as bio inoculant to potato tubers. The results of inoculated plants showed significant differences in vegetative growth parameters as well as photosynthetic pigments.

Glick (2012) concluded the review on PGPR stating that it is already being used successfully in a number of countries in the developing world and this practice is expected to grow. In the more developed world, where agricultural chemicals remain relatively inexpensive, the use of PGPB occupies a small but growing niche in the development of organic strategies.

While initial PGPB are likely to be non-transformed bacterial strains that have been selected for certain positive traits, it is likely in the future, as a greater understanding of the mechanisms at play in the bacterial stimulation of plant growth is gained, that scientists will genetically engineer more efficacious strains. Scientists will need to prove to both the public and to regulatory agencies worldwide that genetically engineered PGPB do not present any new hazards or risks (Gray and Smith, 2005).

Esitken (2011) explained that PGPR can be used for various purposes such as rooting of cutting, grafting union, fruit setting and thinning, lateral root formation, increasing tolerance against abiotic stress as well as growth, development, and biological control with root inoculation and/or spraying.

Bioremediation, based on bioaugmentation and biostimulation approaches, is a promising strategy for remediating contaminated soil. The use of plant growth-promoting rhizobacteria (PGPR) as a bioaugmentation tool is an effective technique for treating hydrocarbon contaminated soil (Saeed *et al.*, 2011).

## MATERIALS AND METHODS

The soil from the rhizosphere of *Ixora coccinea*, which is a horticulture plant was taken and bacterial strains were isolated.

### 1. Isolation of Bacteria

The bacterial strains were isolated from the soil by the serial dilution and spread plate method.

#### i. Source of Sample

The soil sample was collected from the rhizosphere of *Ixora coccinea* plant from Vaduthala, Corporation of Kochi, Ernakulam district, Kerala.

#### ii. Collection of Sample

The soil sample was collected from the rhizosphere of *Ixora coccinea* with a clean trowel, transferred into a clean polythene bag and stored in the refrigerator in the department laboratory.

#### iii. Isolation of Bacterial Strains

Isolation was done based on the protocol by Benedetto *et al.*, (2019). 10gm of soil sample collected was weighed out. It was then added to 90 ml distilled water taken in a conical flask that was autoclaved. It was mixed well and kept undisturbed for the sediments to settle down.

4 test tubes were taken with cotton plugs. 9ml of distilled water was added to each test tube and autoclaved. 1ml of the sample was pipetted out from the conical flask and added to the first test tube with 9ml of autoclaved distilled water to get  $10^{-3}$  dilution. It was thoroughly mixed with the pipette itself.

1 ml from the  $10^{-3}$  sample was taken and added to the second test tube to get  $10^{-4}$  dilution. It was mixed thoroughly. Again 1ml was taken from the previously diluted sample, transferred to the third test tube and mixed thoroughly to get  $10^{-5}$  dilution. Finally, 1ml was taken from this and transferred to the last test tube to get  $10^{-6}$  dilution.

Now the sample has been diluted to  $10^{-3}$ ,  $10^{-4}$ ,  $10^{-5}$  and  $10^{-6}$  dilutions respectively.

Agar agar bacteriological (for general bacteriological purpose) that contains-

- Moisture 12%
- Ash Content 3%
- Gel Strength 600 gm/cm<sup>2</sup>

Was taken along with Nutrient Broth that has the constitution

- Peptone 5.00 gm/L
- NaCl 5.00 gm/L
- HM peptone B ( equivalent to beef extract) 1.50 gm/L
- Yeast extract 1.50 gm/L
- Final pH 7.4±0.2

Nutrient agar medium was made by adding nutrient broth and agar in the composition

- Nutrient broth 3.9 gm
- Agar 6 gm
- Distilled water 300 ml

It was made in a 500 ml conical flask plugged with a cotton plug, covered and autoclaved. Cotton swabs were also made and autoclaved. Serially diluted samples, 10<sup>-3</sup>, 10<sup>-4</sup>, 10<sup>-5</sup> and 10<sup>-6</sup> were spread on 4 agar plates each using the cotton swabs. These agar plates were kept for incubation for 24hr at 30-37° C in the incubator.

After 24hrs the plates were checked for individual colonies and the colonies that had distinct character like colour, texture and size were selected from the 10<sup>-3</sup>, 10<sup>-4</sup>, 10<sup>-5</sup>, 10<sup>-6</sup> plates . Those were streaked on to new agar plates by quadrant streaking method again kept for incubation in the same temperature requirement for 24 hrs. Pure colonies were obtained.

Nutrient agar slants were prepared for temporary storage of the colonies. For that nutrient broth and agar was added in the following constitution-

- Nutrient broth 2 gm

- Agar agar 3 gm
- Distilled water 150 ml

It was heated until dissolved and poured into test tubes, 10 ml each. The test tubes were covered with cotton plug and autoclaved. After sterilisation test tubes were placed in the LAF in a slanting position and waited until solidified. The colonies from the plates were transferred to each slant and those slants were kept for incubation at 30-37° C for 24hrs. After incubation period the slants were wrapped with cling film and stored in the refrigerator for further analysis.

## 2. Enzymatic Screening of Bacterial Strains

Enzymatic screening was done as preliminary screening. The isolates were screened based on the protocol by Geetha *et al.*, (2014) for the production of amylase, gelatinase and protease. A positive result was indicated by a zone of clearance around the colony. Diameter of the zone of clearance was measured using a scale in centimetres.

### i. Test for Amylase

Starch agar medium plates were prepared by using ready-made starch agar medium along with agar.

The starch agar medium contains the following contents per litre,

- Beef extract 3.0 gm
- Peptone 5.0 gm
- Soluble starch 2.0 gm
- Agar 15.0 gm

200 ml medium was prepared. The following composition was followed for medium preparation.

- Starch agar medium 5 gm
- Agar 1 gm
- Distilled water 200 ml





incubation period, the isolates were tested for presence of ammonia. Nessler's reagent (0.5 ml) was added in each tube.

- Mercuric chloride 10 gm
- Potassium iodide 7 gm
- Sodium hydroxide 16 gm
- Distilled water 100 ml
- pH 13.2±0.05

Development of brown to yellow color was a positive test for ammonia production.

#### ii. Phosphate Solubilizing Activity

The plates were prepared with Pikovskaya's medium. The medium has the following composition in 500 mL-

- Glucose 5 gm
- MgCl<sub>2</sub> . 6 H<sub>2</sub> O 2.5 gm
- MgSO<sub>4</sub> . 7 H<sub>2</sub> O 0.125 gm
- KCl 0.1 gm
- (NH<sub>4</sub>)<sub>2</sub> SO<sub>4</sub> . 0.05 gm
- Tricalcium phosphate 5 gm
- Agar 7.5 gm

The media was prepared and autoclaved along with the petri plates. Then the medium was poured into each petri plate and kept for solidifying. After solidification, the plates were inoculated with the bacterial strains by spot inoculation. It was incubated in an incubator at 28 - 30°C for 3-7 days. The plates were then examined and data were recorded. A clear zone around the colony indicated a positive result.

#### iii. Production of the IAA

Luria Bertani (LB) broth (Himedia) medium modified with tryptophan is used as the test medium. LB broth contains the following constituents.

- Tryptone 10 gm/L
- Yeast extract 5 gm/L
- Sodium chloride 10 gm/L
- Final pH 7.4±0.2

The following constitution of the contents were made to prepare the medium.

- LB broth 1.3 gm
- Tryptophan 1 gm

The media was transferred to test tubes about 5 mL each, plugged with cotton plug, covered and autoclaved for 20 mins. After sterilization the test tubes containing medium was kept to cool down to room temperature. After cooling down, the bacterial isolates were transferred to these test tubes using an inoculation loop. The inoculated tubes were incubated for 24 hours at 28°C.

After the incubation period 2 to 3 drops of orthophosphoric acid were added to 2 ml of supernatant. 4 mL of Salkowski reagent was also added and incubated at room temperature for 25 minutes. Salkowski reagent was prepared by mixing

- 0.5M FeCl<sub>3</sub> 1 ml
- 70% per chloric acid 50 ml

Positive results showed formation of pink color. This indicates IAA Production by the bacterial strains. Yellow coloration or no color change showed a negative result.

#### **4. Morphological Characterization**

##### **i. Gram Staining**

Gram's staining was conducted by following the protocol by Smith and Hussey (2005) for Gram's staining, the bacterial smear was dried in the vicinity of the flame and allowed to cool. It was then stained with crystal violet solution for 1 minute followed by rinsing with water for few seconds. Then the slide was flooded with mordant - Gram's iodine solution and wait for 1 minute. It was followed by adding ethyl alcohol and again wait for 1 minute. Then the slide was again washed with water, drained. The smear was counterstained with safranin for 30 seconds. Finally the slide

was washed with water, drained and air dried and observed under the light microscope at 40 x magnification. At the completion of the Gram Stain, gram-negative bacteria will stain pink/red and gram-positive bacteria will stain blue/purple.

## 5. Biochemical Characterization

The biochemical characterization of the bacterial isolates were done. Tests were conducted according to the protocol by Shoaib *et al.*,(2020).

### i. Indole Production Test

Tryptone broth medium is was the test medium. Tryptone broth medium contained the following constituents.

- Tryptone 1gm/L
- Sodium chloride 0.5gm/L
- Distilled water 100ml

The medium was dispensed 5mL into each test tubes, autoclaved at 15 lbs for 15 minutes. Inoculated the tube of Tryptone water with a loopful of overnight culture of bacterial strains. Incubated for 48 hours –99 hours at 37<sup>0</sup> C. After incubation, 0.5mL of Kovac’s reagent was added to each test tube and kept for 1-5 minutes. The appearance of dark red color on the surface layer which indicated the test was positive.

### ii. Methyl red Test

Glucose-phosphate peptone water medium was used. Glucose-phosphate peptone water medium contains the following composition-

- Glucose 2.5 gm



#### iv. Citrate Test

Isolates were stabbed into Simmons citrate agar slants. It has the following composition-

● Magnesium sulphate	0.1gm/l
● Ammonium dihydrogen phosphate	0.5gm/l
● Potassium hydrogen phosphate	0.5gm/l
● Sodium citrate	1gm/l
● Sodium chloride	2.5gm/l
● Bromothymol blue	0.04gm/l
● Agar	7.5 gm/l
● Distilled water	500ml

Medium was made in a conical flask and 5ml of the medium was taken in each test tube which was covered with a cotton plug and autoclaved at 15 lbs (112<sup>0</sup> C) for 10 minutes. The bacterial strains were stabbed into Simmons citrate agar slants using an inoculating loop and then zig-zagged back and forth on the surface of the slant and incubated at 28±2oC for 24hrs. Change in color from green to Prussian blue indicated positive reaction for citrate utilization.

#### v. Catalase Test

Luria Bertani (LB) broth (Himedia) medium modified with tryptophan ws used as the test medium. LB broth contained the following constituents.

● Tryptone	10 gm/L
● Yeast extract	5 gm/L

- Sodium chloride 10 gm/L
- Final pH 7.4±0.2

The media was prepared and 5ml of the medium was taken in each test tubes, plugged with cotton plug and autoclaved for 20 min. After sterilization the test tubes containing medium were kept to cool down to room temperature. After cooling down, the bacterial isolates were transferred to these test tubes using an inoculation loop. The inoculated tubes were incubated for 24 hours at 28°C.

Under aseptic condition a drop of H<sub>2</sub>O<sub>2</sub> was placed on a clean sterile glass slide with the help of a pipette. With a sterile inoculating loop, a small amount of culture was placed on this and looked for immediate bubbling.

The bubbles resulting from production of oxygen gas clearly indicate a catalase positive result.

vi. **MacConkey Agar Test**

The MacConkey agar media was used as the test medium. MacConkey agar medium contained the following constituents.

- Peptic digest of animal tissue 8.5gm/l
- Proteose peptone 1.5gm/l
- Lactose 5 gm/l
- Bile salts 0.75gm/l
- Sodium chloride 2.5gm/l
- Distilled water 500ml

The medium was prepared in a conical flask and covered with a cotton plug and autoclaved. It was then transferred to the autoclaved petri plates. It was allowed to cool. Then the bacterial strains are streaked on the petri plates. Incubated the plates for 18 to 24 hours at 35° - 37°. If the strains are

lactose fermenting strains then they grow as red or pink color and may be surrounded by a zone of acid precipitated bile.

## **6. Molecular Analysis of Screened Isolates using PCR**

Molecular Characterization and 16S rRNA gene sequence analysis for identification of species of the isolates were conducted . The sequences were analysed using bioinformatic tools for species level identification.

### **i. Genomic DNA isolation**

Genomic DNA isolation was done following the protocol (Esteban *et al.*, 1993).

- A single colony of the isolate was inoculated into Luria Broth (Hi media, India) and incubated at 37°C overnight with constant shaking
- 1.5 mL culture was taken in a microfuge tube and centrifuged at 8000 rpm (Sigma, Germany) for 5 min.
- The pellet was resuspended in 567µL Tris-EDTA (TE) buffer (pH 8)
- To the suspension, 30µL of 10% sodium dodecyl sulphate (SDS) and 3µL Proteinase K (20mg/mL) were added and mixed well
- The culture was then incubated for 1h at 37°C in a water bath.
- 100µL of 5M NaCl and 80µL Hexadecyl trimethyl ammonium bromide (CTAB) (10mg/mL) were added and incubated for 10min at 65°C in a water bath.
- The tubes were allowed to cool to room temperature and an equal volume of chloroform-isoamyl alcohol (24:1) was added.
- The contents were mixed gently and centrifuged at 10000 rpm for 10min.
- The aqueous layer at the top, containing the DNA, was carefully transferred to a fresh microfuge tube using a blunt end sterile tip.
- An equal volume of phenol-chloroform-isoamyl alcohol (25:24:1) was added to the aqueous layer and centrifuged again at 10000 rpm for 10 min.
- The aqueous layer was collected in a fresh tube and 0.6 volume of isopropanol was added to it.
- The contents were mixed gently and centrifuged at 12000 rpm for 10min.

- The supernatant was discarded and the pellet was washed with 70% ethanol and centrifuged.
- The supernatant was discarded and the pellet was dried at room temperature.
- The purified DNA was then dissolved in 100µL TE buffer (pH 8).

The concentration of genomic DNA thus obtained was estimated by the spectrophotometric method (Shimadzu UV-VIS Spectrophotometer, Japan). The purity of the DNA was assayed spectrophotometrically using the automatic calculation of the ratio of optical densities at 260 and 280 nm. The quantification of DNA was done using DNA/Protein pack® software of spectrophotometer. DNA was stored at -20<sup>0</sup>C until further use. An appropriate dilution (~80-100ng) of genomic DNA was used as template for PCR reactions.

## ii. 16S rRNA sequence analysis

A PCR based method using a primer pair for 16S rRNA was used for species identification (Shivaji et al., 2000; Reddy et al., 2000, 2002a; b). A portion of the 16S rRNA gene (1.5kb) was amplified from the genomic DNA. Products after PCR amplification was purified by gene clean kit (Genei, India) and subsequently sequenced, followed by homology analysis.

Sequence	Primer	Reference
16SF	5' AGTTTGATCCTGGCTCA 3'	Shivaji et. al.,2000
16SR	5' ACGGCTACCTTGTTACGACT 3'	Reddy et. al., 2000,2002 a; b

## iii. Polymerase Chain Reaction (PCR)

PCR was performed using the genomic DNA (~100ng) as template and 16S rRNA specific primers as detailed above.

### a. PCR Mix composition

PCR buffer (10X)	2.0µL
dNTPs (2.5mM)	2.0µL
Forward primer (10µM)	1.0µL

Reverse primer (10 $\mu$ M)	1.0 $\mu$ L
<i>Taq</i> DNA polymerase (1U)	0.2 $\mu$ L
Template DNA	0.5 $\mu$ L
MgCl <sub>2</sub> (1.5mM)	1.2 $\mu$ L
Sterile distilled water to make the final volume to	20 $\mu$ L

#### **b. PCR conditions**

Annealing	- 56°C	-30 sec.
Extension	- 72°C	-2 min.

PCR assays were performed in MJ Mini Thermal cycler (Bio-Rad, USA).

#### **iv. Agarose gel electrophoresis**

The agarose gel electrophoresis was carried out for the visualization of PCR products. Agarose gels of appropriate strength (1 - 2%) depending on the size of the PCR product were prepared in Tris-Acetate-EDTA (TAE) buffer. Ethidium bromide (EtBr) solution was added at a concentration of 10mg/mL. Definite volume of PCR product was mixed with gel loading dye and loaded into the wells. DNA markers were run along with the products for confirmation of amplicon size. Electrophoresis was performed at a constant volt (5V/cm) (Genei, India) and the gel pictures were captured with Bio-Rad Gel documentation system.

#### **vi. *In silico* nalysis of the 16S rDNA sequences**

##### **a.DNA sequencing and analysis**

Products after PCR amplification were purified by gene clean kit (Genei, India). The products were sequenced by Sanger's Dideoxy method using ABI 3730 Excel at Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram. The sequenced PCR products were analysed online using BLAST software (<http://www.ncbi.nlm.nih.gov/blast>) and the identity of the sequences were established.

## OBSERVATION AND RESULTS

Bacterial strains were isolated from the soil by serial dilution and spread plate method. 24 colonies were isolated from the  $10^{-3}$ ,  $10^{-4}$ ,  $10^{-5}$ ,  $10^{-6}$  diluted samples. They exhibited difference in their colony characters such as color difference, texture and colony size.

Most of the colonies were milky white or white in color and had different textures like slimy, sticky.

The results of the extracellular enzyme screening, biochemical analysis, morphological screening and molecular identification are given below:

### 1. Enzymatic Screening of Bacterial Strains

The isolates were screened for the production of amylase, gelatinase and protease. The diameter of the zone of clearance formed around the colonies were measured using a scale in centimeters.

#### i. Test for Amylase

The appearance of clear zone surrounding the colony indicated positive result for starch hydrolysis test. Out of 24 strains tested, 20 strains of bacteria exhibited positive results for amylase activity.

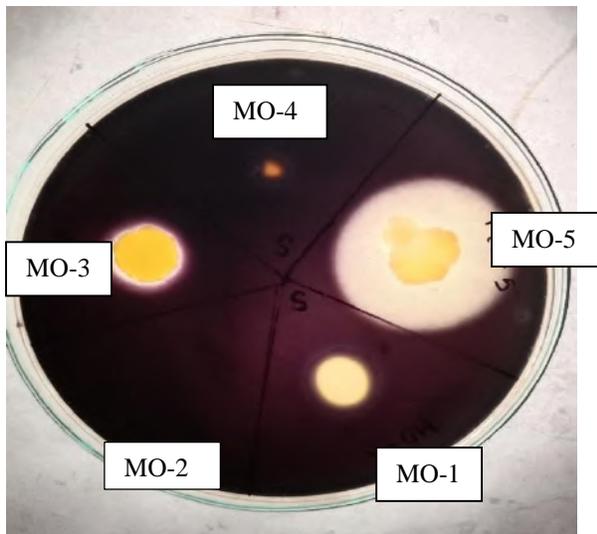


Plate. 1. MO-1 -, MO-2 -, MO-3 +, MO-4 -,  
MO-5 +

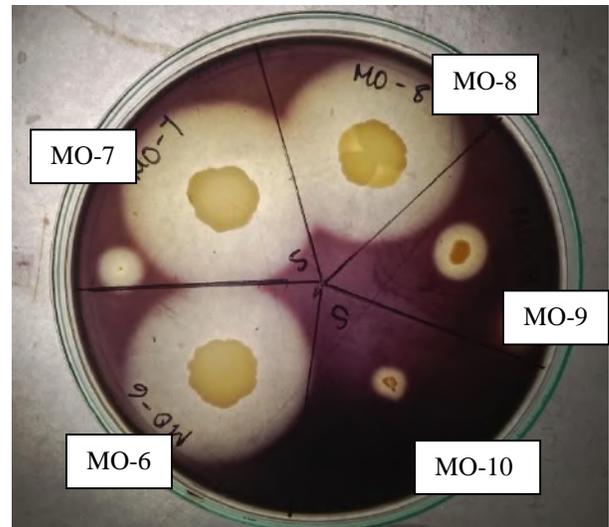


Plate. 2. MO-6 +, MO-7 +, MO-8 +, MO-9 +,  
MO-10 +

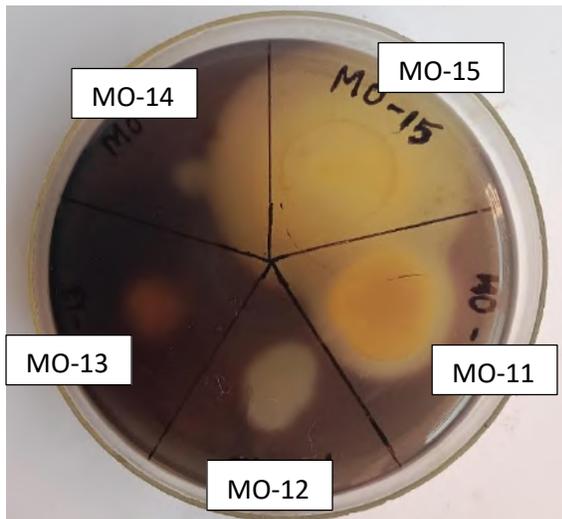


Plate. 3. MO-11 +, MO-12 +, MO-13 +, MO-14 +, MO-15+

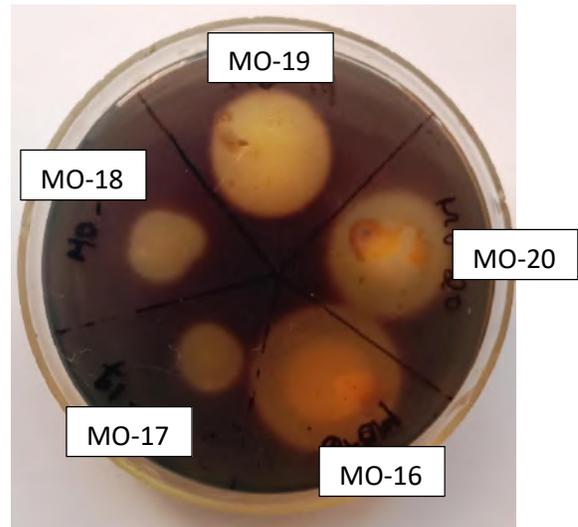


Plate. 4. MO-16 +, MO-17 +, MO-18 +, MO-19+, MO-20+

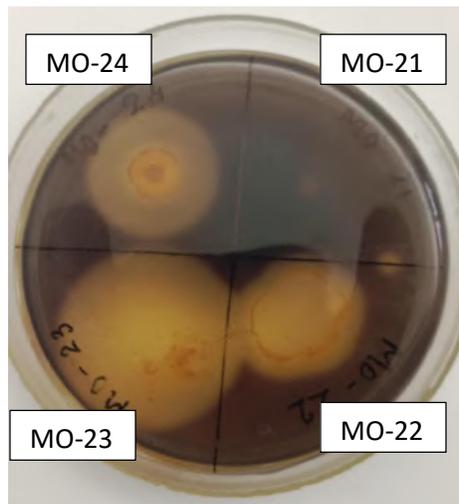


Plate. 5. MO-21 +, MO-22 +, MO-23 +, MO-24+

Bacterial strains showing positive results for amylase production.

