

**A STUDY ON THE PHARMACOGNOSTIC AND PHYTOCHEMICAL  
FEATURES OF *AZADIRACHTA INDICA* L., *OCIMUM SANCTUM* L. &  
*ALOE VERA* L. - THE POTENTIAL REMEDY FOR SKIN DISORDERS**

**DISSERTATION**

**SUBMITTED IN PARTIAL FULFILLMENT OF  
THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF  
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**IN BOTANY**

**BY**

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## CERTIFICATE

This is to certify that the dissertation entitled "A Study on the Pharmacognostic and Phytochemical features of *Azadirachta indica* L., *Ocimum sanctum* L. & *Aloe vera* L. – "The Potential Remedy for Skin Disorders" submitted in partial fulfillment of the requirements for the award of the Degree of Bachelor of Science in Botany is an authentic work carried out by MARY TANIA M. P (Reg. No. AB19BOT040) under the supervision and guidance of Dr. Liza Jacob.



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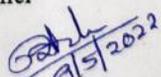
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PLACE:

DATE:

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## INTRODUCTION

Ever since ancient times, in search for rescue for their disease, the people looked for drugs in nature. The beginnings of the medicinal plants' use were instinctive, as is the case with animals. In view of the fact that at the time there was not sufficient information either concerning the reasons for the illnesses or concerning which plant and how it could be utilized as a cure, everything was based on experience. In time, the reasons for the usage of specific medicinal plants for treatment of certain diseases were being discovered; thus, the medicinal plants' usage gradually abandoned the empiric framework and became founded on explicatory facts. Until the advent of iatrochemistry in 16th century, plants had been the source of treatment and prophylaxis. Nonetheless, the decreasing efficacy of synthetic drugs and the increasing contraindications of their usage make the usage of natural drugs topical again.

For thousands of years, medicinal plants have been used in various cultures of the world as a safe therapeutic modality. The operation of medicinal plants is based on the rich experiences of innumerable healers over centuries, inherited from ancestors, healer-to-healer transfer, or developed through personal experiences over time. Modernity or cultural revolutions have not altered the in-depth wisdom of this natural medical paradigm. Consequently, no modern system of medicine can ordinarily lay claim to it.

Extensive investigations have revealed that medicinal plants in different shapes, either in crude form or pure molecules isolated from them, represent the most ancient mode of medication. Archaeological studies have been provided reasonable evidences that the healing properties of plants were known to peoples in prehistoric time.

The chemicals that are produced by plants are called as phytochemicals. These are produced by the plant's primary and secondary metabolism. These phytochemicals are important for the plants to thrive or thwart other plants, animals, insects and microbial pests and pathogens. They also help plants and protect them from disease and damage caused by environmental hazards like pollution, UV, stress and draught. They are used as traditional medicine and as poisons from ancient days.

Medicinal plants are a gift to us from the nature as they provide a number of health benefits to us. In India these medicinal plants are used for about centuries for their properties and are still used to this date.

India has a variety of traditional medical systems like Ayurveda, siddha, unani and a huge class of ethnomedicine. This knowledge of medicine was disappeared due to the western culture that has been on us on the past and is reappearing again as their importance have been realized and lack of side effects are also an important aspect in these types of traditional medicine.

As per a report by World Health Organization (WHO), over 80% of the people of developing countries are relying on the traditional medicines that are extracted from the plants for their primary health needs.

Use of these traditional medicines for the preparation of modern medical preparations is indispensable and thus 'Phytomedicines' are a link between the traditional and modern medicine.

Plants provide the basic nutrients needed for the growth of animals and humans like proteins, carbohydrates, fats, vitamins and oils minerals. The phytochemicals are majorly classified as primary and secondary metabolites. The primary metabolites are responsible for the basic development of the plant which includes the sugars, amino acids, proteins, nucleic acids, chlorophyll, etc

Secondary metabolites are those which are needed for the survival of the plants in a harsh environment. They form the smell, colour and taste of the plants and secondary metabolites such as flavonoids, tannins, saponins, alkaloids, steroids, phytosterols are found to have other commercial applications like they can be used as colouring agents, as drugs as flavouring agents, insecticides, pesticides, anti-bacterial and antifungal products. Moreover, they can also be used to protect humans from many diseases like cancer, diabetes, cardiovascular diseases, arthritis and aging and so on.

## REVIEW OF LITERATURE

Plants constitutes majority of the living population of earth. Among plants, there are so many medically relevant plants that are to be recognized, analyzed and utilized to treat various diseases. Ever since technology has advanced, new methods have been identified to extract and utilize different plant varieties.

Even now scientists are constantly trying to find out new drugs with different pharmacological values such as anti-inflammatory, anti-microbial, anti-fungal properties, etc. Phytochemistry focuses around the study of various chemical components that are accumulated in plants as a part of their own metabolism and biological functions. It includes both quantitative and qualitative estimation of active components such as alkaloids, flavonoids, phenol, etc.

Skin disorders and many other dermatologically related issues are a major concern of the population. There are many herbal remedies available for these problems but they are still unknown to people. Several researches are ongoing in order to find the potential of different medicinal plants for curing various diseases.

Balakumar et al (2011) studied about the Antifungal activity of *Ocimum sanctum L.* on clinically isolated dermatophytic fungi. The leaves were collected and phytochemical analysis was done on various extracts of powdered sample. The extract showed the presence of various secondary metabolites such as tannin, steroids, etc which may be responsible for the inhibition of various dermatophytic fungi.

In a study conducted by P. Prakash et al (2004), therapeutic uses of *O.sanctum L.* with a special note on Eugenol revealed that Eugenol is a major constituent of essential oil and is capable of possessing anti-fungal and anti-viral properties that can be major asset against dermatological problems.

KP Sampath Kumar et al (2010) revealed about the importance of ursolic acid which helps in retaining the elasticity in face and prevent it from ageing and causing wrinkles.

In the phytochemical analysis of *O.sanctum L.*, Priya Pachcal et al (2019) studied about the presence of cirsilineol, circimaritin, isothymusin, apigenin and rosameric acid in the isolated aqueous extract of *O.sanctum L.* which may be useful for treating microbial and fungal infections. From the study, we can conclude that the extract can be used for new formulations and potent antimicrobial drugs of natural origin.

Faiz et al (2009) conducted a study on *Azadirachta indica* to rationalize its traditional use. The isolated phytoconstituents extracted from the leaves of *A. indica* was taken in two concentrations – 50mg/ml and 75 mg/ml and were applied against *Staphylococcus aureus*, *Coryne bacterium bovi* and *E. coli* using disc diffusion method. The results noted was that 75mg/ml concentration was more effective than 50mg/ml.

Garima, Verma and Munna (2014) conducted an objective study to understand the potential of *A. indica* for curing skin ailments. The results suggested that leaves of *A. indica* for curing have some antibacterial and antioxidant property which is due to the presence of certain phytoconstituents.

Melesa et al (2016) conducted a phytochemical analysis of bark and seed extracts of *A. indica*. The data resulted positive for glycosides, phytosterols, polyphenols and saponin. *A. indica* thus found very active against all gram-positive and gram-negative bacteria which was the aim of study

The studies conducted by Alka et al (2018) on *A. indica* showed different properties like antibacterial, antifungal, and antioxidant. The phytochemical analysis on *A. indica* resulted positive for saponins, tanins, phenols, proteins, glycoside, alkaloids, flavanoids, carbohydrate, terpenoids. The aim was to screen out the active components and test the antibacterial activity in different solvents.

Different mechanisms have been proposed for the wound-healing effects of *A.vera* L. gel, which include keeping the wound moist, increasing epithelial cell migration, more rapid maturation of collagen, and reduction in inflammation.

In a study conducted by Davis et al (1994) reported that a high molecular weight polypeptide constituent from the gel demonstrated a healing effect on excisional wounds in rats.

*A.vera* L. has excellent anti-aging effect by producing the collagen and elastin fibres making the skin more elastic and less wrinkled as reported in an in vivo study conducted on mouse ears by Davis et al (1993).

Habeeb et al (2007) has reported the activity of *A.vera* L. inner gel against both Gram-positive and Gram-negative bacteria has been demonstrated by several different methods.

Dinesh et al (2012) conducted a photochemical analysis to examine the phytochemical parameters of *A. vera* L. which can be used as a tool for its standardization. Phytochemical analysis revealed the presence of alkaloid, carbohydrate, tannin, steroid, triterpenoid and glycoside. The results indicate that the plant extract are rich in berberine and gallic acid implying their importance to human health.

## MATERIALS AND METHODS

The study was conducted in order to analyse the pharmacognostic and phytochemical properties of the plants *Azadirachta indica* L. coming under the family Meliaceae, *Ocimum sanctum* L. coming under the family Lamiaceae and *Aloe vera* L. coming under the family Asphodelaceae.

The various parameters utilized for the analysis of the plants are the following:

### PHYTOCHEMICAL ANALYSIS

#### 1. Detection of Alkaloid

To prepare the plant extract, 1 gm of powdered extract was homogenised in 80 percent ethanol (10ml). The homogenate is centrifuged in 15000 rpm for 7 minutes and the supernatant was collected. It is then subjected to various tests using Mayer's, Wagner's and Dragendoff's reagent.

#### Mayer's Reagent

The reagent was prepared by dissolving 1.36 gm of HgCl<sub>2</sub> in 60 ml of distilled water (Solution A) and 5 gm of KI was dissolved in 10ml of distilled water (Solution B). Both of the solutions were mixed and made up to 1000ml with distilled water in a conical flask. The extract were acidified with HCl before adding Mayer's reagent. A slight yellowish coloured precipitate indicates presence of Alkaloid.

#### Wagner's Reagent

The reagent was prepared by dissolving 1.27 gm of Iodine and 2.9 gm gm of KI in 5ml of distilled water and the solutions was made upto 100ml in a conical flask. A reddish-brown precipitate indicates the presence of Alkaloid.

### Dragendoff's reagent

The reagent was prepared by dissolving 8 g of Bismuth Sulphate in 20 ml of conc. HNO<sub>3</sub> (Solution A) and 27.2 g of KI in 50 ml of distilled water (Solution B). The solution were mixed and the supernatant was decanted. It was made upto 100 ml with distilled water. A brick red precipitate indicates the presence of Alkaloid.

### 2. Detection of Flavanoid

A small amount of sample was taken in a test tube, add 2 ml of NaOH followed by 2 ml of H<sub>2</sub>SO<sub>4</sub>. The yellow colour of NaOH changes by adding diluted acid. This indicates the presence of Flavanoids.

### 3. Detection of Saponin - Foam test

Take 1 gm of dried powdered plant material and add 20 ml distilled water into the test tube. It was shaken for about 10 minutes. Formation of frothy solution indicates the presence of saponin.

### 4. Detection of Tannin - Alkaline reagent test

Aqueous extract of the plant was taken. The filtrate was mixed with 2 ml of 5% of Ferric Chloride in a test tube. Formation of green, blue or black precipiate indicated the presence of Tannin.

### 5. Detection of Steroid - Salkowski's test

The ethanol extract of the sample was treated with a few drops of Conc. sulphuric acid. A red colouration in the lower layer of the solution indicates the presence of Steroids.

6. Detection of Bitter

Take 1 gm of powdered sample in a test tube, shake it with ethyl alcohol followed by ethyl acetate. Formation of green colour shows the presence of Bitter.

7. Detection of Resin

A small amount of powdered sample was taken in the test tube and add a few drops of 50% HNO<sub>3</sub>. Formation of brown colour indicates the presence of resins.

8. Detection of carbohydrates

Molisch's Reagent

2 ml of the test sample (aqueous extract) was taken in a test tube, add 2 drops of Molisch's reagent into the extract and mix thoroughly. Add 1 ml of Conc. H<sub>2</sub>SO<sub>4</sub> along the margins of the test tube without shaking. Formation of a purple ring between the junctions of the solution indicates the presence of carbohydrates.

Benedict's Reagent

1 ml of the aqueous extract of the sample was taken in a test tube, add 5 ml of Benedict's reagent into the extract and mix it well. It was then kept in a water bath for 5 minutes. Formation of orange colour indicates the presence of carbohydrate.

Fehling's Reagent

1 ml of Fehling's reagent 'A' was mixed with Fehling's reagent 'B' in a test tube. To this add few drops of aqueous extract of test solution and boiled in a water bath for 5 minutes. Formation of a deep orange red colour indicates the presence of carbohydrate.

## 9. Detection of Protein

### Biuret's test

2 ml of test solution is taken in a test tube, add few drops of  $\text{CuSO}_4$  solution followed by 40%  $\text{NaOH}$  solution and mixed thoroughly. Formation of purple colour indicates the presence of Protein.

### Xanthoproteic Test

In a test tube, add equal volumes of the test solution and Conc.  $\text{HNO}_3$  (0.5 ml). It was mixed and allowed to cool upto the room temperature. Formation of a light yellowish precipitate indicates the presence of Protein.

## **PHARMACOGNOSTIC ANALYSIS**

### 1. ORGANOLEPTIC EVALUATION

### 2. BULK DENSITY ANALYSIS OF THE FINE POWDER

### 3. FOLIAR MICROSCOPIC STUDIES

Stomatal type and stomatal index

Palisade ratio

Vein islet number Vein termination number

## **ORGANOLEPTIC EVALUATION**

Organoleptic evaluation means the study of drugs using organs of senses. For this the colour, taste, odour, touch, texture of the drug was noted.

## **BULK DENSITY ANALYSIS OF THE FINE POWDER**

Using the finely powdered drug bulk density analysis was carried out. About 5 g of the herbal powder was weighed out. This powder was transferred into a 100 ml measuring cylinder. Then the initial volume of the powder was noted. After this the cylinder was tapped thrice from the height of 3cm to obtain a final volume. The final volume was noted. Then the bulk density of the plant was calculated using the formula:

$$\text{Bulk density} = \frac{\text{Initial volume of the herbal powder}}{\text{Final volume of the herbal powder}}$$

## **MICROSCOPIC STUDIES**

### 1. Stomatal type and stomatal index

The stomatal index of the leaf is the ratio of the number of stomata to the total number of stomata and epidermal cells. For determining the stomatal index fresh leaves of the plant were taken. It was then stained with saffranin. Then the peel was placed in clean glass slide and a drop of glycerine is put over it and covered with a coverslip without air bubbles. Then the slide was examined under the compound microscope. After this type of stomata and number of epidermal cells and stomata in the field were noted. The stomatal index was calculated using the formula:

$$\text{Stomatal index} = (S/S+E) \times 100 ,$$

where S = Number of stomata per unit area

$$E = \text{Number of epidermal cells in the same area}$$

### 2. Palisade ratio

Palisade ratio is the average number of palisade cells under one epidermal cell. Fresh leaves of the plants were taken. Then they were boiled with trichloroacetic acid solution. The sample was then mounted in glycerine and observed under microscope. Then the focal length of the microscope was adjusted to see the palisade cells were counted from each field below four adjusted epidermal cells and the ratio was determined by dividing total number of palisade cells by 4. The average palisade ratio was taken. Palisade ratio was calculated using the formula:

$$\text{Palisade ratio} = \frac{\text{Number of palisade cells}}{\text{Number of epidermal cells}}$$

### 3. Determination of vein-islet number

It is defined as the number of vein islet per sq.mm of the leaf surface midway between the midrib and the margin. Leaf pieces were put in trichloroacetic acid and when the leaves become transparent, they were mounted in glycerine. A camera lucida was attached to the microscope. A paper was placed and the vein islet was traced by looking through the microscope when the superimposed image of the leaf portion and the paper were seen at the same time. The number of vein-islet in each 4cm×4cm square was counted and the average vein-islet was calculated.

### 4. Determination of vein termination number

Vein termination number is the number of veinlet terminations per mm of leaf surface. Leaf pieces were placed in trichloroacetic acid. When the leaves become transparent and clean, one of the pieces was mounted in glycerin. Camera lucida drawings were made and the number of vein termination present within the 4cm×4cm square was counted and the average vein termination number was calculated.

## OBSERVATION AND RESULTS

For the present investigation *Azadirachta indica* L. of family Meliaceae , *Ocimum sanctum* L. of family Lamiaceae and *Aloe vera* L. of family Asphodelaceae was used as source plants because of their importance in medical field. Observations are recorded for pharmacognostic and phytochemical study. Morphology, anatomy and microscopic studies were conducted.

## PHARMACOLOGICAL ANALYSIS

### MORPHOLOGY

Tulsi (*Ocimum sanctum* L.)

*O. sanctum* L. is an aromatic perennial shrub which is erect and branched and grows upto a height of 30-60 cm in length. Stems are hairy and leaves are simple, petiolated and purplish-green in colour, it grows upto the length of 3.3 - 5.5 in mature plants and 1.2 -2.5 in younger ones. They are strongly scented and the leaves have slightly toothed margin and are arranged in opposite and decussate phyllotaxy. Flowers are placed in closed whorls or elongated racemes. Tap roots are present in the case of *O. sanctum* L.

Aloe vera (*Aloe vera* L.)

*A. vera* L. is a succulent plant, an evergreen perennial plant. It grows upto 60-100 cm in height. Its leaves are thick and fleshy. They may be green or grey in color with some varieties showing white flecks on their upper and lower stem surfaces. The leaves may produce a yellow, milky latex. The plant has triangular, fleshy leaves with serrated edges, yellow tubular flowers and fruits that contain numerous seeds.

Neem (*Azadirachta indica* L.)

*A. indica* is a medium-sized tree, reaching 15 to 30 m in height, with a large rounded crown up to 10-20 m in diameter. It is mainly evergreen but sometimes shed its leaves during the dry season. Neem has a deep taproot and is a mycorrhizal-dependent species.

## **TAXONOMIC CHARACTERS**

### **Tulsi**

- Habit : Erect shrub.
- Stem : Quadrangular with hair present.
- Leaves : Simple, slightly toothed margin with ovate shape, exstipulate.
- Inflorescence : Verticillaster.
- Flowers : Flowers are arranged in closed whorls in elongated racemes; Bisexual; zygomorphic
- Calyx : 5 sepals present
- Corolla : 5 petals present; bilabiate; gamopetalous
- Androecium : 4 stamens present
- Gynoecium : Hypogynous; superior ovary and bicarpellate

### **Aloe vera**

- Habit : A succulent plant
- Stem : it is a stemless or short stemmed plants
- Leaves : Leaves are succulent, erect, and form a dense rosette; 60 Cm in length. The leaves may produce a yellow, milky latex
- Inflorescence : Spadix inflorescence present.
- Flowers : Flowers have a yellow tubular corolla which is upto 2-3 cm, Complete, perfect, actinomorphic flowers. The color of the flower is ranging from white to yellow to near red.
- Calyx : 3 sepals present
- Corolla : 3 petals. The calyx and corolla are fused into a single, yellowish tube.

Androecium : 6 unfused stamens

Gynoecium : Ovary superior with 3 locules and numerous seeds. The fruit is a capsule at maturity.

### **Neem**

Habit : Medium – sized to large evergreen to semi-desiduous tree, upto 30 m tall.

Stem : The bark is dark grayish on the outside and reddish brown inside, and has numerous oblique furrows.

Leaves : Alternate, exstipulate, compound, imparipinnate; 7-15 shortly stalked pinnae are lanceolate, oblique, serrate, acuminate, unicostate reticulate.

Inflorescence : Compound racemose inflorescence

Flowers : Bracteate, actinomorphic, hermaphrodite, complete, hypogynous and scented.

Calyx : 5 sepals, gamosepalous, light green, valvate

Corolla : 5 petals, polypetalous, imbricate

Androecium : made up of 10, or 8-12 monadelphous

Gynoecium : tricarpyllary, syncarpous, superior, trilocular, two ovules in each locule, axile placentation, style simple, stigma trifid.

Fruit : Drupe

Seed : Fruit one-seeded.

### **ORGANOLEPTIC EVALUATION**

The organoleptic evaluation was done using the powdered leaf sample of the plants.

Neem

In *A. indica* it was found that the color is green, texture is soft and taste is strong bitter taste and odour is characteristic with a slight herbal scent.

Tulsi

In *O. sanctum* L. it was found that the color is green, texture is soft and taste is bitter and odour is characteristic.

Aloe vera

In *A. vera* L. it was found out that the color is dark green or maybe light green, texture is soft, taste is bitter and odour is characteristic.

### **BULK DENSITY ANALYSIS**

The bulk density of the leaf powder was studied and noted. (Table-1)

### **FOLIAR MICROSCOPIC STUDIES**

#### **STOMATAL INDEX**

Neem

The stomata of *A.indica* L is amphistomatous and the number of stomata was found to be greater in adaxial surface as compared to the abaxial surface and the stomatal *index* was found to be 34.17. (Table-1)

Tulsi

The stomata of *O.sanctum* L. is amphistomatous and the number of stomata was found to be greater in adaxial surface as compared to abaxial surface. The stomatal index was found to be 55.7. (Table-1)

Aloe vera

The stomata of *A. vera* L. is amphistomatous and the number of stomata was found to be greater in abaxial surface as compared to the adaxial surface. The stomatal index was found to be 10. (Table-1)

### **PALISADE RATIO**

The palisade ratio of the plant *A.indica* was found to be 5. (Table- 1)

The palisade ratio of the plant *O.sanctum* L. was found to be 6.5. (Table-1 )

The palisade ratio of the plant *A. vera* L. was found to be 4. (Table- 1)

### **VEIN ISLET AND VEIN TERMINATION NUMBER**

Vein islet number and Vein termination number of *A.indica* was found to be 9 and 22. (Table-1)

Vein islet number and Vein termination number of *O.sanctum* L. was found to be 7 and 21.  
(Table-1)

Vein islet number and Vein termination number of *A.vera* L. was found to be 6 and 19 (Table-1).

All the above-mentioned studies were performed in triplicates and the average value was taken.

## **PHYTOCHEMICAL ANALYSIS**

The powdered and water extract of test sample (neem, tulsi and aloe vera) are subjected for the identification of various phytochemicals and the results are recorded in plates

### **Detection of Alkaloids**

The detection of alkaloids was done using the three reagents namely Mayer's, Wagner's and Dragendoff's reagents. (Table-3)

Neem

The sample tested with Mayer's reagents shows slightly yellow coloured precipitate, Wagner's reagent shows reddish brown precipitate and Dragendoff's reagent shows brick red precipitate. (Plate-1)

Tulsi

The sample tested with Mayer's reagents shows slightly yellow coloured precipitate, Wagner's reagent shows reddish brown precipitate and Dragendoff's reagent shows brick red precipitate. (Plate-1)

Aloe vera

The sample tested with Mayer's reagents shows slightly yellow coloured precipitate, Wagner's reagent shows reddish brown precipitate and Dragendoff's reagent shows brick red precipitate. (Plate-1)

### **Detection of Flavonoid**

For the detection of flavonoids, the test samples were treated with NaOH, then diluted acid was added. (Table-2)

Neem

Colour changes during dilution, which indicates presence of flavonoids. (Plate-2)

Tulsi

Colour changes during dilution, which indicates presence of flavonoids. (Plate- 2)

Aloe vera

No colouration was observed, which indicates absence of flavonoids. (Plate -2)

### **Detection of Saponin**

The Detection of Saponin was done by shaking the powdered extract of the test samples vigorously with water. (Table-2)

Neem

Formation of froth was observed, which indicates its presence. (Plate-3)

Tulsi

Formation of froth was observed, which indicates its presence. (Plate-3)

Aloe vera

No froth was formed, which indicates its absence. (Plate-3)

### **Detection of Tannins**

For detecting the presence of tannin, the test samples were treated with 5% Ferric Chloride solution in a test tube. (Table-2)

Neem

A green colour was observed, which indicates the presence of tannins. (Plate -4)

Tulsi

A green colour was observed, which indicates the presence of tannins. (Plate-4)

Aloe vera

No green colouration was observed, which indicates the absence of tannins. (Plate-4)

### **Detection of Steroids**

For detecting the presence of steroids, the ethanol extract of test samples was treated with conc. Sulphuric acid. (Table-2)

Neem

A red layer was formed at the bottom of the test tube, which indicates the presence of steroids. (Plate-5)

Tulsi

A red layer was formed at the bottom of the test tube, which indicates the presence of steroids. (Plate-5)

Aloe vera

A red layer was formed at the bottom of the test tube, which indicates the presence of steroids. (Plate-5)

### **Detection of Bitter**

For the detection of bitter, the powdered extract was treated with ethyl alcohol followed by ethyl acetate. (Table-2)

Neem

A green colouration was observed which indicates the presence of bitter. (Plate -6)

Tulsi

A green colouration was observed which indicates the presence of bitter. (Plate -6)

Aloe vera

A green colouration was observed which indicates the presence of bitter. (Plate -6)

### **Detection of Resin**

For the detection of resin, the test samples were treated with conc. Nitric acid. (Table – 2)

Neem

A dark brown colouration was observed, which indicates the presence of resin. (Plate-7)

Tulsi

A dark brown colouration was observed, which indicates the presence of resin. (Plate-7)

Aloe vera

A dark brown colouration was observed, which indicates the presence of resin. (Plate-7)

### **Detection of Carbohydrates**

The test samples were treated with Molisch's, Benedict's and Fehlings's reagents. (Table-4)

Neem

The test sample shows the formation of a brown ring in Molisch's test, an orange red colouration in Benedict's and red colouration in Fehling's test. This indicates the presence of carbohydrates. (Plate-8)

Tulsi

The test sample shows the formation of a brown ring in Molisch's test, an orange red colouration in Benedict's and red colouration in Fehling's test. This indicates the presence of carbohydrates. (Plate-8)

Aloe vera

The test sample shows the formation of a brown ring in Molisch's tests, an orange red colouration in Benedict's and red colouration in Fehling's test. This indicates the presence of carbohydrates. (Plate-8)

### **Detection of Proteins**

The detection of protein is done by conducting Biuret's and Xanthoproteic test. (Table -5)

Neem

The test sample shows the formation of purple colouration in Biuret's test and orange precipitate in Xanthoproteic test. (Plate-9)

Tulsi

The test sample shows the formation of purple colouration in Biuret's test and orange precipitate in Xanthoproteic test. (Plate -9).

Aloe vera

The test sample shows the formation of purple colouration in Biuret's test and orange precipitate in Xanthoproteic test. (Plate-9)

**TABLE-1**  
**MICROSCOPIC ANALYSIS**

SI No.	Characteristics	Observation		
		NEEM	TULSI	ALOEVERA
1	Stomatal index	55.7	34.17	10
2	Palisade ratio	5	6.5	4
3	Vein islet number	9	7	6
4	Vein termination number	22	21	19

**TABLE-2**  
**PHYTOCHEMICAL ANALYSIS**

**DETECTION OF VARIOUS PHYTOCHEMICALS IN THE PLANT LEAF POWDER**

	Saponin	Tannin	Steroid	Resin	Bitter	Flavonoid
NEEM	+	+	+	+	+	+
TULSI	+	+	+	+	+	+
ALOEVERA	-	-	+	+	-	-

**TABLE-3****DETECTION OF ALKALOIDS**

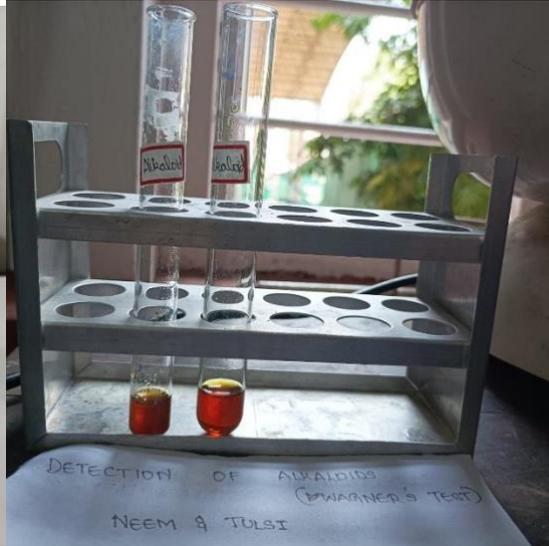
	Mayer's reagent	Dragendroff reagent	Wagner's reagent
NEEM	+	+	+
TULSI	+	+	+
ALOEVERA	+	+	+

**TABLE-4****DETECTION OF CARBOHYDRATES**

	Molisch's test	Benedict's test	Fehling's test
NEEM	+	+	+
TULSI	+	+	+
ALOEVERA	+	+	+

**TABLE-5**  
**DETECTION OF PROTEIN**

	BIURET TEST	XANTHOPROTEIC TEST
NEEM	+	+
TULSI	+	+
ALOEVERA	+	+



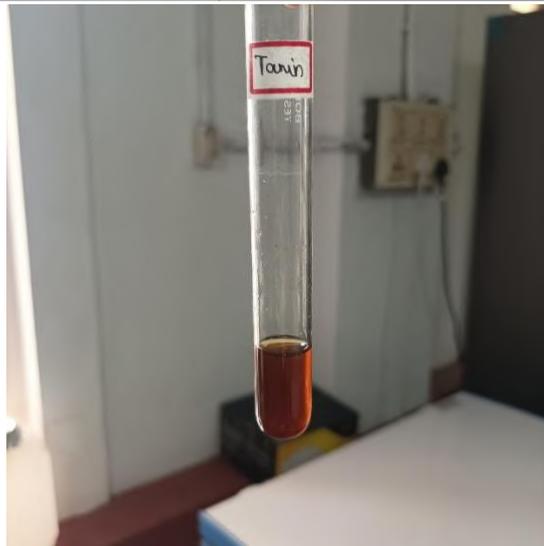
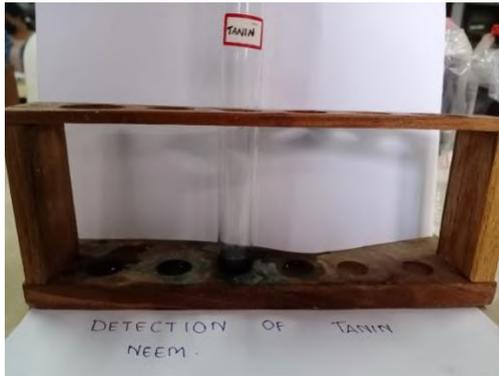
**TEST FOR ALKALOID (PLATE: 1)**



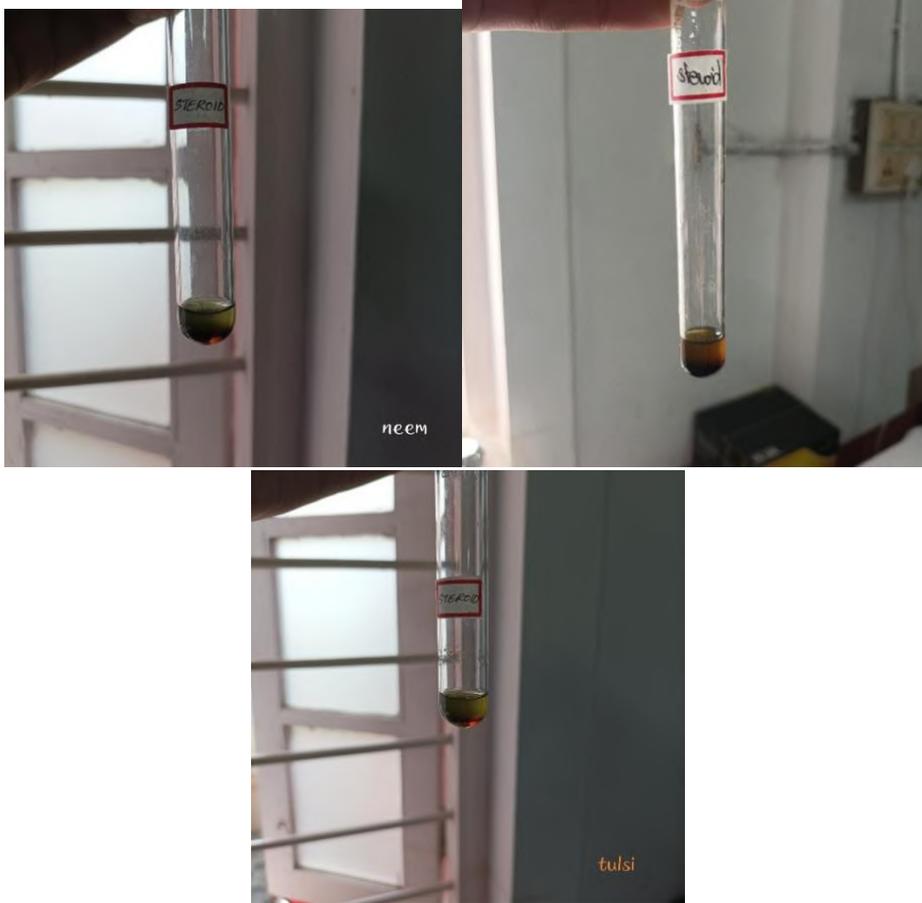
**TEST FOR FLAVANOID (PLATE: 2)**



**TEST FOR SAPONIN (PLATE: 3)**



**TEST FOR TANNIN (PLATE: 4)**



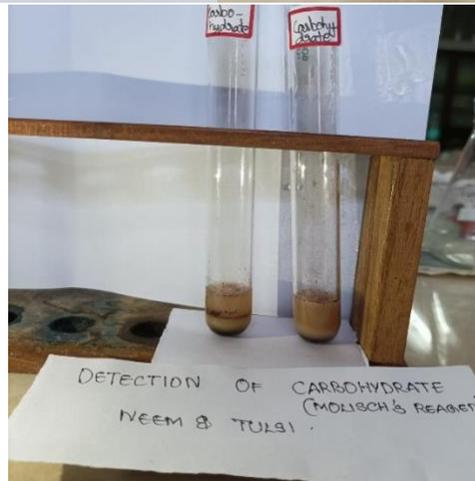
**TEST FOR STEROIDS (PLATE: 5)**



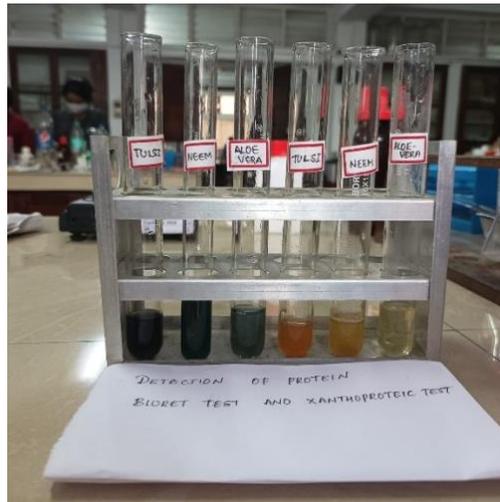
**TEST FOR BITTER (PLATE: 6)**



**TEST FOR RESIN (PLATE: 7)**



**TEST FOR CARBOHYDRATE (PLATE: 8)**



**TEST FOR PROTEIN (PLATE: 9)**

## DISCUSSION

Medicinal plants have long been utilised as a major source of pharmaceutical products due to their significance in treating and curing diseases. Their importance and usage were first discovered by various communities those where tightly knit with nature. They studied about various parts of plants and made different formulations that may or may not have the involvement of many other plants or plant produces. With the help of advancing technology the whole process of trying out different combinations and their effects have been made much more easier and feasible. Presently they are carrying out different experiments and studies that will reveal the full potential of different plants. By studying about the various active principles present in a plant, it is easier to predict different diseases that can be cured with the plant.

*Azadirachta indica* is a natural herb, commonly known as neem is a member of the mahogany family, Meliaceae. *A. indica* has been extensively used in Ayurveda, Unani and Homoeopathic medicine and has become a cynosure of modern medicine. Nearly all parts of the neem tree are useful, and many of its medicinal and cosmetic uses are based on its antibacterial and antifungal properties.

In the present study, *A. indica* is found to be Amphistomatous with a stomatal index of 55.7. The palisade ratio of *A. indica* is 5 and its vein islet and vein termination are 9 and 22 respectively which emphasize the importance of drug authentication.

The phytochemical analysis of *A. indica* conducted in this present study gave a positive result for the presence of protein, carbohydrates, alkaloids, saponins, tannins, steroids, resins, bitter and flavonoids which plays a key role in imparting various medicinal properties to the plant and these results are found to be in agreement with the studies conducted by Mohamed and Ashraf *et al* (2019).

*Ocimum sanctum*. L is an aromatic perennial shrub which is erect, branched and belongs to the family Lamiaceae. It is widely distributed and is commonly found in every households because of its therapeutic values. It is collected from the wild and is used to make different formulations in order to heal various diseases, especially in India. Any part of the plant can be utilised to make medicines. It can be taken raw from the wild or it's extract can be used. It has anti-inflammatory, antibacterial, antifungal, diuretic and several other properties.

Balakumar et al (2011) studied about the Antifungal activity of *O. sanctum* on clinically isolated dermatophytic fungi. The leaves were collected and phytochemical analysis was done on various extracts of powdered sample.

In the present foliar study of *O. sanctum* L., it is found to be amphistomatous but the number of stomata in the adaxial surface was comparatively greater than in the abaxial surface.

The stomatal index is 55.7, palisade ratio is 6.5, the vein islet and vein termination number is 7 and 21 respectively. These characters are important for drug authentication.

The plant was subjected to various phytochemical analysis by extracting with various solvents. It helps in determining the active principles present within the plant so it can be utilised to form different formulations for treating various diseases. It was tested positive for saponin, tannin, steroid, resin, bitter, Flavonoid, alkaloids, carbohydrates and protein. Detection of carbohydrate have three tests, they are Molisch's, Fehling's and Benedict's test. Detection of Protein have two tests, they are Biuret's and Xanthoproteic tests.

*A. vera* L. is a succulent plant grown around the world. It's had known medical uses that date back to ancient times. Both the juice from the leaf and the thicker gel may offer health benefits. *A. vera* L. is commonly used in traditional medicine to treat skin disorders.

A 2013 study from Iran evaluated the effects of aloe lotion in 60 people undergoing radiation therapy. A thin layer of lotion was applied to half of the irradiated area of skin after treatment for four weeks. The researchers found that the areas treated with aloe had a lower grade of dermatitis than areas without the aloe.

*A. vera* L. has various medicinal properties like anti-inflammatory, antibacterial, antiviral, and antitumor properties. Benefits associated with *A. vera* L. have been attributed to the polysaccharides contained in the gel of the leaves.

In the present foliar study of *A. vera* L., it is found to be amphistomatous and the number of stomata was found to be greater in abaxial surface as compared to the adaxial surface. The stomatal index was found to be 10, palisade ratio is 4, vein islet and vein termination number is 6 and 19 respectively which are important for drug authentication.

These studies are good enough proof that drug has immense potential as a therapeutic. So proper diagnosis, knowledge of the traditional medicine, and implementation of that knowledge to the treatment plan are important in ensuring success.

## SUMMARY AND CONCLUSION

Medicinal herbs has been used as a source for treating various kinds of diseases. It has proved to be useful and efficient for treating different types of ailments. The discovery of active principles as the reason behind it's healing potential has changed the whole perspective and more studies were implemented for screening the phytochemical and pharmacognostic potential of plants.

The present work was done to study about the pharmacognostic and phytochemical potential of *Azadirachta indica* L., *Ocimum sanctum* L. and *Aloe vera* L. in treating various skin disorders caused due to fungal or microbial actions. Pharmacognostic studies include morphological and foliar study. Foliar study includes stomatal index, palisade ratio, vein islet and vein termination number. Phytochemical studies involved testing the presence of saponin, tannin, steroids, resin, alkaloids, carbohydrates and proteins. Their involvement and the reason behind their action against skin disorders were analysed.

*Azadirachta indica* L. is a natural herb, commonly known as neem is a member of the mahogany family, Meliaceae. From the results of various pharmacological and phytochemical tests conducted, it can be concluded that *A. indica* has the ability to various treat skin disorders.

*Ocimum sanctum* L. is an aromatic perennial shrub coming under the family Lamiaceae. It has a long history in treating various type of skin disorders. It was taken and several tests for pharmacognostic and phytochemical analysis was carried out. It was tested positive for all the above-mentioned phytochemicals.

*A. vera* L. is an herbaceous and perennial plant that belongs to the Liliaceae family and used for many medicinal purposes. *A. vera* L. is a medicinal plant, traditionally used to improve skin integrity.

The pharmacological attributes of *A. vera* L. have been revalidated in modern sciences through various in vivo and in vitro studies. *A. vera* L. is a promising herb with its various applications in medicine. It was taken for pharmaceutical and photochemical analysis and contain many compounds.

In summary, these plants can play vital roles in disease prevention. However, conscious efforts need to be made to properly identify, recognise and position medicinal plants in the design and implementation. Efforts must be geared towards measures that will enhance the effectiveness, efficacy and rational use of medicinal plants.

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**MALWARE DETECTION USING NAVE BAYES ALGORITHM**

**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**

**MARY TINY BIVERA (SB19BCA013)**

**&**

**REVATHI U (SB19BCA017)**

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

*Under the guidance of*

**Mrs. Archana Menon P**

**DEPARTMENT OF COMPUTER APPLICATIONS**

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**Mrs. Archana Menon P**

**DEPARTMENT OF COMPUTER APPLICATIONS**

**MARCH 2022**

**MALWARE DETECTION USING NAVE BAYES ALGORITHM**

**DECLARATION**

We, undersigned hereby declare that the project report **malware detection using naive bayes algorithm**, 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. Archana Menon P. 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.

Place: Ernakulam

Mary Tiny Bivera (SB19BCA013)

Date: 15-03-2022

Revathi U (SB19BCA017)

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

**DEPARTMENT OF COMPUTER APPLICATIONS**



**CERTIFICATE**

This is to certify that the report entitled **Malware Detection Using Nave Bayes Algorithm** submitted by **Mary Tiny Bivera** and **Revathi U** 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.

*Archana*  
4/4/22  
ARCHANA MENON P

Internal Supervisor



*Fov* Head of the Department

*Amey*  
4/4/22

External Supervisor

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**ABSTRACT**

The governments of developed countries already have the policy framework of national anti-virus software addressing the security issues. Developing nations also tend to follow this trend making comprehensive effort on anti-virus software development. For our country, we are facing with the challenge to develop this "strategic technology". Creating anti-virus software framework and resources in next few years is one of the national security-wide concerns. The detection of malware is the most significant part of malware protection. In this paper, we provide an approach for malicious software detection and performs some experimental investigation on malware detection using Naive bayes algorithm. The goal of this work is to increase the malware detection rates using nave bayes algorithm. With the recent relevance of online platforms capable of executing increasingly complex software and the rising ubiquity of using online platforms in sensitive webpages such as net banking, online shopping etc. there is a rising danger associated with malware targeted at our devices. The problem of detecting such malware presents unique challenges due to the limited resources available and limited privileges granted to the user, but also presents unique opportunity in the required metadata attached to each application. Our system extracts a number of features and trains using Naive Bayes Algorithm.

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<b>LIST OF ABBREVIATIONS</b>
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SL NO.	ABBREVIATIONS	EXPANSION
1	AV	Anti Virus scanning
2	PC	Personal Computer
3	URL	Uniform Resource Locator
4	AV-TEST	Anti Virus Test
5	SQL	Structured Query Language
6	IDA	Interactive disassembler
7	MD5	Message Digest Algorithm
8	VM	Virtual machine
9	ML	Machine Learning
10	AI	Artificial Intelligence
11	SVM	Support Vector Machine
12	ID	Identity
13	CFS	Correlation feature selection
14	ML.PREDICT	Machine Learning Predict
15	ACC	Accuracy
16	TP	True Positive
17	FP	False Positive
18	TN	True Negative
19	FN	False Negative
20	PPV	Precision
21	TPR	True Positive Rate
22	FPR	False Positive Rate

# CHAPTER 1

## INTRODUCTION

Detecting malware on a system can be difficult, and detecting potential malware within an acquired image is even more so. However, this is something analysts in law enforcement, as well as in the public and private sectors have to deal with, and as such, need the knowledge, skills, and process in order to accomplish this task. Antivirus scanning applications may prove insufficient for this task, and analysts may have to look for artifacts of a malware infection, rather than the malware itself, in order to locate the malware. As such, it is important for analysts to understand the characteristics of malware in order to understand the types of malware artifacts that may be present on a system, as well as where and how to locate those potential. Analysts should always document their activities, and developing a checklist of malware detection techniques can be very valuable, particularly when the analyst fills that checklist in with the results of each technique, or a statement or justification for not using the technique.

We spend every day online conducting business, browsing Facebook, searching for new information. It's become so common place that we often forget just how dangerous the internet can be for users. While there are countless legitimate websites out there with effective Cyber security measures in place, there are also many malicious websites that are created solely to cause harm. Hackers are working 24 hours a day to try to exploit vulnerabilities or dupe users into giving them access to their personal information—and it's shockingly effective. Sure, there are best practices that everyone can and should follow to avoid this situation, including not clicking on unfamiliar links or downloading anything from someone you don't trust. But hackers are far more sophisticated now than they were in the year 2000. They can infect your computer without you even clicking on anything.

We visit various websites daily and it is important to know which sites are secure. A malicious website is a site created to steal data from users. These dangerous sites typically resemble legitimate websites, and your computer can be attacked by simply visiting a malicious website. You may be prompted to download software that your computer appears to need. A hazardous installation can compromise your machine, and your sensitive information as well. Here are a few things that can happen when you unknowingly visit a malicious website.

A drive-by-download can do all the damage that an untrusted download can do, with one important detail: it doesn't wait for your permission. When you click on an untrusted download, you are giving explicit permission for the program to install itself on your machine. But drive-by-downloads bypass all of that and install themselves onto your computer without asking for your permission. Hackers can install software onto sites that watch for vulnerabilities and pounce on them as soon as possible – leading to drive-by-downloads to your PC.

JavaScript infections sound technical, so let's break it down briefly. JavaScript is the language in which a lot of the internet is written. Many web applications, like Google Docs, use JavaScript to run their site. But if there are bugs or vulnerabilities in that code, hackers jump on it. JavaScript malware will install itself onto your computer and then run malicious code on your machine. It could scrape sensitive information or even redirect your computer to even more malicious sites, creating a chain reaction that could impact your life.

Another widespread phenomenon is malvertising, which is a form of hacking where an ad – one of any of the billions of ads that are online today – is hijacked. The hacker then uses that ad's network to spread it even farther. You don't notice that this one particular ad is hijacked, and you might click on it. Before you know it, you've installed malicious software on your computer and spread it to others.

URL injections are simple but effective. Targeting a platform like Word press (which powers 60% of today's blogs), hackers embed malicious URLs into a web page – sometimes even taking over entire pages. Once you visit a page like this from your web browser, code is executed on your PC that redirects you to other malicious sites, downloads malware to your computer, or scrapes personal information from you. This is also done with malicious redirects and browser hijackers, both of which will force you to visit other malware-infected sites.

It doesn't stop there: phishing websites often set themselves up to appear like credible sites, such as Amazon or eBay, where you would normally enter your credit card information. It's another powerfully convincing way to get you to share your data.

## 1.1 MALWARE

Malware is malicious software's, such as viruses, ransomware and spyware. Typically consists of code developed by cyberattacks, designed to cause extensive damage to data and systems or to gain unauthorized access to a network & delivered in the form of a link or file over email and requires the user to click on the link or open the file to execute the malware.

Malware has actually been a threat to individuals and organizations since the early 1970s when the Creeper virus first appeared. Malware delivers its payload in a number of different ways. From demanding a ransom to stealing sensitive personal data, cyber criminals are becoming more and more sophisticated in their methods.

Malware, short for malicious software, is a blanket term for viruses, worms, trojans and other harmful computer programs hackers use to wreak destruction and gain access to sensitive information. In other words, software is identified as malware based on its intended use, rather than a particular technique or technology used to build it.

### 1.1.1 Types of Malwares:

There are a number of different ways of categorizing malware; the first is by how the malicious software spreads. You've probably heard the words virus, trojan, and worm used interchangeably, but they describe three subtly different ways malware can infect target computers:

- a) **Worms** - Worms get their name from the way they infect systems. Starting from one infected machine, they weave their way through the network, connecting to consecutive machines in order to continue the spread of infection. This type of malware can infect entire networks of devices very quickly. A worm is a standalone piece of malicious software that reproduces itself and spreads from computer to computer.
- b) **Virus** - Possibly the most common type of malware, viruses attach their malicious code to clean code and wait for an unsuspecting user or an automated process to execute them. Like a

biological virus, they can spread quickly and widely, causing damage to the core functionality of systems, corrupting files and locking users out of their computers. They are usually contained within an executable file. A virus is a piece of computer code that inserts itself within the code of another standalone program, then forces that program to take malicious action and spread itself.

- c) **Trojans** - Just like Greek soldiers hid in a giant horse to deliver their attack, this type of malware hides within or disguises itself as legitimate software. Acting discreetly, it will breach security by creating backdoors that give other malware variants easy access. A trojan is a program that cannot reproduce itself but masquerades as something the user wants and tricks them into activating it so it can do its damage and spread.

Malware can also be installed on a computer "manually" by the attackers themselves, either by gaining physical access to the computer or using privilege escalation to gain remote administrator access.

Another way to categorize malware is by what it does once it has successfully infected its victim's computers. There are a wide range of potential attack techniques used by malware:

- i) **Spyware** is defined as "malware used for the purpose of secretly gathering data on an unsuspecting user." In essence, it spies on your behavior as you use your computer, and on the data you send and receive, usually with the purpose of sending that information to a third party. A keylogger is a specific kind of spyware that records all the keystrokes a user makes—great for stealing passwords. Spyware, as its name suggests, is designed to spy on what a user is doing. Hiding in the background on a computer, this type of malware will collect information without the user knowing, such as credit card details, passwords and other sensitive information.
- ii) A **rootkit** is, as described as "a program or, more often, a collection of software tools that gives a threat actor remote access to and control over a computer or other system." It gets its name because it's a kit of tools that (generally illicitly) gain root access (administrator-level control, in Unix terms) over the target system, and use that power to hide their presence.
- iii) **Adware** is malware that forces your browser to redirect to web advertisements, which often themselves seek to download further, even more malicious software. As The New York Times notes, adware often piggybacks onto tempting "free" programs like games or browser extensions.
- iv) **Ransomware** is a flavor of malware that encrypts your hard drive's files and demands a payment, usually in Bitcoin, in exchange for the decryption key. Several high-profile malware outbreaks of the last few years, such as Petya, are ransomware. Without the decryption key, it's mathematically impossible for victims to regain access to their files. So-called scareware is a sort of shadow version of ransomware; it claims to have taken control of your computer and demands a ransom, but actually is just using tricks like browser redirect loops to make it seem as if it's done more damage than it really has, and unlike ransomware can be relatively easily disabled. Also known as scareware, ransomware comes with a heavy price. Able to lockdown networks and lock out users until a ransom is paid, ransomware has targeted some of the biggest organizations in the world today with expensive results.

v) **Cryptojacking** is another way attackers can force you to supply them with Bitcoin—only it works without you necessarily knowing. The crypto mining malware infects your computer and uses your CPU cycles to mine Bitcoin for your attacker's profit. The mining software may run in the background on your operating system or even as JavaScript in a browser window.

vi) **Malvertising** is the use of legitimate ads or ad networks to covertly deliver malware to unsuspecting user's computers. For example, a cybercriminal might pay to place an ad on a legitimate website. When a user clicks on the ad, code in the ad either redirects them to a malicious website or installs malware on their computer. In some cases, the malware embedded in an ad might execute automatically without any action from the user, a technique referred to as a drive-by download.

### 1.1.2. How to prevent malware

With spam and phishing email being the primary vector by which malware infects computers, the best way to prevent malware is make sure your email systems are locked down tight—and your users know how to spot danger. We recommend a combination of carefully checking attached documents and restricting potentially dangerous user behavior—as well as just familiarizing your users with common phishing scams so that their common sense can kick in.

When it comes to more technical preventative measures, there are a number of steps to take, including keeping all your systems patched and updated, keeping an inventory of hardware so you know what you need to protect, and performing continuous vulnerability assessments on your infrastructure. When it comes to ransomware attacks in particular, one way to be prepared is to always make backups of your files, ensuring that you'll never need to pay a ransom to get them back if your hard drive is encrypted.

### 1.1.3 Malware protection

Antivirus software is the most widely known product in the category of malware protection products; despite "virus" being in the name, most offerings take on all forms of malware. While high-end security pros dismiss it as obsolete, it's still the backbone of basic antimalware defense. Today's best antivirus software is from vendors Kaspersky Lab, Symantec and Trend Micro, according to recent tests by AV-TEST.

When it comes to more advanced corporate networks, endpoint security offerings provide defense in depth against malware. They provide not only the signature-based malware detection that you expect from antivirus, but anti-spyware, personal firewall, application control and other styles of host intrusion prevention.

### 1.1.4 Malware examples

There is a long, storied history of malware, dating back to infected floppy disks swapped by Apple II hobbyists in the 1980s and the Morris Worm spreading across Unix machines in 1988. Some of the other high-profile malware attacks have included:

- i) **ILOVEYOU**, a worm that spread like wildfire in 2000 and did more than \$15 billion in damage.

- ii) **SQL Slammer**, which ground internet traffic to a halt within minutes of its first rapid spread in 2003.
- iii) **Conficker**, a worm that exploited unpatched flaws in Windows and leveraged a variety of attack vectors – from injecting malicious code to phishing emails – to ultimately crack passwords and hijack Windows devices into a botnet.
- iv) **Zeus**, a late '00s keylogger Trojan that targeted banking information
- v) **CryptoLocker**, the first widespread ransomware attack, whose code keeps getting repurposed in similar malware projects.
- vi) **Stuxnet**, an extremely sophisticated worm that infected computers worldwide but only did real damage in one place: the Iranian nuclear facility at Natanz, where it destroyed uranium enrichment centrifuges, the mission it was built for by U.S. and Israeli intelligence agencies.

## 1.2 MALWARE DETECTION METHOD

Malware analysis is a process or technique of determining the origin and potential impact of a specified malware sample. Malware could be anything that looks malicious or acts like one like a virus, worm, bug, Trojan, spyware, adware, etc. Any suspicious software that may cause harm to your system can be considered as a malware. Regardless of the increasing use of anti-malware software programs, the world is witnessing a rapid evolution in malware attacks. Anything that is connected to the Internet is prone to malware attack.

Malware detection continues to pose challenge as potential attackers find new and advanced ways to escape from detection methods. This is where malware analysis comes to the picture. Malware analysis gives a better understanding of how a malware functions and what can be done to eliminate those threats. The malware analysis can be done with different objectives in mind like to understand the extent of malware infection, to know the repercussions of the malware attack, to identify the nature of the malware, and to determine the functionalities of the malware.

### i. Static Analysis:

Static analysis is a process of analyzing a malware binary without actually running the code. Static analysis is generally performed by determining the signature of the binary file which is a unique identification for the binary file and can be done by calculating the cryptographic hash of the file and understanding each component. The malware binary file can be reverse-engineered by loading the executable into a disassembler such as IDA. The machine-executable code can be converted assembly language code so that it can be easily read and understood by humans. The analyst then looks at the program to have a better understanding of what it is capable of and what it's programmed to do.

Static analysis examines a malware file without actually running the program. This is the safest way to analyze malware, as executing the code could infect your system. In its most basic form, static analysis gleans information from malware without even viewing the code. Metadata such as file name, type, and size can yield clues about the nature of the malware. MD5 checksums or hashes can be compared with a database to determine if the malware has been previously recognized. And scanning with antivirus software can reveal what malware you're dealing with. Advanced static analysis—also known as code analysis—dissects the binary file to study each component, still without executing it. One

method is to reverse engineer the code using a disassembler. Machine code is translated into assembly code, which is readable and understandable. By looking at the assembly instructions, an analyst can tell what the program is meant to do. A file's headers, functions, and strings can provide important details. Unfortunately, modern hackers are adept at evading this technique. By embedding certain syntax errors into their code, they can misdirect disassemblers and ensure the malicious code still runs. Because static malware analysis can be more easily foiled, dynamic malware analysis is also necessary.

## ii. Dynamic Analysis:

The dynamic analysis approach involves the execution of the application on either a virtual machine or a physical device. During the analysis, the behavior of the application is observed and can be analyzed. The dynamic analysis results in a less abstract view of the application than the static analysis. The code paths executed during runtime are a subset of all available paths. The main goal for analysis frameworks is to reach high code coverage because all possible actions should be triggered to observe any possible malicious behavior. Research has shown that fully randomized input achieves a 40% or lower code coverage. Multipath execution is a way to increase the code coverage. Whenever a branch is taken, the current state of the VM is saved in a snapshot so that it can be rolled back and executes the other branch. However, this is only partially applicable because this behavior much likely breaks network protocols.

Depending on the data of interest, different techniques exist to monitor the applications behavior. One analysis technique is taint tracking. A system, wide implemented taint propagation is able to analyze the message flow and potential misuse of private sensitive information through third party applications. A popular framework which uses that technique is TaintDroid. Developed with the Dalvik Virtual Machine, it monitors how applications access and manipulate user data in real time. It labels the sensitive data as it flows through variables, files and messages. However, TaintDroid is only able to detect explicit data flow and is not able to analyze implicit flow through control flow. Private information could be transmitted over that channel.

## 1.3 MALWARE INFECTION METHODS

There are several methods that the Android devices could be infected with malware. The following are *four* different methods which malware can be installed on the phone.

### a) Repackaging legitimate application

This is one of the most common methods used by the attackers. They may locate and download legitimate popular applications from the market, disassemble it, add malicious code and then reassemble and submit the new apps to the official or alternative Android market. Users could be vulnerable by being enticed to download and install these infected applications. It was found that 86.0% repackaged legitimate applications including malicious payloads after analyzing more than 1,200 Android malware samples.

### b) Exploiting Android's application bug

There could be a bug in the application itself. The attacker may use this vulnerability to compromise the phone and install the malware on the device.

### c) Fake applications

It was also discovered that there are fake applications created to include malware which allows attackers to access your mobile device. Attackers upload on the market fake applications that seem legitimate to users but they are malware by themselves. For example, Spyeeye's fake security tool was found in the market which is a malware.

### d) Remote Install

The malware could be installed in the user phone remotely. If the attacker could compromise user's credentials and pass them in the market, then in this case, the malware will be installed into the device without the user's knowledge. This application will contain malicious codes that allow attackers to access personal data such as contacts.

## 1.4 MACHINE LEARNING

Machine learning (ML) is a type of artificial intelligence (AI) that allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so. Machine learning algorithms use historical data as input to predict new output values.

Machine Learning is the field of study that gives computers the capability to learn without being explicitly programmed. ML is one of the most exciting technologies that one would have ever come across. As it is evident from the name, it gives the computer that makes it more similar to humans: The ability to learn. Machine learning is actively being used today, perhaps in many more places than one would expect. Machine Learning (ML) can be explained as automating and improving the learning process of computers based on their experiences without being actually programmed i.e, without any human assistance.

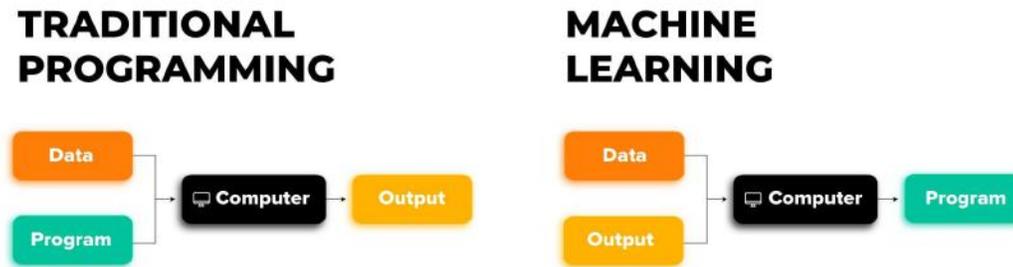
The process starts with feeding good quality data and then training our machines (computers) by building machine learning models using the data and different algorithms. The choice of algorithms depends on what type of data we have and what kind of task we are trying to automate. Machine learning is a part of artificial intelligence which is described as the science to getting computers to do things without being directly programmed.

Machine learning focuses on the study of computing algorithms and data into the system to allow it to make decisions without writing manual code. Machine learning is revolutionizing the way we do business and our day-to-day activities. The old or traditional software programmers were loaded with a lot of work. They first wrote logic based on the current state of the business and then added relevant data. But, with time, and with the advent of technology, major changes started happening.

### 1.4.1 Basic Difference in ML and Traditional Programming

- Traditional Programming: We feed in DATA (Input) + PROGRAM (logic), run it on machine and get output.

- Machine Learning: We feed in DATA(Input) + Output, run it on machine during training and the machine creates its own program(logic), which can be evaluated while testing.



*Fig 1.1 Difference between traditional programming and machine learning*

## 1.4.2 Applications of machine learning

Sample applications of machine learning:

- Web search
- Computational biology
- Finance
- E-commerce
- Space exploration
- Robotics
- Information extraction
- Social networks
- Debugging

## 1.4.3 Key Elements of Machine Learning

Every machine learning algorithm has three components:

- **Representation:** how to represent knowledge. Examples include decision trees, sets of rules, instances, graphical models, neural networks, support vector machines, model ensembles and others.

- **Evaluation:** the way to evaluate candidate programs (hypotheses). Examples include accuracy, precision and recall, squared error, likelihood, posterior probability, cost, margin, entropy k-L divergence and others.
- **Optimization:** the way candidate programs are generated is known as the search process. For example, combinatorial optimization, convex optimization, constrained optimization.

#### 1.4.4 Types of machine learning

There are four types of machine learning:

**i) Supervised learning:-** It is also called inductive learning. Training data includes desired outputs. This is spam this is not, learning is supervised.

**ii) Unsupervised learning:-** Training data does not include desired outputs. Example is clustering. It is hard to tell what is good learning and what is not.

**iii) Semi-supervised learning:** Training data includes a few desired outputs.

**iv) Reinforcement learning:** Rewards from a sequence of actions. AI types like it, it is the most ambitious type of learning.

Supervised learning is the most mature, the most studied and the type of learning used by most machine learning algorithms. Learning with supervision is much easier than learning without supervision.

Inductive Learning is where we are given examples of a function in the form of data ( $x$ ) and the output of the function ( $f(x)$ ). The goal of inductive learning is to learn the function for new data ( $x$ ).

- **Classification:** when the function being learned is discrete.
- **Regression:** when the function being learned is continuous.
- **Probability Estimation:** when the output of the function is a probability.

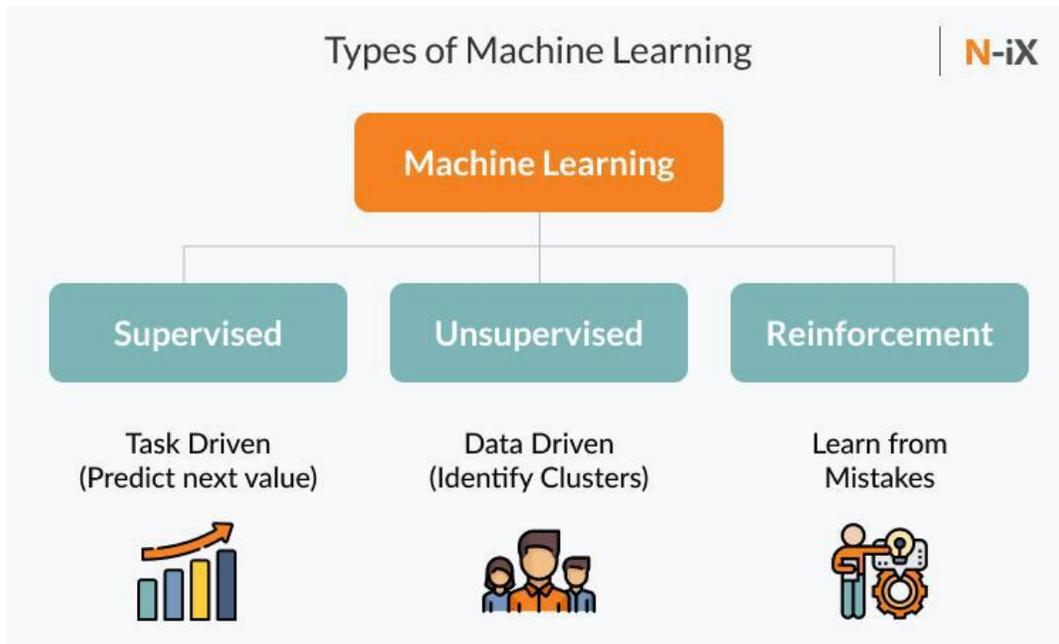


Fig 1.2 Types of machine learning

## 1.5 SVM Algorithm

Support Vector Machine or SVM is one of the most popular Supervised Learning algorithms, which is used for Classification as well as Regression problems. However, primarily, it is used for Classification problems in Machine Learning. The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future. This best decision boundary is called a hyperplane. SVM chooses the extreme points/vectors that help in creating the hyperplane. These extreme cases are called as support vectors, and hence algorithm is termed as Support Vector Machine

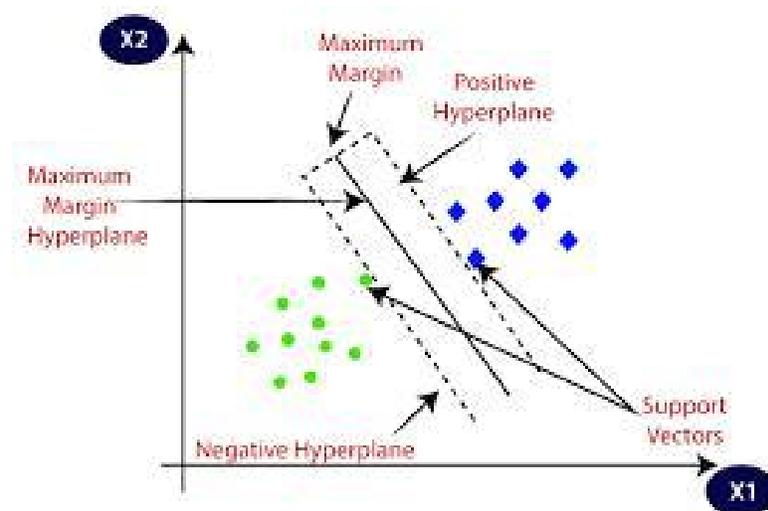


Fig 1.3 SVM algorithm

## 1.5.1 Types of SVM

SVM can be of two types:

- **Linear SVM:** Linear SVM is used for linearly separable data, which means if a dataset can be classified into two classes by using a single straight line, then such data is termed as linearly separable data, and classifier is used called as Linear SVM classifier.
- **Non-linear SVM:** Non-Linear SVM is used for non-linearly separated data, which means if a dataset cannot be classified by using a straight line, then such data is termed as non-linear data and classifier used is called as Non-linear SVM classifier.

## 1.5.2 Advantages of SVM algorithm

- SVM works relatively well when there is a clear margin of separation between classes.
- SVM is more effective in high dimensional spaces.
- SVM is effective in cases where the number of dimensions is greater than the number of samples.
- SVM is relatively memory efficient.

## 1.5.3 Disadvantages of SVM algorithm

- SVM algorithm is **not suitable for large data sets**.
- SVM does not perform very well when the data set has more noise i.e. target classes are overlapping.
- In cases where the number of features for each data point exceeds the number of training data samples, the SVM will underperform.

## 1.6 Naïve Bayes Classifier Algorithm

Naïve Bayes algorithm is a supervised learning algorithm, which is based on Bayes theorem and used for solving classification problems. It is mainly used in text classification that includes a high-dimensional training dataset. Naïve Bayes Classifier is one of the simple and most effective Classification algorithms which helps in building the fast machine learning models that can make quick predictions. It is a probabilistic classifier, which means it predicts on the basis of the probability of an object. Some popular examples of Naïve Bayes Algorithm are spam filtration, Sentimental analysis, and classifying articles.

It is a classification technique based on Bayes' Theorem with an assumption of independence among predictors. In simple terms, a Naive Bayes classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature.

For example, a fruit may be considered to be an apple if it is red, round, and about 3 inches in diameter. Even if these features depend on each other or upon the existence of the other features, all of these properties independently contribute to the probability that this fruit is an apple and that is why it is known as 'Naive'.

Naive Bayes model is easy to build and particularly useful for very large data sets. Along with simplicity, Naive Bayes is known to outperform even highly sophisticated classification methods.

Bayes theorem provides a way of calculating posterior probability  $P(c|x)$  from  $P(c)$ ,  $P(x)$  and  $P(x|c)$ .

$$P(c|x) = \frac{P(x|c)P(c)}{P(x)}$$

Likelihood
Class Prior Probability  
Posterior Probability
Predictor Prior Probability

$$P(c | X) = P(x_1 | c) \times P(x_2 | c) \times \dots \times P(x_n | c) \times P(c)$$

Where,

- $P(c|x)$  is the posterior probability of *class* ( $c$ , *target*) given *predictor* ( $x$ , *attributes*).
- $P(c)$  is the prior probability of *class*.
- $P(x|c)$  is the likelihood which is the probability of *predictor* given *class*.
- $P(x)$  is the prior probability of *predictor*.

### 1.6.1 Advantages of Naive Bayes

- It is easy and fast to predict class of test data set. It also performs well in multi class prediction.
- When assumption of independence holds, a Naive Bayes classifier performs better compare to other models like logistic regression and you need less training data.
- It performs well in case of categorical input variables compared to numerical variable(s). For numerical variable, normal distribution is assumed (bell curve, which is a strong assumption).

### 1.6.2 Disadvantages of Naive Bayes

- It is easy and fast to predict class of test data set. It also performs well in multi class prediction.
- When assumption of independence holds, a Naive Bayes classifier performs better compare to other models like logistic regression and you need less training data.
- It performs well in case of categorical input variables compared to numerical variable(s). For numerical variable, normal distribution is assumed (bell curve, which is a strong assumption).

### 1.6.3 Applications of Naive Bayes Algorithms

- **Real time Prediction:** Naive Bayes is an eager learning classifier and it is sure fast. Thus, it could be used for making predictions in real time.

- **Multi class Prediction:** This algorithm is also well known for multi class prediction feature. Here we can predict the probability of multiple classes of target variable.
- **Text classification/ Spam Filtering/ Sentiment Analysis:** Naive Bayes classifiers mostly used in text classification (due to better result in multi class problems and independence rule) have higher success rate as compared to other algorithms. As a result, it is widely used in Spam filtering (identify spam e-mail) and Sentiment Analysis (in social media analysis, to identify positive and negative customer sentiments).
- **Recommendation System:** Naive Bayes Classifier and Collaborative Filtering together builds a Recommendation System that uses machine learning and data mining techniques to filter unseen information and predict whether a user would like a given resource or not

## 1.7 Random Forest

The idea behind the random forest algorithm is to construct a forest of random trees. It is an ensemble learning method for classification. It works by building a decision tree at training time and outputting the class by individual trees. The training algorithm for random forests uses the general technique of bootstrap aggregating, or bagging, to the learners. The advantages of random forest algorithms are its efficiency on large databases, successfully handling thousands of input variables without deleting any variable. Moreover, it has an effective method for estimating missing data and maintains accuracy when a large proportion of the data are missing. Random forest algorithm is selected in the analysis of permission-based malware detection as a third decision tree algorithm.

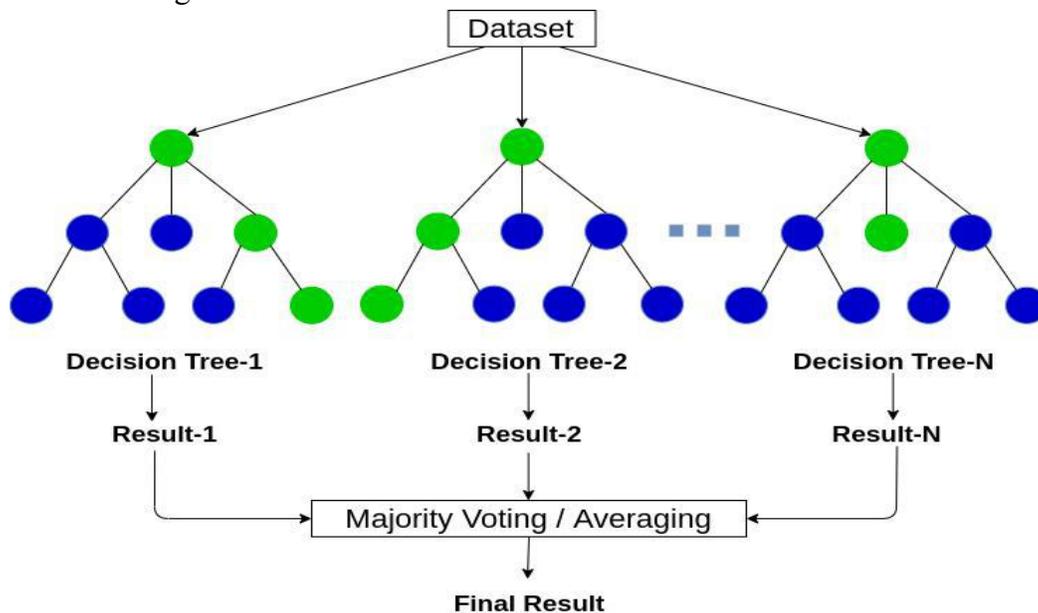


Fig 1.4 Random forest algorithm

### 1.7.1 Advantages of random forest algorithm

- Random Forest is based on the bagging algorithm and uses Ensemble Learning technique. It creates as many trees on the subset of the data and combines the output of all the trees. In this way it reduces overfitting problem in decision trees and also reduces the variance and therefore improves the accuracy.
- Random Forest can be used to solve both classification as well as regression problems.
- Random Forest works well with both categorical and continuous variables.
- Random Forest can automatically handle missing values.
- No feature scaling required: No feature scaling (standardization and normalization) required in case of Random Forest as it uses rule based approach instead of distance calculation.
- Handles non-linear parameters efficiently: Non linear parameters don't affect the performance of a Random Forest unlike curve based algorithms. So, if there is high non-linearity between the independent variables, Random Forest may outperform as compared to other curve based algorithms.
- Random Forest can automatically handle missing values.
- Random Forest is usually robust to outliers and can handle them automatically.
- Random Forest algorithm is very stable. Even if a new data point is introduced in the dataset, the overall algorithm is not affected much since the new data may impact one tree, but it is very hard for it to impact all the trees.
- Random Forest is comparatively less impacted by noise.

### 1.7.2 Disadvantages of random forest algorithm

- **Complexity:** Random Forest creates a lot of trees (unlike only one tree in case of decision tree) and combines their outputs. By default, it creates 100 trees in Python sklearn library. To do so, this algorithm requires much more computational power and resources. On the other hand decision tree is simple and does not require so much computational resources.
- **Longer Training Period:** Random Forest require much more time to train as compared to decision trees as it generates a lot of trees (instead of one tree in case of decision tree) and makes decision on the majority of votes.

## CHAPTER-2

### LITERATURE SURVEY

Malware is a worldwide epidemic. Studies suggest that the impact of malware is getting worse. Malware detectors are the primary tools in defence against malware. The quality of such a detector is determined by the techniques it uses. It is therefore imperative that we study malware detection techniques and understand their strengths and limitations. In this paper, we provide a "data mining" approach for malicious software detection and perform some experimental investigation on malware detection using linear SVM algorithm. The goal of the work [1] is to show actual results of malware detection rates of SVM method. The SVM classifier is approved to detect unknown samples of malware with a probability of 74 - 83 percent.

Text classification algorithms, such SVM, and Naïve Bayes, have been developed to build up search engines and construct spam email filters [2]. As a simple yet powerful sample of Bayesian Theorem, Naïve Bayes shows advantages in text classification yielding satisfactory results. Malware, short for Malicious Software, is growing continuously in numbers and sophistication as our digital presence continues to grow. It is a very serious problem and many efforts are devoted to malware detection in today's cybersecurity world. Many machine learning algorithms have been used in automatic detection of malware problems in recent years. Recently Deep Learning is being used with better performance. Deep Learning models work much better in the analysis of long sequences of system calls.

Every time a web search engine like Google is used to search the internet, one of the reasons that works so well is because of a learning algorithm that has learned how to rank web pages. These algorithms are used for various purposes like data mining, image processing, predictive analytics, etc. to name a few. The main advantage of using machine learning is that, once an algorithm learns what to do with data, it can do its work automatically. In the paper [3], a brief review and future prospect of the vast applications of machine learning algorithms has been made.

To defeat current commercial antivirus software, the virus developers are employing obfuscation techniques to create mutating viruses. The current antivirus software cannot handle the obfuscated viruses well since its detection methods that are based upon static signatures are not resilient to even slight variations in the code that forms the virus. In [4], a new type of virus signature, called dynamic signature, and an algorithm for matching dynamic signatures was proposed. A dynamic signature is created based on the runtime behaviour of a virus. Therefore, an obfuscated virus can also be detected using a dynamic signature as long as it dynamically behaves like the original virus. Issues related to deploying the virus detection approach was also discussed. The proposed method is effective in identifying obfuscated viruses.

Conventional signature matching-based antivirus systems fail to detect polymorphic, obfuscated, and new, previously unseen malicious executables. Hence, automated behaviour-based malware detection using machine learning techniques is considered a profound solution. The behaviour of each malware on an emulated (sandbox) environment will be automatically analysed and will generate behaviour reports. These reports will be pre-processed into sparse vector models for further machine learning (classification). The classifiers used in this research are k-Nearest Neighbors (kNN), Naïve Bayes, Decision Tree, Support Vector Machine (SVM), and Artificial Neural Network (ANN). According to the analysis of the test and experiment results of all the 5 classifiers, the overall best performance goes to J48 with a recall (true positive rate) of 95.9%, a false positive rate of 2.4%, a precision (positive predictive value) of 97.3%, and an accuracy of 96.8%. It can be concluded that a proof-of-concept based on automatic behaviour-based

malware analysis and the use of machine learning techniques could detect malware quite effectively and efficiently[5].

With an increase in popularity and usage of smartphones, attackers are constantly trying to get sensitive information from smartphones. To protect the information, researchers are constantly working on the effective detection of android malware. Since there has been a large-scale increase in the number of new malwares being detected, machine learning-based techniques have to turn towards effective large-scale detection [6].

Machine-learning algorithm detects and validates the principles that support the information. With this information, the algorithm can 'consult' the properties of previously unrecognised samples. At the detection of malware, a previously unrecognised sample may be a new file to the program. Its subtle assets can be malware or benign. The set of customised terms in terms of data is called a model. Machine learning has many broad approaches that are needed in solving one approach. These methods have different capabilities and different appropriate functions. In [6], have used advanced machine learning algorithms and use the most accurate algorithm in the proposed model to detect if a file is malware or not.

With the recent emergence of mobile platforms capable of executing increasingly complex software and the rising ubiquity of using mobile platforms in sensitive applications such as banking, there is a rising danger associated with malware targeted at mobile devices. The problem of detecting such malware presents unique challenges due to the limited resources available and limited privileges granted to the user, but also presents a unique opportunity in the required metadata attached to each application. In [7], a machine learning-based system for the detection of malware on Android devices. The proposed system extracts a number of features and trains a One-Class Support Vector Machine in an offline (off-device) manner, in order to leverage the higher computing power of a server or cluster of servers.

## CHAPTER-3

### EXISTING SYSTEM

#### 3.1 Overview

The governments of developed countries already have the policy framework of national anti-virus software addressing the security issues and developing nations also tend to follow this trend - making comprehensive effort on anti-virus software development.

The spread of malware is being epidemic as a consequence of rapid growth of computer technology and its usage. Malware is defined as any code designed to infiltrate or damage a computer system without owner's consent. The term malware is brief of the word "malicious software". In recent years, increasing number of malware instances require dramatic improvement on malware detection technology. The malware protection technology is one of the 30 top priority topics of the world information and communication technology development trends since 2003. For our country, we are facing with the challenge to develop this "strategic technology" and create anti-virus software framework and resources in a next few year, which is one of the national security wide concerns. The detection of malware is the most significant part of malware protection.

They provide a "data mining" approach for malicious software detection and performed some experimental investigation on malware detection using linear SVM algorithm. The goal of this work is to show actual result of malware detection rates of SVM method. The SVM classifier is approved to detect unknown samples of malware with the probability of 74 - 83 percent. The detection principle is that, SVM algorithm generates detection model learning from the sufficient data set of malicious software.