## ii. Test for Gelatinase

None of the strains exhibited the gelatinase production.

## iii. Test for Protease

Proteolytic enzyme production was detected as formation of a clear zone around the colony on skim milk agar medium. Out of 24 strains tested, 20 strains showed proteolytic activity.

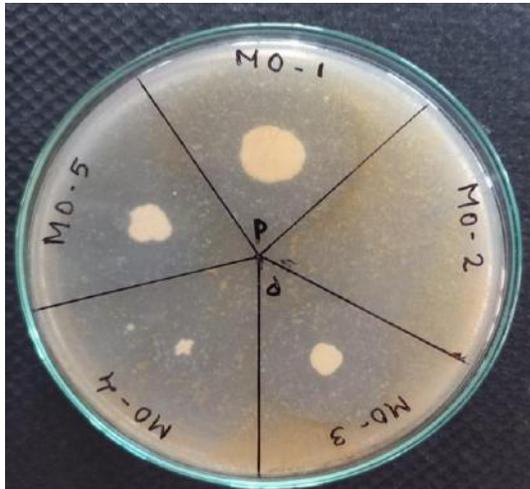


Plate 6. MO-1 +, MO-2 -, MO-3 +, MO-4 +,  
MO-5+

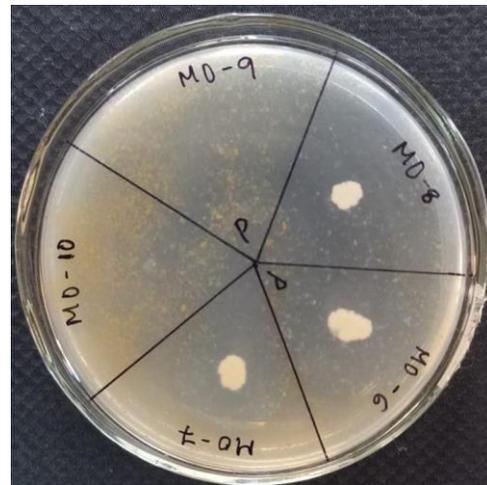


Plate. 7. MO-6 +, MO-7 +, MO-8 +,  
MO-9 +, MO-10 +

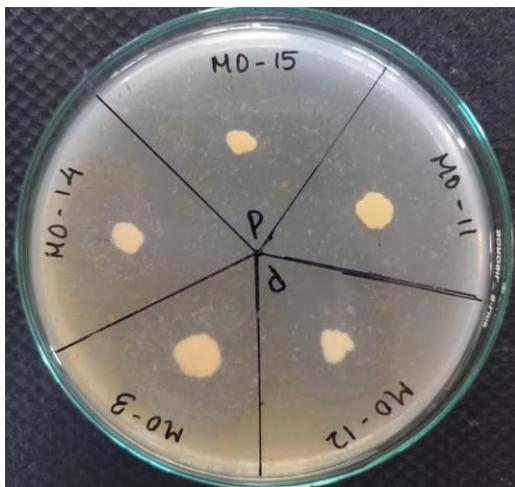


Plate. 8. MO-11 +, MO-12 +, MO-3 +,  
MO-14 +, MO-15+

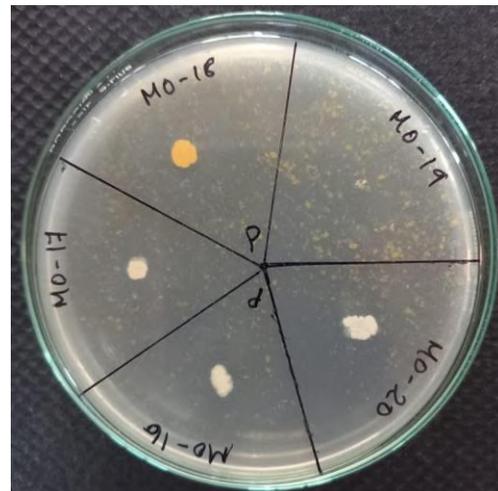


Plate. 9. MO-16 +, MO-17 +, MO-18 +, MO-  
19 -, MO-20+

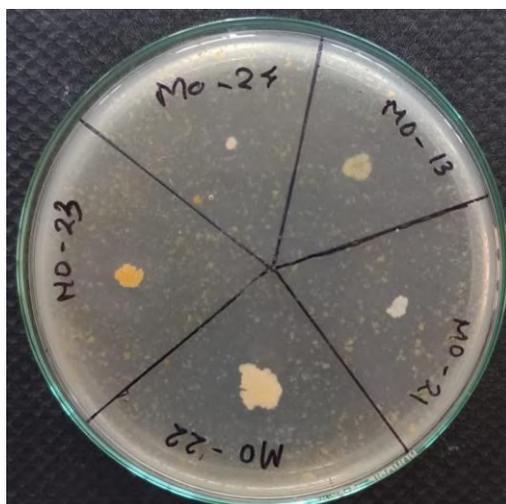


Plate. 10. MO-21 +, MO-22 +,  
MO-23 +, MO-24+, MO-13+

Bacterial strains showing positive results for protease production.

The following table provides the results of the enzymatic screening of the strains. The diameter of the zone of clearance in centimeters is given:-

Table 1. Enzymatic screening of the bacterial strains.

Bacterial strains	Amylase production (in cm)	Protease production (in cm)	Gelatinase production (in cm)
MO-1	--	+ 3.4cm	--
MO-2	--	--	--
MO-3	+ 1.5cm	+ 2.6cm	-
MO-4	--	+ 1cm	-
MO-5	+ 3.1cm	+ 2.4cm	-
MO-6	+ 3.4cm	+ 2.9cm	-
MO-7	+ 3.4cm	+ 2.5cm	-
MO-8	+ 3.3cm	+ 3cm	-
MO-9	+ 3.2cm	--	-
MO-10	+ 0.6cm	--	-
MO-11	+ 2.2cm	+ 2.4cm	-

MO-12	+ 1.5cm	+ 2.5cm	-
MO-13	+ 1.2cm	+ 1.9cm	-
MO-14	+ 0.5cm	+ 2cm	-
MO-15	+ 4.2cm	+ 2.4cm	-
MO-16	+ 2.6cm	+ 1.7cm	-
MO-17	+ 1.1cm	+ 1.9cm	-
MO-18	+ 1.3cm	+ 2cm	-
MO-19	+ 2cm	-	-
MO-20	+ 2.1cm	+ 1.6cm	-
MO-21	-	+ 1cm	-
MO-22	+ 2.2cm	+ 3cm	-
MO-23	+ 3cm	+ 2cm	-
MO-24	+ 2.3cm	+ 1.2cm	-

Out of the 24 strains tested, best performing 10 strains were selected for the next stage of screening – plant growth promoting characters. They are, MO-5, MO-6, MO-7, MO-8, MO-11, MO-15, MO-16, MO-20, MO-22, and MO-23.

## 2. Screening for plant growth promoting characters

### i. Production of Ammonia.

In the test for ammonia, after addition of Nessler's reagent all the bacterial strains were tested positive for ammonia production. 4 strains showed dark yellow color. They are: -MO-5, MO-7, MO-8, and MO - 20.





Plate 11. Bacterial strains showing positive results for ammonia production.

### ii. Test for phosphate solubilizing activity.

None of the bacterial showed a clear zone around the colonies. All the bacterial strains were tested negative for phosphate solubilization. None of the strains solubilized phosphate present in the medium.

### iii. Production of IAA.

On adding Salkowski reagent to the cultures, 9 out of the 10 isolates were tested positive. The negative cultures did not have any color change. Among the 10 isolates 5 exhibited dark pink color. They are - MO- 5, MO- 6, MO- 7, MO- 8, MO-20.





Plate 12. Bacterial strains showing positive results for IAA production.

Table 2. Screening for plant growth promoting characters:-

<b>Bacterial strains</b>	<b>Ammonia production</b>	<b>Phosphate solubilisation</b>	<b>IAA production</b>
MO-5	+	-	+
MO-6	+	-	+
MO-7	+	-	+
MO-8	+	-	+
MO-11	+	-	+
MO-15	+	-	+
MO-16	+	-	+
MO-20	+	-	+
MO-22	+	-	+
MO-23	+	-	-

Finally 4 strains that exhibited best results were selected for the morphological analysis and biochemical screening. They are: - MO- 5, MO- 7, MO- 8, & MO-20.

### **3. Morphological characterization**

The previously screened 4 strains i.e., MO- 5, MO- 7, MO- 8, & MO-20 were subjected to Gram's staining and the following results were obtained. All the 4 strains were tested Gram positive. i.e., MO- 5, MO- 7, MO- 8 & MO- 20. They showed a violet color on staining.

#### **4. Biochemical Analysis**

##### **i. Indole Production Test**

On adding Kovac's reagent to the Tryptone broth no appearance of dark red color on the surface layer was detected. All of the strains were tested negative for indole production test.

##### **ii. Methyl red Test**

On adding methyl red indicator to cultures incubated in the glucose-phosphate peptone water medium no red colored ring was formed on the surface of the tube. This indicated a negative result for methyl red test.

##### **iii. Voges-Proskauer Test**

No red/pink color was formed while adding Baritt's reagent to the cultures incubated in the glucose-phosphate peptone water. They were tested negative.

##### **iv. Citrate Test**

There was no change in color of the Simmons citrate agar slants from green to Prussian blue. This indicated a negative result.

##### **v. Catalase Test**

No bubbles were formed during addition of the fresh inoculum to a drop of hydrogen peroxide. Therefore no oxygen was evolved and it indicated a negative result.

##### **vi. MacConkey Agar Test**

None of the bacteria were able to grow on the MacConkey agar medium. This indicated that none of the strains were gram -ve and enteric bacteria.

Table 3. Biochemical Analysis

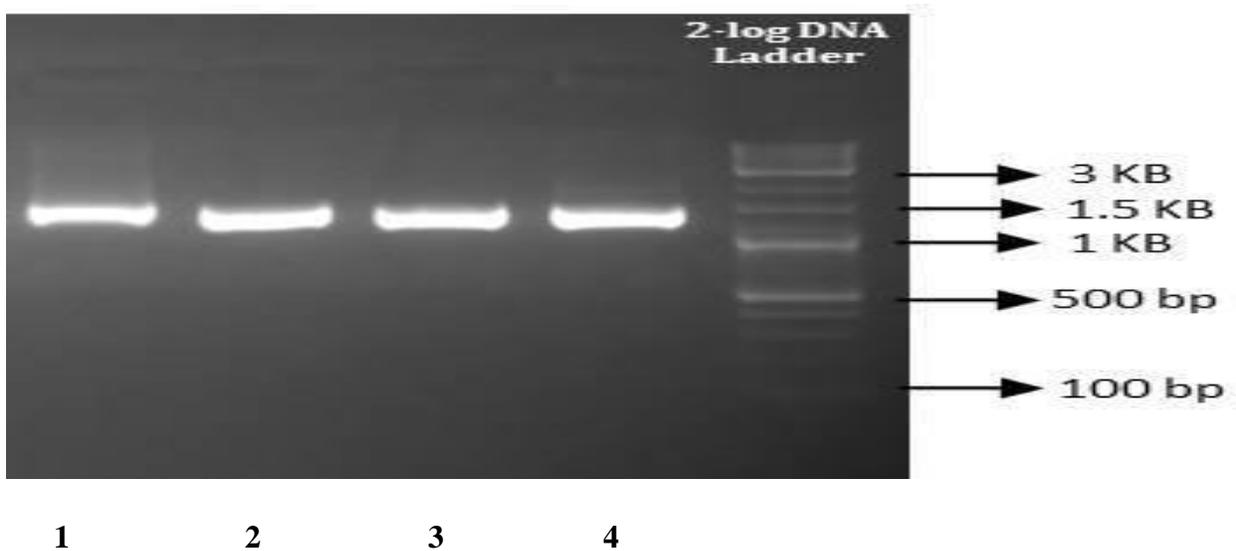
Bacterial strains	Indole test	Methyl red test	Voges-proskauer test	Citrate test	Catalase test	MacConkey test
MO-5	-	-	-	-	-	-
MO-7	-	-	-	-	-	-
MO-8	-	-	-	-	-	-
MO-20	-	-	-	-	-	-

### 5. Molecular identification of screened isolates using PCR

The 4 isolates were subjected to molecular level of identification based on 16S rRNA Gene Sequence Analysis for identification of species. All the 4 strains belonged to the genus *Bacillus*. The identity of the strains are listed below.

Strain	Identification	% of identity
MO- 5	<i>Bacillus tropicus</i> strain 6TM-12	99.85%
MO- 7	<i>Bacillus cereus</i> strain MUGA205	99.84%
MO- 8	<i>Bacillus cereus</i> strain ES-4a1	99.70%
MO-20	<i>Bacillus cereus</i> strain AN630_A3	100%

i. The agarose gel electrophoresis was carried out for the visualization of PCR products.

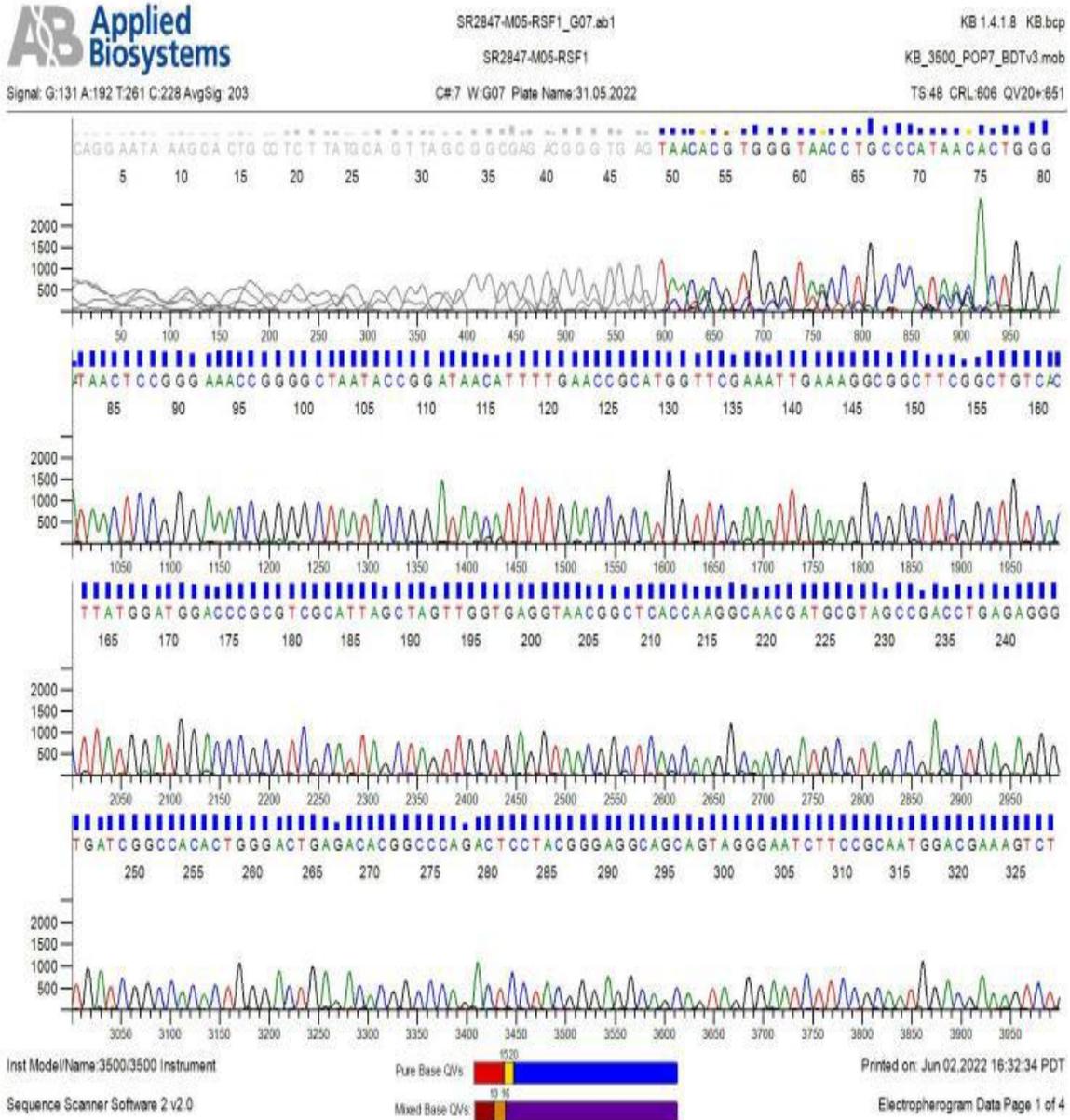


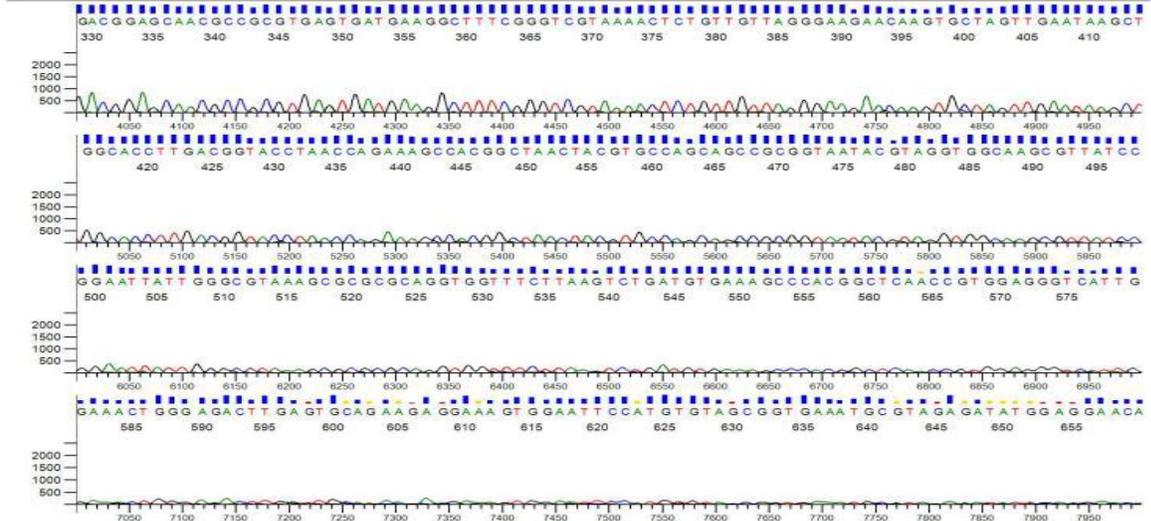
Lane 1- MO-5, Lane 2- MO-7, Lane 3 – MO-8, Lane 4 – MO-20

## ii. Electropherogram of the Identified Bacterial Strains

Electropherogram was produced when the electrophoresis is used as the analytical technique.