### 3.2 FLOWCHART

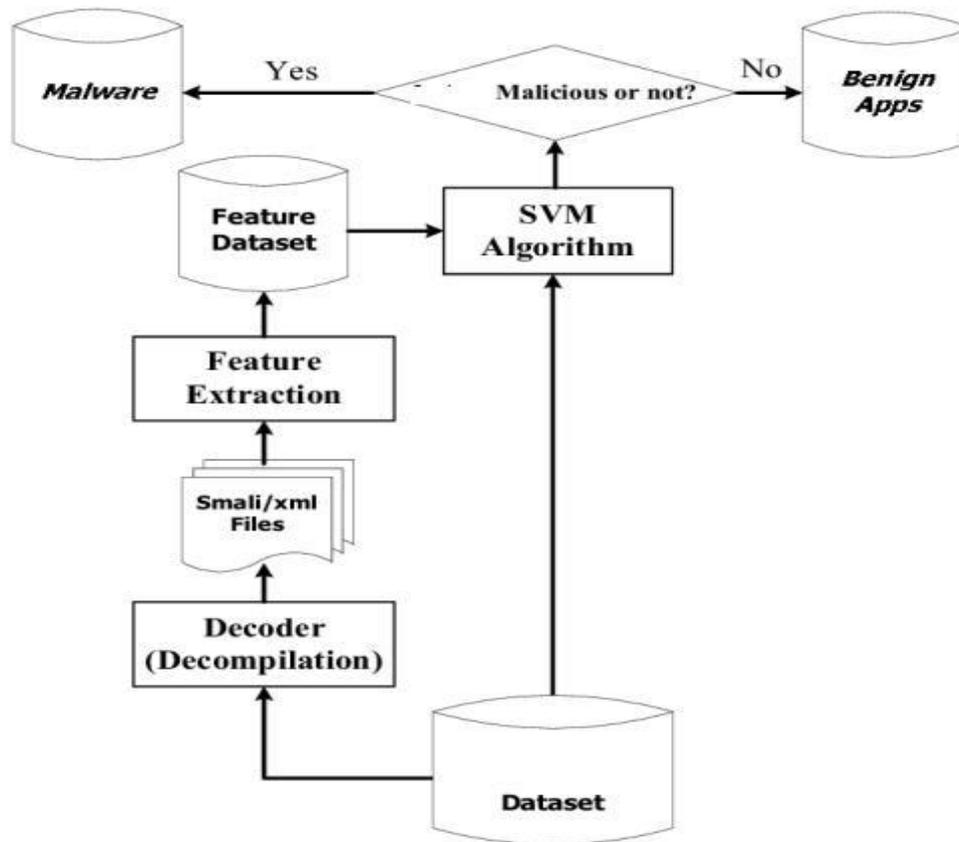


Fig 3.1 Existing system architecture

### 3.4. DRAWBACK

Although the system works successfully, it has a drawback i.e, The accuracy of existing systems in malware detection is low while looking to the latest highly accurate data mining techniques.

whereas SVM looks at the interactions between them to a certain degree, as long as you're using a non-linear kernel.

And also, when the number of features larger than the number of samples, it is crucial to choose suitable Kernel function and regulation.

# CHAPTER-4

## PROPOSED SYSTEM

### 4.1 OVERVIEW

Due to the numerous increases of malware in the networks nowadays, it has become a serious danger that threatens our computers. Network attackers did these attacks by designing the malware. A designed system model is needed to defy these threats, prevent it from multiplying and spreading through the network, and harm our computers. In this paper, we designed a detection system model for this issue. The designed system detects the malware that depends on the information of the dataset, the system will receive the input package and then analyse it, the Naïve Bayesian classification technique will start to work and begin to classify the package, by using the data mining technique, the system worked fast and gained great results in detecting the malware. By applying the Naïve Bayesian classification technique using its probability mathematical equations for both threat data and benign data, the technique will detect the malware and classify data whether it was threat or benign. The results of the experiments were 95% of malware detection accuracy and 98% of detection rate with 21% false positives, which makes it more accurate and effective to detect the malware by using the proposed dataset for this work.

#### Summarizing our system:

- We describes about the machine learning technique i.e, traning and testing the data set.
- Then we use naïve bayes algorithm for malware detection.
- For classifying the image detected, glm features are used.

### 4.2 METHOD OF ANALYSIS

We use Machine Learning algorithms for analyzing these permissions. Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention. Machine-learning algorithms use statistics to find patterns in massive amounts of data. And data, here, encompasses a lot of things—numbers, words, images, clicks, what have you. If it can be digitally stored, it can be fed into a machine learning algorithm.

Machine-learning algorithms are responsible for the vast majority of the artificial intelligence advancements and applications you hear about. A feature vector for each application is created based on a total of 152 permissions which is considered as the feature dataset. The accuracy of detecting the malware samples based on the features extracted is evaluated by applying machine learning classification algorithms like Naive Bayes, Randomforest, etc.

### 4.3 ARCHITECTURE

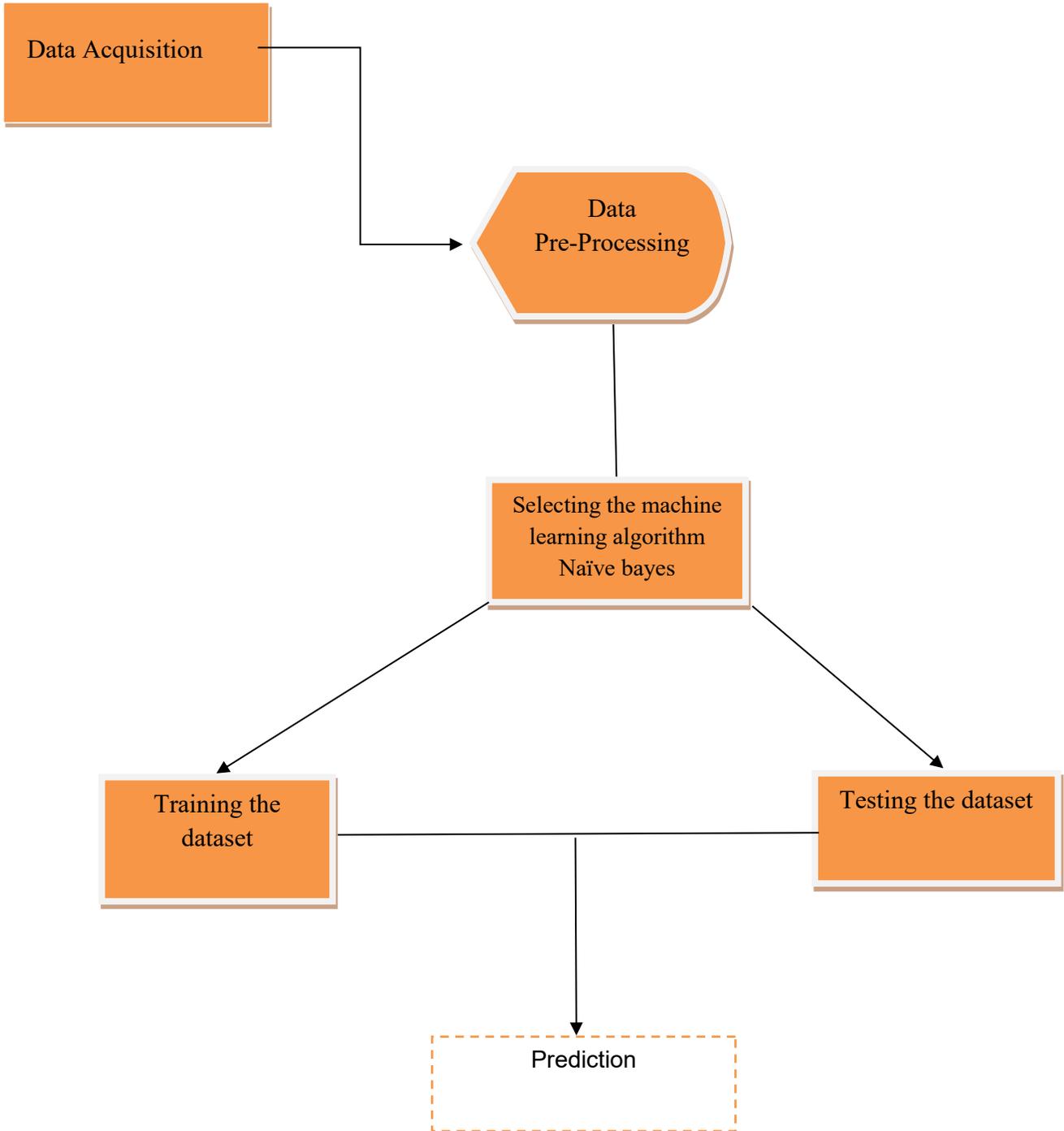


Fig 4.1 Architecture of proposed system

#### **4.4 SYSTEM WORKING**

Step 1: First admin needs to login with username and password.

Step 2: Then add the staff details, then admin need to assign work for the staff. Admin can view all the works done by the staff.

Step 3: Staff needs to login with a unique username and password.

Step 4: Staff can upload their work and admin can view it.

Step 5: Staff can upload URL and image to check if it is malicious or not.

Step 6: Staff can upload complaints if any and admin can view the complaint.

## CHAPTER-5

# SYSTEM REQUIREMENT SPECIFICATIONS

### ➤ SOFTWARE REQUIREMENTS

- Coding Platform
- Machine Learning Algorithms
- Any Operating System (Windows, Linux, etc...)

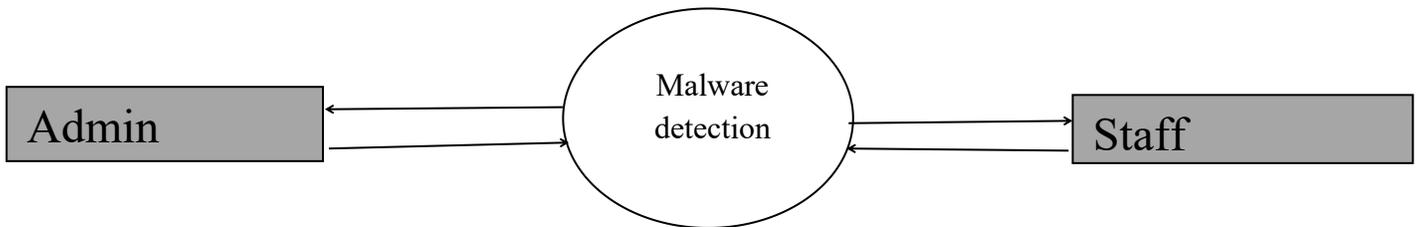
### ➤ HARDWARE REQUIREMENTS

- 8 GB RAM
- Hard disk
- i5 Processor
- Monitor
- Keyboard
- Mouse

## CHAPTER-6

### SYSTEM DESIGN ARCHITECTURE

**Level 0:**

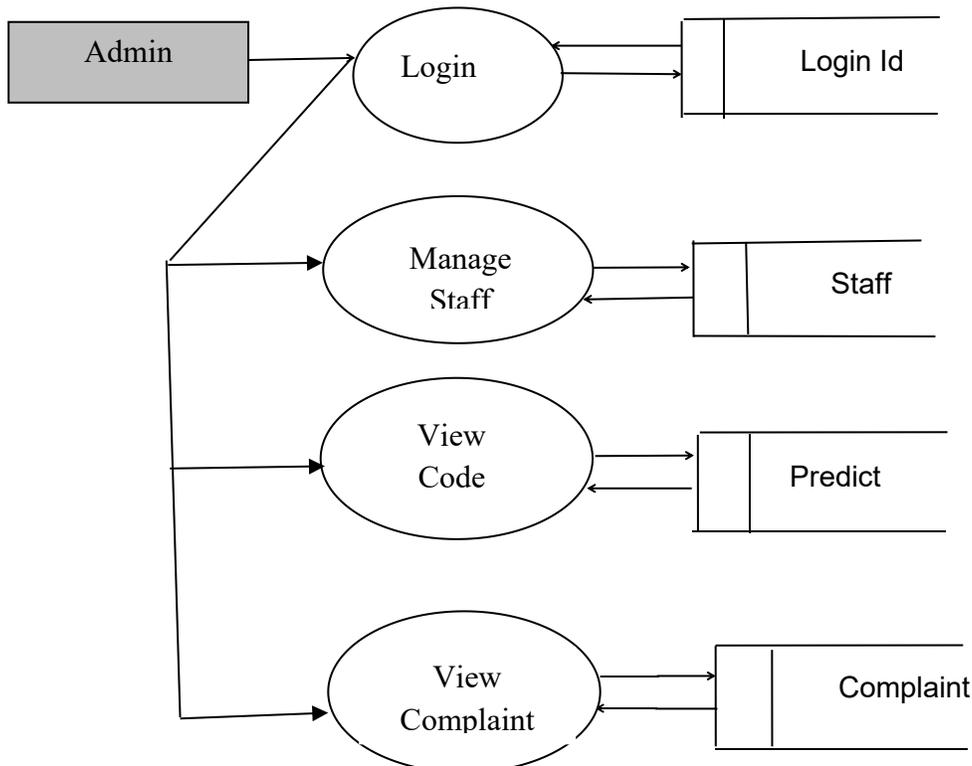


*Fig 6.1. Basic abstract of system*

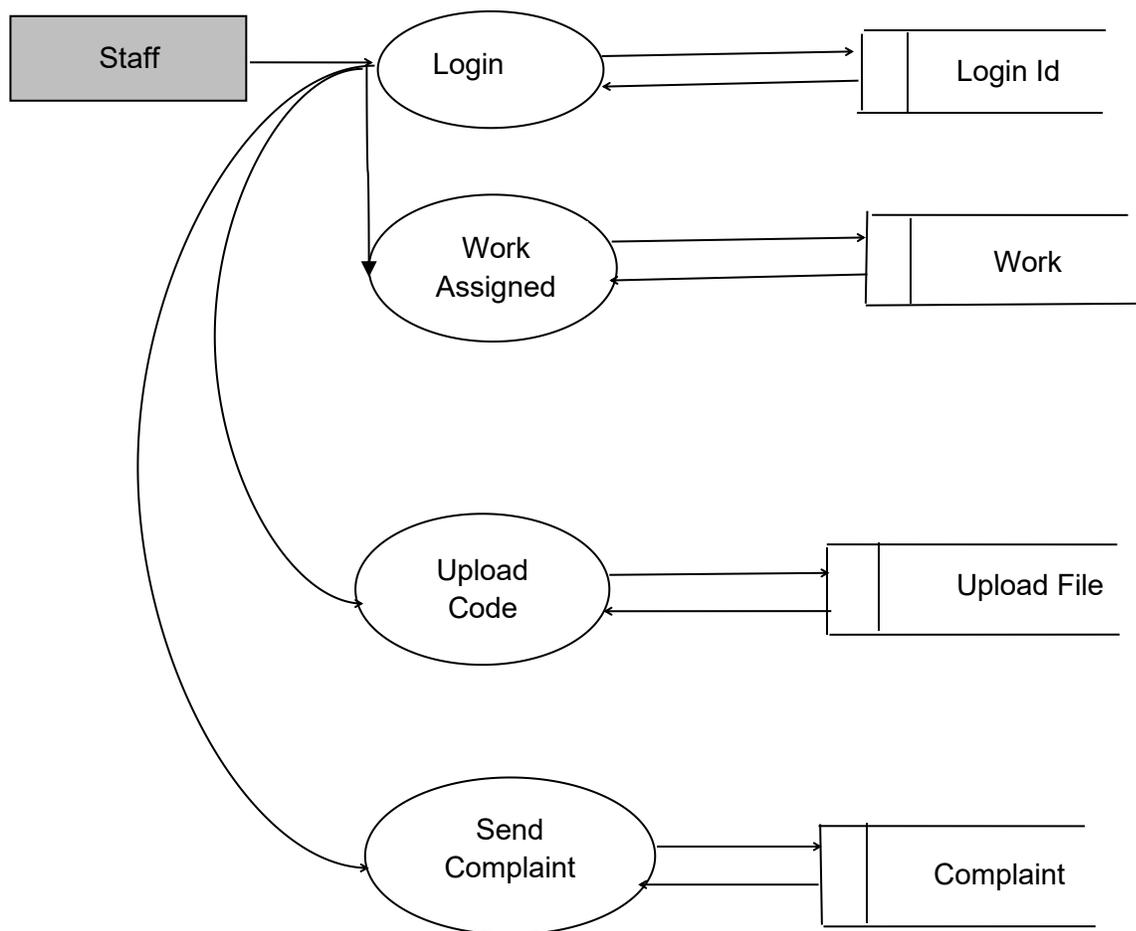
Level 0 describes the basic working of our system. The system has two login form that is admin and staff. Here the admin login and add staff to the system. Each staff in will have a login ID and Password and they can Do their work according to the work assigned from the Admin.

**Level 1:**

Level- 1.1

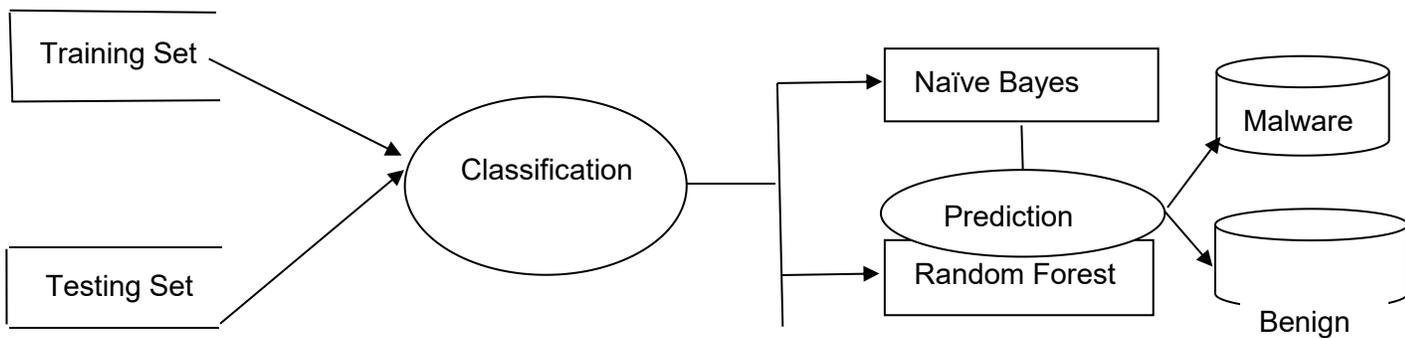


Level-1.2

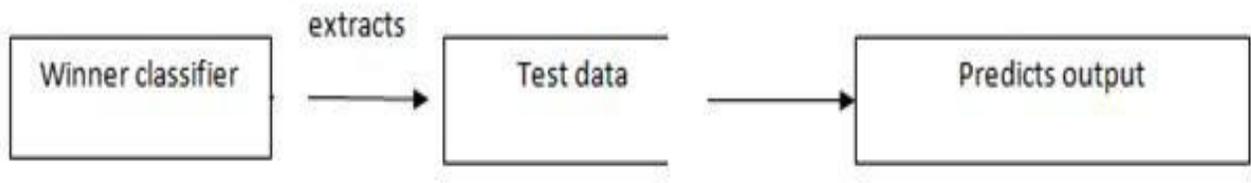


*Fig 6.2. Working of System*

Level-1.3



*Fig6.3. Extracting the best classifier algorithm via accuracy check*



*Fig6.4. Output prediction*

## CHAPTER-7

### MODULE DESCRIPTION

The system consists of four modules:

- ❖ **Module 1: Machine Learning**
- ❖ **Module 2: Extraction**
- ❖ **Module 3: Training and Testing**
- ❖ **Module 4: Classification**

#### MODULE 1: MACHINE LEARNING

Machine learning (ML) is a type of artificial intelligence (AI) that allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so. Machine learning algorithms use historical data as input to predict new output values. Machine learning is important because it gives enterprises a view of trends in customer behavior and business operational patterns, as well as supports the development of new products. Many of today's leading companies, such as Facebook, Google and Uber, make machine learning a central part of their operations. Machine learning has become a significant competitive differentiator for many companies. Classical machine learning is often categorized by how an algorithm learns to become more accurate in its predictions. There are four basic approaches: supervised learning, unsupervised learning, semi-supervised learning and reinforcement learning. The type of algorithm data scientists choose to use depends on what type of data they want to predict.

Supervised machine learning requires the data scientist to train the algorithm with both labeled inputs and desired outputs. Unsupervised machine learning algorithms do not require data to be labeled. They sift through unlabeled data to look for patterns that can be used to group data points into subsets. Most types of deep learning, including neural networks, are unsupervised.

In this module we use machine learning for training and testing of the data set that which the admin wants to check whether it is safe or malicious site or image. Machine Learning techniques also helped in creating the dataset which we used for training the system and testing the accuracy of the system. In our work we use python code for extraction features.

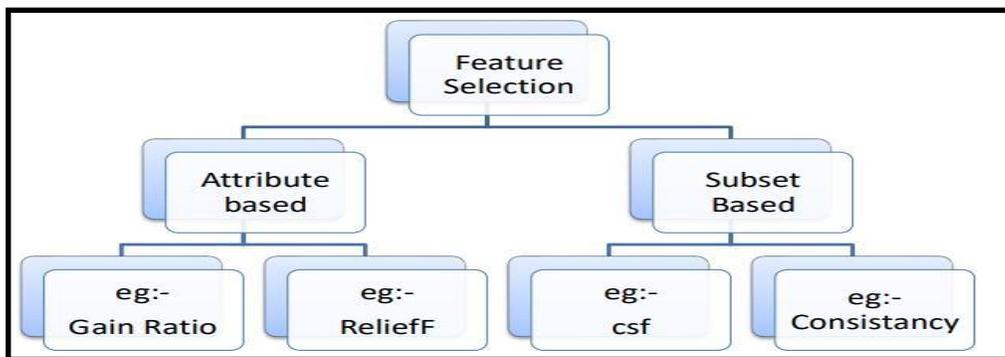
#### MODULE 2 : EXTRACTION

##### Feature Selection Methods

Feature selection methods are beneficial for the performance of classification algorithms because a large number of extracted features, some of which are redundant or irrelevant, present several problems

such as misleading the learning algorithm, over-fitting, reducing generality, and increasing model complexity and run-time. These bad effects are even more crucial when applying machine learning methods on mobile devices, since they are often restricted by processing and storage-capabilities. Applying fine feature selection before machine learning, enabled the use of malware detectors more efficiently, with a faster detection.

Feature selection methods can be divided into two groups as attribute based and subset based feature selection methods. Attribute based feature selection methods evaluate each feature independent from other features. These methods need a class feature to evaluate each feature with this class feature defined by the analyzer in attribute feature selection methods. The dependency of features to other features is out of consideration but the relation with class features is under consideration in those feature selection methods. Gain Ratio and Relief attribute feature selection methods are this type of methods. In subset based feature selection methods, the subsets of features are constructed and the subset including some number of features which best represent the whole features is selected by feature selection method. In these feature selection methods, the dependency of features to each other and class feature is considered in feature selection. Correlation feature selection(Cfs) and Consistency subset feature selection methods are used for subset type feature selection methods.



*Fig 7.1. Feature selection*

In Our project, we extracted some important features from the content that is image or any URL according to each features position we make compression with the contents in the trained set . Then the permissions requested by an application is represented as a binary value, one for each permission, where 1 (TRUE) stays for the presence of that particular permission while 0 (FALSE) stays for its absence. In our database, we also store the application behavior in the last column, saved as either benign or malicious (1 for benign and 0 for malicious).

Example:

Formal ware application

1,1,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,1,0

For goodware application

0,0,0,0,0,0,0,1,1,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,1,0,1

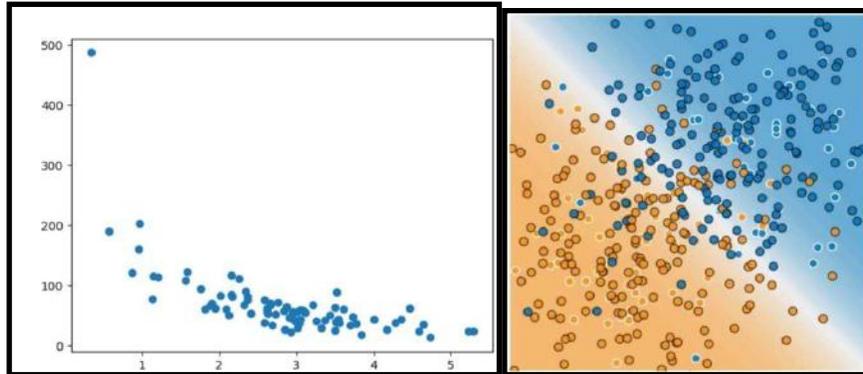
### MODULE 3: TRAINING AND TESTING

In a dataset, a training set is implemented to build up a model, while a test (or validation) set is to validate the model built. Data points in the training set are excluded from the test (validation) set. Usually, a dataset is divided into a training set, a validation set (some people use testset instead) in each iteration, or divided into a training set, a validation set and a test set in each iteration. In Machine Learning, we basically try to create a model to predict the test data. So, we use the training data to fit the model and testing data to test it. The models generated are to predict the results unknown which is named as the test set. In contrast to machine learning, fitting means training. There is a fit function in ML, that is used for training of models using data examples. Fit function adjusts weights according to data values so that better accuracy can be achieved.

As we pointed out, in this module the dataset is divided into train and test set in order to check accuracies, by training and testing it on it. Train/Test is a method to measure the accuracy of our model. It is called Train/Test because you split the data set into two sets: a training set and a testing set. The *training* set should be a random selection of 69% of the original data. The *testing* set should be the remaining 31%. In our system we divided the dataset in the same way i.e, 69% for training, and 31% for testing. We *train* the model using the training set. We *test* the model using the testing set. *Train* the model means *create* the model. *Test* the model means test the accuracy of the model.

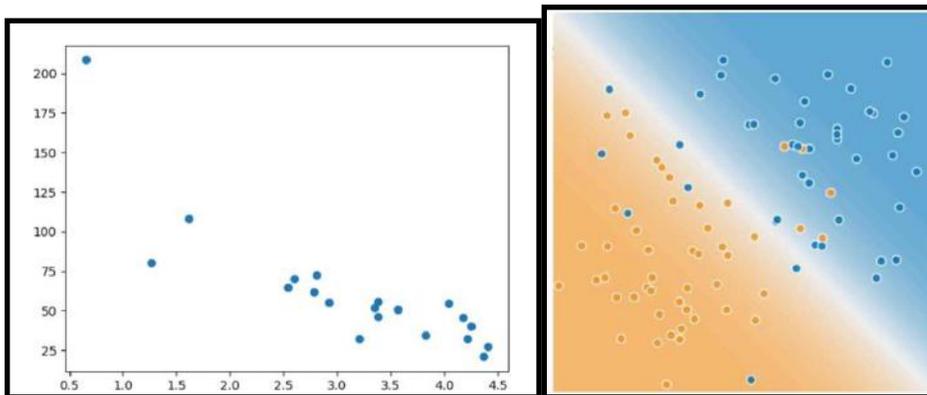
**i) Training Set:** Here, you have the complete training dataset. You can extract features and train to fit a model. To train any machine learning model irrespective what type of dataset is being

used you have to split the dataset into training data and testing data. Here we have used the 'train test split' to split the data in 69:31 ratio i.e. 69% of the data will be used for training the model while 31% will be used for testing the model that is built out of it. We got a dataset from Kaggle.



*Fig 7.2 Training set*

**ii) Testing Set:** Here, once the model is obtained, you can predict using the model obtained on the training set.



*Fig 7.3 Testing set*

When splitting a dataset there are two competing concerns:

- If we have less training data, our parameter estimates have greater variance.
- And if we have less testing data, your performance statistic will have greater variance.

The data should be divided in such a way that neither of them is too high, which is more dependent on the amount of data we have. If our data is too small then no split will give you satisfactory variance so we will have to do cross-validation but if your data is huge then it

doesn't really matter whether you choose an 69:31 split or a 70:30 split (indeed you may choose to use less training data as otherwise, it might be more computationally intensive).

## MODULE 4: CLASSIFICATION

Machine learning techniques have been widely applied for the detection of malicious applications in the literature. The studies about the detection of malware in the mobile platforms are mostly made by using the classification and clustering analysis. We have used Decision Tree, Gradient Boost, AdaBoost, Naïve Bayes and Random Forest classification analysis for android malware detection approach. The classifiers performances were measured and evaluated in the detection of android malware.

### i) Naive Bayes

Naive Bayes classifiers are a collection of classification algorithms based on Bayes Theorem. It is not a single algorithm but a family of algorithms where all of them share a common principle, i.e. every pair of features being classified is independent of each other. A Naive Bayes classifier is a probabilistic machine learning model that's used for classification tasks. Naive Bayes algorithms are mostly used in sentiment analysis, spam filtering, recommendation systems etc. They are fast and easy to implement but their biggest disadvantage is that the requirement of predictors to be independent. In most of the real life cases, the predictors are dependent, this hinders the performance of the classifier. The crux of the classifier is based on the Bayes theorem.

Bayes Theorem:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

*Fig 7.4 Bayes Theorem*

where:

$P(A)$ = The probability of A occurring  $P(B)$ = The probability of B occurring  $P(A| B)$ =The probability of A given B  
 $P(B| A)$ = The probability of B given A

The assumption made here is that the predictors/features are independent. That is, the presence of one particular feature does not affect the other. Hence it is called naive.

## ii) Random Forest

The idea behind the random forest algorithm is to construct a forest of random trees. It is an ensemble learning method for classification. It works by building a decision tree at training time and outputting the class by individual trees. The training algorithm for random forests uses the general technique of bootstrap aggregating, or bagging, to the learners. The advantages of random forest algorithms are its efficiency on large databases, successfully handling thousands of input variables without deleting any variable. Moreover, it has an effective method for estimating missing data and maintains accuracy when a large proportion of the data are missing. Random forest algorithm is selected in the analysis of permission-based malware detection as a third decision tree algorithm.

In machine learning, classification refers to a predictive modeling problem where a class label is predicted for a given example of input data.

Examples of classification problems include:

- Given an example, classify if it is spam or not.
- Given a handwritten character, classify it as one of the known characters.
- Given recent user behavior, classify as churn or not.

From a modeling perspective, classification requires a training dataset with many examples of inputs and outputs from which to learn. A model will use the training dataset and will calculate how to best map examples of input data to specific class labels. As such, the training dataset must be sufficiently representative of the problem and have many examples of each class label. Class labels are often string values, e.g. *-spam*, *-not spam*, and must be mapped to numeric values before being provided to an algorithm for modeling. This is often referred to as label encoding, where a unique integer is assigned to each class label, e.g. *-spam* = 0, *-no spam* = 1.

The algorithm will generate probable values for an unknown variable for each record in the new data, allowing the model builder to identify what that value will most likely be. The ML.PREDICT function can be used to classify outcomes using the model. Classification can be done during model creation, after model creation, or after a failure (as long as at least 1 iteration is finished). ML.PREDICT always uses the model weights from the last successful iteration.

The predict() function enables us to predict the labels of the data values on the basis of the trained model. The predict() function accepts only a single argument which is usually the data to be tested. It returns the labels of the data passed as arguments based upon the learned or trained data obtained from the model. Thus, the predict() function works on top of the trained model and makes use of the learned label to map and predict the labels for the data to be tested.

#### 4.1 Evaluation Measures for Classification Algorithms

The performance evaluation of feature selection methods and classification algorithms are made in this part of analysis to determine the best performing feature selection method and classification algorithm. The evaluation of classification algorithm implementations are made by looking at Overall Accuracy (ACC), TP Rate (TPR), FP Rate (FPR), Precision (PPV), Recall and F-Measure values which are the output of classification algorithms.

**True Positive (TP):** Number of correctly identified benign applications.

**False Positive (FP):** Number of wrongly identified malware applications.

**True Negative (TN):** Number of correctly identified malware applications.

**False Negative (FN):** Number of wrongly identified benign applications.

Table below summarizes the four basic classification measures (confusion matrix) described above

		Prediction	
		Malware	Benign
Reality	Malware	TRUE NEGATIVE	FALSE POSITIVE
	Benign	FALSE NEGATIVE	TRUE POSITIVE

**Table 7.5** Confusion metrics

# CHAPTER-8 IMPLEMENTATION

## 1. Home page



*Fig 8.1 Home page*

This is the home page while entering to the web page

## 2. Admin login page

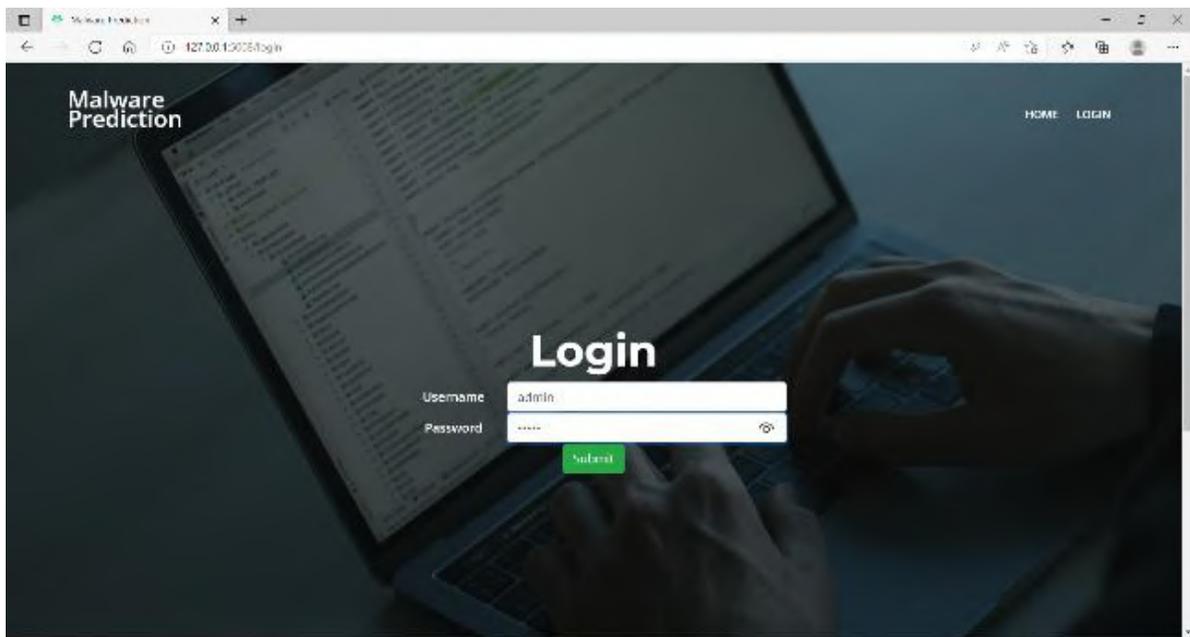


Fig 8.2 Admin login

After entering to the home page, admin can login with a unique username and password and can login by clicking the submit button.

## 3. Admin's home page

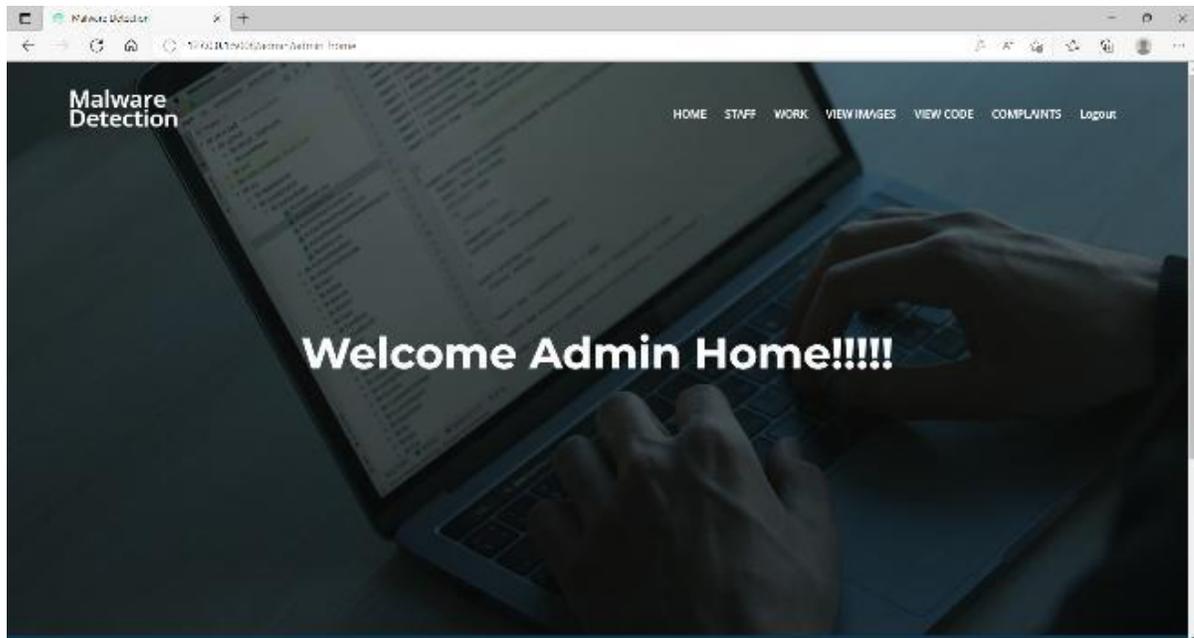


Fig 8.3 Admin home

When admin login with the username and password, admin is directed to a welcome page consist of different tasks such as home, staff, work, view image, complaints and logout.

#### 4. Add Staff

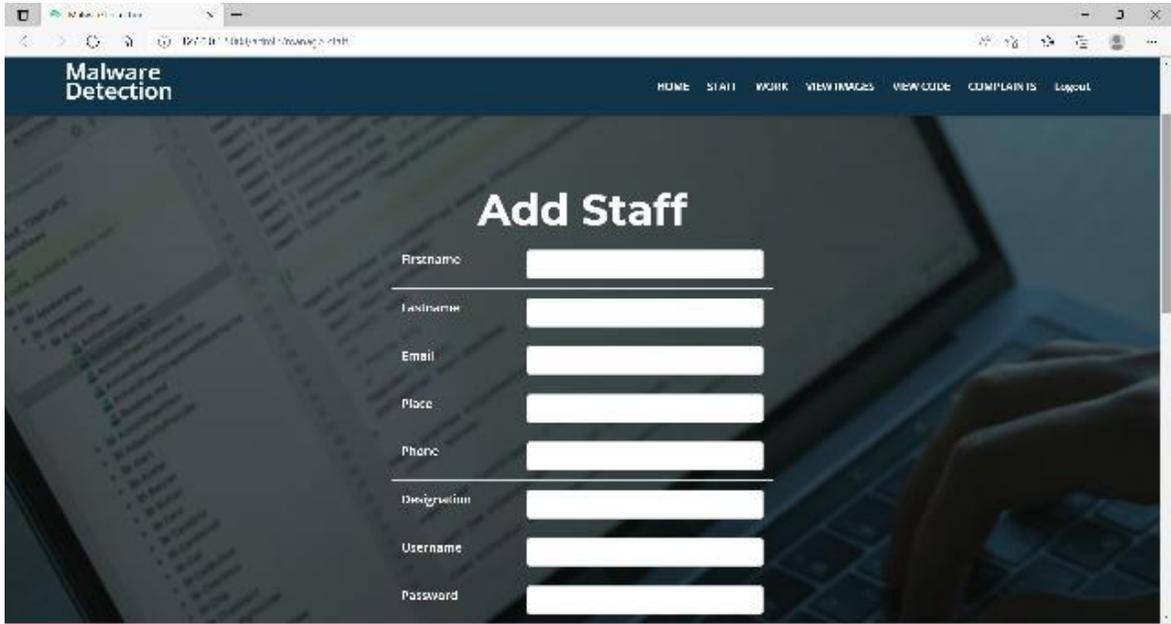


Fig 8.4 Add staff

Admin can add staff details like name, email, place ,phone, designation,etc. Admin provide username and password for the staff to login.

#### 5. Add work for staff



Fig 8.5 Add work

Admin assign works for the staff and can view the works done by the staff. Also update and delete the work is provided.

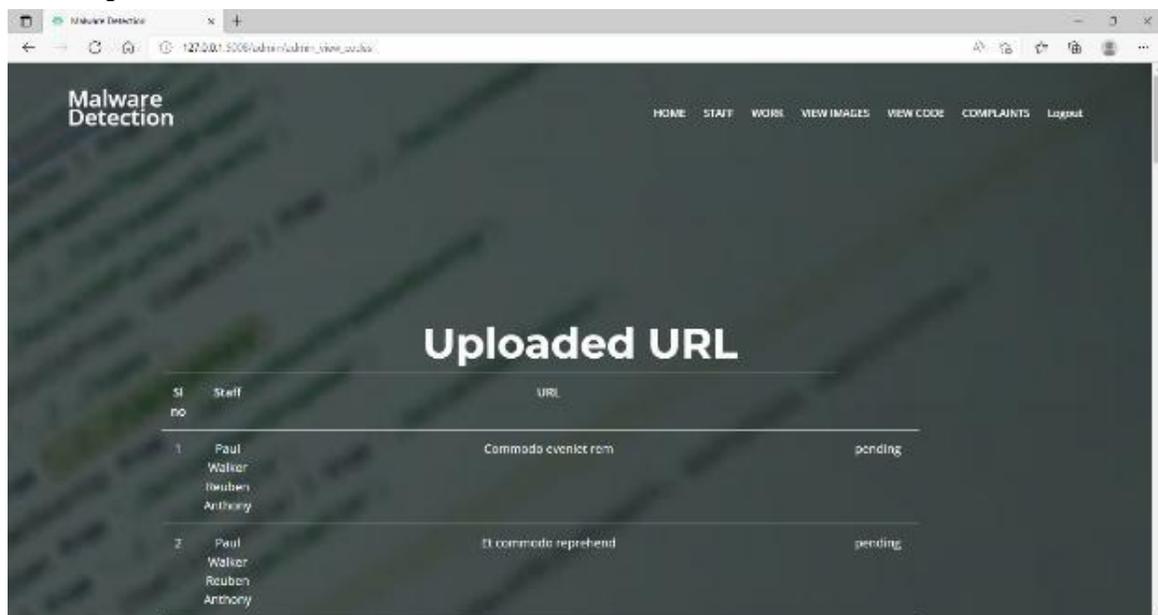
## 6. Staff complaints



*Fig 8.6 Complaints*

Admin can view the complaints send by the staff and can give reply according to their problems.

## 7. Admin view uploaded URL



*Fig 8.7 View uploaded URLs*

Admin can view the uploaded URL and can see if the checked URL is malicious or not.

### 8. Admin view uploaded image



Fig 8.8 View uploaded images

Admin can view the uploaded image and can see if the checked image is malicious or not.

### 9. Staff login

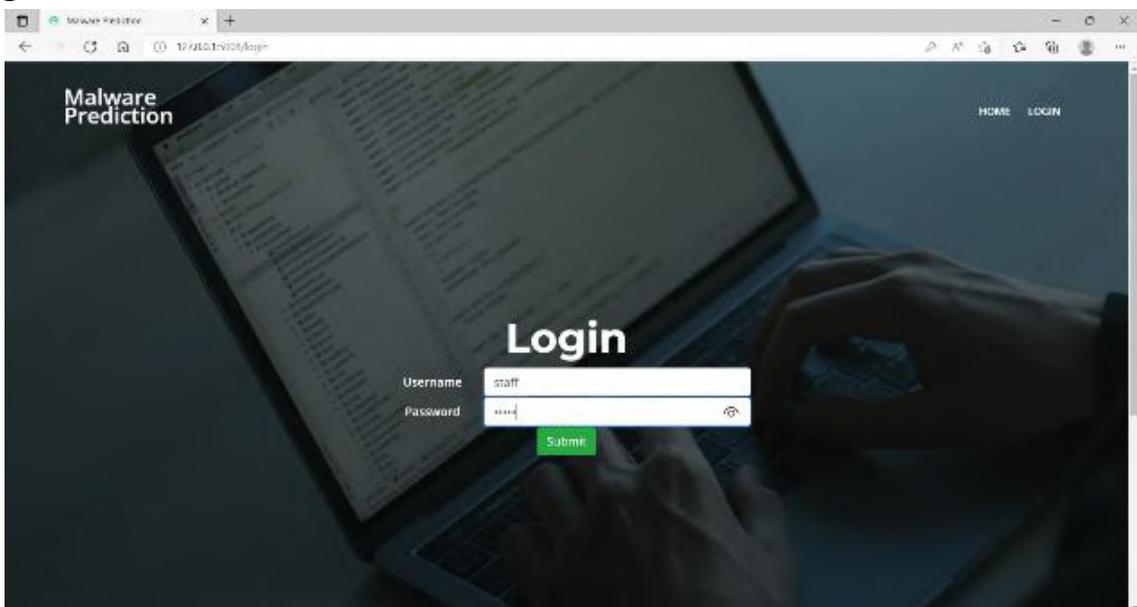


Fig 8.9 Staff login

### 10. Staff login

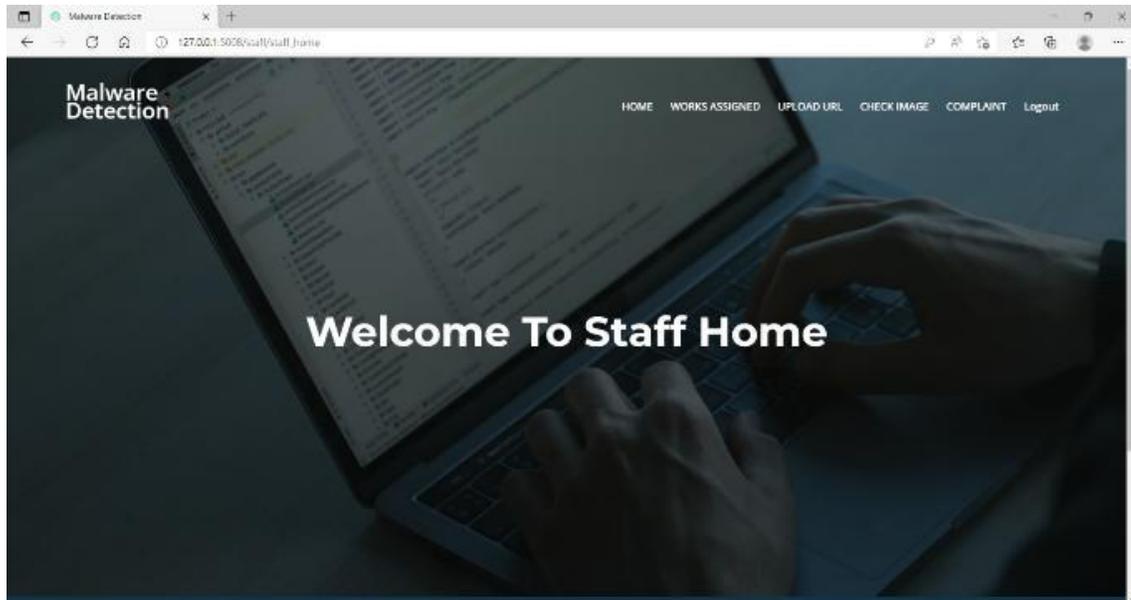


Fig 8.10 Staff home

Staff is directed to a home page of staff ,there staff can view the work assigned ,uplode url and imge for checking malecious or not and can send complaints it any.

### 11. URL detection

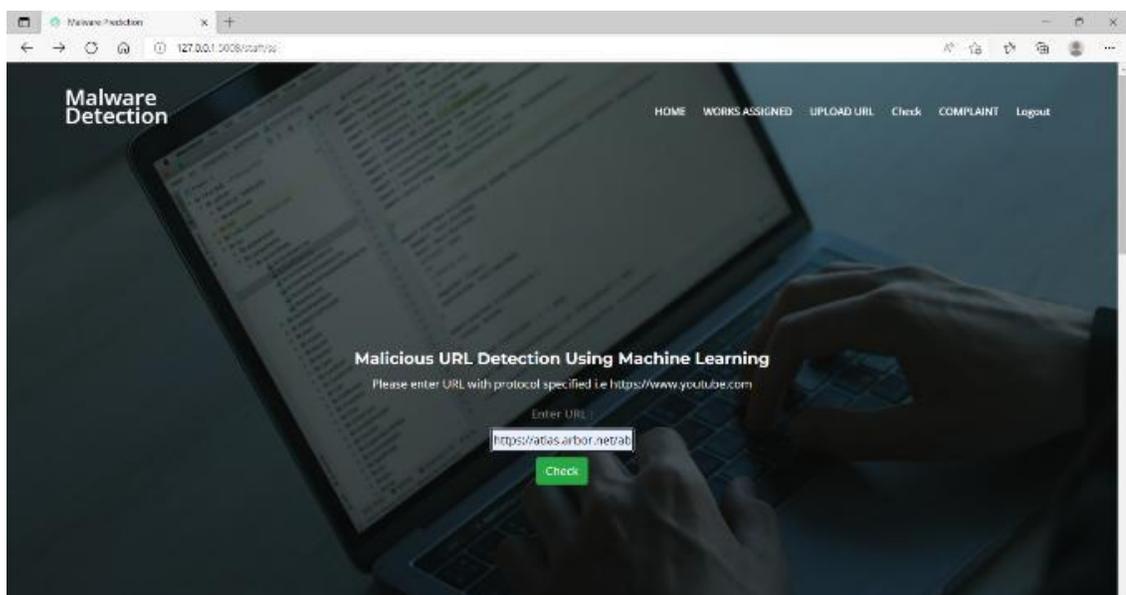


Fig 8.11 Uploading the urls

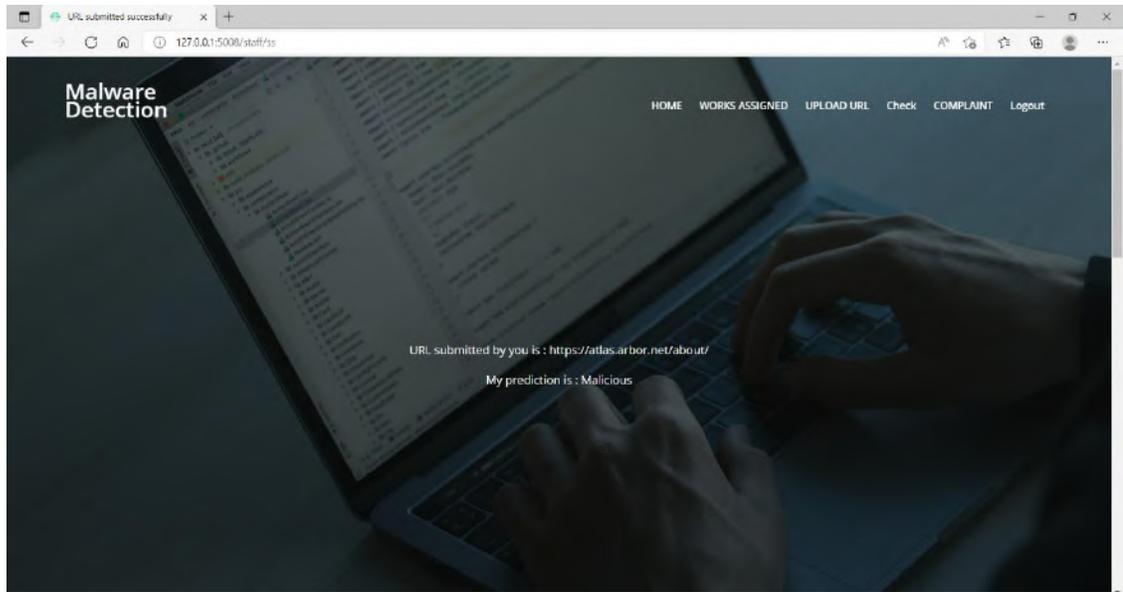


Fig 8.12 Viewing the result (Malicious)

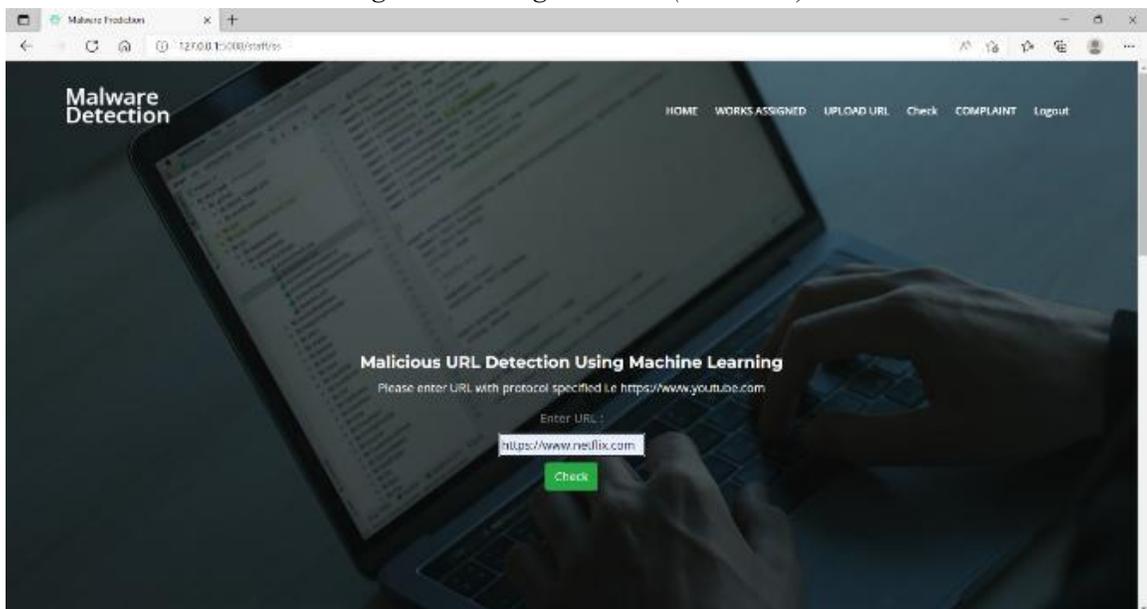


Fig 8.13 Uploading the urls

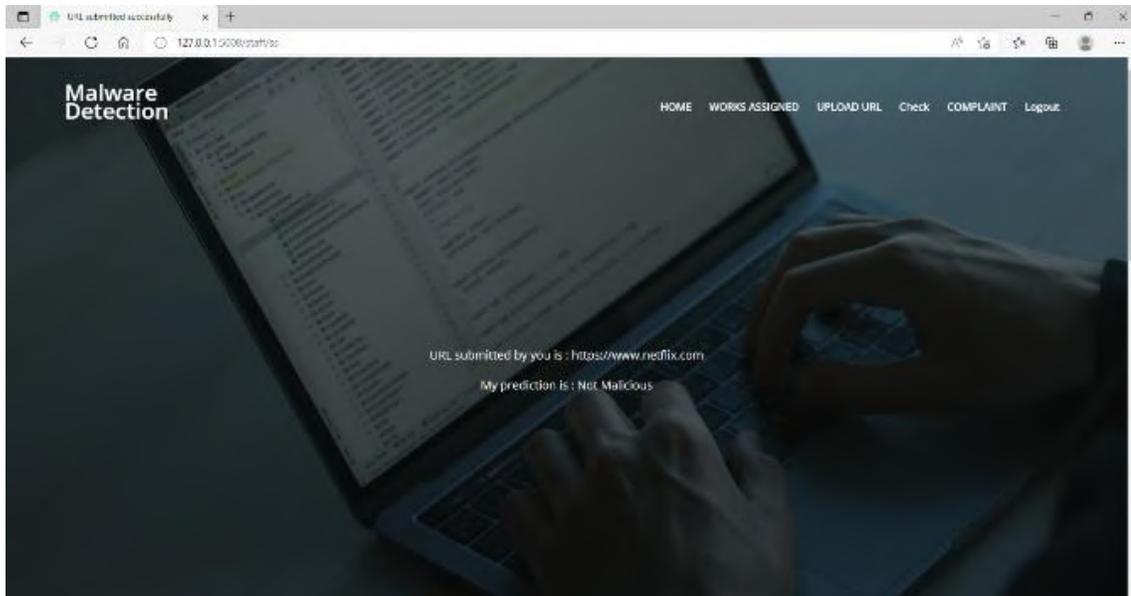


Fig 8.14 Viewing the result ( Not Malicious)

Staff can upload urls in the space provided. By clicking the check button the user can view the result according to the url uploded.i.e, maleicious or not.

## 12. Upload image

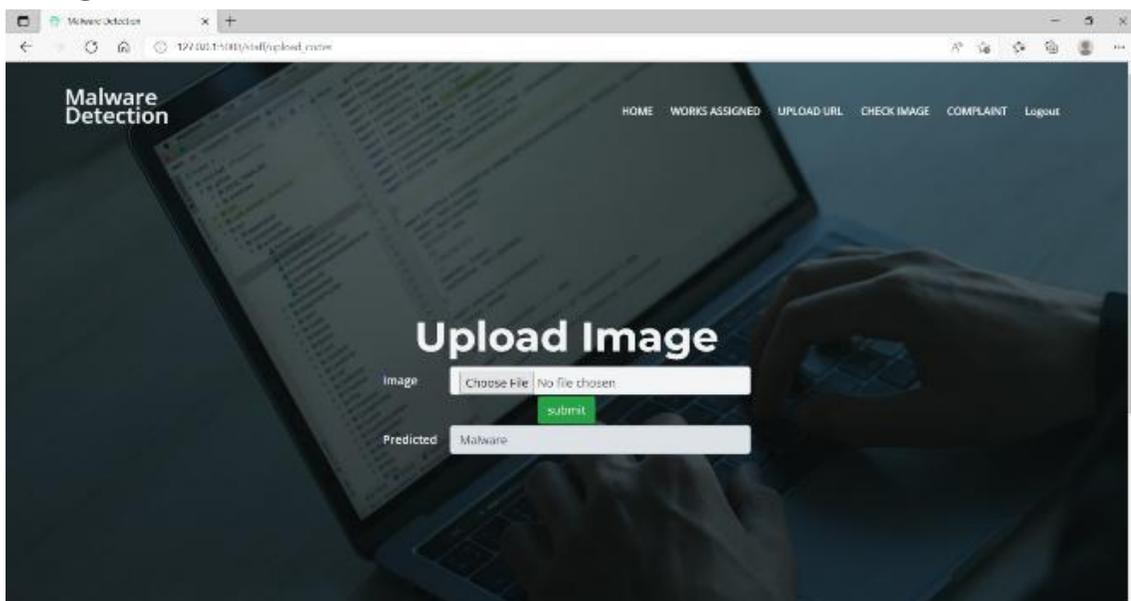


Fig 8.15 Uploading the image and viewing the result (Malware)

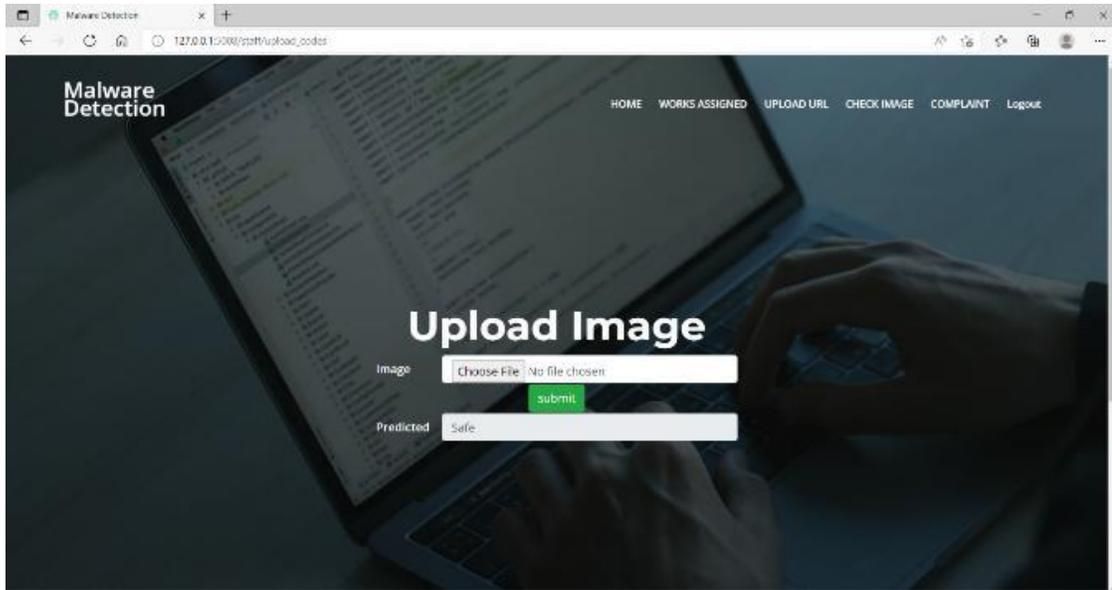


Fig 8.16 Uploading the image and viewing the result(safe)

### 13.Send complaints

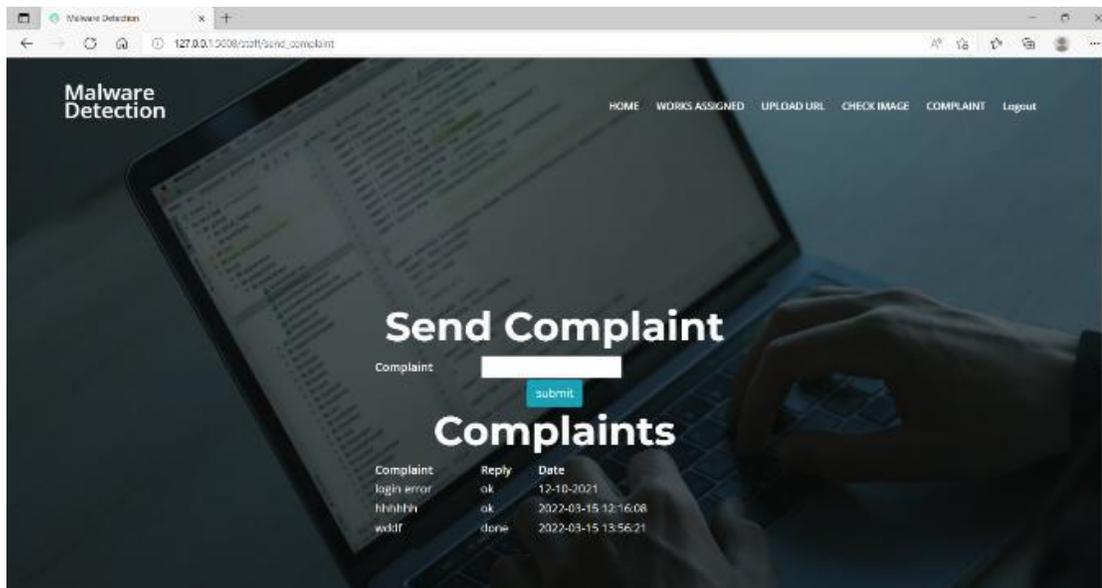


Fig 8.17 Send complaints

User can send complaints if any. Admin will view the complaints and provide better solutions for it.

## CHAPTER-9

# RESULT AND ANALYSIS

We split the dataset into two subsets, training set and test set. Training set used 69 percent of whole dataset and test set used 31 percent. We performed the experiment 4 times. In each experiment, we randomly selected the training and test set from primary dataset. After creating the training set, we trained the data using linear Naïve bayes algorithm for the classification. For conclusion, these experiments showed that using naïve bayes algorithms for detection of malware is apparently beneficial. The average detection rate is 80%, which is not such bad result. In some cases where the training set was too small, our experiment gave slightly low result. The result of our research is that we demonstrated the malware detection rate of naive bayes algorithm ranges between 80 - 90% where the machine learning data is at least 10000 per class. The detection rate can be increased if we evaluate the features and eliminate low weighed ones.

We take two [www.netflix.com](http://www.netflix.com) and [image static/upload/bd5fe811-8a60-48b0-adcb-f85453177cfffmorphed tree.jpg](http://image.static/upload/bd5fe811-8a60-48b0-adcb-f85453177cfffmorphedtree.jpg) , extract the features .After analysing the features our machine learning model classifies the file as malware or not malware and the performance of these Naive Bayes algorithms

## **CHAPTER-10**

### **CONCLUSION**

In this work, our prime focus was to develop a machine learning model which can identify malicious samples as truthfully as possible, with zero false-positive rate. Among the different machine learning algorithm we have experimented for malware detection, Naive Bayes algorithm achieved highest accuracy rate.

To be a segment of a competitive business outcome, various alternative strategies must be added to this model. According to our observation, machine learning-based malware detection model is the best technology along with the conventional anti-virus software's. It is very important to note that to enhance the malware detection rate, the machine learning models are highly essential and also result in better accuracy. Machine learning systems must be developed in such a way that the results being delivered to the end-user are ethical, easy to understand and allow for proper monitoring.

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5. Min Feng and Rajiv Gupta- "Detecting Virus Mutations Via Dynamic Matching."
6. Batta Mahesh- "Machine Learning Algorithms."
7. Bugra Cakir and Erdogan Dogdu- "Malware Classification Using Deep Learning Methods."
8. Baigal tugsSanjaa and Erdenebat Chuluun- "Malware Detection Using Linear SVM."
9. Haiyi Zhang and Di Li- "Naïve Bayes Text Classifier."

## APPENDIX

### MAIN CODE

```

from flask import *

from public import public

from admin import admin

from staff import staff

from database import *

# //////////////////////////////////

from flask import Flask, render_template

from flask_wtf import FlaskForm as Form

from wtforms import StringField

from wtforms.validators import InputRequired, URL

import joblib

import re

# //////////////////////////////////

app=Flask(__name__)

app.secret_key='abc'

app.config['SECRET_KEY']= 'aa'

app.register_blueprint(public)

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

app.register_blueprint(staff,url_prefix='/staff')

def trim(url):

    return re.match(r'(?!\w*://)?(?:\.)?([a-zA-Z-1-9]\.[a-zA-Z]{1,})\.*', url).groups()[0]

def getTokens(input):

    tokensBySlash = str(input.encode('utf-8')).split('/')

    allTokens = []

    for i in tokensBySlash:

        tokens = str(i).split('-')

```

```

tokensByDot = []
for j in range(0,len(tokens)):
    tempTokens = str(tokens[j]).split('.')
    tokensByDot = tokensByDot + tempTokens
allTokens = allTokens + tokens + tokensByDot
allTokens = list(set(allTokens))
if 'com' in allTokens:
    allTokens.remove('com')
return allTokens

class LoginForm(Form):
    url = StringField('Enter URL : ', validators=[InputRequired(), URL()])

@app.route('/staff/ss', methods=['GET', 'POST'])
def ss():
    sid=session['staff_id']
    form = LoginForm()
    if form.validate_on_submit():
        model = joblib.load('pre-trained/mal-logireg1.pkl')
        vectorizer = joblib.load("pre-trained/vectorizer1.pkl")
        prediction = model.predict(vectorizer.transform([trim(form.url.data)]))
        if prediction[0] == 0:
            #prediction = "NOT MALICIOUS"
            q="insert into predict values(null,'%s','%s','NOT
MALICIOUS')"%(sid,trim(form.url.data))
            print(q)
            insert(q)
            return render_template("success.html", url = form.url.data, status =
"Not Malicious")
        else:

```

```

        q="insert into predict
values(null,'%s','%s','MALICIOUS')"%(sid,trim(form.url.data))

        print(q)

        insert(q)

        #prediction = "MALICIOUS"

        return render_template("success.html", url= form.url.data, status =
"Malicious")

        #return render_template('success.html', url = form.url.data, prediction =
prediction)

        return render_template('index.html', form=form)

app.run(debug=True,port=5008)

```

### **GLCM CODE**

```

import cv2

from skimage.feature import greycocomatrix, greycoprops

def glfeature(img):

    xs=[]

    img = cv2.cvtColor(cv2.imread(img), cv2.COLOR_BGR2GRAY)

    glcm = greycocomatrix(img, [5], [0], 256, symmetric=True, normed=True)

    xs.append(greycoprops(glcm, 'contrast')[0,0])

    xs.append(greycoprops(glcm, 'dissimilarity')[0, 0])

    xs.append(greycoprops(glcm, 'homogeneity')[0, 0])

    xs.append(greycoprops(glcm, 'ASM')[0, 0])

    xs.append(greycoprops(glcm, 'energy')[0, 0])

    xs.append(greycoprops(glcm, 'correlation')[0, 0])

    # print("xssssssssssss",xs)

    return xs

```

### **PUBLIC CODE**

```

from flask import *

from database import *

public=Blueprint("public",_name_)

@public.route('/')

```

```

def index():
    return render_template('index1.html')

@public.route('/login',methods=['get','post'])
def login():
    if 'submit' in request.form:
        user_name=request.form['uname']
        pswrd=request.form['pwd']
        q="select * from login where password='%s' and
password='%s'"%(user_name,pswrd)
        res=select(q)
        if res:
            if res[0]['usertype']=='admin':
                return redirect(url_for('admin.admin_home'))
            if res[0]['usertype']=='staff':
                q="select * from staff where login_id='%s'"%(res[0]['login_id'])
                res=select(q)
                session['staff_id']=res[0]['staff_id']
                return redirect(url_for('staff.staff_home'))

    return render_template('login.html')

```

### **SAMPLE CODE**

```

from os import walk
import os
import numpy as np
from myknn import *
from glcm import glfeature
def train():
    data=[]

```

```

samples=[]
names=[]
for dir,d_path,filenames in walk("static/dataset/Safe"):
    for file in filenames:
        sample=glfeature(os.path.join(dir,file))
        names.append(1)
        samples.append(sample)
for dir,d_path,filenames in walk(r"static/dataset/Malware"):
    for file in filenames:
        sample=glfeature(os.path.join(dir,file))
        names.append(2)
        samples.append(sample)

np.savetxt("sample.data",samples)
np.savetxt("labels.dat",names)
# train()
res=prep("static/dataset/Safe/4.jpg")
print(res,"result")

```

### **STAFF CODE**

```

from flask import *
from database import *
import uuid
from test import mains
from train import train_me
import urllib
# from apps import *
from myknn import *
staff=Blueprint("staff",_name_)
@staff.route('/staff_home',methods=['get','post'])
def staff_home():

```

```
        return render_template('staff_home.html')
    @staff.route('/view_works_assigned',methods=['get','post'])
def view_works_assigned():
    data={}
    q="select * from works where staff_id='%s'"%(session['staff_id'])
    print(q)
    res=select(q)
    data['works']=res
    if 'action' in request.args:
        action=request.args['action']
        id=request.args['id']

    else:
        action=None
    if action=='upload':
        q="select * from works where work_id='%s' "%(id)
        res=select(q)
        print(res,'.....')
        data['up']=res
    if 'upload' in request.form:
        file=request.files['file']
        path='static/upload/'+str(uuid.uuid4())+str(file.filename)
        file.save(path)
        q="insert into uploadfiles values(NULL,'%s','%s')"%(id,path)
        insert(q)
        return redirect(url_for('staff.view_works_assigned'))
    return render_template('staff_view_works_assigned.html',data=data)
```

```

@staff.route('/send_complaint',methods=['get','post'])
def send_complaint():
    data={}
    if 'submit' in request.form:
        complaint=request.form['complaint']
        q="insert into complaints values
(NULL,'%s','%s','pending',now())"%(session['staff_id'],complaint)
        insert(q)
        return redirect(url_for('staff.send_complaint'))
    q="select * from complaints where staff_id='%s'"%(session['staff_id'])
    res=select(q)
    data['complaints']=res
    return render_template('staff_send_complaint.html',data=data)

@staff.route('/upload_code',methods=['get','post'])
def upload_code():
    data={}
    if 'submit' in request.form:
        # try:
            url=request.form['code']
            print(url)
            # print(url)
            urllib.request.urlretrieve(url, "markup.txt")

            print("In Here")
            predictss=mains(url)
            q="insert into predict values
(NULL,'%s','%s','%s')"%(session['staff_id'],url,predictss)
            insert(q)
            return redirect(url_for('staff.upload_code'))

        # except:

```

```

        #      flash("Entered Link is not correct")
        q="select * from predict where staff_id='%s'"%(session['staff_id'])
        res=select(q)
        data['code']=res
        return render_template('staff_upload_code.html',data=data)
@staff.route("/urlupload")
def home():
    return render_template("popup.html")

@staff.route("/check/", methods=['POST'])
def check_url():
    url = request.form.get("url")
    print("cc"+url)
    urllib.request.urlretrieve(url, "markup.txt")

    print("In Here")
    return mains(url)
@staff.route('/upload_codes',methods=['get','post'])
def upload_codes():
    data={}
    sid=session['staff_id']
    if 'submit' in request.form:
        val=""
        image=request.files['image']
        path="static/upload/"+str(uuid.uuid4()+image.filename)
        image.save(path)
        s=prep(path)
        print(s)
        if s=="1":
            val="Safe"

```

```

        q="insert into uploadfiles values(null,'%s','%s','Safe')"%(sid,path)
        insert(q)
    elif s=="2":
        val="Malware"
        q="insert into uploadfiles values(null,'%s','%s','Malware')"%(sid,path)
        insert(q)
    print(val)
    data['output']=val

    return render_template('staff_upload_codes.html',data=data)

```

### **ADMIN CODE**

```

from flask import *
from database import *
admin=Blueprint("admin",_name_)
@admin.route('/admin_home',methods=['get','post'])
def admin_home():
    return render_template('admin_home.html')
@admin.route('/manage_staff',methods=['get','post'])
def manage_satff():
    data={}
    if 'submit' in request.form:
        fname=request.form['fname']
        lname=request.form['lname']
        email=request.form['email']
        phone=request.form['phone']
        place=request.form['place']
        designation=request.form['designation']
        uname=request.form['uname']
        password=request.form['password']
        q="insert into login values(NULL,'%s','%s','staff')"%(uname,password)

```

```

        id=insert(q)

        q="insert into staff
values(NULL,'%s','%s','%s','%s','%s','%s',curdate())"%(id,fname,lname,place,phone,email,designation)

        insert(q)

        return redirect(url_for('admin.manage_satff'))

if 'action' in request.args:

    action=request.args['action']

    id=request.args['id']

else:

    action=None

if action=="delete":

    q="delete from staff where staff_id='%s'"%(id)

    delete(q)

    return redirect(url_for('admin.manage_satff'))

if action=="update":

    q="select * from staff where staff_id='%s'"%(id)

    res=select(q)

    print(res)

    data['updater']=res

if 'update' in request.form:

    email=request.form['email']

    phone=request.form['phone']

    place=request.form['place']

    designation=request.form['designation']

    q="update staff set email='%s',phone='%s',place='%s',designation='%s' where
staff_id='%s'"%(email,phone,place,designation,id)

    update(q)

    return redirect(url_for('admin.manage_satff'))

q="select * from staff"

```

```
res=select(q)
data['staff']=res
return render_template('admin_manage_staff.html',data=data)

@admin.route('/manage_work',methods=['get','post'])
def manage_work():
    data={}
    q="select * from staff"
    res=select(q)
    data['staff']=res
    if 'submit' in request.form:
        work=request.form['work']
        details=request.form['details']
        q="insert into works values(NULL,0,'%s','%s',now())"%(work,details)
        insert(q)
    q="select * from works"
    res=select(q)
    data['works']=res
    if 'action' in request.args:
        action=request.args['action']
        id=request.args['id']
    else:
        action=None
    if action=="delete":
        q="delete from works where work_id='%s'"%(id)
        delete(q)
        return redirect(url_for('admin.manage_work'))
    if action=='update':
        q="select * from works where work_id='%s'"%(id)
        res=select(q)
```

```

        data['updater']=res
    if 'update' in request.form:
        details=request.form['details']
        q="update works set details='%s' where work_id='%s'"%(details,id)
        update(q)
        return redirect(url_for('admin.manage_work'))

    if action=='assign':
        q="select * from works where work_id='%s'"%(id)
        res=select(q)
        data['assign']=res

    if 'assign' in request.form:
        staff_id=request.form['staff_id']
        print(staff_id,"////////////////////")
        q="update works set staff_id='%s',assigned_date=curdate() where
work_id='%s'"%(staff_id,id)
        print(q,'////////////////////')
        id=update(q)
        print(id,'.....')
        return redirect(url_for('admin.manage_work'))

    if action=='assigned':
        q="select * from works inner join staff using(staff_id) where
work_id='%s'"%(id)
        res=select(q)
        print(res,'.....')
        data['assigned']=res

    return render_template('admin_manage_work.html',data=data)

@admin.route('/view_complaints',methods=['get','post'])
def view_complaints():
    data={}

    q="select * from complaints inner join staff using(staff_id)"
    res=select(q)

```

```

data['complaints']=res
if 'action' in request.args:
    action=request.args['action']
    id=request.args['id']
    session['cid']=id

else:
    action=None

if action=='reply':
    q="select * from complaints inner join staff using(staff_id) where
complaint_id='%s'"%(id)
    res=select(q)
    data['complaint']=res
    return render_template('admin_send_reply.html',data=data)
    return render_template('admin_view_complaints.html',data=data)

@admin.route('/reply_complaints',methods=['get','post'])
def reply_complaints():
    reply=request.form['reply']
    q="update complaints set reply='%s' where complaint_id='%s'"%(reply,session['cid'])
    update(q)
    return redirect(url_for('admin.view_complaints'))

@admin.route('/admin_view_codes',methods=['get','post'])
def admin_view_codes():
    data={}
    q="SELECT * FROM predict INNER JOIN staff USING(staff_id)"
    res=select(q)
    data['code']=res

```

```
        return render_template('admin_view_codes.html',data=data)
@admin.route('/admin_view_upload_files',methods=['get','post'])
def admin_view_upload_files():
    data={}
    q="SELECT * FROM works INNER JOIN uploadfiles USING(work_id)"
    res=select(q)
    data['code']=res
    return render_template('admin_view_upload_files.html',data=data)
```

A study on  
**EFFECTS OF ADVERTISING ON SMARTPHONES WITH REFERENCE TO  
COCHIN CITY**

**Project Report**

**Submitted by**

**MARY STEFINI D'CRUZ:(SB19BCOM034)**

**Under the guidance of**

**Ms. LIYA XAVIER**

**In partial fulfillment of the requirement for the Degree of  
BACHELOR OF COMMERCE**



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

This is to certify that the project titled "A STUDY ON EFFECTS OF ADVERTISING ON SMARTPHONES (with reference to Cochin city)" submitted to Mahatma Gandhi University in partial fulfillment of the requirement for the award of Degree of Bachelor in Commerce is a record of the original work done by Mary Stefini D'cruz under my supervision and guidance during the academic year 2019-22.

Guided by,

Ms. Liya Xavier

(Assistant Professor)

Department of Commerce (SF)

St Teresa's College

Ernakulam

Viva/ Voice Examination held on...

Counter signed by,

Smt. Jini Justin D'costa

(Head of the Department)

St. Teresa's College

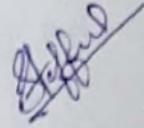
Ernakulam

External Examiners



## DECLARATION

I, Mary Stefini D'cruz, final year B.Com students, Department of Commerce (SF), St. Teresa's College (Autonomous) do hereby declare that the project report entitled **STUDY ON EFFECTS OF ADVERTISING ON SMARTPHONES WITH REFERENCE TO ERNAKULAM DISTRICT** submitted to Mahatma Gandhi University is a bonafide record of the work done under the supervision and guidance of Ms. Liya Xavier, Assistant Professor of Department of Commerce (SF), St. Teresa's College (Autonomous) and this work has not previously formed the basis for the award of any academic qualification, fellowship, or other similar title of any other university or board.



PLACE: ERNAKULAM

MARY STEFINI D'CRUZ

DATE: 30.04.2022

## Acknowledgement

First of all, I am grateful to God Almighty for his blessings showered upon us for the successful completion of our project.

It is my privilege to place a word of gratitude to all persons who have helped me in the successful completion of the project.

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I will remain always indebted to our family and friends who helped us in the completion of this project.

Last but not the least; I would like to thank the respondents of our questionnaire who gave their precious time from work to answer our questions.

**MARY STEFINI D'CRUZ**

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**CHAPTER 1**  
**INTRODUCTION**

## 1.1 INTRODUCTION

'Advertise' is a verb form of English word 'Advertising'. It has its origin in a classical Latin word 'Advertere'. The objective of all business is to make profits and a merchandising concern can do that by increasing its sales at remunerative prices. This is possible, if the product is widely polished to the final consumers, channel members and industrial users and through convincing arguments it is persuaded to buy it. Publicity makes a thing or an idea known to people. It is a general term indicating efforts at mass appeal.

On the other hand, advertising denotes a specific attempt to popularize a specific product or service at a certain cost. It is a method of publicity. It is always intentionally and openly sponsored by the sponsor which involves a certain cost and hence is paid for. It is a common form of non-personal communication about an organisation and or its products idea, service etc. that is transmitted to a target audience through a mass medium. In simple words, the term publicity and advertising are used synonymously.