Figure 2. shows the electropherogram of MO-05





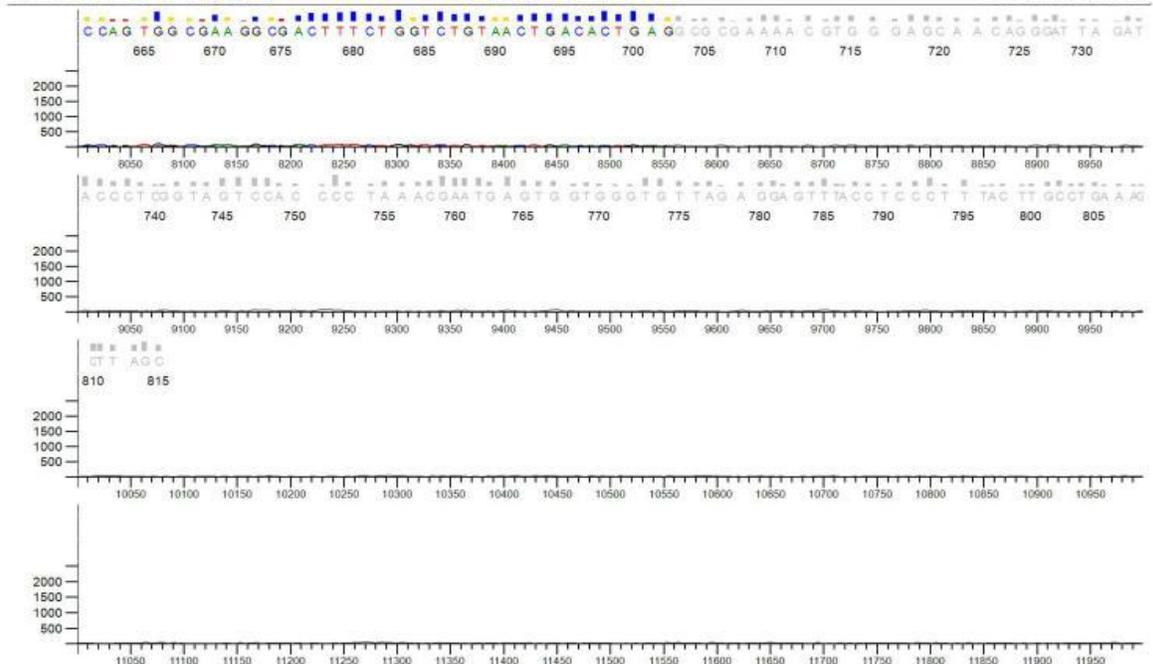
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Sequence Scanner Software 2 v2.0

Electropherogram Data Page 2 of 4



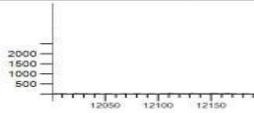
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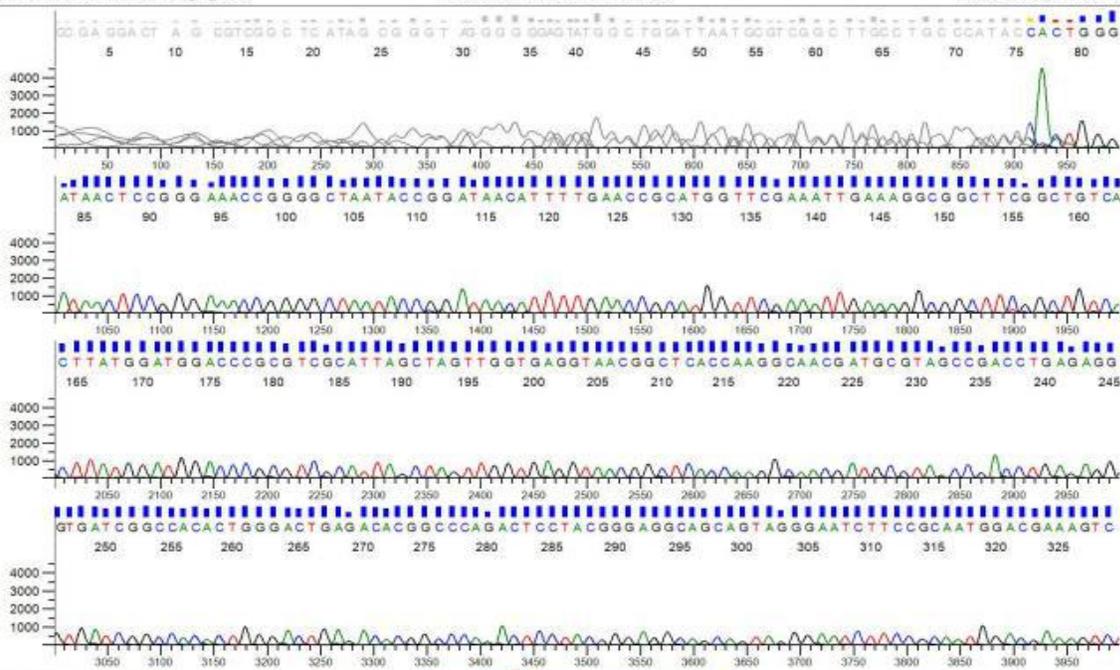


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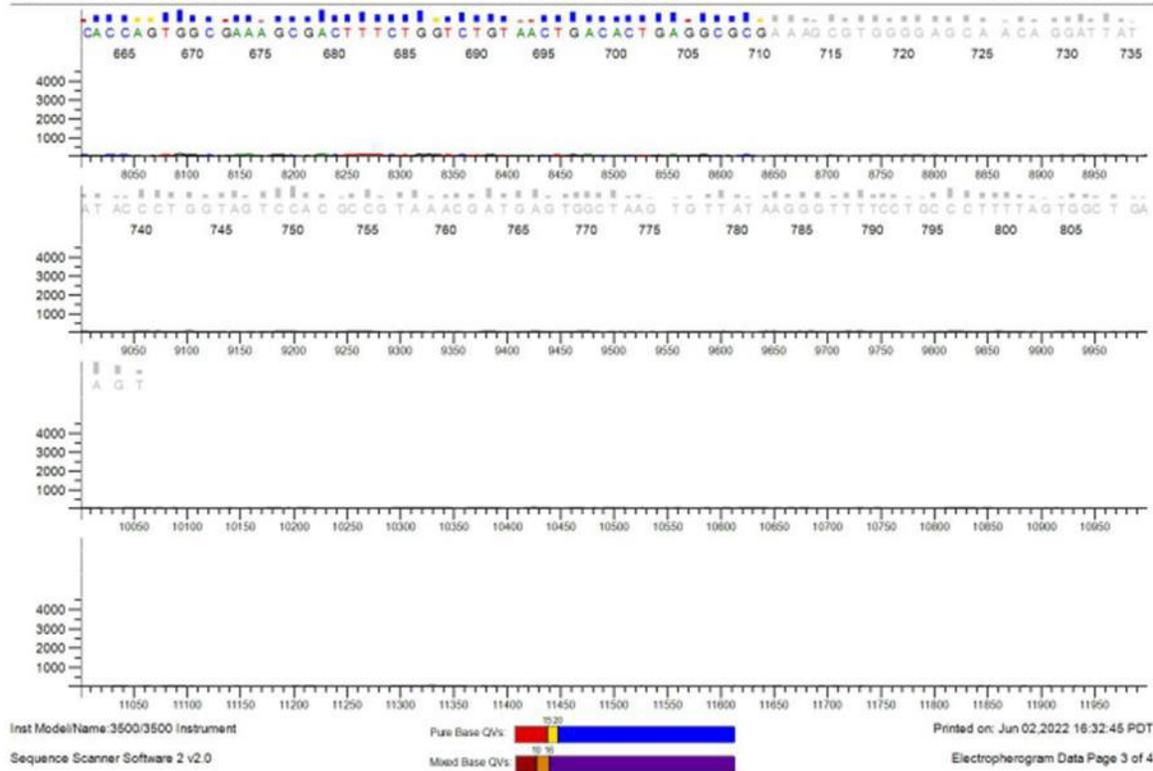
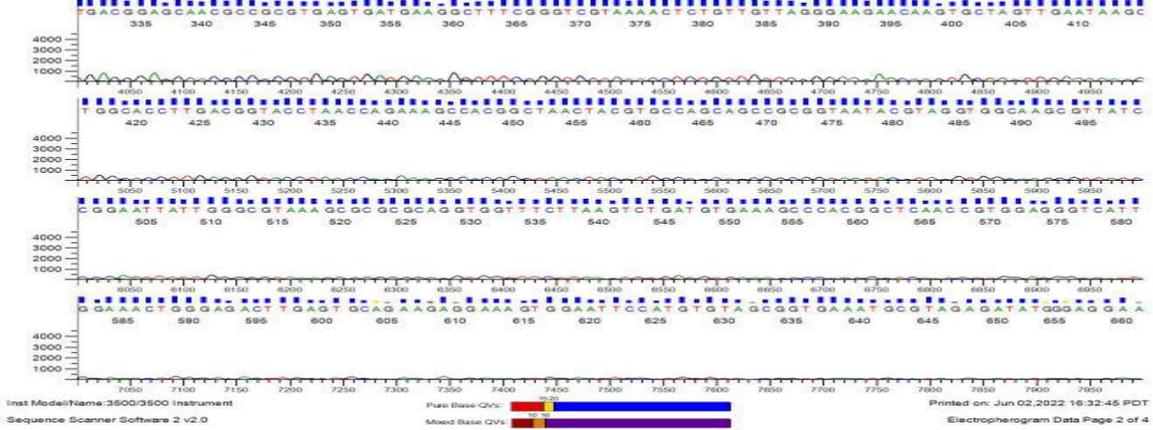
Figure 2. shows the electropherogram of MO-07



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Sequence Scanner Software 2 v2.0



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Electropherogram Data Page 1 of 4



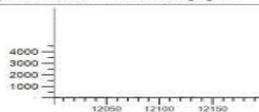
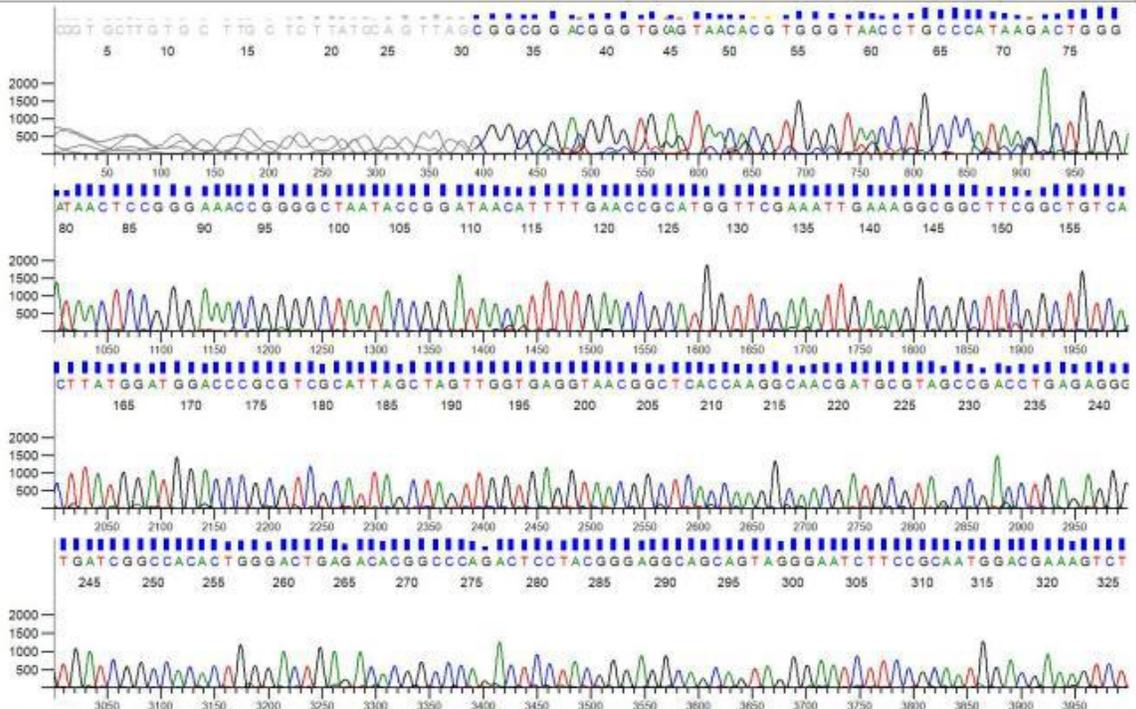
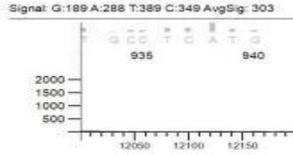


Figure 3. shows the electropherogram of MO-08







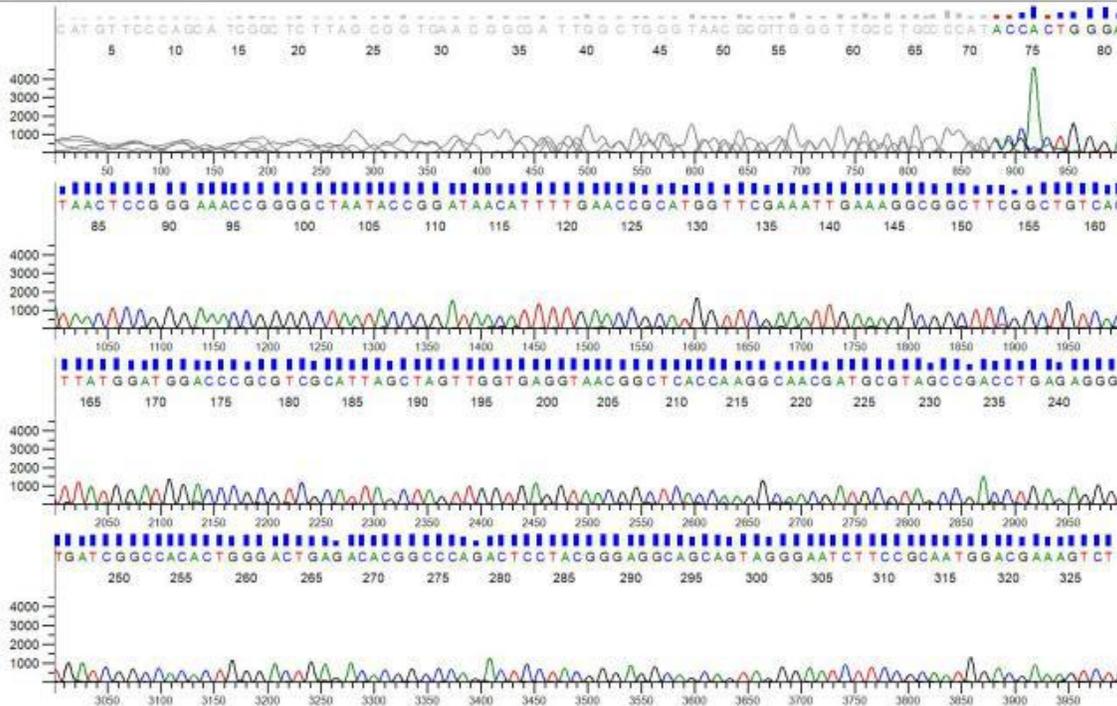
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Electropherogram Data Page 4 of 4

Figure 2. shows the electropherogram of MO-07

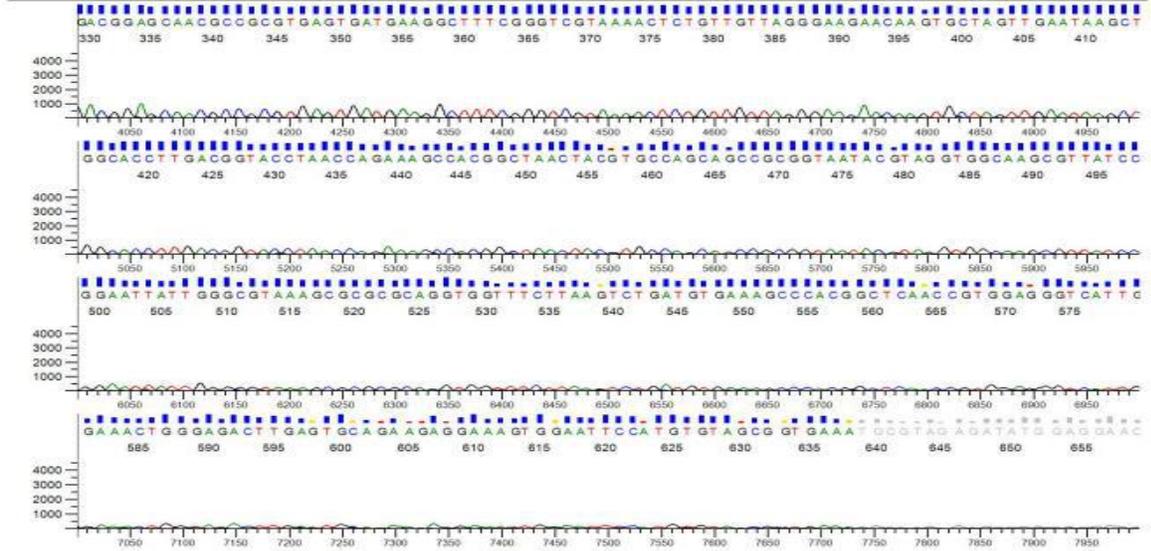
Signal: G:87 A:122 T:156 C:142 AvgSig: 126



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Electropherogram Data Page 1 of 4



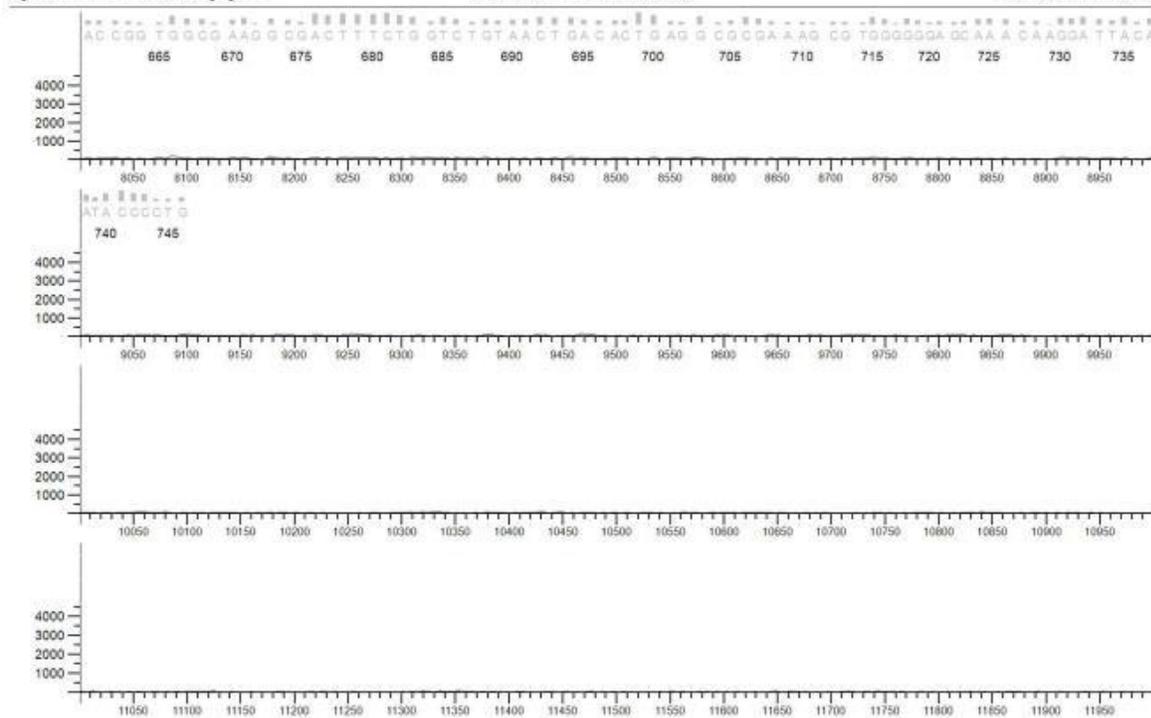
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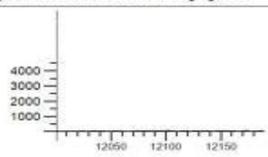


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Sequence Scanner Software 2 v2.0

Electropherogram Data Page 3 of 4

Signal: G: 87 A: 122 T: 156 C: 142 AvgSig: 126



Inst ModelName: 3500/3500 Instrument  
Sequence Scanner Software 2 v2.0



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Electropherogram Data Page 4 of 4

## DISCUSSION

The soil from the rhizosphere of Out of the 24 isolates that were isolated finally 4 isolates were screened on the basis of enzyme test, plant growth promoting characters and biochemical analysis. They are MO- 5, MO- 7, MO- 8, MO- 20.

21 bacterial strains each from the amylase and protease test showed positive results.

Strain MO – 02 exhibited – ve results for all the three enzyme tests. Thus MO-02 does not help directly in plant growth.

MO - 15 isolate had the maximum zone of clearance of 4.2 cm in amylase test. This indicates that MO-15 produces maximum amylase enzyme.

Amylases' main function is to hydrolyze the glycosidic bonds in starch molecules, converting complex carbohydrates to simple sugars. Such enzymes hydrolyze the starch molecules into polymers composed of glucose units. There are three main classes of amylase enzymes; Alpha, beta- and gamma-amylase, and each act on different parts of the carbohydrate molecule. In plants, the amylase can be found in seeds to break down starch into sugar to be used by the embryo to induce growth (Esitken, 1970). Amylase enzymes help plants develop as the seeds germinate, sprout, and root. Amylase is an enzyme that acts as a catalyst to hydrolyze carbohydrates. The role of amylase in plants is for breaking down starches. Starches are usually processed in this way during seed germination, and turned into sugars.

The production of  $\alpha$ -amylase is essential for conversion of starches into oligosaccharides. Starch is an important constituent of the human diet and is a major storage product of many economically important crops such as wheat, rice, maize, tapioca, and potato. Starch-converting enzymes are used in the production of maltodextrin, modified starches, or glucose and fructose syrups (Esitken, 2006).

None of the strains showed a positive result in gelatinase test.

Gelatinase allows the organisms that produce it to break down gelatin into smaller polypeptides, peptides, and amino acids that can cross the cell membrane and be utilized by the organism.

Gelatinase hydrolyzes gelatin, releasing peptides and amino acids into the environment that may be utilized by bacteria as nutrients. Gelatinase is expressed in several bacteria including *Pseudomonas aeruginosa* and *Serratia marcescens*. Mostly gelatinase is produced by fungi. Strains of *Bacillus* does not produce gelatinase (Goswami *et al.*, 2016).

In the protease test 3.4 cm round clear zone was exhibited by MO-01 strain indicating a high protease production.

Proteases are involved in the physiology of the plants during their entire cycle life (chloroplast photoinhibition, defense mechanisms, photomorphogenesis, and seed germination. The function of proteases is to catalyze the hydrolysis of proteins, which has been exploited for the production of high-value protein hydrolysates from different sources of proteins such as casein, whey and soy protein (Saharan & Nehra, 2011).

From the preliminary screening for enzymatic production, 10 best performing bacterial strains were selected for PGP characterization.

The strains MO-5, MO-6, MO-7, MO-8 and MO-20 exhibited the maximum production of IAA.

IAA is a derivative of indole, containing a carboxymethyl substituent. It is a colorless solid that is soluble in polar organic solvents. IAA is predominantly produced in the apical bud of and young leaves of plants and is known to be an inducer of cell division and elongation (Saharan & Nehra, 2011). IAA is the main auxin in plants, regulating growth and developmental processes such as cell division and elongation, tissue differentiation, apical dominance, and responses to light, gravity, and pathogens. Roots are most sensitive to fluctuations in IAA level (Goswami *et al.*, 2016).