In June of 2004 the Economist magazine published an article describing the changing nature of the advertising and marketing industry, calling the then-current period "one of the most disorienting periods in its history." Traditional forms of advertising and marketing were no longer delivering due to the increasing diversity of media and the emergence of new technology, most notably the internet.

According to a 2019 report by the research firm eMarketer, as people spent more of their time going online to shop, be entertained, and seek out a variety of digital information platforms, such as computers, tablets, and mobile phones the traditional forms of advertising and marketing, such as television and print forms, were displaced. Today, people are connected to the internet at any time and from anywhere, and it is primarily the smartphone that is responsible for this ubiquitous connectivity.

According to the Pew Research Center, as of 2021, 85% of Americans now own smartphones, up from just 35% in 2011. Smartphone users are more likely to be under the age of 50, college graduates, earn \$75,000 per year or more, and live in urban areas. Both men and women own smartphones in equal numbers. Understanding the various demographics regarding people who use smartphones and how they use them has become a vital part of how marketers advertise products or services to target audiences.

## 1.2 SIGNIFICANCE:

The main significance of this project is to understand the effectiveness of advertising on smartphone. It helps us to find an estimate of the number of buyers interested in buying smartphones. The project provides us the most popular brand preferred by the consumers.

It's helps us to find out the increase in sales of smartphones during the pandemic time.

### 1.3 OBJECTIVES:

- To find the smartphone brand mostly preferred by consumers.
- To find the advertisement feature that plays an important role in influencing consumers.
- To investigate the factors that inhibit the use of smartphone as a learning tool.
- To study the influence of smartphone among college students.

### 1.4 SCOPE OF THE STUDY:

The scope of study extends to consumers of smartphones in Cochin city. It is one of the metropolitan cities which pave the way for new trends and technology and secures highest position in literacy rate. The survey was conducted for a group of 60 respondents in Cochin City.

### 1.5 STATEMENT OF PROBLEM:

With every passing day, smartphone is overtaking our daily lives. Regardless of age, gender, ethnicity, career or economic status, smartphone have become not just an object, but for many a best friend.

The study is thus taken up to find the level of satisfaction of the customers regarding smartphones and to know the effectiveness of advertising among smartphone users.

### 1.6 RESEARCH METHODOLOGY

1.6.1 **Research design:** The present study is descriptive, quantitative and analytical in nature. It is descriptive in the sense that it tries to identify various characteristics of research problem. It is quantitative because it involves numerical expression. And it is analytical since it examines analyses and interprets collected data in order to arrive at conclusion

1.6.2 **Collection of data:** Both primary and secondary data were used for data collection.

- **Primary data:** Primary data was collected by means of structured questionnaire. It was distributed to sample respondents of Cochin City.
- **Secondary data:** Information from secondary sources like journals, newspapers, books, magazines, reports, websites etc has contributed to this study.

**1.6.3 Sample design:** Random sampling technique was used to select the samples from population.

- **Population:** 60 residents of Kochi.
- **Sample size:** A sample out of the whole Smartphone users in Kochi. Size of 60 was selected for the survey.

#### 1.6.4 Tools for analysis:

The collected data were used with the help of statistical tool like percentages. The technique of ranking was used to study the effects of smartphone advertisements on the whole population of the city. Tabular and graphical presentations were used for presentation of data. Graphical presentation includes bar diagram, pie chart etc.

### 1.7 LIMITATIONS

1. A small sample size of 60 people is taken, so we can draw inferences about the population from this sample size.
2. Time period is short and resource restraints.
3. The scope of the project is limited to the city of Kochi, so we cannot say that the same response will exist throughout India.
4. This study is based on the prevailing customer satisfaction. But the customer's satisfaction may change according to time, fashion, technology, development, etc.

### 1.8 CHAPTERISATION

#### Chapter 1- Introduction:

This chapter contains a brief introduction of the topic, its significance, and statement of the problem, objectives, methodology, keywords, limitations and chapterisation of the study.

**Chapter 2- Review of literature:**

This chapter deals with the literature review which includes the past studies conducted by various researchers on the smartphone advertisements.

**Chapter 3-Theoretical framework:**

This chapter includes the professional introduction of the marketing of Smartphones, different brands and the way their advertisements has paved a path for the customers to purchase the products.

**Chapter 4-Data analysis and interpretation:**

In this chapter data collected are analysed and interpreted based on various observations from the questionnaire obtained after the survey.

**Chapter 5-Findings, suggestions and conclusions:**

This chapter contains the summary of findings and recommendations. It also contains the final conclusion of the study.

**CHAPTER 2**  
**LITERATURE REVIEW**

## 2.1 LITERATURE REVIEW:

- **Hande Kimiloglu, V. Aslihan Nasir, Süphan Nasir, 2020:** Aims to discover consumer segments with different behavioural profiles in the mobile phone market. Pragmatic consumers are found to give high importance to the functional, physical and convenience-based attributes of the product. The abstemious group also gives importance to functionality along with design. While value-conscious consumers focus strongly on price, the charismatic segment represents the want-it-all group valuing many attributes such as technological superiority, practicality, durability, functionality, and design. The study also includes findings and discussions about the differences these clusters display in terms of their involvement and loyalty styles.
- **Jaakko Sinisalo, Jari Salo, Heikki Karjaluoto, Matti Leppäniemi, 2020:** States that the purpose of their study is twofold. First, in order to guarantee a coherent discussion about mobile customer relationship management (mCRM), this paper presents a conceptualization of mCRM delineating its unique characteristics. Second, the authors develop the empirically grounded framework of the underlying issues in the initiation of mCRM. Researchers have identified issues that can be divided into three categories (exogenous, endogenous and mCRM-specific) the company has to take into account when moving towards mCRM.
- **Fred Robins, 2019:** He analysed that the marketing of the next generation of mobile phones. It begins with comments on the state of the telecom industry and draws attention to elements of technological and product convergence, highlighting the point that while industry convergence on digital technology is a fact, today's mobile telephony marketplace is nonetheless characterized by three generations of technology and the latest generation, 3G, embraces three related but competing standards.
- **Androulidakis, G. Kandus, 2019:** correlated the brand of mobile phone users' security practices. Users show different behaviour in an array of characteristics, according to the brand of the mobile phone they are using. As such, there is categorization of arrears, different for each brand, where users are clearly lacking security mind, possibly due to lack of awareness. Such a categorization can help phone manufacturers enhance their mobile phones in regards to security, preferably transparently for the user.
- **Nasr Azad, Maryam Safaei, 2019:** States that there are many evidences to believe that customers select their products based on brand name. Products also maintain their own characteristics, which make them differentiable from others. In this paper, researchers have presented an empirical study to determine important factors influencing customers' purchasing intend for cellular phones in capital city of Iran, Tehran. The results

of the study show that there are some positive relationships between exclusive name and quality perception, between exclusive name and word of mouth advertisement, between quality perception and fidelity, between word-of-mouth advertisement and brand name and between brand name image and brand name.

- **Heikki Karjaluoto, Jari Karvonen, 2019:** They had analyzed that Mobile phone markets are one of the most turbulent market environments today due to increased competition and change. Thus, it is of growing concern to look at consumer buying decision process and cast light on the factors that finally determine consumer choices between different mobile phone brands. On this basis, this research deals with consumers' choice criteria in mobile phone markets by studying factors that influence intention to acquire new mobile phones on one hand and factors that influence on mobile phone change on the other are some general factors that seem to guide the choices.
- **Akhand Pratap Singh, 2019:** Advertising in its true sense can be defined as "any device which first arrests the attention of the passer-by and then induces him to accept a mutually advantageous exchange". Now that is a general definition, especially in the 20th century, but during the late 17th century "word of mouth", was the only way to advertise. Advertising was much more product and customer service oriented, the better the combination of advertising and customer service, the more people talk about the product.
- **Faulkner, 2018:** Cameron Faulkner in his article "3 reasons why now are a terrible time to buy a new Smartphone" and he quoted that snapdragon 845 can increase a boost in speed and ability to handle robust applications, embedded fingerprint sensors are the latest trend and better cameras where optical image stabilization (OIS) going to rule the market.
- **Hall & Grabham, 2018:** Chris Hall and Dan Grabham in their article "Best smart phone 2018: The best phones available to buy today" and they have listed out the best smart phone for the year 2018 such as Apple iPhone X, Samsung galaxy S8, Samsung Galaxy Note 8, Google pixel 2, Huawei Mate 10 pro, P10, P10 plus, Apple iPhone 9 plus, Google pixel 2XL, One Plus 5T, HTC U11, LG G6, Blackberry Keyone, Lenovo P2 and Nokia 6. All these brands have excellent features which tend the consumers to purchase the same in the market.
- **Mr. A. David. and Anish Kumar.K, 2018:** Tajzadeh Namin A. A.; Rahmani Vahid Tajzadeh Namin Aidin (2012) analysed that the process of deciding over (choosing) a brand may be influenced by situation and content. The findings suggest a significant relationship between the variables "brand attitude", "corporate attitude", and "product (cell phone) choice". In addition, no significant relationship was found between individual decision-making processes (independent or mediated) and product choice.
- **John Abbas Sayed, 2018:** Dissanayake, (2015) paper has concentrated on reviewing brand identity as a fundamental strategic component in expand global brands via figuring out literature more along with the case practices on Smartphone Brands. The

study entitled literature review is based on case marketing of Smartphone. Researchers followed a more as literature review along with case review to connect theory into practice by sourcing the formally produce verification. This literature review also helped in findings the brand identity.

- **Kyle Mickalowski, Mark Mickelson, Jaciel Keltgen, 2018 :** The Wall Street Journal's technology guru, Walter Mossberg, finally published his review of the iPhone only two days before its launch. Overall, he described the iPhone as a breakthrough handheld computer despite some shortcomings.
- **G. Yoganandan, G. Saranya ,2017:** P. Jagadeesh in his research article "Consumer's preference and satisfaction towards mobile phone brands: A study with reference to consumers in Vijayawada" he assessed the preference level of mobile phone users of different brands. He concluded that advertising and word of mouth publicity are the major source of awareness creation among the mobile phone users.
- **Sinha, 2017:** Robin Sinha in his article "Buying a smart phone: 10 things to consider," he stated that due to the availability of wide variety in the market it is tough while deciding which one to purchase based on the features such as quality, display, processor, camera, battery, OS version, storage, security, USB port. He concluded that it is preferable to purchase smart phone which has extra security features.
- **Kaushal & Kumar, 2016:** S.K. Koushal and Rakesh kumar in their research article "Factors affecting the purchase intension of Smartphone: A study young consumers in the city of Lucknow" and their objectives were to explore the factors affecting consumers' purchase intension of Smartphone. The study concluded that compatibility, dependency and social influence are the factors which influence the purchase of smart phones.
- **MD Arifur Rahman, MD Shariful Haque,2016:** Nowadays, consumers are eager to pay high prices for different experience causing different brand experience can reduce consumer sensitivity to price. For this reason, product differentiation and diversification are increasing rapidly and in consequences companies begin to realize the value of brand. Kotler (2009) cited that the American Marketing Association defines brand as a name, term, sign, symbol, or design, or a combination of them, intended to identify the goods or services of one seller or group of sellers and to differentiate them from those of competitors.
- **Dr. Dileep Kumar Singh,2016:** The strategy that specifies broad principles for achieving objectives connected to specific SBUs and target markets," according to Camra (1995). This comprises the major marketing budgets, marketing functions, and resource allocation in this sector. These include, for example, Decision: Segmentation, positioning, and communication methods.
- **Ganlari, Deka, & Dutta, 2016:** Deepika Ganlari, Pradeep Kr. Deka and Chandan Dutta in their paper "A study on consumer buying behavior of mobile phones" they analyzed the internal and external factors which influence a consumer's

decision in purchasing a smart phone. External influences on consumer behavior are culture, demographics, social status, reference groups, family and marketing activities. Some of the internal influences are perception, learning, memory and motivation.

- **UlasAkkucuk, Javad Esmaeili, 2016 :** In the Purpose of this research is to study the factors behind Smartphone purchase decisions of consumers. The author represents a literature review on Empirical Study on Smartphone Buyers. Nowadays companies make use of different strategies in order to attract new customers, maintain existing customers and differentiate their products from those of their competitors. Maybe, the most important and effective strategy to influence consumer behavior in the product selection is emphasizing the brand name of the products.
- **Trivedi & Raval, 2016:** Rinky Trivedi and Rahul Raval in their article "Consumer buying intentions towards smartphones: A conceptual framework and they assessed different factors affecting buying intentions of customers towards smart phones. Social influence, price, product feature, convenience and brand name have positive impact towards consumers purchase intention.
- **P. Subikshaa and Murugan Ramu, 2015:** Advertising in other words mobile advertising is the technique that focuses on marketing smart phones. Marketing which forms a bridge gap between the product and customer. A market generally takes into consideration the 4 important Ps that is Product, Place, Price, Promotion. The marketer while decided to promote a product he tries to fulfill the 4ps so that the product information reaches perfectly to the target consumers.
- **Manimekalai and Dr. K. Ramesh, 2015:** On the basis of investigation, first of all study describes the trends in the mobile sector in order to illuminate the issues underlying consumer behavior. This will be followed by review of recent studies concerning factors that seem to affect the choice of a mobile Phone, operator as well as intentions to adopt new mobile phone features and services such as multimedia messaging services and sending emails. The author conducted an extensive review on literature on national and international perspectives of mobile phone consumer purchase intention/behavior of last 15 years.
- **Dr. Vijayalakshmi P, Dr.V.Priyadarshini, Dr. Umamaheswari K, 2015:** Mesay sata (2013) conducted a study on factors affecting consumer buying behavior of mobile phone devices specifically in Hawassa town, Ethiopia. Accordingly, the result of the study showed that the six independent variables i.e., price, social factors, durability, brand name, product features and after sales factors will influence the dependent variable i.e., decision to purchase (Mobile phone buying decision).
- **Sethi & Chandel, 2015:** Amit Sethi and Ajay Chandel in his paper "consumer buying preference towards entry level smartphone" investigated about customer buying preference for entry level smartphones among youths. Sampling method was stratified sampling method and employed 200 respondents for his study. Conjoint analysis was

adopted to find out the related importance for the attributes. They concluded that brand was the most important attribute.

- **Raghupathi & Prabu, 2015:**M. Raghupathi and G. Prabu in their study “A study on customer satisfaction towards smart phone users” and carried out the research among college students. It is noted from the study that students use mobile phones for accessing the web, to download apps etc.

- **Nisha Sharma Adhikari ,2013:** The research aims at finding out the factors that majorly influence the buying decision of a customer while choosing a Smartphone. By reading the relevant literature, various factors have been found, based on the consumer choices about the Smartphone. The previous researches provide a range of variables which affect the purchase decision, combining several dominant variables, certain major factors can be drawn out. In the first quarter of 2012, Smartphone sales accounted for 34% of total mobile phone sales (Gartner.com, 2012). It is predicted that Smartphone sales will approach one billion units in 2016 (IDC.com, 2011). A study by (Magar, 2016) on factors affecting consumers purchase decision towards smartphones in Kathmandu valley, it is found that main reason for smart phone purchase is its features and the advertisement in the internet.

- **Rashid Saeed, HashimZameer,2012:** In the purpose of his paper is to inspection the buying behavior of consumers in India and compares the customer’s behavior of urban consumers and rural consumers in India. The author represents a literature review on Mobile phone buying behavior of customers a comparative study of rural and urban customer in India.

**CHAPTER 3**  
**THEORETICAL FRAMEWORK**

### 3.1 THEORETICAL FRAMEWORK

Advertising effectiveness can be defined as the extent to which advertising generates a certain desired effect. Measuring the effects of advertising is very important, given the amount of investments needed for advertising. While it is not possible to obtain a global measure of the advertising effectiveness, we should seek to develop and apply methods and measures for a partial verification of results.

Advertising effectiveness pertains to how well a company's advertising accomplishes the intended. Small companies use many different statistics or means to measure their advertising effectiveness. These measurements can be used for all types of advertising, including television, radio, direct mail, Internet and even billboard advertising. A company's advertising effectiveness usually increases over time with many messages or exposures. But certain advertising objectives can be realized almost immediately.

#### ○ Reach

One metric for advertising effectiveness is reach. This measurement pertains to the number of people who actually saw a company's advertising. Small business owners usually know how many people can potentially see their ads. Local television stations report the number of viewers for certain shows. Similarly, magazines report circulation figures. But not all of these viewers or readers notice the ads. That is why small business owners often use market research surveys to measure reach. For example, 10 percent of a local restaurant's viewing audience may recall seeing their latest television advertisement. Advertising should be designed to attract attention, build interest and prompt action, according to the experts at "Mind Tools" online.

#### ○ Sales and Profits

One of the most important objectives of advertising is to increase sales and profits. A profitable advertisement is an effective one. The best way to build sales and profits is by reaching the right target audience. In other words, small business owners must make sure their advertising reaches the people who are most likely to purchase their products. Companies often develop customer profiles from warranty cards or marketing research to gather this information. Target audience variables or demographics can include age, gender, income and education. For example, a high-end women's clothing retailer may effectively drive sales and profits by targeting women with higher incomes,

### ○ Brand Awareness

Brand awareness is another metric of advertising effectiveness. Brand awareness is the percentage of people who recognize a company's brand of products. It usually takes many years and lots of ad exposures to build high brand awareness. Television and radio are two of the best mediums for building brand awareness. Small companies can also build their brand awareness on the Internet by advertising in online Yellow Pages, or promoting their wares through major search engines like Google and Yahoo

### ○ Testing Advertising Effectiveness

Small companies can test their advertising effectiveness in several different ways. One way is to insert certain "word flags" into the advertising messages, according to "Entrepreneur." This may be a simple phrase or word that customers recognize and can, therefore, mention when inquiring from an advertisement. The word flag can also be in the form of a question. For example, a small restaurant company may prompt customers to ask, "What's the super special of the day?" The restaurant owner can then track the number of people who ask about the super special throughout the day. Those who use direct mail can insert codes on order forms. For example, a mail order operator would know that order forms with the "215" code came from a mailing

Much scientific evidence is available to put to rest the myth that we cannot measure the effectiveness of advertising in promoting customer brand awareness, knowledge, and purchase behavior. The myth is based on the false premise that because many factors may cause increases in the outcome, we cannot isolate any single influence, such as the influence of advertising, to determine its effect-for example, how many additional sales occurred due strictly to the advertising

#### **3.1.1 Important characteristics of effective advertising:**

As consumers, we've all seen our fair share of ads that wow us, and ads that, well, flop. So what makes a good advertisement? There are 10 characteristics that make for a strong ad or campaign

##### **1. It's Promotional**

At its core, advertising is a form of communication that aims to publicize a product or service and encourage sales. By nature, good advertising is promotional.

While some may refer to advertising as "propaganda", they are in fact two separate concepts. Propaganda seeks to influence a population's ideology and ways of thinking, while advertising focuses on influencing purchasing habits. A good advertisement is promotional in nature, though this promotion can be more or less subtle.

## 2. It's Persuasive

To achieve their main objective (to increase sales of a certain product or service), effective ads must convince consumers that a certain product or service is better than a similar offering from a competitor. Persuasive advertising assures that a product can solve a consumer's need or improve their life in some way.

## 3. It's Part of the Company's Overall Marketing Strategy

Behind every campaign, there is a lot of strategic thinking involved. Advertising always aligns with a specific marketing objective that ladders up to the global interests of the brand or company. Thus, a strong advertising strategy should be framed within the general marketing plan, like in Nike's Just Do It campaign.

## 4. It's Targeted

In the past, advertising relied on mass media such as radio and television to reach as wide an audience as possible. Effective advertising in today's world requires highly targeted and segmented audiences.

Every brand has a buyer persona or ideal customer profile they are trying to attract. The more focused your advertising is on a particular audience, the more effective it can be. The content of your advertising messages should be specially designed to appeal to the feelings and needs of your audience. Ads do not work if they are not trying to appeal to a specific type of person.

## 5. It's an investment

Advertising campaigns require an investment of time, resources, and of course, money. Generally, the channel issuing the advertisements charges a certain amount in exchange for its dissemination.

A good ad campaign will increase the company's profits, and this should exceed the invested cost. To understand the relationship between costs, advertisers measure the campaign's ROI (return of investment). A positive ROI indicates that the advertising campaign has been a success.

## 6. It's Original

It's no secret that advertising suffers from market saturation. Consumers are exposed to hundreds of ads a day in different formats, and most don't even pay attention to them.

Therefore, effective advertising stands out from the competition by using unexpected formats and resources. You can grab a user's attention by emphasizing the novelty of your product or service, offering a great deal, or doing something completely out of the box, like Coca-Cola's "Share a Coke" campaign.

### 7. It's Creative

Videos that tell stories, shocking images, unforgettable speeches, catchy jingles, etc. Effective ads use creativity to stand out and make a brand immediately identifiable or memorable. The best creative ads manage to surprise users, move them to action, and become instantly memorable, all while remaining faithful to the principles of the brand. A great example of this is Old Spice's viral ad campaign, The Man Your Man Could Smell Like.

### 8. It's Consistent

Truly great ads stay consistent with the core of the brand and the values associated with it. Generally, a single ad can't achieve this goal, especially in a saturated environment. Therefore, a key aspect of advertising is consistency.

Ideally, each consumer within the target audience should receive enough impact to remember the brand and its message, but not so much that it becomes annoying or saturated. It is also interesting to consider that impacts can be repeated through the same medium (for example, watching the same TV commercial several times) or transmitting the same message by adapting it to different channels (cross-channel or multi-channel advertising).

### 9. It's Personalized

Personalization is an increasingly important trend in recent times and it's getting easier than ever. Truly effective ads are increasingly personalized to the characteristics and needs of a particular user. For example, you can use marketing automation to send e-mails with personalized content, like the one below by Sephora. These kinds of emails are activated when a user performs a certain action and are a great example of incorporating personalization into advertising. Remarketing is another great way to use personalized ads, especially for ecommerce or retail stores.

### 10. It's Ethical

Because of its persuasive power, advertising should be controlled to prevent misleading information or unethical campaigns. While there are several public bodies that regulate the ethical aspect of advertising, it is also essential that advertisers and agencies take responsibility. In the end, honest and clean advertising reflects the values of the advertiser, contributes to improving a brand's image, and is beneficial in the long run.

### **3.1.2 5 Metrics to Measure the Effectiveness of Advertising Campaigns:**

Below are some important metrics to help you monitor the success of your advertising campaigns.

#### **1. Traffic Sources and Channels**

When it comes to paid traffic sources, some will always be more effective than others. It's up to you to figure out which ones work the best for your business!

#### **2. Click-Through Rate**

You may already be familiar with this one. It is the ratio of clicks to impressions for an ad campaign and is most often used to measure ad efficiency.

#### **3. Conversion Rate**

This is the most important metric of your campaign because it tells you the percentage of users who completed a certain action on your website. The action can be anything from filling out a form to signing up for a free trial of your product or service.

#### **4. Retention Rate**

The retention rate measures how many of your customers you have managed to retain, or keep, over a certain period of time. It typically equates to a user using your product or service more than once a day, week month, etc.

#### **5. Social Metrics**

Lastly, we have social media metrics. Social media is one of the most important tools for brands when it comes to running ad campaigns. Indicators like the number of shares, views, likes, comments, and so on can help you understand how your ad campaign is performing.

### **3.1.3 Advantage of mobile(smartphone) advertising:**

- It reaches people in real-time situations.
- It requires less content to be effective
- It creates instantaneous user responses
- It places advertising content where people happen to be.
- It creates content that can be shareable.

### **3.1.4 Disadvantages:**

- It creates advertising that people hate
- It needs to be perfect the first time around.
- It may force some users to make assumptions about your company.
- It does not have a standard display option to use.
- It costs the user something to receive your advertisement.

## **3.2 ADVERTISING STRATEGY OF A FEW POPULAR SMARTPHONE BRANDS**

### **3.2.1 SAMSUNG**

For any company, the success mainly depends on the advertising strategy. If advertising strategy fails then it is not possible to dominate the market. Samsung also has their own advertising strategy to promote their products. All of their advertisements are usually designed to provide accurate information to the customers. Samsung can reach to their customers and persuade them to buy their products and services with the help of their advertising strategy. Through marketing strategy which also includes the advertisement plans, Samsung ensures that they are effectively getting their products known to their customers and they emphasize the benefits of their products to the customers which will drive them to successful sales.

Samsung involves heavy promotions in their advertising strategy by using both push and pull strategy. By following push advertising strategy, Samsung places their products through sales and advertising strategies. It is done by heavy investment on traditional advertising. In the push advertising strategy, Samsung spot placements in the major events like Super Bowl.

Again, Samsung uses social networking sites such as Facebook, Twitter, Youtube etc. to maintain their online presence regularly. Through these social media marketing strategies, Samsung builds and maintain a relationship with the customers. They also declare announcements of their new products in the social networking sites. These types of initiatives are included in pull advertising strategy.

Samsung used to tie up with celebrity in advertising their products. They never tied up with David Beckham for the advertising of their Samsung Galaxy Note & Samsung Galaxy. Again, Samsung hired Bollywood actress Nargis Fakhri for advertising Samsung Galaxy in India.

Samsung used to follow another way of advertising their mobile phones by focusing their attention on gathering audiences. Samsung started the advertisement by telling basic information about Samsung phones to the customers. This technic informs the customers about the brand name of the phones by zooming into Samsung phones so that the customers are able to see the brand name printed on the phones.

In terms of Samsung Electronics, all of their advertising activities are designed to provide accurate information to the customers through high-quality advertisements and these sorts of advertisements help the customers to take the decision whether they will buy the products or not. In a broad sense, Samsung's advertisement is centred on the empowerment of corporate brand identity and product.

Besides these, common global advertising strategy ways of Samsung are:

1. TV advertisement
2. Print advertisement
3. Point of Sale advertisement

In conclusion, we can say that Samsung is very effective in terms of advertising their products. Samsung creates association with their products and uses those associations to appeal their customers and try to make them one of the customers of their products. Samsung basically uses their advertising method in two ways, direct & indirect methods. The indirect method, they advertise their products through television, internet, and other media. And in the indirect method, Samsung let their customers know that the new products are good to use.

### 3.2.2 OPPO

One main marketing tactic OPPO uses is celebrity endorsements. With this marketing method OPPO harvests huge traffic and exposure. The reason for this tactic is because those under 30 are the target consumer group, who spends time on the mainstream internet.

In 2008, Oppo leveraged the Korean wave. OPPO signed with Kook Ji Yeon, a famous Korean actor to film a television commercial.

In 2009, OPPO cooperated with a famous boy group, Super Junior M. During the cooperation, OPPO filmed a widely known advertisement, where every member of Super Junior M took a role.

The significant effect of marketing via high-traffic stars can be seen from fans' behavior on social media. Recently, OPPO leveraged Karry Wang (one member of TFBOYS) and plans to launch a new mobile phone on September 21st, which is his birthday.

On Weibo, we can see that his fans support him by posting via an OPPO mobile phone and acclaiming OPPO's right choice in selecting a spokesman. In this way, the brand exposure can, to some extent, be largely increased.

OPPO's strategy redefines the concept of spokesman. OPPO invited a group of high-traffic stars, including Yang Yang, Mi Yang, Dilraba Dilmurat, Joy Chow and more, to build an OPPO family. On top of that, purchasing naming rights or sponsored of variety shows to increase brand exposure is one of OPPO's strategies. For example, OPPO sponsored the variety shows like 'the birth of actors' and 'Sing!China', which are both on the top TV channels and are popular among the young. The rollout of OPPO R15 also shows some highlights in OPPO's market strategy. OPPO cooperated with Zhejiang Satellite TV. Unlike other brands' normal launches, OPPO and Zhejiang Satellite TV invited half of the entertainment circle, creating a spring grand ceremony. The launch of OPPO R15 was only a small part of this event. Through this grand show, OPPO became a household name, harvesting a strong brand tension and traffic. Plus, OPPO increased consumers' interest and strengthened its young and fashionable brand image.

### 3.2.3 APPLE

Along with amazing innovations, creative marketing strategies have always been the prime reasons behind the success of leading consumer electronics companies. The success of Apple advertising has been based upon the stories through its buzz marketing and perception building strategies. Apple advertising has mainly been concentrating upon product placement and the buzz via good word-of-mouth from the media and celebrities.

Apple has changed the game and turned the tables in the last three decades with unparalleled revenue growth from \$80 billion in 2004 to \$180 billion in 2014.

They are not just limited to a computer brand but have emerged as a culture, as a lifestyle-defining mechanism. Although European countries mostly contribute to its revenues, the Asian countries like China and Japan have contributed majorly too. In 2014, it sold more iPhones in China than in the United States.

In 2019, China and India surpassed the United States and other European countries, in the first countries that use the iPhone the most. Is it just brand fetishism that drives people crazy, or has Apple got something special to impress people and leave a mark?

Yes, it has, and the answer is, advertisements of its products so that it reaches the vast majority of audiences, who later turn into regular customers.

### **History of Apple**

In December 1983, an 18-page brochure titled "Macintosh Introduction" was included with several leading magazines of that time, and on page 11 of the brochure featured Bill Gates.

It created a buzz among people when in 1984, it bought all the pages in the special post-election edition of Newsweek, and most importantly, it extensively promoted "Test Drive a Macintosh" which allowed potential buyers with a credit card to try a Macintosh and return it to the dealer after completion of 24 hours.

In January 1984, the Macintosh personal computer was launched in the United States through a television commercial that concluded with the message and voice over "On January 24th, Apple Computer will introduce Macintosh. And you will see why 1984 won't be like '1984'."

The 1985 "Lemmings" was a significant failure. Two years later, it released Pencil Test, a short film showcasing the Macintosh II's animation capabilities.

Later in the 1990s, "What's on your PowerBook" campaign was launched. Print ads and television commercials featured celebrities sharing their experiences of using the PowerBook. "The Martinettis Bring Home a Computer", an infomercial to sell Macintosh computers, ran during 1995. It featured a fictional Martinetti family where the father had to be convinced to keep the first (Macintosh) computer they bought, reasonably for the various purposes that it served.

The advertising slogan "Think Different" dominated its advertising campaigns during the late 1990s. Its television commercials featured video footage of influential people from different nationalities, including Albert Einstein, John Lennon, Martin Luther King, Mahatma Gandhi, Bob Dylan, Alfred Hitchcock, Muhammad Ali, and Picasso.

Apple launched another advertising campaign, the "Switch" that focused on people who had changed or 'switched' from Microsoft Windows to Mac. An International ad campaign promoted a website where various myths about Mac were dispelled.

Apple promoted the iPod and iTunes with its silhouette commercials that transformed over time, making it better and more realistic. The television commercials used a variety of songs from mainstream and relatively unknown artists, and some ads featured silhouettes of artists like Lennon, Eminem, Caesars, and so on.

In 2006, during the "Get a Mac" campaign, the ads were directed by Phil Morrison and featured actor Justin Long and author and humorist John Hodgman as a Macintosh Computer and a Windows PC. Similar commercials appeared in the UK and Japan with actors specific to their respective countries.

Apple's first advertisement for the iPhone was released in 2007 during the national broadcast of the Academy Awards. The "Joke" showcased numerous aspects of Siri as the iPhone 4s' built-in AI feature. The most impressive characteristic was Siri's ability to tell jokes, bringing in it a human element.

The "Don't Blink" web video campaign, launched in 2016, describing the new Apple product line in 107 seconds, has been ruling social media since then. In 2016, Taylor Swift's new Apple Music ad, featuring a Drake song resulted in a 431% jump in sales for Drake.

Although its advertisements, at times, have faced severe criticisms for plagiarising the content and misleading customers, nonetheless these had and are still dominating the world of ad campaigns.

### **Unique Features of Apple Advertising Strategy**

#### **1. Product placement**

Celebrities were sharing their personal experiences, and the promotion of its products in popular television shows, laden with positive reviews always create a buzz. It also gives importance to the customer experience.

The company also convinces and sends products to several content creators and social influencers, to test and review these while a massive crowd watches these.

Nevertheless, the reviews are full of positive guarantees reflecting on the eye-catching features. This 'free trial' was introduced in 1884 with the "Test Drive a Macintosh" campaign.

Nielsen's research on consumer trust in marketing shows that 92% of the consumers rely on recommendations by friends and family and the other 70% rely on reviews published online. 'Unboxing' of products gets a majority of customers.

#### **2. A simplistic way of approach**

Instead of using jargon and highly technological or industrial terms (like gigabytes, RAM and so on) which eventually confuse the customers, they keep in mind the audience and use simple and direct words that seem to be beneficial ("durable glass and aluminium design", "4.7-inch retina HD display", "triple-camera system").

With a monochromatic background and easy words, it does the bare minimum, which eventually attracts the buyers' attention. Even the Apple retail stores have minimalist decorations, mostly monochromatic, with warm lighting that comforts the customers.

### 3. Unique Value Proposition

Apple reiterates the value proposition in its iPhone range of products; elegant and aesthetic designs, ease of use, and security features, all of which justify the price it charges for a respective product.

It focuses on the 'magical' experience of using an iPhone. Unlike others, it focuses mainly on the entire product and not merely on one particularly interesting aspect. Although minimalistic and brief, the descriptions give an insight into the actual product and outline all of its most unique features in a simple user-readable language.

It also offers a variety of options at different price points. Apple's Macbooks laptop line offers larger screens and more enhanced features, for a higher price. Simply put, one gets as much as they pay, neither more nor less.

### 4. Lifestyle-defining products and product descriptions

iPad Pro as "your next computer is not a computer" with features like LiDAR (Light Detection and Ranging) Scanner, which is being used by NASA for the next Mars landing mission, being faster than most other PCs: "faster than you can say PC", multi-camera, multi-tasking capacities, light-weight "yes it floats", adjustable angles and so on.

Apple Watch "has apps to keep an eye on your heart" which means that it has an ECG app to check the heart rate, "and lets you track your cycle with a tap" which says that the cycle tracking app makes it easy to log information about one's menstrual cycle, "and streams your favourite 60 million songs."

iPhone 11 with camera features like no other; "it just got a lot harder to take a bad photo" with 12 MP Ultra-Wide camera to shoot and edit sharp 4k video at 60 fps across all its cameras. It has various modes too.

"Go from pics to videos faster than a speeding toddler." Its other features include "toughest glass in a smartphone", water-resistance up to 2 metres for 30 minutes, all-day battery life and fastest chip ever in a smartphone. After all, what makes life easier and looks 'cool' makes one feel good too.

### 5. Emotional Connections

These are the key to successful marketing strategies. This is what makes certain posts, and memes go viral. High aroused emotions of happiness, awe, and amusement make the content and product go viral, for instance, Siri being able to crack jokes.

Neurological Science says that while evaluating a business, a consumer is more likely to be influenced by their experiences and emotions rather than facts. The people featured in their advertisement look content and happy and relaxing, which affects the audience watching them

## 6. Comparing Apple's products with rival products

The "Switch" advertising campaign and the "Get a Mac" advertising campaigns showcase that Mac platforms are better than the Microsoft Windows platform. They have proved it too.

This has also been quite an efficient, creative advertising strategy that played a crucial role in establishing Apple as the market leader in its segments.

## 7. Creation of a Brand, a Culture, a Group of Customers

They have a cool and fun community of users, and the marketing strategies make the non-users want to belong to the community.

For long-lasting impact and a sustainable customer base, a brand must make its place in the heart and mind of its customers. Apple has been quite successful in this. It has become a brand that enjoys the most loyal fan-base who looks for the new product-launches from Apple.

### Year-by-year Apple Advertising Campaigns – Evolution of Apple Advertising

#### 1. '1984' ad shown in the 1984 Super Bowl

This ad campaign, with its dramatic cinematography regarding George Orwell's dystopian classic revolutionized the thinking of the world about computers.

#### 2. Crazy Ones in 1997

It was the first ad talking about Think Different campaign of Apple. It featured celebrated rebels like Martin Luther King, Picasso, and Gandhi.

#### 3. Three Steps in 1998

It has a straightforward explanation of how to set up an iMac at home that did not even take three steps.

#### 4 'Silhouette' (2003- 2008)

It comprises modern young silhouettes of Apple who were getting loose to their favourite songs on iPod.

#### 5. 'Hello' in 2007A brief history of Apple Advertising

It was used for the launch of the iPhone, and it was premiered at 2007 Oscars. The ad had many onscreen legends and characters answering phones with Hello.

#### 6. '1, 2, 3, 4' in 2007

It was used for the launch of iPod nano.

#### 7. 'Envelope' in 2007

It was used for the launching of MacBook showcasing the thin and compact abilities that it can even fit in the official envelope.

#### 8. 'Joke' in 2011

With this Ad, Apple introduced Siri as its built-in AI feature.

#### 9. The Rock x Siri: Dominate the Day' in 2017

This one is again a Siri Ad that has the evergreen Apple advertising strategy of brand placement.

#### 10. WWDC Commercial in 2017

This Apple ad is an incredible example of promoting a brand by making fun of itself. Apple did this adeptly by delving into the catastrophizing of older generations of Gen Z's and millennials for their reliance on technology.

Apple has stayed in and dominated the market circle since its inception.

It has been possible majorly because of the brilliant advertising and marketing strategies that it makes use of. Most importantly, it takes into account the needs of its customers; loyalty towards them has gained all the appreciation that it deserves.

### 3.2.4 VIVO

Vivo is a Chinese technology company founded in the year 2009 by Morgan Moore. It is headquartered in Dongguan, Guangdong, China.

The Vivo brand had entered the telecommunication and electronics industry with landline and wireless phones and in 2011 started manufacturing its own range of smartphones. Currently it offers various models of smartphones and smartphone accessories.

The promotional and advertising strategy in the Vivo marketing strategy is as follows:

Vivo is very proactive when it comes to advertising and promoting its brand. Vivo embraces a 360degree marketing strategy and promotes its products through various conventional and traditional mediums like ATL, BTL, print media, television commercials, social media, celebrity endorsements and on-ground activities. It focuses specially on its on-ground activities which it considers as its strongest advantage in China as well as in India. It also focuses on out of home advertising to a good extent. Vivo has been actively sponsoring events like FIFA world cup, IPL cricket and other big sporting events world over. The brand has also roped in several celebrities as their brand ambassadors, who star in their commercial and talks about the new Vivo phones. Vivo has also tied up with OOH companies to display its new smartphones on billboards globally. This concludes the marketing mix of Vivo.

### 3.2.5 ONEPLUS

Over the past few years, OnePlus has moved from no paid promotions to heavy advertising by signing on A-listed celebrities like Robert Downey, Jr. Even in terms of route to market, OnePlus products today are available across leading e-tailers and brick and mortar stores globally. The 'exclusivity' angle is long gone. In fact, critics believe that in the pursuit of a larger customer base and to keep costs competitive, OnePlus has started using the same business growth strategy, sales, and marketing channels, resources, hardware, etc., as Oppo, their sister concern. Thus, making it increasingly difficult for users to differentiate some of the OnePlus flagship phones from their comparable Oppo equivalents.

Will OnePlus manage to hold on to its core enthusiast segment that they had worked so hard to acquire, or will it become another mainstream brand vacating this space for a new enthusiast brand, only time will tell.

What is still commendable though is how this start-up has disrupted the smartphone industry globally, carving out a niche market for itself in a short span of time by focusing on the needs of its customers, launching a great range of products at a fantastic price to performance ratio and extraordinary community marketing.

### 3.2.6 NOKIA

Back in the days, Nokia was counted amongst the second most popular phone makers in terms of volume after Samsung with a global market share as large as 18% at a point in time which got down to a much lower number as other competitive brands started coming in. Nokia, a Finnish company by origin entered the Indian market in the year 1994. The first ever GSM call was made on a Nokia handset by the name of Nokia 2110.

This was the time when consumers did not prefer using mobile phones and tariffs on importing phones were as high as 27%. Nokia faced stiff competition from Motorola, Siemens and Ericson.

The promotional and advertising strategy in the Nokia marketing strategy is as follows:

Nokia uses all media channels to ensure that its customers are communicated about the products. In order to promote itself well within the global smartphone market, Nokia established a partnership with Windows to roll out Lumia phones which gained immense popularity in the markets. When it came to promoting the brand, by associating with brand ambassadors like Shahrukh Khan, Nokia truly upheld its purpose of connecting people by bringing them together through handsets and a mobile phone penetration no one had previously imagined. Nokia promoted itself through television advertisements, sign boards, bill boards, radio and newspapers, brochures, posters, dummies and display

stands. They also engaged in personal selling by providing significant product training to the dealers and distributors who sold the product. Nokia, in an attempt to place itself in the minds of the people also introduced gifting concepts back in the early 2000s when they gave the customers attractive offers of grabbing a chance to win Yamaha Bikes and Toyota Vios cars. Hence this gives an insight in Nokia marketing mix.

### 3.3 CONCLUSION

Because of the higher growing similar of the product and multiplicity of Brands, it has to built distinct brands personality and define different brand image on the buyer. Effective advertisement is inevitable in this modern dynamic economy. Advertisement-a powerful media of communication and a vital marketing tool, it should attempt effectively to correct all defects in the promotion and distribution channels and make it more effectiveness of the Brand. Since the advertisement media succeeded in creating awareness and knowledge of the made in the minds of the buyers, advertisement can be more effective and larger through this media. Since the buyer of the Mobile Phones Brands is the age groups of 18 to 40 years are more attracted towards advertisement to attract the young buyers. The advertisement should have more attractive characters and transparent message, so that it will influence the buyers to buy the Brand. The advertisement should be more popular, so that they will be higher brand recognition and usage for the Brand.

**CHAPTER 4**  
**DATA ANALYSIS AND INTERPRETATION**

## 4.1 DATA ANALYSIS AND INTERPRETATION

This data is collected to analyse the effect of advertising on Smartphones. This analysis had been made on the basis of primary data collected from a sample of sixty respondents. The data has been collected through questionnaire method. Random sampling has been used for the selection of samples. Following are the table figures and interpretations of Primary data collected.

### 4.1 GENDER OF THE RESPONDENTS

**Table 4.1** Table showing the gender of the respondents

Gender	Respondents	Percentage
Female	31	51.67
Male	29	48.33
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary Data)

**Fig 4.1:** Graphical representation showing the gender of respondents



**Interpretation:** From the above table and graph, out of 60 people 51.67% are female smartphone users while 48.33% of them are male smartphone users. Thus, it is evident that the number of female smartphone users have increased in the recent years.

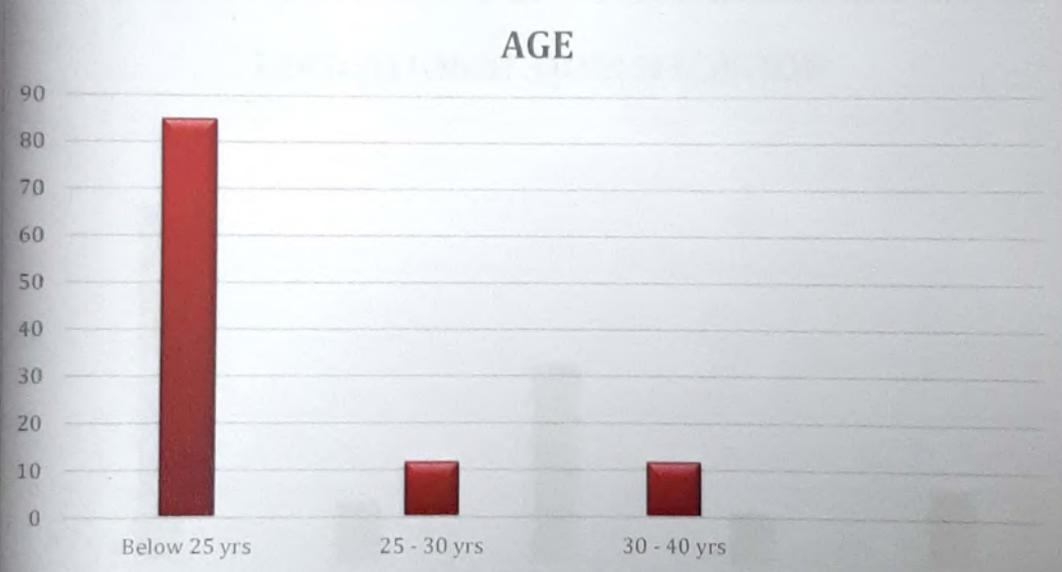
## 4.2 AGE OF THE RESPONDENTS

**Table 4.2** Table showing the age group of respondents

Age	Respondents	Percentage
Below 25 years	51	85
25 – 30 years	7	11.67
30 – 40 years	2	3.33
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.2:** Graphical representation showing the age of respondents



**Interpretation:** From the above-mentioned bar diagram, we can estimate that in the recent years the number of smartphone users are high among the age group below 25 years. The smartphone users below 25 years are 85%, 25-30 years are 11.67% and 35-40 years are 3.33%. This kind of spike in the number of smartphone users among the youth is mainly seen during the last two years because of the COVID-19 pandemic.

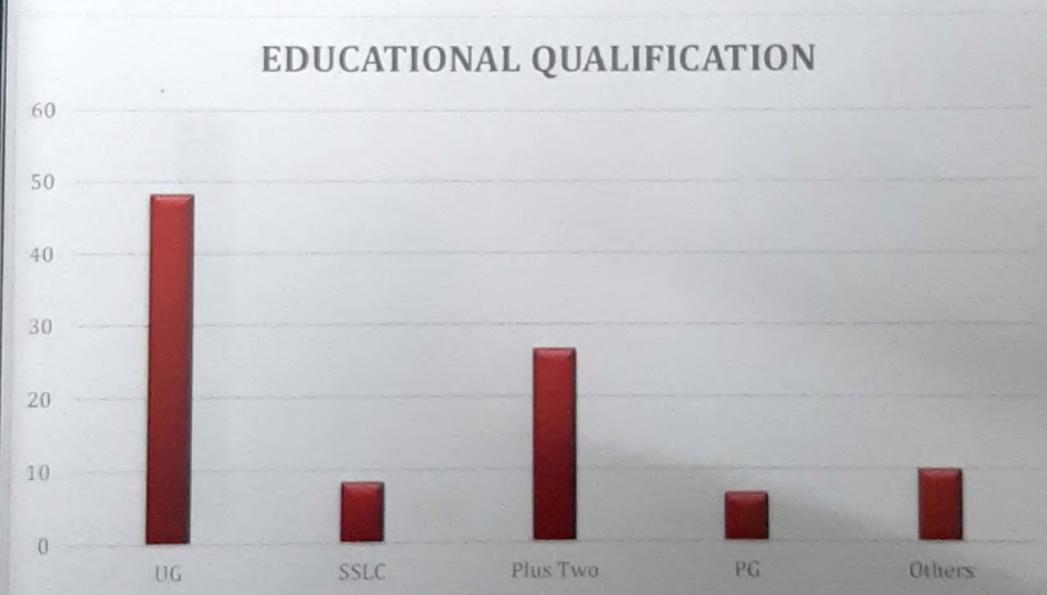
### 4.3 EDUCATIONAL QUALIFICATION OF THE RESPONDENTS

Table 4.3 Table showing the educational qualification of the respondents

Educational Qualification	Respondents	Percentage
UG	29	48.33
SSLC	5	8.33
Plus Two	16	26.67
PG	4	6.67
Others	6	10
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

Fig 4.3: Graphical representation showing the educational qualification of the respondents



**Interpretation:** From the above-mentioned bar diagram, we can understand that out of the sixty respondents about 48.33% of them are UG students, 26.67% of them are plus two students and the remaining respondents comes under the category of SSLC 8.33%, PG 6.67% and others 10%. Thus, it seems that there is an increase in the smartphone users among the students.

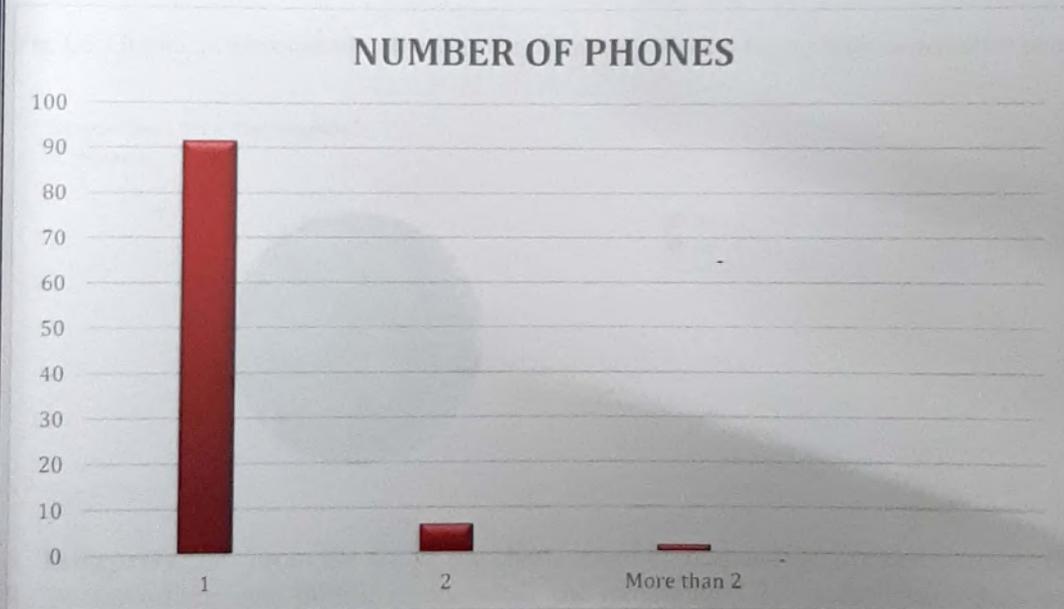
#### 4.4 NUMBER OF PHONES PER RESPONDENT

**Table 4.4** Table showing the number of phones per respondents

No. of phones	Respondents	Percentage
1	55	91.67
2	4	6.67
More than 2	1	1.66
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.4:** Graphical representation showing the number of smartphones with the respondents



**Interpretation:** From the above bar diagram, we can understand that 91.67% of them have only 1 phone while 6.67% have 2 phones and 1.66% have more than 2 phones. Thus, we can say that most of the respondents have only one phone while a few of them have two or more phones.

#### 4.5 PERCENTAGE OF USERS HAVING THEIR OWN SMARTPHONES

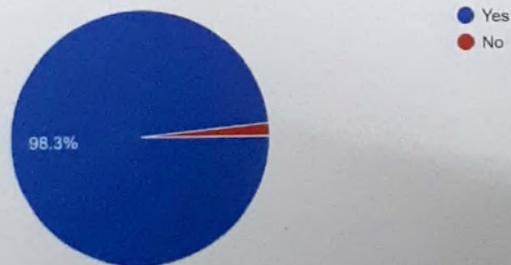
**Table 4.5** Table showing the percentage of users having their own smartphones

Whether owning a smartphone	Respondents	Percentage
Yes	59	98.3
No	1	1.7
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: primary data)

**Fig 4.5:** Graphical representation showing the percentage of users having their own mobile phone

Do you have your own mobile?  
60 responses



**Interpretation:** From the above pie chart, out of 60 respondents we can estimate that 98.3% have their own mobile phone while the remaining 1.7% doesn't have their own mobile phone

#### 4.6 BRAND OF THE SMARTPHONES

**Table 4.6** Table showing different brands of smartphones used by the respondents

Brand	Respondents	Percentage
Apple	4	6.67
OnePlus	1	1.67
Samsung	8	13.33
Others	47	78.33
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.6:** Graphical representation showing different brands of smartphones used by the respondents



**Interpretation:** The bar diagram mentioned above shows that out of the 60 respondents, almost 78.33% of them chose the 'Other' category while the remaining chose the categories Samsung 13.33%, Apple 6.67% and the least being OnePlus 1.67%

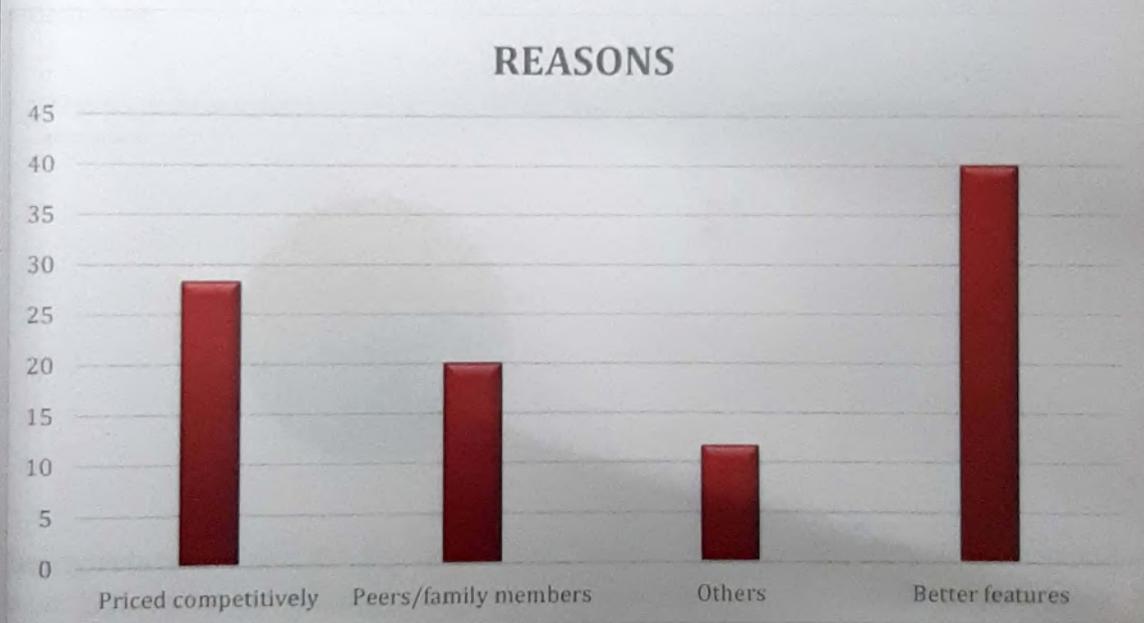
### 4.7 REASON FOR CHOOSING THE BRAND

**Table 4.7** Table showing the reason for choosing the brand

Reasons	Respondents	Percentage
Priced competitively	17	28.33
Peers/family members using and satisfied with this brand	12	20
Others	7	11.67
Better features	24	40
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.7:** Graphical representation showing the reason for choosing the brand.



**Interpretation:** In the above bar diagram, we can understand that out of the 60 respondents 40% of them chose a particular over the other because of the better features. 28.33% of them chose a particular brand over the other because of their price competitiveness. 20% of them chose a particular brand because of family influence and 11.67% of them chose a particular brand because of other reasons.

#### 4.8 ADVERTISEMENT INFLUENCE ON PURCHASING A SMARTPHONE

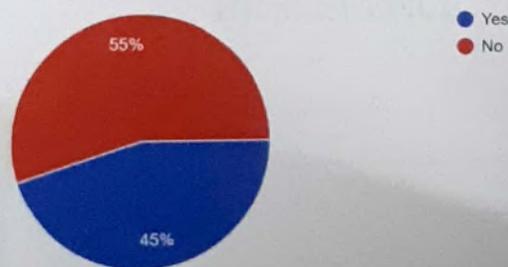
**Table 4.8** Table showing the influence of advertisement on purchase of a smartphone

Influenced by the advertisements	Respondents	Percentage
Yes	27	45
No	33	55
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.8:** Graphical representation showing the influence of advertisement on purchase of a smartphone.

Where you influenced by the advertisements to purchase your current mobile phone?  
60 responses



**Interpretation:** From the above pie chart, we can estimate that 45% of the respondents were influenced by Advertisements to purchase their current mobile phones while the remaining 55% weren't influenced by the advertisements.

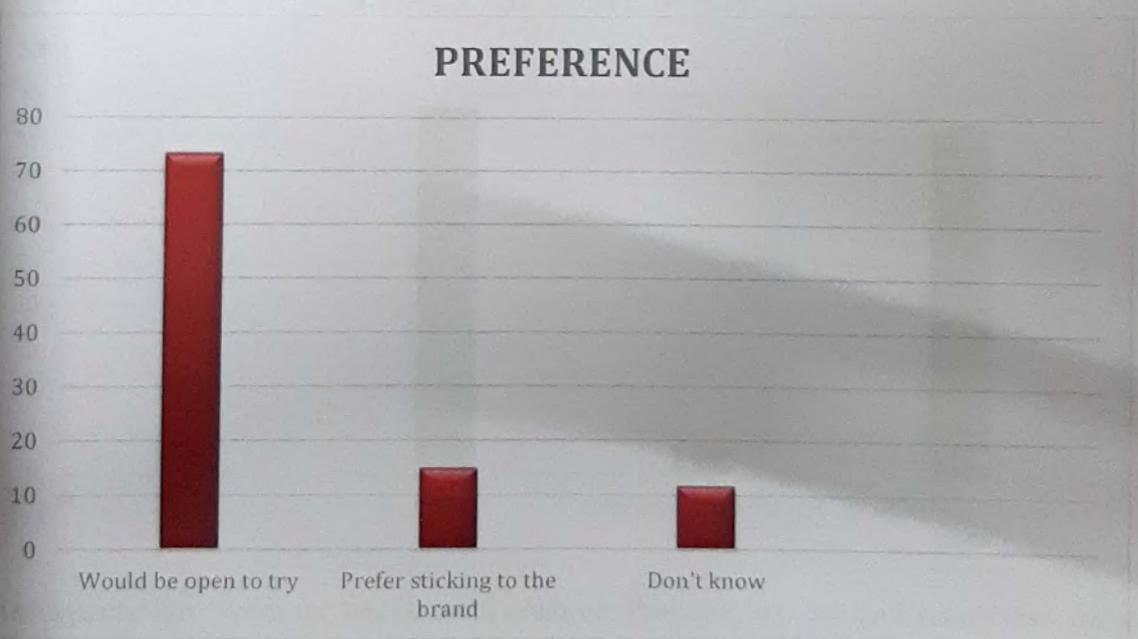
#### 4.9 PREFERENCE TO STICK TO THE CURRENT BRAND OR NOT

**Table 4.9** Table showing the preference to stick to the current brand in the future or not

Preference	Respondents	Percentage
Would be open to try a different brand	44	73.33
Prefer sticking to the brand	9	15
Don't know	7	11.67
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.9:** Graphical representation showing the preference to stick to the current brand in the future or be willing to purchase a different brand.



**Interpretation:** From the bar diagram mentioned above, we can understand that 73.33% respondents would be open to try a different brand, 15% respondents prefer sticking to their current brand while the remaining 11.67% chose the "Don't know" category.

#### 4.10 PLACE OF PURCHASE

**Table 4.10** Table showing the place of purchase of the smartphone

Place	Respondents	Percentage
Others	7	11.67
Online	26	43.33
Official exclusive brand outlets	2	3.33
Branded mobile retail stores	25	41.67
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: primary data)

**Fig 4.10:** Graphical representation showing the place of purchase of the smartphone.



**Interpretation:** From the above-mentioned bar diagram, we can understand that out of 60 respondents, about 43.33% of them bought their mobile phones through online platforms, 41.67% of them bought their mobile phones from branded mobile retail stores where as the remaining respondents chose from the categories of official exclusive brand outlets 3.33% and others 11.67%.

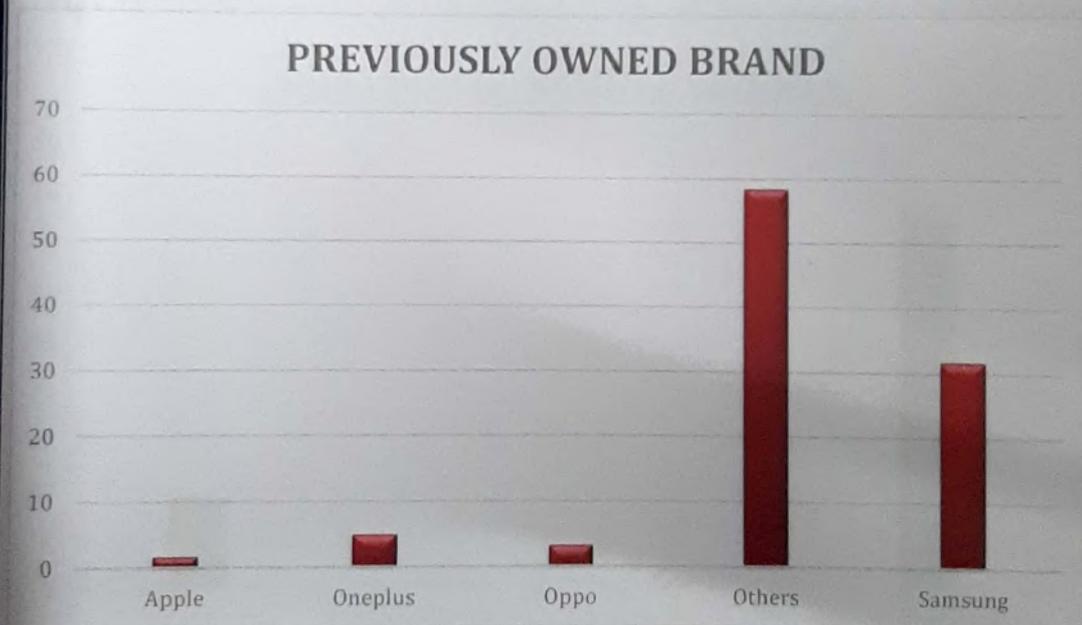
#### 4.11 PREVIOUSLY USED/OWNED BRAND

**Table 4.11** Table showing the brand of the previously used mobile phone

Brand	Respondents	Percentage
Apple	1	1.67
OnePlus	3	5
Oppo	2	3.33
Others	35	58.33
Samsung	19	31.67
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.11:** Graphical representation showing the brand of the previously used mobile phone



**Interpretation:** From the above-mentioned bar graph, we can estimate that most of the respondents chose the "Other" 58.33% category while only a few chose Samsung 31.67%, OnePlus 5%, Oppo 3.33% and Apple 1.67% category.

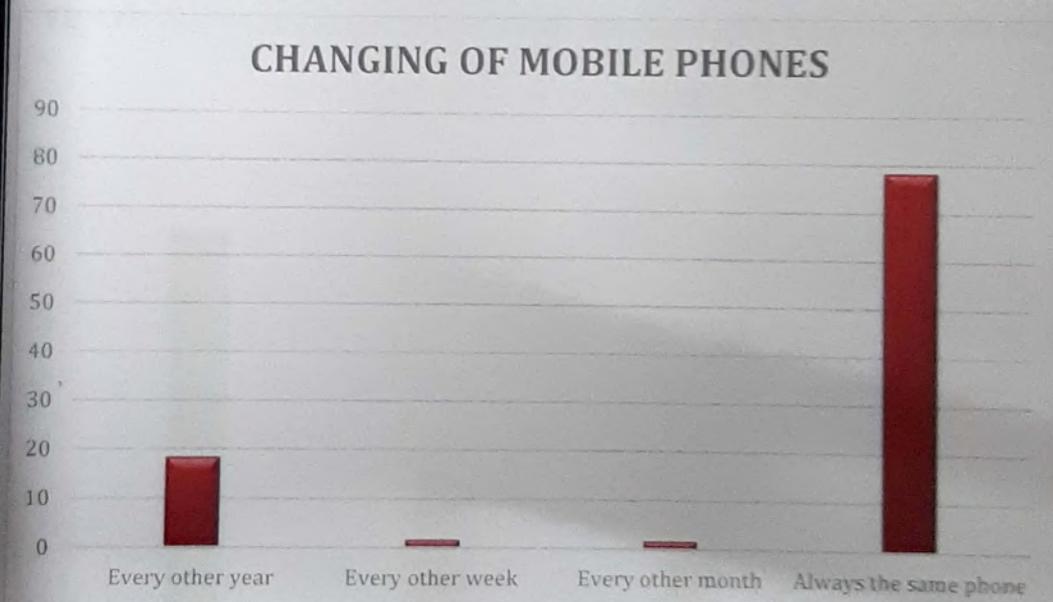
### 4.12 CHANGING OF MOBILEPHONE

**Table 4.12** Table showing the number of times of changing the mobile phone

Time	Respondents	Percentage
Every other year	11	18.33
Every other week	1	1.67
Every other month	1	1.67
Always the same phone	47	78.33
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.12:** Graphical representation showing the number of times of changing the mobile phone.



**Interpretation:** From the above-mentioned bar diagram, we can estimate that out of 60 respondents 78.33% of them always use the same phone, 18.33% of them change their mobile phone every year while the remaining respondents of them change their phones every other week 1.67% or month 1.67%. Thus, almost all of them use their same phone and do not change it.

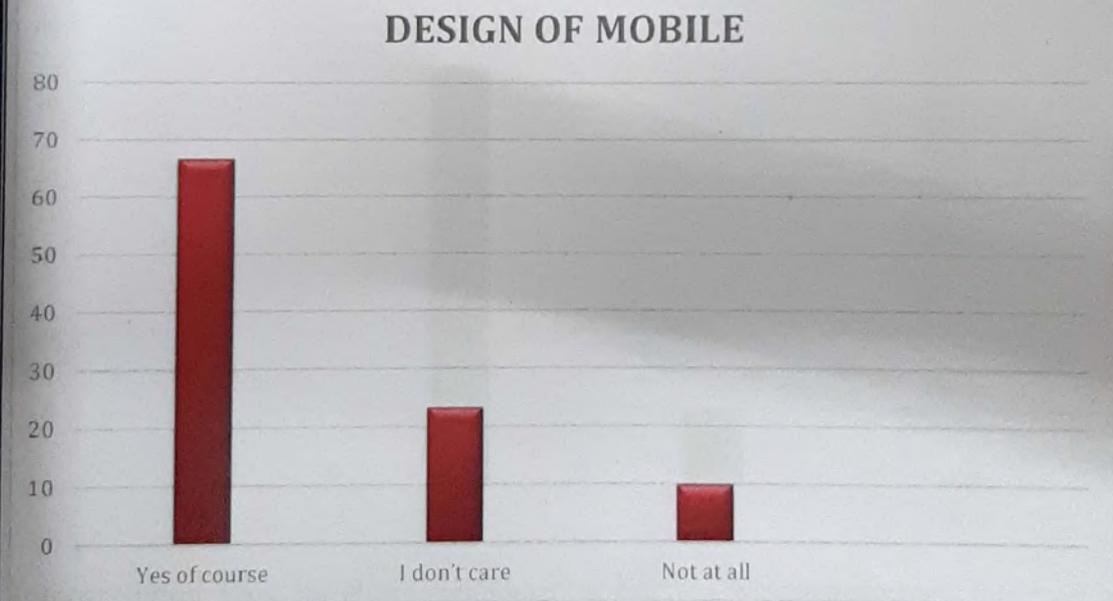
### 4.13 IMPORTANCE OF DESIGN OF THE MOBILEPHONE

**Table 4.13** Table showing the importance of the design of a mobile phone

Response	Respondents	Percentage
Yes of course	40	66.67
I don't care	14	23.33
Not at all	6	10
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.13:** Graphical representation showing the importance of the design of a mobile phone.



**Interpretation:** From the above-mentioned bar diagram, we can understand that most of them 66.67% agree that the design of the mobile phone is important while the remaining 33.33% doesn't give any Importance nor care about the design of the mobile phones.

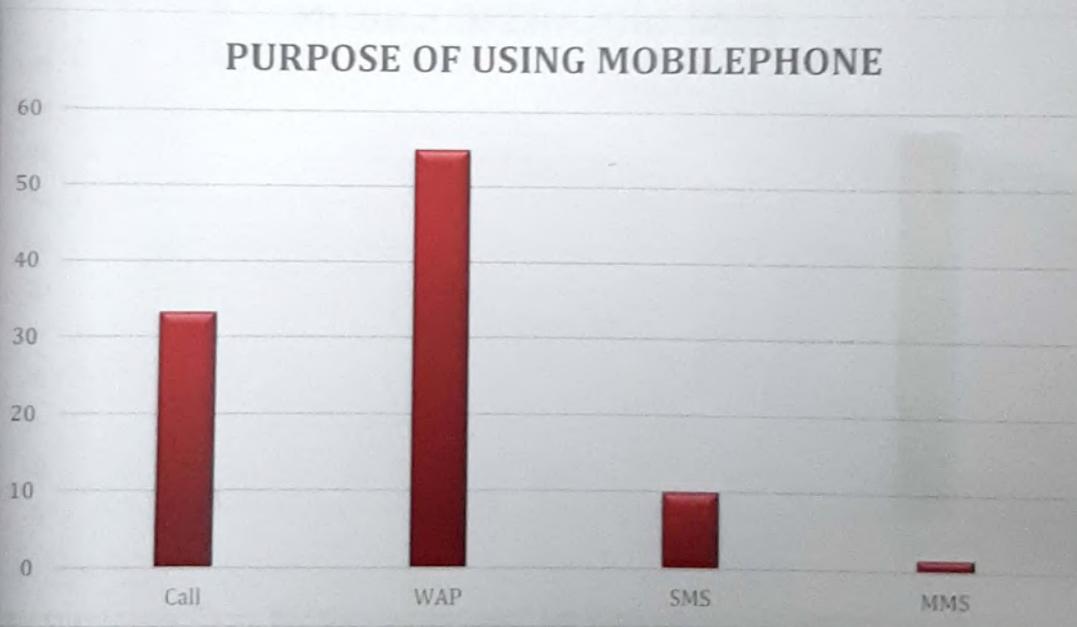
#### 4.14 PURPOSE OF USING THE MOBILEPHONE

**Table 4.14** Table showing the purpose of using the mobile phone

Purpose	Respondents	Percentage
Call	20	33.33
WAP(Internet)	33	55
SMS	6	10
MMS	1	1.67
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.14:** Graphical representation showing the purpose of using the mobile phone



**Interpretation:** From the above-mentioned bar diagram, we can understand that most of the respondents use their mobile phones for using internet 55% and calling 33.33% while only a few of them use it for SMS 10% and MMS 1.67% purposes. Thus, we can understand that the number of internet users are high according to the given data.

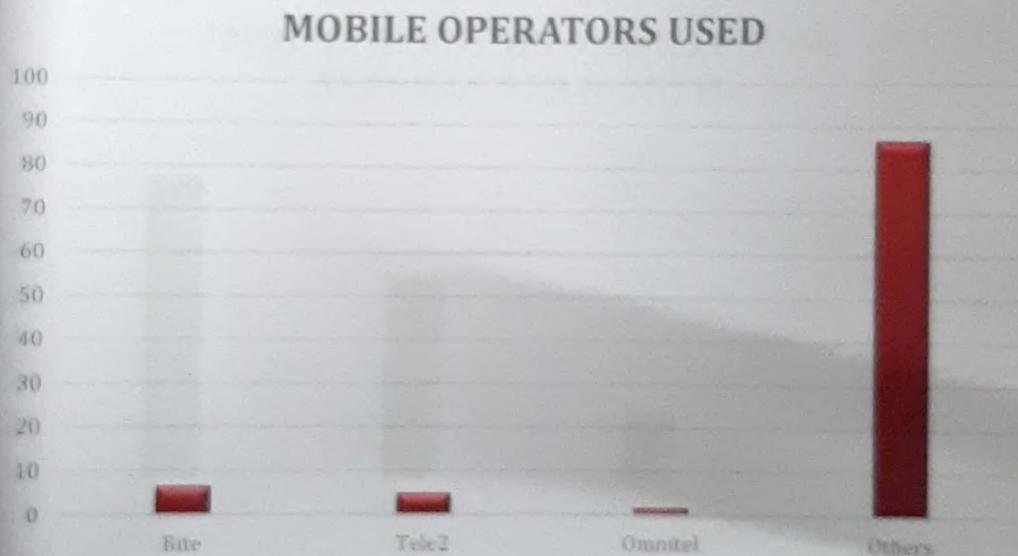
### 4.15 MOBILE OPERATORS USED

Table 4.15 Table showing the mobile operators used

Mobile operators	Respondents	Percentage
Bite	4	6.67
Tele2	3	5
Omnitel	1	1.66
Others	52	86.67
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

Fig 4.15: Graphical representation showing the mobile operators used



**Interpretation:** From the above-mentioned bar diagram, we can understand that most of the respondents have chosen the "Others" 86.67% category while a few have chosen Bite 6.67%, Tele2 5% and Omnitel 1.66%.

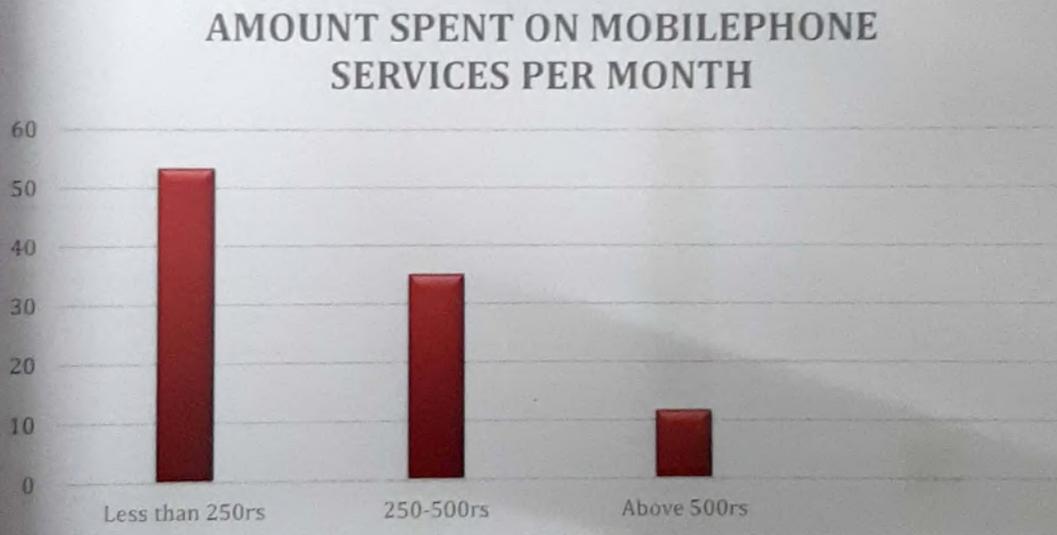
#### 4.16 MONEY SPENT ON MOBILE SERVICES PER MONTH

**Table 4.16** Table showing the amount spent on mobile services per month

Amount	Respondents	Percentage
Less than 250rs	32	53.33
250-500rs	21	35
Above 500rs	7	11.67
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.16:** Graphical representation showing the amount spent on mobile services per month.



**Interpretation:** From the above-mentioned bar diagram, we can understand that out of the 60 respondents 53.33% of them spend less than 250 rupees on mobile services per month, 35% of them spend 250-500 rupees on mobile services per month while the remaining 11.67% of them spend more than 500 rupees on mobile services per month.

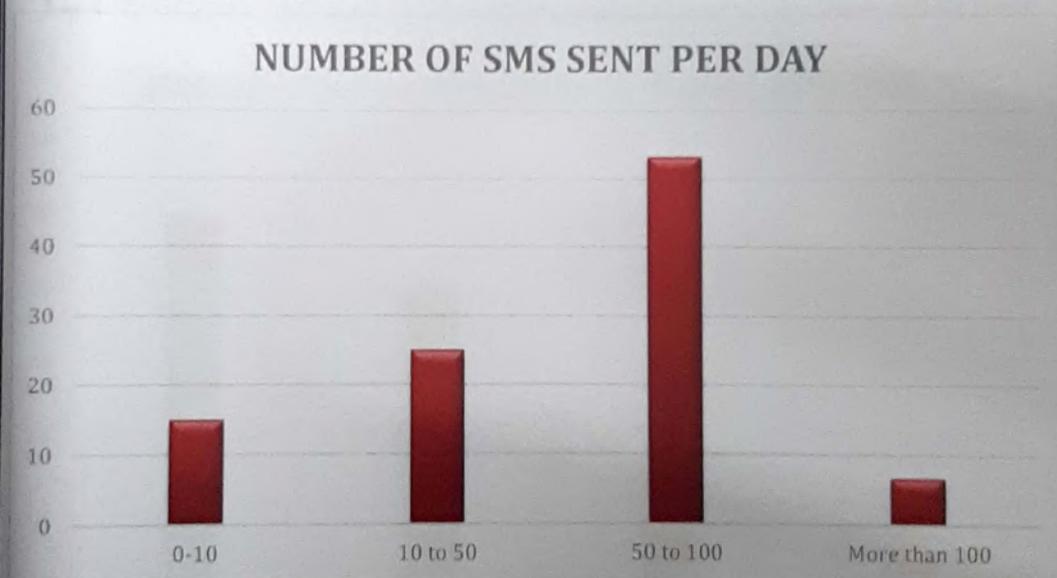
#### 4.17 NUMBER OF SMS SENT PER DAY

**Table 4.17** Table showing the number of SMS sent per day

Number of SMS	Respondents	Percentage
50-100	9	15
10-50	15	25
0-10	32	53.33
More than 100	4	6.67
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.17:** Graphical representation showing the number of SMS sent per day.



**Interpretation:** From the above-mentioned bar diagram, we can understand that most of the respondents send less than 10 messages per day 53.33% while the remaining chose the 10-50 25%, 50-100 15% and more than 100 6.67% categories.

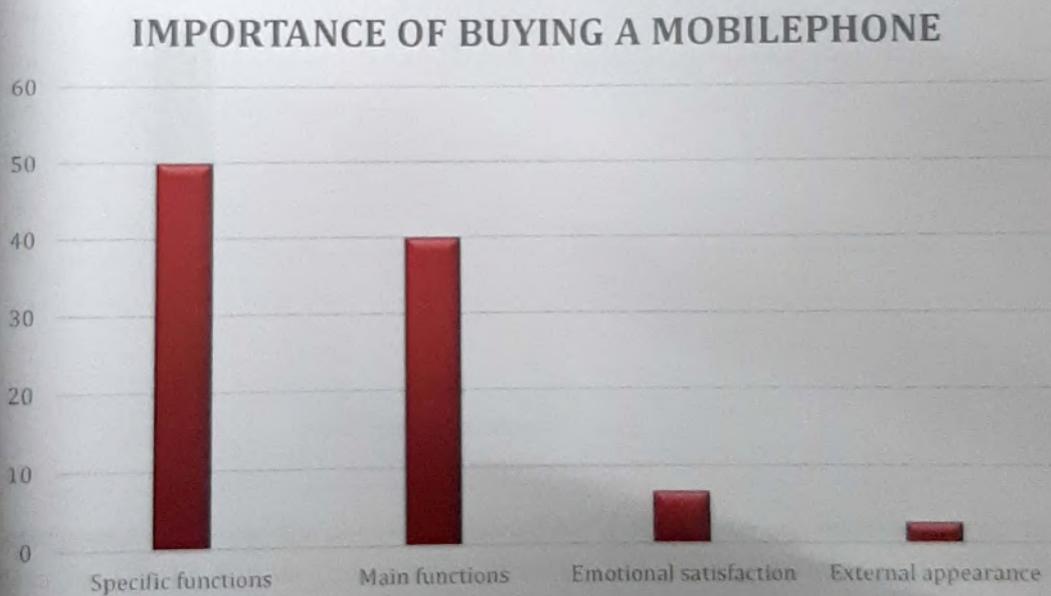
#### 4.18 IMPORTANCE OF BUYING A NEW MOBILEPHONE

**Table 4.18** Table showing the importance of buying a new mobile phone

Reasons	Respondents	Percentage
Specific functions	30	50
Main functions	24	40
Emotional satisfaction	4	6.67
External appearance	2	3.33
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.18:** Graphical representation showing the importance of buying a new mobile phone.



**Interpretation:** From the above-mentioned bar diagram, we can understand that out of 60 respondents 50% of them bought new smartphone because of their specific functions, 40% of them bought it because of its main functions, 6.67% of them bought it for emotional satisfaction while the remaining 3.33% bought it because of its external appearance.