Phosphorus is involved in the photosynthetic core of any high-yield crop production system, the crucial point at which energy is transformed from light into sugar and then into compounds which plants provide. Phosphate solubilization is usually exhibited by group of fungi (Goswami *et al.*, 2016). Phosphorus (P) is vital to plant growth and is found in every living plant cell. It is involved in several key plant functions, including energy transfer, photosynthesis, transformation of sugars and starches, nutrient movement within the plant and transfer of genetic characteristics from one generation to the next.

None of the strains exhibited a positive result for phosphate solubilizing test.

MO-5, MO-7, MO-8, MO-20 had the maximum ammonia production.

Ammonium is an important source of nitrogen for plants. It is taken up by plant cells via ammonium transporters in the plasma membrane and distributed to intracellular compartments such as chloroplasts, mitochondria and vacuoles probably via different transporters in each case. Ammonia binds air borne nitrogen and makes the most important crop nutrient, nitrogen, available for nitrogen fertilizer production. It is an important base material for fertilizers. Today, roughly 80% of the annually produced ammonia is used for fertilizer production (Goswami *et al.*, 2016).

From these results it is understood that bacterial strains MO-5, MO-7, MO-8, and MO-20 exhibited the best results in the enzymatic screening and PGP characterization. These strains were further tested for biochemical, morphological and molecular characterization.

Tests for indole, glucose utilization, organic and acetoin production and citrate utilization were conducted.

In the study conducted by Kloepper and associates, (1980) it is noted that indole derives auxin molecules that can control the division and elongation rate, as well as the identity or differentiation state of cells. Accumulation of and response to auxin have been shown to regulate many growth and developmental processes. Indole test was done to identify production of indole.

Methyl red (MR) test detects the production of sufficient acid during the fermentation of glucose and the maintenance of conditions such that the pH of an old culture is sustained below a value of about 4.5, as shown by a change in the color of the methyl red indicator which is added at the end of the period of incubation (Saharan & Nehra, 2011).

Some bacteria can utilize glucose and convert it to a stable acid like lactic acid, acetic acid or formic acid as the end product (Adesemoye *et al.*, 2008). Organic acids play a role in plants in providing redox equilibrium, supporting ionic gradients on membranes, and acidification of the extracellular medium.

The majority of plant growth promoting rhizobacteria (PGPR) confer plant immunity against a wide range of foliar diseases by activating plant defenses that reduce a plant's susceptibility to

pathogen attack. Acetoin trigger induced systemic resistance (ISR) and protect plants (Saharan & Nehra, 2011). It is detected by Voges-proskauer test.

Citrate test useful in selecting bacteria that use citrate as its main carbon and energy source.

Citrate is one of the most abundant stored form of carbon in plants that utilizes citrate. Simmons citrate agar is the medium used (Saharan & Nehra, 2011). Plants maintain their metabolic balance by transforming a part of stored malate to citrate via the TCA cycle. None of the strains were tested positive for biochemical analyses.

In molecular characterization, all the 4 strains were reported as different strains and species of *Bacillus*. In a study conducted by Sivasakthi and co-workers, (2014), obtained various PGPR members including *Bacillus*. It is the most abundant genus in the rhizosphere and the PGPR activity of these strains has been known for many years, resulting in broad knowledge of the mechanisms involved. There are a number of metabolites that are released by these strains which strongly affect the environment by increasing nutrient availability of the plants. *Bacillus* species are naturally present in immediate vicinity of the roots.

MO- 20 had difference in their production of amylase when compared to other strains but belonged to the same species. This difference may be caused due to any genetic mutation that had occurred.

MO-5, MO-7, MO-8, MO-20 exhibited the best results in the enzymatic screening and PGP characterization.

These strains can be used as a consortium or as individual strains for plant growth tests that is expected to have a higher growth rate than the control and development of biofertilizers.

These biofertilizers can be encapsulated in a biofilm thus making a more ecofriendly way to sustainable agriculture.

Since these bacterial strains exhibited hydrolysis of organic compounds like starch and protein, these have a potential use in waste management.

Biochar is a carbon-rich residue, which acts as a source of nutrients, and is also a bio-stimulating candidate to enhance the activities of oil-degrading bacteria. The application of biochar as a nutrient source to bioremediate oil-contaminated soil is a promising approach for reducing PHA contamination. These PGPR strains can be used for making biochar (Saeed *et al.*, 2011).

In horticulture plants, the production of IAA is of prime importance were proper flowering, growth of the plant and timely production of flowers are needed (Goswami *et al.*, 2016).

Inoculation in PGPR by dipping and seed priming before sowing in field under greenhouse condition, displayed increase in seedling growth up to 65% and rootstock up to 79% with PGPR strains treatment (Odoh, 2017). The inoculation of phosphate- solubilizing bacteria (PSB) along with phosphate fertilizer enhanced the performance of fertilizer and also abated its requirement by 75%. This helps in better leaf growth and can be utilized for foliage leaves that are important part of horticulture.

The blend of microbial inoculation revealed more efficiency than the inoculation of sole strain (Adesemoye *et al.*, 2008).

There is a direct need of increasing the growers' interest to adopt the technology of PGPR along with the use of chemical fertilizers in order to enhance their efficiency, and mitigate the negative impact of chemical fertilizers by abating their excessive use, which not only rises the input cost of crop production but also harms the environment and human health (Odoh, 2017).

A lot of study showed that inoculation with PGPR resulted in significant yield increases in different crops, rooting of hardwood and semi-hardwood cuttings, increased germination and enhanced emergence of seeds under different conditions, promoted nutrient uptake of roots, total biomass of the plants, increased seed weight, induced early flowering. Thus PGPR is a better option for sustainable and ecofriendly agriculture practice (Kaymak, 2010).

## CONCLUSION

Out of the 24 strains isolated finally 4 bacterial isolates were screened out after the preliminary screening by enzymatic activity, plant growth promoting characters and biochemical analysis. These can be further tested for effect of these strains in seed germination and the growth to the plantlet stage can be done in order to find their direct effect on the plants.

These isolates were tested positive for the enzyme production and exhibited best results among the 10 finally screened plant growth promoting characters.

Since these strains were the best performing in the tests conducted it can be used as a potential biofertilizers.

It has been suggested that development of plant growth promoting consortium (PGPC), could be a feasible strategy for increased activity and better viability of plant growth promoting rhizobacteria. The triad of interactions existing between the bioinoculant microorganism(s), resident soil microbiota, and host plant(s) is vital not only for the overall growth and higher productivity of the crop plants but also for maintaining the integrity of our planet's health and proper biogeochemical cycling.

Chemical fertilizers prove detrimental to soil and environmental health, while biofertilizers are natural products and do not pose threats to the ecosystem. Thus, to manage long-term soil fertility and sustain crop productivity, natural-products-based fertilizers prove to be an integral and vital component of sustainable agriculture. Thus PGPR needs to be produced commercially in order to meet these needs.

The more widespread utilization of PGPB will necessitate that a number of issues be addressed. They offer the potential to address multiple modes of action, multiple pathogens, and temporal or spatial variability. PGPR offer an environmentally sustainable approach to increase crop production and health. The application of molecular tools is enhancing our ability to understand and manage the rhizosphere and will lead to new products with improved effectiveness.

Further studies:

The seed germination studies can be conducted by immersing the seeds in the cultures of the bacterial strains individually and as a consortium. A consortium is considered to be more effective.

The bacterial inoculum can be further studied in developing biofertilizers and commercialized.

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**CERTIFICATE**

**This is to certify that the project titled "A STUDY ON THE FREQUENT SHIFT OF PEOPLE FROM EMPLOYMENT TO ENTREPRENEURSHIP WITH SPECIAL 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. Mary Sonika Joseph, Ms. Maria SilaRenny, Ms.Ridhya Xavier, under my supervision and guidance during the academic year 2019-22.**

**Project Guide**

**Ms.Namitha N A**

**Assistant Professor**

**Department of Commerce (SF)**

**Viva/Voice Examination held on....**

**Smt. Jini Justin D'Costa**

**(Head of the Department)**

**Department of Commerce (SF)**

**External Examiner(s)**

## **DECLARATION**

**We, Mary Sonika Joseph, MariaSilaRenny, Ridhya Xavier, final year B.Com students. Department of Commerce (SF), St Teresa's College Autonomous do hereby declare that the project report entitled STUDY ON FREQUENT SHIFT OF PEOPLE FROM EMPLOYMENT TO ENTREPRENEURSHIP WITH REFERENCE TO ERNAKULAM DISTRICT submitted to Mahatma Gandhi University is a bonafide record of the work done under the supervision and guidance of Namitha NA, 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**

**MARY SONIKA JOSEPH**

**DATE:**

**MARIYA SILA RENNY**

**RIDHYA XAVIER**

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**Mary Sonika Joseph**

**MariyaSilaRenny**

**Ridhya Xavier**

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**CHAPTER- 1**  
**INTRODUCTION**

## **1.1 INTRODUCTION**

An entrepreneur is someone who makes money by sharing their own business, especially when this involves seeing a new opportunity and taking risks. Entrepreneurship has been described as the “capacity and willingness to develop, organize and manage a business venture along with any of its risks in order to make a profit.” While definitions of entrepreneurship typically focus on the launching and running of the businesses, due to the high risks involved in launching a start-up, a significant proportion of start-up businesses have to close due to “lack of funding, bad business, decisions, an economic crisis, lack of market demand- or combination of all of these.

An employee (also known as a salaried employee) is a worker who is paid a fixed amount of money or compensation (also known as salary) by an employer. For example: a salaried employee might earn Rs.50,000 per year. Employees are typically paid by a regular, bi-weekly or monthly pay check. These employees can be also called salaried employees, because they receive their salary on a regular basis. They are often also known as exempt employees, according to the Fair Labour Standards Act (FLSA).

A white collar job is a perfect example of an employee. A white collar worker is a person who performs professional, managerial, or administrative work. White-collar work may be performed in an office or other administrative setting. An employee can be confined into a person having white collar job. People having blue collar job will also come under the category of employees. This project deals with all types of employees going into entrepreneurship and researching and understanding the reasons behind it.

## **1.1 SIGNIFICANCE OF THE STUDY**

Nowadays there is a trend that employees are going into entrepreneurship. This is mainly because people want to work independently and not under any one. Also the feeling of satisfaction that more freedom in entrepreneurship than paid jobs. The entrepreneur is the leader of his enterprise where as in big companies there are restrictions. There are many positives and negatives to this trend. This is a study about the frequent shit of people from employee to entrepreneur.

## **CHANGES IN TREND IN ENTREPRENEURSHIP**

- Co-working spaces – Also known as co-working communities, these spaces provide entrepreneurs and small business owners with a collaborative, open environment to work in. The concept is similar to a business incubator, except there are no actual office spaces or cubicles for individual businesses, and tenants are encouraged to collaborate and Support one another.
- Boot-camps – An entrepreneurship boot camp is an intense hands-on program for small Business owners, start-up founders and new entrepreneurs. Boot-camps will focus more of their attention on teaching the practical application for new venture creation and smallbusiness management within a short period of time. Their aim is to help teach, equip and direct entrepreneurs.
- Fully Online Entrepreneurship Degree -There used to be a lot of resistance to the idea of offering an entrepreneurship major fully online. With the innovation in technology, growth in social media Interaction for start-ups and funding options that are being generated online, more Universities have adopted a virtual option for their entrepreneurship seeking students.

### **1.3 OBJECTIVES OF THE STUDY**

- To study whether demographic factors like age, gender, education, background etc. influence the shift towards entrepreneurship.
- To check awareness of entrepreneurs about the training programs made available for entrepreneurs.
- To analyse the various financial and non-financial factors that led people to make a sudden shift to entrepreneurship.
- To ascertain the current trend in entrepreneurship.

### **1.4 STATEMENT OF PROBLEM OF ENTREPRENEURSHIP**

An ideal economy should be something which provides a platform for everyone to participate the making of the economy. All should be able to work freely and earn a return from it. A prospective working community looks towards a ground where they have

benefits like having an opportunity to earn good income, be satisfied in their field of work, can think creatively and apply it in their own interest, working under no force, platform to improve themselves, people of same interest able to work together etc. But our economy is not designed or developed into an ideal working place. The working community in our country works under so much pressure. Some employees are happy or satisfied with their current situation. But a huge part of the total working community do not enjoy the benefits of good return, better working conditions, less pressure, freedom, right to make decisions etc. Our economies have many issues like unemployment, employees working under employers not able to contribute their part, less Motivation, lack of pay, dictatorship etc.

## **1.5 SCOPE OF STUDY**

This research is focused on those entrepreneurs who were earlier an employee under any employer or any institution. it focuses on the reasons why they chose entrepreneurship over being an employee. It points out the advantages and disadvantages of entrepreneur as well as employee. This project is limited to Ernakulam district. Sample size is 50 for the study. Respondents were selected on random basis from Ernakulam district.

## **1.6 METHODOLOGY**

### **1.6.1 RESEARCH DESIGN**

The research design used for the study is survey-based. It is a framework or blueprint of the research study, which guides the collection and analysis of data. Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge.

### **1.6.2 DATA COLLECTION**

Primary Data are those which are collected for the first time use. So it is original in character. The method used for collection of data was questionnaire method. For this study primary data is collected using questionnaire method. Secondary Data was collected from various other sources. These include journals, articles, textbooks, internet etc. Statistical Data are the various statistical information presented is through tables, mathematical, graphical, percentage etc.

### **1.6.3 TOOLS OF ANALYSIS**

In order to sort and analyse the primary data collected from samples, MS Excel was used. Along with descriptive statistics such as mean and ranks are also used. Ranks were computed based on the mean scores calculated. The collected data were classified, tabulated, and appropriately presented using tables, charts, percentages and diagrams.

### **1.7 LIMITATIONS**

- Difficulty in finding the data.
- Sample size is limited to 50.
- Time consuming
- Lock-in period
- People not willing to cooperate

### **1.8 CHAPTERISATION**

- Chapter 1- INTRODUCTION
- Chapter 2- LITERATURE REVIEW
- Chapter 3- THEORETICAL FRAMEWORK
- Chapter 4- DATA ANALYSIS AND INTERPRETATION
- Chapter 5- FINDINGS, CONCLUSION AND SUGGESTIONS.

**CHAPTER -2**  
**REVIEW OF LITERATURE**

Michael William (2014) This article presents a review of the literature on rural entrepreneurship, and argues that rural entrepreneurship is a distinct area of entrepreneurship research and practice, with alternative opportunities for local development that do not necessarily follow the mainstream literature. (Supporting rural entrepreneurship, 2014).

Praag and Peter H Versloot (2017) This article examines to what extent recent empirical evidence can collectively and systematically substantiate the claim that entrepreneurship has important economic value. Based on 57 recent studies of high quality that contain 87 relevant separate analyses, they conclude that entrepreneurs have a very important—but specific—function in the economy. They engender relatively much employment creation, productivity growth and produce and commercialize high-quality innovations.

S P Kerr, W R Kerr, Tina X U (2017) The review is the extensive literature since 2000 on the personality traits of entrepreneurs. They first consider baseline personality traits like the Big-5 model, self efficiency and innovativeness, locus of control, and the need for achievement and then consider risk attitudes and goals and aspirations of entrepreneurs. This literature shows common results and many points of disagreement, reflective of the heterogeneous nature of entrepreneurship.

Miguel Amaral and Rui Baptista (2017) Study about the determinants of individuals choices of switching occupation from paid employment to entrepreneurship using a detailed longitudinal matched employer-employee data base including data on individuals careers, educational backgrounds and transitions between firms, sectors and occupations. (Baptista, 2007)

Hellmann (2002) This paper develops a multi-task incentives model to analyze optimal corporate strategies towards employee innovations. The model explains when employees become entrepreneurs (sometimes even involuntarily); When they become entrepreneurs, managing internal ventures; when they become managers of a corporate spin-off; and when they are denied all of these options. Important

determinants for these choices are the allocation of intellectual property rights, and the availability of outside resources, such as venture capital.

11 Schumpeter ( 1934,1942) The main agents of economic are the entrepreneurs. The aim of this paper is to summarize and critically review the concept of the strategic entrepreneurship in the light of economics history by creating a better understanding of the intersection of the academic fields of entrepreneurship and strategic management.

Garavan (1994) According to this research , highlighting a number of problems associated with entrepreneurship education and training programs . The major problem relates to balance: too much of an emphasis on knowledge and not enough on competence; too much emphasis on information transfer learning methods and not enough on individual small group learning methods such as project teams, peer exchange, individual counseling and workshops.

Morris et al.(2001) The study gives details about the entrepreneurship is a step-wise process affected by both exogenous and endogenous factors like presence of business friendly environment, required factor endowments, capability to acquire required resources, and implementation and management of business concept . Enormous studies highlighted the importance of entrepreneurship for eradication of unemployment issues.

Nair Et.Al (1998) The study is by far the largest survey-based study on Entrepreneurship in Kerala. Based on a field survey involving 300 rural entrepreneurs in Kerala ,the study found that in the particular context of Kerala, contextual circumstances play a dominant role in facilitating entrepreneurship .The institutions created to support the growth of small scale industries suffer from complex , cumbersome and bureaucratic practices and cause many problems for entrepreneurs.

Praag(2008) this paper provides a review of empirical studies into the impact of formal schooling on entrepreneurship selection and performance in industrial countries . The entrepreneurship literature on education can benefit from the technical sophistication used to estimate the returns to schooling for employees.(praag ,2008,pp. 795-841)

Orza (1988) The major assumptions of Entrepreneurship Development Programs (EDPs) and its rationale in the context of India. After a brief overview of the history of the EDP movement in India and its contribution to developing small-scale industries, he puts forward a methodology for the evaluation of EDPs.

Terjesen, S., & Sullivan, S. E. (2011) The purpose of this study is to examine the under researched subject of the role of mentoring relationships within and outside of organizational boundaries as individuals make the career transition from being a corporate employee to becoming an entrepreneur. It is also among the few studies to examine mentoring of Entrepreneurs and gender differences in mentoring within the entrepreneurial work context.

## **CHAPTER – 3**

### **THEORETICAL FRAMEWORK**

## **INTRODUCTION**

Entrepreneurship is the art of starting a business, basically a start-up company offering creative product, process or service. We can say that it is an activity full of creativity. An entrepreneur perceives everything as a chance and displays bias in taking decision to exploit the chance.

An entrepreneur is a creator or a designer who designs new ideas and business processes according to the market requirements and his/her own passion. To be a successful entrepreneur, it is very important to have managerial skill and strong team building abilities. Leadership attributes are a sign of successful entrepreneurs. Some political economists regard leadership, management ability and team building skills to be the essential qualities of an entrepreneur.

An entrepreneur is an innovator or a creator who introduces something new to the firm or economy. It can be a New method of production, a new product, a new source of material, a new market or any other similar innovation. Thus, an entrepreneur is an innovator, creator, borrower, purchaser etc.

### **3.1 EMPLOYEE**

Definition of employee says succinctly that an employee is “a person who works for another in return for financial or other compensation.”

#### **3.1.1 CHARACTERISTICS OF A GOOD EMPLOYEE**

**Professionalism:** Being polite, well spoken, calm and presentable is all part of being professional at work.

**Honest and integrity:** Telling the truth about tricky subjects, such as workload, work/life balance, difficult customer or colleagues and ineffective procedures makes for a good employee.

**Problem-solving abilities:** Employees who work on something until it's solved or complete and who bring their best efforts to solve problems are considered good employees.

**Ambitious:** When Employees have a clear, personal career plan or goal in mind, they're not under the assumption that their employer will drive their career for them. So they strive for advancement.

**Dependability, reliability and responsibility:** Employees, who take responsibility for their actions, are dependable, arrive on time, do what they say, and don't let the others in their team down and are highly valued employees.

**Conflict resolution:** Good employees address and resolve conflict maturely, rather than trying to avoid it, by maintaining respect for those involved, not placing blame and not acquiescing just to keep to peace.

**Positive attitude:** Employees who bring a positive attitude to work have a positive impact on those around them and improve the energy in the team.

### **3.1.2 FUNCTIONS OF AN EMPLOYEE**

- a) Representing members fairly and effectively in relation to matters arising within the undertaking or establishment in which they work and which concern employment and conditions of Employment.
- b) Participating in negotiations and grievance procedures as provided for in employer/trade union agreements or in accordance with recognized custom and participate in the understanding or establishment in which they work.
- c) Co-operating with the management of the undertaking or establishment in ensuring the proper implementation and observation of employer/trade union agreements, the use of agreed dispute and grievance procedures and the avoidance of any action, especially unofficial action, which would be contrary to such agreements or procedures and which would affect the continuity of operations or services.

- d) Acting in accordance with existing laws and regulations, the rules of the union and good industrial relations practice; liaising with and seeking advice and assistance from the appropriate full-time

### **3.2 ENTREPRENEURSHIP**

Joseph Schumpeter defined —Entrepreneur as a person who innovates, raises money, assembles inputs, chooses managers to set the organization going with his ability to identify opportunities which others are not able to, and make use of such economic opportunities.

As early as 1876 Francis Walker defined —Entrepreneur as one who is endowed with more than average capabilities in the task of organizing and coordinating the various other functions of production. He should be a pioneer and captain of industry.

Peter Drucker defined —Entrepreneur is one who always searches for change responds to it and exploits it as an opportunity.

#### **Concept**

The term ‘entrepreneurship’ refers to the functions performed by an entrepreneur. It is the process involving various actions to be undertaken by the entrepreneur in establishing a new enterprise. In fact, what an entrepreneur does is regarded as entrepreneurship. Thus, entrepreneurship can be viewed as a function of:

- Identifying and using the opportunities exist in the market;
- Converting the ideas into action;
- Undertaking promotional activities to launch an enterprise;
- Striving for excellence in his/her field of work;

1. Decision Making
2. Management Control
3. Division of Income
4. Risk-Taking and Uncertainty-Bearing
5. Innovation.

### **1. Decision Making:**

The primary task of an entrepreneur is to decide the policy of production. An entrepreneur is to determine what to produce, how much to produce, how to produce, where to produce. Moreover, he is to decide the scale of production and the proportion in which he combines the different factors he employs.

### **2. Management Control**

Earlier writers used to consider the management control one of the chief functions of the entrepreneur. Management and control of the business are conducted by the entrepreneur himself. So, the latter must possess a high degree of management ability to select the right type of persons to work with him. But, the importance of this function has declined, as business nowadays is managed more and more by paid managers.

### **3. Division of Income**

The next major function of the entrepreneur is to make necessary arrangement for the division of total income among the different factors of production employed by him. Even if there is a loss in the business, he is to pay rent, interest, wages and other contractual incomes out of the realized sale proceeds.

#### **4. Risk-Taking and Uncertainty-Bearing**

Risk-taking is perhaps the most important function of an entrepreneur. Modern production is very risky as an entrepreneur is required to produce goods or services in anticipation of their future demand. Broadly, there are two kinds of risk which he has to face. Firstly, there are some risks, such as risks of fire, loss of goods in transit, theft, etc., which can be insured against. These are known as measurable and insurable risks. Secondly, some risks, however, cannot be insured against because their probability cannot be calculated accurately. These constitute what is called uncertainty (e.g., competitive risk, technical risk, etc.). The entrepreneur undertakes both these risks in production.

#### **5. Innovation**

Another distinguishing function of the entrepreneur, as emphasized by Schumpeter, is to make frequent inventions — invention of new products, new techniques and discovering new markets — to improve his competitive position, and to increase earnings. At a time when policy makers are pooling efforts to restore growth and overcome the global economic and financial crisis, specific attention has been focused on innovative entrepreneurship, as it can play an important role in contributing to economic growth, job creation and poverty reduction, and can help address key social challenges.

### **3.2.3 TRAITS OF AN ENTREPRENEUR**

Across all industries, and among all types of small business owners, there's one thing no one can argue: there are specific traits that make successful entrepreneurs. Whether those traits are innate or developed over time remains the unanswerable question. And while how a business owner chooses to use these characteristics may vary, the fundamental elements are the same across the board.

1. **Mental ability:** Mental ability consists of intelligence and creative thinking. An entrepreneur should possess the ability to analyze problem and to find out

solutions. He should anticipate changes and make decisions to cope with them. He must be optimistic.

2. **Looking for opportunities:** Entrepreneur is the person who looks for opportunities, and whenever he finds an opportunity he will take adequate steps to make use of the opportunity.
3. **Persistence:** Entrepreneur should make continuous or repeated efforts to overcome the obstacles in the way of achieving the goals. The Japanese —fall seven times; stand up eight is applicable in the case of entrepreneurs.
4. **Self-confidence:** It is the most important factor to overcome difficulties. An entrepreneur is the person who has confidence in his abilities and skills. It enables him to overcome the risks and uncertainties in business.
5. **Motivation:** As the top level executive, the entrepreneur must motivate his subordinates to achieve the goals.
6. **Self-Awareness:** Entrepreneurs who have a sense of self-awareness that they are able to apply professionally to achieve business success. When an entrepreneur is self-aware they are able to own up to their strengths and weaknesses related to running their business.
7. **Future foresight:** The entrepreneurs have good foresight to know about the future market development and the external business environment. He can take proper decision according to the market situations and market changes. This also helps them to take timely actions.
8. **Highly Optimistic:** An entrepreneur always thinks positive in all the activities. He is always optimistic with the market situations even in failure times. Such positive attitude helps the enterprise to run successfully.

9. **Communication Skills:** This refers to communicate effectively. It is very important that the sender and receiver of the message are being understood perfectly. An entrepreneur has to communicate to various parties i.e. customers, suppliers, creditors, employees, etc.
  
10. **Creativity:** Creativity is the ability to bring something new into existence. Innovation is the process of doing new things, and creativity is a prerequisite to innovation. An entrepreneur should be creative, because ideas usually evolve through creative process whereby imaginative people bring them into existence, grow them and develop them positively.
  
11. **They Don't Fear Risks:** By its very nature, entrepreneurship is risky. There's no guarantee business will succeed, so an entrepreneur takes a chance that his idea will be one that makes it. He's willing to take risks because he sees the bigger picture of what this idea could become, and is willing to put the money and effort into making his dreams a reality. This embracing of risk may seem foolhardy to most, but remember Trait 1 and know that an entrepreneur never jumps into risk without doing his due diligence.
  
12. **They Love What They Do:** Entrepreneurs tend to launch businesses in fields they are passionate about or know a lot about. An entrepreneur could talk for hours about what he does, much to the dismay of everyone else at the cocktail party. The reason he quit his last job is likely tied to his desire to do something he loved (and run the company himself). It's not surprising that many entrepreneurs end up launching businesses completely different from the experience they've gained professionally. We've all heard of the accountant who decided to open a vineyard and make wine example.
  
13. **They Are Experts:** Because entrepreneurs love what they do and live it, they, by proxy, become experts in their field. If they choose the public path, they share this knowledge through writing and speaking engagements. They may author books or contribute their expertise on the company blog. At the very least, a conversation with an entrepreneur can tell you everything you ever

wanted to know about his industry, which can be a very appealing marketing tool.

14. **They Make Themselves Available:** Though their schedules might be jam-packed, entrepreneurs tend to be more open to casual chats—be it with an employee, a customer, a reporter, or just someone who wants to learn more. They are interested in others, which is why they enjoy talking to as many people as they can, at trade shows and industry events, conferences, and even their own office.

15. **They Never Stop Learning:** Entrepreneurs are a curious breed. Meaning: they constantly thirst for answers. They read stacks of books (or the digital equivalent of a stack of books). They devour magazines and blogs. They attend conferences to learn more about their industries. An entrepreneur knows the value of learning, and knows he'll never learn everything there is to know. He recognizes the value of education.

### **3.2.4 TYPES OF ENTREPRENEURS**

In the initial stages of economic development, entrepreneurs tend to have less initiative and drive. As development proceeds, they become more innovating and enthusiastic. The various types of entrepreneurs are classified on certain parameters. Some important classifications are described below:

#### **1. On the Basis of Economic Development:**

Clarence Danhof classified entrepreneurs into four groups on the basis of economic development.

A. **Innovating Entrepreneurs:** They are the entrepreneurs who have creative and innovative ideas of starting a new business. An innovating entrepreneur sees the opportunity for introducing a new technique or a new product or a new market. He may raise money to launch an

E. IT Entrepreneurs: IT entrepreneurs are creating a new business platform that takes them straight to the top. They are confident, ambitious innovative and acquired creativity in the competitive global environment and created a niche of their self. They are the brave new bunch of entrepreneurs who are raring to take on the world of information technology.

### **3.3 ENTREPRENEURIAL DEVELOPMENT PROGRAMME (EDP)**

EDP is a programme meant to develop entrepreneurial abilities among the people. In other words, it refers to inculcation, development, and polishing of entrepreneurial skills into a person needed to establish and successfully run his / her enterprise. Thus, the concept of entrepreneurship development programme involves equipping a person with the required skills and knowledge needed for starting and running the enterprise.

According to N. P. Singh (1985), —Entrepreneurship Development Programme is designed to help an individual in strengthening his entrepreneurial motive and in acquiring skills and capabilities necessary for playing his entrepreneurial role effectively. It is necessary to promote this understanding of motives and their impact on entrepreneurial values and behavior for this purpose. Now, we can easily define EDP as a planned effort to identify, inculcate, develop, and polish the capabilities and skills as the prerequisites of a person to become and behave as an entrepreneur.

The major objectives of the Entrepreneurship Development Programme (EDPs) are to:

- a) Develop and strengthen the entrepreneurial quality, i.e. motivation or need for achievement.

- b) Analyze environmental set up relating to small industry and small business.
- c) Select the product.
- d) Formulate proposal for the product.
- e) Understand the process and procedure involved in setting up a small enterprise.
- f) Know the sources of help and support available for starting a small scale industry.
- g) Acquire the necessary managerial skills required to run a small-scale industry.
- h) Know the pros and cons in becoming an entrepreneur.

### **3.3.1 Special agencies for Entrepreneurial development and training**

Entrepreneurship development institutions are those which are engaged in identifying and selecting prospective entrepreneurs and giving training to them. Finance is a key factor for entrepreneurship development. But money alone cannot materialize that objective. Hence, it is imperative that prospective entrepreneurs should be motivated to start their own entrepreneurs.

In India, there are both private and government agencies involved in entrepreneurial training. Till independence only some private institutions were engaged in entrepreneurship development programs. After independence, the government of India relies that the key role of entrepreneurship in the economic development of the country. So it has been decided to assist the potential

entrepreneurs through several programme. These programs are mainly meant for small scale and other entrepreneurs.

Several private and public institutions are now engaged in entrepreneurial development programs. They are described below:

### **1. DEVELOPMENT BANKS**

Development banks normally provide medium and long-term funds to industrial enterprises. The working capital needs of the units are met by commercial banks. They are financial institutions which provide vital inputs such finance, and development assistance to the entrepreneur. The role of Development Banks is more pronounced in developing countries where governments have taken upon themselves the task of accelerating the pace of economic development.

#### **Features**

- a. Development Bank does not accept deposits from the public like commercial banks and other financial Institutions who entirely depend upon saving mobilization.
- b. It is a specialized financial institution which provides medium term and long term lending facilities.
- c. It provides financial assistance to both private as well as public sector institutions.
- d. The objective of this bank is to serve Public Interest rather than earning profits.

### **2. TECHNICAL CONSULTANCY ORGNISATIONS (TCOs)**

Technical Consultancy Organization (TCOs) was established in different parts of the country to provide consultancy services to small and medium enterprise at

reasonable costs. The entrepreneurs require high quality technical consultancy service to improve their operational, efficiency and product quality. All India financial institutions have set up technical consultancy originations in many part of the country to impart consultancy services in technical matters and training to small entrepreneurs. At present, there are 17 TCOs operating in the various states, some of them covering more than one state.

The following are the important functions performed by the TCOs:

- i) Identifying the potential industries having the chances to develop.
- ii) Analysing the feasibility of the project for investment purposes
- iii) Conducting market research.
- iv) Offering merchant banking services
- v) Conducting entrepreneurship development programme.
- vi) Providing post-training counseling and guidance in business matters.

### **3. NATIONAL INSTITUTE OF ENTREPRENEURSHIP AND SMALL BUSINESS DEVELOPMENT (NIESBUD)**

The National Institute for Entrepreneurship and Small Business Development is a premier organization of the Ministry of Skill Development and Entrepreneurship, engaged in training, consultancy, research, etc. in order to promote entrepreneurship and Skill Development. The major activities of the Institute include Training of Trainers, Management Development Programs, Entrepreneurship-cum-Skill Development Programs, Entrepreneurship Development Programs and Cluster Intervention.

It is a society under Government of India Society Act of 1860. The major activities of institute are:

- o Make effective strategies and methods
- o To standardize model syllabus for training
- o To develop training aids, tools and manuals
- o To conduct workshops, seminars and conferences.
- o To evaluate the benefits of EDPs and promote the process of Entrepreneurial Development.
- o To undertake research and development in the field of EDPs.

#### **NATIONAL RURAL EMPLOYMENT GUARANTEE ACT (NREGA)**

Mahatma Gandhi Employment Guarantee Act 2005 (later renamed as the “Mahatma Gandhi National Rural Employment Guarantee Act” or MGNREGA), is an Indian labor law and social security measure that aims to guarantee the ‘right to work’. This act was passed in September 2005 under the UPA government of Prime Minister Dr.Manmohan Singh.

It aims to enhance livelihood security in rural areas by providing at least 100 days of wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work.

The MGNREGA was initiated with the objective of “enhancing livelihood security in rural areas by providing at least 100 days of guaranteed wage employment in a financial year, to every household whose adult members volunteer to do unskilled manual work”. Another aim of MGNREGA is to create durable assets (such as roads, canals, ponds and wells). Employment is to be provided within 5 km of an applicant’s residence, and minimum wages are to be paid. If work is not provided within 15 days of applying, applicants are entitled to an unemployment allowance. That is, if the government fails to provide employment, it has to provide certain unemployment allowances to those people. Thus, employment under MGNREGA is a legal entitlement.

#### **4. SMALL INDUSTRIES SERVICE INSTITUTES (SISI)**

The small industries service institutes (SISI’s) are set-up one in each state to provide consultancy and training to small and prospective entrepreneurs. The

activities of SISs are co-ordinate by the industrial management training division of the DC, SSI office (New Delhi). Now the SISIs have branches in all states.

### **Functions**

- o To serve as an interface between central and state governments
- o To render technical support services.
- o To conduct entrepreneurship development programs.
- o To initiate promotional programs.
- o Small industries development organization (SIDO)

SIDO was established in October 1973 now under Ministry of Trade, Industry and Marketing.

SIDO is an apex body at Central level for formulating policy for the development of Small Scale

Industries in the country, headed by the Additional Secretary & Development Commissioner (Small Scale Industries) under Ministry of Small Scale Industries Govt. of India. SIDO is playing a very constructive role for strengthening this vital sector, which has proved to be one of the strong pillars of the economy of the country. SIDO also provides extended support through Comprehensive plan for promotion of rural entrepreneurship.

### **5. NATIONAL SMALL INDUSTRIES CORPORATION LTD. (NSIC)**

The NSIC was established in 1995 by the Central Government with the objective of assisting the small industries in the Government purchase Programme. The Corporation provides a vast market for the products of small industries through its

marketing network. It also assists the small units in exporting their products in foreign countries.

#### **6. CENTRE FOR ENTREPRENEURSHIP DEVELOPMENT (CED)**

The Centre for Entrepreneurship Development (CED), FORE aims to promote Entrepreneurship amongst the management students by creating a conducive ecosystem for the students to develop their creative ideas into brilliant business plans such that they are motivated to come up with their own start-ups.

### **3.3.3 ENTREPRENEURIAL DEVELOPMENT PROGRAM IN KERALA**

#### **Kerala Institute For Entrepreneurship Development (KIED)**

Department of Industries & Commerce, Government of Kerala formulated a scheme to set up Entrepreneurship Development Clubs in schools and colleges of the State to inculcate Entrepreneurial Culture amongst youth and equip them with the skills, techniques and confidence to act as torch-bearers of Enterprise for the new generation. The objectives of Entrepreneurship Development Club are to inculcate entrepreneurship qualities, to sensitive industrial scenario of the state, to nurture the latent entrepreneurial talent, develop awareness among its members of the attitudes, values, and skills of successful entrepreneurs around the globe etc.

Promoted by the Government of India and Government of Kerala and registered under the Travancore-Cochin Literacy, Scientific and Charitable Societies Registration Act, KIED aims to provide Human Resources Development in the area of entrepreneurship development

## ❖ **Training programmes**

### **i. EIW and ToT: TRAIN THE MENTORS**

In both EMPERTEC Inter-phase workshop (EIW) and ToT workshop envisaged by United Nations Conference on Trade and Development (UNCTAD) and International Labour Organization (ILO) respectively, officers of the Department of Industries and Commerce in Government of Kerala participated. EIW was a three-phase workshop in the development of the said officers as mentors who could train young people by identifying their entrepreneurial skills and molding it through behavioral approach.

### **ii. SIYB: Setting people for the Task**

Association with International Labor Organization was vital in devising another important programme for budding entrepreneurs. This was called SIYB (Start and Improve Your Business). The focus of SIYB was the economy in transition both in the nation and in the state. What would be opportunities created by the newer economic policies? What would be the demands in the market? On the basis of these questions, mentors and trainers selected through EIW and ToT programs gave training to budding entrepreneurs about starting a new venture by locating the needs and demands in the market as well as improving it by optimizing their productivity.

### **iii. Making the Most of the Current Pool**

KIED has been instrumental in giving maximum exposure to the officers in the Department of Industries and Commerce so as to upgrade their skills. It has conducted WPEC (Workshop on personal entrepreneurial characteristics) awareness classes for Entrepreneurship Development clubs and orientation programs. Every year, KIED conducts Induction Training for Industries Extension Officers of the Department for a duration of 4 and a half month. KIED has associated with National Institute for Micro Small and Medium Enterprises,

headquartered in Hyderabad. Besides, KIED is giving refresher training programs to the Middle-Level Officers for the enhancement of their proficiency. KIED also conducts training programs sponsored by KSIDC, Women Development Corporation, and Coir Board, ANERT.

All these programs are mainly aimed at the enhancement of the skill of all level entrepreneurs in small-scale and medium enterprises.

### ❖ MAJOR PROGRAMS

- i. Skill Development Programme for Tribal Women, Kozhikode District District wise Entrepreneurship Development Training Programme for Women
- ii. District wise Entrepreneurship Development Training Programme for Widows.
- iii. Workshop on Personnel Entrepreneurial Competencies (WPEC) for ED Club Students & Co-ordinators.
- iv. Refresher Training to Industries Department officers
- v. Handloom Short Term Training for Cooperative Inspectors Handloom
- vi. Etiquette Training to Industries Department Officers Job Induction Training to Industries Extension Officers
- vii. Entrepreneurship Development Training for Colleges.

### **3.3.4 Entrepreneurial development schemes to new Entrepreneurs in Ernakulam district**

#### **Entrepreneur Support Schemes Register Progress**

A total of 2338 new small and micro enterprises in Ernakulam district generated 13,529 employment Opportunities during 2015 – 16 from a total investment of Rs.369.44 crore.

The district saw the registration of 2,167 new enterprises after the UdyogAadhar scheme came into effect in September 2015.

A review of the operations of the District Industries Centre (DIC) for the last financial year said Entrepreneur support programmes under the prime Minister's Employment Generation Programme (PMEGP) and the state government's Entrepreneur support Scheme has shown considerable Progress in the district.

### **Funds**

The DIC distributed Rs.6.39 crore under the state government scheme and Rs.66.83 lakh in subsidy under the PMEGP during the last financial year.

The DIC received a total of 200 applications under the state government scheme for which a total of Rs.8.74crore was sanctioned during the last financial year.

Of them, 92 entrepreneurs were given the support money, according to the review.

### **Cooperative societies**

The DIC also identified 38 sick enterprises for last year for which help is being extended for rivival and rehabilitation.

The center has also been successful in coming to the aid of cooperative societies.

There are around 2500 workers in the industrial cooperatives in the district.

The total of 21 handloom cooperative societies, 36 handicraft cooperatives and 228 cooperatives in Other sector have been registered in the district.

Of them, 13 handloom societies are in operation and eight are not operational. One of these is on the verge of liquidation.

Among the handicraft societies, 21 were not functional, said the review report.

### **Industrial Clusters**

The district has also been on the forefront of industrial cluster development.

There are six clusters in various sectors in operation.

There are a total of 215 members registered in these industrial clusters.

## **CHAPTER – 4**

### **ANALYSIS AND INTERPRETATION**

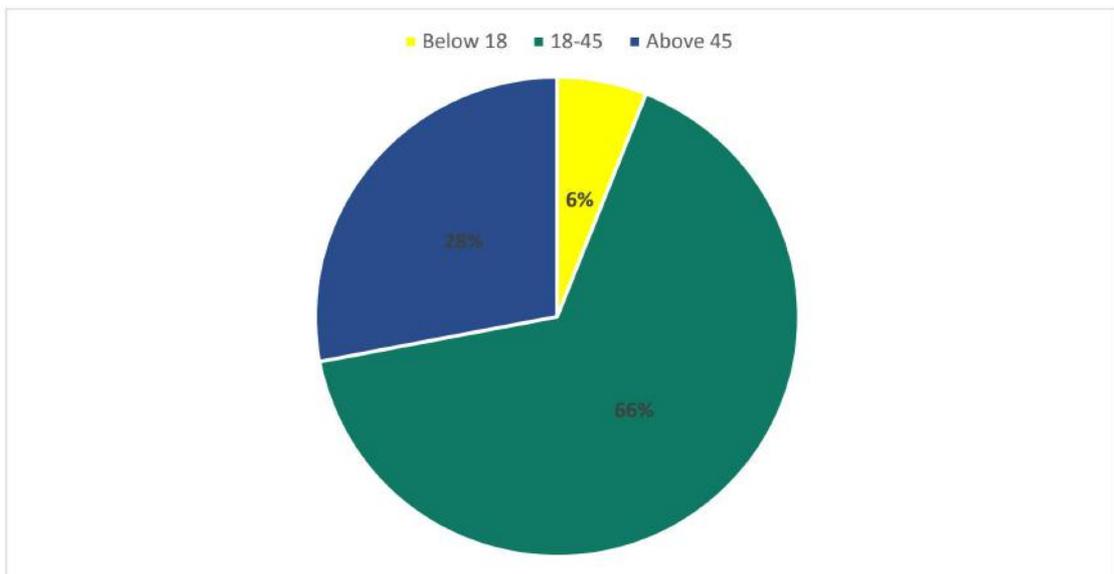
## **AGE GROUP OF RESPONDENTS**

<b>Age</b>	<b>No. of respondents</b>	<b>Percentage</b>
Below 18	3	6%
18 – 45	33	66%
Above 45	14	28%
Total	50	100%

**Table no. 4.1 age of respondents**

Source: Primary Data

**Figure 4.1 age of respondents**



Source table : 4.1

## **INTERPRETATION**

Among the 50 candidates 66% are between the age group 18-45 years. 28% are above the age 45. And the rest 6% are below the age 18.