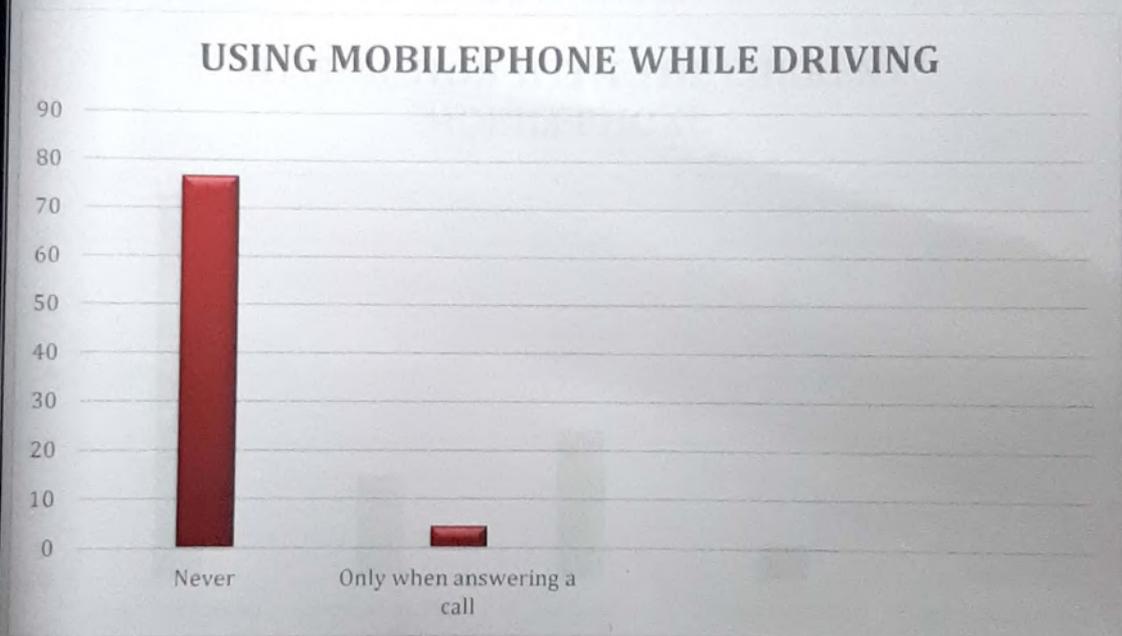
### 4.19 USAGE OF MOBILEPHONES WHILE DRIVING

**Table 4.19** Table showing the usage of mobile phone while driving

Response	Respondents	Percentage
Never	46	76.67
Only when answering a call	14	23.33
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.19:** Graphical representation showing the usage of mobile phone while driving.



**Interpretation:** From the above-mentioned bar diagram, we can understand that most of them 76.67% do not use their mobile phones while driving whereas only a very few of them 23.33% use their phones while driving.

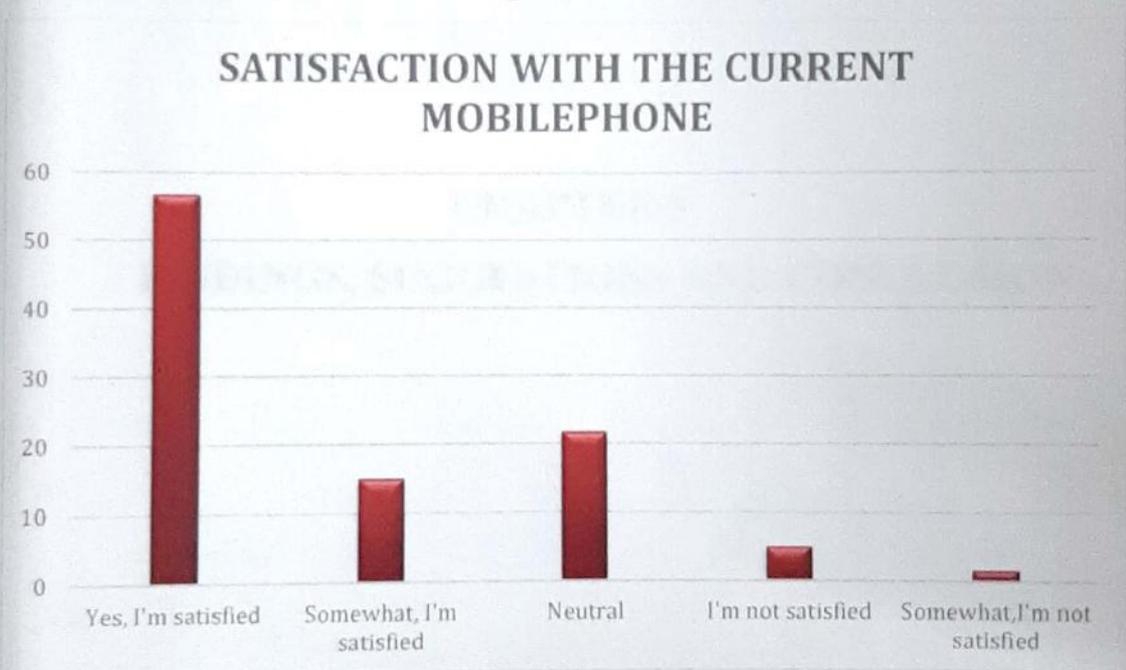
## 4.20 SATISFACTION WITH THE CURRENT MOBILE BRAND

**Table 4.20** Table showing the satisfaction with the current mobile phone brand

Responses	Respondents	Percentage
Yes, I'm satisfied	34	56.67
Somewhat, I'm satisfied	9	15
Neutral	13	21.67
I'm not satisfied	3	5
Somewhat, I'm not satisfied	1	1.66
<b>TOTAL</b>	<b>60</b>	<b>100</b>

(Source: Primary data)

**Fig 4.20:** Graphical representation showing the satisfaction with the current mobile phone brand.



**Interpretation:** From the above-mentioned bar diagram, we can understand that most of them are satisfied 56.67% with their current mobile phone brand while only a few of them are feeling neutral 21.67% or not satisfied 5% with their current brand.

**CHAPTER 5**  
**FINDINGS, SUGGESTIONS AND CONCLUSION**

## 5.1 FINDINGS

The findings of this study were based only on descriptive, lower-level statistics. Further research is thus needed to gain more insight into the effectiveness of advertising of smartphones. It is recommended that more Advanced statistical procedures, such as regression and factor analyses, should be utilized for further development of the knowledge base to truly understand the advertising effectiveness of smartphones. Although some of the survey results were evenly distributed over the measuring scale and therefore in conclusive, many people responded similarly to scenarios that enabled certain factors to stand out.

1. The number of male and female smartphone users are almost equal but in the recent years, the number of female smartphone users have increased.
2. There is a spike in the number of smartphone users among the age of 25yrs and below, mainly seen during the last two years of Covid-19 pandemic.
3. As per the analysis, in the educational qualification category, most of the smartphone users are UG students.
4. It is found that the number of phones a smartphone user have is mostly one while only a few of them have two or more.
5. According to the study, 98.3% have their own mobile phones while the remaining 1.7% doesn't have their own.
6. 78.33% of the respondents chose the 'other category'. The other category includes: Oppo, Redmi, Vivo etc.
7. As per the study 40% of the respondents chose a particular brand over the other because of their better features while the remaining 60% chose it due to price competitiveness, family influence and other reasons.
8. 45% of the respondents were influenced by the advertisements to purchase their current mobile phones while the remaining 55% weren't influenced by the advertisements.
9. As per the study, majority of the respondents are open to buy a different brand of smartphone.
10. It is found that most of the respondents bought their mobile phones through online platforms and branded mobile retail stores.
11. Majority of the respondents chose the 'others category' which includes Redmi ,Vivo etc.
12. A large section of the smartphone users prefer to use the same phone in the long run.
13. The design of mobile phones play an important role during the purchase of mobile phones.
14. Most of the smartphone users use mobile phones for internet and calling purposes.
15. Mobile operators used among 86.67% of the respondents are under the 'other category' which includes Airtel, Jio, BSNL etc.

16. Money spent on mobile phone services per month by majority of respondents is less than 250 rupees.
17. Number of SMS sent per day by majority of respondents is only 53.33%.
18. As per the study, 50% of the respondents purchase their mobile phones mainly because of its specific functions.
19. It is found that most of the respondents do not favour to use their mobile phones while driving.
20. According to the analysis, majority of the respondents are satisfied with their current mobile phone brand.

## 5.2 SUGGESTIONS

1. It is important to identify the right target audience that would be interested in mobile ads. Brands should make sure that ads are relevant to the device users that they are being shown to
2. It is important to ensure the ad is just not for the promotion of your offering but it should genuinely aim to solve the target audience's problems.
3. Keep the ads lightweight so that the users can easily load on the mobile devices of your users.
4. Employ video content in the ads because they have a higher engagement percentage.
5. Capturing the emotions of the audience with ads is a great strategy if rightly implemented.
6. Know more on how to establish and polish the mobile marketing strategies to effectively target communication, deliver optimum effectiveness, capture the audience, and deliver your business goals.
7. The advertisement should have more attractive characters and transparent message, so that it will influence the buyers to buy the Brand.
8. The advertisement should be more popular, so that they will be higher brand recognition and usage for the Brand.

## 5.3 CONCLUSION

Because of the higher growing similar of the product and multiplicity of Brands, it has to build distinct brands personality and define different brand image on the buyer. Effective advertisement is inevitable in this modern dynamic economy. Advertisement-a powerful media of communication and a vital marketing tool, it should attempt effectively to

correct all defects in the promotion and distribution channels and make it more effectiveness of the Brand. Since the advertisement media succeeded in creating awareness and knowledge of the made in the minds of the buyers, advertisement can be more effective and larger through this media.

Smartphones are clearly impacting society and say a great deal about what we - the consumers - want from our technology. But to categorize the smartphone's effects into positives and negatives, benefits and consequences, is not the correct way to approach looking at this cultural phenomenon. The smartphone perception varies, and therefore this relatively new technology is received and interpreted in many different ways, by many different people. For instance, someone who is not easily distracted may not mind having a smartphone and using it only when they need to. Meanwhile, a person who is easily distracted may find the smartphone is interrupting their work time, their study time, and even time spent in personal relationships. It all depends on what kind of person you are, and what technology you are capable of handling.

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APPENDIX

## QUESTIONNAIRE

We, the students of St. Teresa's College have prepared a questionnaire for the purpose of understanding the effects of advertising on Smartphones. In order to complete our research, a few questions must be answered and the information's/feedbacks will be kept confidential.

Name:

Gender:

Male     Female     Others

Age:

Below 25 years     25-30yrs     30-35yrs  
 35-40yrs     Above 40yrs

Educational Qualification:

SSLC     Plus Two     UG     PG     Others

1. Do you have your own mobile phone?  
a) Yes    b) No
2. How many phones do you have?  
a) 1    b)2    c) more
3. What brand is it?  
a) Samsung    b) Apple    c) One plus    d) Others
4. Why did you choose this brand over the others?  
a) Better features (compared to similar model from other brands)  
b) Priced competitively (compared to similar models from other brands)  
c) Peers/Family members using and satisfied with this brand  
d) Others

5. Were you influenced by the advertisements to purchase your current mobile phone?
  - a) Yes
  - b) No
  
6. Would you prefer to stick to your current brand in the future or would you be willing to purchase a different brand?
  - a) Prefer sticking to the current brand
  - b) Would be open to try a different brand
  - c) Don't know
  
7. Where did you buy your mobile phone from?
  - a) Branded mobile retail store
  - b) Official exclusive brand outlets
  - c) Online
  - d) Others
  
8. What brand of phone did you previously own?
  - a) Samsung
  - b) Apple
  - c) One plus
  - d) Oppo
  - e) Others
  
9. How often do You change Your mobile?
  - a) Every other year
  - b) Every other month
  - c) Every other week
  - d) Always the same phone
  
10. Is the design of a mobile phone important for You?

- a) Yes, of course
- b) I don't care
- c) Not at all

11. You often use your phone to:

- a) Call
- b) SMS
- c) WAP (Mobile internet)
- d) MMS

12. Which mobile operator do you use?

- a) TELE2
- b) Omnitel
- c) Bite
- d) Others

13. How much money do you spend on mobile services per month?

- a) Less than rs.250
- b) 250-500rs
- c) Above rs.500

14. How many SMS do you send per day?

- a) 0-10
- b) 10-50
- c) 50-100
- d) more than 100

15. Buying a new mobile phone for You is important:

- a) Main functions (making calls, writing SMS, MMS...)

- b) Specific functions (camera, MP3 player, Dictaphone etc.)
- c) External appearance
- d) Emotional satisfaction

16. Do You use your mobile phone while driving?

- a) Never
- b) Just when SMS comes
- c) Only when answering a call

17. Are you satisfied with your current mobile phone brand?

- a) Yes
- b) No

Project Report

On

**STUDY ON ONLINE CLOTH SHOPPING  
BEFORE AND DURING COVID**

*Submitted*

*in partial fulfilment of the requirements for the degree of*  
**BACHELOR OF SCIENCE**

*in*

**MATHEMATICS**

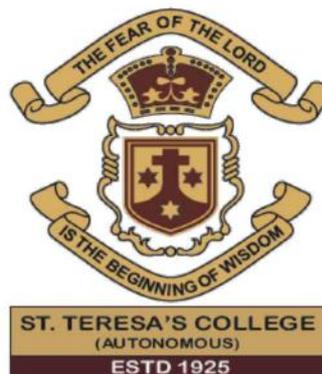
*by*

**DIYA JAJI**

(Register No. AB19AMAT014)

*Under the Supervision of*

**DR ELIZABETH RESHMA M T**



**DEPARTMENT OF MATHEMATICS  
ST. TERESA'S COLLEGE (AUTONOMOUS)**

**ERNAKULAM, KOCHI - 682011**

**APRIL 2022**

ST. TERESA'S COLLEGE (AUTONOMOUS), ERNAKULAM

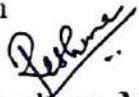


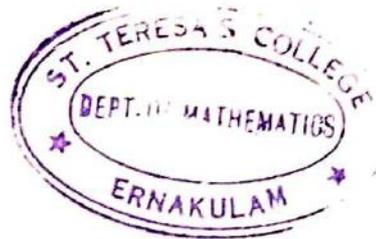
CERTIFICATE

This is to certify that the dissertation entitled, **STUDY ON ONLINE CLOTH SHOPPING BEFORE AND DURING COVID 19** is a bonafide record of the work done by Ms. **DIYA JAJI** under my guidance as partial fulfilment of the award of the degree of **Bachelor of Science in Mathematics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

Date: 04/03/2022

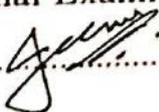
Place: Ernakulam

  
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2: .....

# DECLARATION

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

Ernakulam.

Date: 04/03/2022



DIYA JAJI

AB19AMAT014

# ACKNOWLEDGEMENT

I wish to express my gratitude to our project guide, Dr Elizabeth Reshma M T of the Department of Mathematics and Statistics of St Teresa's College(Autonomous), Ernakulam. The completion of this project could not have been possible without the assistance of Smt. Reshmi S and Smt. Rosmin Raju.

I thank all the teachers who in one way or another shared their support. Also, I would like to thank everyone who helped me in finishing my project.

Ernakulam.

Date: 04/03/2022

DIYA JAJI

**AB19AMAT014**

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# Chapter 1

## INTRODUCTION

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For the last decade, the evolution in technology is remarkable. We are in the era of globalization where online shopping is one of the greatest achievements. For the last couple of years, the increase in online shopping is very evident due to the widespread of Covid 19. Our whole country went to a complete lockdown by the end of March 2020. Every sector was negatively affected by it, directly or indirectly. The economy of India, like many other countries, has decreased considerably. During these dark times, one of the possible means to buy things was online shopping.

Before this study was conducted, many people had already done studies over online shopping in this pandemic period. Among these studies, we referred some which happened to be helpful.

'Trust in online shopping during Covid 19 - A case study from Kosovo (Faculty of Economics, University of Prishtina "Hasan Prishtina", Kosovo)' states that online shopping is the easiest way in this busy world especially during Covid 19. They studied the convenience of online shopping. The increase in e-shopping with the development of information technology has an impact on the world economy. E-shopping enables us to be more global and also reduces trade barriers. They concluded that the shopping behaviour changes due to some factors.

'A study on the influence of Covid 19 pandemic on customers' buying behaviour (by Bharati Aggarwal and Deepa Kapoor)' says that online shopping is

an e-business that allows purchasing goods by using the internet with the help of a web browser. They concluded that the internet plays an important role in e-business that provides various facilities (by Rani and Charumathi). The study says that the increase in the usage of the internet has changed the trend in shopping. They concluded that the online shopping has tremendously increased during Covid 19.

'Online shopping behaviour during Covid 19 pandemic in India (by Amit Ranjan, Madhavendra Misra and Jitendra Yadav)' affirms that e-commerce is a platform where customers can enjoy their shopping through different websites and channels. They say that the customers need something beyond their expectations and gratification. They just don't need high-quality products but also require multi-channel services.

'Impact of Covid 19 pandemic on online consumer purchasing behaviour (by Shengyu Gu, Beata S'lusarczyk, Sevba Hajizada, Irina Kvalyova and Amina Sakhbieva)' asserts that by 2020 the number of e-commerce publications has increased more compared to 2000. They concluded that seven clusters were introduced through the analysis of e-commerce publications.

## **1.1 SIGNIFICANCE OF THE STUDY**

The study tries to examine user behaviour and experiences of consumers participating in online shopping. Online shopping has created a space for small scale businesses to become successful. So by examining consumer behaviours, business owners can make optimized marketing plans and strategies to improve their commerce. The survey also investigates the factors responsible for consumers' choices and preferences in online shopping. This paper also mentions various challenges people face in online shopping. The results could also be used for future references.

## **1.2 OBJECTIVES OF THE STUDY**

- Identify various factors affecting preference of shopping and role of discount
- Relation between monthly income and monthly purchase rate

### **1.3 LIMITATIONS OF THE STUDY**

The study is limited to the Ernakulam district of Kerala. The study is only based on consumer behaviour in shopping online. The data collected for research purposes is based exclusively on the primary data provided by the respondents. There is a risk of personal bias. So the accuracy is not right. Due to time constraints and other restrictions, the survey was limited to only 261 participants.

# Chapter 2

## DATA DESCRIPTION

---

### 2.1 DATA SOURCE

Here we have used the primary method. Due to the pandemic, the survey was done by means of google form. Moreover, an online questionnaire is cost-effective, especially in this era of social distancing. We have collected 332 samples out of which we selected 261 samples which are from Ernakulam district. For getting more effective results samples are only collected from Ernakulam district. The age group which we are concentrating on is 15-65, which includes students, employees, unemployed, housewives, etc.

### 2.2 DATA DESCRIPTION

The variables are

- Age
- Gender (Female/Male)
- Place of residence (Urban/Rural)
- Monthly income (Below 10,000/10,000-50,000/50,000-1,00,000/Above 1,00,000)
- Status of online purchase - Yes(have purchased online) or No(have not purchased online)
- Role of discount - Yes(it has a role) or No(it does not have a role)
- Monthly purchase rate (Below 1,000/-, Below 2,000/-, Above 2,000/-)

# Chapter 3

## METHODOLOGY

---

### 3.1 STATISTICAL SURVEY

It is a scientific process of collection and analysis of numerical data. The facts and figures related to our area of interest are called data, which may be qualitative or quantitative. Planning is the most essential step in the statistical survey. A questionnaire is a list of questions used for the collection of information in an investigation. The success of the study depends to a very great extent on the questionnaire. In the absence of adequate and accurate data, the application of statistical techniques cannot fetch good and reliable results. Then the classification is done based on the characteristic under consideration. After the collection and classification of data, statistical analysis and interpretation of the results are done. Finally, a report that contains a complete description of all the stages of enquiry is published.

Statistical surveys allow us to reach thousands of participants. Surveys provide a high level of general capability in representing a large population. It is of low cost and can be administered to the participants in a variety of ways. Because of the high representativeness brought about by the survey method, it is often easier to find statistically significant results than other data gathering methods.

Statistical surveys have disadvantages too. Questions that bear controversies may not be precisely answered by the participants. The general questions may not be as appropriate for all the participants as they should be.

## 3.2 TEST USED

### CHI-SQUARE TEST ( $\chi^2$ TEST)

It is a statistical hypothesis test that is used to compare the observed results with expected results. It is used to find whether there is a relationship between two variables. The two commonly used  $\chi^2$  tests are the  $\chi^2$  goodness of fit test and the  $\chi^2$  test of independence.  $\chi^2$  goodness of fit is used when you have a single measurement variable and  $\chi^2$  test of independence is used when you have two measurement variables. Here, we use the  $\chi^2$  test of independence.

We take the null hypothesis,  $H_0$ : There is no relation; and the alternate hypothesis as  $H_1$ : There is a relation. Degrees of freedom =  $(d_1 - 1)(d_2 - 1)$ ; where  $d_1$  is the category for the first variable and  $d_2$  is the category for the second variable. To get a more reliable result, we take  $\alpha = 0.05$  (5%). The p-value of 0.05 or greater is considered critical, anything less means the deviations are significant and the null hypothesis being tested must be rejected. The  $\chi^2$  test is a one-sided test because we never have negative values of  $\chi^2$ .  $\chi^2$ , the sum of the difference of observed and expected squared is divided by the expected, thus it is always a positive number or it may be close to zero. The theoretical value depends on both the  $\alpha$  value and the degrees of freedom of our data.

Let  $E_i$  be the expected frequency of the  $i^{th}$  class and  $O_i$  be the observed frequency of the  $i^{th}$  class, then

$$\chi^2 = \frac{\sum_{i=1}^k (O_i - E_i)^2}{E_i} \quad (3.1)$$

follows the  $\chi^2$  distribution with  $k-r-1$  degrees of freedom where  $k$  is the number of classes and  $r$  is the number of independent constraints to be satisfied by the frequencies.

$\chi^2$  test often refers to tests for which the distribution of the test statistic approaches the  $\chi^2$  distribution asymptotically, meaning that the sampling distribution of the test statistic approximates a  $\chi^2$  distribution more and more closely as sample size increases.

## Chapter 4

# DATA ANALYSIS

---

### 4.1 GRAPHICAL ANALYSIS

We have collected a total of 332 samples out of which 261 is from Ernakulam district. As we are only concentrating on Ernakulam district, our sample size is 261.

In 261, 54 were males and 207 were females. About 90% of the respondents belong to the age group 18-25. From urban 162 responded and from rural 99 responded.

Out of the 261 samples collected, 231(89%) have purchased clothes online at least once and the remaining 30(11%) have never purchased clothes online.

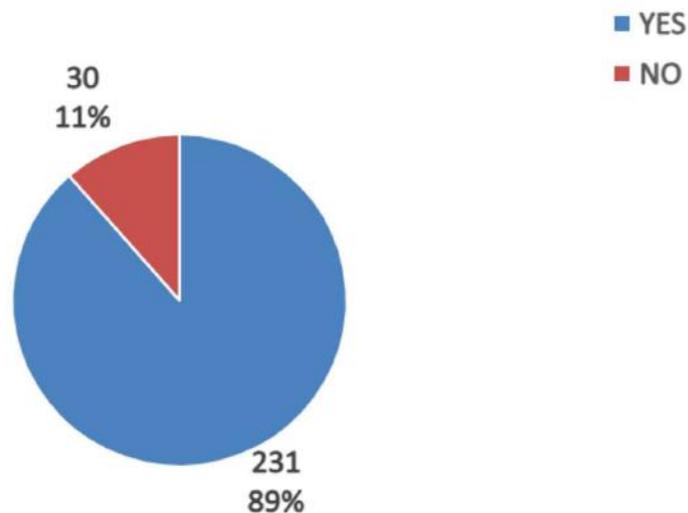


Figure 4.1: Status of online purchase

One of the biggest concerns among people who have never purchased online is that the expected product is not received. Some other concerns include online transactions are riskier, risk of identity theft and lack of knowledge about online shopping.

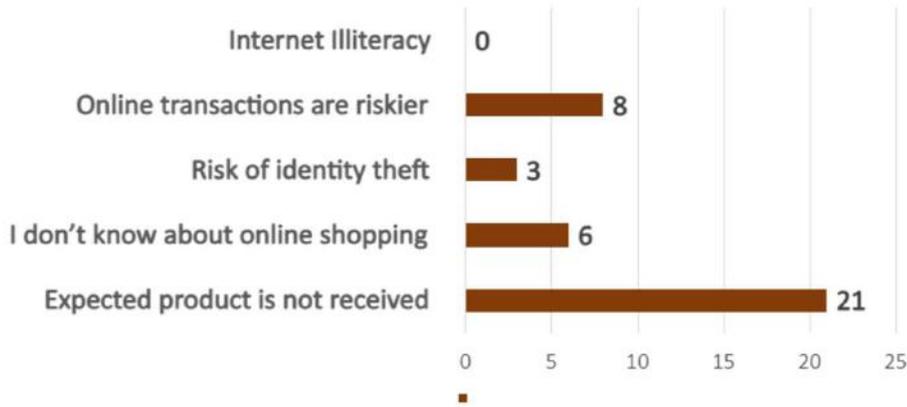


Figure 4.2: Reasons for not participating in online shopping

From the 231 responses on the frequency of online shopping, 163 (71%) people shop online once in a few months, 28 (12%) shop online once in a month, 25 (11%) twice or thrice in a month and 15 (6%), more than thrice in a month.

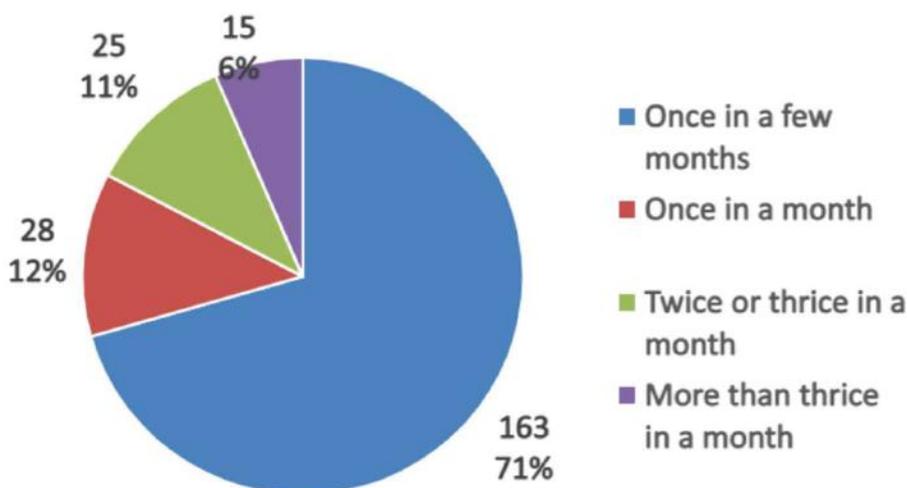


Figure 4.3: Frequency of online shopping

From the 231 responses on the frequency of people purchasing in person, 151 (65%) people shop once in a few months, 45 (19%) shop once in a month, 20 (9%) twice or thrice in a month and 15 (7%), more than thrice in a month.

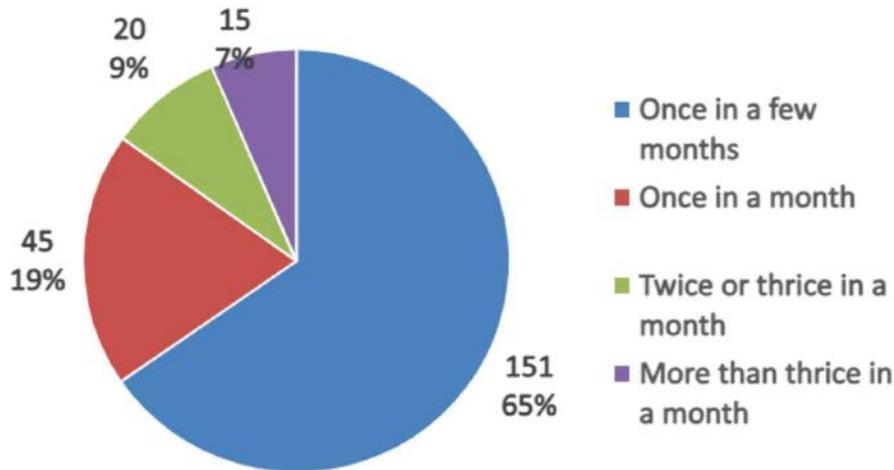


Figure 4.4: Frequency of in-person shopping

153 people out of 231 would rate their overall online shopping experience as average, 72 rate their experience as excellent and the remaining 6, as poor.

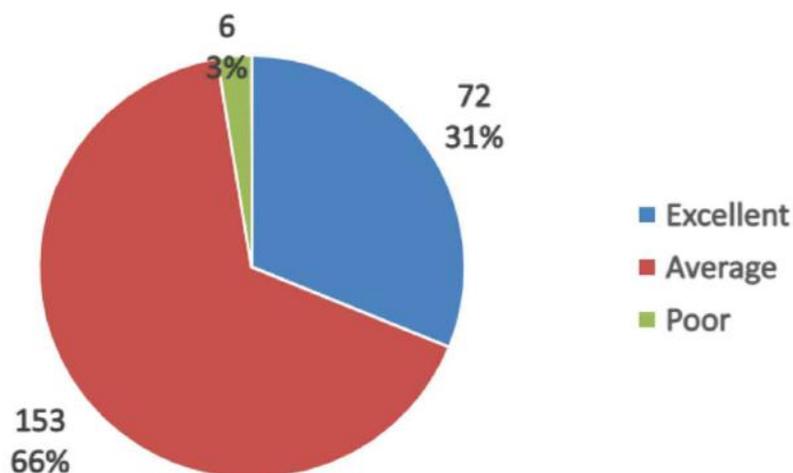


Figure 4.5: Rating - Online shopping

Some of the main reasons for people to prefer online are a wide range of choices (29%), time-saving (24%), Convenience and flexibility(14%), easy returns(14%), discounts/ offers(9%), and no contact home delivery(9%). There are other(1%) reasons as well.

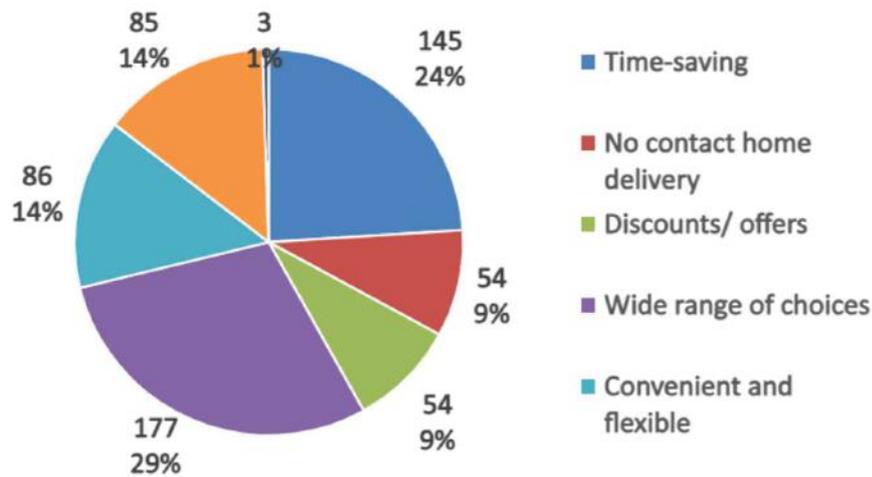


Figure 4.6: Advantages of online shopping

Among the concerns people have in online shopping, the prominent one is poor quality (50%). Other concerns include breach of personal information/ payment details (39%), poor internet connection (8%)and others (3%).

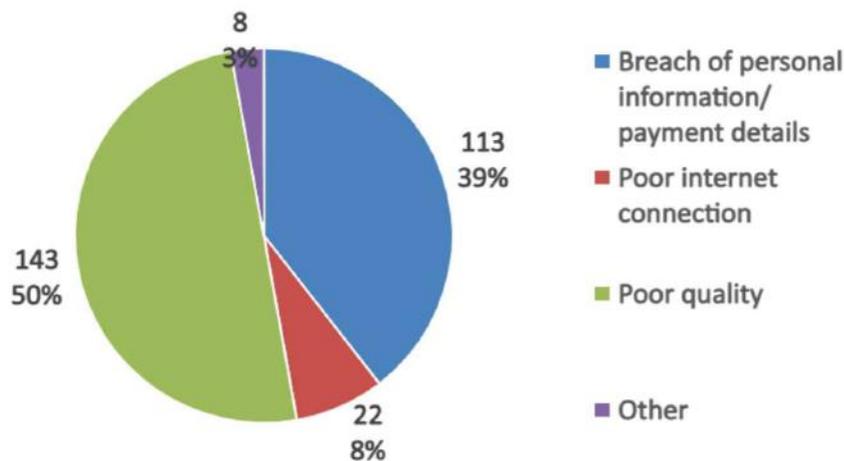


Figure 4.7: Concerns in online shopping

Out of the 231 people who responded to the impact of Covid 19 on online shopping, 188 (81%) answered that their online shopping increased during Covid 19 and the remaining 43 (19%) did not find any increase.

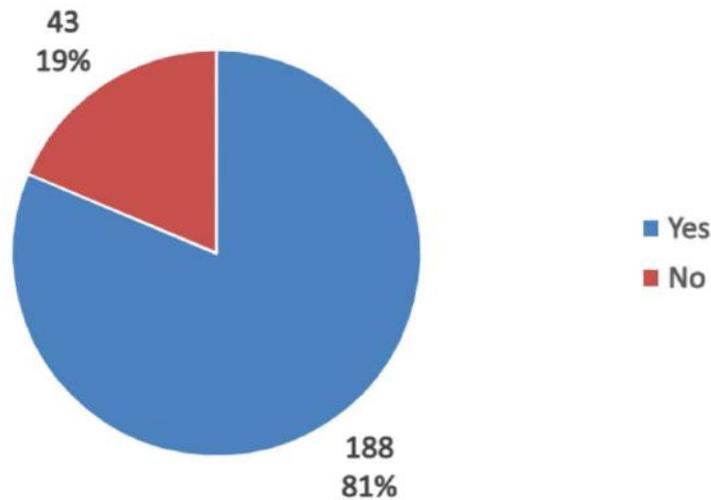


Figure 4.8: Covid 19 and Online shopping

Of the 188 people who responded that their online shopping increased during Covid, only 12 admitted to have done their entire shopping online, 90 says more than half of their purchases was done online and 86 says that only limited purchases were increased online.

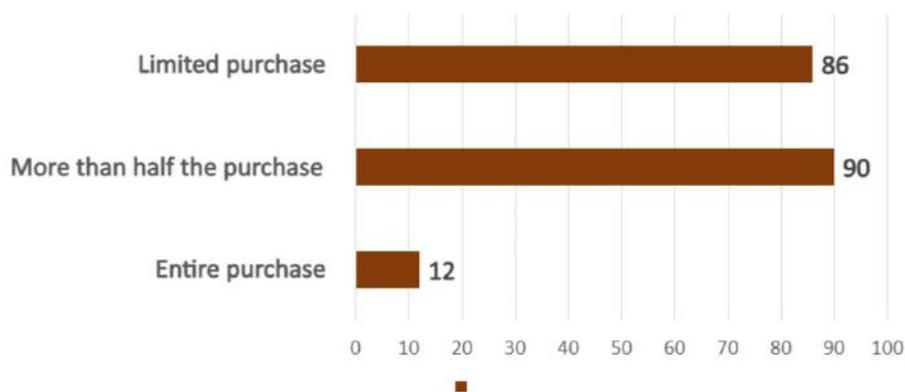


Figure 4.9: Impact of Covid 19 on online shopping

Regarding the amount spent on online shopping every month, 133 spend money below 1,000/-, 68 spend below 2,000/- and the remaining 30 spend more than 2,000/- on online shopping on a monthly basis.

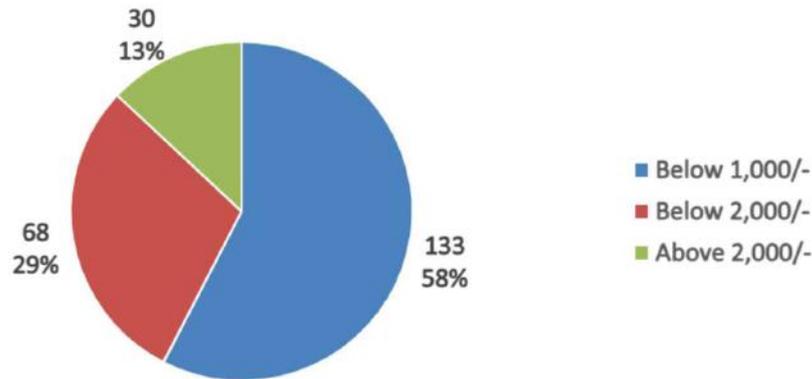


Figure 4.10: Monthly purchase rate

To the query about the discounts/offers in online shopping, almost 88% of the people responded that discounts play a role in their online shopping and 12% responded otherwise.

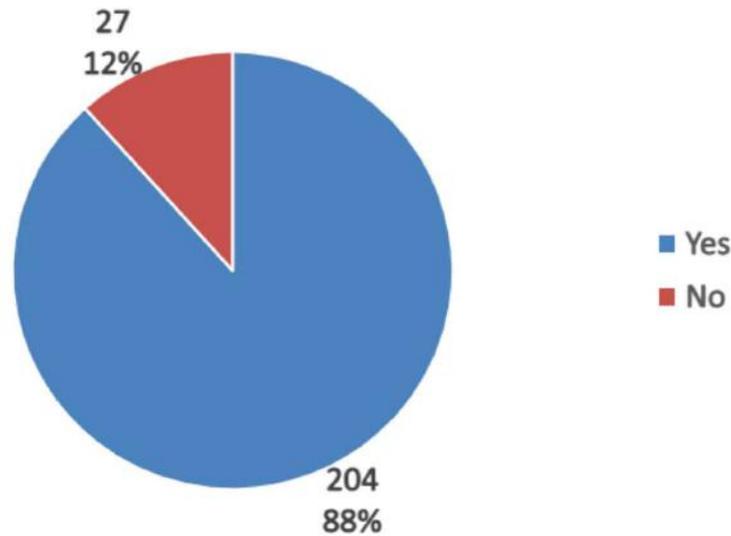


Figure 4.11: Discounts and Online shopping

Out of the 204 people who responded that discounts play a role in their online shopping, 116 look for discounts only if they want to buy something and 88 buy clothes whenever there is a discount.



Figure 4.12: Role of discounts in online shopping

About the ease in finding products online, 40% of people responded that it was easy for them to find what they were looking for, 13% responded to it as very easy, 44% responded to it as neutral, and 3% as difficult.

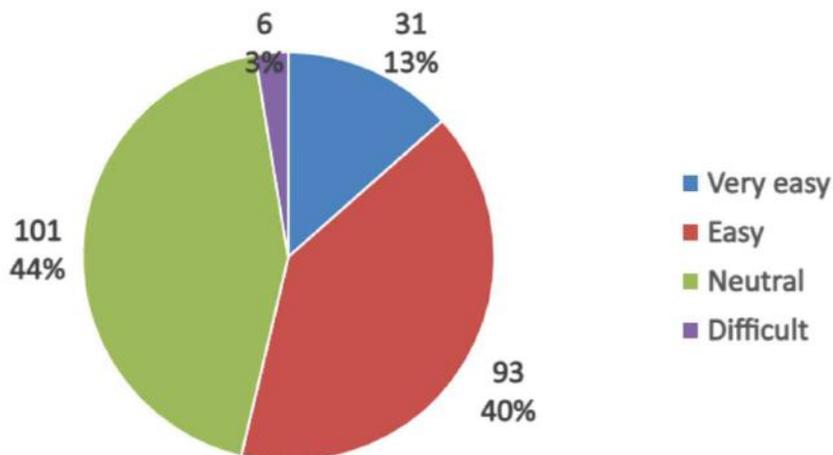


Figure 4.13: Finding products online

Among the responses on how likely they are to recommend online shopping to their friend (one being the least and five being the most), 48% are more likely to recommend, only a few responded that they are least likely to recommend.

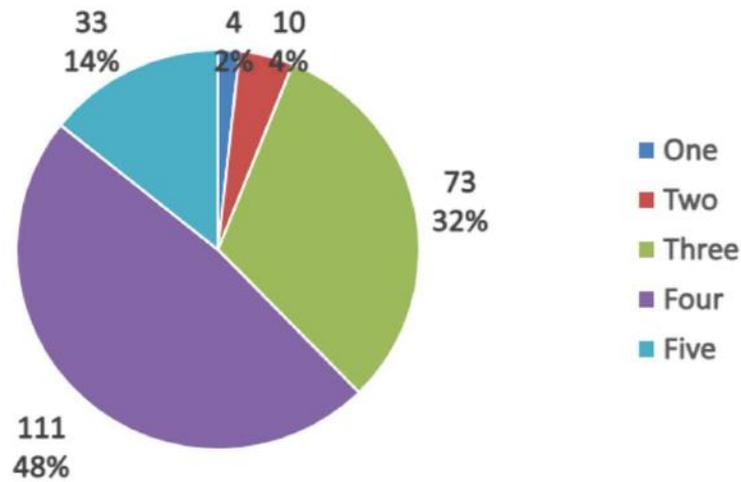


Figure 4.14: Recommending online shopping

## 4.2 STATISTICAL ANALYSIS

### 4.2.1 EFFECT OF FACTORS ON THE PREFERENCE OF SHOPPING

As we are doing the chi-square test of independence, two measurement variables are needed. So we are considering demographic variables like age, gender, place of residence and financial variables like monthly income as one variable and response to the question 'Have you ever done online shopping?' as the other.

#### COMPARISON BETWEEN PREFERENCE AND GENDER

$H_0$ : There is no relation between preference and gender.

$H_1$ : There is relation between preference and gender.

PREFERENCE	MALE	FEMALE	TOTAL
YES	47	184	231
NO	7	23	30
TOTAL	54	207	261

Figure 1: Preference vs Gender - Observed frequency

PREFERENCE	MALE	FEMALE	TOTAL
YES	47.79310345	183.206896	231
NO	6.206896552	23.7931034	30
TOTAL	54	207	261

Figure 2: Preference vs Gender - Expected frequency

$$p\text{-value} = 0.703972477$$

Since the p-value is greater than 0.05, we accept  $H_0$  and there is no relation between preference and gender. In this 21<sup>st</sup> century, everyone has a smartphone and access to an internet connection irrespective of their gender. Hence, the preference for shopping is independent of gender.

### COMPARISON BETWEEN PREFERENCE AND RESIDENCE

$H_0$ : There is no relation between preference and residence.

$H_1$ : There is relation between preference and residence.

PREFERENCE	URBAN	RURAL	TOTAL
YES	148	83	231
NO	14	16	30
TOTAL	162	99	261

Figure 3: Preference vs Residence - Observed frequency

PREFERENCE	URBAN	RURAL	TOTAL
YES	143.3793103	87.62068966	231
NO	18.62068966	11.37931034	30
TOTAL	162	99	261

Figure 4: Preference vs Residence - Expected frequency

$$p\text{-value} = 0.0646$$

Since the p-value is greater than 0.05, we accept  $H_0$  and there is no relation between preference and residence. Due to the Covid crisis, people living in both rural and urban areas had no other choice but to shop online.

**COMPARISON BETWEEN PREFERENCE AND AGE**

$H_0$ : There is no relation between preference and age.

$H_1$ : There is relation between preference and age.

AGE GROUP	YES	NO	TOTAL
15-19	46	6	52
20-25	163	20	183
26-65	22	4	26
TOTAL	231	30	261

Figure 5: Preference vs Age - Observed frequency

AGE GROUP	YES	NO	TOTAL
15-19	46.02298851	5.977011494	52
20-25	161.9655172	21.03448276	183
26-65	23.01149425	2.988505747	26
TOTAL	231	30	261

Figure 6: Preference vs Age - Expected frequency

$$p\text{-value} = 0.800756564$$

Here, the p-value is greater than 0.05, we accept  $H_0$  and there is no relation between preference and age. People of all age groups started shopping online as they were forced to stay home due to the lockdown.

**COMPARISON BETWEEN PREFERENCE AND INCOME**

$H_0$ : There is no relation between preference and income.

$H_1$ : There is relation between preference and income.

INCOME	YES	NO	TOTAL
BELOW 10,000	88	15	103
10,000-50,000	96	9	105
50,000-1,00,000	32	3	35
ABOVE 1,00,000	15	3	18
TOTAL	231	30	261

Figure 7: Preference vs Income - Observed frequency

INCOME	YES	NO	TOTAL
BELOW 10,000	91.16091954	11.83908046	103
10,000-50,000	92.93103448	12.06896552	105
50,000-1,00,000	30.97701149	4.022988506	35
ABOVE 1,00,000	15.93103448	2.068965517	18
TOTAL	231	30	261

Figure 8: Preference vs Income - Expected frequency

$$p\text{-value} = 0.45703882$$

As we can see that the p-value is greater than 0.05, we accept  $H_0$  and there is no relation between the preference and income of people. People belonging to all income groups have increased their purchases online because of Covid 19. So there is no relation between a particular income group and online shopping.

#### 4.2.2 RELATION BETWEEN MONTHLY INCOME AND MONTHLY PURCHASE RATE

Here the variables we use are financial variables - monthly income and response to the question 'How much do you spend on online shopping every month?'.  
**COMPARISON BETWEEN MONTHLY INCOME AND MONTHLY PURCHASE RATE**

#### COMPARISON BETWEEN MONTHLY INCOME AND MONTHLY PURCHASE RATE

$H_0$ : There is no relation between monthly income and monthly purchase rate.

$H_1$ : There is relation between monthly income and monthly purchase rate.

INCOME	BELOW 1,000	BELOW 2,000	ABOVE 2,000	TOTAL
BELOW 10,000	55	25	8	88
10,000 - 50,000	59	26	11	96
50,000 - 1,00,000	15	10	7	32
ABOVE 1,00,000	4	7	4	15
TOTAL	133	68	30	231

Figure 9: Purchase Rate vs Income - Observed frequency

INCOME	BELOW 1,000	BELOW 2,000	ABOVE 2,000	TOTAL
BELOW 10,000	50.66666667	25.9047619	11.42857143	88
10,000 - 50,000	55.27272727	28.25974026	12.46753247	96
50,000 - 1,00,000	18.42424242	9.41991342	4.155844156	32
ABOVE 1,00,000	8.636363636	4.415584416	1.948051948	15
TOTAL	133	68	30	231

Figure 10: Purchase Rate vs Income - Expected frequency

$$p\text{-value} = 0.094193177$$

As the p-value is greater than 0.05, we accept  $H_0$  and there is no relation between monthly income and monthly purchase rate. Even people with high income do not prefer to shop for clothes above 2000/- online, maybe due to poor quality and other concerns faced in online shopping.

#### 4.2.3 EFFECT OF FACTORS ON THE ROLE OF DISCOUNT

Here we consider the demographic variables like age, gender, place of residence and financial variable - monthly income as well as the response to the question 'Do discounts/offers play a role in your online shopping?'.  
'Do discounts/offers play a role in your online shopping?'

#### COMPARISON BETWEEN DISCOUNT AND RESIDENCE

$H_0$ : There is no relation between discount and residence.

$H_1$ : There is relation between discount and residence.

DISCOUNT	URBAN	RURAL	TOTAL
YES	131	73	204
NO	17	10	27
TOTAL	148	83	231

Figure 11: Discount vs Residence - Observed frequency

DISCOUNT	URBAN	RURAL	TOTAL
YES	130.7012987	73.2987013	204
NO	17.2987013	9.701298701	27
TOTAL	148	83	231

Figure 12: Discount vs Residence - Expected frequency

$$p\text{-value} = 0.898549779$$

Since the p-value is greater than 0.05, we accept  $H_0$  and hence there is no relation between the role of discount and place of residence. Due to the sudden upsurge of Covid 19, everybody looks for discounts. Hence there is no particular relation between them.

### COMPARISON BETWEEN DISCOUNT AND INCOME

$H_0$ : There is no relation between discount and income.

$H_1$ : There is relation between discount and income.

INCOME	YES	NO	TOTAL
BELOW 10,000	79	9	88
10,000-50,000	88	8	96
50,000-1,00,000	25	7	32
ABOVE 1,00,000	12	3	15
TOTAL	204	27	231

Figure 13: Discount vs Income - Observed frequency

INCOME	YES	NO	TOTAL
BELOW 10,000	77.71428571	10.28571429	88
10,000-50,000	84.77922078	11.22077922	96
50,000-1,00,000	28.25974026	3.74025974	32
ABOVE 1,00,000	13.24675325	1.753246753	15
TOTAL	204	27	231

Figure 14: Discount vs Income - Expected frequency

$$p\text{-value} = 0.14167761$$

Since the p-value is greater than 0.05, we accept  $H_0$  and there is no relation between the role of discount and monthly income. In order to save money, people look for discounts, especially in online shopping.

### COMPARISON BETWEEN DISCOUNT AND GENDER

$H_0$ : There is no relation between discount and gender.

$H_1$ : There is relation between discount and gender.

DISCOUNT	MALE	FEMALE	TOTAL
YES	39	165	204
NO	8	19	27
TOTAL	47	184	231

Figure 15: Discount vs Gender - Observed frequency

DISCOUNT	MALE	FEMALE	TOTAL
YES	41.50649351	162.4935065	204
NO	5.493506494	21.50649351	27
TOTAL	47	184	231

Figure 16: Discount vs Gender - Expected frequency

$$p\text{-value} = 0.202288914$$

Here the p-value is greater than 0.05, we accept  $H_0$  and there is no relation between the role of discount and Gender. Both males and females prefer discounts while doing online shopping. So we could clearly say that there is no particular relation between discount and gender.

### COMPARISON BETWEEN DISCOUNT AND AGE

$H_0$ : There is no relation between discount and age.

$H_1$ : There is relation between discount and age.

AGE GROUP	YES	NO	TOTAL
15-19	40	6	46
20-25	147	16	163
26-65	17	5	22
TOTAL	204	27	231

Figure 17: Discount vs Age - Observed frequency

AGE GROUP	YES	NO	TOTAL
15-19	40.62337662	5.376623377	46
20-25	143.9480519	19.05194805	163
26-65	19.42857143	2.571428571	22
TOTAL	204	27	231

Figure 18: Discount vs Age - Expected frequency

$$p\text{-value} = 0.198625881$$

As we can see the p-value is greater than 0.05, there is no relation between the role of discount and age. Most people of all age groups look for discounts in order to save money and to purchase more clothes.

## Chapter 5

# CONCLUSION

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Online shopping offers many advantages to the consumers like a wide range of products, customer feedback and ratings, shopping in the comfort of our home etc. Those were the main reasons for an increase in online shopping. But in the current scenario, social distancing plays a major role to avoid the virus, so online shopping is the only safest option one can opt for. It also has some other added benefits like discounts and offers.

Through this study we couldn't find any variables particularly responsible for the behaviour pattern of the consumers. Nevertheless, the online shopping of 81% respondents from Ernakulam district has increased during this pandemic. Also 88% of the respondents say that discount is an important factor for them to shop online.

Age group doesn't play a role in people's choice to shop online. People tend to shop online if their technical knowledge is above average. In this era, many of the older generation as well as the middle aged people are as good as the younger generation in terms of technology. So it is not the age group but the technical knowledge of people that make them shop online. Moreover Covid created a situation where online shopping is the safe way to buy things especially for the older generation.

Nowadays everybody wants to dress up and look stylish no matter their gender. Everyone is on their own journey to create new styles. Following the trends

and fashion is one of the ways to achieve it. For those people, online stores offer a variety of clothes at a comparatively affordable price. Also one of the biggest advantages of online shopping over in-person shopping is that it has all the sizes from xs to xxxl.

Another factor that doesn't influence people's decisions to go for online shopping is the monthly income. Online we can buy clothes of all price ranges. So people from all income groups can participate in online shopping evenly.

In this peak time, people from all places of residence would go for online shopping as it is more convenient. People's knowledge on technology and access to internet connection does not depend on where they live (urban or rural).

One of the biggest concerns people have on online shopping is the quality of the product received. Even if it is your 50<sup>th</sup> time doing online shopping, the quality of the clothes you buy might not be predictable. So the majority of the respondents from all income groups buy clothes under 2,000 rupees so that a large amount of money won't be at risk. This would lead that the monthly income and monthly purchase rate have no particular relation.

Discount is something we all look for irrespective of our age, gender, place of residence and financial condition. One of the major motives behind it is to save money. But in most cases people don't need a reason to look for discounts. The thought that we bought something for a price lower than its MRP would give us satisfaction. This satisfaction is a universal feeling.

So in general, though it has some drawbacks, online shopping can be considered as a reliable and efficient way to buy clothes even when Covid 19 and such pandemics are wiped out completely.

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# ANNEXURE

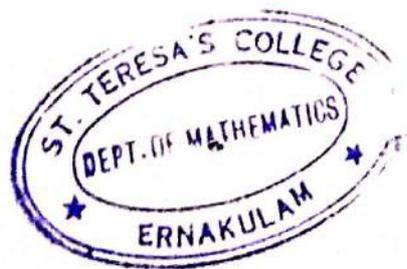
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## Questionnaire

1. Age:
2. Gender:
3. Place of residence
  - Urban
  - Rural
4. Monthly income:
  - Below 10,000/-
  - 10,000/- or above till 50,000/-
  - 50,000/- or above till 1,00,000/-
  - Above 1,00,000/-
5. Have you ever purchased clothes online?
  - Yes
  - No
6. If no, what are the reasons?
  - I don't know about online shopping
  - Online transactions are riskier
  - Internet illiteracy
  - Expected product is not received
  - Risk of identity theft
7. How often do you shop online?
  - Once in a few months
  - Once in a month
  - Twice or thrice in a month
  - More than thrice in a month

8. How often do you purchase in-person?
  - Once in a few months
  - Once in a month
  - Twice or thrice in a month
  - More than thrice in a month
9. How would you rate your overall online shopping experience?
  - Poor
  - Average
  - Excellent
10. Why do you prefer online shopping?
  - Time-saving
  - No contact home delivery
  - Discounts/ offers
  - Wide range of choices (collection, rate, size, colour, etc.)
  - Convenient and flexible
  - Easy returns
  - Other
11. What are your biggest concerns regarding online shopping?
  - Breach of personal information/ payment details
  - Poor internet connection
  - Poor quality
  - Other
12. Have your online shopping increased during Covid 19?
  - Yes
  - No
13. If yes, to what extent?
  - Entire purchase
  - More than half the purchase
  - Limited purchase

14. How much do you spend on online shopping every month?
- Entire purchase
  - More than half the purchase
  - Limited purchase
15. Do discounts/offers play a role in your online shopping?
- Yes
  - No
16. If yes, by how?
- I buy clothes whenever there is a discount sale
  - I only look for discounts if I want to buy something
17. How easy was it for you to find what you were looking for online?
- Very easy
  - Easy
  - Neutral
  - Difficult
18. On a scale of 1 to 5, how likely are you to recommend online shopping to your friend? (one being the least and five being the most)
- One
  - Two
  - Three
  - Four
  - Five



**ST. TERESA'S COLLEGE (AUTONOMOUS)  
AFFILIATED TO MAHATMA GANDHI UNIVERSITY**



**Statistical Analysis of Depression, Anxiety and Stress  
among the students during pandemic and a self testing  
website**

**PROJECT REPORT**

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

**BACHELOR OF SCIENCE IN  
COMPUTER APPLICATIONS  
[TRIPLE MAIN]**

By

**MEENAKSHY MANOJ**

**III B.Sc. Computer Applications [Triple main]**

**Register No: SB19CA018**

**Under the guidance of  
Mrs. Mary Andrews**

**DEPARTMENT OF COMPUTER APPLICATIONS**

**2019-2022**



An ISO 9001:2015 Certified Company



APRIL 5, 2022

**TO WHOM SO EVER IT MAY CONCERN**

This is to certify that **MEENAKSHY MANOJ**, 6<sup>th</sup> semester **BSc COMPUTER APPLICATION (Triple Main)** student of **ST. TERESA'S COLLEGE, ERNAKULAM** has successfully completed a project titled "**STATISTICAL ANALYSIS OF DEPRESSION, ANXIETY & STRESS AMONG THE STUDENTS DURING PANDEMIC & A SELF TESTING WEBSITE**" from our organization.

The duration of the project was for 3 months. The Project was incorporated in **PYTHON** and was implemented successfully.

Thanking you,

For **LCC Computer Education**

**T.S. Ramaswamy**  
**Director**



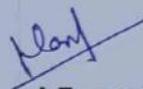
Date:



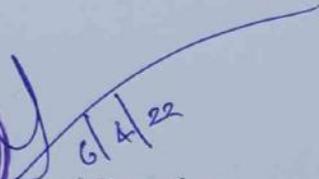
## CERTIFICATE

This is to certify that the project report entitled "Statistical Analysis of Depression, Anxiety and Stress among the students during pandemic and a self testing website", a bona fide record of the work done by MEENAKSHY MANOJ during the year 2021-22 and submitted in partial fulfilment of the requirements for the degree of Bachelor of Science in Computer Applications (Triple Main) under Mahatma Gandhi University.

  
Head of the Department

  
Internal Examiner



  
External Examiner

6/4/22

# Declaration

I, MEENAKSHY MANOJ , BSc Computer Applications[Triple Main].final year student of St.Teresa's College (Autonomous), Ernakulam, Register No SB19CA018, hereby declare that the dissertation submitted for the Bachelors of Degree in Computer Applications is my original work. I further declare that the said work has not previously been submitted to any other university or academic body.

Date: 5/4/2022

*Meenakshy*

MEENAKSHY MANOJ

Place: Ernakulam

## **ACKNOWLEDGEMENT**

I am extremely grateful **Rev. Sr. Dr.Vinitha (CSST)**, Manager and Provincial Superior Director **Rev. Sr.Emeline (CSST)** and Principal **Dr. Lizzy Mathew** for giving me this opportunity. I express my sincere gratitude towards the Head of the department **Mrs. Raji S Pillai** and the Course coordinator **Mrs. Sheeba Emmanuel** for the support. We deeply express my sincere thanks to my guide **Mrs.Mary Andrews** for her proper guidance and support throughout the project work. I am also grateful to the participants for their anonymous review through google form. I take this opportunity to thank our lecturer **Mr.Prashob Rajan** who have directly or indirectly helped our project and also pay our respects and love to our parents and all other family members for their love and encouragement. I express my thanks to my teammate **Mr.SivaSruthy S** and my friends for their cooperation and support. Last but not the least, I thank God Almighty for his blessings.

MEENAKSHY MANOJ

# SYNOPSIS

**Statistical Analysis** has been used to provide solutions to complex problems in such diverse areas such as communications, stability, finding patterns in data sets of variables and other areas of interest. The results of statistical analysis have been significant both for explanation of a pattern and also for prediction. Statistical analysis is a general scientific method and it has applications in many areas of scientific research.

In this paper, the objective is to examine the prevalence rates of depression, anxiety and stress and their socio-demographic correlates among the students of ST. TERESA'S COLLEGE(Autonomous) Ernakulam.

Participants completed an anonymous online survey via google forms in 2021. Depression, Anxiety and Stress were measured using Patient Health Questionnaire (PHQ-9), Generalised Anxiety Disorder (GAD-7) and Perceived Stress Scale (PSS-10) respectively.

The paper consists of implementing a statistical analysis in python programming language, which provides patterns to explain research questions pertaining to the students. The paper uses statistical analysis methods like correlation to examine the relationship between different variables obtained in the dataset.

From the study, 56.08% of the participants were moderate to severely depressed, 68.24% of them were moderate to severe anxiety and 90.59% of the participants were moderate to highly stressed. The binary logistic model suggests that covid has no influence on the mental health conditions of students. Some graphical analysis of the data from the dataset is shown using different libraries and functions of python.

The results of this study indicate mental health conditions like Depression, Anxiety and Stress were prevalent among the students during the pandemic in ST. TERESA'S COLLEGE(Autonomous) Ernakulam.

Key words: - Statistical analysis, covid-19 pandemic, Stress, Depression,

**Mental Health Website-** a self-testing website allows the users to carry out their depression and anxiety test. These self-tests ask some important questions that can help the individual to know their severity levels and can make a plan for feeling better soon. Mentally affected ones can make better use of this website. The website strives to provide the highest quality mental health assessment by themselves. Recognizing that taking care of mental and emotional health is just as important as taking care of the body, the website was created.

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# **Module I: Statistical Analysis**

# **1. INTRODUCTION**

## **1.1 About Project**

The impact of Covid19 has resulted in the closure of educational institutions all over the world. As an outcome, education has changed drastically with the marked increase in eLearning and thereby teaching has taken a new turn through digital platform. The pandemic and lockdown haven't been kind to our student population affecting their mental wellbeing.

The study examines the prevalence rates of depression, anxiety and stress and their sociodemographic correlates among the students of ST. TERESA'S COLLEGE(Autonomous) Ernakulam

## **1.2 About Organisation**

St. Teresa's College (Autonomous), is one of the finest colleges pledged to empower women since 1925. With an admirable set of staff, the college helps students reach Excellence in academics as well as extracurricular which the college is extremely fond of.

## **1.3 Objectives of the Project and the Organisation**

The main objective of the project was to find the prevalence rates of Depression, Anxiety and Stress and their sociodemographic correlates among the students during covid19 pandemic.

## **2. MATERIALS AND METHODS**

### **2.1 Data source**

The survey was conducted in the third week of October, from October 17 to November 11, 2021. Students enrolled in different courses from of St. Teresa's college Autonomous were the target population. An easy-to-understand questionnaire was used to collect 'basic information,' 'depression,' 'anxiety' and 'stress' related information. An online-based platform was used to distribute the e-questionnaire, developed by using the Google Form, to the students.

### **2.2 Sampling technique**

The Snowball sampling technique was used for collecting information from students. The participants were asked to share the e-questionnaire with their friends using their social media platforms.

### **2.3 Ethical Issues**

The study was formally approved by the principal of St. Teresa's college Autonomous Ernakulam. The participants responded anonymously to the online survey by filling up the questionnaire through google form.

### **2.4 Measures**

#### **2.4.1 Basic information**

Basic information contained: - Age, Gender (Female), Institution name, whether the student is 'Feeling connected with their teachers'(Yes/no), 'feeling connected with their friends'(Yes/no), Able to score good marks (Yes/no), tested positive for covid-19(Yes/no).

#### **2.4.2 Depression**

Depression was determined by using the Patient Health Questionnaire (PHQ9). PHQ-9 is an easy way to use in a questionnaire for screening depression of the responses that are used to predict depression of an individual

and what state he/she is in during the survey. The scores in PHQ-9 range from '0 = not at all' to '3 = almost every day'. The reason for choosing PHQ-9 was that it proved to be a useful tool for detecting depression. The levels of depression for the study were categorised as 'mild = 5–9', 'moderate = 10–14,' 'moderately severe = 15–19,' 'severe =  $\geq 20$ .'

### **2.4.3 Anxiety**

Anxiety was evaluated by using the Generalised Anxiety Disorder (GAD7). In the questionnaire, the questions were used for screening anxiety states of an individual on a scale ranging from '0 = not at all sure' to '3 = almost every day'. GAD-7 has been found successful in identifying anxiety among different populations and thus used for its reliability. The levels of anxiety for the study were categorised as 'none-minimal =  $<5$ ,' 'mild = 5–9,' 'moderate = 10–14 and 'severe =  $\geq 15$ .'

### **2.4.4 Stress**

Stress was identified by using the perceived stress scale (PSS-10). The questions in the scale ask about your feelings and thoughts during the last month ranging from '0=never' to '4=very often'. This questionnaire is a classic stress assessment instrument. The levels of stress for the study were categorised as 'low stress=0 - 13', 'moderate stress = 14 -26' and 'high perceived stress =27 -40'.

### **2.4.5 Statistical analysis**

Frequency tabulation was used to summarise basic information of respondents, as well as their response to depression, anxiety and stress. Binary logistic regression was used to identify variables influencing depression and anxiety among students by categorising the outcome variable into two categories, i.e., depressed = 'yes' and 'no', anxious = 'yes' and 'no,' and stress = 'yes' and 'no' which would provide a clearer idea about how intensely different factors are influencing the outcomes.

Logistic regression generates the coefficients (and its standard errors and significance levels) of a formula to predict a logit transformation of the probability of the presence of the characteristic of interest:

$$\text{Logit}(p) = b_0 + b_1X_1 + b_2X_2 + \dots + b_iX_i$$

Where  $p$  is the probability of the presence of the characteristic of interest. The logit transformation was defined as the logged odds:

$$\text{Odds} = \frac{p}{1-p} = \frac{\text{Probability of presence of characteristic}}{\text{Probability of absence of characteristic}}$$

Estimation in logistic regression accepts parameters that maximise the likelihood of observing the sample values.

### 3. RESULTS

Table1: shows the descriptive information of different selected variables of the university student in Ernakulam district. Results show that 143 (56.08%) students were found to have moderate to severe depressive symptoms, and 174(68.24%) students were found to have moderate to severe anxiety symptoms,231(90.59%) students were found to have moderate to high stress. All the participants were females. More than a half percent of students (62.7%) say that they were able to score good marks, and also more than half of the students (61.2%) believed that they were connected with their teachers but less than half (48.6%) connected with friends.

Variables	Frequency	Percentage
<b>Age</b>		
17-19	76	29.8
20	110	43.1
>20	69	27.1
<b>Feeling connected with their teachers</b>		
Yes	124	48.6
No	131	51.4
<b>Feeling connected with their friends</b>		
Yes	156	61.2
No	99	38.8
<b>Able to score good marks</b>		
Yes	160	62.7
No	95	37.3
<b>Tested positive for covid-19</b>		
Yes	66	25.9
No	189	74.1
<b>Depression</b>		
Minimal or no depression	44	71.3
Mild depression	68	26.7
Depression present	50	19.6
Severe depression	67	26.3
Very severe depression	26	10.2
<b>Anxiety</b>		
Mild anxiety	81	31.8
Moderate anxiety	67	26.3
Moderate severe anxiety	67	26.3
Severe anxiety	40	15.7
<b>Stress</b>		
Low stress	24	9.4
Moderate stress	205	80.4
High stress	26	10.2

**Table2:** shows the prevalence of depression, anxiety and stress among the students with respect to the variables under study. The students who are having depression level of  $\geq 10$  are considered 'yes' for showing depressive symptoms, having anxiety score  $\geq 5$  are considered 'yes' for anxiety symptoms and also having stress level  $\geq 14$  are considered 'yes' to stress symptoms.

Variables	Depression		Anxiety		Stress	
	No	Yes	No	Yes	No	Yes
<b>Age</b>						
17-19	33(12.9%)	43(16.9%)	30(11.8%)	46(18.0%)	6(2.4%)	70(27.5%)
20	52(20.4%)	58(22.7%)	29(11.4%)	81(31.8%)	15(5.9%)	95(37.3%)
>20	27(10.6%)	42(16.5%)	22(8.6%)	47(18.4%)	3(1.2%)	66(25.9%)
<b>Feeling connected with their teachers</b>						
No	47(18.4%)	84(32.9%)	38(14.9%)	93(36.5%)	8(3.1%)	123(48.2%)
Yes	65(25.5%)	59(23.1%)	43(16.9%)	81(31.7%)	16(6.3%)	108(42.4%)
<b>Feeling connected with their friends</b>						
No	37(14.5%)	62(24.3%)	28(11.0%)	71(27.8%)	4(1.6%)	95(37.3%)
Yes	75(29.4%)	81(31.7%)	53(20.8%)	103(40.4%)	20(7.8%)	136(53.3%)
<b>Able to score good marks</b>						
No	36(14.1%)	59(23.1%)	23(9.1%)	72(28.2%)	4(1.6%)	91(35.7%)
Yes	76(29.8%)	84(32.9%)	58(22.7%)	102(40.0%)	20(7.8%)	140(54.9%)
<b>Tested positive for covid19</b>						
No	88(34.5%)	101(39.6%)	63(24.7%)	126(49.4%)	17(6.7%)	172(67.5%)
Yes	24(9.4%)	42(16.5%)	18(7.1%)	48(18.8%)	7(2.7%)	59(23.1%)

**Table3:** reveals that the students who are not feeling connected with their teachers during this pandemic were 2 times (95% CI:1.192-3.252) more likely to be depressed than the students who feel connected. Students who are not able to score good marks through this online mode were 1.8 times (95%CI:1.007-3.146) more likely to show anxiety than the students who are able to score good marks. Students who are not feeling connected with their friends were 3.5(95% CI:1.157-10.546) times stressed than their counterparts who feel connected. And also the students who are not able score good marks through online education system were 3.3(95% CI:1.076-9.817) times stressed than the students who are able to score good marks.

Variables	Depression			Anxiety			Stress		
	p value	OR	95% CI Lower-Upper	p value	OR	95% CI Lower-Upper	p value	OR	95% CI Lower-Upper
<b>Feeling connected with their teachers</b>									
Yes (ref)									
No	0.008	1.969	1.192-3.252	0.331	1.299	0.766-2.204	0.061	2.278	0.938-5.531
<b>Feeling connected with their friends</b>									
Yes (ref)									
No	0.092	1.552	0.928-2.595	0.339	1.305	0.754-2.259	0.013	3.493	1.157-10.546
<b>Able to score good marks</b>									
Yes (ref)									
No	0.134	1.483	0.884-2.489	0.043	1.78	1.007-3.146	0.021	3.25	1.076-9.817
<b>Tested positive for covid-19</b>									
Yes	0.148	1.525	0.856-2.716	0.358	1.333	0.717-2.480	0.703	0.833	0.3292-2.108
No (ref)									

\*Statistically significant at p value<0.05.

Correlation refers to the relationship between two variables. Correlation coefficient ranges from -1 to 1. Correlation coefficient of 0 indicates that there is no relationship between two variables. -1 indicates that the two variables are in perfect negative correlation and 1 indicates that they are in perfect positive correlation.

Fig1: shows the scatterplot between depression and anxiety. Correlation coefficient obtained was 0.764 which means there exists a positive correlation between depression and anxiety

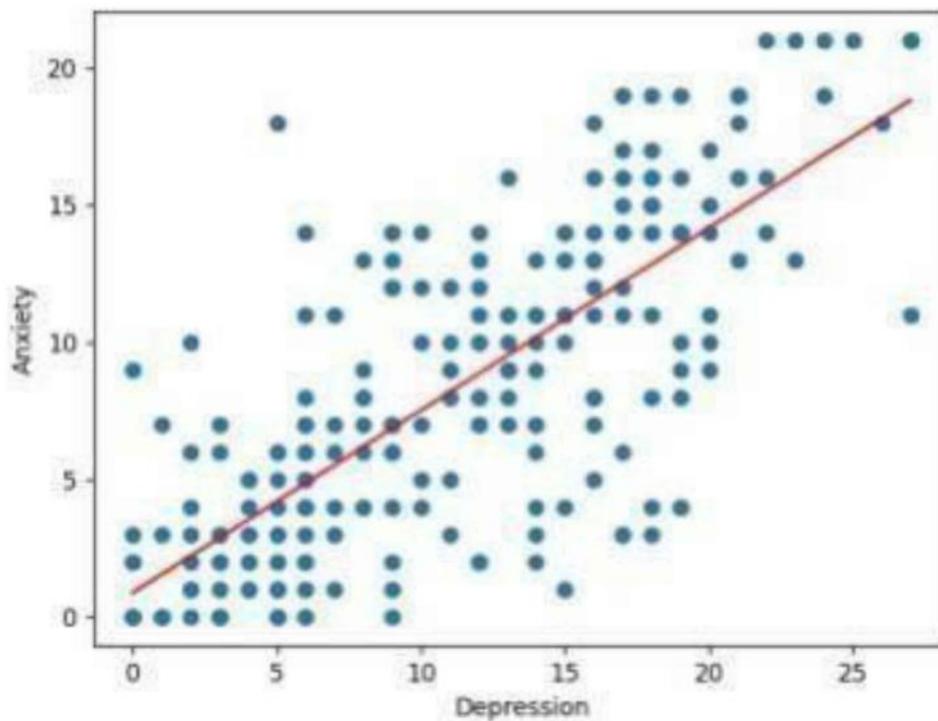


Fig1

Fig2: shows the relationship between anxiety and stress. Correlation coefficient obtained was 0.544 which also indicates that the anxiety and stress are positively correlated.

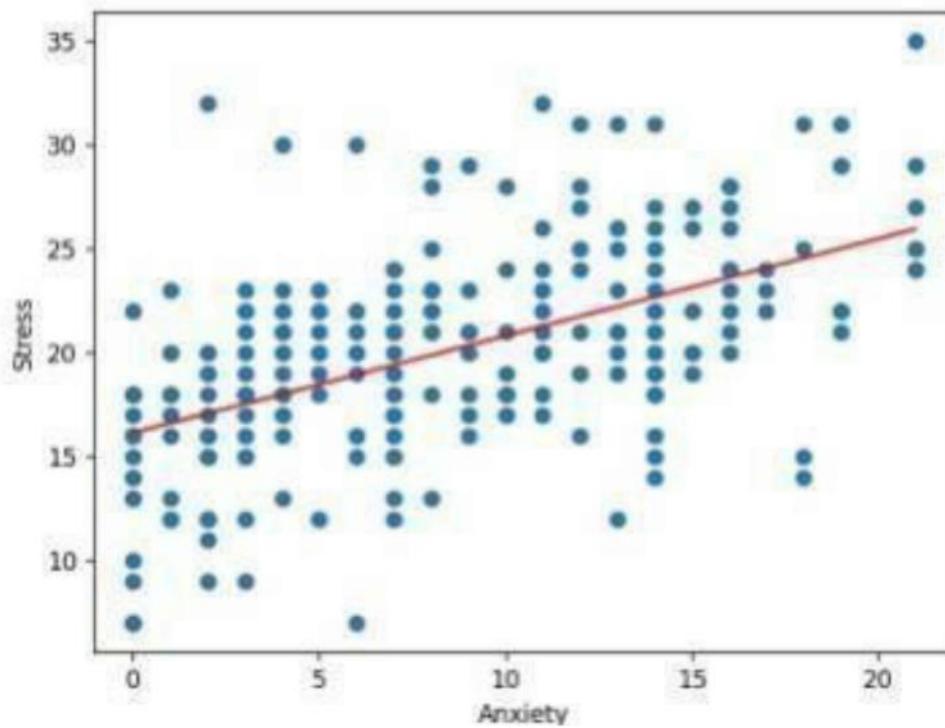
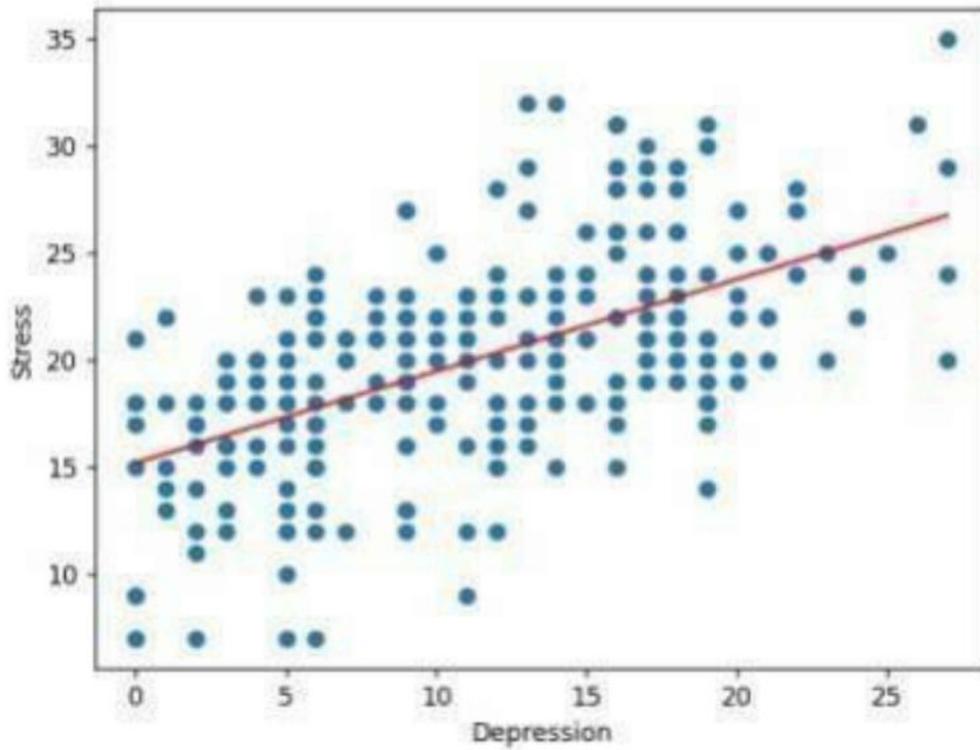


Fig2

Fig3: shows the scatterplot between Depression and stress. Correlation coefficient between them was 0.573 which reveals that both are positively correlated.



## **4.DISCUSSION**

To fully realise the mental health crisis that India faces in relation to COVID19, one has to begin with recognising the very serious situation that existed even before the pandemic. The government's National Mental Health Survey reported that about 10 percent of adults meet diagnostic criteria for a mental health condition (ranging from mood and anxiety disorders to severe mental illness). The Global Burden of Disease study estimated that nearly 200 million people in India have experienced a mental disorder, nearly half of whom suffer from depressive or anxiety disorders. India accounts for more than a third of the female suicides globally, nearly a fourth of all male suicides, and suicide has been the leading cause of death in young Indians. Yet, the government has spent very little on mental healthcare (estimated at less than one percent of the health budget), and this expenditure has been almost entirely on doctors, drugs, and hospitals in urban areas. There is little community-oriented mental healthcare anywhere in the country. Unsurprisingly, between 70 to 92 percent of affected individuals have received no care from any source, of any kind, for their mental health conditions.

## **5. STRENGTH AND LIMITATION**

The strengths and limitations of the current study are determined by several issues. The e-questionnaire allows us to assess the prevalence of anxiety, depression and stress among university students while maintaining the WHO recommended “social distance” during the COVID-19 pandemic, which otherwise would be impossible. Moreover, the data for the e-survey were collected by globally validated standardised tools for quantitative analysis. On the contrary, given the limited resources available and the time-sensitivity of the COVID-19 outbreak, the snowball sampling strategy was chosen instead of random samples. In this cross-sectional study, the identified factors are regarded as associated factors, which could be either the causes or the results of depression, anxiety or stress. Furthermore, due to ethical requirements on anonymity and confidentiality, the contact details of the respondents were not collected. However, the use of validated screening e-questionnaire was considered as a cost-effective approach to explore the situation in general, therefore, used in this study. Since the research methodology could not reach people with medically examined depression, anxiety and stress symptoms, the provision of the results may not fully reflect the severity of depressive, anxiety and stress symptoms among students. Another limitation of this study is not using the tools designed specifically for the COVID-19 pandemic, such as the coronavirus anxiety scale (CAS). Meanwhile, it would be ideal for conducting a prospective study on the same group of participants with tools developed especially for the COVID-19 pandemic after a period to provide a concrete finding and to facilitate the demand for a focused public health initiative.

## **6.CONCLUSION**

In this study on the student population, many reported symptoms of depression, anxiety and stress during this ongoing pandemic. In addition, not feeling connected with their teachers and friends, not being able to score good marks is contributing to the rise of depression, Anxiety and stress among the college students. This also shows that being tested positive for covid does not makes any difference in the mental health of students. To minimize the growing mental health problems, the government, along with the universities, should work together to deliver promptly and accurately economic-oriented psychological support to the university students.

## **Module II: Mental Health Website**

# **1. INTRODUCTION**

## **1.1 About Project**

Mental health refers to cognitive, behavioural, and emotional well-being. It is all about how people think, feel, and behave. People sometimes use the term “mental health” to mean the absence of a mental disorder. Mental health can affect daily living, relationships, and physical health.

Online screening is one of the quickest and easiest ways to determine whether you are experiencing symptoms of a **mental health** condition.

## **1.2 About Organisation**

St. Teresa’s College (Autonomous), is one of the finest colleges pledged to empower women since 1925. With an admirable set of staff, the college helps students reach Excellence in academics as well as extracurricular which the college is extremely fond of.

## **1.3 Objectives of the Project and the Organisation**

The main objective of the project was to handle the mental health conditions and to reduce the risk of suicidal attempts. This is especially for the patients who are mentally ill.

## **2.SYSTEM ANALYSIS**

### **2.1 Introduction**

System Analysis is the complete study of the system and identifying its objectives mainly for problem solving purposes. Each and every module of the system is evaluated. Inferences are made from these studies to ensure that all the components of the system are working efficiently. System Analysis involves gathering information related to the system and developing the accurate tools for analysis. Studying and analysing the existing system is important for system analysis. Identifying the drawbacks in the existing system and how it has been rectified in the proposed system is one of the main aims.

### **2.2 Existing System**

The patients have to manually book appointments with a Psychologist in the hospital and get a medical diagnosis to know their mental health status. If they have a mild mental illness with well-controlled symptoms, treatment from their primary care provider may be sufficient.

All these procedures take a tremendous amount of time and are difficult to track their progress.

### **2.3 Proposed System**

The proposed system focuses on providing an online platform where the patients could self-test their anxiety or depression level before consulting a psychologist. Although the website does not cure mental illness, it will help to recognise the major mental health problems that are anxiety and depression by giving their answers to the corresponding questions.

## 2.4 System Specification

System specification specifies the hardware and software configuration of the new system. It helps to define the operational and performance guidelines of the system.

## 2.5 Operating System

An Operating System (OS) is an interface between computer user and computer hardware. It is a software which performs all the basic tasks like file management, memory management, process management, handling input and output and controlling peripheral devices such as disk drives and printers. The operating system required for proper execution of the system is Windows.

## 2.6 Languages and Software Packages

- **PYTHON**

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. It was created by Guido van Rossum during 1985-1990. Like Perl, Python source code is also available under the GNU General Public License (GPL). This tutorial gives enough understanding on Python programming language. Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently whereas other languages use punctuation, and it has fewer syntactic constructions than other languages.

- **Django**

Django is a Python-based free and open-source web framework, which follows the model-template-view (MTV) architectural pattern. Django's primary goal is to ease the creation of complex, database-driven websites. The framework emphasises reusability and pluggability of components, less code, low coupling, rapid development, and the principle of don't repeat yourself. Python is used throughout, even for settings files and data models. Django also provides an optional administrative create, read, update and delete interface that is generated dynamically through introspection and configured via admin models.

- **Hypertext Mark-up Language (HTML)**

It is the standard mark-up language for documents designed to be displayed in a web browser. It can be assisted by technologies such as Cascading Style Sheets (CSS) and scripting languages such as JavaScript.

Web browsers receive HTML documents from a web server or from local storage and render the documents into multimedia web pages. HTML describes the structure of a web page semantically and originally included cues for the appearance of the document.

- **Cascading Style Sheets (CSS)**

It is a style sheet language used to describe the presentation of a document written in HTML or XML (including XML dialects such as SVG, Math or XHTML). CSS describes how elements should be rendered on screen, on paper, in speech, or on other media.

- **MySQL**

MySQL is the most popular Open-Source Relational SQL Database Management System. MySQL is used for developing various web-based software applications.

## **2.7 Hardware and Software Specifications**

Operating System	: Windows
Technology	: PYTHON
Framework	: Django
Web technologies	: Html, CSS, JavaScript
Web Server	: Django
Database	: MySQL

### 3.SYSTEM DESIGN

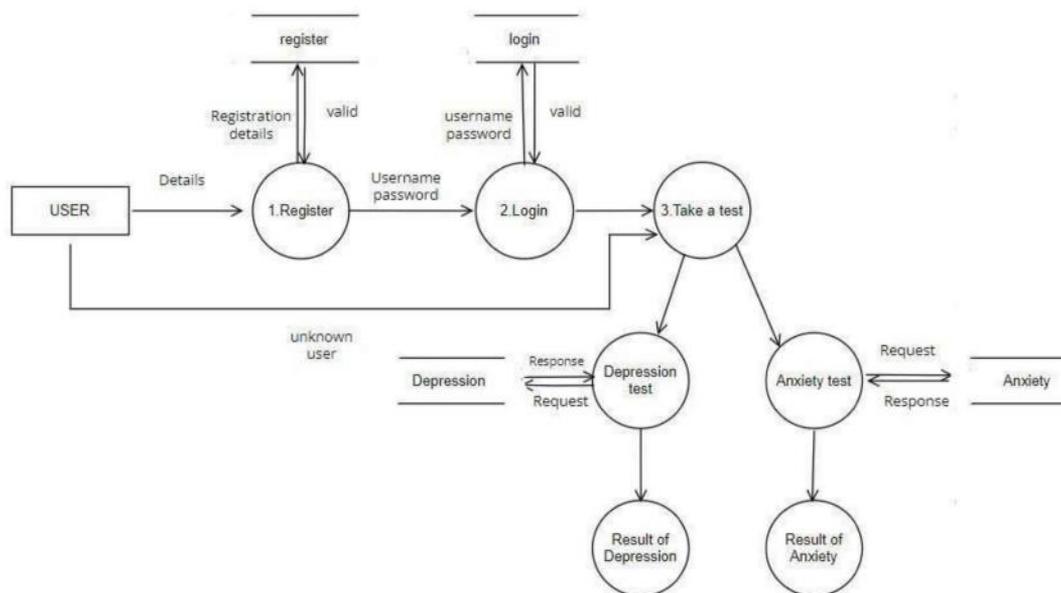
#### 3.1 Introduction

It is a process of planning a new business system or replacing an existing system by defining its components or modules to satisfy the specific requirements. Mainly focuses on how to accomplish the objectives of the system.

#### 3.2 Data flow diagram

Data flow diagram (DFD) is a graphical representation of the “flow” of data through an information system, modelling its process aspects. A DFD is often used as a preliminary step to create an overview of the system without going into great detail, which can later be elaborated. A DED shows what kind of information will be input to and output from the system, how the data will advance through the system, and where the data will be stored.

#### DFD LEVEL ONE



### 3.3 Data Dictionary

A data dictionary contains metadata. The data dictionary is very important as it contains information such as what is in the database, who is allowed to access it, where is the database physically stored etc. The users of the database normally don't interact with the data dictionary, it is only handled by the database administrators.

### 3.4 Database Design

**Database Design** is a collection of processes. The main aim of database designing is to produce logical and physical design models for the suggested database system.

The logical model focuses on the data requirements and the data to be stored independent of physical components.

The physical data design model translates the logical design of the database onto physical media using hardware resources and software systems.

#### Register

<b>Column</b>	<b>Data type</b>	<b>Null</b>	<b>Default</b>
Name	varchar(100)	No	None
Email_id	varchar(50)	No	None
Password	varchar(50)	No	None
Confirm_password	varchar(50)	No	None

### Login

Column	Data Type	Null	Default
Username	varchar(30)	No	None
password	varchar(20)	No	None

### Depression

Column	Data Type	Null	Default
Q1	int(10)	No	None
Q2	int(10)	No	None
Q3	int(10)	No	None
Q4	int(10)	No	None
Q5	int(10)	No	None
Q6	int(10)	No	None
Q7	int(10)	No	None
Q8	int(10)	No	None
Q9	int(10)	No	None
Answer	int(10)	No	None
username	varchar(50)	yes	NULL
idx	int(11)	No	None

**Anxiety**

<b>Column</b>	<b>Data type</b>	<b>Null</b>	<b>Default</b>
Q1	int(10)	No	None
Q2	int(10)	No	None
Q3	int(10)	No	None
Q4	int(10)	No	None
Q5	int(10)	No	None
Q6	int(10)	No	None
Q7	int(10)	No	None
Answer	int(10)	No	None
username	varchar(50)	yes	NULL
idx	int(11)	No	None

## **4.SYSTEM DEVELOPMENT**

### **4.1 Introduction**

Software Development is the process of analysing, designing, testing, implementation and maintenance. It is called Software Development Life Cycle (SDLC). Different SDLC include waterfall, prototyping, iterative, incremental, spiral development, rapid application development and agile methodology.

### **4.2 Process Description**

Different processes of each module are as given below:

- **User registration**

The user has to enter their full name, email id, password and confirm password in the registration fragment.

- **User login**

The user must enter the existing username and password to log into their account in the login fragment.

- **Depression**

Depression was determined by using the Patient Health Questionnaire (PHQ9). PHQ-9 is an easy way to use in a questionnaire for screening depression of the responses that are used to predict depression of an individual and what state he/she is in during the survey. The scores in PHQ-9 range from '0 = not at all' to '3 = almost every day'. The reason for choosing PHQ-9 was that it proved to be a useful tool for detecting depression. The levels of depression for the study were categorised as 'mild = 5-9', 'moderate = 10-14,' 'moderately severe = 15-19,' 'severe =  $\geq 20$ .'

- **Anxiety**

Anxiety was evaluated by using the Generalised Anxiety Disorder (GAD-7). In the questionnaire, the questions were used for screening anxiety states of an individual on a scale ranging from '0 = not at all sure' to '3 = almost every day'. GAD-7 has been found successful in identifying anxiety among different populations and thus used for its reliability. The levels of anxiety for the study were categorised as 'none-minimal = <5,' 'mild = 5–9,' 'moderate = 10–14 and 'severe =  $\geq 15$ '.

- **Result**

The Result shows Score/level of the corresponding test. Online screening tools are meant to be a quick snapshot of your mental health. If their results indicate they are experiencing symptoms of a mental illness, consider sharing their results with someone.

- **Email result**

The registered users can get their results through email id. A mental health provider (such as a doctor or a therapist) can give you a full assessment and talk to you about options for how to feel better by sharing these result

- **Depression and anxiety history**

The users can view their previous test results.

## **5. SYSTEM TESTING AND IMPLEMENTATION**

### **5.1 Introduction**

Software testing is defined as a process to check whether the actual results match the expected results and to ensure that the software system is error free. Software testing also helps to identify defects, gaps or missing requirements in contrast to the actual requirements. It can be done manually or using automated tools.

### **5.2 Implementation**

Implementation is the action that must follow any preliminary thinking in order for something to actually happen. Software/hardware implementations should always be designed with the end user in mind and the implementation process usually benefits from user involvement and support from managers and other top executives in the company. If users participate in the design and implementation of the system, ideally it will serve their business objectives more accurately and reflect their priorities and the ways in which they prefer to work.

### **5.3 Debugging**

Debugging is the process of finding and resolving defects or problems within a system that prevent the proper functioning of the system.

Different types of debugging methods used in this system are:

- **Unit Testing**

The application was divided into smaller components and tested individually. Each code was executed separately to ensure accuracy.

- **Integration Testing**

Each small component was integrated or combined into a module to ensure that each module works properly when put together. This was done to check connectivity between modules.

- **System Testing**

The system as a whole was tested by combining every module. This was to ensure that each process had a particular order. This was to ensure that the system does not crash while using.

- **Validation Testing**

In the registration fragment, validation is carried out to ensure the user enters values in all the fields and the fields like full name, contact number, email and monthly income are validated individually. In the login fragment, incorrect inputs like username incorrect and password incorrect if used for login, then it was ensured that the appropriate error message was displayed. In the health data fragment, validation is carried out in fields like height, weight, hip, waist measurements, blood pressure, total cholesterol, HDL cholesterol, blood sugar, serum triglyceride individually. In activity tracker fragment, validation is carried out to ensure user enters values in the water intake field, energy spent field, diet field.

## **5.4 System Security**

Password encryption is used to protect each user's details.

## **5.5 Scope for Future Enhancement**

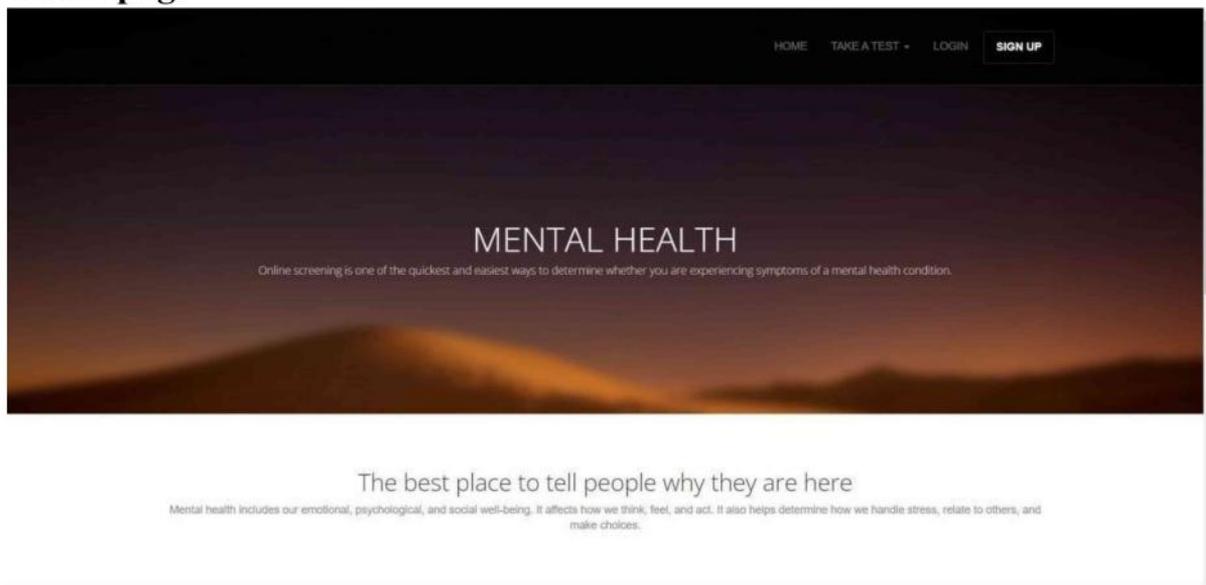
The current system is flexible and can be modified in the future.

## **6. CONCLUSION**

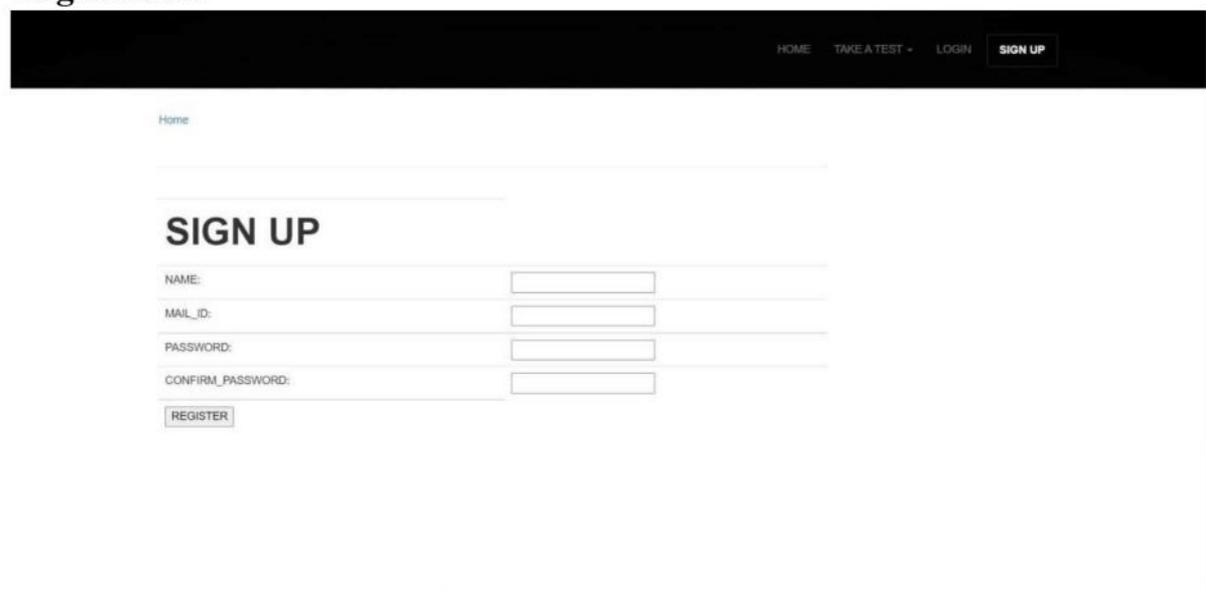
The software developed has fulfilled the necessary requirements as required by the user. It is ensured that all the programs are working properly in the “Mental Health-a self-testing website”. The system is used to operate in a user-friendly manner. Proper documentation done from different areas provides smooth running of all the operations without difficulty. The system that has been developed in Python to improve the user interactivity. This project avoids errors. The system has achieved the objective of helping the user through indicating their anxiety and depression levels and also sharing these results via Gmail. The project has been implemented and tested.

## 7. APPENDIX

### Home page



### Registration



## Login

The screenshot shows a login page with a dark header bar containing navigation links: HOME, TAKE A TEST, LOGIN, and SIGN UP. Below the header, there is a 'Home' link. The main content area contains a login form with two input fields: 'username' and 'password'. A 'Submit' button is located below the password field. To the right of the password field is a 'Forgot password' link. Below the 'Submit' button is a 'New user' link.

## Depression test page

### DEPRESSION TEST

1. Do you think that you have no interest or pleasure in doing things/works?	<input type="radio"/> Not at all	<input type="radio"/> Several days	<input type="radio"/> More than half the days	<input type="radio"/> Almost everyday
2. Do you feel hopeless and depressed?	<input type="radio"/> Not at all	<input type="radio"/> Several days	<input type="radio"/> More than half the days	<input type="radio"/> Almost everyday
3. Do you have trouble sleeping, either sleeping too much or not at all?	<input type="radio"/> Not at all	<input type="radio"/> Several days	<input type="radio"/> More than half the days	<input type="radio"/> Almost everyday
4. Do you feel tired or have little energy?	<input type="radio"/> Not at all	<input type="radio"/> Several days	<input type="radio"/> More than half the days	<input type="radio"/> Almost everyday
5. Do you overeat or have a poor appetite?	<input type="radio"/> Not at all	<input type="radio"/> Several days	<input type="radio"/> More than half the days	<input type="radio"/> Almost everyday
6. Do you feel like a failure or you've let people down?	<input type="radio"/> Not at all	<input type="radio"/> Several days	<input type="radio"/> More than half the days	<input type="radio"/> Almost everyday
7. Do you feel restless or impetuous?	<input type="radio"/> Not at all	<input type="radio"/> Several days	<input type="radio"/> More than half the days	<input type="radio"/> Almost everyday
8. Do you have trouble concentrating?	<input type="radio"/> Not at all	<input type="radio"/> Several days	<input type="radio"/> More than half the days	<input type="radio"/> Almost everyday
9. Do you have any harmful thoughts towards yourself?	<input type="radio"/> Not at all	<input type="radio"/> Several days	<input type="radio"/> More than half the days	<input type="radio"/> Almost everyday

## Depression result page

# YOUR DEPRESSION TEST SCORE WAS

13

## Depression Present

These results do not mean that you have Depression disorder, but it may be time to start a conversation with someone you trust to explore what is going on and how things can get better.

Email result

## Anxiety test page

# ANXIETY TEST

- |  |                                  |                                    |   |                                       |
|--|----------------------------------|------------------------------------|---|---------------------------------------|
| 1. Feeling nervous, anxious or on edge                 | <input type="radio"/> Not at all | <input type="radio"/> Several days | <input type="radio"/> More than half the days | <input type="radio"/> Almost everyday |
| 2. Not being able to stop or control worrying          | <input type="radio"/> Not at all | <input type="radio"/> Several days | <input type="radio"/> More than half the days | <input type="radio"/> Almost everyday |
| 3. Worrying too much about different things            | <input type="radio"/> Not at all | <input type="radio"/> Several days | <input type="radio"/> More than half the days | <input type="radio"/> Almost everyday |
| 4. Trouble relaxing                                    | <input type="radio"/> Not at all | <input type="radio"/> Several days | <input type="radio"/> More than half the days | <input type="radio"/> Almost everyday |
| 5. Being so restless that it's hard to sit still       | <input type="radio"/> Not at all | <input type="radio"/> Several days | <input type="radio"/> More than half the days | <input type="radio"/> Almost everyday |
| 6. Becoming easily annoyed or irritated                | <input type="radio"/> Not at all | <input type="radio"/> Several days | <input type="radio"/> More than half the days | <input type="radio"/> Almost everyday |
| 7. Feeling afraid, as if something awful might happen. | <input type="radio"/> Not at all | <input type="radio"/> Several days | <input type="radio"/> More than half the days | <input type="radio"/> Almost everyday |

submit

## Anxiety result page

YOUR ANXIETY TEST SCORE WAS

7

Moderate Anxiety

These results do not mean that you have anxiety disorder, but it may be time to start a conversation with someone you trust to explore what is going on and how things can get better.

Email result

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**DISSERTATION ON**  
**DRAMA THEORY AND PRACTICE**

**SUBMITTED BY**  
**MEENU M**  
**REG NO : SM20BHA003**  
**II. M.A. BHARATHANATYAM**

**DEPARTMENT OF BHARATHANATYAM**

**ST. TERESA'S COLLEGE , ERNAKULAM**

**AFFILIATED TO M.G. UNIVERSITY**

(2020 – 2022)

## CERTIFICATE

**CERTIFIED THAT THIS IS A BONAFIDE RECORD OF FINAL YEAR DISSEMINATION ON “ DRAMA THEORY AND PRACTICE” SUBMITTED BY MEENU M (SM20BHA003)**

**AND SUBMITTED IN PARTIAL FULFILMENT OF REQUIREMENT OF AWARD OF M.A BHARATHANATYAM IN THIS COLLEGE**



**MR SURESH KUMAR C K.**

**(Head of the department).**

**Dept. Of Bharathanatyam.**

**St.Teresa's college.**

**Ernakulam**



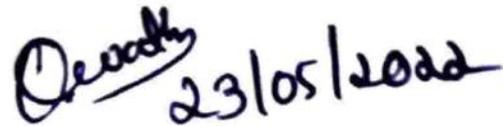
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**Dept. Of Bharathanatyam**

**St.Teresa's college**

**Ernakulam**



**External examiner**

**College seal.**

**Date of submission**

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Tanjore Brothers and Bharathanatyam, Balasaraswati, Rukmini Devi Arundale, Vaggeyakaras in Bharathanatyam – Uthukkadu Venkatasubbayyar, Papanasam Sivan, Kuchippudi, Odissi

## **11.Reference**

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## **DRAMA THEORY AND PRACTICE**

### **Introduction**

This dissertation, Theory and practice of drama stands apart from many other books in this category in terms of content and approach.

Human acts with an artistic touch, such as dance and drama, are born and grow out of practice, not out of any competition. On closer Inspection, some people find the verb germ to be more intimate than others, which is generally referred to as instinct. We need the help of a grateful teacher to nurture our instincts through practice.

Although the book is about drama, it seems to highlight the dance forms of Bharatanatyam and Kuchippudi and their parts. Kerala is a country where the Indian tradition of Natyavedi exists in its ancient form of expression. There is also a caste that has made the art of drama a genocide. Thus Kerala has a long tradition and history of caste-based drama. Therefore, Kerala's relationship with theatrical art is not merely contextual.

It is said that in ancient times the arts were the private property of an elite class. That is not entirely correct. Only elite art was considered in the category of art. The artistic performances of the downtrodden were confined to the liturgy of the communities. Elite art is also confined to an elite section of the society. But their content and evolution show that these two tissues were not in watertight chambers. The Margi traditions, which are enduring Indian sciences in the fine arts, as well as the national traditions in the indigenous communities, as well as elements from the folk art of the common people of the respective regions , can be traced. Elements of the scientific arts are not inaccessible to the artistic

performances of local communities. In any case, in today's social system, the distinction between the elite and the inferior is irrelevant.

It is interesting to note that this work which focuses on science and rules, is in line with the current state of Kerala art scene. At a time when anything is becoming popular and marketable, theatrical art alone cannot escape. As a result, counterfeit coins have much more to offer.

No matter how much work and tactics are put into action, it is difficult to describe it verbally.

My dissertation is divided into nine chapters. There is a rejection of the ancient concept in the very first chapter which discusses the beginning of dance. This chapter which discusses the beginning of dance. This replaces the blind belief that Shiva and Parvathi are the creators of Tandava and Lasya and concludes that Parvathi is the symbol of the supreme personality of God head and nature, and therefore the origin of the universe itself through dance. Similarly, it is established that drama originated from primitive man and is an art. The second chapter on acting also rejects some of the old notions. One of them is that there are no Chaturvidha Abhinayas. Sathvikabhinaya is exempted from this. In the expressions discussed in chapter three, traditional method is questioned. Different views of Abhinavagupta , Shankuka , Hemendra , Bhoja ect. were raised after Bharata.

In the fourth chapter , Angikabhinaya(gestures) are discussed a lot. The verses in Abhinayadarppanam explain the benefits of each mudras in acting. The text does not say how mudras can be used in each act. It also briefly describes the method of applying the mudra based on certain Tamil texts. It also gives instructions on how to show Deva Hastah , Bandhu Hastah and Ashtadikpala Hastah etc. A total of about four hundred words describe how to apply mudras in acting Everywhere there is a reason to quote the text Abhinayadarppanam. Many people adopt different characters, mudras and different styles for their acting. The author will be questioned if he gives an explanation without quoting science. The first goal is to

sit without stoning the wrongdoer. It is known that no one has published the Malayalam commentary on Abhinayadarppanam. The second goal is to get it to the Malayalees.

Adavus are explained in the fifth chapter. There are no explanations for how to make each adavus. I am convinced that writing like that is useless. Exercises to tame the body are explained before starting to practice the Adavus. It was written to illustrate the importance of learning dance.

Chapter six gives only general regarding items. Chapter seven contains training lessons for those who want to practice Nattuvangam. It is not found in any other book. Those are all lessons that are shaped by light in self experience. The last chapter in history records a history that only touches on the artistic careers of certain geniuses.

# **Chapter - 1**

## **The beginning of the dance**

The search by modern scientists for the origin of the universe is far from over. Many people have different opinions to satisfy themselves. Some have suggested that the beginning of the universe came from a big bang. In addition, many questions remain unanswered. What was the infinite sky like before this explosion? The explosion must have had a cause and a cause? Doesn't it have to be a force to be reckoned with? What is the source of that power? Does the universe have boundaries? If so, what's beyond that? The scientists is powerless to answer these questions. To be satisfied by remembering the poet's verse that the infinite unknown is indescribable. If you start thinking about where and when space and time started, you will never see the end.

Until scientists find credible answers to the above questions, there is no other way but to believe the delusion stated by Indian philosophers. Vedanta declares that the universe we see is just a feeling and that the truth is only the mind. The universe we see is confined within this mind. The universe is not real but real. Essence is the substance used in creation. The object used in all creation cannot be seen by itself. Sree Narayana Guru's Decade of God praises God that you are the creation, the Lord of creation and the material of creation. Science is not a belief that the universe is made up of five demons. Those five demons cannot be seen in their pure state. It is experienced only in the state of intermingling. The real one can be understood through the non-existent objects. It is derived from this thought in the concept of God in India. We come to the conclusion that it is not

wrong to imagine God in any form because the omnipresent presence of God is found in all things.

When the whole universe is confined to one mind, the question arises as to where the human mind is. Whether it stands inside or outside the human body? The structure of us, a small part of the universe, will not change. Any grain of sugar in a kilogram tastes good because it contains the overall sweetness of sugar. Our minds are as wide as the sky. See also Chidambaram. Natarajan, Lord Shiva, gave that form by contemplating the divine power which is imbued in the Chidakasha principle in a particular form. The idol of Nataraja at the Shiva temple in Chidambaram, Tamil Nadu is based on this principle. The main deity of the temple is Natarajan, who imagines the aura of light as a circle and fills it with dancing. The ancients believed that this place was the center of the universe. The name was given in that sense. It is believed that Lord Shiva danced at the request of sage Patanjali at this centre of the universe. There is also a mandapa inside the temple which is believed to be the place where Lord Shiva danced.

## **Sacrifice of sage Patanjali**

Sage Patanjali and his disciples went to a forest and started sacrificing for Lord Shiva. At the end of the sacrifice, Lord Shiva came to the shrine in the guise of a savage. He threw stones and other objects and tried to disrupt the sacrifice. To oppose this evil deed, the sage meditated and offered meanings in the Homakunda. A leopard with a terrified dog came out of it. The leopard was sent towards the savage. The savage killed the leopard and began to dress it with leather. The sage who created the savage serpent from Homakunda sent it to the savage. Savage took the snake and strangled it. Thirdly, he was commissioned to confront the savage who created the monster Muyaalakan. As soon as he saw the demon, Lord Shiva, the savage, trampled him on the ground and started dancing on the ropes outside him. Then the enlightened sage, recognizing the savage with his wise eyes, prostrated himself. Lord Shiva appeared to the sage with his right hand. The sage pleaded with Lord Shiva to show him the dance once more. The happy Lord Shiva

told the sage that he could come and see Chidambaram dancing on the pooya day of the month of Thai and disappeared.

The rhythm of Brahma, the sound of Vishnu, the maddala of Nandi, the flute of the Sun and Moon, the veena of Saraswati's, and the melody on the appointed day fulfilled the sage's wish by going to Chidambaram and dancing. This is the story that is being told based on the Nataraja deity of Chidambaram. Many hymns about Natarajan used to dance in bharathanatyam are mentioned in the dance. It is enough to think that all these stories are the imaginary addresses of man.

## **Mudras on the idol of Nataraja**

The idol of Nataraja in the Chidambaram temple is World famous. Idols made of metal modeled after this are common in the markets. Made of Pulp, clay and plaster of Paris, they are also available for sale in commercial areas. All of these are going to home showcases. Some may always come to the Pooja rooms.

Nataraja idol in the Chidambaram temple carved out of a single stone by an unknown sculptor who spent most of his life. The soul of the unknown sculptor will be imbued in this work. In this sculpture, Lord Shiva is seated as the Almighty Lord of creation, destruction, blessing and salvation. The four hands are the symbols of the Damaru creation in the right hand, the left forearm position held by dola, right hand is held by fire destruction and the blessing of the right forearm. Stepping out of the monster with the right foot and raising the left leg in the sense that it trampled on the wicked and gives salvation. The very imagination of the dancing Ishwar itself indicates a high level of knowledge. There is motion even in an atom in the universe. It is this universal force that gives energy to that motion. It is believed that the concept of Shiva is existed in India even before the Vedas were written. Vedic culture is the worship of the forces of nature. Gods such as Indra, Vayu, Varuna and Agni were worshipped as their deities, symbolizing natural phenomena. The Sun was worshipped as the Almighty God who gives life, heat, light and energy to life on earth. But the man began to think that the Sun, moon, and stars were small objects in the vast universe, and that they were created by another force. The confrontation between the Aryan culture that came to India

with the Vedas and the Dravidian culture that existed here before that may have changed the mindset of both groups and the worship of the universally accepted trinity began. A fusion of Aryan-Dravidian cultures was made possible by the assumption that the three powers of Brahma, Vishnu and Shiva were three elements of the divine power of a Parabrahma. Indian culture can be said to be a continuation of this unified culture.

## **The emergence of the art of dance**

Dance is as old as the creation of the universe. There are indications of this in the concept of Shiva. Ishwar was made a dancer because the man of that time thought so. There are other stories of man thinking that the creation of the universe took place through dance. Dakshaprajapati performed a sacrifice. Many goddesses came up from Homakunda. They danced and flew across the sky. Eventually their bodies all disintegrated and turned into molecules. The universe was created by combining them again.

There is a similar story in Greek mythology. God first created an angel. She floated in the sky and walked. She begged God to give her a place to dance. The story goes that earth and the heavens were created to fulfill her desire. The movement of all the spheres in the sky is a choreography.

## **The beginning of the drama**

In Natya shastra written by Bharatamuni, Natyam says about creation. Extensive Vedic verses and mantras are inaccessible to the common man. Brahma, the creator, felt that there should be a new way for all people to understand it. Drama was created by taking lessons from the Rig Veda, acting from the Yajurveda, music from the Samaveda and rasa from the Atharvaveda. It is considered to be the fifth Veda, the Natya Veda. It is considered to be the fifth Veda, the Natya Veda. Brahma instructed his new creation Bharata for all people

to see and enjoy. Bharathan and his 100 sons first edited the story Palazhi Mathanam and presented it to Indra Sadas. The happy Brahma and the gods asked Bharata to present this sculpture to Lord Shiva.

The absence of women to portray female characters affected the beauty of the country. To fill this gap, Bharathan requested Brahma to create 24 Apsaras and entrust him with Bharathan. Bharata's sons and Apsaras performed a dance in front of Lord Shiva. Delighted, Lord Shiva advised Bharata to add the lively dance he had created to the dance. Bharata asked the sage to teach him this art as he understood the path actions of Lord Shiva, pathakriyas, karanas, rechakas, angaharas etc. This dance is called Tandavam because of the teachings of Tandu. Parvati also taught the Apsaras the Lasya dance she had composed. The dance, which consists of Tandav and Lasya, is thus expanded and added to the dance to make it more enjoyable. In theatrical composition, various aspects of acting are analyzed and all topics are discussed, from body movements to dance. Not only dance but also other arts associated with dance such as music, literature and sculpture are observed in Natyashastra. Explains the grammar of prose verses when it comes to literary composition for drama and the architecture when it comes to the stage for performing drama. Thus, Natyashastra became the first science textbook of all other arts. Separate texts were later written for each branch, expanding on its conclusions and making new observations. Bharathanatyam is practiced and performed in accordance with the provisions of Nandikeshwara's Abhinayadarppanam and Bharatarnavam. These texts are based on other classical dances in India.

## **Antiquity of the book Natyashastra**

Dance and music may have existed since the time of mankind on earth, but they are not considered to have been written by rhetoric at the time. Scholars suggest that the theatrical composition may have been composed about 2500 years ago. It is suggested that Bharata codify the earlier dance and the rules adopted in it and to add his own views in it. Some references to Buddhist monks suggest that Natyashastra may have been written during the time of the Buddha. The epics

Ramayana and Mahabharata were written after Natyashastra. If the stories of Rama and Krishna were popular, they would be given in Natyashastra in the meantime. Dashavathara stories were also not popular then.

The first arts of the human race must have been dance and music. Non-linguistic music in which a single rhythmic group makes some sounds and claps to the rhythm. When the rhythm is tightened, other movements occur automatically. Some sounds, gestures are used to communicate. This is the first play. As man progresses and acquires knowledge in all fields, these arts may have grown.

## **Dance and music-imitations of nature**

In nature there are scenes, sounds and movements that frighten and delight man. Thunderstorm, floods, wildfires etc. cause fear in humans. There are many things in nature that make man happy. There is music in the voices of small insects and many kinds of birds. Their movement is dance. The wings have been shown solely to give a sense of proportion. Peacocks, pigeons and birds can be seen singing and dancing to the delight of their mates. The sound made by the group of dots seems to be chirping. There is great music in the stormy storm and the trees in it. You can hear soft music from the leaves that the wind blows so hard. The corner of the beetle resembles the sound of a tambura. Sound of the flute can be heard as the wind blows through the hole they make in the bamboo. The weedy sound of small streams swaying on the rocks seems to be a rapid percussion. The waves of the calm and slow flowing rivers are as beautiful as the dance. Flowering trees, plants and vines create a different kind of color in the universe.

Man has become accustomed to imitating the sounds of birds and animals. They learned to imitate their footsteps and movements and to take new steps. Natured melodic music. The dance also expanded with the variety of steps. The man who lived as a group may have danced to this music while making fun. Having lived by hunting. It is a pleasure to have an animal for them. The group travels from one place to another, enjoying a place where food is more available.

The development of language must be from the very foundation of music. Communication of all subjects with gestures was difficult. They imitate the sounds and movements of birds and animals to tell others about them. Effects can show their shape and convince others. It is difficult to distinguish fruits from each shape. Here came the need for language

## **The Vedas**

The Vedas were written before the invention of the script. They have been preserved for thousands of years and passed on to the next generation. It covers the life style, rituals, beliefs, rituals and mantras of the man of that time. The Rig Veda, originally written, describes the sunrise as the most beautiful sight given to man by nature, as if a woman were dancing. We need to understand that dance had grown into such a beautiful art during that period. The Vedas also teach us about music. The Vedas were initially judged by Western thinkers to be mere words of a group of primitive men. But later scholars such as Max Muller stated that the Vedas were written by people of high cultural standards. The Upanishads, the Brahmanas, the Epics and the Puranas were later written containing the essence of the Vedas. In all these works the arts of dance, music and drama have been given prominence.

## **Folk arts**

We have observed that in primitive man there was dance and music. They lived by hunting and eating wild fruits and tubers and shifted their way of life to involved in cattle rearing and later to agriculture. When he started cultivating, he had to stay in one place permanently. Until then man had lived in caves and make shift huts and had to build permanent fortified houses. The fact that houses are built and lived in close groups can also be considered as evidence of human group consciousness.

There was no way to learn from a guru then . The younger generation grew up watching and learning what adults are doing. Education at that time was to pass on the experience of adults to the younger generation. It can be assumed that song, dance, farming and animal husbandry were all passed down through the generations and grew with each passing generation. Special ceremonies were held for the cultivators as well as for the harvest. They may have done so to the advantage of the forces of nature. These ceremonies later developed into Ishwara pooja. It is not wrong to assume that Ishwara pooja was performed by singing and dancing. Today's people see music and dance as their faith in God grows stronger.

One can only imagine that man would miss this beautiful period in two ways. One is the tug of war over the controlling power of a group. War was inevitable when there was enmity between groups. It took a leader to win the war. He chose someone strong enough to lead them. Historians have also observed how the leader and his followers first came into being.

The rituals were designed to disguise themselves as demons or devils dancing in front of the goddess. This is followed by the dancing of Darika and Kali, Bhoothathan, Karinkutty, Madan, Marutha etc. Which is seen in the temples today during festivals. Different stories are being told behind the scenes in each country. Today, there are ceremonies in which such demons are chanting all over the country for the woman and children of the manager's house to see. Not only in Kerala but also in others parts of India, there are many such folk dances performed for the sake of goddess Preethi. Poikkal horse races in Tamil Nadu, Mylattam, karakattam and kavadiyattam are examples of this. Kanyarkali in Palakkad is a local festival performed for the sake of goddess Preethi. Until, recently folk dances such as Parichamuttukali, ayavarkali, were performed during festivals at the Bhagavati temples. Theyyam, Thira in Northern Kerala is also an art of high artistic quality.

## **Classical Dances**

We have seen that the development of language has had an impact on the development of dance and music. With the spread of Sanskrit in India, the knowledge of Natyashastra has also spread. The study of rhetoric has made it possible to scientifically refine dance. Learned from the text Natyashastra and did not copy the types of Charis, karanas, angaharas etc. described in it form a new dance style. The text Natyashastra only used the suggestions to modify the dance forms that were practiced in the respective countries. Nritta hastas, mandalas etc., have been adopted in Natyashastra to enhance the beauty of the steps in folk dances. However, no country has implemented the reform by abandoning the folk style altogether. That is why all classical dances are different in costume and performance. Bharathanatyam, Kuchippudi, Odissi, Manipuri and Kathak are classical dances developed in this way. Kerala's unique Kathakali and Mohiniyattam do not show allegiance to the Natyashastra torrent. Even the hastas used for abhinaya in these are suggested in the Hastalakshanadeepika written by a Keralite Natyacharya. It is true that stories from epics like the Ramayana and the Mahabharata are lessons learned Kathakali. Kathakali did not accept the presentation of Sanskrit plays. But the literature in it is similar to Manipravalam which is a mixture of Sanskrit and Malayalam. In Kathakali, characters who have cultivated folk arts such as Thira, Darika, Kali, Bhootham etc. and stories that have been adapted from the steps of these arts are mostly used. In Sanskrit influence of this art on Keralites is reflected in the traditional Kerala instruments such as Chenda, Idakka, Maddalam and folk instruments such as Chengila and Elathalam.

## **Indian Music**

Indian music differs from world music in its melody. There is a statement in the musicology that there are 22 srutis in classical music. This means that the sound can be applied to 22 different swara sthanas. But it is difficult to express it clearly. Today 12 swarabedhas are used. Of these, 7 swaras are taken as the main swara and five swaras can be slightly differentiated and each swara can be used so that twelve swara sthanas can be applied. Each of these ragas can be sung with only a specific swara. It is estimated that it can produce thousands of ragas. It is the study and practice of these ragas that sets Indian music apart from other musicians. Each raga has a different bhava. One can study music scientifically to determine the ragas and sing the melody to create the mood . It is conceivable that there were

variations in the songs sung before this scientific method came into being. The songs sung on each occasion had the appearance of respective themes. Then the raga had changed accordingly without their knowing it. The musicians who studied these changes later made the law by understanding the ragas used in each swara. The name of the raga was given to determine the difference in the raga before determining the swarasthanas. If we think like this, we can see that classical music is developed from folk music itself.

Samaveda is said to have the first rules of music. Sharangadeva's Sangeetha Ratnakar is an important textbook on this art. The dance and music that are scientifically organized and practiced are known as 'Margi' and the folk arts are known as 'Desi'. Indian classical music has two subdivisions, North Indian and South Indian. Although both are based on raga, differences in practice set them apart.

## **Nritta, Nritya and Natya**

Some consider dance to be an art form of dance. The above are the three major ones in visual arts. Although there is a connection between nritta and nritya and Natya stands apart.

can be performed without Nritta and Nritya. Dance is the movement of the limbs to the rhythm. If there is abhinaya along with nritta, it will be permanent. It is customary to sing the word and act without adding any nritta. Can you call them nritta? In Nritta and Natya padacharis and nritta hastas does not use, but is performed by performing Lasya gestures. Padhas are taken with the rhythm of the song as it moves from one place to another. In story telling abhinaya will be lokadharmi but in nritta it is natyadharmi.

In padabhinaya there is also the abhinaya of sitting in certain contexts. When singing and acting a sloka, dance can be avoided at all. Of you think like this, you

will not be able to call abhinaya as nritya without the ingredients of Nritta. Bharathanatyam performance like varnam is at the forefront of nritta.

The definition of natya as presenting a story through nritta and nritya is not entirely correct. There is no nritta and nritya but there is dance. The logic is that the art of natya has become a separate entity from others.

## **Chapter 2 – Abhinaya**

When he behaves and speaks like a great innocent who has done wrong, we say that it is his acting. The same thing is done with natya. Everything you do in Natya is a lie. Suppose the durbar raga of Emperor Ashoka is performed in a play. There is no emperor Ashoka and no throne and no soldiers. The sword in the hands of the soldiers is made of paper frames. The gold crown is just a card board wrapped in gilt paper. The palace has no wooden planks and the roof is covered with thatch. The audience comes to see the play knowing all this. The audience arrives knowing what the story is. Audiences may be curious to know what the characters in that story say and do. Why do people come to see it when famous myths like Ramayana are dramatized? Everyone has heard and read that story so many times. Now when presented here the audience will be eager to know how its

characters are portrayed and who is presenting them. Audiences will be more interested if they know that the characters are played by famous actors. Everyone is familiar with Kumaranasan's poem Karuna. It starred Augustine Joseph as Upaguptha and Ochira Velukutty as Vasavadatta during its theatrical run. Many people come to see the play with the sole aim of seeing their performance. This is a testament to the fact that actors talent is increasingly a factor in their enjoyment of drama.

Abhinaya enjoy new social dramas performed by unknown actors? The characters and actors are unfamiliar. Its events are taken from the audience's surroundings. There is another level of enjoyment here. Suppose the play reveals some things that the audience does not notice in normal events. Actors make the show their own when they paint it with spontaneity.

Abhinaya is the act of making what exists non-existent and showing that what does not exist exists. It is the process of forgetting the place and time and taking the audience to the place where the events of the story took place and to that period. Natya is the combination of three elements, the playwright, the director and the actors. The audience is the fourth factor that is more important than these three factors. The other three factors need to work for the audience to know the country, time and culture. Their clarity of purpose and the insight to achieve it require skill in their work.

Abhinaya is only mixed in Natya and Nritta. The main purpose of abhinaya is to entertain the audience. When all the characters in a play come on stage and reveal their character, the audience will like the character for their own character and hate the characters who are against the characters will. The audience will accept the difficulties that arise in the favourite character as their own sorrow and the happiness of that character as their own happiness. Rasa arises when the expression is thus poured into the audience. Rasa will arise happily. This process is discussed in detail in another chapter.

The question here is whether the above mentioned sense of humour is reflected in the performance of the dance. In the dance, the acting of many characters is done alternatively by one person. Some stories are told that way.

Suppose the dancer has performed the bhavabhinaya and Angikabhinaya in a better way. Will the situation here be the same as the audience that was in the Natya? The opinion is no. This is why everyone loves to see these arts even if the audience does not enjoy the rasa? Here the enjoyment takes place in a different way. There is a lyrics to the song used for the dance. The shape will have a consistency. It sings in a way that evokes that look. It will be a pleasure to hear it with the musical background. When the sound of the instruments is heard aloud with the rhythm, the mind of the audience is awakened. The mood of the audience is the same no matter what the mood of the dance is. In short, when pleasure is easily derived from nritta, there is only right from natya. Likewise the pleasure in nritta will be fleeting and the pleasure in Natya is long lasting.

If abhinaya is to be expressive, then what elements are needed? When the story of Lord Rama is presented in a normal play, the role of Lord Rama should be in keeping with the period in which Lord Rama lived. There should be an understanding of the costume worn that day. The king's robes and crown should be worn at the coronation day. The seated throne should be properly decorated. Women should stand on two sides to spread the charm. There should be armed guards at both ends of the front. At the back is a cloth or other patterned curtain to mark the inside of the palace. In this way the time, place and context are decorated in such a way as to make the audience feel and then the characters who have taken its place have a dialogue. Demonstrates body movement and gestures to make the meaning of the conversation more clear. Everything said in these descriptions is part of the abhinaya. In Natyashastra, abhinaya is categorized into four categories according to their nature: angika, vachika, aharya and satvika.

1. Angika: Abhinaya with angas is angika. Mudras, head, neck, hands,feets, all movable parts of the body are used for abhinaya. You can also express yourself by creating many images with body curves. Angikabhinaya is described in detail in another chapter.
2. Vachika: This is abhinaya with words. In plays, prose and verse come literally. In classical dances such as Bharathanatyam and Kathakali, the dancers usually act out the songs sung by the singer in the background.

Singing and acting a song is called *sugeetha vachika* and singing in the background is called *upageetha vachika*. The *chollukettus* used during the song for dancers to do on their own is called *sushabda vachika* and the *chollus* for the dancers to be used in the background is called *upashabda vachika*. *Sugeetha vachika* and *Sushabda vachika* are not used in dance, especially in classical dances. The folk dance is more about the dancer singing and dancing himself. *Sugeetha vachika* are found in all the folk dances like *thiruvathira*, *oppana*, *mappilakolkali*, *parichamuttu* etc.

It was mentioned in the previous chapter that the play is performed without *vachika*. Radio drama is a way of presenting a play with only the *vachika*. The story is told through their dialogue without seeing the actors. It does not require *bhavabhinaya*, *angikabhinaya* and *aharyabhinaya* as in visual dramas. But when writing a dialogue, one must understand its limitations. Conversation is necessary for those who are listening to the play to understand the verbs in the story of the play. If a third person comes in while two people are talking, it should be mentioned in the conversation. Say hello and where are you from now? The new character can also be introduced through conversations.

In this way the objects in the scene and the verbs in which the characters are sitting or standing, one pushing and knocking over another can be explained through dialogue. Although there are some limitations to expressing gestures, the speakers facial expressions can be visualized by the listener. Verbs that are difficult to perform in visual drama are also easier to perform in radio drama. It's hard to show all this in visual drama. This explains the importance of *vachikabhinaya* in drama. '*kaku*' is the act of lowering and raising the voices according to the tone of the dialogue in the play. If the song is lyrical, then the melody should be considered to enhance the tone of the song. It's the duty of those who arrange the music.

The lyrics of the song sung in the background in the dance are very important. If the meaning of the song is not understood, it will affect the enjoyment of the audience. Today, the meaning of the hymns sung in Carnatic music concerts is unknown to the viewers and listeners. The only goal in both groups is to enjoy

the music. The audience will enjoy listening to the melodies and rhythms. But the enjoyment of dance is not limited to music. Abhinaya is the key. To fully understand the abhinaya, one must understand the words of the song and its meaning. So singers need to be careful about that. A line song will also feature a variety of performances. It will be done according to the ability of the dancer. The performance and the nature of the song should be understood and changes should be made in the singing of the song. That is the mood of the singer. When you sing like that, you can see that the abhinaya reaches a high level by combining dance and music.

3. Aharya : Let us go back to the theatrical adaption of the Ramakadha given earlier as an example. No one knows what the role of the mythical character Rama will be. Some painters may have created their own imaginative paintings. Those images are firmly entrenched in the minds of the general public. The audience will get the impression of Rama only if they are dressed in clothes that do not change much from that. The crown and ornaments should be worn accordingly. The throne in which Rama sits is made to look like a king. This includes all objects used to define place, time and character. The question arises as to whether the guards and attendants are included. If they are not characters they can be included in the Aharya.

The word aharya means artificial. All of the above are artificial standing and wearing. There is nothing wrong with taking the meaning of the word. The following are some of the variations on aharyabhinaya suggested in the Mahabharata choodamani.

1. Nijaharyam : It is a traditional form of dress worn in every country, with costumes and ornaments worn, and hair danced. This aharya is used in folk dances such as kaikottikali.
2. Abhichari Aharyam : Abhichari is said to have worn different ornaments for each character in the play. In mythology, different dresses and crowns

are used for characters like Rama and Krishna. Similarly different aharyas are prescribed for gods and demons.

3. Vyabhichari Aharyam : Each dance form has its own set of costumes and hair. There are different roles in the stories but different characters are given the same role. The main characters in the sringara are dressed in green. This role is the same for all the great characters like Rama, Lakshmana, Yudhisthira and Arjuna. Heroic characters like Ravana play the role of a kathi vesha and cruel characters play the role of a red beard. Some characters like Sri Krishna and Hanuman are seen in special roles. The minukku vesha given to women and the thadi vesha given to Brahmins and sages are all common costumes. Bharathanatyam plays different roles in classical dance forms such as Mohiniyattam. The role is not used according to the character. This method is called vyabhichari Aharya.

## **Sathvikabhinaya**

Sathvam is the mind. Sathvikabhinaya is the expression of the emotions that come to mind. In normal life, different expressions may come to mind in each situation. Their appearance will vary according to the nature of each individual. The face is the mirror of the mind. The first appearance of the state of mind is on the face itself. Emotions on the face become comprehensible through the movement of the cheeks, lips, teeth etc. Other parts of the person are more likely to be in motion when the emotion arises. Fear can also cause the body to contract, tremble and run. Therefore, it can be understood that the disturbances in the mind become gestures. It is difficult to include the mind acting. The mind is not an organ of the mind, but can be described as a state of force or condition caused by the activity of the brain. The brain is a super computer that stores all the movements of the mind.

Thinking like this, there is no real feeling in the mind of the actor that the acting element of Satvika is irrelevant. Emotion is for the character. The actor has

learned how to act when the character has an emotion. The audience understands the emotion that the actor feels when the actor expresses it through his acting actions. The actions performed by the actor here are angikabhinaya.

Acting is like pretending to have what you don't have. What is not in the actor is only the mind of the character. Angika, Vachika and Aharya are mostly used to convince the audience of any emotion. If you think like this, acting is one thing. Satvika only. This idea is hidden in the structure of the sloka beginning with ' angikam bhuvanam yasya ', the gesture of salutation to Shiva. Shiva himself is the Satvika. By this sloka we mean the concept that fills the universe has no form. Only the monster survives. There is no way to see this creature. The other three factors are proof that it exists.

Today's Natyacharya's Chaturvidha Abhinaya says that Satvika is the expression on the face. Natyashastra says there are eight satvik expressions. They are: Sthamba, svetha, romanja, swarabedha, vepadhu, vaivarnyam, asru, pralaya. All of these are self-inflicted when the mind is in turmoil. Natyashastra dictates how these are acted out. Their performance is given below.

1. Sthamba: Stay motionless, feel like emptiness, feel like you're frozen.
2. Svedha: wipe away sweat, sweat and blow with a whistle.
3. Romanja: Do it like it explodes frequently and lower it there in the body.
4. Swarabedha: Rub in the throat as if it were stumbling.
5. Vepadhu: Show as if shaking.
6. Vaivarnya: Torture the nerves and change the colour of the face.

7. Asru: Wipe away tears from time to time.
8. Pralaya: Hold your breath and roll on the floor.

The above satvika abhinayas or satvika bhavas are not all the expressions that arise in the mind. It is only an act of sorrow and fear. Many other expressions come to mind and cause irritation. It is clear from the performances of the above satvika bhava that the actor also had the impression that he had no emotion in his mind.

There are many different kinds of people in the world. Tradition, environment, education and employment all play a role in a shaping human behaviour. One who is frustrated with life does not enjoy the beauty of the nature. A class that has been living a life of slavery for generations can accept the harm done to them by their bosses without much fuss. A philanthropist on the outside will explode with anger when he sees it. Poets like Kumaranasan can grieve at the sight of a fallen flower and see the mortal human life in it. When all this brought into the drama which is an imitation of world life, itself must learn to act it out. Natya activists have to observe life in this way and put it into practice. It is important to understand what each event looks like and how it should be performed. Only a few examples are available from the text.

## **Loka Dharmi and Natya Dharmi**

Loka Dharmi and Natya Dharmi is another division of acting. Verbs performed in ordinary life are called Loka Dharmi and the verbs that are not in ordinary life are called Natya Dharmi. Men's female role, women's male role, dance and music etc. are said to be Natya Dharmi.

It seems that this comment needs to be amended. Loka Dharmi is the use of dance and music performed by ordinary people on special occasions. A story cannot be told without changing the place and time. Isn't pious to tell the same story that happened before the time when drama was performed in an area?

Another view is that the presentation of supernatural stories is natya dharmi and the presentation of world events is loka dharmi.

There is another opinion that there are these two branches in Chaturvidha Abhinaya as well. Natya Dharmi acts in a way in angikabhinaya that is scientifically determined. In normal life gestures can be made without predetermining the shape of the mudras. In some cases, mudras such as pathaka, ardhachandra, mushti, sarppasheersha, kadakamukha etc. are used. Everything that is applied in this way is Loka Dharmi. Just because the body rests in the form given to it by science does not mean that it is natyadharmi. Mandalas and mudras are derived from the actions of human beings in ordinary life. Hand gestures not used in worldly life and using them to imitate god's, demons etc. can be said to be natyadharmi. Natyadharmi is also known for acting as dashavathara, ashtadhikpalakas, navagrahas, bandhus etc. in the manner prescribed in the Natya scriptures. There is also this division in vachika abhinaya. There is a fabrication in the dialogues between the gods and the kings, leaving out the folk dialect. All of that is natyadharmi. Some people say that all the objects used in the drama are natyadharmi. The costumes of the kings and the gods and the costumes, ornaments, weapons and theatrical costumes that they wear can be said to be natyadharmi. At the same time, when a world event is dramatized, it is safe to say that the setting and weapons used in itsre lokadharmi.

Some acharya's have argued that everything that happens in the world is lokadharmi and everything that is done in drama is natyadharmi. I do not see a way to accept this. Lokadharmi and natyadharmi are the two branches of acting. Acting is not something that happens between worlds. Therefore, this opinion can be rejected.

You can see how much natyadharmi and lokadharmi is used in each dance form. Let's take Kathakali for the first time. The entire acting of Kathakali is natyadharmi. Vachikabhinaya is performed in music. All the stories presented are adapted from myths and legends. It is not usual to tell the stories of ordinary people in Kathakali. All the roles are imaginary. They do not have the appearance of ordinary people. So Kathakali is completely natyadharmi.

In bharathanatyam, words are composed of vachika and music. Although some of the symbols are used unknowingly in ordinary life as mentioned earlier, they are all applied in dance with hand gestures that are commonly used by the general public. Although the upangas such as eyebrows, cheeks, lips etc. which are the categories for expression are done in lokadharmi, the rechakas, sthanas are quite natyadharmi.

When a story is acted out, the verbs of the different characters reveal the plot in which the dancer takes turns acting. This acting is being done as lokadharmi. Only famous stories are usually acted out in this way. A part of the story that no one knows cannot be understood by the audience through this performance. Because there is no singing in the background to indicate this story. Some people say that this performance is a show of lokadharmi.

It is not appropriate to take a small part of an art and determine whether it is lokadharmi or natyadharmi. All of the dances can include in natyadharmi. This applies to all the classical dance forms.

## **Suchika Abhinaya**

When a padha is sung, the meaning of the words is shown by the mudras is called suchika abhinaya.

## **Bhava Abhinaya**

The facial expression should be displayed while showing the mudras by hand. The facial expressions should be worn so that the upangas are all together. This is called bhavabhinaya.

## **Bhavika Dhwanthabhinaya**

Bhavika Dhwanthabhinaya is a way of expressing the meaning of the poem by having the dancer sing and perform the above two types of acting. At present the practice of performing dances in this manner is not practiced in classical dances. This system is also common in Kerala arts such as martial arts and kanyarkali and therukoothu in Tamil Nadu.

## **Laakshanika Abhinaya**

It is the way in which the dancers express their intimacy through their own acting, without acting directly on the objects or persons referred to in the world. This method is sometimes used when sanchari in dances. Suppose the theme of the word is the expression of the heroine who knows that Krishna will come to her. She is waiting for Krishna to receive flowers and prepare a garland unbeknownst to her, Krishna comes up behind her. The heroine hesitates as she hears Krishna walking slowly. Krishna closes her eyes. Instead of showing Krishna here, the audience can experience Krishna's actions through the acting of the heroine.

This method is used very effectively in plays. Suppose the theatre is now the front of a house. Someone enters the scene from one side. You can only hear the dog's voice to signal that the dog is barking. Agathan takes a stick or an umbrella in his hand and prepares to hit the dog.

Another example is when two couples are conversing in one place and the audience can be convinced of what they are doing through the reaction of someone who is watching and listening to it in secret. All the couples need to do is listen to their conversations without being on stage and the actor on stage showing his gestures and movements accordingly.

Some events, whether in dance or drama, are more enjoyable to cover up and create an impression on the audience than to be staged or acted out. This style has been used in many plays written and directed by Thoppil Bhasi and N.N.Pillai in Malayalam theatre.

This style is also relevant in poetry. In the poem the disciple and son of the great poet Vallathol, Parashurama describes a scene of him walking towards Kailasa. The majesty of Parashurama is more beautiful than the direct depiction of the appearance and movement of the people standing in the path he was walking on.

The Chaturvidha Abhinayas in Natya and Nritta are all equally important. What makes these arts heartwarming is their apt performance. Angikas and Bhavabhinayas should be given priority as visual arts. It is not good to over emphasize vachika in a play. Most of the spectators who come to see the play come to the stage to watch the performance. If you can understand the story by listening only to the dialogue in these days of loudspeakers, you can go far away on the field and listen to the play. There should be more acting. In nritya, music and literature are the acting ground for the tree to take root. Abhinaya is the tree that gives the flower, its fragrance and sweet fruit to the meaning of literature. Acting and padhabhinaya is useless. It is enough for the audience to see the performance in their minds while listening to the song. It's more fun to listen to a song with emotion than to see a bad performance. Performing a dance without understanding the meaning of the song and the meaning it contains is not at all brilliant. Even if the dancers do not sing, if they can sing emotionally, the acting will be brilliant. That is the purpose of saying that music should be practiced along with dance.

## **Chapter 3 – Bhava – Rasa**

If you see a rose hanging with fragrance, it is rare for people to pass by without looking at it. If the girl sees it, she will break the flower and try to warm it in her hair. If a cow or a goat sees it, it will bite it. Stomach fullness is the main issue for animals. It is only man who enjoys seeing the beauty of not only the flower but all the scenery in nature. The man who does not enjoy it is like the cow mentioned above. A person who does not want to be taken aback when he sees a baby lying on the floor, smiling and shaking his limbs, and a person who shows discomfort when listening to music can be categorized as one of the above. The pleasure that comes from such scenes is beyond the reach of average person. When he shifts to other activities in life, the pleasure he got is lost. This is not a bad thing at all.

There are seldom in the society those who see the special scenery of nature and get emotional about it and keep it in their mind for a long time. Some of them will use their visions to lead a society that is going in the wrong direction. Others will recreate and present the joy that others have been able to experience for others to have. There are many people who create art for the sole purpose of entertaining others. Artists are few and far between, entertaining as well as thinking and pointing in the right direction. Their creations will last forever. Early poet's like Valmiki, Vyasan, Kalidasan, Ezhuthachan, Poonthanam, Melpathur, Bhattathiri, mediaeval poet's, Tagore, Kumaranasan, modern poets, all of them are artists as guides of the society.

## **Aesthetics**

We use the word in the sense of ordinary beauty. Beauty is the state of mind of the artist and the person who enjoys it. This is the reason for the happiness mentioned earlier. There is no beauty in an event that is the basis of a work of art. It can happen in the mind of the one who sees it. When one reaches that state one does not have to do artwork. If a person writes a poem, paints or songs about an event about an object without that condition, it does not rise as a work of art. There is only one description. When there is movement in the reader of the work of art, it also imparts an inherent look to it. That feeling rises to the level of enjoyment. It is the duty of the artist to convey to the reader of the beauty he has seen through his

work. There is no denying that beauty is art. There are those who argue that the aesthetic theory of Western thinkers is the same as the Theory of rasa of Indian thinkers. It is difficult to form a final opinion on this subject. In the state of mind that arises when one sees an object, there is something other than the appearance of the object. Keralapanini's caused great grief among Malayalam language lovers. Kumaranasan does not end his grief by crying. It paved the way for the creation of the lament of persecution. It is said that Ramanan was inspired to write by Changampuzha due to the grief caused by the death of Edappally Raghavan Pillai. From this it can be seen that when one emotion is received another state of mind arises. But this condition is not enjoyable. That can be made clear when discussing rasa.

## **Art**

Plato, a Greek philosopher, argues that art is an imitation of nature. Art is useless if it is just imitation. When nature itself is at the forefront, its imitation is unnecessary. Aristotle, a disciple of Plato, added that he did not agree with the Guru. The message of nature may not be understood by the common man. The artist is a creator in this sense that he embodies the message when he recreates it into the imagination of the artist and conveys it to the audience. A skilled artist will get more pleasure from the work than he gets directly from nature.

We do not have to be happy with everything we see and experience in our daily lives. Death of loved ones, the pity of children starving due to poverty, the human mind hurts from the cruelty inflicted by a cruel neighbour. When someone who looks at these events with sympathy will also have grief. Who accepts and sees the consequences of these evil deeds is suffering. But when we read these events in a story, we are enjoying the sadness. When we read the lament of Kuchela's wife who is suffering from poverty, we feel sadness on an enjoyable level. The events of life are the subject of the artist. Literature, music, dance, film etc. are different media of art. The mentality of the artists who are the creators of all this has not changed. Every artist thinks that others should feel the same way they feel in an event. The only difference is the medium they adopt.

In normal life we may have seen the grief that mothers feel when their grandchildren die. There will be sharing in their grief. Vylloppilly portrays the intense grief of a mother weeping over her dead baby when she first sees a mango ripen from a tree in the yard, in the poem 'mambazham'. There are few Malayalees who do not enjoy reading it. We would love to read that poem again and again. We are the ones who bear the sorrow of Sita in the Ramayana like this. Whatever from the story takes, the audience will still love it.

There will be no one who does not see the flowers falling and crying. When he saw such a falling flower, a poem formed in the mind of Kumaranasan, who was saddened by its fate. Veena poovu depicts a vision of life likened to a flower that is about to join the scorched earth.

## **Rasanishppathi**

'Rasa is the quality that makes for understanding between the artist and the spectator. On a literal level, 'rasa' means that which is being tasted or enjoyed.

In 6<sup>th</sup> chapter of 'Natyasastra', the author Bharata says in Sanskrit:-

“vibhavanubhava vyabhichari

Samyogath rasa nishpathi”

That is, by the combination of Vibhava, Anubhava, Vyabhichari bhava, a rasa is born.

Just as people after eating a sumptuous meal constituting of masalas (condiments), rice and other ingredients experience the taste of 'rasa' and feel happy and satisfied, so also people after experiencing or tasting the sthaya bhavas and other become full of joy and satisfaction, this, then is called Natyarasa. Some people are of the opinion that 'rasas' and 'bhavas' arise from their union. But this is

not correct, because 'rasas' are born out of bhavas, but bhavas are not born out of rasas. It is for this reason that the origin of rasas are called bhavas.

Just as a mixture of masala, vegetables, jaggery etc. create a taste of rasa, so also a combination of sthayibhavas and other bhavas create a rasa hence, there is no rasa without sthayibhava and there is no sthayibhava which does not give rise to rasa. And so, the union of sthayibhava, vibhava, anubhava and vyabhichari bhavas give rise to rasa.

## **Vibhava – Anubhava**

Vibhava is the cause or reason or motivation. Vibhava is called so since through it the representation of speech, body gestures and mental feelings are expatiated. There are two types of Vibhavas.

1. **Alambana Vibhava** – It is the chief cause for the origination of Bhava. The evoking of emotions by the died of an object or person can be termed as the 'alambana vibhava'.

Eg:- The joy caused by the seeing of the lover by the beloved is alambana vibhava.

2. **Udippana vibhava** – These are the objects that excite the emotions, such as qualities, actions, decorations and environments.

Eg:- Incidents, the beauties of nature, the encouragement of friends etc.

'Anubhava is that which results by words and 'Angabhinaya'. It is the resultant of Vibhava. This is the expression of the emotional feelings, sentiments felt by the person embedded in the mind.

## **Sthayi Bhava**

Sthayibhava can be termed as the origin of drama from which rasa is originated. Emotions that are being stable and universal can be termed as 'sthayibhavas'.

Vibhavas, Anubhavas and Vyabhichari bhavas become subservient to the sthayibhavas. The sthayiens become chief since others are dependent on them and the vyabhicharians are like their subordinates. Under the particular sthayi, the other bhavas assume a subservient attitude and these sthayiens become sentiments in turn and the vyabhicharians become ancillaries that is the sthayiens coming in conjunction with vibhavas, Anubhavas and Vyabhichariens get the name of rasa.

Natyashastra says that – just as a good taste is produced by the mixing of different spices, medicinal herbs and other articles, “just as a confectionary taste is produced by the processing of other articles along with the spices and herbs, the different sthayibhavas become rasas when they combine with the different bhavas” i.e, it diterminents, consequence and transitories.

It is noticed that the emotions culminate in the productions of sentiments. As the spices in the combination with the different articles help to produce the dish, the bhavas help the production of rasa with proper gesticulations and representations. There is no rasas without the accompaniment of bhava, nor there is any bhava devoid of rasa. There are eight sthayibhavas in number. They are Rati(love), Utsaha(energy), Soka(sorrow), Hasa(mirth), vismaya(wonder), Bhaya(fear), Jugupsa(disgust) and Krodha(anger).

Some people include 'Sama' as the nineth sthayibhava corresponding to 'Santha' the nineth rasa.

## **Sanchari bhavas or Vyabhichari bhavas**

'Vy' and 'Abhi' are prefixes, these are added meaning 'towards'. Root 'char' means 'to move'. Hence, those which lead different object or ideas towards rasa are called 'Vyabhicharians'. Here, it may be asked:- 'how do they lead?'. The answer is – it is well known from the world that, the sun leads this day or star. He does not carry by his arms or by his shoulders. Still it is said in this world that the

sun leads the star or the day. Thus these carry forward the performance and are to be designated as 'Vyabhicharians'.

1. **Nirveda**(discouragement) – Among women and people of low dispositions, self disparagement is produced. The determinants like poverty, insult, abuse, shouts, separation from dear ones etc. It should be represented by ensuants crying, singing, heaving, deliberation etc.
2. **Glani**(weakness or debility) – The feeling of debility is generated by the determinants like vomiting, ailments, penance, drinking of liquor, over exercise, too much of travel, hunger, thirst, absence of sleep etc. It should be represented by the ensuants like feeble utterance, pale cheek, slow steps, change of colour, learn etc.
3. **Sanka**(apprehension) – It is caused by determinants like doubt, symfull activity to the ruler etc. It should be represented by gaze, hesitating movement, dryness of mouth, licking the lips, change of face colour.
4. **Asuya** (envy) – The feeling called envy, generated by vibhavas like hatred, other people wealth, good luck, intelligence, erudition etc. This is to be represented by anubhavas such as fault finding before an assembly, the decrying of qualities, bending the face, abusing others etc.
5. **Mada**(intoxication) – It is caused by drinking of liquor and such other things. Intoxication is of three kinds- Taruna(youthful), Madya(medium) and Avakarishtha (lowly). The inebriated fellow sings, weeps, laughs, speech, harsh words or sleeps
6. **Sama**(weariness) – It results from long journey and from physical exercise etc. It should be represented by ensuants like gentle message of the body, singing, yearning, slow walk, contraction of the eyes etc.
7. **Alasya**(indolence) – It is caused by determinants like natural disposition, signess, satiety, pregnancy. It should be represented by browsiness, absence of interest in all kinds of activities, sitting idle etc.

8. **Diana**(depression) – Depression is the result of poverty, mental agony, bad luck etc. It is represented by consequents like unhappiness, head ache, paralysis of limbs, mental imbalance, unclean body etc.
9. **Chinta**(reflection or anxiety) – Reflection is produced by the determinants like loss of prosperity, theft of a dear object, poverty etc. It should be represented by ensuants like deep size, heaving, meditation, thinking with a downcast face etc.
10. **Moha**(distraction) – The feeling of distraction produced by vibhavas like cruel stroke of face, affliction, disease, fear, remembering past hatred etc. It should be represented by anubhavas like loss of consciousness, falling down, reeling, loss of sight etc.
11. **Smriti**(recollection) – Recollection is the nature of remembering the feeling experienced in pleasure and misery. It is caused by determinants like ease, loss of sleep in the previous night, thinking etc. It is represented by ensuants like nodding, looking down, raising of eyebrows etc.
12. **Driti**(contentment or equanimity) – It is caused by determinant like courage, knowledge, proficiency in Vedic, large wealth, cleanliness, piety, pass time etc. It should be represented by the enjoyment of whatever acquired and desisting from worrying over what has not been obtained.
13. **Vida**(shame) – This is generated by the determinants like humiliation, repentance, inability to fulfill one's pledge disobedience to teachers etc. It should be performed by ensuants like hiding the face, bending the heads, drowing lines on the ground, biting the nails, twisting and touching of the clothes and ring etc.
14. **Chapalatha**(inconstancy or unsteadiness) – The feeling is generated by vibhava like passions, hatred, rivatry, anger, jealousy, opposition etc. It is represented by ensuants like harsh words, rebuke, thrashing, killing, imprisoning, fighting etc.
15. **Harsha**(joy) – It is caused by vibhavas like attainment the desire, meeting with dear ones, mental happiness, receiving food, clothing, money and

enjoying them. It should be represented by the brightness of the eyes, Nidra and face, speaking of agreeable words, embracing, horribitating, tears, perspiration etc.

16. **Avega**(agitation, flurry) – The feeling called flurry by vibhavas like wind or rain, fire, mad, rest of elephants in rut, hearing of good or bad news, lightning, thunder etc. It should be represented by the loosening of all the limbs, mental distraction, loss of facial colour, wonder etc.

17. **Jadatha**(stupor, stupefaction) – It is produced by the vibhavas like hearing and seeing of disirable and undisirable objects, sickness etc. It should be represented by not replying, misrepresenting, keeping silence, becoming helpless etc.

18. **Garva**(arrogance) – It is caused by determinants like kingship, noble birth, charmingness, youthfulness, education, power, wealth etc. It is represented by ensuants like jealous, disrespect, disregard, refuse to answer, not greeting others, looking at one's own limbs, use of harsh words, insulting others etc.

19. **Vishada**(despair, despondency) – It is caused by determinants like inability to finish work and accidental calamity etc. It is represented by ensuants like looking for alies, loss of courage, absent mindness, deep breathing etc.

20. **Matsuyama**(impatience, curiosity) – These feeling is produced by the vibhavas like the recollection of the separation from the dear ones, sight of a good scene etc. It should be represented by the ensuants like deep breath, thinking with down cast face, sleep, desire for lying down etc.

21. **Nidra**(drowsiness) – It is produced by vibhavas like physical ability, fatigue, intoxication, too much eating etc. It is represented by ensuants like gravity of the face, massaging of the body, rolling of the eyes, yawing, streching of the physical pain, laziness, shrinking of the eye etc.

22. **Apasmara**(epilepsy) – This is a kind of madness. It is caused by the determinants like the possession of the spirits of super human power such as an evil deity, Yaksha, Naga, Rakshasa, Pisacha, living in an haunted house,

untimely journey etc. This should be represented by anubhavas like jumping, running, falling down, sweating, paralyzing, foaming, in the mouth.

23. **Supta** (dreaming) – The feeling of dreaming produced by the determinants like enjoying objects of senses, lying down ground or mattresses by stretching or contracting the body. It should be represented by snoring, dullness of the limbs, closing the eye limbs, feeling of weakness to all senses, talking in one's sleep etc.
24. **Vibodha**(awakening) – It is produced by vibhavas like digestion of food, break of sleep, evil and bad dreams, loud noise, sensitive touch etc. It is represented by ensuants like yawning, rubbing of the eyes, getting up from the bed etc.
25. **Amarsha**(intignation) – It is caused to persons who are abused or insulted by their superiors in learning in wealth, and in power. It should be represented by the anubhavas like shaking of head, perspiration, looking down, thinking, meditating, searching for means of help etc.
26. **Avahitha**(dissembling) – It is generated by the vibhavas such as shame, defeat, greatness, cruelty. It should be represented by ensuants like misrepresentation of facts, change of topic of conversation etc
27. **Ugrata** (fierceness, sternness) – This feeling is produced by the vibhava like detection of the thief, doing offence to the king, speaking ill of others etc. It should be represented by ensuants like killing, arresting, beating, rebuking etc.
28. **Mati**(assurance, resolve) – It is caused by determinants like assurance, the knowledge of the sasthanas etc. It should be represented by ensuants like clearing of doubts, pointing out, variations etc.
29. **Vyadhi** (sickness) – It is caused by determinants like wind, cold, thirst and bodily ailments. It is represented by ensuants like shivering due to fever, tremor of entire body, bending the body, shaking of jawse, dryness of mouth, horriculation etc.

30. **Unmada**(insanity, madness) – The feeling of madness is produced due to vibhavas like the separation from the dear ones, loss of wealth, injury as a result of beating, viciation of the three harmones – wind, bike etc. It should be represented by anubhavas like laughing without any cause, crying, lying down, reclining, dancing, singing, throwing up ashes, sand, dust etc.
31. **Marana** (death) – This came through sickness or by accidental injury. The determinants from sickness are intestinal malady, malady of the liver, fever, colera etc. It is represented by ensuants like closed eyes, looking for family members etc. Death due to accidental injury is caused by determinants like injury due to weapons, snake bites, taking position due to the attack of wild animals etc. It is represented by ensuants like falling down on the ground, development of poisonous symptoms, tremor, burning, sensition form from the mouth, paralisis, death etc.
32. **Trasa**(fright, alarm) – The feeling called alarm is produced by the vibhavas like lighting, fall of a comet, strike of a thunder bolt, roaring of the wild animals etc. It should be represented by anubhavas such as contraction of the limbs, shuddering, getting shocked, incoherent talk etc.
33. **Vitarka**(deliberation) – This feeling is generated by vibhavas like deliberation contemplation, improbability etc. It is represented by various anubhavas like various discussion, rising of eyebrows and head etc.

## **Rasa**

In dance and dramas there are eight ‘rasas’ These rasas are created by Brahma and they consists of ‘Sringara(the erotic), Hasya(comic), Karuna (pathetic), Raudra(furious), Veera (heroic), Bhayanaka(odious) and Athbutha(marvellous). Apart from these rasas, there is nineth rasa – Santha. This nineth rasa Santha is Bharata’s contribution.

There are four rasas which are considered as basic they are Sringara, Raudra, Veera and Beebhatsa, and the others Hasya, Karuna, Athbutha and Bhayanaka are derived from the former four. That is from Sringara, the rasa Hasya is generated, from Raudra comes Karuna, from Veera comes Athbutha, and Beebhatsa generates the rasa of Bhayanaka.

Certain colours have been specified for the artistic representation of these rasas. Green is used for Sringara, red for Raudra, wheatish brown for Veera, blue for Beebhatsa, white for Hasya, grey for Karuna, black for Bhayanaka and yellow for Athbutha. To give further significant both ritualistic and godly, these rasas are sent to have presiding deities, namely Vishnu for Sringara, Siva ganas for Hasya, Rudra for Raudra, Yama for Karuna, Indra for Veera, Mahakala for Beebhatsa, kama Deva for Bhayanaka and Brahma for Athbutha.

**1. Sringara** – The sentiment of Sringara (erotic) has its origin from the permanent mood called ‘rathi’(love). Whatever we see in the world that is pure and radiant is known as Sringara. Sringara is related to men and women and exists in bright young. That is this refers to the love between man and woman, and its consequences. A much deeper sense is actually conveyed by this term. The meaning of this term Sringara is beauty, soundarya. That is why Sringara lahari is also known as ‘Soundarya lahari’.

The beauty in man is love and this love is what distinguishes man and makes him supreme in all creation. Hence love is beauty. That is Sringara is truth and naturally, it is considered to be the king of rasa. It has got two bases – Sambhoga Sringara and Vipralambha Sringara.

- **Sambhoga Sringara** – It is generated by the vibhavas like the pleasant seasons, garlands, ornaments, people dear and near, sensual objects like music, good houses, enjoyment of pleasure visit to gardens, experiencing, hearing and seeing things of pleasure and so on. This should be represented with the dexterious movements, sweet dispositions and agreeable words. The vyabhichari of this are those thirty emotions except the three – alasya, ugrata and Jugupsa.

Sambhoga Sringara is again divided into Samkshipta and Sampanna. Samkshipta Sringara is shown by the Satvika bhavas and shyness. Sampanna Sambhoga is the reunion after separation and all the full expression of love.

Union is the blissful state in which the two playful lovers in complete agreement with each others and enjoying, seeing and touching each other etc.

- **Vipralambha Sringara** – The variety called love in separation is to be represented by the transitory feelings of Nirveda, Glani, Sanka, Asuya, Srama, Chinta, Autsukya, Avega, Bhaya, Visada, Dainya, Nidra, Supta, Vibhodha, Vyadhi, Unmada, Apasmara, Jadatha, Moha and Marana.

The rasa prakarana divides Vipralambha into two: Ayoga (love in privation) and Viprayoga (love in separation). Ayoga Vipralambha is a state of the heroine before meeting the beloved. This is seen in 'Mugdha Nayika'. For example, Parvati's love for Siva or Rukmini's love for Krishna before marriage. Ayoga Vipralambha can be shown in several ways, the main being ten:- Abhilasha (desire to hear or see the beloved), Chinta (anxiety as to how to fulfill the desire), Smriti (recollection), Guna kadha (praise of the beloved's good qualities, virtues etc.), Udveg (distress), Pratap (vaiving), Unmada (madness), Samajvara (love fever), Jadatha (stupor), Marana (death).

Viprayoga is of two kinds – separation arising from absence and separation arising from resentment. Separation due to absence is known as Pravasa. It is seen in the heroine called Proshita Bharthruka or Proshita priya. It is the state of two lovers at different places due to business, confusion or curse. Separation arising from resentment is the mood of anger caused by separation between lovers who do not desire to see it or embrace each other. It is of two kinds – Pranaya mana or Pranaya kopa and Irshya mana. Pranaya mana is shown by silence, because of anger and turning the head a side. Irshya mana is shown by abusing, apprehension, turning the face away, tears and impatience.

**2. Hasya** – The comic statement is born out of the permanent or dominant mood called Hasa (mirth). It is generated by the determinants such as Vikrataparavesa, Vikratalankara, Dharstya, Laulya, Kuhaka, Asatpratapa, Vyangadarsana and Dosodaharana. It should be represented by gestures like Osthaspandana (twitching of the lips), Nasaspandana (trembling of the nose), Kapotaspandana (throbbing of the nose), Dristivyakosa (opening and closing of the eyes), Drustyakuncana (contraction of the eyes), Aasyaraga (colour of the face) and Parsvagrahana (pressing of the side). The transitories of this

sentiment are Alasya (indolence), Avahitha (dissembling), Srama(weariness), Supta(dreaming), Vibodha (awakening), Asuya (envy) etc.

This comic sentiment is of two kinds. Atmasta(based on oneself and Parasta(based on others). When one laughs at oneself it is called Atmasta and when one makes others laugh it is called Parasta. There are six varieties of laughter. They are:-

- **Smita**(slight smile) – It should be shown by the swelling of the cheeks, graceful, glances and without showing the rows of teeth.
- **Hasitha**(gentle laugh) – It should be shown by full blown cheeks, eyes, face and showing slightly the line of teeth.
- **Vihastha**(laughter) – It should be shown by the slight contraction of the cheeks and eyes, sweet, gentle sound and make appropriately in time with change of the colour of the face.
- **Upahastha**(ridicule) – It should be shown by the expanded of nose, contracted and closed eyes and by bending the shoulders and the head.
- **Apahastha**(moking) – It should be shown by the eyes which are tearful love noising laughter and hands holding on to the sides (at the hip).