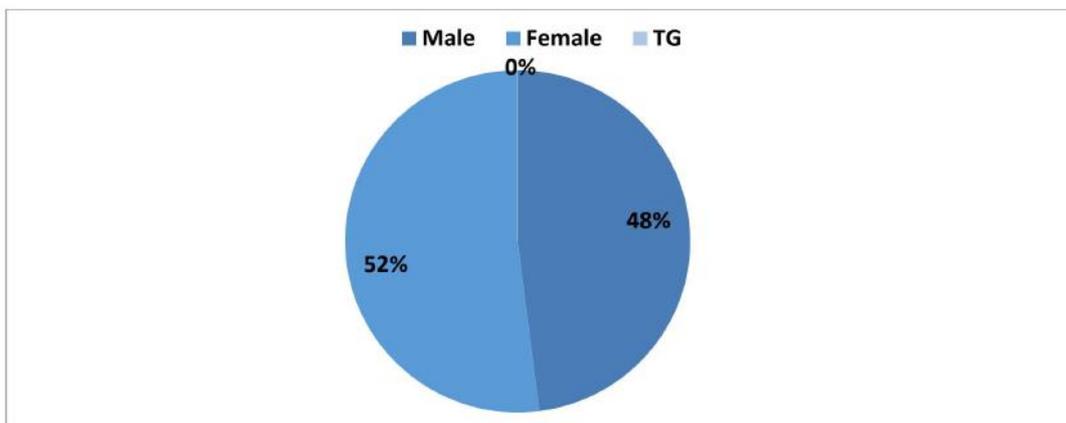
## GENDER OF THE RESPONDENTS

**Table no. 4.2 Gender**

Gender	No. of respondents	Percentage
Male	24	48%
Female	26	52%
TG	Nil	Nil
Total	50	100%

Source: Table 4.2

**Figure 4.2 Gender**



Source: Table 4.2

## INTERPRETATION

Among the 50 candidates of this survey, 52% of the respondents are Female and the rest 48% are Male.

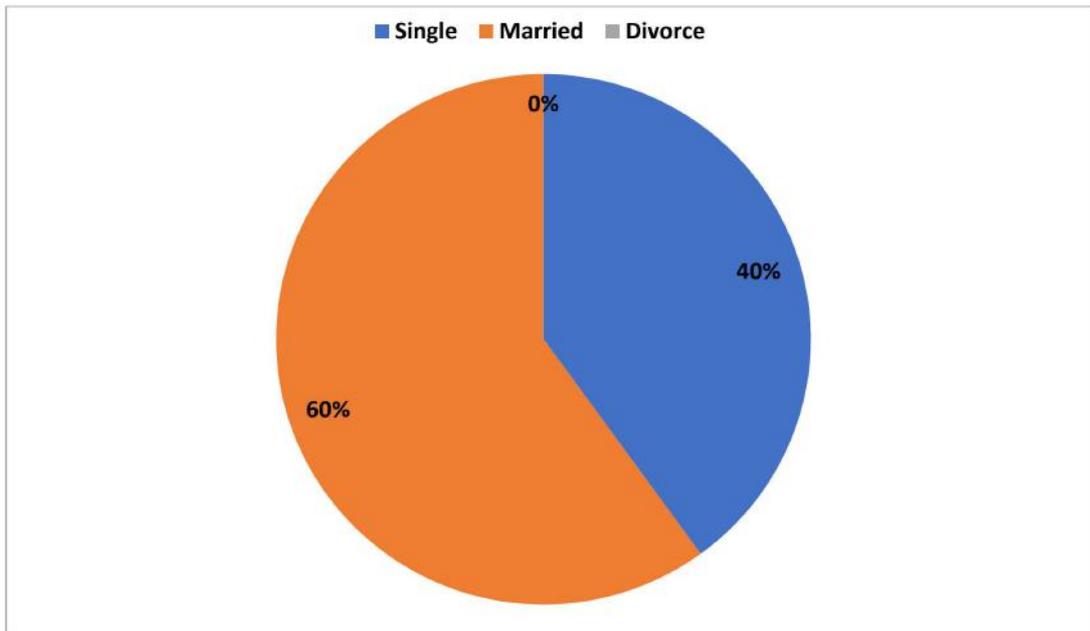
## MARITAL STATUS OF RESPONDENTS

Table no. 4.3 Maritalstatus

Respondents	No. of respondents	Percentage
Single	20	40%
Married	30	60%
Divorce	Nil	Nil
Total	50	100%

Source: Primary data

**Figure 4.3 Marital status**



Source: Table 4.3

## INTERPRETATION

From the above table it can be inferred that among all the respondent 60% of them are married and 40% of them are single. There were no divorcees.

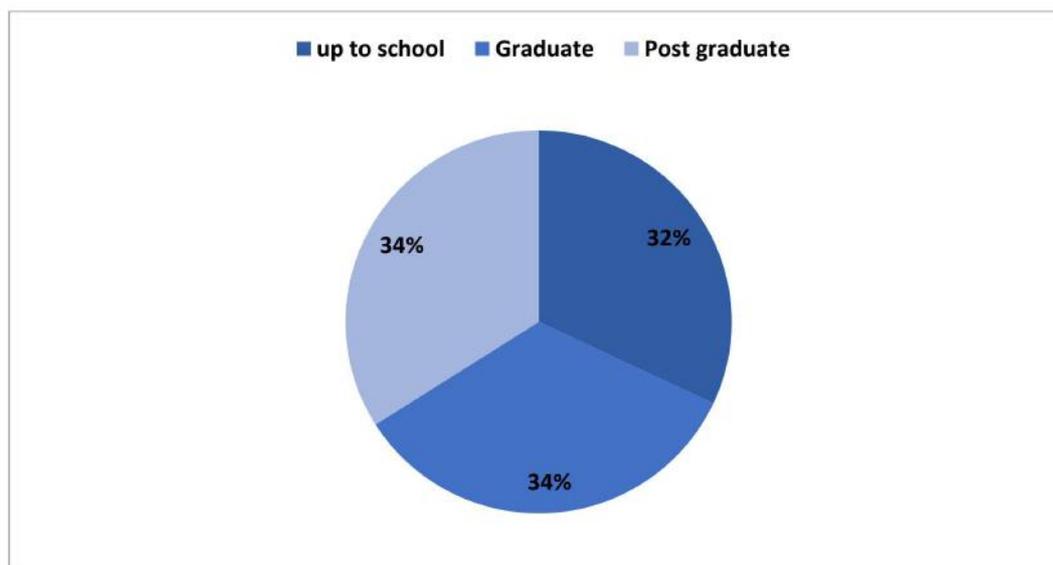
## **EDUCATIONAL QUALIFICATION OF THE RESPONDENTS**

**Table no. 4.4 Qualification of respondents**

<b>Qualification</b>	<b>No. of respondents</b>	<b>Percentage</b>
Up to school	16	32%
Graduate	17	34%
Post graduate	17	34%
Total	50	100%

Source: Primary Data

**Figure 4.4 Qualification of respondents**



Source : Table 4.4

### **INTERPRETATION**

Out of the 50 respondents, 34% was qualified to post graduation. Another 34% of the respondents had done their graduation. And the rest 32% had completed only their school level education.

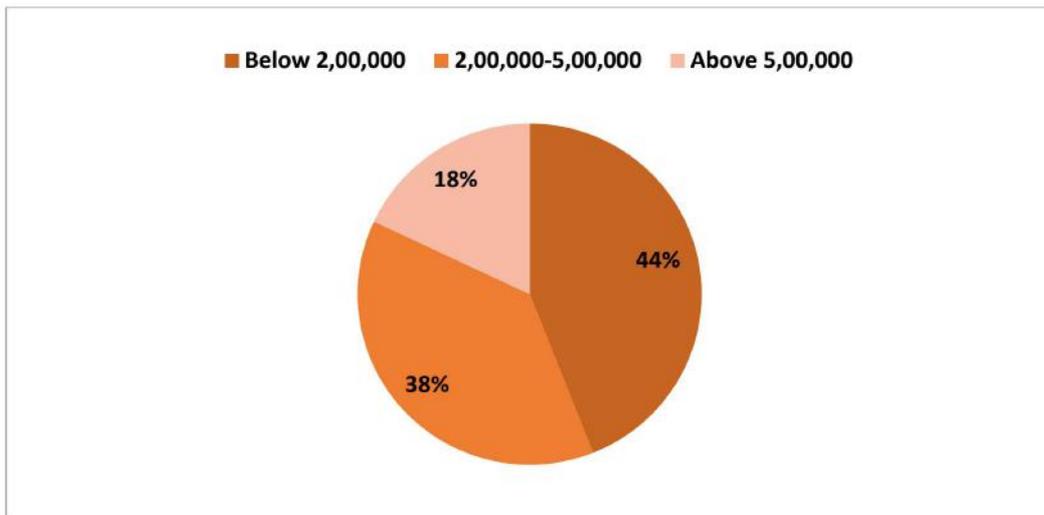
## ANNUAL INCOME OF RESPONDENTS

**Table no. 4.5 Annual income**

<b>Annual income</b>	<b>No. of respondents</b>	<b>Percentage</b>
Below 200000	22	44%
200000 – 500000	19	38%
Above 500000	9	18%
Total	50	100%

Source: Primary Data

**Figure 4.5 annual Income**



Source table: 4.5

## INTERPRETATION

From the table given above 44% of the 50 candidates have an annual income below 2 Lakh. 38% of the respondents have income between 2 lakh and 5 lakh. And the rest 18% have an income above 5 lakh.

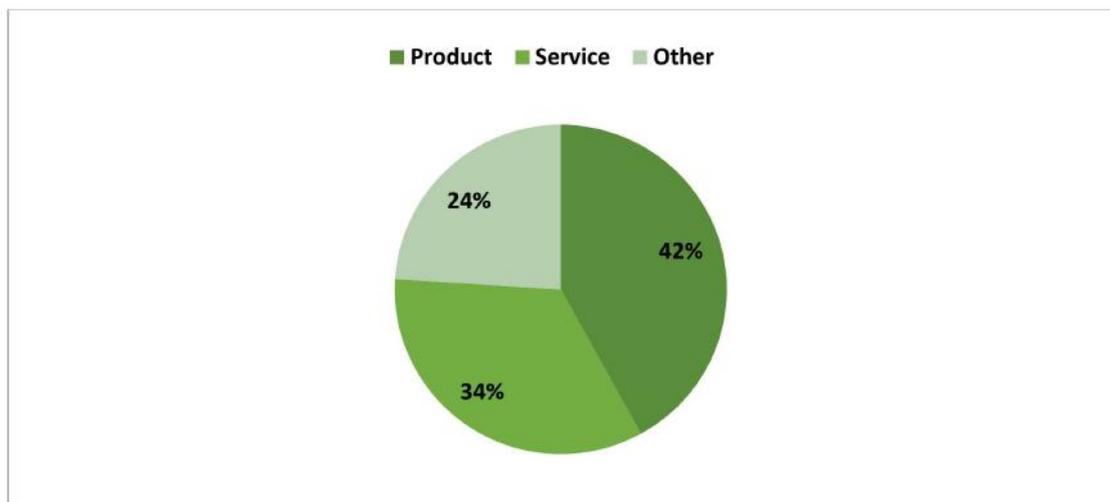
## **TYPE OF BUSINESS OF THE RESPONDENTS**

**Table no. 4.6 Type of Business**

<b>Type of Business</b>	<b>No. Of Respondents</b>	<b>Percentage</b>
Product	21	42%
Service	17	34%
Other	12	24%
Total	50	100%

Source: primary data

**Figure 4.6 on the basis of type of business**



Source: Table 4.6

## **INTERPRETATION**

From this table it can be inferred that almost 42% of the respondents are into production. 34% of them are in to the field of service whereas only 24% of them were into other business.

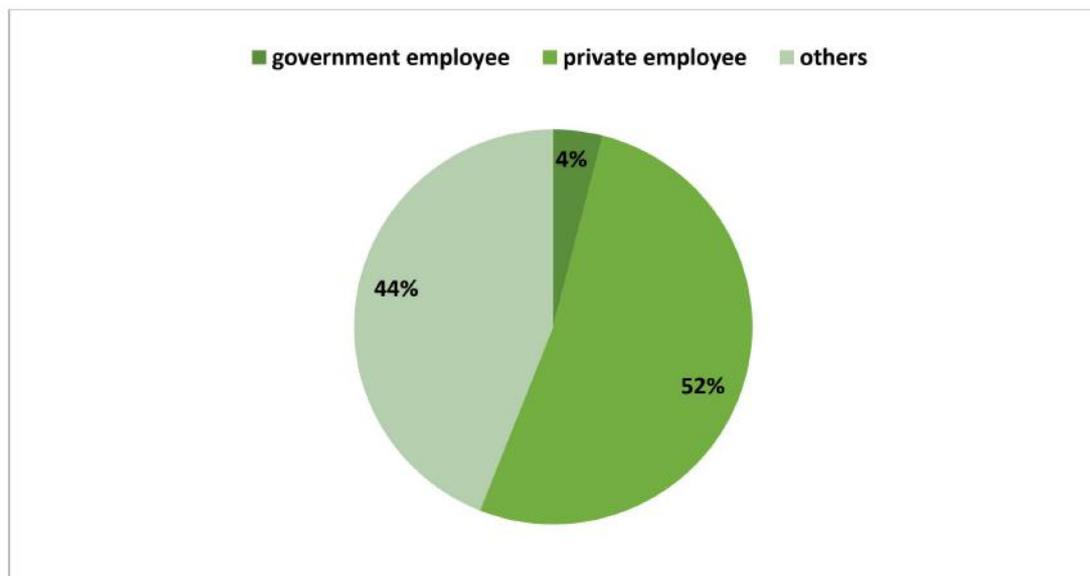
## **EMPLOYMENT OF THE RESPONDENTS**

**Table no. 4.7 on the basis of employment**

<b>Employment</b>	<b>No. of respondents</b>	<b>Percentage</b>
Government employee	2	4%
Private employee	26	52%
Others	22	44%
Total	50	100%

Source: primary data

**Figure 4.7 on the basis of employment**



Source: table 4.7

## **INTERPRETATION**

Out of 50 respondents, it is found that majority 52% of the respondents are private employees. 4% of the respondents are of government employees and the rest of them are in other employments.

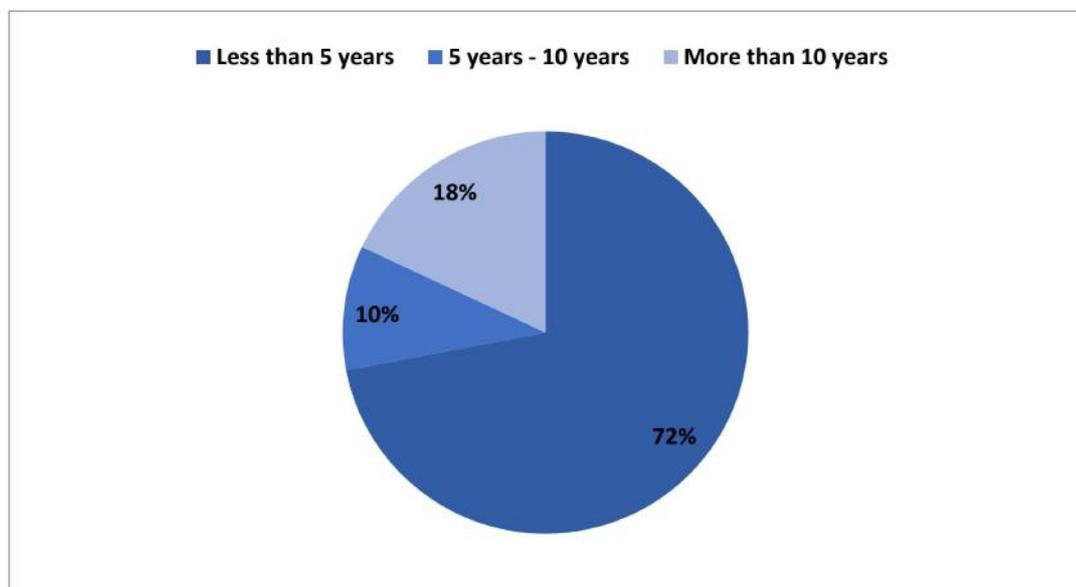
## **TIME PERIOD OF RESPONDENTS AS EMPLOYESS**

**Table no. 4.8 on the basis of no. of years of worked**

<b>Time</b>	<b>No. Of respondents</b>	<b>Percentage</b>
Less than 5 years	36	72%
5 years – 10 years	5	10%
More than 10 years	9	18%
total	50	100%

Source: primary data

**Figure 4.8 on the basis of no. Of years worked**



Source: table no. 4.8

## **INTERPRETATION**

Out of the entire responses majority 72% of the respondents worked for less than 5 years. 10% of the respondents worked for 5 to 10 years and 18% of the respondents worked above 5 years.

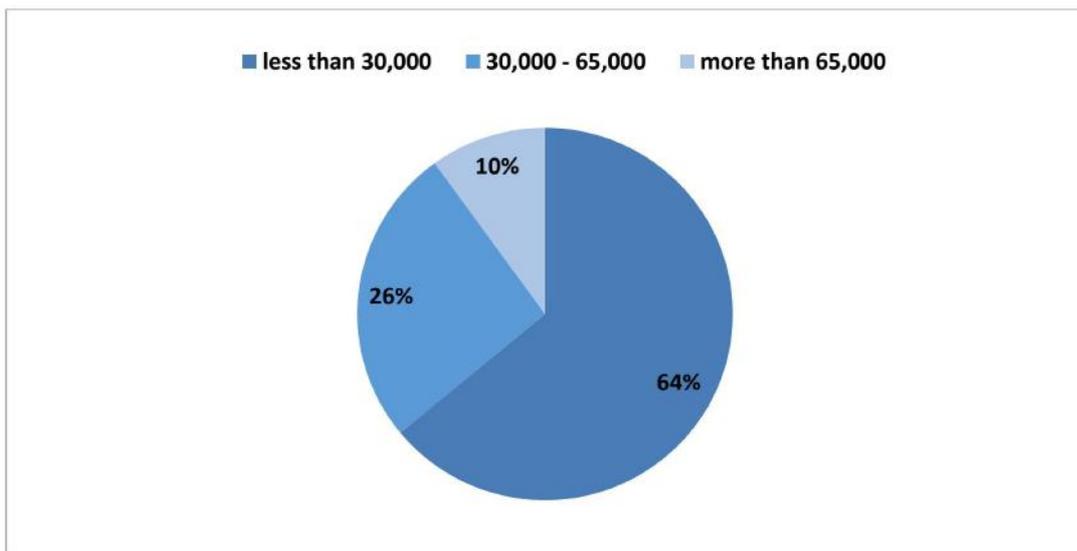
## **REMUNERATION PROVIDED FOR THE RESPONDENTS**

**Table no. 4.9 on the basis of salary received**

<b>Amount of remuneration</b>	<b>No. Of respondents</b>	<b>Percentage</b>
Less than 30,000	32	64%
30,000 - 65,000	13	26%
More than 65,000	5	10%
total	50	100%

Source: primary data

**Figure 4.9 on the basis of salary received**



Source: table no. 4.9

### **INTERPRETATION**

From the table given below, it is found that the respondents of 64% was remunerated less than 30000 and 26% was remunerated between 30000– 65000. The rest 10% was remunerated above 65000 respectively.

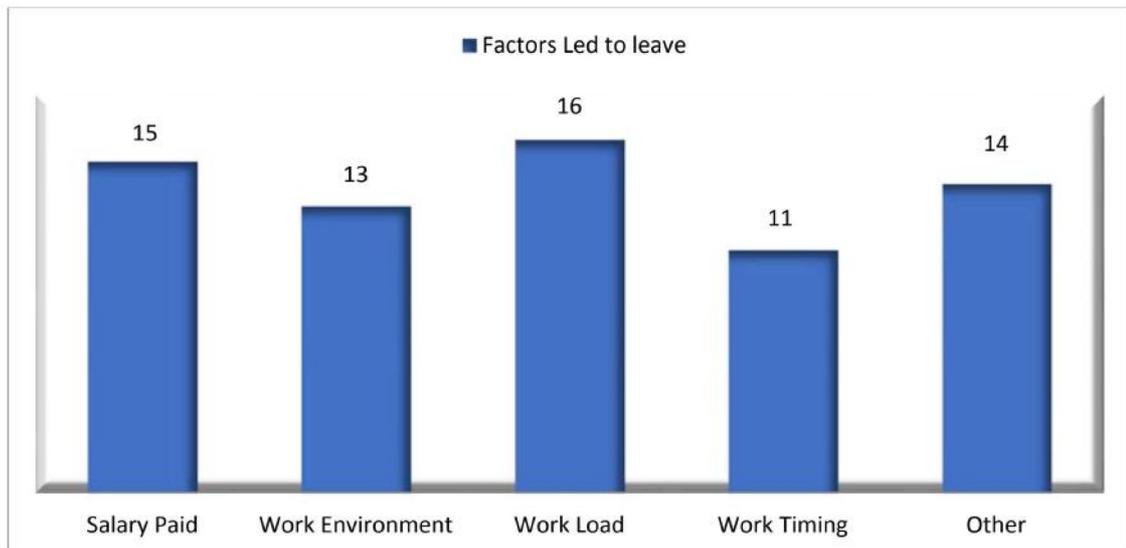
## **FACTORS THAT LED TO LEAVE THE EMPLOYMET**

**Table no. 4.10 on the basis of the factors for leaving the employment**

<b>Factors led to leave</b>	<b>No. Of respondents</b>	<b>Rank</b>
Salary paid	15	2
Work environment	13	4
Work load	16	1
Work timing	11	5
Others	14	3

Source: primary data

**Figure 4.10 on the basis of the factors for leaving**



Source: Table 4.10

## **INTERPRETATION**

Majority of the respondents are leaving their employment due to heavy work load.

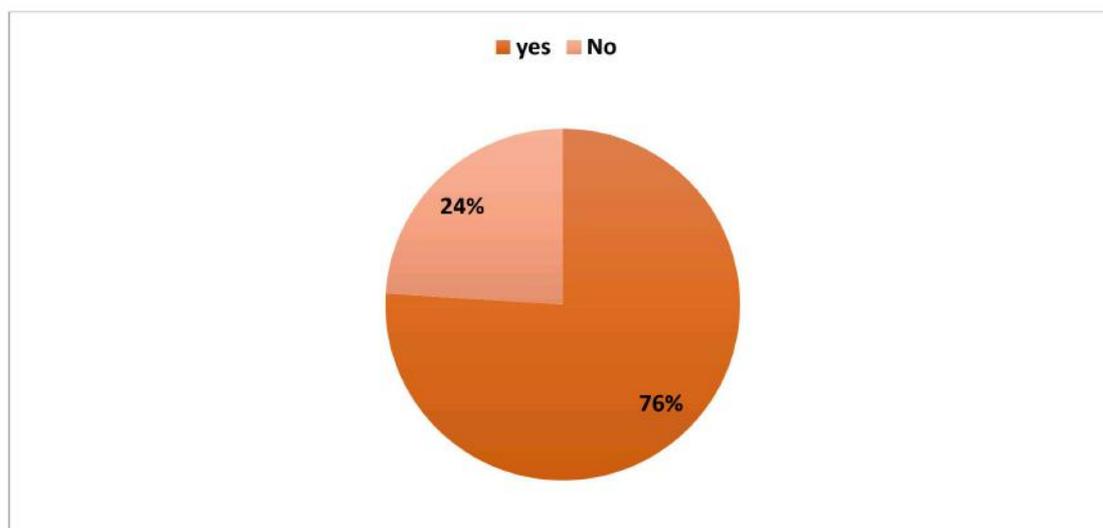
## **REASONS FOR LEAVING THE EMPLOYMENT BEING SIMILAR TO STARTING UP THEIR ON BUSINESS**

**Table no. 4.11 Reasons for leaving the employment being similar to starting up their own business**

<b>Responses</b>	<b>No. of respondents</b>	<b>Percentage</b>
Yes	38	76%
No	12	24%
Total	50	100%

Source: Primary data

**Figure 4.11 Reasons for leaving the employment being similar to starting up their own business.**



### **INTERPRETATION**

From the table given above, majority (76%) of the respondents are leaving the employment to starting up their own business.

## SATISFACTION OF EMPLOYEES IN THE WORKPLACE

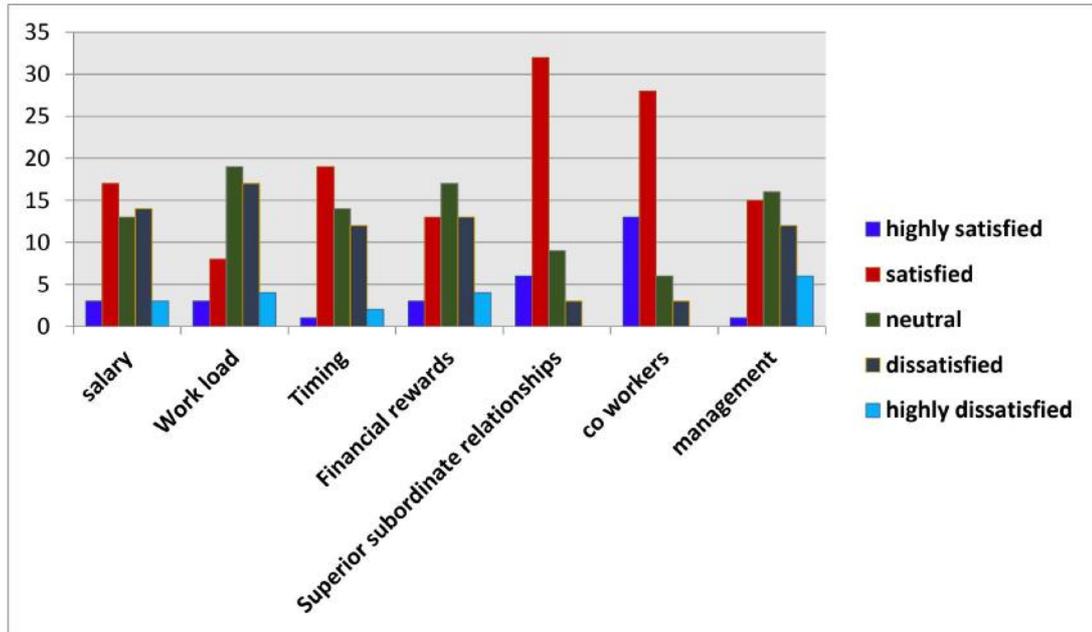
**Table no. 4.12 Satisfaction of employees in the work place**

Showing the satisfaction level of employees on various factors such as salary, management, co-workers, timing, work load, superior subordinate relationship and other financial rewards in the firms they used work as an employee.

Satisfac tion of employees	Highly satisfied	Satisfied	Neutral	Dissatisfied	Highly dissatisfied	Total score	Mean	Rank
Salary	3	17	13	14	3	153	1.53	3
Work load	3	8	18	17	4	142	1.42	7
Timing	1	1	14	12	2	149	1.49	4
Financial Rewards	3	13	17	13	4	148	1.48	5
Superior Subordinate relationships	6	32	9	3	0	191	1.91	2
Co-workers	13	28	6	3	0	201	2.01	1
Management	1	15	16	12	6	143	1.43	6

Source: sorted from Primary data

**Figure 4.12 Satisfaction of Employees in the work place**



Source : Table 4.12

### **INTERPRETATION**

The table observed that, first rank is for Co-workers. Second rank is given to superior subordinate relationship. Next is salary related to employees. 4th rank goes to timing. 5<sup>th</sup> rank is financial rewards. Next is management. The 7<sup>th</sup> rank is for the work load for the Employees.

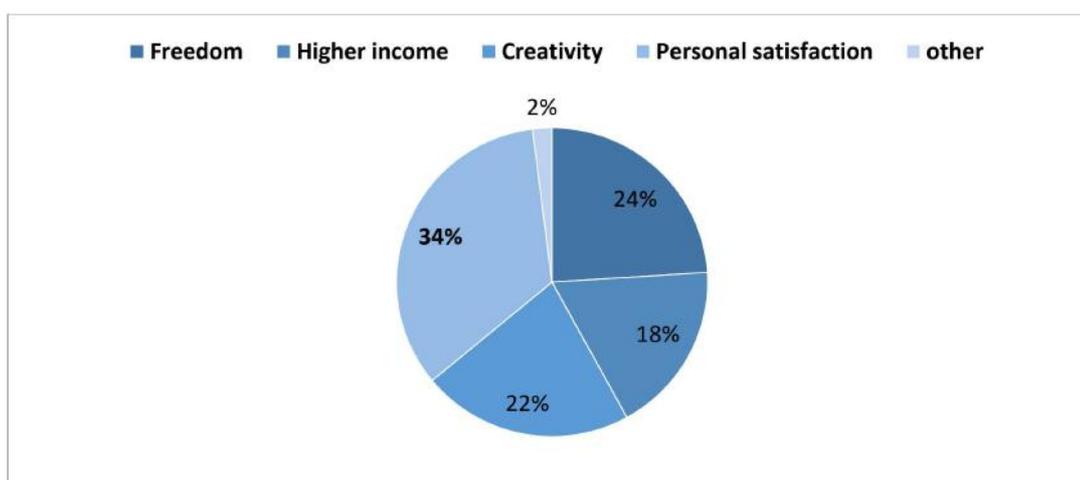
## REASONS THAT MOTIVATED THE RESPONDENTS TO BE AN ENTREPRENEUR

**Table no. 4.13 Motivation for becoming an entrepreneur.**

<b>Responses</b>	<b>No. of respondents</b>	<b>Percentage</b>
Freedom	12	24%
Higher Income	9	18%
Creativity	11	22%
Personal Satisfaction	17	34%
Other	1	2%
Total	50	100%

Source: Primary Data

**Figure 4.13 Motivation for being an entrepreneur.**



Source Table: 4.13

### INTERPRETATION

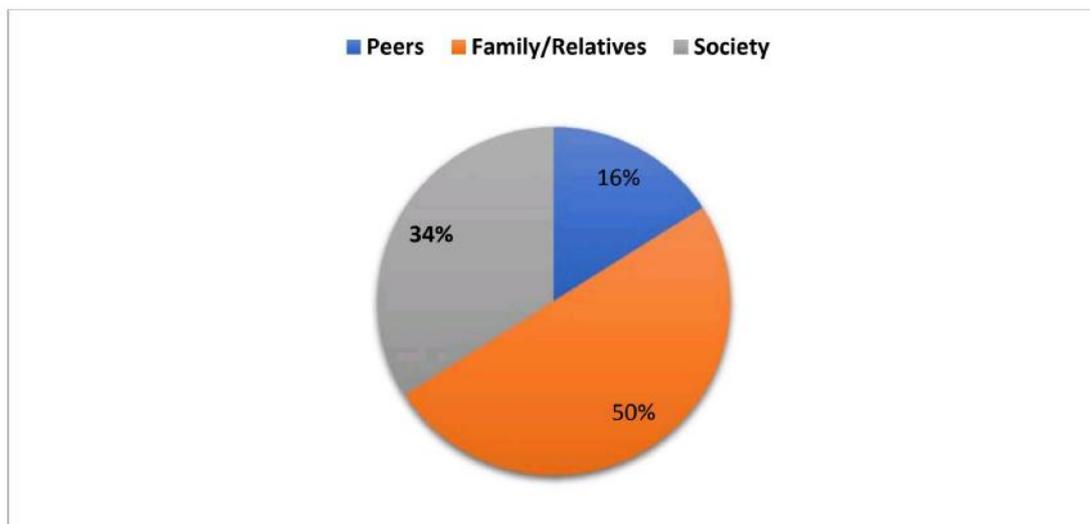
Out of all the respondents, 34% responded personal satisfaction was their main motivation. 24% said that motivation towards entrepreneur was because of the freedom they enjoyed. and 22% said it was because of the creativity that they would use and 18% said motivation was because of the higher income.

## **ORIGIN OF THE IDEA OR CONCEPT OF THE BUSINESS**

**Table no. 4.14 Origin of the idea or concept of the business**

<b>Responses</b>	<b>No. of respondents</b>	<b>Percentage</b>
Peers	8	16%
Family/relatives	25	50%
Society	17	34%
Total	50	100%

**Figure 4.14 Origin of the idea or concept of Business**



Source: table 4.14

### **INTERPRETATION**

We have found that half of the respondent's got the idea from family or relatives and 34% got idea from the society. Rest 16% was got the idea from peers.

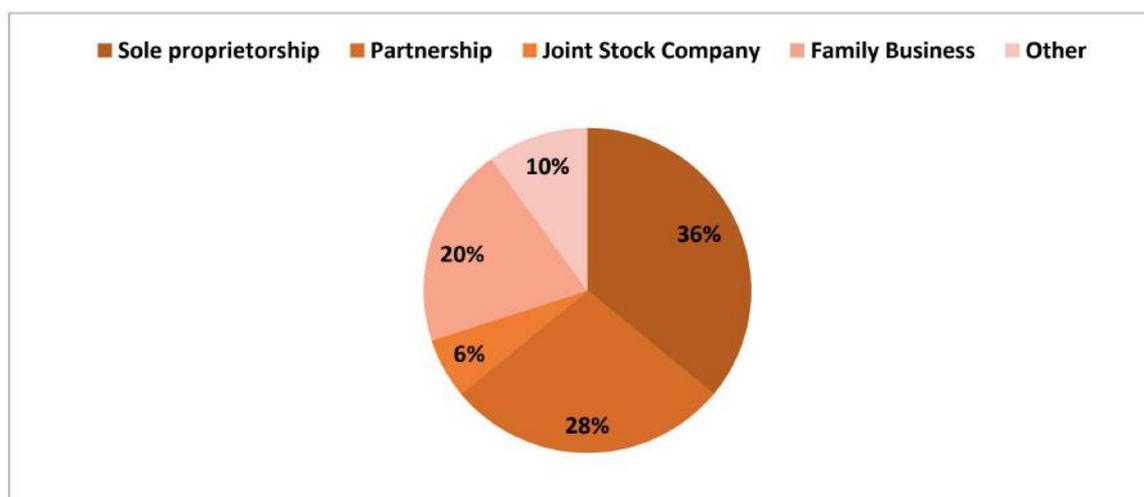
## **FORM OF BUSINESS THAT RESPONDENTS RUNNING**

**Table no. 4.15 Form of business**

<b>Form of business</b>	<b>No. of Respondents</b>	<b>Percentage</b>
Sole Proprietorship	18	36%
Partnership	14	28%
Joint stock company	3	6%
Family business	10	20%
Other	5	10%
Total	50	100%

Source: Primary Data

**Figure 4.15 Form of Business**



Source: Table 4.15

### **INTERPRETATION**

From the table given above inferred that 36% started the business as a sole proprietorship, and 28% started with partnership. Only 6% started the business as a joint stock company. Also 20% started it as a family business.

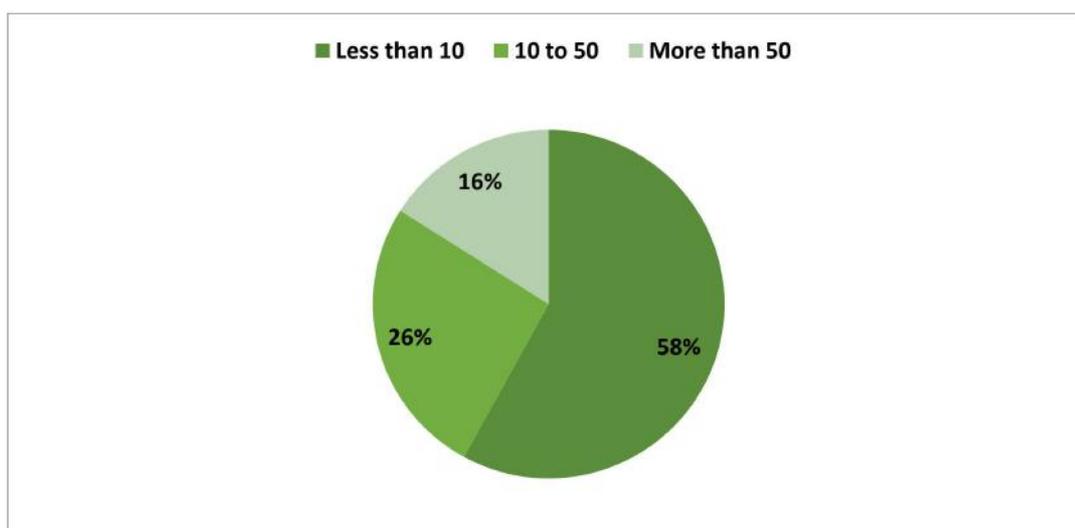
## **THE NO. OF EMPLOYEES EMPLOYEED BY THE RESPONDENT ENTREPRENEURS**

**Table no. 4.16 Number of Employees Employed by the respondents**

No. of Employees	No. of Respondents	Percentage
Less than 10	29	58%
10 – 50	13	26%
More than 50	8	16%
Total	50	100%

Source: Primary Data

**Figure 4.16 No. Of Employees Employed by the respondents**



Source: primary Data

### **INTERPRETATION**

Majority of the respondent entrepreneurs have less than 10 employees. 26% of the respondents have employees between 10 and 50 and the rest of the respondents have more than 50 employees.

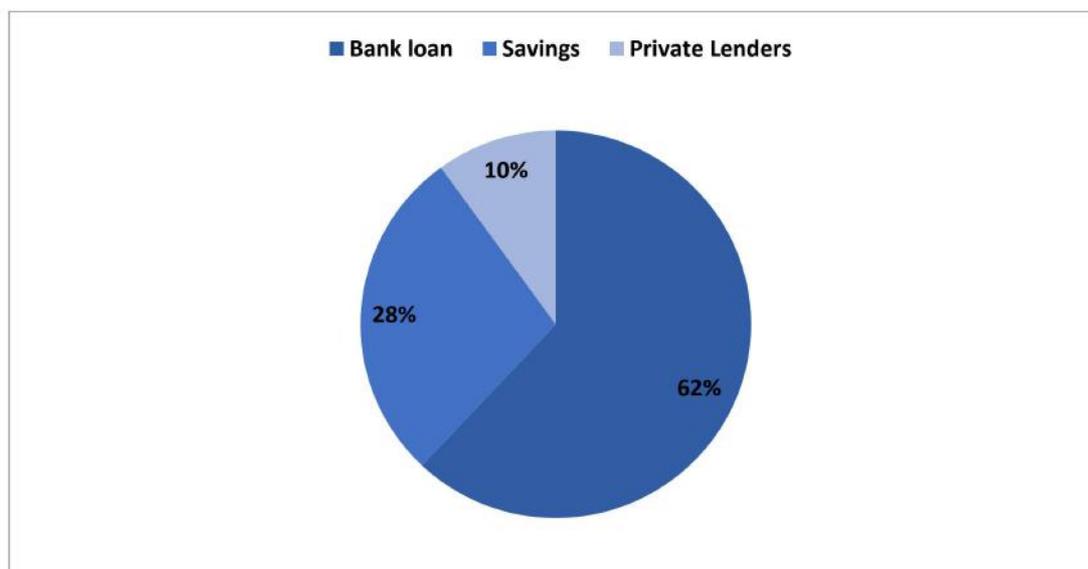
## **THE VARIOUS SOURCES OF CAPITAL FOR THE REAL ENTREPRENEURS**

**Table no. 4.17 Source of capital**

<b>Source of capital</b>	<b>No. of respondents</b>	<b>Percentage</b>
Bank Loan	31	62%
Savings	14	28%
Private Lenders	5	10%
Total	50	100%

Source: Primary Data

**Figure 4.17 Source of capital**



Source: Table 4.17

### **INTERPRETATION**

Among the 50 respondents, almost more than half of the respondents have raised their capital with bank loan, 28% of the respondents have raised their capital with their savings whereas only 10% of the respondents have raised their capital with the help of private lenders.

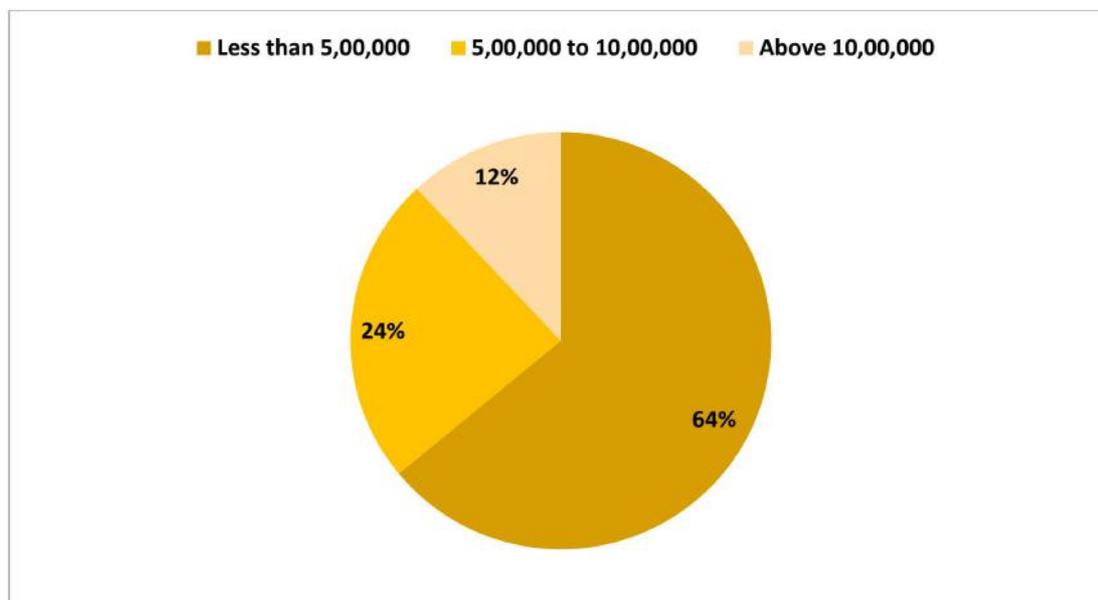
## **THE INITIAL CAPITAL INTRODUCED TO SETUP THE BUSINESS**

**Table no. 4.18 Initial Capitals**

<b>Initial Capital</b>	<b>No. of respondents</b>	<b>Percentage</b>
Less than 5,00,000	32	64%
5,00,000 to 10,00,000	12	24%
Above 10,00,000	6	12%
Total	50	100%

Source: Primary Data

**Figure 4.18 Initial capital**



Source: table no. 4.18

### **INTERPRETATION**

From this table it can be inferred that the initial capital of 32 Respondents were less than 5,00,000 , initial capital of 12 respondents were between 5,00,000 and 10,00,000 and the initial capital of the respondents were more than 10,00,000.

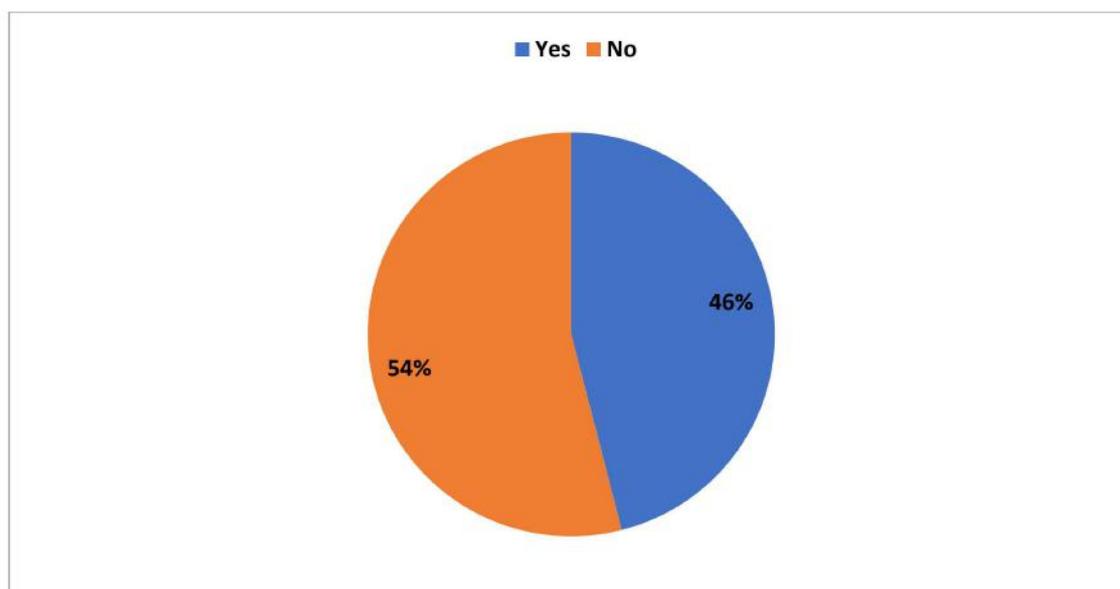
## **NUMBER OF RESPONDENTS WHO RECEIVED GOVERNMENT AID**

**Table no. 4.19 Government Aid received**

<b>Government aid</b>	<b>No. of respondents</b>	<b>Percentage</b>
<b>Yes</b>	<b>23</b>	<b>46%</b>
<b>No</b>	<b>27</b>	<b>54%</b>
<b>Total</b>	<b>50</b>	<b>100%</b>

Source: Primary Data

**Figure 4.19 Government aid received**



Source: Table 4.19

### **INTERPRETATION**

Among the 50 respondents, 27(54%) of the respondents doesn't received any government aid and the rest 23 (46%) respondents had received the Government aid.