Of these Smita and Hasitha are for the superior type of character Uthama, Vihastha and Upahastha are the characters of middle class Madhyama, Apahastha and Adhastha are the lowest type of people, Adhama.

**3. Karuna** – The sentiment of Karuna(pathos) is generated out of the Permanent mood called Soka(sorrow). It is produced by the determinants like the separation from dear ones and relatives, loss of wealth, loss of life, imprisonment, flight, misfortunes etc. It should be represented by the ensuants like asrupta(shedding of tears), paridevana(lamentation), mukhasoshana(parched throat and mouth), vaivarnya (paleness), swarabedha (change of voice), srashtagatra(drooping of limbs), niswasa (singing) and smriti lopa(loss of memory). It's transitory feelings are – nirveda, glani, chinta, autsukya, avega, moha, Srama, vishada, dainya, vyadhi, jadatha,

unmada, apatsmara, trasa, alasya, marana. It's Satvika bhavas are stamba, vepadhu, vaivarnya, asru and swarabhanga.

Karuna rasa also arises from the sight of the murder of the dear one, or from the hearing of the unpleasant words. This should be represented by the actions like crying aloud, lossing consciousness, lamenting and weeping bitterly and also by physical torture and beating one's chest. Karuna the pathetic sentiment is of three kinds:-

- Produced due to the damage of one's virtue(dharmopagataja)
  - Produced by the loss of wealth
  - Produced by the death of relatives
- In the three, the first one is Uthama and the other two are of Madhyama and Adhama.

**4.Raudra** – The sentiment called Raudra (the furious) is produced out of the permanent mood Krodha(anger) and it usually takes its origin in Rakshasas, Dhanavas and very hot human beings resulting invariably in battle. It is generated by the determinants like Krodhakarshana(to pull away in anger), adhikshepa(abuse), apamana (insult), anrithavyachana(uttering false food), Upagatha(striking of household servants and the like), Vakprishya(use of harsh words), adhidroha(decide to kill) and mathsarya (jealousy). The actions by which it is represented are like thadana(beatng), pattana (tearing), peedana(harrassing), chethana (cutting), praharana (striking), adharana(putting away), sashtra sampatha (striking with weapons), sampraharaha(woonding with weapons), ruthirakarshana(shedding of blood) and so on. Further it is to be represented by the ensuants like rakthanayana(making the eyes red in anger), brukuthikarana(knitting of eyebrows), avasthambha(show of hotiness), dhandoshtapeedana(biting of the lips), gandhasfurana(throbbing of the cheeks), hasthagranispesa(crushing of the palms mutually), transitories of the sentiments are vibhoda, avega, amarsha, chapalatha and garva. It's satvika bhavas are Romancha, Sweda, Vaivarnya, Vepadhu and Asru.

Thus the sentiment of Raudra is seen in as produced by fear words, actions of limbs etc. and full of terrible activities like the weilding of weapons and cruel actions. Raudra is of three kinds – the Raudra by words(vak), by makeup (nepadhya) and by limbs(anga).

**5.veera** – The sentiment of Veera (heroic) is born out of the permanent mood Uthsaha (energy). The heroic sentiment is connecting with the people of superior in positions and is characterised by energetic enthusiasm. It is produced by the determinants like asamoha(composure), adhyavasaya(deligents), Naya(good tactics), vinaya(humility), parakrama(valuar), sakthi(power), prathapa(agrashan) and prabhava(prowess). It should be represented by the ensuants like sthyrya(firmness), dhyeya(bravery), saurya(heroism), thyaga(renunciation) and vaisaradhya(proficiency). The transitories of this sentiment are dhrithi, mathi, garva, avega, ugrata, amarsha, smriti and vibhoda. Veera rasa admits of three types:-

- **Dhana Veera** (the munificent one) – The person who has become Veera by Dhana or giving gifts is termed as Dhana Veera. This person will be ready to part with any precious thing for the sake of others. Eg – Karna.
- **Daya Veera** (dharma Veera, the pious) – The person will be sympathetic to all irrespective of class or creed. He will be kind to his own people as well as to strangers. Eg – Yudhishtira.
- **Yudha Veera** (the fighting one) – The person will be very courage, bold and brave. Fighting in war front will be his own aim without the fear of death. Eg – Arjuna. It's satvika bhavas are Sweda, horriculation, vaivarnya and swarabhanga.

**6. Bhayanaka** – The sentiment called bhayanaka is born out of the permanent mood bhaya. It is generated by the determinants like the sight of cruel animals with strange and terrific noise as Jackals, howls etc. An empty and hounded house so journ in a secluded forest, sight of death or captivity of dear one's , or the news of it or discussions about it etc. It should be represented by the actions like troumbling of hands, feet, eyes etc. and raising of the hairs or limbs out of fear. Other ensuants in this connection are Mukha vaivarnya, swabedha. The transitories of it are jadatha, sankha, moha, dainya, avega, chapalatha, trasa, apasmara and Marana. It's satvika bhavas are stamba, Sweda, romanacha, swarabedha, vepadhu, vaivarnya, asru and pralaya.

The Bhayanaka rasa is of three types- Vyaja, Aparadha and Vithrasithaka.

**7. Beebhatsa** – The sentiment of Beebhatsa (odious) is generated from the permanent mood called Jugupsa (disgust). The determinants of this sentiments are the hearing and seeing of ahridya, apriya, achoshya and anishta. Hearing about these things and speaking about them also come contribute to the generation of this sentiment. The ensuants through with this is to be represented are savangasamhara, nishthivana, udvejana etc. The transitories of this feeling are apatsmara, avega, moha, vyadhi and marana.

The sentiment called Beebhatsa is also generated by seeing what is unfavourable and due to the state of agitation caused by fawl smell, bad taste and unfavourary touch. It should be represented by actions like the contraction of the face and eyes, covering the nose by fingers, bending the face and moving with gentle steps. Beebhatsa is of three kinds- Sudha, Udvegi and Kshobhana.

**8. Athbutha** – The sentiment called Athbutha has its origin from the permanent mood Vismaya. The determinants of this are Divyajanadarshana, Ipsitavapti, Manorathavapthi, Upavanagama, Devalayagamana, Subhadarshaba, Vimanadarshana and Mayendragala sambhavana. It should be represented by the ensuants like Nayana visthara, Animeshaprekshana, Harsha, Sadhuvada, Danoprabandha, Hahakarana and Bahuvadanchelanguri bramana. The transitories of this sentiment are Avega, Hasha, Chapalatha, Unmada, Drithi and Jadatha. It's Satvika bhavas are Sthamba, Swetha, Romancha, Asru and Pralaya.

Athbutha is of two types – Divya and Anandaja. Divya Athbutha is one caused by same desteral actions or sights and Anandaja Athbutha is resulting from joyful deeds or sights.

**9. Santha** – The sentiment of Santha is generated from the permanent mood called Sama and it leads to freedom from all wordly desires and actions. Thd determinant for the sentiments are Tattvajana, Vairagya and Asayasudhi. The ensuants by which this sentiment is to be represented by Yama, Niyama, Adhyatmadhyana, Dharana, Upasana and Sarvabhutadaya. The transitories of this

are stated as Nirveda, Smriti, Drithi and Mati. It's Satvika bhavas are Sthamba and Romancha.

The sentiment of Santha has been enumerated by the yogies as that which is leading to imanicipation by the real knowledge of the supreme self. Santha rasa is that state in which all creatures find pleasure. Budhindriyas and Karmendriyas are closed when the real knowledge of the supreme self is realised.

## **Nayaka and Nayika Bhava**

In the depiction of different moods and sentiments Bharathanatyam repertoire takes recourse to the medium of Nayaka and Nayika, who are referred to as hero and heroine in common parlance.

Varnams and Padams are replete with episodes portraying the love – lorn Nayikas pining for the Nayakas or the romantic moments they spent together or the jealousy of the Nayika for the other woman in the Nayaka's life. Quite often the Nayikas may be Gods and deities and the Nayikas, the female devotees who fall in love with them. Cupid plays an important role in the Nayaka-Nayika relationships. It is very interesting to note that our sages had such deep and analytical knowledge of the romantic aspects of the Nayaka-Nayika relationships and of their unique behaviour depending on birth, character and feelings that they could bring out such details vividly.

In the Indian dancing the dancer is the devotee separated from her beloved. She expresses every mood of a woman who yearns for her lover. She is the eternal Nayika.

## **Classification of Nayikas**

The Heroine or Nayika is supposed to be the wife or lover of the Nayaka.

Classification of nayika according to birth:

- **Divya** – She is of divine origin or possessing divine characteristics.
- **Nrupathnee** – A royal consort.
- **Kulasthree** – Of noble birth, belonging to respectable family.
- **Ganika** – A courtesan.

## Sringara Nayikas:

They are called as Sringara Nayikas or those who experience the Rasabhava. They are

- **Sweeya:** She is a woman who is upright and has good character. She is one who loves only her husband and none another. She is of three types.
  - i. **Mugdhaa** – She is tender, youthful young. She is a girl who is unable to give expression to her ideas, shy in love, gentle in anger and silent eventhough offended. Mugdhaa Nayika is further divided into two types:
    - **Gyata Yauvana** – One who is aware of men and their characters.
    - **Agyata Yauvana** – Youth without such knowledge.
  - ii. **Madhya** - A young wife who has tasted her husband's love ad who possesses love and shyness in equal measure and intoxicated by her husband. This Nayika is further divided into three types.
    - **Dheera** – This Nayika greets her deceitful lover with sarcastic words and indirect comment.
    - **Adheera** – This Nayika scolds her lover harshly.
    - **DheeraAdheera** – This Nayika rebukes her lover tearfully.
  - iii. **Pragalbhaa** – She is mature and passionately in love with her husband. She is a woman in her full beauty able to express fully her sentiments. This Nayika further divided into three types.
    - **Dheera** – She is constant. She is indifferent towards love due to anger yet respectful towards the lover.
    - **Adheera** – She shows her feelings towards the lover by putting him to shame, by hurting and by anger.

- **DheeraAdheera** – She vexes her lover by sarcasm when indignant.

The three types of Dheera, Adheera, DheeraAdheera heroines are again divided into two.

- **Jyeshtha** – The older and loved more by the Nayaka.
  - **Kanishta** – The younger one.
- **Parakeeya** – A disloyal woman one who is attached to a man other than her husband or lover is called Parakeeya. She is of two types.
    - **Kanya** – Maiden
    - **Praudaa** – Matured and married
  - **Saamaanya** – A woman who is a courtesan or public woman well – versed in the arts, possessed of boldness and seeking to better herself through her lover’s attachment.

## Ashta Nayikas:

Bharatamuni classified the Nayikas into eight categories according to their characters and emotional states or moods. They are called Ashta Nayikas. They are:

- I. **Vaasakasajjika** – A heroine who is ready to receive her lover and decorates herself and the room or place.  
**Her activities:** she adorns herself, dresses pleasingly, arranges the bed of flowers in the lover’s room, keeps looking out from the threshold of her house and is playful with her sakhi who tease her.
  
- II. **Virahotkandita** – The heroine in distress due to the non-arrival of her lover.  
**Her activities:** She shows distress, she trembles, she gets exhausted, discontented, tearful and expresses her anxiety to her Sakhi . This heroine is also called Uthkata, Uthkaa and Uthkanditha.

**III. Svaadheenapathika** – A heroine whose husband is devoted and faithful to her and who tends to please her in every way.

**Her activities:** She worships the God of Love for her lover.

**IV. Vipralabdhaa** – Nayika to whom the lover sends, with confidence a message appointing the time and place of their meeting, but ultimately disappoints her.

**Her activities:** she is disappointed, anxious, sorrowful, depressed and tearful, sighs and faints.

**V. Khandithaa** – Heroine who is infuriated on seeing on her husband the marks of enjoyment of another woman.

**Her activities:** She breaths deeply, is indifferent, fearful, sorrowful and restless and speak words of abuse.

**VI. Kalahaantharithaa** – The heroine who abuses her husband in anger and repents later.

**Her activities:** She sighs deeply and is sorrowful and restlessly wanders about, lamenting her wilfulness.

**VII. Proshitabharthruka** – A heroine, who suffers the separation from her husband, who is in a distant land.

**Her activities:** She is sleepless, restless, neglects her personal appearance, inactive and pines for her husband, and she counts the days for his return.

**VIII. Abhisarika** – The heroine who goes out to meet her lover with passionate feelings or one who acts overtly to get to her husband.

**Her activities:** She is anxious and feels harassed according to circumstances.

## Classification of Nayakas

The hero is one who has reputation and powers, blessed with righteousness (dharma), desire (kama) and wealth (artha) and is a good administrator.

The hero is one who is humble, sacrificial, expert, sweet conversationalist, popular, pure, stabilized, intelligent, enthusiastic, well-versed in Sastra, patroniser of fine arts, courageous, determined, religious and has sharp memory.

There are four types of heroes:

- **Dheerodhaatha** (brave and noble) – The frivolous or light hearted possessing self control.
- **DheerodhDhatha** (brave and haughty) – The vehement one with self control.
- **Dheeralalitha** (brave and firm, good matured) – The exalted and esteemed one with self control.
- **Dheerashaantha** (brave and calm) – The quiescent one with self control.

## Sringara Nayaka (erotic hero)

The erotic hero is one who forms the supportive determinant for love. They are Pati, Upapati and Vaishika. Their corresponding heroines are Sweeya, Parakeeya and Saamaanya.

- **Pathi** (husband) – A hero married according to Vedic rites. He leads a life in accordance with righteousness, wealth, desire and moksha. He will be highly respected by his wife, parents and the entire society. Eg- Sri Rama.
- **Upapati** – He is a hero who indulges himself in love affairs. Eg- Sri Krishna.

- **Vaishika** – A lover of loose virtues who hires lovers. Eg – Kovalan.  
The Nayaka have been further classified according to their character into four types namely,
  - a. **Anukoola** – He is a faithful Nayaka. He will be an ideal, comforting, understanding and loyal husband. He will be sincere and truthful to his wife. He will try to please his wife in all respects.
  - b. **Dakshina** – One who is impartial. He has several wives and treats them all impartially by speaking with tenderness to all so that no one can find fault in him.
  - c. **Shata** – One who is an unreliable, deceitful and rakish lover.
  - d. **Dhrshta** – One who is shameless. He is not faithful to his wife and secretly does her harm.

## **Sakhee :**

The friend of the heroine who is trustworthy and accompanies her is called Sakhee. The Sakhee, who is a prominent character in Nayaka-Nayika concept, acts as mediators to hero and heroines.

Their activities according to Sringara Manjari and Rasamanjari are: Decoration (mandana), Criticism (upaalamba), Instruction(shiksha), Teasing (parihaasa), Praise (prashansa), Entertainment (vinodha), To humiliate (maanaapanodha), To advocate self-respect (maanopadhesha), Listening to and questioning her feelings (aashayaprashna), Consoling(viraahaashvaasa).

And accompanying the heroine in games such as those in forests, ponds and tanks, swinging, doll games, ball games, hide and seek, intoxication, gathering flowers and other pleasant games.

## **Dhoothee:**

A woman who helps Nayaka and Nayika through conveying messages, pleasing her Nayika or Nayaka by assuming activities or songs, dance and music is called Dhoothee. She is very intelligent

and we'll versed with the current affairs of the country and time. Dhoothees assist their Nayaka-Nayika by all the means.

According to Amoda, a Dhoothee or messenger is one who is skilled in conveying the messages. She can be: Friend (sakhi), Neighbour (prathiveshini), Maid-servant(shaadi), Daughter of foster mother (daathreyee), Make-up artist (linginee), One who couples hero and heroine (svaa), Attendant(kaaru), A female ascetic(yoginipravrajitha), Beautiful woman brought to her(shilpinee), Relative (sambandhini), Skilled in singing, dancing etc.(natee), A female fortune-teller(viprashnikaa), A girl who is unaware of love (baalaa).

## **Nayaka Sahaayaah(Companions of the hero)**

The companions of the hero are those who support and assist him in accomplishing his goal. They are five types.

1. **Narmasachiva** – One who accompanies the hero in sports and ministerial duties; he is trust worthy friend of Sringara Nayaka. He is very close to Nayika also and pacifies her anger towards Nayaka.
2. **Vita** – one who is well-versed in the art of erotic.
3. **Vidhooshaka** – One who makes people laugh by his gestures; he consoles Nayaka when he is depressed or sad in love.
4. **Peettamardha** – One who pacifies the angry heroine.
5. **Chettaka** – One who arranges to bring the hero and the heroine together.

## **Chapter 4 – Angika Abhinaya**

Although gestures are performed face to face, all the organs of the body must be involved in the performance in order to fully express the meaning and expression of the lyrics. Not all words in a language can have meaning just by showing hand gestures. Gestures without gestures are as lifeless as puppets. In real life, when we have a bhava in mind. The angas themselves move accordingly. When there is fear, the body experiences movements such as shaking, wrinkling, making noises and stagnation. It is common for the movements of different individuals to have the same substance that causes the expression. When you see a joke in a play or a movie, there are those who burst out laughing and those who express only happiness on their faces. Facial expressions are less numerous. The body movements are numerous. These movements are used for dancing and acting. There are different movements in each dance form. Some specific movements seen in one system may not be seen in another. If you look at it this like this, you can see thousands of different movements in every dance form in the world.

In the text Natyashastra, body movements are discussed in detail. The movements used for acting and dancing is differentiated. Not only the movements of the major limbs such as hand, leg, head but also the thighs, back, shoulders and lateral abdomen, which do not have the same freedom of movement, are characterized by movements. These movements suggest which acting can be used. Symptoms and uses refer to images that can be created by flexing and straightening the fingers in a variety of ways. The essence is that a comprehensive study of the angachalanas itself has been done in Natyashastra.

In Nandikeshwara's Abhinayadarppanam after Bharata, the symptoms of limb movements were reduced to head, neck and eyes only. The number of hasta mudras suggested in the bulk Natyashastra determined the form and use of the greater number. The condition of the body is not determined by the full acceptance of the Natyashastra. The more varied movements were designed in such a way that they could be used for dancing. In Natyashastra the symptoms of many movements are vague and numerous. But Abhinayadarppanam are written in such a way that the movements are easy learn, remember and apply.

Nritha hastas described in Natyashastra, rechakas, Charis, karanas, angaharas etc. Nandikeshwara did not touch. He must have thought that all the special movements of the dances performed in the respective countries should remain the same. Bharathanatya mudras, their uses and other performances are based on Abhinayadarppanam.

Angalakshanas, mudras and acting given in this chapter, which explains about acting are based on Abhinayadarppanam. Some have been taken from the Natyashastra for comparative study. Tamil texts written in recognition of Abhinayadarppanam have also been used for writing this chapter. The book 'Abhinayavaneetham' explains how an actor performs using a mudra. The instructions and the impressions made in the Guru are aptly given in the chapter. The angas are divided into three:-

- Angas – These are the limbs that are more flexible and more commonly used in dance and acting. Angas are six, with the head, arms, hips, sides and feet. In some texts the fingers are added as the seventh Anga. A hand is not a picture of a hand without fingers. Fingers are the basis of everything shown by hand. So the fingers do not have to be used in another organ.

- Prathyangas – These are the organs that do not have the same importance and freedom of movement as the angas, but support the movement of the angas. Prathyangas are of six they are Arm, neck, wrist, thighs, knees and shoulders. There are also those who include the wrists, ankles and back. The wrist and ankle are the joints of two angas. When the chest, abdomen and side effects move, the movement of the back will occur automatically. So there seems to be no reason to add these three organs together.
- Upangas – Facial organs fall into this category. These are used in bhavabhinaya. Upangas are of ten – eyes, eye lashes, eyebrows, cheeks, nose, breath, teeth, lips, tongue, upperlips etc. It is included because it has a place in the breathing organ or acting.

The following are the movements of and positions of the head, eyes and next. Symptoms and uses are explained by quoting verses from Natyashastra.

## **Sirobhedah**

Samamudvaahitamadhomukhamaalolitam dhutam  
Kampitam ca paraavrttamutksiptam parivaahitam  
Navadhaa kathitam sirsam naatyasaastravisaradaih

Head movements are said to be nine fold by the experts of Natyashastra.

## **Drsti Bheda**

Samamalokitam saci pralokitanimilite  
Ullokitaanuvrte ca tathaa caivaavalokitam  
Ityastau drstibhedah syuh kirtitah purvasurabhih

Sanam, alokitam, saci, pralokitam, nimilitam, ullokitaam, anuvrttam and avalokitam are eight drsti bhedas as explained by ancient scholars.

## **Griva Bhedah**

Sundari ca tirascina tathaiva parivartita  
Prakampitaa ca bhavajnai jneya griva caturvidhaa

Scholars on bhavas know the Griva Bhedas i.e, the movements of neck to be fourfold- sundari, tirascinaa, parivartita and prakampitaa.

## **Hastha Bhedas**

### **Asamyuta Hastah(single hand gestures)**

Pataakah tripataako-ardhapataakah kartarimukhah  
Mayurakhyo-ardhacandrasca araalah sukatundakah  
Mustisca sikharaakhyasca kapitthah katakaamukhah  
Suci candrakalaa padmakosah sarpasirastathaa  
Mrgasirsah simhamukhah kaangula scaalapadmakah  
Catur brahamarascaiva ca hamsaasyo hamsapaksakah  
Samdamso mukulascaiva taamracudah strisulakah  
Ityasamyuta hastaanaamastaavimsatiriritaa

### **Samyuta Hastah(combined hand gestures)**

Anjalisca kapotasca karkatah savastikastatha  
Dolaahastah puspaputa utsangah sivalingakah  
Katakaavardhanascaiva kartarisvastikastathaa  
Sakatah sankhacakre ca samputah paasakiakau  
Matsyah kurma varaahasca garudo naagabandhakah  
Khatvaa bherunda ityete sankheaataa samyutaataah karaah  
Trayovimsatirityuktaah purvagairbharataadibhih

## **Deva Hastah**

- Brahma Hastah – If Catura and Hamsasya hastas are held by left and right hands respectively, it is Brahma Hasta.

- Sambu Hastah – When Mrgasirsa and Tripataka hastas are held by the left and right hand respectively, it is Sambu Hastah.
- Vishnu Hastah – Both hands holding Tripataka hastas denote Lord Vishnu.
- Sarasvati Hastah – When right hand holds suci Hastah and left hand holds Ardhachandra, then it is Saraswati Hastah.
- Parvati Hastah – when two Ardhachandra Hastah are held by left and the right hand as Varada hasta and Abhayahasta, respectively and extended downward (left hand) and up wards (right hand) respectively, it is known as Parvati Hastah.
- Lakshmi Hastah – If both hands hold kapittha hastas near the respective shoulders, it becomes Lakshmi Hastah.
- Vigneswara Hastah – When two kapittha hastas are held in front or on the chest, then it is Vigneswara Hastah.
- Sanmukha Hastah – If Trisula hasta in left hand and sikhara hasta in right hand are extended upwards, then it is to be known as Shanmukha hasta.
- **Manmata Hastah** – If left and right hand holds Sikhara hasta and katakaamukhah hasta, respectively, then it is known as Manmata Hastah.

## **Dikpala Hastah**

- Indrahastah – If two Tripataka hastas are crossed, it is considered as Indra Hastah.
- Agnihastah - If Tripataka hasta is held by right hand and Kangula hasta by the left hand experts on Natyashastra describe it as Agni Hastah.
- Yamahastah – When left hand assumes Pasahasta and right hand assumes Suci hasta then it is considered as Yama hasta.
- Nirrtihastah – When one hand holds Khatva hasta and the other Sakata hasta, then it is considered as Nirrtihastah.
- Varuna Hastah – When right hand assumes Pataka hasta and left hand Sikhara hasta then it is Varuna Hastah.
- Vayu Hastah – When right hand holds Atala Hastah and left hand Ardhpataka hasta then, it is said to be vayu hasta .

- Kubera Hastah – When left hand assumes alapadma hasta and right hand assumes gada hasta then, it is Kubera Hastah.
- Isana Hastah – Standing on saivasthanaka when the right hand holds Tripataka hasta and the left hand holds musti hasta obliquely then it denotes Isana hasta.

## **Dashavathara Hastah**

- Matsya-Avatara Hastah – When the hands assuming Matsya hasta are held at the level of the shoulders, it is said to be Matsya avatara hasta(form of fish).
- Kurma-Avatara Hastah – Holding Kurma hasta at the level of the shoulders is said to be kurma avatara hasta(form of tortoise).
- Varaha-Avatara Hastah – When Varaha hasta is held on the sides of the waist it is said to be Varaha avatara hasta(form of wild boar).
- Narsimha -Avatara – When left assumes simhamukha and right hand Tripataka hasta, it is said to be Narasimha avatara hasta (form of half lion and half man).
- Vamana-Avatara – Assuming Musti hasta in both left and right hand; if left hand is held upwards and the right hand down-wards, then it is said to be hasta for Vamana avatara(form of dwarf).
- Parasurama-Avatara Hastah – When the left hand is placed on the left side of the waist and the right hand assumes Ardhapataka hasta; then it is said to be Parashurama Avatara hasta.
- Ramachandra-Avatara Hastah – When the right hand assumes kapittha hasta and left hand shikhara hasta pointing upwards, it is Ramachandra hasta.
- Balarama-Avatara Hastah – When right hand assumes Pataka hasta and left hand musti hasta; then it is considered as Balarama-Avatara Hastah.
- Krishna-Avatara Hasta – When the two hands assume Mrgasirsah hasta facing one another near the face, it is said to be Krishna hasta by the scholars.
- Kalkya-Avatara Hastah – If right hand assumes Pataka hasta and left hand assumes Tripataka hasta, it is said to be the hasta for Kalki-Avatara.

- Buddha-Avatara Hastah – Standing with feet together while assuming Dola hasta on the sides is to be Buddha avatara hasta.

## **Bandhava Hastah**

- Dimpati Hastah (wife and husband) - If left hand assumes Sikhara hasta and right hand assumes mrgasirsah hasta, experts on Bharata's sastra, consider it as Stri-pumsa or Dampati hasta.
- Matr Hastah (mother) – After left and right hand assume Ardhachandra and samdamsa hasta respectively, if the left hand is turned around on the stomach, and assumes Strihasta; then scholars consider it as Matr(mother) hasta. This Hasta denotes both mother and daughter.
- Pitr Hastah (Father) – If the right hand of Matr hasta assumes Sikhara hasta, it is considered as Pitr hasta by the experts. This Hasta denotes both Janaka (father) and Jamata(son in law).
- Svasruhastah (mother in law) - Right hand with Hamsasya hastas is held near throat at first and then changed to samdamsam hasta. Left hand turned around the belly, is held as Strihasta; then it becomes svasruhastah and this hasta denotes Svasru.
- Svasurahastah(father in law) – At the end of Svasru hasta, if the right hand assumes Sikhara hasta, it is considered by the scholars as Svasurahastah.
- Bhartrbhratr Hastah (husband's brother) – When left hand assumes Sikhara hasta and right hand assumes kartarimukha hasta and are held on the respective sides, then it is considered as husband's brother i.e brother in law
- Nanandr Hastah (husband's sister) – If Strihasta is assumed by the right hand after showing Bhartr-bhratr hasta experts on Natya consider it as husband's sister.
- Jyesthakanisthabhratr Hastah (elder and younger brother) – When mayura hasta is held in front or on the side, then it is considered as gesture for elder brother and younger brother.
- Putra Hastah (son) – samdamsa hasta is held in right hand on the belly and then moved around, while left hand assumes Sikhara hasta, it is considered as Putra Hastah.

- Snusaa Hastah (daughter in law) – At the end of Putra Hastah if right hand assumes Strihasta; it is said to be Snusaa hasta by the experts on Natyashastra.
- Bhartr Hastah (husband) – When the left hand with Hamsasya hasta is held at the throat and right hand assumes Sikhara hasta then, it is considered to denote a husband.
- Sapatni Hastah (another wife of husband) – After holding pasa hasta if both hands assume stri hasta experts on bhava know it as another wife of her husband.

## **Navagraha Hastah**

- Surya Hastah(sun) – If alapadma and kapittha hastas are held near the shoulders; then that hasta is considered to represent sun.
- Candra(moon) – If alapadma is assumed by left hand and Pataka hasta by right hand, it is said to be represent moon by scholars.
- Kujahastah(Mars) – If left hand assumes Suci hasta and right hand holds Musti hasta, then it is considered as Kuja hasta by the experts on Natyashastra.
- Budha(Mercury) – If left hand holds musti hasta obliquely and right hand assumes Pataka hasta, it is said to represent the planet Budha.
- Guru, Brahaspati Hastah(Jupiter) – When both hands with Sikhara hasta are held as if holding the sacred thread, then it is considered as Guru hasta, This is the hasta for rshi as well as Brahmin.
- Sukra Hastah (Venus) – After assuming Musti hasta in both hands, if the left hand is raised and the right hand is lowered then experts on Natyashastra consider it as hasta for the planet sukra.
- Sani Hastah (Saturn) – When left hand assumes Sikhara hasta and right hand Trisula hasta, then it is considered by the experts on Natyashastra as the hasta for the planet Saturn.
- Rahu Hastah( Dragon’s head) – When left hand assumes sarpasirshah hasta and right hand suci hasta, then it is considered by the experts on Natyashastra as the hasta for Rahu.

- Ketu Hastah (dragon's tail) – When left hand assumes Suci hasta and right hand Pataka hasta, then it is considered by Bharata, as the hasta for ketu.

## **Chapter 5 – Adavus**

Adavu training is important in dance. If dance is likened to a story, each sentence can be considered as a jathi, each word as one adavu, each letter can be counted as pathakriya. Dance characters include Charis, rechakas, nritta hastas, karanas etc. According to Natyashastra angaharas are formed by combining these. Angahara is the adavu used in bharathanatyam. It also comes with a category

called sthanakas. These are mostly for acting. There mandalas in Abhinayadarppanam. These are the same sthanakas in Natyashastra. Bharathanatya Acharyas teach a division of padhabedhas. It will be more useful to practice adavus.

**Charis** – steps that move the feet front, back and side to side is known as Chari. This includes jumping and running. Chari means leaning. It is safe to say that Charis are the basis of dance. Basic adavus are formed when the mandalas and Nritta hastas join the Chari. Rechakas enhance the beauty of this adavus. Multiple adavus can be created by applying different mandalas and Nritta hastas. The style of the Adavus itself changes when the elements that are appropriate for each dance form are combined. This is how many dance forms are different not only in India but all over the world.

Natyashastra mentioned 16 bhoocharis and 16 Akasha Charis. There are so Charis mentioned in Sangeetha ratnakara also. Many other texts describe many other Charis that are still different. The study of Charis will help in creating new adavus or steps suitable for classical dances as well.

## **Chari bedhah**

Aadau tu calanam proktam pascaanamkramanam tathaa

Saranam vegini caiva kuttanam ca tatah param

Luthitam lolitam caiva tato visamasancaraha

Caaribhedaa ami astay proktaa bharatavedibhih

The variations of Cari are eight in numbers : Calana Cari, Cankramana Cari , Saranam Cari, Vegini Cari, Kuttana Cari, Luthita Cari, Lolita Cari and Visama sancara Cari.

- Calana Cari – If a foot is moved from its original place, then it is known as Calana Cari.
- Cankramana Cari – Moving forward (jumping) with the outer sides of the feet alternatively, is Cankramana Cari.
- Saranam Cari – Assuming Pataka hasta with both hands, moving forward while dragging the heel of one foot with the heel of the other foot like a leech, is considered as Saranam Cari.

- Vegini Cari – Assuming Alapadma and Tripataka hasta and moving forward quickly on the heels or the toes, is considered as Vegini Cari.
- Kuttanam Cari – Striking the ground with the heel or the forepart or the entire sole of the foot is considered as kuttanam Cari.
- Luthitam Cari – If in the svastika position of the feet the ground is struck by the forepart of a foot, it is considered as Luthita Cari.
- Lolitam Cari – After striking the ground, if the feet, without touching the ground are moved forward slowly, then it is Lolita Cari.
- Visamasancaraha Cari – When the left foot is encircled by the right foot and likewise the right foot is encircled by the left foot alternatively, and moving forward in this manner is Visamasancaraha Cari.

## Gati Bhedah

Hamsi Mayuri ca margi gajalilaa turangini

Simhi bhujangi manduki gativiraa ca manavi

Dasautaa gatayo jneyaa naatyasaastravisaradaih

The ten characteristics of gati bhedas identified by the experts on Natyashastra are : Hamsi gati, Mayuri gati, Margi gati, Gajalila gati , Turangini gati, Bhujangi gati, Manduki gati, Vira gati and Manavi gati.

- **Hamsi gatih(female swan)** - Assuming Kapittha hastas with both hands, turning the body on both sides alternatively, placing one foot at a distance of one vitasti from the other foot and proceeding forward like a hamsa is considered as Hamsi gati .
- **Mayuri gatih (peahen)** – Standing on the ground on the foreparts of the feet, assuming Kapittha hastas with both hands, and moving the knees forward, alternatively is considered as mayuri gati.
- **Mrgigatih(deer)** – Assuming Tripataka hastas with both hands, turning the body towards front and sideways and moving forward quickly is considered Mrgi gati.
- **Gajalila gatih(playful gait of an elephant)** – Moving forward slowly in Samapada holding pataka hasta on both sides is considered as Gajalila gati.

- **Turangini gatih (mare)** – Raising the right foot and jumping forward repeatedly, assuming Sikhara hasta with left hand and Pataka hasta with right hand, is considered as Turangini gati.
- **Simhi gatih(lioness)** – Assuming Shikhara hastas with both hands, and standing on the foreparts of the feet, moving to the front quickly with jumps is considered as Simhi gati.
- **Bhujangi gatih(female serpent)** – Holding Tripataka hastas with both hands on both sides, if the Simhi gati is repeated, it is considered as bhujangi gati.
- **Manduki gatih(female frog)** – Holdings Sikhara hasta with both hands, and proceeding forward almost like a lioness is considered as Manduki gati.
- **Viragatih(heroic gait)** – Holding Sikhara hasta with left hand and Pataka hasta with right hand, proceeding forward as if coming from a distance, is considered as Vira gati.
- **Manavi gatih(gait of a spirited woman)** – Holding left hand on the waist and assuming Katakaamukha hasta with right hand and moving in circle and coming forward is considered as Manavi gati.

## **Bhramari Lakshanam**

Utplutabhramari cakrabhramari garudaabhidhaa  
 Tathaekapaadabhramari kuncitabhramari tathaa  
 Aakasabhramari caiva tathaangabhramariti ca  
 Bhramaryah sapta vijneya naatyasaastravisaradaih

It shall now describe the various characteristics of bhramari as considered by the experts on Natyashastra :- Utpluta bhramari, cakra bhramari, Garuda bhramari, Ekapada bhramari, Kuncita bhramari, Akasa bhramari and Anga bhramari.

- **Utplutabhramari** – Standing in Samapada position and turning around with a jump (without touching the ground) then it is Utplutabhramari.

- **Cakrabhramari** – Holding Tripataka hasta in both hands and striking the ground with feet repeatedly, if one turns around in a circle, it is considered as cakrabhramari.
- **Garudabhramari** – Stretching out one foot obliquely (i.e. across the other leg), placing the knee on the ground and stretching out the two hands, while turning the body around quickly is Garuda bhramari.
- **Ekapadabhramari** – If one turns around quickly on one foot, it is considered as Ekapadabhramari.
- **Kuncitabhramari** – Turning around while bending the knees is considered as kuncitabhramari.
- **Aakasabhramari** – Jumping with the two feet stretched apart while turning around the body is Akasa bhramari.
- **Angabhramari** – While keeping the two feet apart at a distance of one vitasti, if the body is turned around, it becomes Anga bhramari.

## Utplavana Bhedah

Alagam kartari vaa'svo'tplavanam motitam tathaa  
Krpaaalagamiti khyaatam pancadhotplavanam budhah

The characteristics of Utplavana bhedas as considered by the scholars are : Alaga utplavanam, Kartari utplavanam, Asva utplavanam, Motita utplavanam and Krpalaga utplavanam.

- **Alagotplavanam** – After taking a leap, the two hands holding Sikhara hasta have to be placed on the two sides of the waist, then it is Alagotplavanam.
- **Utplavanakartari** – After taking a leap standing on the toes, one foot behind the other, left hand as Kartari hasta is to be placed behind, and the other right hand holding Sikhara hasta has to be placed on the right side of the waist pointing downwards. This posture is Kartari Utplavanam or Utplavanam Kartari.
- **Asvotplavanam** – Assuming Tripataka hasta with both hands, a leap to the front has to be taken with one leg and then the second leg has to be placed along the first leg – this is known as Asotplavanam.

- **Motitotplavanam** – Assuming Tripataka hasta with both hands, if leaps are made as was done in Kartari on both sides, alternatively, it is considered as Motita- Utplavanam.
- **Krpalagotplavanam** – Raising the heels to the hips alternatively, holding Ardhachandra hasta is Krpalagotplavanam.

**Rechakas** – Angas moving from one place to another is known as rechakas. In Natyashastra there are 4 types of rechakas : paadha rechaka, kadi rechaka, shiro rechaka, hasta rechaka. Not only these organs, but all the organs of the body as a whole have these rechakas. These are different for each dance form. It is difficult to read or study pictures or photographs that day that the hands is in motion as it moves from one place to another. It must be learned from the Guru himself. Movement is the process of moving the body from one image to another. The waist plays a major role in this. When the foot is moved from one side to the other, the weight of the body is brought to the foot by the movement of the waist as determined by the foot. The inclination of the head, the rotation of the neck, the position of the hands, all these can be applied properly in these body pictures to create beauty.

**Nritta hastas** – Nritta hastas are shaped by observing how to move the hands, what position to hold, and what gestures to use. It is 33 in number.

Nritta hastas in Natyashastra are not accepted in bharathanatyam. Some of the bharathanatya adavus include Chathura hasta and Latha hasta. Kari hasta is used in the acting of the elephant. Nritta hastas used in bharathanatyam are not specifically named. It is common to learn adavus as well as practice them. They exist only as a part of adavus.

**Karanas** – Bharata suggests 108 karanas. The Chidambaram Nataraja temple has 108 karanas carved in stone. The recently constructed kalamandalam has the same karanas engraved on the pillars of koothambalam. In Natyashastra there are clear signs for each karana. There are also movements in it before the whole body is put into a picture. The name karana is probably due to its movement. These

karanas are not used in bharathanatyam. It's just that some may have similarities. Paadha Charis, nritta hastas and rechakas are required to perform a karana.

**Angahara** – Angaharas are formed by Charis and Karanas. These are the Adavus. In saying that a angahara is a Chari, rechaka, nritta hasta and karana and so on all go hand in hand. There must be one or two karanas in angaharas.

**Sthanakas** – Bharata suggests 9 sthanakas, including 6 for men and 3 for women. These sthanakas which are suggested for abhinaya, can also be used in dance.

1. **Samam** – Do not bend the knee with both feet together. Hands should be placed at the waist.
2. **Mandalam** – Stand with both feet turned to either side and knees bent to either side.
3. **Vaishnavam** – With the foot slightly out of samanila, place the foot slightly back to the side of the foot in the manure.
4. **Vaishakam** – Keep the body part on one leg from the mandala Nila and keep the other leg two and a half inches apart at the curve of both the knees.
5. **Aalidam** - Stretch the right leg slightly backwards on the same side from the mandala Nila and place the entire body weight on the leg, keeping the body forward.
6. **Prathyaalidham** – Move the body from aalidam to the right leg and bend the right leg to keep the body in a mandala position and the left leg extended.

## **Sthanakas for women**

- **Aayatham** – Put the right foot Samapada and hold the left foot slightly to the left and slightly away from the waist to the right.

- **Avahitham** – Move the legs in aayatham and rotate the right leg slightly.
- **Ashwaakrantham** – Raise the heel so that the feet are level and the heel of one foot is next to the big toe of the other foot. Bend the knee of that leg slightly forward. Move the body to the hips so that the weight is on the other leg.

## Mandala Bhedah

Sthaanakam caayataalidham prenkhanapreritaani ca

Prathyaalidham svastikam ca motitam samasucikaa

Paarsvasuciti ca dasa mandalaaniritaaniha

Sthanaka mandalam, Ayata mandalam, Alidha mandalam, Prekhana mandalam, Prerita mandalam, Pratyalidha mandalam, Svastika mandalam, Motita mandalam, Samasuci mandalam and Parsvasuci mandalam – these are the ten Mandalas described here.

- **Sthanakamandalam** – Standing on Samapada, keeping the body straight and placing the two Ardhachandra hastas on either side of the waist, is sthanaka mandala.
- **Ayatamandalam** – Standing in Caturasra, bending the knees slightly and obliquely and keeping a distance of a vitasti between the two feet is called ayatamandalam.
- **Alidhamandalam** – When in front of the right foot is placed at a distance of 3 vistastis away, left hand and right hand assume Sikhara hasta and Katakaamukha hasta, respectively, then it is considered Alidhamandalam.
- **Pratyalidhamandalam** – If the position in the Alidha mandalam is reversed, it becomes Pratyalidhamandalam. Altering the feet of Alidha is Pratyalidha.
- **Prenkhanamandalam** – When one foot is placed by the side of the heel of the other foot and kurmahasta is assumed, then it is Prenkhanamandalam.

- **Prerita mandalam** – To strike the ground with one foot on the side of the other foot at a distance of three vitastis, and to stand with the knee bent, holding Sikhara hasta on the chest with one hand and extending the other hand as Pataka hasta, this posture is called Prerita mandalam.
- **Svastika mandalam** – Standing with the right foot placed across the left foot and the right hand placed across the left hand is known as svastika mandalam.
- **Motitamandalam** – Standing on the toes and assuming Tripataka hastas with both hands, if the ground is touched by the knees alternatively, then it is considered as Motita mandalam.
- **Samasucimandalam** – If the ground is touched by the toes as well as the knees, then it is Samasuci mandalam.
- **Parsvasucimandalam** – Standing(or sitting) on the toes, if the ground is touched by one knee on one side, it is considered as parsvasucimandalam.

## Sthanakabhedah

Samapaadam caekapaadam naagabandhastatah param  
Aindram ca garudam caivam brahmasthaanamiti kramaat

By the variation in the movements of the feet, the sthanaka positions are of six types : Samapada sthanakam, Ekapada sthanakam, Nagabandha sthanakam, Aindra sthanakam, Garuda sthanakam and Brahma sthanakam.

- **Samapada sthanakam** – Standing with feet in Sama position is considered as Samapada sthanakam.
- **Ekapada sthanakam** – Standing on one leg and placing the other leg on the knee of the first leg obliquely, is considered as Ekapada sthanakam.
- **Nagabandha sthanakam** – The standing posture in which the two legs are intertwined and the two hands are likewise crossed, is called Nagabandha sthanakam. This sthanakam is used to depict Nagabandham.

- **Aindrakasthanakam** – Standing with one leg bent, raising the knee of other leg and holding the hands downwards is known as Aindra sthanakam.
- **Garuda sthanakam** – Standing at first in Alidha mandalam, then with one knee placed on the ground and the two hands forming a circle is known as Garuda sthanakam. This sthanakam depicts the bird Garuda.
- **Brahma sthanakam** – If one sits keeping one leg on the knee of the second leg and the second leg on the knee of the first leg, it is Brahma sthanakam. This sthanakam depicts meditation etc.

## Paadhasthaana Bhedah

- **Samapadam** – This is same as in the case of sthanakas and mandalas.
- **Mandalapadam** – Put both feet together and fold the foot prints back to either side.
- **Kunchitapadam** – Hold the mandalapada and lift both heels and feet with the toes resting on the floor. This can be done by lifting only one leg.
- **Anchitapadam** – Lean on the heel and lift the mat. This can also be done on one leg.
- **Parshwakapadam** – Pictures of the feet lift the inside and lean on both sides. It is also called vadimbu. It is widely used in Kathakali steps.
- **Thaadithapadam** – Stick the front edge of the right leg picture to the left side of the left leg.
- **Nagabandham** – Hold the swastika and place the heels on the ground with both feet raised.
- **Prishtakam** – Place the left foot on the ground, with the right foot bent close to the left foot.
- **Garudanila padam** – Sit with toes and knees of the left foot on the floor and the right foot is stretched forward two inches.
- **Nrittamoorthi padam** – Raise the left leg from the ankle and hold it slightly to the right so that it is equal to the waist. Some hold the raised thighs horizontally and the knees perpendicular to the ground.

# Starting Practice

## Thattikkumbidal

From time immemorial, certain rules have been observed to mark the beginning of education in the gurukula system. Those rules have no place in today's education. Vijayadashami is a day celebrated as the beginning of education. On this day, the ritual of writing is being performed by all, irrespective of caste or creed. Those who come to learn the alphabet, Harishree writes to their children in white rice. Harishree writes with a gold ring on his tongue. There is a way of saluting when classical dances, kalarippayattu start. Each art has its own style. The name is also different. In Bharathanatyam it is called thattikkumbidal.

The first time student must pay the stipend and give the money to the teacher according to their ability. The guru should turn to the west and the student to the east and give the dakshina with the Guru at his feet. The Guru should bless both the hands of the disciple with his hands. There may be those who believe that all these rituals are meaningless. It is necessary to always keep in mind the beginning of a teacher-disciple relationship and to make the child feel that he or she has become a humble person who has dedicated everything to the teacher. This ceremony is also an oath that the Guru who accepts a disciple will sincerely do whatever is necessary for his or her growth. It is important to remember that only those who are sure that they have what they need to give to those who ask for knowledge are eligible to buy dakshina in this way.

Greetings should be given to the disciples standing in the stable. Recite the Ganapati sthuthi. Which begins with vakrathunda mahakaya, followed by the Saraswati Vandana, followed by Shiva sthuthi, and finally the hymns to the Goddesses Bhoomi.

'Samudravasane devi

Parvathasthanamandale

Natyamkarushye bhoodevi

Paadaahaaram kshemasvame

Then hold the katakaamukhah mudras in both hands and bring them to the front of the chest. Lift the feet straight up in the right-left order and tap both feet on the ground. Then put the Shikhara mudra on both hands and bring it over the shoulder and place the Pathaka mudra and sit on the sama mandala. Bring both pathaka hastas in front of the hands and touch to the ground. Then with your arms folded, touch the tattupalaka in front of the Guru, move back to greet him and stand in the place indicated by the Guru. Let's start practicing now.

## Chapter 6 – Bharathanatyam Margam

The fixed number of items decided by the old Gurus for a programme of bharathanatyam is called a margam.

In a margam items are Alarippu, Jatiswaram, Shabdham, Varnam, Padam and Thillana. Since bharathanatyam was performed in temples by the devadasis, margam took them closer to the Almighty. This was a worship through which the NARTHAKI attained the divine ecstasy of body and soul. Through this path there is a union of Jeevaatma and Paramaatma.

The dancer after learning a margam attains the basic knowledge of Nritta, Nritya and Natya aspect of Bharathanatyam. A versatile dancer has knowledge of many such margams. As Alarippu can be composed in all five Jatis, Jatiswaram can be composed in any Carnatic raga. Shabdham and Varnam can be composed according to any krutis by great poets and musicians. Thillana are also in varied raga patterns. Padams can be danced in any language. Slokams are based mainly on Bhakti dedicated to Gods and Goddesses and at the end of a Bharathanatyam performance, there is Mangalam. The beginning of the programme is always with an invocation to Lord Ganesha, the elephant headed God and the destroyer of all obstacles.

- 1. Alarippu :** It is the beginning of a Bharathanatyam performance and it is the shortest dance. This is the beginning of basic movements of head, eyes, neck and shoulders. Through this dance item one can know how much control the dancer has on these Upangas. Alarippu literally means flowering; as we offer flowers during the pujas, the same way the dancer is offering her dance to the Lord of dance Nataraja. The dancer with folded hands is invoking the Ashtadhikpalas and the

Rangaadhidevata. With Anjali hasta above her head she is invoking the Gods, near the face she is invoking the Gurus and near the chest she is invoking the learned Brahmins and the sabha i.e, the audience. This is an example of Shuddha Nritya. Alarippu can be danced in all five Jatis. The simplest is Tishra jati. In alarippu, Sholkattu is important.

2. **Jatiswaram** : After the very simple Alarippu, the dancer goes on to exhibit her command over Angashuddha, Talashuddha and clarity of Mudras. Jatiswaram is a combination of Jatis or time measures, and swaram or melodic notes. This is also an example of Shuddha Nritta. Abhinaya does not hold any place in Jatiswaram. Jatiswaram can be composed in any carnatic raga. Taking the swarams of the particular raga Bharathanatyam adavus are set in beautiful tala patterns. Some of the common Jatiswarams are Kalyani, Vasanta, Chakravaakam, Saveri etc.
3. **Shabdam** : Shabdam is an introduction to Abhinaya. This is the third item in a Bharathanatyam Margam. Through this dance the dancer brings out the Nritya aspect of Bharathanatyam. Nritya means the piece where there is a specific theme or story in it. In Shabdam the dancer according to the words of the song shows specific mudras with facial expressions. Different moods or Navarasas are used in this dance like Sringara, Veera, Karuna, Adbhuta, Bhayanaka, Hasya, Bibhatsa, Raudra and Shanta. Shabdam is dedicated to Gods, Goddesses, kings or any popular personality. Shabdam means the song of praise. In Sanskrit, it is known as Kirtigana. The popular raga used in Shabdam is Kamboji and tala is Misrachappu. It is mostly divided into four paragraphs. After each paragraph Sanchari bhava is used. It begins with Sholkattu. The first paragraph is known as Pallavi, the second as Anupallavi, third as Charanam, and the fourth as anucharanam. The rasa is mostly Sringara but ending is always with Bhakthi. It ends always with Salamura or Namasthute. Most of the Shabdams are in Telugu or Tamil but now other languages are also taking its place.

- 4. Varnam :** Varnam is the most important item in Bharathanatyam. It tests the skill of a dancer. Varnam literally means colour. It is a joyous combination of all the three components of dance namely Nritta, Nritya and Natya. Varnam is dedicated to either Gods or Kings. In this importance is given to Sringara rasa. A versatile dancer's favourite dance is Varnam. With experience and practice Varnams gives brighter colours. Varnam is basically divided into two parts. First deals with Pallavi, Anupallavi, Chittaswaram and Sahithyam based on swarams. The second part deals with Charanam and three Swarams and Sahithyam based on these Swarams. The beginning of Varnam is with Mukkal tirumaanam and their abhinaya is shown based on the Sahithyam. Whenever there is tirumaanam or swaram there is Nritta, and wherever there is padam there is Nritya. Theme of Varnams are usually viraha, wherein the nayika is waiting for the beloved. Philosophically it is the longing of the Jeevaatma to meet the Paramaatma. In Varnam one sees Talasanchari, Bhavasanchari and Ragasanchari. In olden times Varnams were danced for one and half hours to two hours but now it is reduced to 25-30 minutes.
- 5. Padam :** With Padam intense abhinaya starts. It can be classified into Padams, kirtanams and javali. When Sringara rasa is predominant, it is called Padam. Some of the popular Padams are of love songs of Radha and Krishna. When bhakti is predominant it is called Kirtanams. In Padams, according to the meaning, hasta mudras are performed with the appropriate rasas. In olden times Padams were danced in Tamil, Telugu and Kannada. In Padams, nayika is presented as Virahotkandita, Khanditha, Abhisarika etc. In olden times the dancer used to sing and enact the Padam.
- 6. Shlokam :** Shlokams are descriptive pieces of Abhinaya. In this the use of Talam is not there.
- 7. Thillana :** Thillana is the last item in a margam. It is a joyous ecstasy of scintillating rhythm, varied tala patterns and

sculpturous poses. The adavus are composed in vilambita, madhyama and dhrutalaya. In five Jatis according to the melodic note of the ragas Thillana is divided into five parts : Mai adavu, Korvai, Peria adavu, Anthara and Sahithyam.

- 8. Mangalam :** Mangalam is thanks giving to Gods and sabha for the success of the programme. It is composed by saint poet Thyagaraja. In mangalam there is no movement. Keeping hand on the hips or with folded hands the dancer stamps her feet and at the end of it there is Namaskar.

## Chapter 7 – Exercises

**1. Eye :** Exercising for the eyes should be done with the eyelids outstretched. It may seem a little difficult at first. Keep the eyelids apart with the index finger and thumb to rotate the eyes. These are the exercises done in bharathanatyam.

- Move the eyes left and right. Initially the speed should be reduced. Should be accelerated regularly.
- Move the eye up and down.
- Move the angle from corner to corner. This should be done on both sides.
- Round the eye in a circle. This should be done on both sides.

**2.Neck :** Move the neck left and right. Do not tilt your head or turn your face while moving your neck. If it difficult to do this in the beginning, keep both hands above the head. Keep every inch away from the ear. Ask him to tap his ear. So gradually stir the neck. Its movement is possible only if it is done without giving any strength to the neck. Move the neck forward and then alternatively to the samanila.

**3.Shoulders :** Raise each shoulder up and down to the back and bring it down and wrap it around the circle. After doing one shoulder so many frequencies, wrap the two shoulders together. Then rotate the bicycle pedal in both directions. Pull one shoulder back and the other shoulder forward. Repeat this.

- 4. Hands :** Extend the right hand to the right, fold the handkerchief over the head and hold it upside down. Then lower the raised knee and forearm, and bring the forefinger back to the side of the shoulder and back slightly. Now extend the hands that have been converted from the Pathaka mudra to the Shikhara to the first position. Replace the Shikhara with the Pathaka again. When changing, straighten the fingers so that the joints of all the fingers move and bring them to the starting position. Repeat this. Repeat with the left hand. Then do the same with both hands at the same time. This exercise helps to move all the joints of the hand and strengthen the muscles of the hand.
  
- 5. Waist :** keep your legs apart and your left arm around your waist as you did in the previous exercise. Bring the whole body up and down with the hand on the left side, bend the spine to the back and tilt it to the right and bring it down. Rotate repeatedly. Do this by looking at the tip of the fingers of the out stretched hand. Bend the body as far to the sides and back as possible. Do the same exercise with the left arm outstretched and the right arm bent. Then hold both hands parallel and wrap them around both sides as if wrapped with one hand.

## **Things to look out for when exercising**

- The exercises area should be level and generally smooth. If it becomes too smooth, he may slip. If it is a rough surface, it can cause the skin on the body to peel off.
- Exercise should be done in a well-ventilated area. If you are in a room, there should be plenty of ventilated windows.
- Do not exercise during hot weather. It is best to exercise before dawn or early in the morning.
- Stomach should be empty while exercising. If you eat solid food, you should exercise only after the digestive process is over.

- It is good to apply oil all over the body and exercise. This will prevent the body temperature from rising to some extent. Also, the ointment is good for loosening the skin and muscles easily.
- Do not drink any beverages immediately after exercise. All exercises should be done equally on right and left. Do it five times on the right side and five times on the left side. Or both parts will have different mobility and growth. It applies to dance and ordinary life.
- If you sprain any part during exercise, gently rub that part and do the other side of sprain during any exercise. Exercising regularly will prevent sprains. The mind must be fully attuned to what is being done. Properly exercised, it can reduce stress and increase concentration.

## **Opportunities not to exercise**

Do not exercise when you have a fever or other illness. Do not exercise immediately after strenuous physical activity or running.

**Food :** It is best to give up workaholics who practice arts such as music and dance. Increased mucus when eating these can cause the singer's voice to become hoarse. For dance practice it is best to have a plant book to enable more relaxed body movement. People who are overweight need to stay healthy by eating less starchy foods like rice and eat more fruits and vegetables. Those who are not obese have no problem eating enough starch. This does not mean cutting down on food.

## **The ideal age to start learning dance**

People of any age can start learning dance. As they get older, they will have to work harder as they have not done any other type of exercise. Starting before the age of 20 is not difficult at all. But do not start before the age of seven. You need to be

able to follow the instructions of the Guru. Some children become proficient by the age of ten. There will be a delay in moving forward. Teaching dance and music to mentally unprepared children is a waste.

Old gurus have suggested that you start studying dance at the age of seven. The ancestral religion was higher education, beginning at the age of seven and ending at the age of fourteen. Further study is meant to acquire knowledge in the Vedic puranas as well. A person who has learned in this way will be able to express their own talent when performing dance. Art is not copying what others do.

## **The right time for training**

Most people study music and dance as a form of leisure while pursuing formal education. They only spend an hour on vacation days. This does not have a significant effect. If you do not get enough exercise one or two days a week, your exercise will be in vain.

Practice, whether dancing or music, should begin before dawn. Get up at 5 a.m. and start exercising after breakfast. Music students practice their lessons. Dance students do half an hour of exercise and half an hour of adavu training. Those who are just learning the basics of dance should spend an hour memorizing it. This should be done daily without interruption. No one should doubt that this will have a detrimental effect on formal education. You can take a bath 15 minutes after you finish exercising in the morning. Then do the homework you learned in school. It will be more useful to study the subjects newly taught in the class during this time. The body and mind will be properly awake. Then the subjects studied will come to mind. Many people do not understand this and may force their children to read all the time. If the body doesn't move, health will be lost. A strong mind does not exist in an unhealthy body.

## **Clothing to wear during training**

During dance practice, clothing should not feel like a nuisance. Do not wear clothing that interferes with the proper stretching and movement of the limbs.

Under age girls can wear churidhars. Take a half meter wide and two and a half meter long piece of thin cloth around the shoulder and wrap around the waist twice and tie it around the waist. For taller children, dupatta may need up to three meters. Adult girls should wear practice saree. For boys it is enough to wear pajamas and tie a belt around the waist only. The waist band is designed to secure the waist while exercising. When the belt is not tied, there is a risk of strain on the waist or spine. The belt should be folded at least three inches wide and round. Wrapped around like a rope, it can disrupt blood circulation and cause pain in the abdominal organs.

## **Chapter 8 – Nattuvangam**

The Nattuvanar is responsible for teaching Bharathanatyam and performing the dance on the stage in a way that is pleasing to the audience. Dance choreography, organize and train the cast and crew, disciples. It is the duty of the Nattuvanar to adapt the rhythm to the movements of the dance, to give instructions to the singers and musicians or to control them and to pronounce the jathis at the intervals of the song.

Training children should be in the right rhythm from the beginning. You need a piece of wood and stick to catch the rhythm. The piece of wood should be 21cm long, 7cm wide and 3cm thick. The base of the tree should be cut to a thickness of one centimetre so that the feet stand on both ends. Now it will look like a small pedestal. The top of the best should be smooth and the edges should roll. A round stick 27cm long and 6 cm in circumference should be used for beating. Wood and sticks should be made of heavy wood that does not break easily. The best tree for the stick is col tamarind. This is called thattumani and stick. Use for tapping only after good drying. Get the sound of a xylophone, a musical instrument made of wood. Tell a adavu in the first instance. When

changing the adavu to the second and third speed, the chilli should be said in the first speed. Doing so will keep the kalapramana intact.

The dance is performed by changing the nadaas and stepping inside the rhythm. The kalapramana is likely to change as we move to different nadaas. This is common in jathiswaram. These skills can only be acquired through constant training. Do not teach the lesson to those who do not know the rhythm and do not know how to do the tricks with the children. This work is destroying a generation. This is the great sin of pinching the stem of a bamboo. Those who become gurus should remember that according to the beliefs of the ancients, even if seven births are sacred, it is still a sin. Any Bharathanatyam teacher who deals with these subjects independently can do the training himself.

## **Training**

Chathurasram, tisram, misram, khandam, sankeernam say five nadaas in order and three times in rhythm.

X adi

U veechu

### **Lesson 1. Chathurasram**

X,,,	X,,,,.	X,,,	U,,,
Tha,,,,.	Ka,,,,.	Dhi,,,,.	Mi,,,
Tha,ka,.	Dhi,mi,.	Tha,ka,.	Dhi,mi,
Thakadhimi.	Thakadhimi.	Thakadhimi.	Thakadhimi

### **Lesson 2. Tisram**

X,,,,.	X,,,,.	U,,,
Tha,,,,.	Ki,,,,.	Ta,,,
Tha,ki,.	Ta,tha,.	Ki,ta,
Thakitatha.	Kitathaki.	Tathakita

### Lesson 3. Misram

X,,.	X,	x,.	X,,.	X,.	x,
Tha,ki.	,Ta.	,Tha.	,Ka,.	Dhi,,.	Mi,
Thakita.	Thaka.	Dhimi.	Dhimi		
Thakitathakadhi.	Mitakita.	Thakadhimi.	Thakadhimi		

### Lesson 4. Khandam

X,.	X	X,.	X,.	X	X,
Tha,.	Ka.	,Tha.	,Ki	,	ta,
Thaka.	Tha.	Kita			
Thakathaki.	Tatha.	Kathakita			

### Lesson 5. Sankeernam

X,.	X,,.	X,	X	X,
Tha,.	Ka,.	Dhi,,.	Mi.	,Tha
,Ka.	,Tha.	,Ki.	,.	Ta,
Thaka.	Dhi mi.	Tha ka.	Tha.	Ki ta
Thakadhimi.	Thakathaki.	Tathakadhi.	Mitha.	Katakita

## **Chapter 9 - Nattuvanars And History**

### **Tanjore Brothers**

Tanjore deserves a special place in promoting arts. The four brothers of Tanjore namely Chinnayya, Ponnayya, Shivanandam and Vadivelu gave a structure to Bharathanatyam items in order that dancing programme could be staged. They classified it and supplied the necessary musical formats, thereby giving new life to these dancers.

The sons of Subbarayya, these brothers had their training in music under Muthuswami Dikshitar, one of the trinity of music. In addition to this practice in music arrangements were made by King Serfoji of Tanjore for them to learn languages like Tamil, Telugu etc. These brothers were proficient in Laya, Swara

and Sahithya. They also formulated methods of learning Bharathanatyam and for its performance in the stage.

### **Chinnayya**

Chinnayya, the eldest among the two brothers born in 1802. He was the official musician in the royal courts of Tanjore. Then he moved to Mysore State, during the reign of Sri Samaraja Wodayar. The court poet of Mysore court made several compositions in praise of Krishnaraja Wodayar, Samaraja Wodayar and Chamundeswari. Those composition were in the form of Keerthanams, Tanavarnams, Swarajathis and Padavarnams. Beside he composed so many javalis in Kappi, Bhilahari, Chenchurutti, Kedara gowla, Bhairavi, Kalyani, Todi ragas to be useful for dance performances.

### **Ponnayya**

The second son of Subbarayya was born in 1804. He received his gurukula training in music along with his brothers from Muthuswami Dikshitar. His proficiency in Tamil, Telugu and Sanskrit made him a great poet and composer and had patronised by the King Serfoji of Tanjore. These 4 had composed nine Keerthanams called “Navaratnamala” in praise of their guru.

He composed dance songs in different ragas and talas in Tamil and Telugu languages. Setting them in their own characteristic styles with suitable theermanams. Afterwards they formulated various types of Alarippu, Jatiswaram, Shabdam, Padavarnams, Swarajathis, Padam, slokam and Thillana.

The four brothers left Tanjore and settled in Orathunadu because of a difference of opinion between the dance master Vadivelu and king Serfoji with respect to music dance duties in the Periya Koil. Swathi Thirunnaal can to know this and on his invitation, Vadivelu settled in Travancore, Chinnayya moved to Mysore and patronaged by the King of Mysore. When the Tanjore King called back the 4 brothers only Shivanandam and Ponnayya returned.

### **Shivanandam**

The third among the four brothers born in 1808. He stayed in Tanjore inseparably with his eldest brother, Ponnayya, and did years of service. He devised methods of jathi and tala, when Lord Nataraja would start on his procession, ‘Santhi’, ‘Nrityam’ during festival days like flag hosting day tala, Jathi and Nritya

to suit the occasions of Deeparadhana and Sodopachara. He taught all these to his students conducted arangetram and had them perform in the temple.

He was a devotee of Lord Siva. In order that Puja takes place on Shivaratri day in Periya Koil in Tanjore, he donated his invaluable possession of Navaratnamala and had the puja conducted 4 times everyday. He celebrated the festival of kalaimagal by conducting musical performance of distinguished singers of the day, daily. He died at the age of 60.

### **Vadivelu**

The fourth son of Subbarayya Nattuvanar by name Vadivelu was born in 1810. He learned music in gurukula system from his father and from Muthuswami Dikshitar. King Serfoji of Tanjore appointed him even at the age of 14 as an exponent in Sangeetha Vidwath Sabha.

There was a Christian priest in Tanjore who was an expert in playing the instrument 'fiddle'. Vadivelu learned to play on the fiddle from him. Thereafter, he provided accompaniments on the instrument, whatever his brothers made musical performances. Thanks to this practice of Vadivelu, violin came to be recognised as an instrument of accompaniment during carnatic musical performances.

At the invitation of the Maharaja Swathi Thirunnaal, Vadivelu went with his brothers to Travancore. The king was so deeply impressed with his performance on violin. King built a house called 'Sankara villas' for their stay in Travancore. He died at the age of 37. He was a good Tamil and Telugu scholar besides being a poet.

### **Balasaraswati**

Born in 1918, Balasaraswati belong to a family of great musician and dancer. Her mother 'Jayammal' was a noted musician and she practiced dance also. Balan's grandmother was the great musician 'Veena Dhanammal'. Bala received training in bharathanatyam from Kandappa, a descent of Tanjore Quartette, who had shaped Bharathanatyam in the present form. Thus she was taught the great tradition of the dance form.

Bala's arangetram was held at Amanakshiyamma temple, at kancheepuram in 1925, when she was only 7 years of old. Even as a child her performance mentioned high standards.

There are few dancers like Balasaraswati who become a legend during their life time. She was the undisputed queen of Abhinaya. A thorough knowledge of music and Sahithya made her resisers of Padam exceptional good. She combined intellect with induction marvellously in her performance. Her sanchari bhavas were very long and inimitable.

She presented Bharathanatyam in foreign countries like United States, Japan and Britain. Also she taught the dance form in U.S. No other dancer has been honoured in India and abroad like Balasaraswati.

Her book on Bharathanatyam is still considered an authentic text for reference. She co-authored it with Dr.V.Raghavan Tamil Nadu Government and National Center for Performing Art(NCPA). Mumbai produced a documentary on her. Sathyajith Rai directed this. Dr.V.K.Narayana Menon wrote a book in titled Balasaraswati. She passed away on Feb 29, 1984 in Chennai.

## **Rukmini Devi Arundale**

Rukmini Devi was born in Feb 29,1904 in Madurai. Her father was a well known Sanskrit scholar A.Nilakanta Sastri. Her mother Seshammal belonged to Thiruvayur.

Rukmini was involved in the activities of theosophical society from very early age. This brought her in close contact with people like Dr. Annie Besant and Dr. George Arundale. In 1920 she married Dr. George Arundale even though there was strong opposition from the orthodox Brahmins community.

Rukmini accompanied her husband in the foreign tour. On such occasions she gave lectures on Indian culture. She met the great Russian ballet dancer Anna Pavlova in Australia. The beauty of the western classical attracted her and she wanted to learn it. But Anna Pavlova advised her to learn Indian classical dance. Therefore after returning to India, she studied under the great master Meenakshi Sundaram Pillai. She also had training under Mailapur Gouriamma and Muthukumara Pillai.

Her debut performance was held in at the age of 32. Rukmini Devi's main contribution to Bharathanatyam are :

- Choreography of more than 25 dance dramas, half of which are Sanskrit composition. Kalidasa's Kumarasambhav, Jayadeva's Gita Govinda and Swathi Thirunnaal's Kuchelopakhyana are some of them.
- Institution of kalakshetra, Adyar for the revival and promotion of Bharathanatyam, apart from her own great gurus. She brought Dandhayudhan Pillai, Karaikkal Saradhambal and Chokkalingam Pillai to kalakshetra to train the dancers. She also brought great musicians like Mysore Varadachariar, Tiger Varadachariar and Papanasam Sivan. They helped her by composing music for her choreographies.
- Her own entry to Bharathanatyam was an act of courage and revolution. During those days when only Devadasis used to perform Bharathanatyam. She was the first Brahmin lady to learn this classical dance form. Many ladies from descent families followed her thereafter. Dancing became a noble profession in India because of her only.

Rukmini Devi was honoured with many awards and titles. She passed away on Feb 29, 1986.

## **Vaggeyakaras in Bharathanatyam**

### **Uthukkadu venkatasubbayyar**

Venkatasubbayyar is a name that will never be forgotten by those who study Bharathanatyam. There is no way that there are people in Bharathanatyam and Kuchippudi who do not use his songs. His works are both literary and musical. There is no written history about him. It is known that he was a yogi who enjoyed his devotion to Krishna throughout his life, composing songs and singing in front of temples, without creating a series of unmarried disciples. Uthukkadu is considered to be the lifeblood of the trinity of music. According to the Palmyra texts of the temples, he lived between A.D 1700 and 1765.

He was born in Mannargudi in Thanjavur district. Later he moved to Uthukkadu. His brother Krishna Iyer was a musician, famous singer and palace singer to the King of Thanjavur. Venkata's music studies began with Puranoor Nateshabagavathar, also known as Raja Bhagavathar. His mother advised him to accept Lord Sri Krishna as his guru and continue his studies.

He went to a Krishna temple in Kumbakonam, wrote songs in worship of Krishna and lived there.

He wrote songs about other deities but most of them were about Lord Krishna. He has written songs in Sanskrit and Tamil. He wrote the song not with the intention of spreading it. Thanjavur Rudra Pasupathi, a nagaswara scholar, used to memorize his songs and sing them in front of the temple. Only his works are in circulation today.

Needless to say , the song ' thaye Yashoda unthan aayar kulathuditha', which was once used by all Bharathanatyam students for acting, is a beautiful blend of poetry and music. To retrieve the works, all the available palm leaf books in Thanjavur were examined. These are some of the works that are being used for dance now.

Maragathamanimayachela – Arabhi

Swagatham Krishna – Mohanam

Alaipayuthey – Kanada

Palvadiyum mugham – Nattakurinji

Kuzhaloodi manamellam – Kamboji

Adath ashangathuva – Kedaragoula

Neerada samaneelakrishna – Jayanthashri

**Sri Papanasam Sivan (1890 – 1973)**

Papanasam Sivan was born on 26.9.1890 as the second son of Ramamritha Ayer and Yogambal Ammal at Polagam in Tanjore district. His parents gave him the name of ' Ramayya'. Because of his devotion to God Shiva. He is known by the name Papanasam Sivan. Sivan's early years were spent in the Travancore area of Kerala where the kings patronised fine arts. Sivan came under the influence of eminent musicians Noorani Mahadeva Bhagavathar, Samba Bhagavathar and Karamani Neelakanta Dasar. While at Trivandrum, Sivan studied in the Maharaja's Sanskrit college and obtained the title 'Upadhyaya'.

Rukmini Devi Arundale was among the first to recognise his genius. She appointed him as a music teacher in Besant High school, and subsequently at kalakshtera. Sivan was associated with kalakshtera from 1934-39, where Rukmini Devi was also one of his student. Kalakshtera may have inspired Sivan to compose several Padavarnams that are now part of standard repertoire in Bharathanatyam.

He started composing songs as early as in 1910 and he used to sing them himself. Almost all eminent vidwans of yester years, viz. Ariyakuri Ramanuja Iyengar, Maharajapuram Viswanatha Iyer, Chembai Vaidyanatha Bhagavathar, Musiri Subramania Iyer, Semmangudi Srinivasa Iyer and others have sung numerous compositions of Sivan in their performances. Sivan's compositions cover a wide gamut of songs ranging from Varnams, krithis and operas to Padams and javalis.

Sivan compiled and brought out a rhyming Sanskrit Dictionary titled 'Sanskrittha Bhasha Sabhta Samudhaha' in 1952. The last works of Sivan were 'Sri Rama Charitha Geetham', the Ramayana epic sung in 24 stanzas in 24 ragas and 'Kaaraikkal Ammaiyar Charitham'. Both these operas have published in book form.

## **Kuchippudi**

The name Kuchippudi denotes both the dance style that has come to prominence since the fifties and the tiny remote village where it was born. Kuchippudi village is situated in the Krishna district of Andhra Pradesh. Six miles away from it lies Srikakulam, the ancient capital of the Satavaha empire, Movva the birth place of Kshetryna, the great composer of devotional Padams is about two miles away from Kuchippudi. Thus the whole vicinity of Kuchippudi was filled with flavours or art. The history of Andhra has influenced this art very much. The Satavahana dynasty had patronised 300 Devadasis. With the rise of Buddhism and Jainism, Devadasis lost the royal patronage. But with advent of Jayappa who was a follower of Shiva cult, devadasis regained their earlier stature. In this period Jayadeva's Geet Govinda became very popular and also Narayana Tirtha propagated Krishna cult and wrote the Tarangams which became a part of Kuchippudi.

Into this prevailing atmosphere of Krishna intoxication was born a boy named Siddappa. He was a profound scholar and dedicated artist. He released himself from the family ties and came to be known as Siddhendra Yogi. He began to propagate the Bhama cult known as Madhura Bhakthi. He imagined himself to be Satyabhama longing to unite with Sri Krishna and keep him entirely to herself. In this ecstasy, song after song poured out of Siddhendra's heart and this when compiled together became the vehicle of an unsurpassed beauty which came to be called Bhamakalapam. The temple

dancers and court dancers wanted to learn this but Siddhendra did not want to pollute the Madhura Bhakthi, so he initiated young Brahmin boys into the art and taught them Bhamakalapam. Under Siddappa's leadership they travelled from village to village performing these dances and came to be called Kuchilu. Brahmins started treating Kuchilu as socially inferior, so Siddhendra took them to a wasteland and made residential settlement which was gradually transformed into a village known as Kuchilapudi, the abode of dancer – actors. This was later shortened as Kuchippudi.

Kuchippudi is based on Bharata's Natyashastra. The four aspects of abhinaya i.e Angika, Vachika, Aharya and Satvika are found in ample measure in Kuchippudi style. Vachika abhinaya is a special feature of Kuchippudi where the dancers not only dance but also act with gestures and words. Siddhendra Yogi can be called the father of Kuchippudi as he changed the simple folk steps into classical ones. Tala patterns were introduced, delicacy was brought to acting, the language also acquired classical polish and dignity, the music used is strictly classical and the lyrics are specially composed. There are some 20 Shabdams, Jatiswarams and new compositions are added now and then whenever the need arose. Jayadeva's Geet Govinda, Narayana Tirtha's Tarangams and Padams from Kshetrappa and Shiv Tandavams form the Kuchippudi repertoire. Kuchippudi in the present form is the work of Late Shri Vedantam Lakshminarayan Shastri who taught the male dominated dance to women dancers.

## **Odissi**

Odissi is one of the oldest dance forms of Orissa. Jagannath temple is the birth place of Odissi. Even now the temple is the main source of development for this art form. Thousands of Mahiris perform in the temple as part of worship to Lord Jagannath. The kings and temple authorities used to support the Mahiris. To keep up this dance forms alive they used to adopt girls.

Angika abhinaya is of prime importance in Odissi. The sculpturous poses gave this dance form an additional beauty. It has Vaishnavite influence, so Geet Govinda is the popular theme and Radha and Krishna, the favourite couple. In 12<sup>th</sup> century only the female dancers called Mahiris used to perform in Jagannath temple but by 19<sup>th</sup> century the male dancers known

as Gotipuvras also started learning this art and started dancing in temples. The predominant rasa in Odissi is Sringara.

Like other dance forms Odissi also had its set back due to the social elements but after independence, girls from respectable families took up this great art form and regained its lost glory. Sanjukta Panigrahi and her guru Kelucharan Mohapatra were responsible in popularising this art.

This art is basically a religious art so the theme is taken from Geet Govinda and Krishna Leela Tarangini. Ashtanayika is a popular item. Adavus are known by the name of Bhangu and poses are known as Karno. Odissi is the only form in which Karanas from Natyashastra are fully utilised.

From 1077 to 1147, Chaud Gangadev established Jagannath Puri and in that there is a mention of Odissi dance. Twice in a day this art was offered to the deity during Arti and Mahiris performed and sang in praise of Shri Jagannath. The music is based on classical Hindustani music.

## **Conclusion**

In my dissertation Drama Theory and Practice, stands apart from many other books in this category in terms of content and approach.

Human acts with an artistic touch, such as dance and drama, are born and grow out of practice, not out of any competition. On closer inspection, some people find the verb germ to be more intimate than others, which is generally referred to as instinct. We need the help of a grateful teacher to nurture our instincts through practice.

Explaining the theory and practice of drama, this book has 9 chapters on dance, abhinaya, bhava – rasa , angikabhinaya, adavus, bharathanatyam items, tala, natyuvangam , Nattuvanars And History etc. In the first chapter contains a touching description of the history of dance and the last one contains facts about famous South Indian talented dancers. Others include descriptions of the theoretical theories of theatrical art and suggestions for problems in practice on stage. This dissertation progresses with a special emphasis on expression in acting and the simple use of gestures and adavus to make students understand.

It is said that in ancient times the arts were the private property of an elite class. That is not entirely correct. Only elite art was considered in the category of art. The artistic performances of the downtrodden were confined to the liturgy of the communities. Elite art is also confined to an elite section of the society. But their content and evolution show that these two tissues were not in watertight chambers. The Margi traditions, which are enduring Indian sciences in the fine arts, as well as the national traditions in the indigenous communities, as well as elements from the folk art of the common people in the respective regions, can be traced. Elements of the scientific arts are not inaccessible to the artistic performances of local communities. In any case, in today's social systems, the distinction between the elite and the inferior is irrelevant.

Although the book is about drama, it seems to highlight the dance forms of Bharathanatyam and Kuchippudi and their parts. Kerala is a country where the Indian tradition of Natyavedi exists in its ancient form of expression. There is also a caste that made the art of drama a genocide. Thus Kerala has a long tradition and history of caste-based drama. Therefore, Kerala's relationship with theatrical art is not merely contextual.

It is in these strong threads of tradition that the present day dance scene in Kerala is shaped by its interaction with contemporary needs. At venues such as the Youth festival, there is a growing perception that arts enjoyment is becoming a bargaining chip that has both insider and enjoyable levels. That is a fact to a large extent. This dissertation, drama theory and practice, is also a constructive response to such objections as if the verb were merely an answer.

It is not a trivial matter that it can be effectively told over time to find new meaning in saying that acting is quadrupedal and that dance is derived from Shiva.

There is an Indian concept called Guru parampara. Each teacher is not only an individual but also a representative of a tradition. There is a long series from Bhathan onwards. Those who come later do not blindly follow those who have gone before, otherwise there will be no local stylistic variations in the practice of Bharathanatyam science all over India. That is why the art traditions remains perpetually innovative as the ancestors are studied, modified and renewed from time to time.

My dissertation is divided into nine chapters . There is a rejection of the ancient concept in the very first chapter which discusses the beginning of dance. This replaces the blind belief that Shiva and Parvati are the creators of Tandava and Lasya and concludes that Parvati is the symbol of supreme personality of God head and nature, and therefore origin of the universe itself through dance. Similarly, it is established that the drama originated from primitive man and is an art. The second chapter on acting also rejects some of the old notions. One of them is that there are no Chaturvidha Abhinayas. Sathvikabhinaya is exempted from this. In the expressions discussed in chapter three , traditional method is questioned. Different views of Abhinavagupta, Shankuka, Hemendra, Bhoja etc were raised after Bharata.

In the fourth chapter angikabhinaya are discussed a lot. The verses in Abhinayadarpanam explain the benefits of each mudras in acting. The text does

not say how mudras can be used in each act. It also briefly describe the method of applying the mudra based on certain Tamil texts. It also gives instructions on how to show Deva Hastah, Bandhu Hastah and Ashtadhikpala Hastah.

Adavus are explained in the fifty chapter . There are no explanations for how to make each adavu. I am convinced that writing like that is useless. Exercises to tame the body are explained before starting to practice the Adavus. It was written to illustrate the importance of learning dance.

Chapter six gives only general regarding items. Chapter seven describes the talas of carnatic music, it also features the talas found in Sanskrit and Dravidian circles. Attempts to explain how talas are created. This chapter gives you knowledge, to organise your own jathis and theermanas and to set mathras in systematic terms.

Chapter eight contains training lessons for those who want to practice nattuvangam. It is not found in any other book. Those are all lessons that are shaped by light in self experience. The last chapter in history records a history that only touches on the artistic careers of certain geniuses.

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- Tandava Lakshanam  
Veda Bandhu  
Department of culture, government of Kerala



Project Report

On

# FETAL HEALTH CLASSIFICATION

*Submitted*

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

MASTER OF SCIENCE

*in*

APPLIED STATISTICS AND DATA ANALYTICS

*by*

MEERA AJAYAKUMAR

(Register No. SM20AS016)

(2020-2022)

*Under the Supervision of*

MS.ANU MARY JOHN



DEPARTMENT OF MATHEMATICS AND STATISTICS

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APRIL 2022



## CERTIFICATE

This is to certify that the dissertation entitled, **FETAL HEALTH CLASSIFICATION** is a bonafide record of the work done by Ms. **MEERA AJAYAKUMAR** under my guidance as partial fulfillment of the award of the degree of **Master of Science in Applied Statistics and Data Analytics** at St. Teresa's College (Autonomous), Ernakulam affiliated to Mahatma Gandhi University, Kottayam. No part of this work has been submitted for any other degree elsewhere.

Date: *26/05/2022*

Place: Ernakulam

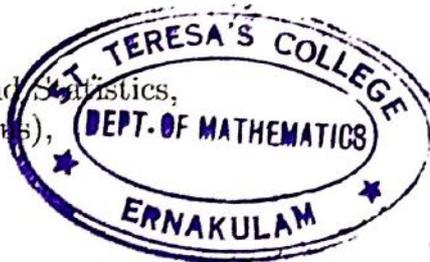
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## DECLARATION

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

Ernakulam.

Date: 09 / 05 / 2022



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In addition, the very energtic and competitive atmosphere of the Department had much to do with this work.

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# ABSTRACT

Pregnancy is a cycle that invites us to give upon the hidden power of all life. A stable pregnancy is a good thing. The likelihood of safe pregnancy is increased by timely and daily fetal treatment. But perinatal mortality is an alarming issue in the world which needs immediate attention. To address this issue both intrapartum and antepartum fetal health state monitoring is essential. Fetal and maternal risk can be assessed by monitoring the fetal heart rate. Cardiotocography records the fetal heart rate and uterine contractions and it is this CTG data which is used in this study. This study mainly focus on analyzing the fetal state using four supervised machine learning models which are gradient boosting, random forest, decision tree and k-nearest neighbors. It also focuses on analyzing the results after applying a dimensionality reduction which is principal component analysis. The modeling results proved that gradient boosting algorithm is the optimal model of choice for the dataset used as it has relatively highest combination of precision, recall and F scores. Also after applying principal component analysis it is observed that all the models gave higher accuracies than that was obtained before reducing the dimension of the dataset.

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# Chapter 1

## Introduction

---

### 1.1 Fetal health detection and its importance

A foetus or fetus is an unborn offspring of an animal that develops from an embryo. It is after the embryonic development the fetal stage of development takes place. In human beings the fetal development begins from the ninth week after fertilization and continues until birth. A fetus is characterized by the presence of all the major body organs, though all the body parts may not be fully developed yet. The period of first three months of pregnancy is called as the first trimester. It is the earliest phase of pregnancy also It is a time of great anticipation and of rapid changes for both mother as well as the baby. Detection of fetal health plays a major role in this period of pregnancy.

**Fetal monitoring:** During pregnancy period the most significant procedure to be done is to check the health of the unborn baby that is the fetus. This procedure is mainly done by checking the baby's heart rate and other functions. Monitoring can be done in two ways. One is internal monitoring and the other is external monitoring. Fetal heart rate monitoring is used to check the rate and pattern of the heartbeats. This is done by checking for increases and decreases in the baby's heart-beat. It also checks the change in heartbeat per second. The average fetal heart rate is between 110 and 160 beats per minute. An abnormal pattern may mean that the baby is not getting enough oxygen or there are other problems.

**Risk associated with fetal monitoring:** There are no known physical risks detected with external monitoring. But there may be a slight risk of infection with internal monitoring. The device used for internal monitoring may cause a mark or small cut on the baby's head. But this often heals quickly. An abnormal fetal heart rate pattern doesn't always mean the baby is in danger. But electronic fetal monitoring can be fatal depending upon the health conditions of mother and the baby.

**Advantages of fetal monitoring:** The researches show that continuous fetal monitoring improves birth outcomes. This helps in detecting the health of fetus at an early stage of pregnancy which is not only associated with oxygen deprivation problems. This procedure gives a reassurance and reduces stress throughout the months of pregnancy. During this time the fetal heart is displayed on a digital screen so that the mother is able to see and feel the baby's heart beats. Continuous monitoring allows a doctor to track whether the baby's heart is responding at all times. This information is often made use to make decisions about when the labor is to be conducted.

**Disadvantages of fetal monitoring:** As it is said, every process has its own disadvantages fetal monitoring has also got few disadvantages. External monitoring may restrict the mother's movements during labor as it needs to be kept on baby's heart. The process should not be always carried out for monitoring women at low risk. Internal monitoring has a high chance of transmitting HIV infection to the baby if the mother is HIV positive.

## 1.2 General awareness of the problem

A major contributor to under-five mortality is the death of children in the first three months of life. It is therefore receiving particular attention from health authorities. According to the UNICEF data the first 28 days of life called the neonatal period is the most vulnerable time for a child's survival. Children face the highest risk of dying in their first month of life. The average global rate of 17 deaths per 1000 was recorded in the year 2019. A systematic analysis of global, region

and national causes of child mortality identified preterm birth complications and infections to be two major causes of neonatal deaths across the world. Studies show that the neonatal mortality rate is the highest in India with 522 deaths per 1000 followed by Nigeria and Pakistan. This high and uneven numbers of neonatal mortality reflects the global inequities of access to medical services and medical treatment. The fact that these disparities in mortality rates persist even between high income and low income women living in rural as well as urban areas becomes the reason for this to remain the leading cause of death in developing countries as well. In order to assess fetal well being and monitor for increased risk of complications during pregnancy, cardiotocography (CTG) is a widely used method of continuously measuring and recording the fetal heart rate (FHR) and uterine contractions during pregnancy. Uterine contractions, the FHR along with its variability, reactivity and possible decelerations are important measurements for assessment of fetal well being. The FHR, uterine contractions and fetal movement activity collected from CTG data is utilized to identify dangerous situations for the fetus.

### 1.3 Fetal cardiotocography and its importance

Cardiotocography (CTG) is a form of electronic fetal monitoring which is usually used continuously. Modern day CTG was developed and introduced in the 1950s and early 1960s by Edward Hon, Roberto Caldeyro-Barcia and Konard Hammacher. CTG is mainly used during labour. It can be used as a tool to identify high risk women in the trimester period. When it is used continuously for monitoring, it provides a paper trace using Doppler ultrasound to record the baby's heartbeat and a pressure transducer is used to record the mother's contractions. The most common method used is external CTG where two separate probes are there to measure the heartbeat where the probes are attached to mother's abdomen and held in place by belts. In internal CTG a single probe is used to measure both heartbeat and contractions, here the probes are attached directly to the baby's head or bottom. For

either external or internal CTG the other sides of the probes are attached to the recorder by long wires. The basic concept of CTG results is achieved by evaluation of its three main components: basal frequency, variability and short term changes (accelerations and decelerations). Reviews have shown that use of cardiotocography reduces the rate of seizures in the newborn. When introduced, this practice was expected to reduce the incidence of fetal demise. Its use became almost universal for hospital births worldwide. Moreover, delivery decisions can also be made from the data obtained from CTG.

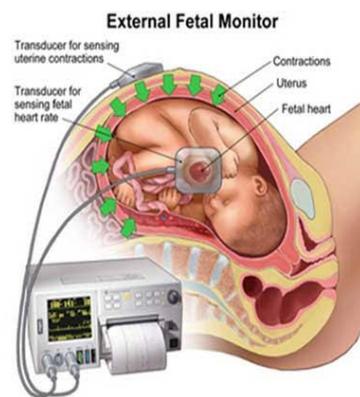


Figure 1.1: External Fetal Monitor

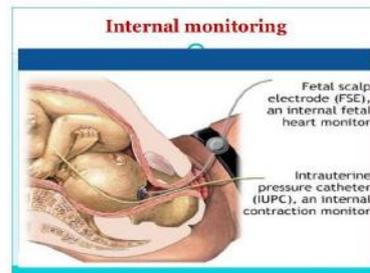


Figure 1.2: Internal Fetal Monitor

## 1.4 Specific objectives of the study

1. The objective of my study is to classify / predict the health of a fetus as normal, suspect or pathological (is at high risk) using 4 classification algorithms

- a) Gradient boost
- b) Decision tree

- c) Random forest.
  - d) KNN
2. To compare the results when a dimensionality reduction technique, principal component analysis is used.

# Chapter 2

## Literature Review

---

Safe pregnancy with normal delivery, physically and mentally sound baby is the yearning of almost all mothers. So perinatal care is of utmost importance for determining the appropriate delivery method, preparing the mother psychologically and physically

### 2.1 Literature Review

In ‘Classification of Fetal State from the Cardiotocogram Recordings using ANN and Simple logistic’, Hakan Sahin and Abdulhamit Subasi., (2012) presented a comparison of machine learning techniques using antepartum cardiotocography data. Here they have used two machine learning techniques which are ANN and Simple logistic. The CTG data was trained using these two models to predict the normal and pathological states. The classification results for two implementation methods were applied on the dataset. Two statistical indices sensitivity (Se) and specificity (Sp) were calculated and the accuracy of the two models was found. The accuracy obtained for ANN is 98.47 and for Simple Logistic accuracy is 98.74. According to these results, it is easily said that for this data type using Simple Logistic is more appropriate than ANN.

In ‘Classification of Cardiotocography Records with Naive Bayes’, Emre Avuçlu and Abdullah Elen., (2019) they have introduced the naïve bayes machine learning algorithm to classify the given CTG data recording. The Naïve Bayes Classifier is a simple probabilistic clas-

sification method based on Bayes theorem. In Bayes' theorem, two (and) random events occur one after the other. Bayes' theorem defines the relationship between a random event that arises from a random process and conditional probabilities and marginal probabilities for another random event. The various statistical measures used to analyze the classification results in this paper were precision, accuracy and F value. The result was 97.18 for training data and 95.68 for test data. Here they also discuss the fact that one of the disadvantages of naive bayes is that it works best with only small dataset.

In 'modeling fetal morphologic patterns through cardiotocography data: Decision tree-based approach', R. S. Kamath and R. K. Kamath., (2018) aims at decision tree (DT) modeling of fetal morphologic patterns by exploring cardiotocography (CTG). Decision tree model is the most commonly used data mining technique for classification and prediction. According to the paper, the revealed investigation delineates ideal decision tree architecture accomplished by tuning parameters such as min split, min bucket, max depth, and complexity. They have carried out the experiment in Rattle data mining platform to obtain optimum model structure by varying configuring tuning parameters of DT model. The results suggests that the derived decision tree model leads to values for tuning parameters such as min split, min bucket, max depth, and complexity are 20, 7, 30, and 0.01, respectively. The 1488 observations from the inputted dataset are considered for the construction of the tree. Root node error is 0.7211. Thus, derived DT model efficiently classifies validation data with very less error. This article suggests that the decision tree model has the potential to exhibit as the best tool for modeling of CTG data

The paper, 'use of machine learning algorithms for prediction of fetal risk using cardiotocographic data', Zahra Hoodbhoy, Mohammad No-man, Ayesha Shafique, Ali Nasim, Devyani Chowdhury, and Babar Hasan.,(2019)., studies the precision of machine learning algorithm techniques on CTG data in identifying high risk fetuses. Here they have trained the dataset with ten machine learning classification algo-

gorithms which are MLP, XGBoost classifier, decision tree, random forest, logistic regression, SVM linear kernel, SVM RBF kernel, KNN, naïve bayes, Adaboost. It also used SMOTE balancing technique to avoid the bias of the model toward skewed data, hence improving prediction accuracy of the machine learning algorithm. The results of this study showed that the model generated by the XG boost classifier algorithm gave maximum accuracy of 98 followed by SVM linear kernel and naïve bayes which gave an accuracy of 97 for test data.

In ‘Classification of the Cardiotocogram Data for Anticipation of Fetal Risks using Bagging Ensemble Classifier’, Abdulhamit Subasi, Bayader Kadasa, Emir Kremic., (2019) introduces several ensemble machine learning models examined to classify the CTG data as unhealthy or healthy based on the three obstetricians’ decisions. The contribution of this paper is to implement Bagging ensemble method to classify the CTG data. Here they have compared the performances of the single and ensemble learners utilizing the open source WEKA software in terms of F measure, accuracy and ROC area. The bootstrap aggregating (or bagging) is a simple ensemble learner which combines the base models for construction and aggregation in which base models are created using bootstrap samples of the training set and voting or averaging for the prediction. The experimental results reveal that the bagging ensemble method improved the classifier performance; specifically bagging with Random Forest achieved superior performance during the classification of CTG data. The Bagging with Random Forest achieved an accuracy of 99.02 with CTG data. Also the paper says that the highest ROC curve value belongs to RF as 0.999 nearly 1 as a single and ensemble classifier. It shows that the Random Forest can recognize the CTG data with high accuracy.

In ‘Intelligent classification of antepartum cardiotocography model based on deep forest’, Yandi Chen, Ao Guo, Qinqun Chen, Bin Quan, Guiqing Liu, Li Li, Jiaming Hong, Hang Wei, Zhifeng Hao., (2021) introduces a method to improve the classification accuracy by using Deep Forest (DF) algorithm. After data preprocessing, deep forest

multi-granularity scanning phase was used to explore the connection between the cases characteristic. Then the cascade forest phase, which was designed to integrate Random Forest (RF), Weighted Random Forest (WRF), Completely Random Forest (CRF) and Gradient Boosting Decision Tree (GBDT) as the basic classifiers, performed deep iterations and finally got the best performance model. Compared with the traditional machine learning models, deep neural network and the state-of-CTG classification models, the results show that the accuracy value, average F1 value and Area Under the Curve (AUC) value were 92.64 , 92.01 and 0.990 respectively in the external public data set, and were 91.64 , 88.92 and 0.9493 respectively in the internal private data set, which were the most excellent among all comparison models. In conclusion, the proposed DF model is effective and feasible, and has a good application prospect in the intelligent.

In ‘classifying the type of delivery from cardiotocographic signals: A machine learning approach’, C.Ricciardi G, F.Amato, G.Cesarelli, M.Romano ., (2020) a custom-made software is exploited to extract 17 features from the available CTG. A preliminary univariate statistical analysis is performed; then, five machine learning algorithms, exploiting ensemble learning, were implemented (J48, Random Forests (RF), Ada-boosting of decision tree (ADA-B), Gradient Boosting and Decorate) through Knime analytics platform to classify patients according to their delivery: vaginal or caesarean section. The performance of the algorithms was evaluated using 10 folds cross validation with different evaluation metrics: accuracy, precision, sensitivity, specificity, area under the curve receiver operating characteristic (AUCROC). The RF obtained the best results: accuracy (91.1), sensitivity (90.0) and AUCROC (96.7). The Ada-boost achieved the highest precision (92.6) and specificity (93.1). As expected, the lowest scores were obtained by J48 that was the base classifier employed in all the others empowered implementations. Excluding the J48 results, the AUCROC of all the algorithms was greater than 94.9.

In ‘Fetal Health State Monitoring Using Decision Tree Classifier from

Cardiotocography Measurements’, M.Ramla, S.Sangeetha, S.Nickolas., (2018) discuss an efficient method to predict the high-risk pregnancy based on the fetal health status using CART is proposed. 5-fold cross validation is done, and the proposed methodology using CART was quantified using precision, recall and F-score. CART is a decision tree algorithm used for classification and regression prediction problems. They provide the foundation for other algorithms like Random Forest, Bagged Trees and Boosted trees. CART can be represented as a binary tree. CART uses gini index to select the attribute which has maximum information. Accuracy of 88.87 is obtained using entropy calculation and accuracy of 90.12 is obtained using gini index. This work can be further extended by boosting and bagging techniques to achieve greater accuracy.

In ‘Fetal Health Status Classification Using MOGA-CD Based Feature Selection Approach’, Jayashree Piri, Puspanjali Mohapatra, Raghunath Dey., (2020) focused on an evolutionary multi-objective genetic algorithm (MOGA) for extracting important factors causing fetal death by cardiotocographic analysis of fetal evaluation. Using seven classification algorithms which are Logistic regression, Random forest, Decision tree, SVM, XG boost, Gradient Boost and KNN. In this article, to extract the most influential factors to assess fetal health status, the MOGA-CD approach is proposed as a feature selection mechanism. The classification accuracy of the reduced dataset is compared with other standard classifiers, following seven of the most significant features of 21, and it is found that DT, RF, GNB, SVM and Extreme Gradient Boosting perform well for the classification of fetal health status.

In ‘Enhanced Optimal Feature Selection Techniques for Fetal Risk Prediction using Machine Learning Algorithms’, J. Jayashree, Harsha T, Anil Kumar C, J. Vijayashree., (2020) examines the Fetal Risk Prediction using MRMR Feature Selection algorithm on four different Classifiers SVM Classifier. The performance of the proposed work is analyzed using the following metrics: accuracy, precision, recall and F-score. It also represents the comparison between the classifiers terms of

accuracy. The results of this work shows that four different Classifiers SVM Classifier with high F-score (97.6), sensitivity (97.6), Precision (97.3).SVM Classifier have got the maximum metrics percentage for MRMR Feature selection algorithm.

In ‘Fetal Health Classification Based on Machine Learning’, t Jiaming Li, Xiaoxiang Liu., (2021) examines twelve machine learning single models have firstly experimented on CTG dataset. Secondly, the soft voting integration method is used to integrate the four best models to build the Blender Model, and compared with the stacking integration method. Various classification model evaluations are used to evaluate and analyze all machine learning models, as well as the confusion matrix and ROC curve of the Blender Model. Experiments of this study shows that, compared with the traditional machine learning models, the Blender Model performed excellently in various classification Model evaluations , with an accuracy rate of 0.959, an A UC of 0.988, a recall rate o f 0.916, a precision rate of 0.959 , a F1 of 0.958 and a MCC of 0.886 .

The paper entitled ‘Fetal health classification from cardiotocographic data using machine learning’, Abolfazl Mehbodniya, Arokia Jesu Prabhu Lazar, Julian Webber, Dilip Kumar Sharma, Santhosh Jayagopalan, Kousalya K, Pallavi Singh, Regin Rajan, Sharnil Pandya and Sudhakar Sengan., (2021) deploys various ML algorithms to predict fetal health from the cardiotocographic (CTG) data by labeling the health state into normal, needs guarantee, and pathology. This work assesses the influence of various factors measured through CTG to predict the health state of the fetus through algorithms like support vector machine, random forest (RF), multi-layer perceptron, and K-nearest neighbors. In addition to this, the regression analysis and correlation analysis revealed the influence of the attributes on fetal health. The results suggest that random forest model performs best with an accuracy of 95 followed by support vector machine with 93 accuracy.

# Chapter 3

## Dataset and Exploratory Data Analysis

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### 3.1 Preliminaries (definitions of attributes in dataset)

Baseline value[FHR]	Average fetal heart rate
Accelerations	Short term rises in the heart rate per second
Fetal movement	Number of fetal movements per second
Uterine contractions	Number of uterine contractions per second
Light decelerations	Light decrease in the fetal heart rate per second
Severe decelerations	Severe decrease in the fetal heart rate per second
Prolonged decelerations	Number of prolonged decelerations per second
Abnormal short term variability	Time period of short abnormal variation in fetal heart rate
Mean value of short term variability	Mean value of time period of short variation in fetal heart rate
Percentage of time with abnormal long term variability	Percentage of time with abnormal long term variations in fetal heart rate
Mean value of long term variability	Mean value of time period of long variation in fetal heart rate
Histogram width	Width of fetal heart rate histogram
Histogram min	Minimum value of fetal heart rate histogram
Histogram max	Maximum value of fetal heart rate histogram
Histogram number of peaks	Number of peaks in the histogram
Histogram number of zeroes	Number of zeroes in the histogram
Histogram mode	Mode of fetal heart rate histogram
Histogram mean	Mean of fetal heart rate histogram
Histogram median	Median of fetal heart rate histogram
Histogram variance	Variance of fetal heart rate histogram
Histogram tendency	Central tendency of fetal heart rate histogram
Fetal health	1- Normal, 2-Suspect, 3- high risk

### 3.1.1 Data Sample

baseline_val	accelerati	fetal_mov	uterine_ct	light_dece	severe_de	prolongue	abnormal	mean_val	percentag	mean_val	histogram	fetal_health									
120	0	0	0	0	0	0	73	0.5	43	2.4	64	62	126	2	0	120	137	121	73	1	2
132	0.006	0	0.006	0.003	0	0	17	2.1	0	10.4	130	68	198	6	1	141	136	140	12	0	1
133	0.003	0	0.008	0.003	0	0	16	2.1	0	13.4	130	68	198	5	1	141	135	138	13	0	1
134	0.003	0	0.008	0.003	0	0	16	2.4	0	23	117	53	170	11	0	137	134	137	13	1	1
132	0.007	0	0.008	0	0	0	16	2.4	0	19.9	117	53	170	9	0	137	136	138	11	1	1
134	0.001	0	0.01	0.009	0	0.002	26	5.9	0	0	150	50	200	5	3	76	107	107	170	0	3
134	0.001	0	0.013	0.008	0	0.003	29	6.3	0	0	150	50	200	6	3	71	107	106	215	0	3
122	0	0	0	0	0	0	83	0.5	6	15.6	68	62	130	0	0	122	122	123	3	1	3
122	0	0	0.002	0	0	0	84	0.5	5	13.6	68	62	130	0	0	122	122	123	3	1	3
122	0	0	0.003	0	0	0	86	0.3	6	10.6	68	62	130	1	0	122	122	123	1	1	3
151	0	0	0.001	0.001	0	0	64	1.9	9	27.6	130	56	186	2	0	150	148	151	9	1	2
150	0	0	0.001	0.001	0	0	64	2	8	29.5	130	56	186	5	0	150	148	151	10	1	2
131	0.005	0.072	0.008	0.003	0	0	28	1.4	0	12.9	66	88	154	5	0	135	134	137	7	1	1
131	0.009	0.222	0.006	0.002	0	0	28	1.5	0	5.4	87	71	158	2	0	141	137	141	10	1	1
130	0.006	0.408	0.004	0.005	0	0.001	21	2.3	0	7.9	107	67	174	7	0	143	125	135	76	0	1
130	0.006	0.38	0.004	0.004	0	0.001	19	2.3	0	8.7	107	67	174	3	0	134	127	133	43	0	1
130	0.006	0.441	0.005	0.005	0	0	24	2.1	0	10.9	125	53	178	5	0	143	128	138	70	1	1
131	0.002	0.383	0.003	0.005	0	0.002	18	2.4	0	13.9	107	67	174	5	0	134	125	132	45	0	2
130	0.003	0.451	0.006	0.004	0	0.001	23	1.9	0	8.8	99	59	158	6	0	133	124	129	36	1	1
130	0.005	0.469	0.005	0.004	0	0.001	29	1.7	0	7.8	112	65	177	6	1	133	129	133	27	0	1
129	0	0.34	0.004	0.002	0	0.003	30	2.1	0	8.5	128	54	182	13	0	129	104	120	138	0	3
128	0.005	0.425	0.003	0.003	0	0.002	26	1.7	0	6.7	141	57	198	9	0	129	125	132	34	0	1
128	0	0.334	0.003	0.003	0	0.003	34	2.5	0	4	145	54	199	11	1	75	99	102	148	-1	3
128	0	0	0	0	0	0	80	0.5	0	6.8	16	114	130	0	0	126	124	125	1	1	3
128	0	0	0.003	0	0	0	86	0.3	79	2.9	16	114	130	0	0	128	126	129	0	1	3
124	0	0	0	0	0	0	86	0.3	72	4	12	118	130	1	0	124	124	125	0	0	3
124	0	0	0	0	0	0	86	0.4	14	4.8	24	122	146	1	0	126	126	127	0	-1	3

## 3.2 Exploratory Data Analysis

In data mining exploratory data analysis (EDA) is an approach to analyzing datasets to summarize their main characteristics, often with visual methods. EDA is used for seeing what the data can tell us before the modeling task. As it is not easy to look at a column of numbers and determine important characteristics of the data. In such situations exploratory data analysis techniques have been designed as an aid. It is important to identify various patterns in the dataset before performing an algorithm. EDA also helps in determining which variables are important and which do not play a significant role in the output. Fur-

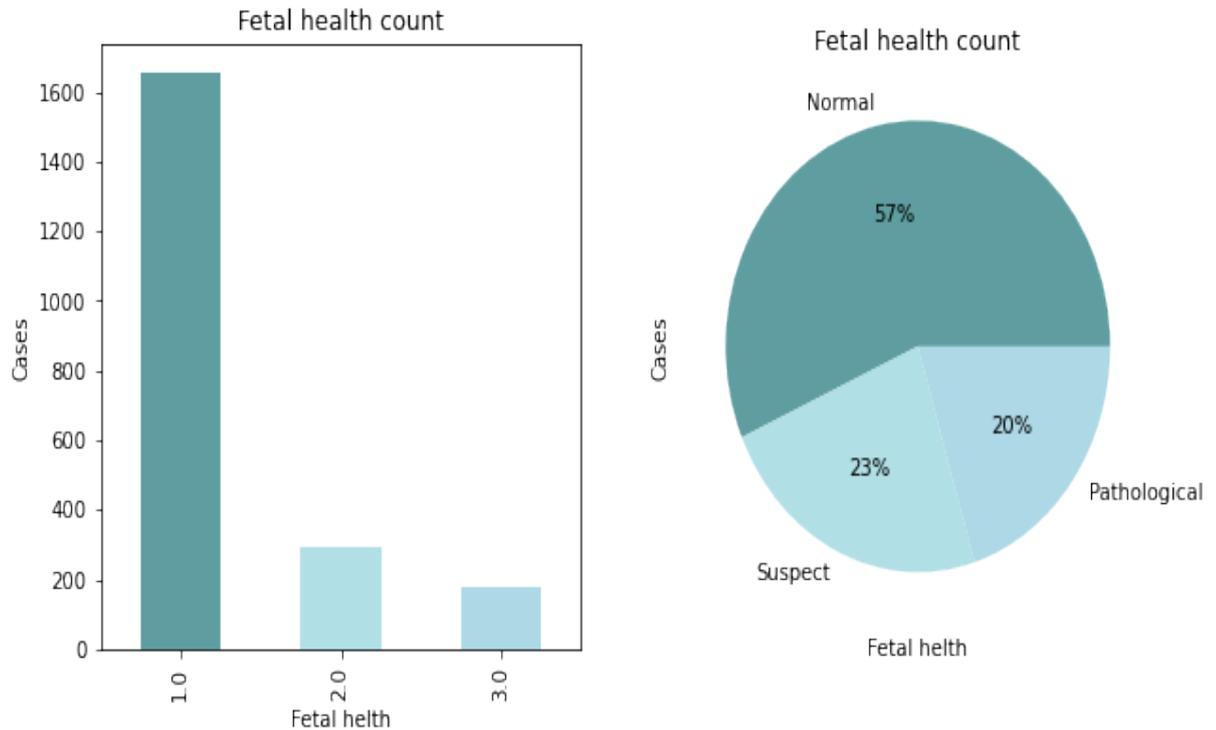


3. Analyzing the statistical values: Here We use the describe() function for our target column to show the descriptive statistics include those that summarize the central tendency, dispersion, and shape of a dataset's distribution, excluding NaN values. The principle challenge is to classify the fetal health in order to prevent child and maternal mortality. So get the info about the column of "fetal health" which was classified by three expert obstetricians into 3 classes:

1. Normal
2. Suspect
3. Pathological

count	2126.0000
mean	1.304327
Standard deviation	0.614377
minimum	1.000000
25%	1.000000
50%	1.000000
75%	1.000000
maximum	3.000000

4. Visualization of target column "Fetal Health": Data visualizations of "fetal health" column makes easier to understand the fetal state, and visualization also makes it easier to detect patterns of the fetal state (Normal, Suspect and Pathological). Hence a bar plot and a pie chart is used to visualize the target column which is "fetal health". The figures given below shows that the number of 'Normal' cases is more followed by 'Suspect' cases followed by 'Pathological' cases. The pie chart also gives a brief idea of the percentage of each case



5. Checking correlation of numeric features with output variable “Fetal health”: Correlation means association. More precisely it is a measure of the extent to which two variables are related. There are three results of a correlation study. They are

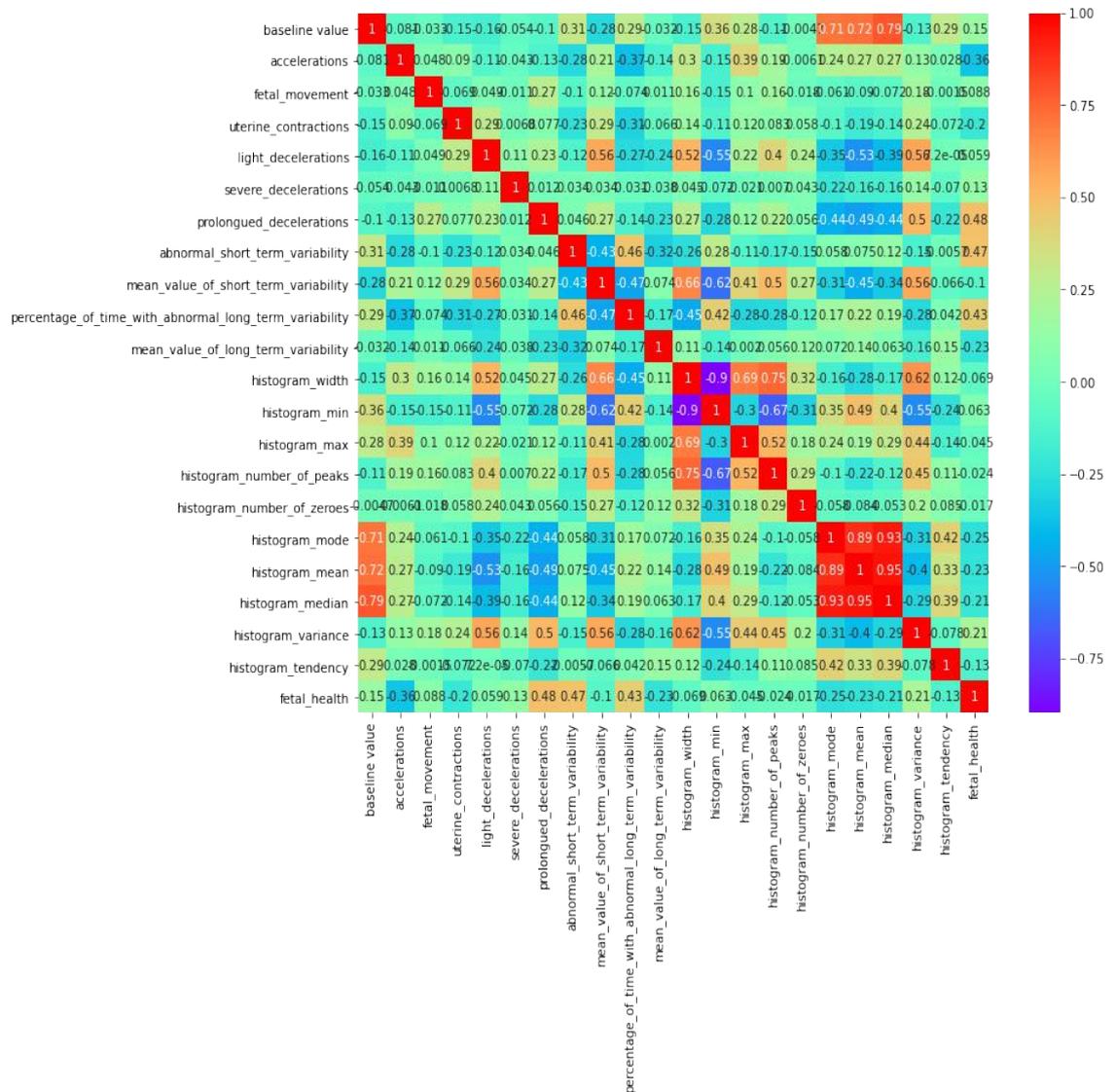
- A positive correlation: Is a relationship between two variables in which both variables move in the same direction. Therefore as one variable increases the other variable increases, or one variable decreases as the other decreases.
- A negative correlation: Is a relationship between two variables in which an increase in one variable is associated with a decrease in the other.
- A zero correlation: It exists when there is no relationship between two variables

Here, we want to show the correlation between numerical features and the target ”fetal health”, in order to have a first idea of the connections between features. The table given below shows the correlation of each feature with the target column “fetal health”.

Features	Fetal health
Fetal health	1.00000
Prolonged decelerations	0.484859
Abnormal short term variability	0.471191
Percentage of time with abnormal long term variability	0.426146
Histogram variance	0.206630
baseline value	0.148151
Severe decelerations	0.131934
Fetal movement	0.088010
Histogram min	0.063175
Light decelerations	0.058870
Histogram number of zeroes	-0.016682
Histogram number of peaks	-0.023666
Histogram max	-0.045265
Histogram width	-0.068789
Mean value of short term variability	-0.103382
Histogram tendency	-0.131976
Uterine contractions	-0.204894
Histogram median	-0.205033
Mean value of long term variability	-0.226797
Histogram mean	-0.226985

From the above table it is clear that three features: prolonged decelerations, abnormal short term variability, percentage of time with abnormal long term variability have high correlation with the target column “fetal health” and four features Uterine contractions, Histogram median, Mean value of long term variability, Histogram mean are highly negatively correlated.

6. Heat map: A heat map is a two-dimensional representation of information with the help of colors. Heat maps can help the user visualize simple or complex information. Correlation heat maps are ideal for comparing the measurement for each pair of dimension values.



From the above figure it is clear that the variables Histogram median, Histogram mode and Histogram mean are highly positively correlated which shows that the significance of all the three variables in determining the target column “fetal health” is same. Also the two variables Histogram min and Histogram max are highly negatively correlated. But since all the features are of utmost important none of the features will be removed from the dataset.

## Chapter 4

# Model Building and Performance

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### 4.1 Model Building

The model building process involves setting up ways of collecting data, understanding and paying attention to what is important in the data to answer the questions, finding a statistical, mathematical or a simulation model to gain understanding and make predictions. A machine learning model is built by learning and generalizing from training data, then applying that acquired knowledge to new data it has never seen before to make predictions and fulfill its purpose. The dataset used in this study is split into two; one for training and the other one for testing, in the ratio 4:1. Now the classification algorithms are modeled over the training dataset and their accuracy, precision, recall and f1 score are evaluated. The algorithms used here are Gradient boost, Random forest, Decision tree and K-Nearest Neighbors. Model Performance Analysis

- **Classification Report:** Report which includes Precision, Recall and F1-Score.

1. **Precision** - Precision is the ratio of correctly predicted positive observations to the total predicted positive observations.

$$Precision = \text{Number of Correctly classified} / \text{total predicted points} \quad (4.1)$$

2. **Recall (Sensitivity)** - Recall is the ratio of correctly predicted

positive observations to the all observations in actual class - yes.

$$\text{Recall} = \text{Number of correctly classified} / \text{Actual total points} \quad (4.2)$$

3. F1 score - F1 Score is the weighted average of Precision and Recall. Therefore, this score takes both false positives and false negatives into account. Intuitively it is not as easy to understand as accuracy, but F1 is usually more useful than accuracy, especially if there is an uneven class distribution. Accuracy works best if false positives and false negatives have similar cost. If the cost of false positives and false negatives are very different, it's better to look at both Precision and Recall.

$$\text{F1 Score} = 2(\text{Recall Precision}) / (\text{Recall} + \text{Precision}) \quad (4.3)$$

4. Accuracy - The accuracy of a classifier is given as the percentage of total correct predictions divided by the total number of instances

$$\text{Accuracy} = \text{Number of correctly classified points} / \text{total number of points} \quad (4.4)$$

5. Confusion Matrix: The confusion matrix is a specific table layout that allows visualization of performance of an algorithm. Each row represents the instances in an actual class while each column represents the instances in prediction.

#### 4.1.1 Model Selection and Results

- **GRADIENT BOOST:** Gradient boosting is a machine learning technique used in regression and classification tasks, among others. It provides a prediction model in the form of an ensemble of weak prediction models, which are typically decision trees. When a decision tree is the weak learner, the resulting algorithm is called gradient-boosted trees; it usually performs better than random forest. A gradient-boosted trees model is built in a stage-wise fashion as in other methods, but it generalizes the other methods by permitting optimization of an arbitrary differentiable loss function.

Classification report:

	precision	recall	F1 score
1	0.97	0.97	0.97
2	0.87	0.83	0.85
3	0.88	0.97	0.92

Accuracy: 0.9460093896713615

## Confusion matrix:

$$\begin{bmatrix} 314 & 16 & 3 \\ 10 & 54 & 0 \\ 1 & 0 & 28 \end{bmatrix}$$

- RANDOM FOREST

It is a supervised machine learning algorithm that is used widely in classification and regression problems. One of the most important features of random forest algorithm is that it can handle the dataset containing continuous variables as in the case of regression and categorical variables as in the case of classification. It performs better results for classification problems.

Classification report:

	precision	recall	F1 score
1	0.96	0.98	0.97
2	0.88	0.78	0.83
3	0.93	0.90	0.91

Accuracy: 0.9460093896713615

## Confusion matrix:

$$\begin{bmatrix} 327 & 5 & 1 \\ 13 & 50 & 1 \\ 1 & 2 & 26 \end{bmatrix}$$

- **DECISION TREE**

Decision tree is one of the predictive modeling approaches used in statistics, data analytics and machine learning. It uses a decision tree (as a predictive model) to go from observations about an item (represented in the branches) to conclusions about the item's target value (represented in the leaves). Tree models where the target variable can take a discrete set of values are called classification trees; in these tree structures, leaves represent class labels and branches represent conjunctions of features that lead to those class labels.

Classification report:

	precision	recall	F1 score
1	0.97	0.94	0.95
2	0.77	0.84	0.81
3	0.90	0.97	0.93

Accuracy: 0.9295774647887324

Confusion matrix:

$$\begin{bmatrix} 314 & 16 & 3 \\ 10 & 54 & 0 \\ 1 & 0 & 28 \end{bmatrix}$$

- **K-NEAREST NEIHBORS** It is one of the simplest machine learning algorithms based on supervised learning technique. K-NN can be used for regression as well as for classification but mostly it is used for classification problems. It is also called a lazy learner algorithm because it does not learn from the training dataset immediately instead it stores the dataset and at the time of classification it performs an action on the dataset.

Classification report:

	precision	recall	F1 score
1	0.91	0.95	0.93
2	0.63	0.56	0.60
3	0.95	0.69	0.80

**Accuracy:** 0.8732394366197183

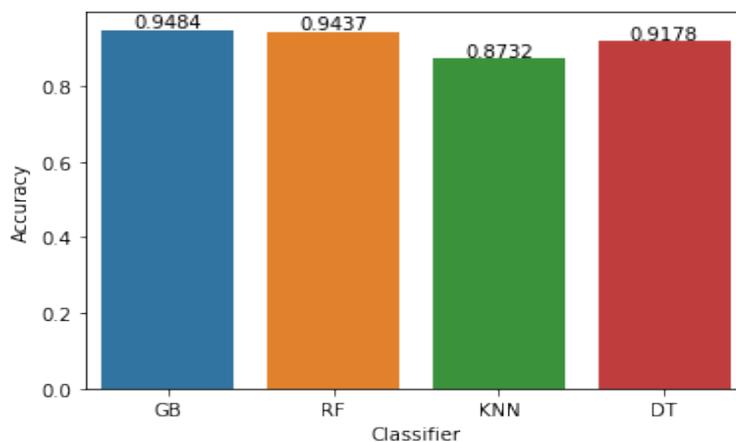
**Confusion matrix:**

$$\begin{bmatrix} 316 & 16 & 1 \\ 28 & 36 & 0 \\ 4 & 5 & 20 \end{bmatrix}$$

## COMPARISON OF THE ABOVE RESULTS

MODEL	ACCURACY SCORE
Gradient boosting	0.948357
Random Forest	0.943662
Decision Tree	0.917840
K-Nearest Neighbors	0.873239

## Graphical representation



The above comparison shows the accuracy scores of classification algorithms. Clearly it can be concluded that gradient boosting is an optimal model of choice of the given dataset as it has relatively the highest combination of accuracy followed by random forest, Decision tree and K-Nearest Neighbors.

## Chapter 5

# Principal Component Analysis

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### 5.1 Definition

Principal Component Analysis is an unsupervised learning algorithm that is used for the dimensionality reduction in machine learning. It is a statistical method that converts the observations of correlated features into a set of linearly uncorrelated features with the help of orthogonal transformation. These newly obtained transformed features are called the Principal Components. It is one of the popular tools that is used for exploratory data analysis and predictive modeling. It is a technique to draw strong patterns from the given dataset by reducing the variances.

PCA generally tries to find the lower-dimensional surface to project the high-dimensional data. PCA works by considering the variance of each attribute because the high attribute shows the good split between the classes, and hence it reduces the dimensionality. Some real-world applications of PCA are image processing, movie recommendation system, optimizing the power allocation in various communication channels. It is a feature extraction technique, so it contains the important variables and drops the least important variable.

The PCA algorithm is based on some mathematical concepts such as:

- o Variance and Covariance
  - o Eigen values and Eigen factors
- Some common terms used in PCA algorithm:

o **Dimensionality:** It is the number of features or variables present in the given dataset. More easily, it is the number of columns present in the dataset.

o **Correlation:** It signifies that how strongly two variables are related to each other. Such as if one changes, the other variable also gets changed. The correlation value ranges from -1 to +1. Here, -1 occurs if variables are inversely proportional to each other, and +1 indicates that variables are directly proportional to each other.

o **Orthogonal:** It defines that variables are not correlated to each other, and hence the correlation between the pair of variables is zero.

o **Eigenvectors:** If there is a square matrix  $M$ , and a non-zero vector  $v$  is given. Then  $v$  will be Eigen vector if  $Av$  is the scalar multiple of  $v$ .

o **Covariance Matrix:** A matrix containing the covariance between the pair of variables is called the Covariance Matrix.

#### STEPS FOR PCA ALGORITHM

1. **Getting the dataset:** Firstly take the input dataset and divide it into two subparts  $X$  and  $Y$ . Where  $X$  is the training set and  $Y$  is the validation set.

2. **Representing data into a structure:** Now represent the dataset into a structure. Such as we will represent the two-dimensional matrix of independent variable  $X$ . Here each row corresponds to the data, and the column corresponds to the Features. The number of columns is the dimensions of the dataset.

3. **Standardizing the data:** In this step, standardize the dataset. Such as in a particular column, the features with high variance are more important compared to the features with lower variance. If the importance of features is independent of the variance of the feature, then we will divide each data item in a column with the standard deviation of the column. Here we will name the matrix as  $Z$ .

4. **Calculating the Covariance of  $Z$ :** To calculate the covariance of  $Z$ , we will take the matrix  $Z$ , and will transpose it. After transpose, we will multiply it by  $Z$ . The output matrix will be the Covariance matrix of  $Z$ .

5. Calculating the Eigen Values and Eigen Vectors: Now, calculate the Eigen values and eigenvectors for the resultant covariance matrix  $Z$ . Eigenvectors or the covariance matrix are the directions of the axes with high information. And the coefficients of these eigenvectors are defined as the Eigen values.

6. Sorting the Eigen Vectors: In this step, take all the Eigen values and will sort them in decreasing order, which means from largest to smallest. And simultaneously sort the Eigen vectors accordingly in matrix  $P$  of Eigen values. The resultant matrix will be named as  $P^*$ .

7. Calculating the new features Or Principal Components: Now calculate the new features. To do this, we will multiply the  $P^*$  matrix to the  $Z$ . In the resultant matrix  $Z^*$ , each observation is the linear combination of original features. Each column of the  $Z^*$  matrix is independent of each other.

#### USES OF PCA

- One of the main challenges faced by analysts is the redundancy in the data. Here by reducing the dimension using PCA the redundancy in the data reduces which in turn helps in reducing the computation time.

- Principal components are independent of each other hence it removes correlated features.

- PCA improves the performance of the machine learning algorithms as it eliminates correlated features that don't contribute in any decision making.

- PCA helps in overcoming data over fitting issues by decreasing the number of features.

- PCA results in high variance and hence improves visualization.

- Reduction of noise since the maximum variation basis is chosen and so the small variations in the background are ignored automatically.

##### 5.1.1 Model Selection and Results after applying PCA

The dataset used in this study has been reduced into 14 components from 23 components using principal component analysis. It is then split

into two; one for training and the other one for testing, in the ratio 4:1. Now the classification algorithms are modeled over the training dataset and their accuracy, precision, recall and f1 score are evaluated. The algorithms used here are Gradient boost, Random forest, Decision tree and K-Nearest Neighbor.

## 5.2 Why 14 components

It is understood that the number of dimensions can be reduced from 22 to 14 while preserving 95 percentatge of its variance. Hence, the compressed dataset is now 60 percentage of its original size.

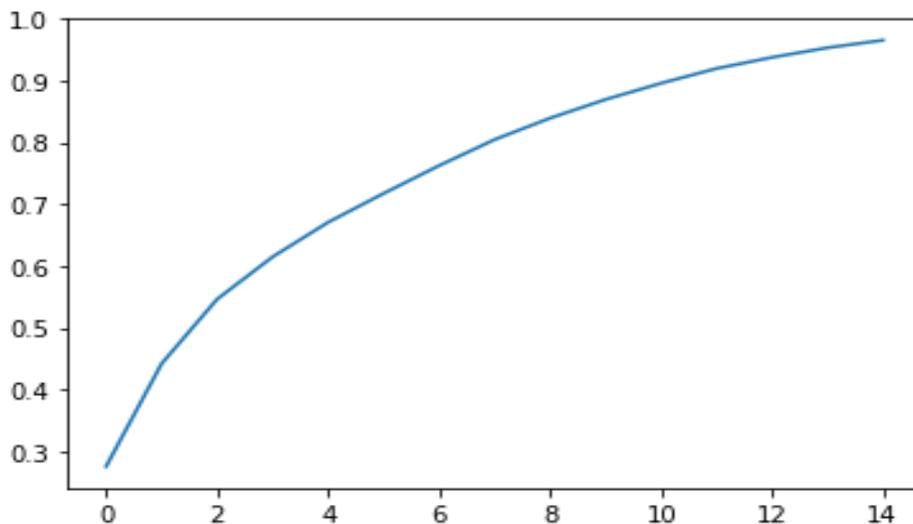
Looking at the plot of the explained variance as a function of the number of principal components, we observe an elbow in the curve. The optimal number of principal components is reached when the cumulative variance stops growing fast.

```
d=np.argmax(cumsum>=0.95)+1  
print (d)
```

```
14
```

```
plt.plot(np.cumsum(pca.explained_variance_ratio_))
```

```
[<matplotlib.lines.Line2D at 0x7fadb712e590>]
```



## REDUCED PRINCIPAL COMPONENTS

```
array([[ -0.23500502,  2.92935745,  1.18325108, ...,  1.21509629,
         1.70940705,  0.74346033],
       [ 1.9366776 , -2.41041186, -0.68376205, ..., -0.34379969,
        -0.27110867, -1.22087484],
       [ 1.95423383, -2.1735663 , -0.87394504, ..., -0.18758241,
        -0.14764106, -1.36128888],
       ...,
       [-2.09312038, -0.37453849,  1.81872779, ...,  0.10087283,
        -0.24326022, -0.13936605],
       [-2.08648319, -0.29955705,  1.92667035, ..., -0.10170511,
        -0.21004259,  0.01996002],
       [-2.32018019,  0.51341244,  0.66692193, ...,  0.24024836,
         0.2713143 ,  0.12780939]])
```

- GRADIENT BOOST

Classification report:

	precision	recall	F1 score
1	0.99	1.00	0.99
2	0.98	0.94	0.96
3	0.97	1.00	0.98

Accuracy: 0.9882629107981221

Confusion matrix:

$$\begin{bmatrix} 332 & 1 & 0 \\ 3 & 60 & 1 \\ 0 & 0 & 29 \end{bmatrix}$$

- RANDOM FOREST

Classification report:

	precision	recall	F1 score
1	0.98	1.00	0.99
2	1.00	0.89	0.94
3	1.00	1.00	1.00

Accuracy: 0.9835680751173709

Confusion matrix:

$$\begin{bmatrix} 333 & 0 & 0 \\ 7 & 57 & 0 \\ 0 & 0 & 29 \end{bmatrix}$$

- DECISION TREE

Classification report:

	precision	recall	F1 score
1	0.97	0.96	0.97
2	0.77	0.83	0.80
3	0.93	0.93	0.93

Accuracy: 0.9366197183098591

Confusion matrix:

$$\begin{bmatrix} 321 & 12 & 0 \\ 7 & 55 & 2 \\ 0 & 2 & 27 \end{bmatrix}$$

- **K-NEAREST NEIHBORS**

Classification report:

	precision	recall	F1 score
1	0.97	1.00	0.98
2	0.93	0.83	0.88
3	0.96	0.90	0.93

Accuracy: 0.9647887323943662

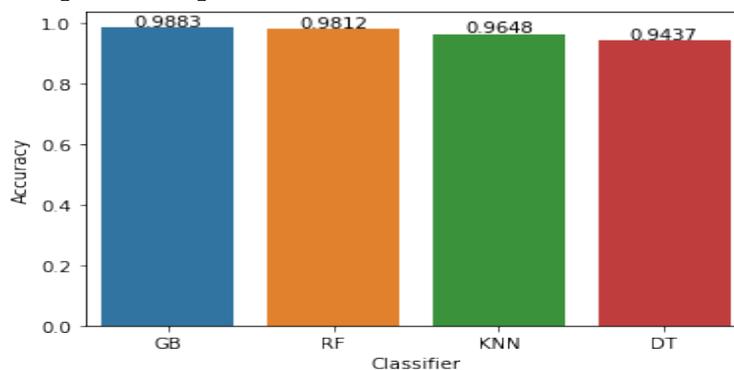
Confusion matrix:

$$\begin{bmatrix} 332 & 1 & 0 \\ 10 & 53 & 1 \\ 0 & 3 & 26 \end{bmatrix}$$

**COMPARISON OF THE ABOVE RESULTS**

<b>MODEL</b>	<b>ACCURACY SCORE</b>
Gradient boosting	0.988263
Random Forest	0.981221
Decision Tree	0.943662
K-Nearest Neighbors	0.964789

**Graphical representation**



**The above comparison shows the accuracy scores of classification al-**

gorithms. Clearly it can be concluded that gradient boosting is an optimal model of choice of the given dataset as it has relatively the highest combination of accuracy followed by random forest, K-Nearest Neighbors and Decision tree. Here one of the important results that is obtained, after applying PCA on the dataset and reducing it into 15 components, we observe that there has been an increase in the accuracies, precision, recall and f1 scores of each of the models. Comparing the two graphs it is clear that there has been a great increase in the accuracy of KNN model from 87 to 96. The accuracy of gradient boosting model increased from 94 to 98 for random forest it is 98 from 94 and the least increase in accuracy is shown by decision tree that is from 91 to 94.

## Chapter 6

# Conclusion

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CTG data is beneficial for obstetricians and utilized to decide for medical intervention before persistent damage on baby. But the visual analysis of the CTG data done by obstetrician could not be objective and correct. The utilization of decision support systems in the medical field to diagnose or predict abnormal situations becomes an ever increasing trend. Fetal and maternal risk can be assessed by monitoring the fetal heart rate. Cardiotocography records the fetal heart rate and uterine contractions. In this study we focused on the diagnosis of fetal risks by employing CTG data. Hence machine learning models can be utilized as a decision support system to identify fetal abnormalities by using the CTG data using four supervised machine learning models which are gradient boosting, random forest, decision tree and k-nearest neighbors. It also focuses on analyzing the results after applying a dimensionality reduction which is principal component analysis. The modeling results proved that gradient boosting algorithm is the optimal model of choice for the dataset used as it has relatively highest combination of precision, recall and F scores. Also after applying principal component analysis it is observed that all the models gave higher accuracies than that was obtained before reducing the dimension of the dataset.

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**Evaluation of foliar micromorphology, Phytochemical screening  
and Elemental analysis of *Chromolaena odorata* (L.) subjected to  
abiotic elicitation in the industrial area of Eloor, Ernakulam  
district of Kerala**

DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE  
REQUIREMENT FOR THE AWARD OF DEGREE OF  
“BACHELOR OF SCIENCE” IN

**BOTANY**

By

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ERNAKULAM**

# CERTIFICATE

This is to certify that the dissertation entitled "Evaluation of foliar micromorphology, Phytochemical screening and Elemental analysis of *Chromolaena odorata* (L.) Kerala" submitted by Miss. Meghana Anil Kumar as a part of the B.Sc degree course for the year 2021-2022 has been carried out under the supervision and guidance of Dr. Asha D., Department of Botany, St. Teresa's College, Ernakulam.



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Meghana Anil Kumar

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## INTRODUCTION

Herbal plants are known to be rich sources of phytochemical ingredients that contribute to healthcare management. Thereby, the demand for plant-based medicinal treatment using natural herbal plants has been shown to rise worldwide. At the beginning of the 21st century, more than half of all the drugs used in clinical applications contained natural products in their medication treatment. Furthermore, various herbal drugs from natural products such as plants, animals, microorganisms, and fungi have been approved in medical treatments. Besides, natural products also serve as an essential source for developing new drug products (Kumar Shakya & Arvind,2016).

In recent decades, people are more attracted to drugs from plant origin as they are highly biocompatible and produce lesser side effects than synthetic drugs. However, productivity and quality of these natural products are not satisfactory due to the slow rate of multiplication, overexploitation, and habitat degradation that is a drawback in meeting the ever-increasing market demand.

Most of the medicinal plant parts are used as raw drugs and they possess varied medicinal properties (Mahesh and Satish 2008). Medicinal plants are easily available, less expensive and also have no side effects (Cathrine et al., 2011). Medicinal plants represent a rich source of the antimicrobial agent (Mahesh et al., 2008).

Environment can be defined as a sum total of all the living and non-living elements and their effects that influence human life. While all living or biotic elements are animals, plants, forests, fisheries, and birds, non-living or abiotic elements include water, land, sunlight, rocks, and air. Environmental science is an interdisciplinary academic field that integrates physical, biological, and geography (including ecology, biology, physics, chemistry, plant science, zoology, mineralogy, oceanography, limnology, soil science, geology and physical geography, and atmospheric science) to the study of the environment, and the solution of environmental problems. Environmental science emerged from the fields of natural history and medicine during the Enlightenment. Today it provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems.

Nature is a synthesis of the five elements air, water, soil, fire and earth and man has been living in balanced harmony with nature since time immemorial. But the changes which man has brought about in his environment were largely determined by his necessities, his knowledge and his value. These are undoubtedly being polluted by the dust, smoke, sewage, sullage, industrial discharge and city refuse.

As a result of rain, dew or fog, leaves and other aerial organs of plants often become wet. In most species, the turgidity of leaves is restored from the wilted condition after immersion of water for 24 hour or less. Water largely entered through the epidermal cells, through hairs and specialized epidermal cells can provide for such entry in some cases. On prolonged immersion the leaves of many species show opening of stomata and some time also the injection the intercellular spaces with liquid water under certain condition, leaves and other aerial parts are capable of absorbing water from the air, it has been reported that pine seedlings *pinus ponderosa* in dry soil can absorb water vapour from the near saturated or unsaturated atmosphere.

Human population size has grown enormously over the last hundred years. This means an increase in demand for food, water, home, electricity, roads, automobiles and numerous other commodities. These demands are exerting tremendous pressure on our natural resources and are also contributing to pollution of air, water and soil. The need of the hour is to check the degradation and depletion of our precious natural resources and pollution without halting the process of development.

### **Macronutrients and Micronutrients in Plants**

The essential elements can be divided into macronutrients and micronutrients. Nutrients that plants require in larger amounts are called macronutrients. About half of the essential elements are considered macronutrients: carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium, and sulphur. The next-most-abundant element in plant cells is nitrogen (N); it is part of proteins and nucleic acids. Nitrogen is also used in the synthesis of some vitamins. Hydrogen and oxygen are macronutrients that are part of many organic compounds and also form water. Oxygen is necessary for cellular respiration; plants use oxygen to store energy in the form of ATP. Phosphorus (P), another macromolecule, is

necessary to synthesise nucleic acids and phospholipids. As part of ATP, phosphorus enables food energy to be converted into chemical energy through oxidative phosphorylation. Light energy is converted into chemical energy during photophosphorylation in photosynthesis; and into chemical energy to be extracted during respiration. Sulphur is part of certain amino acids, such as cysteine and methionine, and is present in several coenzymes. Sulphur also plays a role in photosynthesis as part of the electron transport chain where hydrogen gradients are key in the conversion of light energy into ATP. Potassium (K) is important because of its role in regulating stomatal opening and closing. As the openings for gas exchange, stomata help maintain a healthy water balance; a potassium ion pump supports this process.

Magnesium (Mg) and calcium (Ca) are also important macronutrients. The role of calcium is twofold: to regulate nutrient transport and to support many enzyme functions. Magnesium is important to the photosynthetic process. These minerals, along with the micronutrients, also contribute to the plant's ionic balance.

Deficiencies in any of these nutrients, particularly the macronutrients, can adversely affect plant growth. Depending on the specific nutrient, a lack can cause stunted growth, slow growth, or chlorosis. Extreme deficiencies may result in leaves showing signs of cell death.

### **Medicinal plant selected for the study**

*Chromolaena odorata* Linn (L.) King and Robinson is formerly known as *Eupatorium odoratum* L. belongs to the family Asteraceae (Aster family), genus *Chromolaena* (Thoroughwort), and species *Chromolaena odorata* L. (Vijayaraghavan et. al., 2017). The family Asteraceae or Compositae (known as the aster, daisy, or sunflower family) is the largest family of flowering plants represented by about 950 genera and 20,000 species over the globe (Mahbubur, 2013). *C. odorata* plants are distributed all over the world in almost all habitats (Rahman et., 2008). The common names for these plants are Siam weed, devil weed, Eupatorium, Jack in the bush, Jack-in-the-bush, kingweed, paraffin bush, and paraffin weed (Vijayaraghavan et al., 2018). *C. odorata* has been commonly and widely used in traditional medicine because of its property that can give therapeutic effects on the body.

*C. odorata* has been introduced extensively to tropical Asia, West Africa and some parts of Australia (Zahara, 2019). In general, this plant is able to grow in a wide range of soil pH

(Mandal & Joshi, 2014). However, it seems to grow best at acidic soil areas that contain a high amount of potassium and phosphorus.

### **Distribution of *Chromolaena odorata***

This plant is native to North America and is widely spread from the southern USA to northern Argentina, including Central America and the Caribbean. Besides, *C. odorata* plant has also been extensively introduced to tropical Asia, West Africa and some parts of Australia (Paterson & Zachariades, 2013), pacific region (Ghori, 2011) and subsequently distributed to Asian country including Indonesia, Malaysia, China, Thailand, Taiwan, Laos, Sri Lanka, Bangladesh, Cambodia and India (Vaisakh & Pandey, 2012).

It was grown as medical herbs and ornamental plant and it is also a serious weed in plantation crops globally as it is highly allelopathic and suppresses the vegetation of the neighbouring plants (Zahara, 2019). Collectively, the most suitable habitat for *C. odorata* to grow well includes the moist, humid, warm, cold, and abandoned areas. These features provide a suitable and favourable area for *C. odorata* plants to grow in a wide range of habitats (Mandal & Joshi, 2014).

### **Locality of Sample Collection**

Eloor is a suburb of Kochi and a municipality in Paravur Taluk, Ernakulam District in the Indian state of Kerala, India. It is an industrial area situated around 13 kilometres (8.1 miles) north of the city centre. It is an island of 14.21 km<sup>2</sup> formed between two distributaries of river Periyar and is the largest industrial belt in Kerala. The neighbouring places of Eloor are Kalamassery industrial hub, Aluva, Cheranalloor and Paravur. There are various companies of different kinds along the industrial belt including Fertilisers and Chemicals Travancore (FACT), Indian Rare Earths Limited, Hindustan Insecticides Limited and many others manufacturing a range of products like chemical-petrochemical products, rare-earth elements, rubber-processing chemicals, fertilizers, zinc/chromium compounds and leather products. The industrial belt of Eloor in Kerala is one of the world's 'top toxic hot spots', according to international environment group Greenpeace. Greenpeace holds the Hindustan Insecticides Ltd that has been manufacturing pesticides at its Eloor plant responsible for making the industrial village a toxic hotspot.

The aim of the study was to conduct phytochemical, micromorphological and elemental analysis of *C. odorata* growing in an industrial area.

## **OBJECTIVES**

- To analyse the micromorphological characters of *Chromolaena odorata* growing in an industrial area.
- To detect the phytochemical constituents present in the ethanol extract of *Chromolaena odorata* by qualitative phytochemical analysis.
- To analyse the elemental composition of *Chromolaena odorata* growing in a locality experiencing industrial pollution using SEM-EDX.

## REVIEW OF LITERATURE

- The leaf extracts of *C. odorata* has been shown to possess antioxidant, anti-inflammatory, analgesic, antimicrobial, cytoprotective and many other medicinally significant properties (Vaisakh & Pandey, 2012).
- Jyoti et al., (2008) analysed the amount of Pb, Cd, Cr, and Ni in soil and plant samples of *Abutilon indicum*, *Calotropis procera*, *Euphorbia hirta*, *Peristrophe bycaliculata*, and *Tinospora cordifolia* collected from 3 environmentally different sites.
- It has been shown that *C. odorata* plants not only invade soil that contains potassium and phosphorus, but it can also increase the nutrient contents in the soil, namely potassium, phosphorus, calcium, nitrogen, and magnesium (Ojeniyi et. al., 2012).
- Another study also revealed a significant increase in soil nutrients such as nitrogen and soil organic matter (SOM) from all invaded sites (Mandal & Joshi, 2014). The rise of the amount of nitrogen and soil organic solvent (within the 10 cm layer) of the soil showed that *C. odorata* plants have the potential to invade all fallow areas (Tondoh et. al., 2013).
- The *C. odorata* leaves extracts from ethanol, methanol, and hexane extraction have been reported to exhibit strong inhibitory effects against both Gram-positive (*Bacillus cereus*, *Enterococcus faecalis*, *Staphylococcus epidermidis*, *Staphylococcus aureus*, *Streptococcus pyogenes* and *Propionibacterium acnes*) and gram-negative (*Proteus vulgaris*) bacterial strains (Hanphanphoom & Krajangsang, 2016).
- Besides, it has been reported these extracts exhibited good antibacterial activity against the gram-positive bacteria *Staphylococcus S. aureus*, *S. pyogenes* and *Staphylococcus epidermidis* and the gram-negative bacteria *P. vulgaris*. The results obtained suggested

that the ethanolic, methanolic and hexane leaves extracts of *C. odorata* are promising to be further developed in treating bacterial skin infections ((Hanphanphoom & Krajangsang, 2016).

- A recent study by Udayaprakash et al. (2019), demonstrated that acetone extract of *C. odorata* exhibited high inhibitory activity against *S. aureus* and *P. aeruginosa*. Meanwhile, ethyl acetate extract of *C. odorata* recorded the maximum zone of inhibition against *Bacillus*.
- The *C. odorata* plants also have been shown to exhibit anti-inflammatory property. It was reported that the aqueous and ethanolic extracts of *C. odorata* could retard the inflammatory reaction. The anti-inflammatory activities exhibited by *C. odorata* may be due to the presence of phenolic compounds in these extracts (Omokhua et al., 2016).
- The natural antioxidants present in the *C. odorata* plants such as polyphenols play an important role in preventing the body from oxidative damage. This is because the ideal chemical structure of polyphenols compound makes the plants more effective as an antioxidant against a free radical-scavenging activity as compared to any other compounds such as ascorbate and tocopherols (Srinivasa et al., 2010).
- Substances that relieve pain can be defined as analgesics (painkillers). Analgesics works through various mechanisms and function either centrally (opioids receptor agonism) or peripherally. In recent years, there has been an impetus on the use of traditional medicinal plants with analgesic effects worldwide due to its natural origin and lesser side effects (Rauf et al., 2017).
- Substances that relieve pain can be defined as analgesics (painkillers). Analgesics works through various mechanisms and function either centrally (opioids receptor agonism) or peripherally. In recent years, there has been an impetus on the use of traditional medicinal plants with analgesic effects worldwide due to its natural origin and lesser side effects effects (Rauf et al., 2017).

- It was reported that the stem extract of *C. odorata* plants has been demonstrated to be effective for the treatment of skin infections, particularly caused by the *Propionibacterium acnes* (Pandurangan et al., 2015).
- The extract from the leaves of *C. odorata* has also been widely used in countries such as Vietnam and other tropical countries to treat skin infections and rashes (Wang et al., 2014). Besides, in other countries such as Thailand and India, this plant has been extensively used as a traditional herb to treat skin infection (Vijayaraghavan et al., 2017).
- The species of *C. odorata* plants, found in the West of Africa and Asia were also found to be useful in reducing stomach-ache (Omokhua et al., 2016).
- An elevated level of phosphorus, potassium, magnesium, soil organic matter, and nitrogen as well as acidic soil encourages further invasion of *C. odorata* (Ghori, 2011); (Ojeniyi et. al., 2012).
- Tanhan et al., (2007) analyzed the concentrations of Pb, Cd and Zn in *C. odorata* (L) and their results confirm that *C. odorata* is a hyperaccumulator which grows rapidly, has substantial biomass, wide distribution and has a potential for the phytoremediation of metal contaminated soils.
- Anyasi (2012) studied the ability of *Chromolaena odorata* propagated by stem cuttings and grown for six weeks in the greenhouse to thrive in soil containing different concentrations of PCB congeners found in Aroclor and transformer oil.
- Ikhajiagbe (2016) Investigated the changes in morphological and crude protein content of *Chromolaena odorata* to heavy metal-induced stress.

## MATERIALS AND METHODS

### Plant selected for the study

*Chromolaena odorata* is a tropical and subtropical species of flowering shrub from the sunflower family (Asteraceae).

### Scientific Name

*Chromolaena odorata* (L.)

### Synonyms

- *Eupatorium clematitidis* DC.
- *Eupatorium conyzoides* Mill.
- *Eupatorium dichotomum* Sch.Bip.
- *Eupatorium divergens* Less.
- *Osmia atriplicifolia* (Vahl) Sch.Bip.
- *Osmia clematitidis* (DC.) Sch.Bip.
- *Osmia divergens* (Less.) Sch.Bip.
- *Osmia odorata* (L.) Sch.Bip.

### Systematic Position

- Kingdom: Plantae
- Division : Phanerogamae
- Class: Dicotyledons
- Subclass : Gamopetalae
- Series : Bicarpellatae
- Order: Asterales
- Family: Asteraceae
- Genus: *Chromolaena*
- Species : *Chromolaena odorata* (L)

**Common names:** Siam weed, Christmas bush, Devil weed, Jack-in-the-bush, Kingweed, Paraffinbush, and Paraffinweed

**Malayalam Name:** Communist Pacha

### **Plant collection**

The fresh mature leaves of *Chromolaena odorata* (L.) used for the investigation was obtained from Eloor industrial area, Ernakulam, Kerala (Figure1). The plant specimen was authenticated using the Flora of presidency of Madras. Fresh plant material was washed under running tap water, then air dried and powdered.

### **Leaves preparation**

Fresh mature leaves were cleaned. The leaf portion between midrib and margin from the middle region was cut into small pieces (10 x 10 mm<sup>2</sup>). Tissues were disintegrated by poaching leaf samples in 10% hydrochloric acid under low heat for 1 hr. When bleaching was completed, leaf samples were washed with water and then cleared by gently warming with chloral hydrate solution (4 g of chloral hydrate / 1 ml of water) until it was transparent. After rinsing with water, the leaf sample was mounted with glycerin and observed under a light microscope for the determination of leaf constants.

### **1] Microscopic analysis**

Microscopic evaluation of leaf constants such as stomatal number, stomatal index, epidermal cell number and trichome number were examined.

#### **1.1. Determination of stomatal number and stomatal index**

Stomatal number is an average number of stomata per square millimeter (mm<sup>2</sup>) of epidermis of the leaf. Stomatal index (SI) is a percentage of stomata from the total number of epidermal cells in a same unit area of leaf, which can be calculated as:

$$\text{SI} = \left( \frac{S}{E+S} \right) \times 100$$

Where, S = number of stomata per mm<sup>2</sup> in a given area of leaf

E = number of epidermal cells per mm<sup>2</sup> in the same area of leaf

## 1.2. Determination of epidermal cell number

Epidermal cell number is an average number of epidermal cell per mm<sup>2</sup> of leaf surface. The number of epidermal cell on the upper and lower surface of leaf in 1 mm<sup>2</sup> in each field were counted.

## 1.3. Determination of trichome number

Trichome number is an average number of trichome per mm<sup>2</sup> of epidermis of leaf surface. The number of trichome on the upper and lower surface of leaf in 1 mm<sup>2</sup> in each field were counted.

## Data analysis

All leaf constant parameters were determined at least in five fields of plant sample. The results expressed as mean  $\pm$  standard deviation (SD), minimum and maximum values.

## Extraction

The plant powder was extracted with ethanol using cold extraction. Totally 30 g of dried plant powder was extracted in 250 ml of ethanol for 24 hours in occasional shaking at room temperature. The supernatant was collected and evaporated to make the final volume one-fifth of the original volume. It was stored at 4°C in airtight bottles for further studies.

## 2] Phytochemical analysis

The ethanolic extract of *Chromolaena odorata* was subjected to preliminary phytochemical screening for their presence or absence of active constituents utilizing a standard method of analysis.

### 1. Test for Alkaloids

**Mayer's Test:** 2 ml test sample was treated with few drops of Mayer's reagent along sides of the test tube and the formation of white or creamy precipitate indicated the presence of alkaloids.

(Mayer's Reagent- 1.358g of HgCl<sub>2</sub> was dissolved in 60ml of water and poured into a solution of 5g of potassium iodide in 10ml of distilled water and made upto 100 ml of reagent).

**Dragendorff's Test:** Test sample was treated with 1-2 ml of Dragendorff's reagent and the formation of prominent reddish brown precipitate indicated the presence of alkaloids.

(Dragendorff's Stock reagent- Solution (A): 0.85g basic bismuth nitrate dissolved in 10ml glacial acetic acid and 40 ml water under heating. Solution (B): 8g potassium iodide dissolved in 30 ml water. Stock solution: A and B mixed in 1:1 ratio).

**Wagner's Test:** Test sample was treated with few drops of Wagner's reagent along sides and the formation of reddish brown precipitate indicated the presence of alkaloids.

(Wagner's reagent - 2 g Iodine and 6 g potassium Iodide dissolved in 5 ml distilled water and made upto 100 ml.)

## 2. Test for Flavonoids

**Sulphuric acid test:** A fraction of the extract was treated with concentrated H<sub>2</sub>SO<sub>4</sub> and observed for the formation of orange colour.

**NaOH test:** A small amount of extract was treated with aqueous NaOH and HCl, observed for the formation of yellow orange colour.

## 3. Test for Amino acids

**Ninhydrin Test:** Extract solution was treated with Ninhydrin (Triketohydrindene hydrate) at the pH range of 4 - 8. Development of purple colour indicated the positive response for amino acids.

## 4. Test for Reducing sugars

**Fehling's test for free reducing sugar:** About 0.5 g of extract was dissolved in distilled water and filtered. The filtrate was heated with 5 ml of equal volumes of Fehling's solution A and B. Formation of a red precipitate of cuprous oxide was an indication of the presence of reducing sugars.

**Benedict's Test:** To 5 ml of the extract solution, 5 ml of Benedict's solution was added in a test tube and boiled for a few minutes. Development of brick red precipitate confirmed the presence of reducing sugars.

## 5. Test for Anthraquinones

**Modified Borntrager's Test:** 5 ml of extract solution was hydrolyzed with dilute sulphuric acid and extracted with benzene. 1 ml of dilute ammonia was added to it. Rose pink coloration suggested the positive response for anthraquinones.

## 6. Test for Saponins

**Foam Test:** A small amount of extract was shaken with water and looked for the formation of persistent foam.

## 7. Test for Sterols

**Liebermann-Burchard test:** One ml extract was treated with chloroform, acetic anhydride and added drops of H<sub>2</sub>SO<sub>4</sub> and observed for the formation of dark pink or red colour.

**Sulphuric acid test:** The fraction of extract was treated with ethanol and H<sub>2</sub>SO<sub>4</sub> and observed for the formation of violet blue or green colour.

## 8. Test for Tannins

**FeCl<sub>3</sub> Test:** 5 ml of extract solution was allowed to react with 1 ml of 5% ferric chloride solution. Greenish black colouration indicated the presence of tannins.

**Potassium Dichromate Test:** 5 ml of the extract was treated with 1 ml of 10% aqueous potassium dichromate solution. Formation of yellowish brown precipitate suggested the presence of tannins.

**Lead acetate Test:** 5 ml of the extract was treated with 1 ml of 10% lead acetate solution in water. Yellow colour precipitation gave the test for tannins.

## 9. Test for Phenols

**Ferric chloride test:** A fraction of extract was treated with 5% ferric chloride, formation of deep blue colour confirms the presence of phenol

**Liebermann's test:** The extract was heated with sodium nitrite, add H<sub>2</sub>SO<sub>4</sub> solution diluted with water and add excess of dilute NaOH and observed for the formation of deep red or green or blue colour.

#### 10. Test for Glycosides

**Legal's test:** Dissolved the extract (0.1 g) in pyridine, added sodium nitroprusside reagent and made alkaline with NaOH solution. Pink to red colour solution indicates the presence of glycosides.

**Borntrager's test:** The extract is hydrolyzed with concentrated HCl for 2 hours on a water bath and filtered and few ml of above filtrate was shaken with chloroform, chloroform layer was separated and added 10 % ammonia, formation of pink colour indicates the presence of glycosides

#### 11. Test for Gums

**Molisch's Test:** 2 ml of concentrated sulphuric acid was added to 2 ml of extract solution. Then it was treated with 15%  $\alpha$ -naphthol in ethanol (Molisch's reagent). Formation of a red violet ring at the junction of two layers indicated the positive test for gums.

#### 12. Test for Terpenoids

**Chloroform test:** The plant extract was taken in a test tube with few ml of chloroform and add concentrated sulphuric acid carefully to form a layer and observed for presence of reddish brown colour.

**Liebermann-Burchard test:** 1 ml extracts was treated with chloroform, acetic anhydride and added drops of H<sub>2</sub>SO<sub>4</sub> and observed for the formation of dark green colour.

### Scanning Electron Microscopy (SEM) with Energy Dispersive X-Ray Analysis (EDX)

The ethanol extract derived from plant sample of *Chromolaena odorata* (L.) was subjected to the elemental analysis using Scanning Electron Microscope (SEM) with an energy

dispersive x-ray spectrometer (EDX). For doing the elemental analysis, Scanning Electron Microscope (with EDX) was used with a model number Jeol 6390LV having accelerating voltage: 0.5 kV to 30 kV and resolution at 4 nm (30 kV) which provides images at magnification: 300,000. SEM provides detailed high resolution images of the sample by rastering a focussed electron beam across the surface and detecting secondary or backscattered electron signal. An Energy Dispersive X-Ray Analyzer (EDX or EDA ) is also used to provide elemental identification and quantitative compositional information. SEM provides images with magnifications up to ~X50,000 allowing sub micron-scale features to be seen i.e. well beyond the range of optical microscopes. It is very rapid, high resolution imaging with identification of elements present in the plant samples.

## RESULTS

### Determination of Leaf constants

Microscopic leaf constant values are possibly used to distinguish between some closely related species of which cannot clearly be characterized by general microscopy. Microscopic evaluation is the first step for drug authentication and identifying the correct species. The results of leaf constant numbers consisting of stomatal number, stomatal index, epidermal cell number and trichome number were shown in Table 1.

### Phytochemical screening of plant materials

The phytochemical screening of *Chromolaena odorata* (L.) is displayed in Table 2. Preliminary phytochemical screening of twelve secondary metabolites were done in the ethanol extract of *Chromolaena odorata*. The ethanol extract showed the presence of the maximum number of secondary metabolites in the plant.

### SEM with Energy Dispersive X-Ray Analysis (EDX)

Table 2 shows the results of the elemental composition of *Chromolaena odorata* (L.) using SEM and EDX technique. The SEM - EDX spectra of the ethanol extract of the *Chromolaena odorata* (L.) is shown in figure 2.

The topography of elements was confirmed through SEM images which is displayed in figure 3. Oxygen, Magnesium, Silicon, Chloride, Potassium and Calcium were present in the sample. Many standards were used like CaCO<sub>3</sub>, SiO<sub>2</sub>, KCL, MAD, Ca wollastonites. In all these elements, Carbon and Oxygen were present as high concentrations while all other elements were present only in trace quantities. Trace elements are estimated by determining the percentage abundance (%) of elements in the sample.