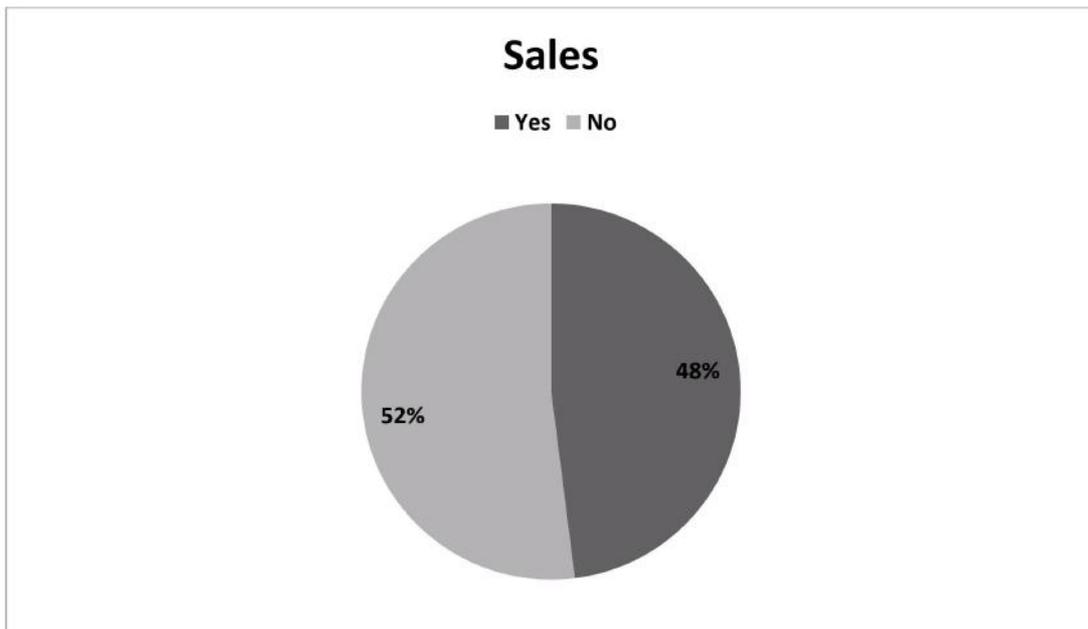
## **DETAILS OF RESPONDENTS WHO ATTENDED FOR ANY EDP PROGRAMMS**

**Table 4.20 Attended for any EDP (Entrepreneurship Development program)**

<b>Attended EDP</b>	<b>No. of Respondents</b>	<b>Percentage</b>
Yes	24	48%
No	26	52%
Total	50	100%

Source: Primary Data

**Figure 4.20 Attended EDP (Entrepreneurship Development Program)**



Source: Table 4.20

### **INTERPRETATION**

Among the 30 Respondents, majority of respondents i.e. 52% have not attended EDP whereas 48% respondents have attended EDP.

## **AWARENESS OF RESPONDENTS ABOUT AGENCIES**

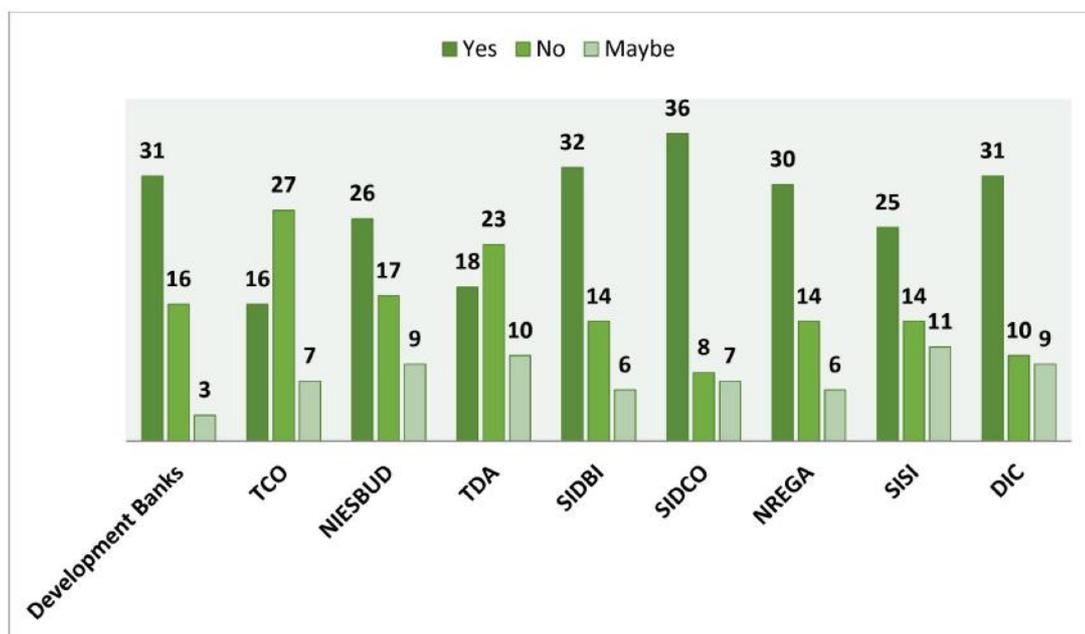
### **PROMOTING ENTREPRENEURSHIP**

**Table 4.21 awareness of agencies and schemes promoting Entrepreneurship**

<b>Agencies/Schemes</b>	<b>Yes</b>	<b>No</b>	<b>Maybe</b>	<b>Total Score</b>	<b>Mean</b>	<b>Rank</b>
Development Banks	<b>31</b>	<b>16</b>	<b>3</b>	<b>128</b>	<b>1.28</b>	<b>3</b>
Technical Consultancy Organization (TCO)	<b>16</b>	<b>27</b>	<b>7</b>	<b>109</b>	<b>1.09</b>	<b>9</b>
National Institute for Entrepreneurship and Small Business Development (NIESBUD)	<b>26</b>	<b>17</b>	<b>9</b>	<b>121</b>	<b>1.21</b>	<b>6</b>
Trade development Authority (TDA)	<b>18</b>	<b>23</b>	<b>10</b>	<b>110</b>	<b>1.10</b>	<b>8</b>
Small Industries Development Bank of India (SIDBI)	<b>32</b>	<b>14</b>	<b>6</b>	<b>130</b>	<b>1.30</b>	<b>2</b>
Small Industries Development Corporation (SIDCO)	<b>36</b>	<b>8</b>	<b>7</b>	<b>131</b>	<b>1.31</b>	<b>1</b>
National Rural Employment Guarantee Act (NREGA)	<b>30</b>	<b>14</b>	<b>6</b>	<b>124</b>	<b>1.24</b>	<b>4</b>
Small Industries service Institute (SISI)	<b>25</b>	<b>14</b>	<b>11</b>	<b>114</b>	<b>1.14</b>	<b>7</b>
District Industries Centre (DICs)	<b>31</b>	<b>10</b>	<b>9</b>	<b>122</b>	<b>1.22</b>	<b>5</b>

Source: Sorted by Primary Data

**Figure 4.21 Awareness of agencies and schemes promoting Entrepreneurship**



Source: Table No.4.21

### **INTERPRETATION**

The most popular agency among the respondents is SIDCO. SIDBI, DIC, Development Banks and NREGA are also known by the respondents, and the most unpopular agency was TCO.

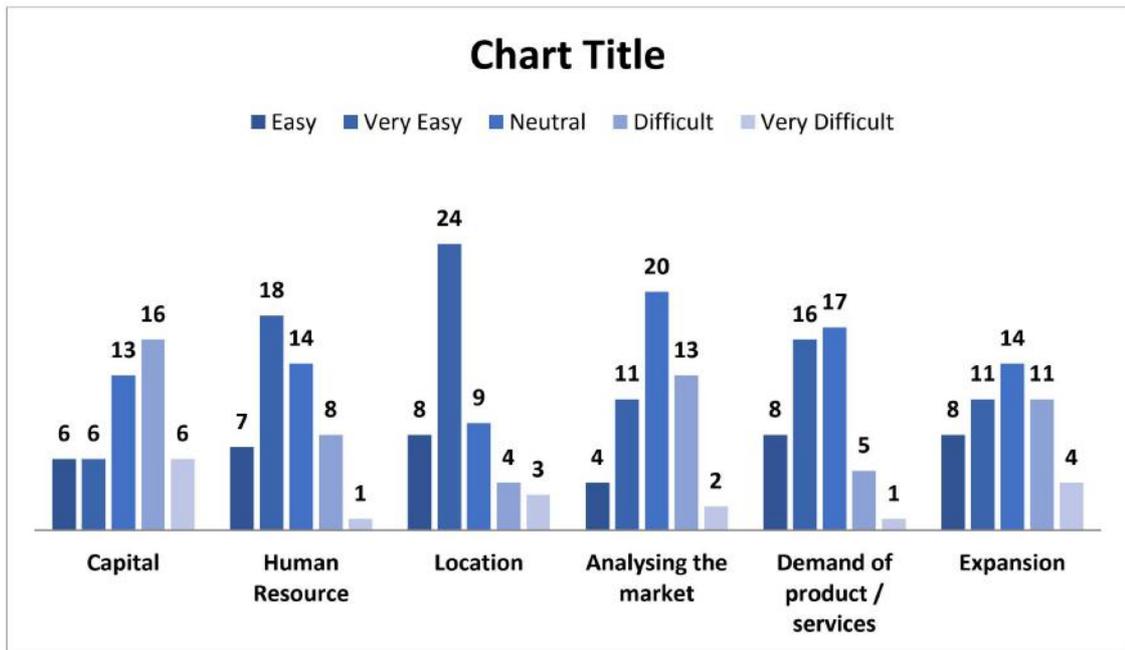
**FACTORS SHOWING THE LEVEL OF DIFFICULTY IN  
SETTING UP AN ENTREPRENEURSHIP**

**Table no. 4.22 Difficulty of setting up an Entrepreneurship**

	<b>Easy</b>	<b>Very Easy</b>	<b>Neutral</b>	<b>Difficult</b>	<b>Very Difficult</b>	<b>Total Score</b>	<b>Mean</b>	<b>Rank</b>
Capital	6	6	13	16	6	131	1.31	1
Human Resource	7	18	14	8	1	166	1.66	4.5
Location	8	24	9	4	3	174	1.74	6
Analysing the market	4	11	20	13	2	152	1.52	2.5
Demand of Product / Services	8	16	17	5	1	166	1.66	4.5
Expansion	8	11	14	11	4	152	1.52	2.5

Source: sorted from Primary data

**Figure 4.22 Difficulty of setting up an Entrepreneurship**



**INTERPRETATION**

It is noted that the entrepreneurs faced the most difficult in raising capital for the organization. Also the easiest one was to get the location for the business.

## **THE BENEFITS THAT ENJOYED AS AN ENTREPRENEUR**

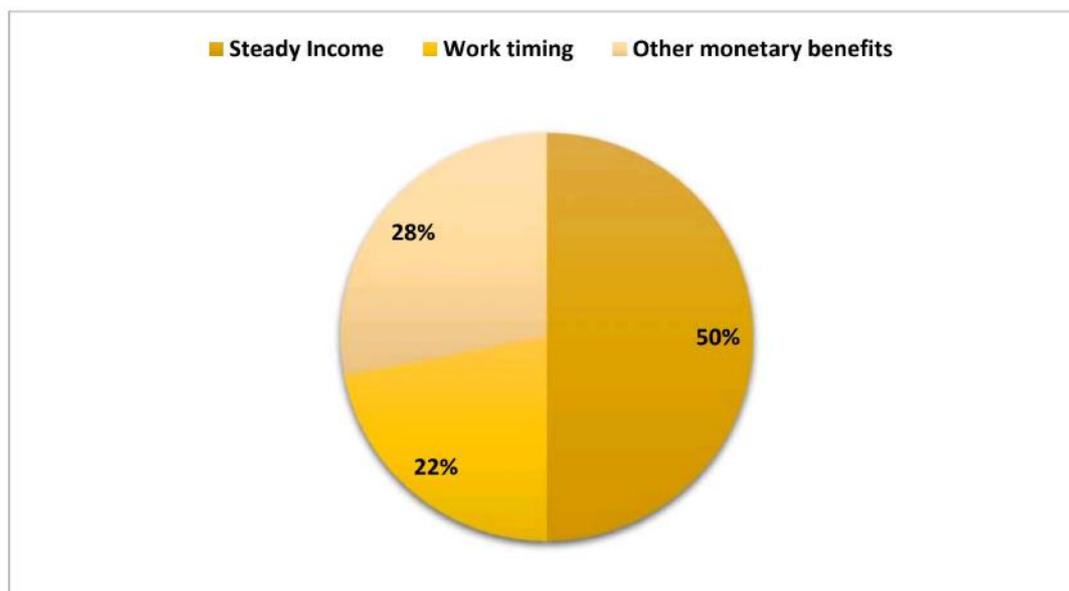
**Table no. 4.23 Benefits enjoyed as an Entrepreneur**

<b>Benefits enjoyed as an Entrepreneur</b>	<b>No. of respondents</b>	<b>Percentage</b>
Steady Income	25	50%
Work timing	11	22%
Other monetary benefits	14	28%
Total	50	100%

Source: Primary

Data

**Figure 4.23 Benefits enjoyed as an Entrepreneur**



Source: Table No: 4.23

### **INTERPRETATION**

Among 50 respondents, 25 (50%) respondents enjoy steady income, 14 (28%) respondents enjoy other monetary benefits received and 11 (22%) respondents enjoy the work timing.

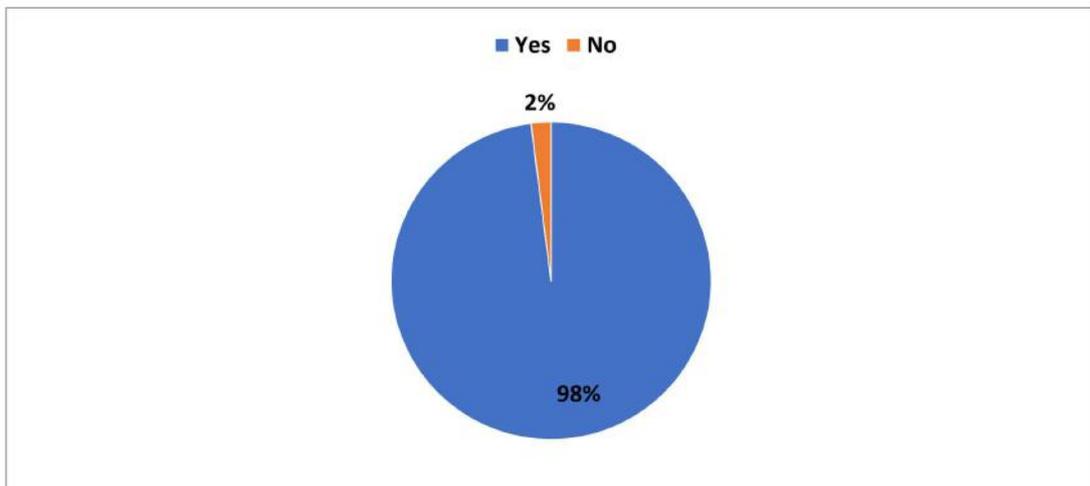
## **INCREASE IN THE STANDARD OF LIVING OF THE RESPONDENTS AFTER SETING UP OF BUSINESS**

**Table no. 4.24 Increase in standard of living**

<b>Increase in standard of living</b>	<b>No. of respondents</b>	<b>Percentage</b>
Yes	49	98%
No	1	2%
Total	50	100%

Source: Primary Data

**Figure 4.24 Increase in the standard of living**



Source: Table 4.24

### **INTERPRETATION**

Among the 50 respondents, there is 98% of the respondents have facing increase in their standard of living.

## **SATISFACTION OF THE ENTREPRENEURS FROM THEIR OWN BUSINESS**

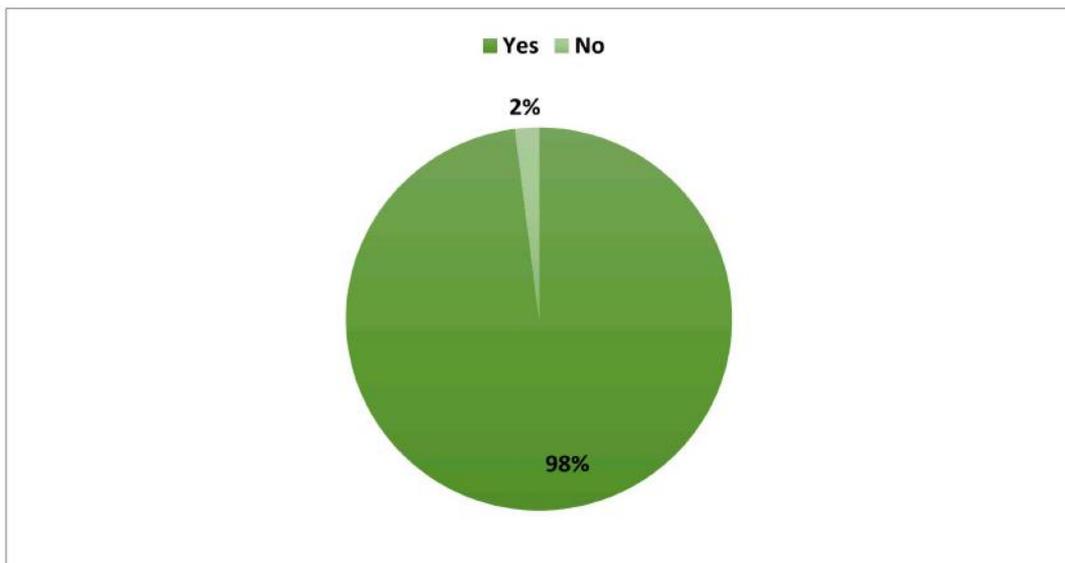
**Table no. 4.25 Satisfaction of Entrepreneurs**

<b>Satisfied</b>	<b>No. of respondents</b>	<b>Percentage</b>
Yes	49	98%
No	1	2%
Total	50	100%

Source: Primary

Data

**Figure 4.25 Satisfaction of Entrepreneurs**



Source: Table 4.25

### **INTERPRETATION**

Among the 50 Candidates, 49 (98%) of them are happy with their decision to shift to entrepreneurship. Only 1(2%) of the candidates are not happy with their entrepreneurship Decision.

**CHAPTER – 5**  
**FINDINGS, SUGGESTION AND**  
**CONCLUSION**

## 5.1 FINDINGS OF THE STUDY

In the study 'A study on the frequent shift of people from employment to entrepreneurship with special reference to Ernakulam district' data were collected from the people of Ernakulam district and 50 samples are collected on the basis of convenient sampling method.

- Most of the respondents in this survey are women in their forties and fifties, demonstrating how demographic factors influence the present entrepreneurial trend.
- 21 of 50 respondents choose production-based businesses, according to the research.
- As a result of the lack of suitable rewards within organizations, a substantial number of private employees are turning to entrepreneurship
- Non-financial factors are the most common causes for employees quitting their jobs, with the majority citing work load and work environment as important factors.
- It is found that, youngsters hesitate to step on to entrepreneurship due to their limited knowledge in entrepreneurial benefits and incapable of making adequate decisions.
- The review shows that just 10% of the respondents got a monthly pay over 65 thousand as an Employee, which perhaps an explanation for their disappointment with the work
- 44% of respondents earn an annual income of Rs. 2 lakh, and 38% earn between Rs.2 lakh and 5 lakh from entrepreneurship which is satisfactory compared to the income earned in employment.
- The majority of respondents prefer to have their own space while making decisions, hence they favour sole proprietorship. Only 6% of those polled preferred a joint stock firm.
- It has been found that 72% of the respondents have worked as an employee for a span of less than 5 years in the employment.
- To raise finance, the majority of entrepreneurs used a bank loan.
- According to the research, the most significant obstacle to starting a business is a lack of finance. This could be due to a lack of knowledge about the numerous sources of funding or a lack of competent guidance.
- The majority of those who responded said they had trouble expanding their firm.

## **5.2 SUGGESTIONS**

1. Since the employee retention is poor, the organizations and employers should give emphasis to non-financial motives along with satisfactory level of financial rewards.
2. The majority of candidates have trouble overcoming the obstacles they confront in their jobs. This can be handled by regularly offering accurate awareness and training programme.
3. Employers should priorities providing a welcoming and healthy environment for their employees.
4. Government should make sure that their entrepreneurial aids are reaching the general public as majority of our respondents failed accessing it.
5. Majority of the candidates haven't received any aid from the government. This shows that even though government introduces many aids to promote entrepreneurship, very few Peoplehave access to it. So, steps should be taken to make these aids reach the general public.
6. Government and other agencies offering entrepreneurial development programmes must promote more number of women as we emphasis women empowerment in the present scenario.

### **5.3 CONCLUSION**

In this study an attempt had been made to learn about the frequent shift of people from employment to entrepreneurship and we came to know that majority of the youngster's tends to shift or transits from job to business. This is primarily due to dissatisfaction with the financial reward paid to them. They also choose to work for themselves because they value their independence, flexibility, creative thinking and other financial and non-financial incentives. Being an entrepreneur provides them with a greater amount of personal fulfilment.

As researcher's we believe that, it is all about people's satisfaction. People can negotiate for better amenities on their job if not willing to move towards business. And more people can come up with small scale business ventures either instead of their job or along with the job if they are not willing to take up risks which are inherent in business.