**Fig. 1: Medicinal plant *Chromolaena odorata* (L.) collected from Industrial area, Eloor**

Leaf constant values	Upper epidermis		Lower epidermis	
	min-max	mean $\pm$ SD	min-max	mean $\pm$ SD
Stomatal number	72 - 108	87.07 $\pm$ 9.95	240 - 408	348.53 $\pm$ 44.67
Stomatal index	5.40 - 8.22	6.43 $\pm$ 0.65	-	-
Epidermal cell number	1084 - 1424	1263.33 $\pm$ 89.28	-	-
Trichome number	4 - 7	5.17 $\pm$ 1.12	43 - 51	47.40 $\pm$ 3.04

**Table 1: Microscopic leaf constant numbers of *Chromolaena odorata***

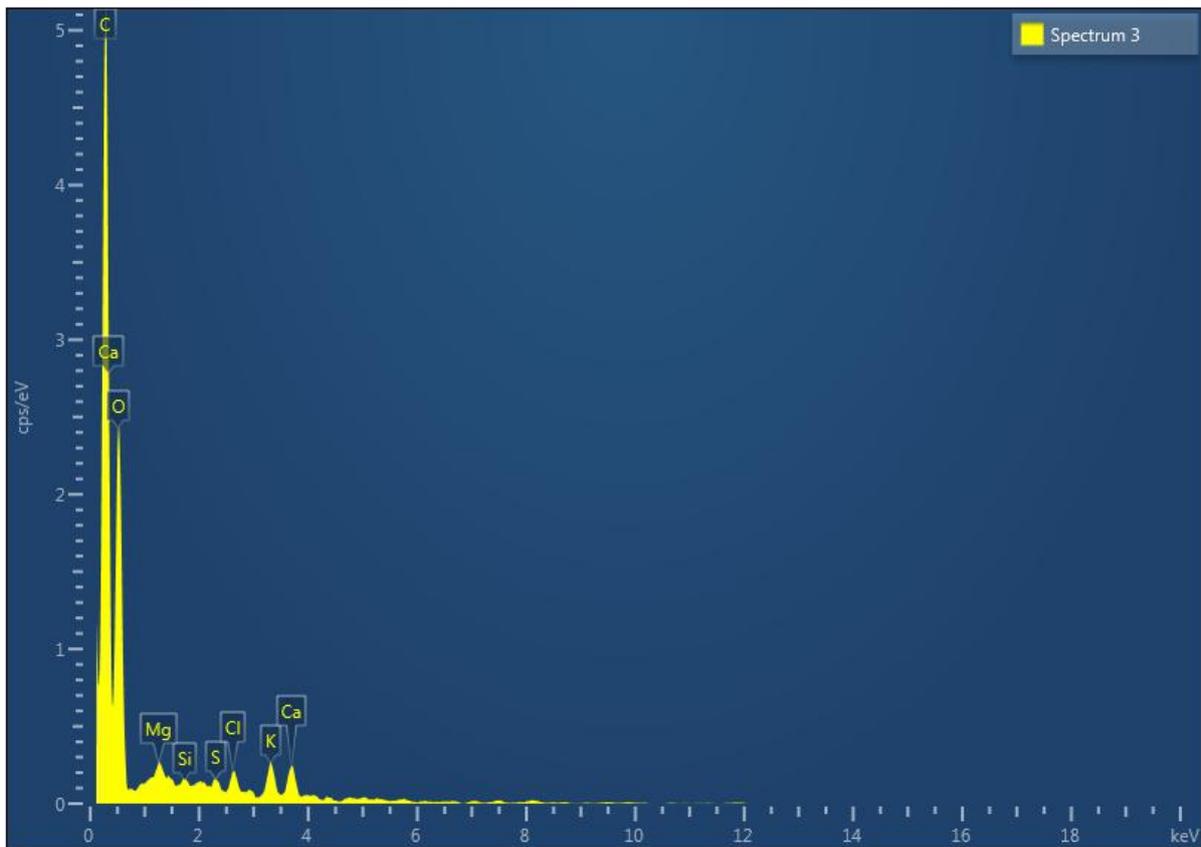
<b>Plant Constituents</b>	<b>Test/ Reagent</b>	<b><i>Chromolaena odorata</i> (L.)</b>
<b>Alkaloids</b>	<b>Mayer's Test</b>	+
	<b>Dragendorff's Test</b>	+
	<b>Wagner's Test</b>	
<b>Phenols</b>	<b>Ferric chloride test</b>	+
	<b>Liebermann's test</b>	+
<b>Tannins</b>	<b>FeCl<sub>3</sub> Test</b>	+
	<b>Potassium Dichromate Test</b>	+
	<b>Lead acetate Test</b>	+
<b>Flavonoids</b>	<b>Sulphuric acid test</b>	-
	<b>NaOH test</b>	-
<b>Anthraquinones</b>	<b>Modified Borntrager's Test</b>	+
<b>Saponins</b>	<b>Foam Test</b>	+
<b>Steroids</b>	<b>Liebermann-Burchard test</b>	+
	<b>Sulphuric acid test</b>	+
<b>Terpenoids</b>	<b>Chloroform test</b>	-
	<b>Liebermann-Burchard test</b>	-
<b>Glycosides</b>	<b>Legal's test</b>	-
	<b>Borntrager's test</b>	-
<b>Reducing sugars</b>	<b>Benedict's Test</b>	-
	<b>Fehling's test for free reducing sugar</b>	-
<b>Amino acids</b>	<b>Ninhydrin Test</b>	-
<b>Gums</b>	<b>Molisch's Test</b>	-

Presence: +, Absence: -

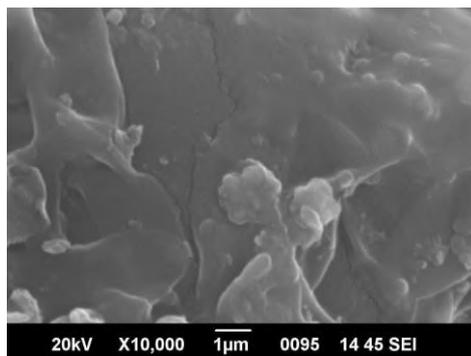
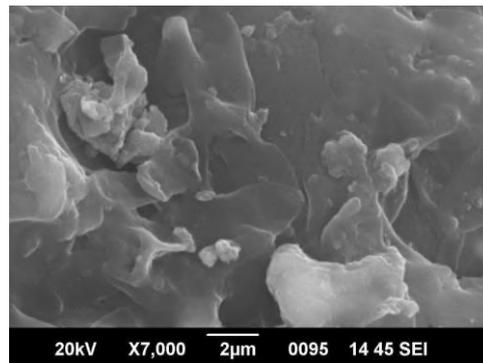
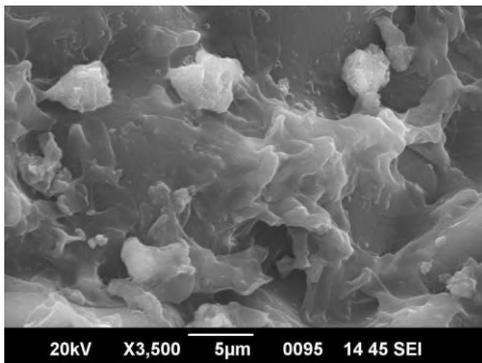
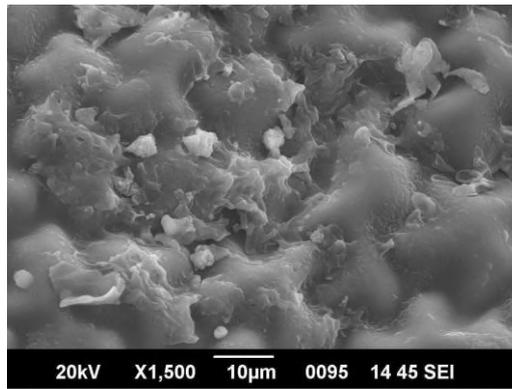
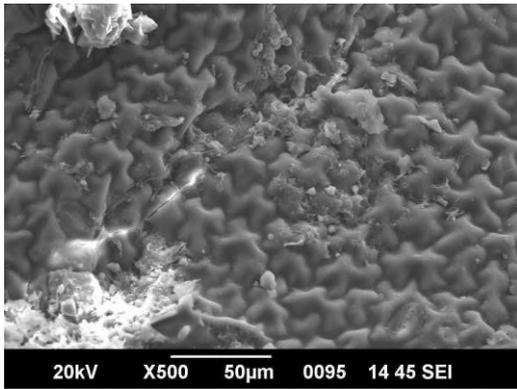
**Table 2: Phytochemical screening of leaf extract of *Chromolaena odorata* (L.)**

<b>Element</b>	<b>Line Type</b>	<b>Weight %</b>	<b>Atomic %</b>
C	K series	61.65	68.99
O	K series	35.71	30
Mg	K series	0.28	0.15
Si	K series	0.14	0.07
S	K series	0.2	0.08
Cl	K series	0.45	0.17
K	K series	0.74	0.26
Ca	K series	0.83	0.28
Total:		100	100

**Table 3: The percentage of trace elements present in ethanol leaf extract of *Chromolaena odorata* (L)**



**Fig. 2:** The SEM EDX spectra of ethanol leaf extract of *Chromolaena odorata* (L.)



**Fig. 3: The SEM EDX images of ethanol leaf extract of *Chromolaena odorata* (L.)**

## DISCUSSION

### Determination of Leaf constants

The microscopic examination is one of the quality control process for herbal material to determine the characteristics, identity and degree of purity of medicinal plant materials, and should be carried out before any further tests are undertaken (WHO, 2011).<sup>7</sup> Microscopic leaf constant numbers are frequently used to identify between some closely related species. It has great value for a quality of the medicinal plants based on these specific characters (Eames & Mac, 1974).

The stomatal number and stomatal index are very specific criteria for identification and characterization of herbal crude drug (Rabinarayan et al., 2018). Although the stomatal number varies greatly with the age of the leaf, the stomatal index remains highly consistent. The one of microscopic evaluation which can distinguish plant species is stomatal type by their form and arrangement in the surrounding cells. The different types of stoma are often available for matured leaves that are distinguished by their form and arrangement in the surrounding cells. In recent study, the stomata type of *C. odorata* was classified as anomocytic or ranunculacious type of stomata. The stomata is surrounded by varying number of cells, which are generally not different from those of the epidermis which supported in characteristics of *C. odorata* (WHO, 2011). The stomata were found on both upper epidermis and lower epidermis which called amphistomatic leaf as distribution of stomata. The previous studies also reported that the stomata type of *C. odorata* were anomocytic type (Sorabh et al., 2014; Adedeji & Jewoola, 2008).

Trichomes are epidermal protuberances located on aerial parts of plant, that protect plant from excess transpiration, high temperature, ultraviolet light, and herbivore attack. Trichome number has been used for identification of some plants that have trichomes covering their leaves (Wagner et al., 2004). The results showed that there were multicellular uniseriate trichomes on both upper and lower epidermis of *C. odorata*. The trichome number on the upper epidermis was found to be  $5.17 \pm 1.12$ , which was less than that of the lower epidermis ( $47.40 \pm 3.04$ ). The result of this study is in accordance with the previous researches reported that *C. odorata* leaf had many long multicellular uniseriate unbranched trichomes (Sorabh et al., 2014). In this study, the glandular trichomes were found on only lower epidermis of *C. odorata*.

Trichomes are epidermal protuberances located on aerial parts of plant, that protect plant from excess transpiration, high temperature, ultraviolet light, and herbivore attack. Trichome number has been used for identification of some plants that have trichomes covering their leaves ((Wagner et al., 2004).). The results showed that there were multicellular uniseriate trichomes.

## **Phytochemical analysis**

Phytochemical screening is of paramount importance in identifying new source of therapeutically and industrially valuable compound having medicinal significance, to make the best and judicious use of available natural wealth (Ambasta et al., 1986; Kokate et al., 1998).

Phytochemical investigation of the ethanolic extracts of *Chromolaena odorata* (L.) revealed the presence of various phytochemicals such as alkaloids, phenols, tannins, flavonoids, anthraquinones, saponins, steroids & terpenoids. The presence of alkaloids in *Chromolaena odorata* (L.) may be associated with their use by traditional medicines for the treatment of different diseases. Phenolic compounds present in it have attracted a great attention in relation to their potential for beneficial effects on health (Narayana et al., 2001). phytochemical analysis of plants for the presence of saponins are widely well known to have expectorant and antitissue activity (Rao et. al., 1984; Sharama et al., 1984 ). Nevertheless, among the variety of plant species available worldwide, only a few plants have been studied for its phytochemical constituents and biological activity that may serve as potential alternative sources of therapeutic agents (Vaisakh & Pandey, 2012).

The phytochemical components of *C. odorata* include alkaloids, flavonoids, flavanone, essential oils, phenolics, saponins, tannins, and terpenoids. The other essential constituents of this plant are chromomoric acid, quercetagenin, and quercetin, all of which contribute to its medicinal properties (Sirinthipaporn & Jiraungkoorskul, 2017).

For instance, it has been reported in several studies that these phytochemicals are able to exhibit a wide spectrum of pharmacological activities including antioxidant activity, hypoglycaemic and hypocholesterolemic effects in animals (Rahman et., 2008). As well as modulation in wound healing stages (Vijayaraghavan et al., 2018).

The presence of the phenolic compound in the *C. odorata* leaf extracts works as an antioxidant, which helps increase the efficacy of *C. odorata* in wound healing. This antioxidant property works by increasing the efficiency of preserving the growth of keratinocytes and fibroblasts on the wounds (Sirinthipaporn & Jiraungkoorskul, 2017).

The presence of several active phytochemical compounds possesses a synergistic wound healing activity. It has been proven that the active constituents from the *C. odorata* extract are able to enhance and improve wound healing in laboratory animals including rats (Vijayaraghavan et al., 2017).

The phenolic compound in *C. odorata* leaves extract has been shown to prevent internal bleeding from diathesis and stomach ulcers. Equally important, is that this compound also preserved the keratinocytes from being damaged and reduces the internal bleeding from the stomach ulcer (Paul et al., 2018).

In the present study, results of EDX showed the presence of trace elements such as Mg, Si, Cl, S, K and Ca in *Chromolaena odorata* (L.). Deficiency of these trace elements in human subjects can occur under the most practical dietary conditions and in much diseased status (Udayakumar & Begum, 2004). Trace elements play both curative and preventive role in combating diseases. Magnesium is important cofactor for the conversion of blood glucose into energy (Bahadur et al., 2011). Calcium is needed in the development of bone and teeth and it regulate heart rhythm, help in normal blood clotting, maintain proper nerve and muscle functions and lower blood pressure (Bibi et al., 2006). Potassium is essential for the transport of nutrients inside the cell. Without potassium, nutrients could not able enter into the cell that lead cell death. Silicon is also another important element to prevent the hardening of veins and arteries. Chloride works with sodium and potassium carry an electrical charge when dissolved body fluids and to regulate the pH in the body. Chloride is also important for digest the food properly and absorb many elements. The presence of these trace elements in *Chromolaena odorata* (L.) marks its use in therapeutic purpose.

## SUMMARY & CONCLUSION

Plant based drugs have been used worldwide in traditional medicines for treatment of various diseases. Phytochemical studies have attracted the attention of plant scientists due to the development of new and sophisticated techniques. These techniques played a significant role in the search for additional resources of raw material for the pharmaceutical industry (Alston & Turner,1963).

The analysis of literature on *Chromolaena odorata* (L.) showed that the plant species are invasive to a wide range of habitats including the grasslands, at the roadsides, agricultural lands, forest margins, polluted areas as well as in the disturbed forests. Despite its invasive properties, this plant is useful as a medicinal herb. So, the main objective of the study was to do the phytochemical evaluation, assessment of leaf micromorphology and elemental analysis through EDX analysis of *Chromolaena odorata* (L.), growing in an industrial area.

The plant showed the presence of many phytochemicals which are responsible for the various pharmacological medicinal properties. The results obtained from the present study revealed that, the ethanol extracts of *Chromolaena odorata* (L.) showed the presence of most of the secondary metabolites like alkaloids, phenols, tannins, flavonoids, anthraquinones, saponins, steroids & terpenoids in the leaves. The SEM-EDX study of the ethanol extract showed the presence of trace elements. However, the species was devoid of any heavy metals eventhough they were collected from an industrial area. The foliar micromorphology revealed the stomatal type, index and trichome numbers of this species which can be used for the identification and authentication of this plant. The intensive study on the out coming active constituents of *Chromolaena odorata* (L.) can lead to the discovery of a new botanical - drug.

The present study also revealed that locally available non-economical weed plant *Chromolaena odorata* (L.) commonly found in waste lands has a great pharmaceutical potential. Based on the result of this study it can be said that *Chromolaena odorata* (L.) has a leading capacity for the development of new good efficacy drugs in future and can be an

effective source to treat and control many diseases due to the presence of phytochemicals. The uses of *C. odorata* in traditional practice give rise to many research studies that are currently ongoing to further validate its medicinal properties.

Thus, it may conclude that the present study will add some specific criteria for the authentication of *Chromolaena odorata* and will be helpful to increase the economic potentiality of this plant.

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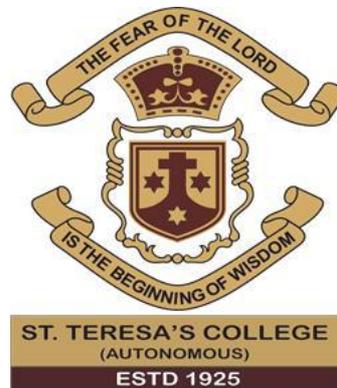
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# **OBSTACLE DETECTION DEVICE FOR VISUALLY IMPAIRED**

**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  
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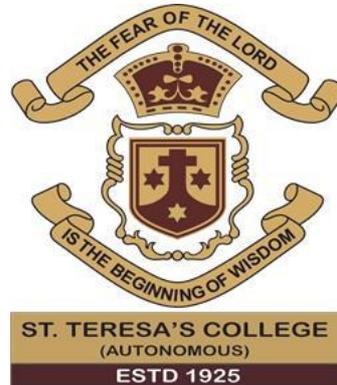
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*Under the guidance of*

**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*  
*Neha Raju K*  
*4/4/22*  
**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 blind lines is one of the problem. 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.

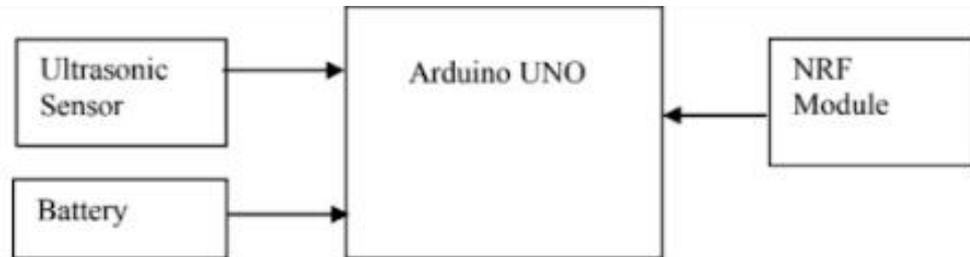
In this project we have the proposed idea that we have two modules. One is the shoe module and the other one is the cane module. Cane module is the primary module and shoe module is the secondary module two have combined these two modules. The NRF module can easily transmit the signal. Our system has 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.

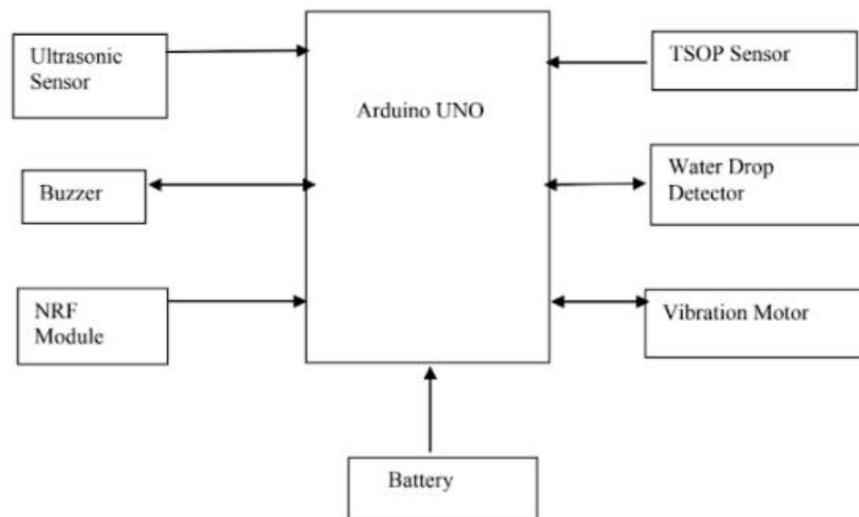
In Shoe Module ultrasonic waves are coming out of it continuously. If any obstacle is present in front of the shoe, the ultrasonic sensor senses the signal and transmits it to the NRF module. Then the NRF transmitters transmit the signal to the NRF receiver which is placed in the cane.

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.

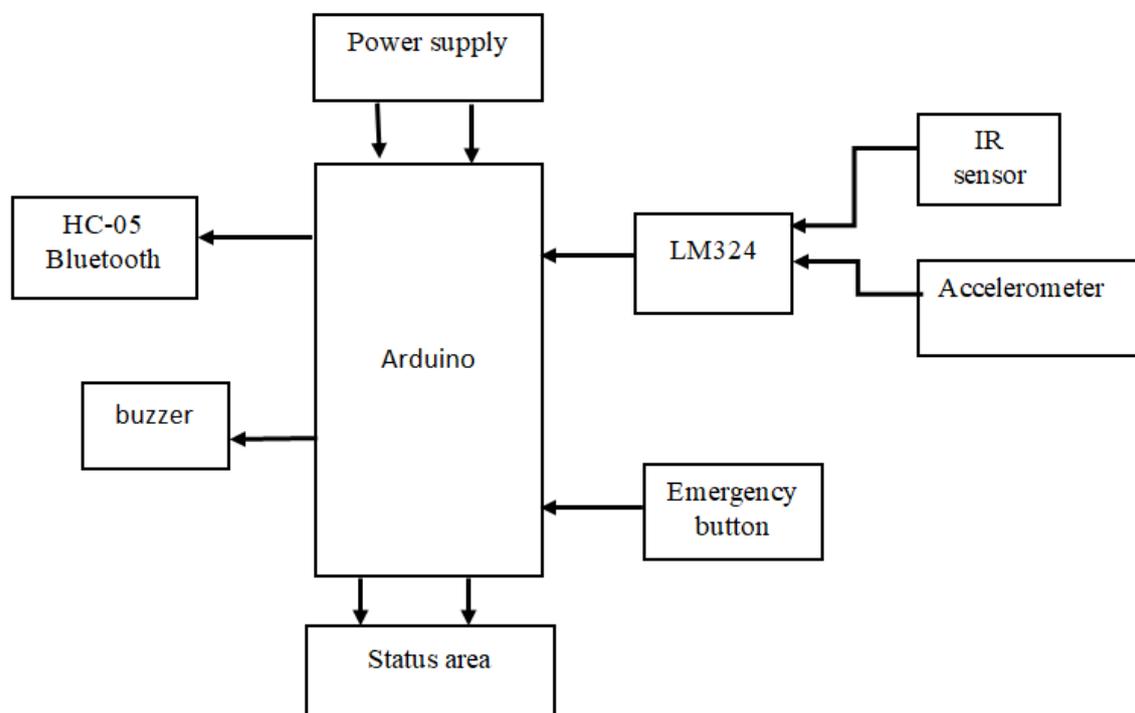
The IR sensor embedded in the stick will detect obstacles and notify the user to avoid the obstacles in his way , using a vibrator motor .

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:**

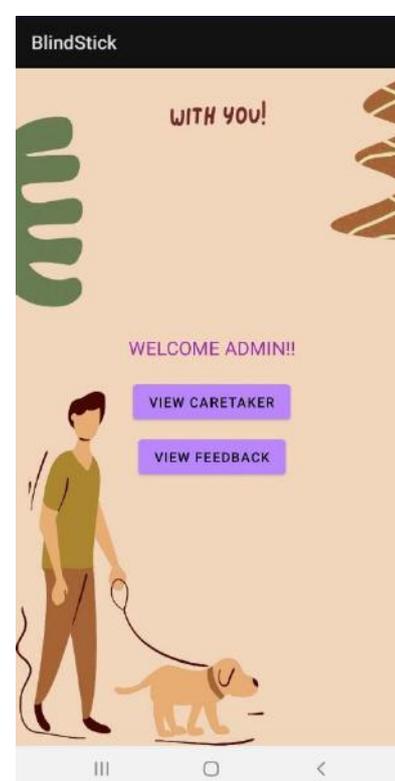
- **Module 1:** Admin
- **Module 2:** Caretaker
- **Module 3:** Blind

#### 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

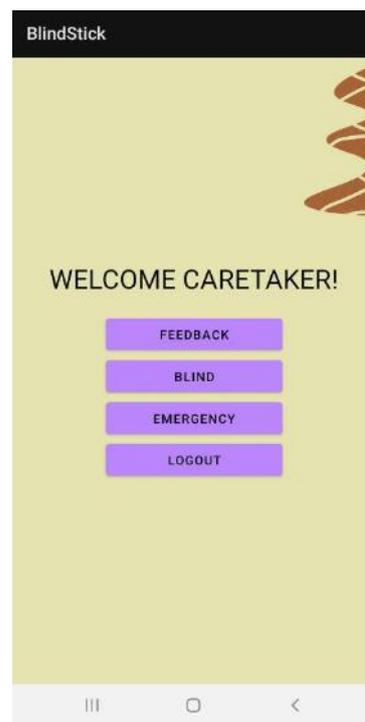
He is the one that gives physical or emotional care and support and serves as caretaker to the younger children but in this context it is a person that supports and takes care of the visually impaired. It is possible to either register the caretaker or login as one. When logged in as a caretaker viewing 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**



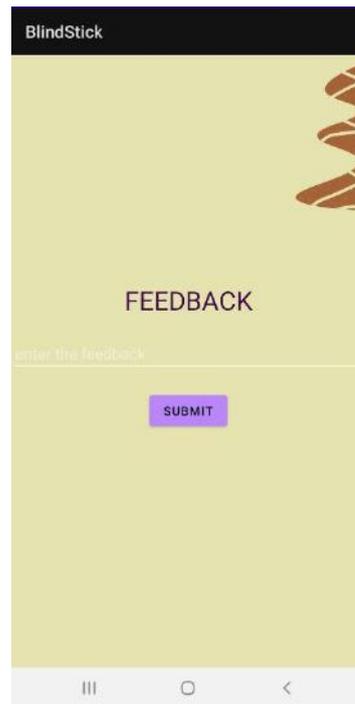
**Fig 6.2.2 Login**



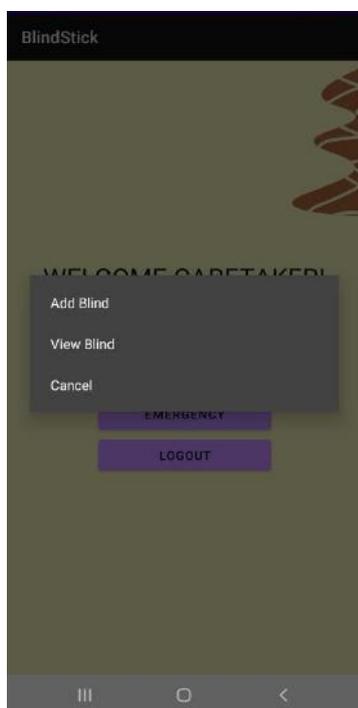
**fig 6.2.3 Home page**



**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

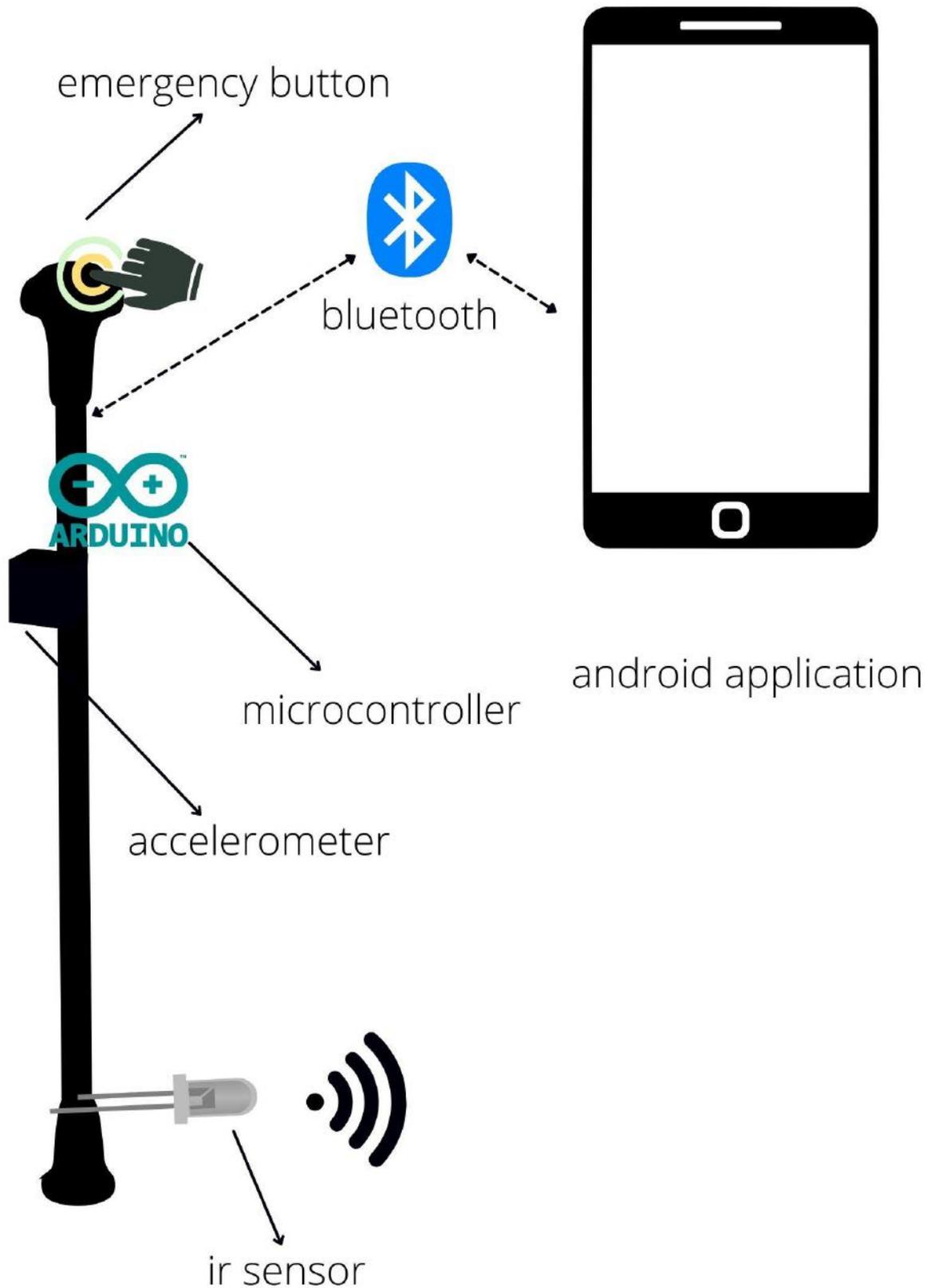
### IMPLEMENTATION

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)
```

**PERCEIVED SOCIAL SUPPORT AND QUALITY OF LIFE AMONG NURSES  
DURING COVID 19 PANDEMIC**

Dissertation submitted in partial fulfilment of the requirements for the award of

Master of Science in Psychology

By

**MEGHANA LESLIE**

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**MARCH 2022**

## **CHAPTER 1: INTRODUCTION**

Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus. Most people infected with the virus will experience mild to moderate respiratory illness and recover without requiring special treatment. However, some will become seriously ill and require medical attention. Older people and those with underlying medical conditions like cardiovascular disease, diabetes, chronic respiratory disease, or cancer are more likely to develop serious illness. Anyone can get sick with COVID-19 and become seriously ill or die at any age. It was first detected in Wuhan, China in late 2019, and it has since spread globally. The rapid spread of the virus transmitted primarily by human to human contact drove the World Health Organization to classify it as a pandemic in March 2020.

Due to the mode of transmission or spread of the virus various countermeasures has been taken to prevent the spread of infection. Social distancing has been done to minimize the spread of virus as in most of the cases the transmission or spread of the virus was from unknown sources. Quarantine was taken to safeguard people against the virus and the infected patients were isolated to limit the spreading of virus. The lockdown , quarantine, isolation has affected people to a great extend especially the mental health. Social functioning were also affected. The healthcare workers were affected as they were more in risk for being infected as they were in contact with infected patients, especially nurses. The virus infection has caused unusual tendency to arouse fear among people.

Now new variation of corona virus has emerged known as Omicron. The Omicron variant is a variant of SARS-CoV-2 (the virus that causes COVID-19) that was first reported to the World Health Organization (WHO) from South Africa on 24 November 2021. Omicron multiplies around 70 times faster than the Delta variant in the bronchi (lung airways) but evidence suggests it is less severe than previous strains, especially compared to the Delta variant. Omicron might be less able to penetrate deep lung tissue. Omicron infections are 91 percent less fatal than the delta variant, with 51 percent less risk of hospitalization. Overall,

the extremely high rate of spread, combined with its ability to evade both double vaccination and the body's immune system, means the total number of patients requiring hospital care at any given time is still of great concern.

The WHO is concerned that a large number of mutations may reduce immunity in people who were previously infected and in vaccinated people. It is also possible the Omicron variant might be more infective in this regard than prior variants. The effects of the mutations, if any, are unknown as of late november 2021. The WHO warns that health services could be overwhelmed especially in nations with low vaccination rates where mortality and morbidity rates are likely to be much higher, and urges all nations to increase COVID-19 vaccinations. Many of the mutations to the spike protein are present in other variants of concern and are related to increased infectivity and antibody evasion. It was not known in November 2021 how the variant would spread in populations with high levels of immunity. It was also not known if the Omicron variant causes a milder or more severe COVID-19 infection.

Nurses plays an important role and have responsibilities during covid 19 pandemic along with other medical field and healthcare workers. They are in front line to take care of patients and they make sure it irrespective of their condition. When a global pandemic arises a strong nursing staff is required and they work over time to take care of the patients and have to stay away from their families. They have actively involved in stopping and reducing the spread of covid 19.

Nurses should be given a positive work place and the support they deserve. Due to the pandemic many of them who were staying in hostels and away from home has faced a very hard time as they were thrown out of hostels and was not given places to stay because people feared that they would spread the infectious disease. They are the warriors who are risking

their lives to keep others safe and helping patients to face the situation. Perceived social support refers to how individuals perceive friends, family members and others as sources available to provide material, psychological and overall support during times of need.

The covid 19 pandemic has isolated nurses from support providers. Due to the stressful situations the mental health of the nurses are in danger and its affects their family life especially the married nurses. Social support is crucial protective factor that help nurses to face the situation. Having friends , family members with nurses when a crisis like covid 19 pandemic arises makes them to focus on their job and a positive , relived outlook to the condition. When they get the perceived social support from their loved ones they can also take care of the patients well as the positive outlook increases their work efficiency. Social support can also causes a great impact on the quality of life too.

Quality of life is the degree to which an individual is healthy, comfortable and able to participate in or enjoy life events. It may also be defined as having ability to live a good life in terms of emotional and physical well-being. Work life can affect quality of life as it is an important part of daily life. Low perceived social support in work life can affect his or her quality of life. Despite of exposed to numerous risk factors during covid-19 time the social support provided to nurses can increase their quality of life. The benefits of social support in terms of positive effects on health and happiness of individuals have a long gained acceptance, perceived social support in particular affects individual to a greater extent by improving their physical and psychological health. The most important function of social support is that it serves as a buffer by reducing or balancing the psychological harms caused by stressful life events and the on going challenges of life. So it is necessary to protect and support nurses physically as well as socially and psychologically to take care of the patients and themselves and prevent them from infecting themselves and other patients and increase their quality of life. These aspects help in improving and increasing healthcare service.

In a research conducted in Malaysia, perceived inadequacy of social support received at work, suffering from some medical illnesses even with covid-19, long working hours without leave, and direct involvement with covid-19 patients lead to frequent exposure significantly predicted higher odds of burnout among healthcare workers in this country during the covid-19 pandemic. Higher levels of burnout are associated with lower general quality of life and psychological quality of life among healthcare workers especially in nurses and who are married and having kids. Lack of perceived social support from friends, family and from the organization or hospital they are working in can affect their quality of life.

In case of married and unmarried nurses the married nurses have to face more difficulties during covid-19 pandemic. As the married nurses and the ones who have kids have more responsibilities as compared to unmarried nurses. Marriage is a commitment and the marital adjustment plays a crucial role for the overall well-being of the family. Nurses have to take care of the family members and look after the needful. The occupation of the partner is of great importance and has a significant importance on marital adjustment. Nursing is a kind of profession in which one should take care of the patients and they must do the job with dedication and with compassion. They must make sure that all the needs of the patients are met, medicines should be given on time for all the patients, regular monitoring is required and nurses should be there if there any emergencies has occurred.

Nursing is a job with lot of complexities and it should be done with at most care, even a minor mistake can cause great risk and even it can harm patients. The increased complexity and ever changing nature of this profession have made sweeping changes. It has a fluctuating work schedules, this job is of high demands, night shifts, long hours of work, low payment can cause problems for married nurses. It can affect the quality of life of the married nurses.

If they are not getting the perceived social support which they needed the most for the well-being of married life it causes low quality of life. The management of the hospital that they are working if make them work for long hours without any leave and salary it causes difficulties to do the job with dedication.

During the time of covid-19 pandemic the nurses who were working with infected covid patients and became positive had to face more consequences. Due to high number of patients infected with virus and low number of nursing faculties to look after the patients made the nurses who are infected with covid-19 virus to work in hospitals. Working and taking care of infected patients even after being tested positive for covid-19 has made the life even difficult for the nurses. Some of them were thrown out of the houses where they were staying as paying guests and in hostels. Married nurses had to stay away from their family and kids and was not able to do the responsibilities at home. Working for hours without any break and salary and being infected by virus puts them into more trouble due to the lack of social support from the organisation they work.

Due to the arrival of Covid virus variant Omicron and it's faster spread makes the life of nurses more difficult as they had to work more due to the increase in number of patients. Nurses had to rush and take care of every patients and medicines should be given on time and arrange ventilators and other necessary items. They are working over time to take care of all the patients in hospital without bothering their own health. They have to sacrifice their life, loved ones and families, married nurses especially.

Even though numerous studies has been done or conducted on the medical aspects of the covid-19 pandemic, only a few studies have focused on the perceived social support and quality of life among married and unmarried nurses during covid-19 pandemic even after nurses deals with infected patient care directly and are the bedrock of healthcare community.

Therefore, this study is conducted to identify the relationship between the perceived social support and quality of life among married and unmarried nurses during covid-19 pandemic.

### **Need and significance of study**

This study helps to identify the rate of perceived social support and quality of life among married and unmarried nurses during covid 19 pandemic. Through this study we can find out how does the perceived social support received by the nurses affects their quality of life and it's relation. This study also helps everyone to understand the struggles undergone by the nurses during such a difficult situation, especially the married nurses. There were many attacks against healthcare workers during the pandemic for isolating the infected from preventing the spread of virus. This study bring an impact to the lives of nurses by making everyone realise that nurses struggles a lot by working overtime without payment and even being inflected for our loved ones as well as for us so that we ought to respect them and follow the rules and restrictions given by government and doctors for the safety of ourselves. This study will change the perspective of how we value nurses especially it is the starting of fourth wave of covid 19. This study uses perceived social support and quality of life because this two variables helps to understand how much support they received and how did it effect their quality of life during the time of covid 19 pandemic. Perceived social support is important for the healthcare workers especially nurses because during a situation like pandemic especially when it is an unknown virus or diseases they need the support of everyone if they do not receive the support they expected it can affect their quality of life which leads affects their working conditions, unable to concentrate on their work. Nursing is a noble profession where they need compassion towards their work and it should be taken care of patients as they are dealing with the life of people. So this study helps us to measure

perceived social support and quality of life among married and unmarried nurses during covid 19 pandemic.

## **CHAPTER 2: REVIEW OF LITERATURE**

Yu, Hung, Wu, Tsai, Wang, Lin (2008) conducted a cross-sectional research to explore the Quality of life and job satisfaction and their inter-relationships among nurses. Participants were 1,020 nurses who had worked for over six months at seven hospitals in Yunlin and Chiayi counties. Nine hundred and eleven questionnaires were returned, with a response rate of 89.3%. The questionnaire comprised three parts: demographic characteristics and work environment, quality of life, and job satisfaction. The Cronbach's alphas were 0.87- 0.94. Data were analyzed by SPSS/PC 13.0. The results showed that factors affecting job satisfaction were support from managers, number of patients cared for during day time, health status, stress from changing units, religion, work stress, and working unit's suitability to one's interests ( $R(2) = 53.5\%$ ). Factors affecting quality of life were job satisfaction, happiness of life, health status, work stress, and age ( $R(2) = 51.0\%$ ). There was a positive correlation between job satisfaction and quality of life. Study concluded that nursing managers should create better work environments to improve nurses' job satisfaction and facilitate their retention in the nursing profession.

Lee (2004) identified correlations between fatigue and quality of life among clinical nurses in Korea. A sample of 294 nurses working in 3 general hospitals answered a questionnaire containing Yoshitake's fatigue scale (1979) and WHOQOLBREF. Data were analyzed using t-test, ANOVA and Pearson correlation coefficients. The SPSS 11.0 version was used for analysis. The score for level of fatigue was 2.11 (52.7%) and quality of life, 2.89 (57.8%).

The level of fatigue was highest in the physical domain followed by psychological and nervous-sensual domain in that order. There were statistically significant differences in scores of fatigue depending on the nurse's age, marital status, career, position, health status and present illness. Quality of life had the highest score in the social domain followed by physical, psychological, and environmental domain. There were statistically significant differences in scores on quality of life depending on nurse's age, marital status, career, position, health status and present illness. The relationship between fatigue and quality of life revealed a significant negative correlation. Based on this study, nursing administrators need to reduce the level of nurse fatigue by providing various programs, which improve quality of life.

Somgiat, Oumtanee (2007) studied Quality of working life of professional nurses and the relationship between variables such as job characteristics, perceived organizational support, and head nurses-staff nurses relationship. The sample consisted of 250 professional nurses working in Police General Hospital, Bangkok, Thailand, who were selected by stratified random sampling technique. Statistical methods used to analyze the data were mean, standard deviation, Pearson's product moment correlation coefficient, and stepwise multiple regression analysis. The results of the study revealed that the overall quality of working life of professional nurses at Police General Hospital was at the moderate level. Variables predicting quality of working life of professional nurses at  $p = 0.05$  were, perceived organizational support and head nurses- staff nurses relationship. These predictors accounted for 49.7 percent of the variance ( $R^2 = 49.7$ ). These findings indicated that the factors, perceived organizational support and head nurses- staff nurses relationship, have effect on the quality of working life of professional nurses so that the nursing administrators should support and create good relationship with their staff nurses in order that they will improve their work qualitatively and effectively.

Hsu, George (2006) carried out a descriptive study with a convenience sample to determine Quality of working life of nurses in Taiwan. A total of 16 focus groups in one medical centre and five regional hospitals informed a quality of working life framework. Each group had three to five participants who were Registered Nurses in medical or surgical wards with at least two years nursing experience, and held a position below assistant nurse manager. A total of 56 nurses' quality of working life categories were identified and fitted into six dimensions: socio-economic relevance, demography, organizational aspects, work aspects, human relation aspects and selfactualization. The issues emphasized by focus group participants were managing shift work within the demands of family life; accommodation; support resources; and nurses' clinical ladder system and salary system. Further research is needed with other groups of nurses in a wider variety of settings in order to examine strengths and weaknesses in the total healthcare work environment and to develop appropriate strategies for nurses' quality of working life.

Alfaia dos Santos, Beresin (2009) conducted a cross-sectional study to evaluate the quality of life of operating room nurses and to collect their opinions as to the influence their professional activity exerts on their quality of life. This was carried out on a sample of 24 nurses of a large private hospital in the city of Sao Paulo. Two questionnaires were applied; one was designed by the researchers, and the other was the Quality of Life Questionnaire (WHOQOL-BREF). As to quality of life, the environment domain obtained the highest score, while the psychological domain obtained the lowest. When asked if their professional activity in the operating room influenced their quality of life, most responded affirmatively. Regarding the justifications offered by the nurses for the influence of their professional activity on their quality of life, 50% mentioned environment-related stress, responsibilities, duties, risk situations, relationships with the multiprofessional team, and the type of work carried out in the operating room. The psychological domain obtained the lowest score in the

nurse quality of life evaluation, pointing out the need to facilitate and/or encourage nurses to seek psychological support. As to the influence of their professional activity on their quality of life, the nurses mentioned stress related to their work environment and professional activities in the operating room. This highlights the importance of managers in this area, paying greater attention to the individual and collective needs of their employees.

Tülay Kılınç RN, MSc, Aslı Sis Çelik RN(2020) conducted a cross-sectional study on Relationship between the social support and psychological resilience levels perceived by nurses during the COVID-19 pandemic. The study comprised the Descriptive Properties Form, the Multidimensional Perceived Social Support Scale, and the Connor–Davidson Resilience Scale were used to collect the data from 720 nurses working at a university hospital in an eastern province in Turkey. It was found that the total average MSPSS score of the nurses included in the study was  $67.33 \pm 11.00$ , and the total average CD-RISC score was  $64.28 \pm 15.99$ . A positive directional significant relationship was observed between the social support perceived by the nurses and their level of psychological resilience; the latter increased as the social support perceived by them increased. Moreover, both age and the economic condition of the nurses affected their perceived social support and psychological resilience levels, while the term of employment and work shift only affected their psychological resilience level. The nature of duties performed by the nurses during the study period was not found to affect either their perceived social support or psychological resilience levels.

Yinmei Yang MD, Peigang Wang, Mohammedhamid Osman Kelifa, Bo Wang PhD, Mingxiu Liu MD, Lili Lu MD and Wei Wang PhD(2020) conducted a study on How workplace violence correlates turnover intention among Chinese health care workers in COVID-19 context: The mediating role of perceived social support and mental health. A cross-sectional survey was conducted among Chinese health care workers (N = 1,063)

between 13 and 20 February 2020. Mediation effects were tested using structural equation modelling with weighted least squares mean and variance adjusted (WLSMV) estimator. The study used 12-item perceived social support (PSS) scale, The Chinese Depression Anxiety Stress Scales-21 (DASS-21), Workplace violence was evaluated using a dichotomous variable (Yes or No), measured turnover intention with a single item (Yes or No). It was found that the workplace violence had both direct and indirect effects on turnover intention among Chinese health care workers. Specifically, perceived social support, mental health and perceived social support together with mental health partially mediated the relationship between workplace violence and turnover intention. Chinese health care workers experiencing violence during the COVID-19 outbreak were more likely to report turnover intention. Enhancing social support and reducing mental health problems would be beneficial in decreasing the detrimental effects of workplace violence on turnover intention.

Tianya Hou, Qianlan Yin, Yan Xu, Jia Gao, Lian Bin, Huifen Li, Wenpeng Cai, Ying Liu, Wei Dong, Guanghui Deng and Chunyan Ni(2021). the study was on The mediating role of perceived social support between resilience and anxiety 1 Year after the COVID-19 pandemic: disparity between high-risk and low-risk nurses in China. Connor-Davidson Resilience scale, Perceived Social Support Scale and Generalized Anxiety Disorder Scale were administrated to 701 nurses from Jiangsu Province, China, 1 year after the COVID-19 outbreak. The mediating effect was examined by Mackinnon's four-step procedure, while the moderated mediation model was tested by Hayes PROCESS macro. The findings presented the prevalence of anxiety among nurses was 21.4% 1 year after the COVID-19 pandemic. High-risk nurses presented a higher prevalence of anxiety (24.5 vs. 19.3%) than low-risk nurses. Age and professional title were significantly associated with anxiety only in high-risk nurses (all  $P < 0.05$ ). Perceived social support mediated the association between resilience and anxiety and the indirect effect was stronger for high-risk nurses than low-risk nurses.

Anxiety remains prevalent among nurses 1 year after the COVID-19 outbreak, and resilience plays a protective role against anxiety.

Anna E. Schierberl Scherr, Brian J. Ayotte, Marni B. Kellogg(2021) conducted study on Moderating roles of resilience and social support on psychiatric and practice outcomes in nurses working during the covid-19 pandemic. Nurses across the United States (N=312) were invited to participate in an online survey collecting data on demographics, resilience, social support, and screening measures of depression, PTSD, anxiety, and distracted practice. Data were analyzed using descriptive statistics and hierarchical regression for each outcome measure. findings support a growing body of research reporting that nurses are experiencing mental health sequelae during the COVID-19 pandemic, especially those providing direct care to patients with the virus. Found that compared to nurses who did not care for patients with COVID-19, those who did reported increased symptoms of PTSD, depression, and anxiety. Nurses providing direct COVID-19 care also experienced increased levels of distracted practice. Also found that resilience and social support acted as moderators of some of these relationships. Fostering resilience and social support may help buffer the effects of providing care to patients with COVID-19 and could potentially decrease nurse vulnerability to developing psychological symptoms and impairment on the job.

Hosseina Ebrahimi, Ezzatb Jafarjalal, Asgharc Lotfolahzadeh, Moghadam Kharghani Melika Seyedeh(2021) conducted a cross-sectional study on The effect of workload on nurses' quality of life with moderating perceived social support during the COVID-19 pandemic. This was a cross-sectional descriptive-analytic study. 336 nurses who worked in inpatient wards with COVID-19 patients were randomly selected and studied. NASA-TLX Workload Questionnaire, WHO Quality of Life Questionnaire and Multidimensional Social Support Perception Scale were used to data collection. Structural equation modelling in PLS software was used to modelling. The results showed that the average score of workload,

perceived social support and quality of life were  $80.87 \pm 20.17$ ,  $56.23 \pm 11.46$  and  $55.87 \pm 13.74$ , respectively. A significant inverse relationship was observed between workload and quality of life ( $P < 0.05$ ). Also, perceived social support had a moderator effect on relationship between workload and quality of life ( $P < 0.05$ ).

### **CHAPTER 3: METHODOLOGY**

### **3.1 Aim**

To find the perceived social support and quality of life among married and unmarried nurses during covid-19 pandemic.

### **3.2 Problem statement**

This study is to identify the perceived social support and quality of life among married and unmarried nurses during covid 19 pandemic. Perceived social support is important for the nurses to improve their quality of life. When they receive the support they perceived from others their quality of life increases and helps them to work efficiently because nursing is a noble profession and they are dealing with the life of people so they have to perform their duties with at most care and with compassion so to perform well they should have a good quality of life and they should receive the perceived social support from others.

### 3.3 Objectives

- ★ To evaluate the relationship between perceived social support and quality of life among married and unmarried nurses during covid-19 pandemic.
- ★ To assess the difference in perceived social support between married and unmarried nurses during covid-19 pandemic.
- ★ To assess the difference in Quality of life between married and unmarried nurses during covid 19 pandemic

### 3.4 Hypothesis

H1: There is a significant relationship between perceived social support and quality of life among married and unmarried nurses.

H2: There is no significant difference in perceived social support between married and unmarried nurses

H3: There is no significant difference in quality of life between married and unmarried nurses.

### 3.5 Operational definition

#### **Perceived social support**

It refers how individuals perceive friends, family and others as sources available to provide material, psychological and overall support during times of need. It has been consistently related to well-being as the perceived levels of support, love and care can provide positive experiences. It is the Independent variable in the study

#### **Quality of life**

It is defined as an individual's perception of their position in life in the context of culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is the dependent variable in the study.

### **3.6 Sample**

The study takes 250 samples in which 126 samples were from married nurses and 124 samples from unmarried nurses.

#### **3.6.1 Population**

The population is done on nurses from India and abroad (3%).

#### **3.6.2 Sampling design**

The study uses snowball sampling method. Snowball Sampling (or chain sampling, chain-referral sampling, referral sampling) is a nonprobability sampling technique where existing study subjects recruit future subjects from among their acquaintances. Thus the sample group is said to grow like a rolling snowball. This is done by passing the questionnaires to the subject and they pass on other subjects under the criteria and it goes on.

#### **Inclusion criteria**

- ★ Married and unmarried nurses
- ★ Who can follow, read and write English language
- ★ Who has the access to social media like whatsapp, mail, instagram and facebook.
- ★ Who are mentally strong

#### **Exclusion criteria**

- ★ Who cannot reads,write and follow English language.

- ★ Who are not mentally sound.
- ★ Who has no social media access.

### 3.7 Tools

- ★ The research tools used are Multidimensional Scale of Perceived Social Support ~~Scale~~ (Zimet and Pahlem,1988). It is a 12 item questionnaire consist of sub scales like social support, family support and friends support. It is a seven-point Likert scale, with scores 1-7 being judged as “very strongly disagree” to “ very strong agree”. The scale shows higher reliability of 0.91 with a reliability of 0.94, 0.90, 0.95 for friends, family and significant others respectively. The subdimension scale score is obtained by adding the total points of the items in each subdimension, and the total score of the scale is obtained by summing the scores of all the items and finding the mean. A high total MSPSS score indicates high social support, whereas a low total score indicates that social support is either not perceived, is not adequate, or not provided at all. The Cronbach alpha value of the scale was calculated as 0.88. The scale has both construct and concurrent validity.
- ★ WHOQOL-BREF questionnaire is used to assess the quality of life, developed by WHO. It has six domains which are physical, psychological, level of independence, social relations, environmental and spiritual. It is a 26 item questionnaire. It is a five-point likert scale. Cronbach alpha values for each six domains ranged from 0.71 to .86. The study has discriminant validity.

### 3.8 Procedure

The sample size of this study is 250(125-married nurses and 125-unmarried nurses). the study was carried out relying on online self-reports under a snowball sampling technique with an attachment of consent form where each participant consented to participate in the survey

after reading the consent form. Two e-questionnaires are given to the participants which are Multi-dimensional Scale of Perceived Social Support(MSPSS) to measure perceived social support and Quality Of Life questionnaire by WHO(WHOQOL-BREF) to measure quality of life. The e-questionnaire is passed on to the participants and then scored accordingly to find ofthe perceived social support and quality of life among married and unmarried nurses and then it is analyzed.

### **3.9 Data analysis technique**

The responses of the subjects were analyzed using Statistical Package for Social Sciences (SPSS) and Excel sheet. Spearman's rho correlation test and Mann-Whitney U test were used.

A Spearman correlation coefficient is also referred to as Spearman rank correlation or Spearman's rho. Like all correlation coefficients, Spearman's rho measures the strength of association between two variables. As such, the Spearman correlation coefficient is similar to the Pearson correlation coefficient. All bivariate correlation analyses express the strength of association between two variables in a single value between -1 and +1. This value is called the correlation coefficient. A positive correlation coefficient indicates a positive relationship between the two variables (as values of one variable increase, values of the other variable also increase) while a negative correlation coefficient expresses a negative relationship (as values of one variable increase, values of the other variable decrease). A correlation coefficient of zero indicates that no relationship exists between the variables.

The Mann-Whitney U test is used to compare differences between two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed. Unlike the independent-samples t-test, the Mann-Whitney U test allows you to draw different conclusions about your data depending on the assumptions you make about your data's

distribution. These conclusions can range from simply stating whether the two populations differ through to determining if there are differences in medians between groups.

## CHAPTER 4: RESULT AND DISCUSSION

### Result

**Table 4.1:** Spearman's rho correlation between Perceived social support and Quality of life among married and unmarried nurses.

variables	Perceived social support
Quality of life	.429**

\*\*p<0.01

p value of correlation is .000

Table 4.1 Spearman's rho correlation between Perceived social support and quality of life among married and unmarried nurses. It has been found that the  $r = .429$ ,  $p = .000$  which shows that it is statistically significant ( $p < 0.01$ ) and it is a positive correlation and has moderate correlation between perceived social support and quality of life among married and unmarried nurses. So the hypothesis which states that there will be a significant relationship between perceived social support and quality of life among married and unmarried nurses is retained.

**Table 4.2:** Mann Whitney U test showing marital difference in Perceived social support among married and unmarried nurses

Variables	Categories	N	Mean rank	U	Sig.
Perceived social support	Married	126	125.57	7803.00	.987
	Unmarried	124	125.43		

Table 4.2 Mann-Whitney test showing difference in perceived social support between married and unmarried nurses. The mean rank in of married and unmarried nurses are found to be 125.57 and 125.44 and  $p = .987$  ( $p > 0.01$ ) which indicates that there is no significant difference in perceived social support between married and unmarried nurses and perceived social support is slightly more for married nurses than unmarried nurses. So the hypothesis which states that there will be no significant difference in perceived social support between married and unmarried nurses is retained.

**Table 4.3:** Mann Whitney U test showing marital difference in Quality of Life among married and unmarried nurses.

Variables	Categories	N	Mean rank	U	Sig.
Quality of life	Married	126	118.60	6943.00	.128
	Unmarried	124	132.51		

Table 4.3 Mann-Whitney test indicates difference in quality of life among married and unmarried nurses. The mean rank of married and unmarried nurses are found to be 118.60 and 132.51 respectively and  $p = .128$  ( $p > 0.01$ ) which shows that there is no significant difference in quality of life among married and unmarried nurses and quality of life is slightly more for unmarried nurses than married nurses. So the hypothesis which states there will be no significant difference in quality of life between married and unmarried nurses is retained.

## Discussion

This study was conducted to understand the perceived social support and quality of life among married and unmarried nurses during covid 19 pandemic. A sample size of 250 was taken in which 126 were married and 124 were unmarried. To measure perceived social support Multidimensional Scale of Perceived Social Support Scale (MSPSS) was used and to measure Quality of life revised version of World Health Organization Quality of life (WHOQOL-BREF) was used.

To find out perceived social support and quality of life among married and unmarried nurses Spearman's rho correlation test and Mann-Whitney U test were used to find out to know whether there is a significant difference in Perceived social support between married and unmarried nurses and also to find out whether there is a significant difference in Quality of life between married and unmarried nurses. Through Spearman's rho correlation test it was found that there is a significant positive correlation between Perceived social support and quality of life among married and unmarried nurses during and has moderate correlation. In Mann-Whitney U test it was found that there is no significant difference in Perceived social support between married and unmarried nurses and perceived social support is slightly more for married nurses than unmarried nurses, also found there is no significant difference in quality of life between married and unmarried nurses and quality of life is slightly more for unmarried nurses than married nurses.

Through Spearman's rho correlation test it was found that there is a significant positive correlation which means there is a significant relationship between perceived social support and quality of life. When perceived social support increases quality of life increases. When the nurses receive perceived social support from others the quality of life of nurses is improved and it becomes positive. This result shows that for the nurses to have a good quality of life perceived social support is required from others like partner, family, friends, colleagues, management so that they can work efficiently.

Through Mann-Whitney U test it was found that there is no significant difference in Perceived social support as well as quality of life among married and unmarried nurses which indicates that there is no difference in the amount of perceived social support and quality of life received by married and unmarried nurses. This must be because now everyone are well educated and most of the people are independent and striving to be independent. People support each other to be independent so even after marriage they get the support from their partners, colleagues and in laws and unmarried nurses get support from their parents, colleagues same as the unmarried nurses and also the work environment they are in also must have played an important role.

### **Conclusion**

This study was conducted to understand the perceived social support and quality of life among married and unmarried nurses during covid 19 pandemic. A sample size of 250 was taken in which 126 were married nurses and 124 were unmarried nurses.

To find it out Spearman's correlation test were used and found that there is a significant positive correlation between Perceived social support and quality of life among married and unmarried nurses. Through Mann-Whitney U test it was found that there is no significant difference in Perceived social support in married and unmarried nurses and perceived social support is slightly more for married nurses than unmarried nurses, also no significant difference in Quality of life among married and unmarried nurses and quality of life is slightly more for unmarried nurses than married nurses.

When the perceived social support increases quality of life increases in nurses and there no difference in the amount of perceived social support and quality of life received by married and unmarried nurses.

## **5.1 Findings**

This study was used to identify and understand the perceived social support and quality of life among married and unmarried nurses during covid-19 pandemic. 250 samples were collected in which 126 were married nurses and 124 were unmarried nurses. This study used to identify mainly the relationship between perceived social support and quality of life among married and unmarried nurses, significant difference in Perceived social support between married and unmarried nurses, and significant difference in Quality of life among married and unmarried nurses.

Spearman's rho correlation test was used to find out the relationship between perceived social support and quality of life among married and unmarried nurses and found there is a significant positive correlation. Which satisfied the first hypothesis. This result indicated that perceived social support has influence on quality of life of nurses. When perceived social support increases quality of life also increase in nurses vice versa.

To identify the whether there is any significant difference in perceived social support between married and unmarried nurses and significant difference in quality of life between married and unmarried nurses Mann-Whitney U test is used and found out there is no significant difference in perceived social support between married and unmarried nurses and perceived social support is slightly more for married nurses than unmarried nurses, also there is no significant difference in quality of life between married and unmarried nurses and found to be slightly more for unmarried nurses than married nurses. Which shows that the amount of perceived social support and quality of life received by married and unmarried nurses during covid-19 pandemic was same and there is no difference.

## **5.2 Limitations**

- Due to the use of questionnaire there is a chance that the participants may fill it without reading carefully and just in sake of filling it out.
- The study conducted only between married and unmarried nurses only.
- Only two variables are used.
- This study is done in small resilience.

### **5.3 Suggestions for future research**

- This study used the questionnaire, the future research should use interviews so that researcher can understand better from their facial expressions, mannerisms.
- Future study can do it on the basis of age, gender, geographical area.
- The future research can include or add other variables like job satisfaction, burnout, resilience.
- Future research can do it in large population.

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## Appendix

### Multidimensional Scale of Perceived Social Support

Instructions: We are interested in how you feel about the following statements. Read each statement carefully. Indicate how you feel about each statement.

Circle the "1" if you **Very Strongly Disagree**

Circle the "2" if you **Strongly Disagree**

Circle the "3" if you **Mildly Disagree**

Circle the "4" if you are **Neutral**

Circle the "5" if you **Mildly Agree**

Circle the "6" if you **Strongly Agree**

Circle the "7" if you **Very Strongly Agree**

	Very Strongly Disagree	Strongly Disagree	Mildly Disagree	Neutral	Mildly Agree	Strongly Agree	Very Strongly Agree
1. There is a special person who is around when I am in need.	1	2	3	4	5	6	7
2. There is a special person with whom I can share joys and sorrows.	1	2	3	4	5	6	7
3. My family really tries to help me.	1	2	3	4	5	6	7
4. I get the emotional help & support I need from my family.	1	2	3	4	5	6	7
5. I have a special person who is a real source of comfort to me.	1	2	3	4	5	6	7
6. My friends really try to help me.	1	2	3	4	5	6	7
7. I can count on my friends when things go wrong.	1	2	3	4	5	6	7
8. I can talk about my problems with my family.	1	2	3	4	5	6	7
9. I have friends with whom I can share my joys and sorrows.	1	2	3	4	5	6	7
10. There is a special person in my life who cares about my feelings.	1	2	3	4	5	6	7
11. My family is willing to help me make decisions.	1	2	3	4	5	6	7
12. I can talk about my problems with my friends.	1	2	3	4	5	6	7

I.D. number

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**ABOUT YOU**

Before you begin we would like to ask you to answer a few general questions about yourself: by circling the correct answer or by filling in the space provided.

What is your **gender**? Male Female  
 What is your **date of birth**? \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_  
 Day / Month / Year

What is the highest **education** you received? None at all  
 Primary school  
 Secondary school  
 Tertiary

What is your **marital status**? Single Separated  
 Married Divorced  
 Living as married Widowed

Are you currently **ill**? Yes No  
 If something is wrong with your health what do you think it is? \_\_\_\_\_ illness/ problem

**Instructions**

This assessment asks how you feel about your quality of life, health, or other areas of your life. **Please answer all the questions.** If you are unsure about which response to give to a question, **please choose the one** that appears most appropriate. This can often be your first response.

Please keep in mind your standards, hopes, pleasures and concerns. We ask that you think about your life **in the last two weeks.** For example, thinking about the last two weeks, a question might ask:

	Do you get the kind of support from others that you need?	Not at all 1	Not much 2	Moderately 3	A great deal 4	Completely 5
--	---	-----------------	---------------	-----------------	-------------------	-----------------

You should circle the number that best fits how much support you got from others over the last two weeks. So you would circle the number 4 if you got a great deal of support from others as follows.

	Do you get the kind of support from others that you need?	Not at all 1	Not much 2	Moderately 3	A great deal 4	Completely 5
--	---	-----------------	---------------	-----------------	-------------------	-----------------

You would circle number 1 if you did not get any of the support that you needed from others in the last two weeks.

Please read each question, assess your feelings, and circle the number on the scale for each question that gives the best answer for you.

		Very poor	Poor	Neither poor nor good	Good	Very good
1(G1)	How would you rate your quality of life?	1	2	3	4	5

		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
2 (G4)	How satisfied are you with your health?	1	2	3	4	5

The following questions ask about **how much** you have experienced certain things in the last two weeks.

		Not at all	A little	A moderate amount	Very much	An extreme amount
3 (F1.4)	To what extent do you feel that physical pain prevents you from doing what you need to do?	1	2	3	4	5
4(F11.3)	How much do you need any medical treatment to function in your daily life?	1	2	3	4	5
5(F4.1)	How much do you enjoy life?	1	2	3	4	5
6(F24.2)	To what extent do you feel your life to be meaningful?	1	2	3	4	5

		Not at all	A little	A moderate amount	Very much	Extremely
7(F5.3)	How well are you able to concentrate?	1	2	3	4	5
8 (F16.1)	How safe do you feel in your daily life?	1	2	3	4	5
9 (F22.1)	How healthy is your physical environment?	1	2	3	4	5

The following questions ask about **how completely** you experience or were able to do certain things in the last two weeks.

		Not at all	A little	Moderately	Mostly	Completely
10 (F2.1)	Do you have enough energy for everyday life?	1	2	3	4	5
11 (F7.1)	Are you able to accept your bodily appearance?	1	2	3	4	5
12 (F18.1)	Have you enough money to meet your needs?	1	2	3	4	5
13 (F20.1)	How available to you is the information that you need in your day-to-day life?	1	2	3	4	5
14 (F21.1)	To what extent do you have the opportunity for leisure activities?	1	2	3	4	5

		Very poor	Poor	Neither	Good	Very good

				poor nor good		
15 (F9.1)	How well are you able to get around?	1	2	3	4	5

The following questions ask you to say how **good or satisfied** you have felt about various aspects of your life over the last two weeks.

		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
16 (F3.3)	How satisfied are you with your sleep?	1	2	3	4	5
17 (F10.3)	How satisfied are you with your ability to perform your daily living activities?	1	2	3	4	5
18(F12.4)	How satisfied are you with your capacity for work?	1	2	3	4	5
19 (F6.3)	How satisfied are you with yourself?	1	2	3	4	5
20(F13.3)	How satisfied are you with your personal relationships?	1	2	3	4	5
21(F15.3)	How satisfied are you with your sex life?	1	2	3	4	5
22(F14.4)	How satisfied are you with the support you get from your friends?	1	2	3	4	5
23(F17.3)	How satisfied are you with the conditions of your living place?	1	2	3	4	5
24(F19.3)	How satisfied are you with your access to health services?	1	2	3	4	5
25(F23.3)	How satisfied are you with your transport?	1	2	3	4	5

The following question refers to **how often** you have felt or experienced certain things in the last two weeks.

		Never	Seldom	Quite often	Very often	Always
26 (F8.1)	How often do you have negative feelings such as blue mood, despair, anxiety, depression?	1	2	3	4	5

Did someone help you to fill out this form?.....

How long did it take to fill this form out?.....

**Do you have any comments about the assessment?**

.....  
.....

**THANK YOU FOR YOUR HELP**

**PROJECT REPORT**  
**A STUDY ON THE IMPACT OF CELEBRITY ENDORSEMENT**  
**ON CONSUMERS' BUYING BEHAVIOR**

Submitted by:  
MEGHNA LILY

Register No:  
SB19PSY021

Under the guidance of  
MS. JISHA SEKHAR

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

**B.Sc. PSYCHOLOGY**



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

Nationally Re-accredited at 'A++' level (4<sup>th</sup> cycle) Affiliated to:

Mahatma Gandhi University

**MARCH 2022**

## CERTIFICATE

This is to certify that the project report entitled, “THE IMPACT OF CELEBRITY ENDORSEMENT ON CONSUMERS' BUYING BEHAVIOR”, is a bonafide record submitted by MS. MEGHNA LILY, Reg.no. SB19PSY021, in partial fulfillment of the requirements for the award of the Degree of Bachelor of Psychology during the academic year 2019-2022.



Ms. Bindu John

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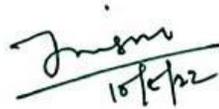
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St. Teresa's College, Ernakulam

External Examiner:



## **DECLARATION**

I, Meghna Lily, hereby declare that the study presented in the dissertation entitled, “The Impact of Celebrity Endorsement on Consumers' Buying Behavior ”, which is submitted to the Department of Psychology, St. Teresa’s College, Ernakulam is a bonafide record of the research work carried out by me, under the supervision and guidance of Ms. Jisha Sekhar, Assistant Professor, Department of Psychology, St. Teresa’s College, Ernakulam, in partial fulfillment of the requirements for the degree of Bachelor of Science in Psychology and has not previously formed the basis for the award of any degree, diploma, fellowship, title or recognition before.

Place: Ernakulam

Meghna Lily

Date: 07/05/2022

## **ACKNOWLEDGEMENT**

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I extend my sincere thanks to my parents and all who have supported me throughout this time. My thanks and appreciations also go to my friends in developing the project and people who have willingly helped me out with their abilities.

Above all, I thank God Almighty for blessing me in all stages of this project and for its successful completion.

Thanking You

Meghna Lily

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**CHAPTER 1**  
**INTRODUCTION**

## INTRODUCTION

### 1.1 BACKGROUND

Watching popular personalities convert themselves to excellent salesmen is something that we witness quite often. Celebrities vouching for or promoting brands and their products is one of the quickest ways for brands to develop an association and a bond in the mind of its consumers. Hence celebrity endorsements are naturally recognized as a viable option for brands to increase their popularity, awareness and credibility. In a world where celebrities are treated as role models, people are changing their life to replicate that of their favourite celebrity. This influence endorsed by the celebrities creates a great impact on the buying behavior of common people. Which attracts the customers and ultimately increases the company productivity.

Celebrities are not always creating any kind of effect on an individual's mind in terms of buying. But mostly it gives a great impact on the perception of choosing any product. We are always thinking that if our favourite celebrity is using them, then we should use that to be like them. These celebrities need not be a superstar, but someone who the target audience can relate to. It has been recognized as a single psychological effect that purchasing a product that has been promoted by a celebrity an individual admires, will allow that particular individual to emulate the celebrity's desired characteristics or attract similar people into their lives.

From the past 150 years advertising is changing in different phases from taking classical forms to modern. Now a days it's the best strategy used by marketers to influence customers by showing celebrities with their products, which includes different appeals like, exciting, absurdity, sexual etc. Belch, G. and Belch, M. acknowledged that the main aim of formulating such specific strategies is to get high brand revelation, longing, concentration and curiosity. For this, marketers attach famous personalities with their products.

McCracken (1989) stated that these famous personalities' had great influence on the consumer's buying behavior that's why it comes off as the most attractive tool of advertising today. The major aim to do advertising and adopt this strategy is to influence customers towards the products. Marketing values have transformed throughout the years. Today marketers make use of celebrities to endorse their products so that they can achieve an edge over their competitors. But this requires great understanding of the concept in order for the celebrity

endorsement to be successful. Hence several factors have to be weighed in order for the celebrity endorsement to be successful.

## **1.2 PROBLEM STATEMENT**

Does celebrity endorsement encourage consumers to take some kind of action towards buying the endorsed product(s)? The study aims to find whether the use of celebrities while endorsing cosmetics products have any impact on the purchase intention among young adult females in Ernakulam district.

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

This research will help to achieve major insights into the impact celebrity endorsements have on consumers' buying behavior. It will assist the marketers to get a better understanding on the different attributes that are important and matters the most to the consumers. Celebrity endorsement influences the behaviours of consumers to buy a specific product through cognition. These perceptions are perceived by consumers through their senses, discernment, attention, recall, reasoning, language, et cetera. Hence this research would provide major help to increase productivity in various businesses.

## **1.4 SCOPE OF THE STUDY**

This is a study done to check whether celebrity endorsements affect buying behavior of the people and to check whether there is a shift in their behavior because of celebrity endorsements. Major emphasis of this research is to determine how marketers select particular celebrities to influence consumers' buying patterns. It also emphasizes how the marketers create a desired image for themselves by selecting strong publicly desirable celebrities. This research also aims at identifying the key factors that may influence consumers buying behavior through celebrity endorsement.

## 1.5 OBJECTIVES OF THE STUDY

The main aim of studying the impact and influence of celebrity endorsement on consumers buying intention is to find the answers to the following:

- To assess the impact celebrities have on the consumers' buying intention with regards to the credibility of the chosen celebrity.
- To assess the impact celebrities have on the consumers' buying intention with regards to the attractiveness of the chosen celebrity.
- To assess the impact that celebrity endorsement have on its consumers in terms of product fit match between the product/brand and the celebrity.
- To see how celebrities transfer meaning to the products they endorse and to what extent does it convince and shape consumers' buying intention.

## 1.6 LIMITATIONS OF THE STUDY

The limitations of this study are as follows:

- As the research will be conducted within Ernakulam district, the perspective of consumers outside Ernakulam district will be left unnoticed.
- Since the respondents will be of young female individuals (between the ages of 18 and 30), individuals above the age of 30 would not be taken into consideration whose opinion regarding celebrity endorsement would likely be very different from the selected sample.
- Respondents belonging to the urban sector, who have an understanding of this issue, are selected while individuals of rural areas will be ignored. Hence, the opinions of people residing in rural areas are not taken into consideration in this study.

**CHAPTER 2**  
**REVIEW OF LITERATURE**

## REVIEW OF LITERATURE

### 2.1 LITERATURE REVIEW

Advertisers regularly practice the strategies intended to attract customer's interest to their message and to differentiate their offerings from rival products with the anticipation of influencing buying behavior of the customer. In today's competitive world, a quality is positioned on an approach, which can accomplish these objectives. One challenge at such a plan includes the use of a celebrity representative. According to Atkin and Block (1983), there are numerous bases as to why a famous endorser may be dominant. First, such a representative attracts consideration toward the commercials into the messy flow of communication. In addition, celebrities are conventionally observed as being greatly active individuals with eye-catching and likable traits.

The use of famous persons in promotions is traced back to the nineteenth century and these general promotional practices have revealed a large quantity of intellectual as well as realistic considerations. Mainly academic analysis of celebrity support encompasses the sphere of spokesperson credibility and charismatic representatives, and recommends that famous persons exercise their impact on customers through apparent traits. A number of research studies reveal that use of eye-catching celebrities serve as a foundation to enhance feelings towards the ads. This mind-set to the commercials is identified as psychological circumstances that are exercised by persons to systematize the manner, how to recognize the surroundings as well as organize the manner a person reacts towards it.

Today the mass media are flooded through descriptions along with information concerning superstars, and because of this, celebrities have high reputations, distinctive traits, and fascinating descriptions according to the community's opinion. Celebrities regularly emerge in promotions in connection among customer goods or services. By means of skill to pierce the hectic mess of publicity, portray customer consideration, produce high memory rates, generate as well as distinguish brand descriptions thus, create trade and income, superstar endorsement have demonstrated to be a helpful approach. No doubt dealers spend huge amounts of capital in utilizing superstars to sponsor their brands.

McCracken (1998) proposes that a superstar is considered like a memorial, entertainer or representative of the business organization. Investigation has established that spokesperson endorsement influences consumers' mind-set in common and it may change the feelings of customers towards the commercial and products as well. This may perhaps effect the improvement of the acquisition plan and as an outcome in the increase of trade. Researchers have intended for extensive concentration to consumer's mind-set to the commercial as a sentimental creation and intervening influence on brand attitudes and acquiring intentions.

This study's main purpose was to study the impact of the celebrity endorsement on effective brand management and evaluate associated factors that contribute to the success or failure of the endorsement. Celebrity endorsement effects are moderated by brand symbolism, such that brands that communicate something about the user yield stronger effects than brands that do not. So, it explains that not just the celebrity but existing brand value plays a very crucial and important role in changing the perception of the target market. This study portrays the light on different purchase patterns of a commodity or a service, when a celebrity is associated with them. The methodology adopted by the researchers was collection of data from libraries and first hand data to conclude the study. The result was that the people would purchase more of the same goods or services due to celebrity endorsements as the consumer tends to neglect the negative effects of the use of that product and also becomes more loyal to the brand.

The researchers of the study focus on the decision making process of consumers after and before the association of a celebrity with a product. The study also showcases the adverse effects of celebrity endorsements. The endorsement is only successful when the right celebrity is associated with the right product. Hence, celebrity endorsement can't be treated as a 'mantra' for success.

## **2.2 RESEARCH GAP**

This research about the "impact of celebrity endorsement on consumers buying behavior" will be useful in many ways :

- There is a lack of research in the field of cosmetic segments in terms of celebrity endorsement. So, the results of this research will highlight how effective the technique of celebrity endorsement is in the cosmetics industry.
- The research about celebrities appearing in cosmetics advertisements in Ernakulam district is rarely done. Hence, the conclusions that would be derived with this research will help in understanding the buying behavior of the females in Ernakulam district.
- This research will help to understand the reaction of women towards celebrity endorsed cosmetic products and will help to judge how much trust women place in celebrities endorsing cosmetics products.

**CHAPTER 3**  
**THEORETICAL FRAMEWORK**

## **THEORETICAL FRAMEWORK**

### **Celebrities**

Erdogan (1999) concludes that celebrities are those people who are well known by the large number of people. They have special uniqueness and features like magnetism, unusual standard of living or special skills that are not commonly experiential in common people. That it can be said that in society they are different from the common people. Among the model forms of celebrities, actors (e.g. Saif Ali Khan, Shah, Salman Khan, Amitabh Bachan etc), models (e.g. Parineeti Chopra, Ali Zafar, Bipasha Basu, Kareena Kapoor etc), Sports-men (e.g. Yousuf Pathan, Shahid Afridi, Sachin Tendulkar, etc.) are significant.

### **Celebrity Endorsement**

Khatri (2006) studied that celebrity endorsement is the Promotion strategy to attract the customers. By analyzing the current market, now it's become the need of the marketers to use the different famous personalities to relate with their brands to create unique identity of the brand and to do famous his company's brand or product, which results high expenditure for the company to use that strategy, however nowadays it is used to be a powerful strategic tool to get maximum profit. It also shows that this can carry risk, because there is no sureness that the celebrity can come up with the sales generation of the firm. But it creates a buzz and gives popularity to the company and the brand. This can increase the expectation of the customers in terms of real stars by delivering the company promise. There are certain perspectives where the real person can work better than the celebrities' endorsement, but not always.

### **Factors Affecting Celebrity Endorsement and Relevant Models**

There are different factors of celebrities influencing the consumer buying behavior when such celebrities endorse any brand. Marketers have to consider some factors while selecting celebrities to endorse brands to get the desired result to use this strategy of celebrity endorsement in terms of brand image, consumer buying behavior and attainment of desired market share. Past researchers have focused on a different mix of factors related to celebrity endorsement

influencing consumer buying behavior, this research is focused on a relatively different and most appropriate mix of factors that a marketer should consider while selecting celebrities to endorse any brand to get a desired effect on consumer buying behavior.

### **a) Credibility**

It refers to the level of believability a beneficiary has towards a message given by the source and expertise of the source or deliverer. In the past source credibility was just considered as an endorser credibility in a commercial. It is proved as a significant basis affecting customer buying behavior and their attitude towards marketing communications. Past publications described three facets of it which are trustworthiness, expertise & attractiveness.

#### **❖ Source Credibility Model.**

Celebrity's integrity relies on his or her physical attractiveness, trustworthiness and expertise that's why researchers who want to study the effectiveness of celebrity endorsement have to consider this model (Ohanian, 1990).

### **i) Trustworthiness**

Trustworthiness is the degree of believability or trust listeners have for communicators (Hovland, 1953). In the case of celebrities it refers to the buyer's trust on celebrities' message for the brand (Ohanian, 1991). In other words if customers have a trust on celebrities being endorsed then the message of such celebrities will be more influential and will help a lot in changing the minds of customers towards the desired action that organizations want for their brand. (Miller and Baseheart, 1969).

#### **→ Impacts of Trustworthiness**

Previously it was researched that more the customers have a trust on communicator the more they get persuaded by the message of that communicator and more the chances of getting customers mind change for the purchase of that brand (Miller & Baseheart, 1969)

### **ii) Expertise**

Expertise is the measure of a communicator's aptitude and attitude which influences customers' decision towards purchase of a brand. Researchers believe that celebrities with

relative and high expertise prove to be more successful in persuading the customers than those who just have physical attractiveness not the combination of attractiveness and expertise (Till and Busler 1998).

### → Impacts of Expertise

Expertise is the ability of a communicator that proves as a helpful factor in taking the decision by a shopper. They generally get inspired by the sayings of learned and expert communicators. Proficient learning skills and expertise of endorsers has a significant reliability impact on customers' belief towards the communication of such endorsers (David H. Silvera, Benedikte Austad, 2004).

### b) Physical Attractiveness

Attractiveness has the power that can easily grab the attention of viewers but it doesn't just relate with the body but the entire physical traits comes under the measure of attractiveness which includes, hair color, facial features, height, weight, complexion, etc and normally public figures have to be attractive to have an influence on their audience and viewers (Temple, 2009).

### ❖ Source Attractiveness Model

Attractive celebrities are more commonly used by organizations for brands' promotions since the inception of this marketing strategy (Erdogan, 1999), once the customers get inspired with the attractive personality of celebrity then they get more involved in the message such celebrities give and then the chances of customers conviction towards the communication of celebrities become more fruitful (Baker & Churchill, 1977; Chaiken, 1979; Debevec & Keman, 1984) such fruitful results probability is normally low with less attractive celebrities.

### i) Similarity

The human brain recognizes celebrities similarly to how it recognizes people we actually know. The effect is that, if consumers happen to be fans, they place a higher value on products that celebrities are endorsing – it is as if they are receiving advice from a valued friend. Consumers feel more sympathetic towards a brand, if their products are promoted by a celebrity they admire or relate to. It's a simple psychological effect: Subconsciously people believe that purchasing a product that's promoted by a celebrity they admire, will allow them to emulate the

celebrity's desired traits or attract similar people into their lives. They will associate the celebrities' success, beauty, athletic skill etc. with a particular product. Shimp (2007) asserted that celebrity similarity involves the degree to which celebrity endorser of a brand matches the target viewers of commercials in terms of some features such as age, gender, ethnicity, et cetera. It is perceived that consumers tend to prefer and rely on messages from celebrity endorsers of a brand that shares these common characteristics. When celebrity endorsers and consumers share similar qualities, such as needs, goals, interest, lifestyle, et cetera the celebrity endorser is better valued in the eyes of the consumers.

## **ii) Familiarity**

Familiarity is a form of remembering in which a situation, event, place, person, or the like provokes a subjective feeling of recognition and is therefore believed to be in memory, although it is not specifically recalled. Familiarity has been shown to be positive and reassuring for most people, while perceived similarity results in the assumption that people have more in common, facilitating warmer, more comfortable interactions (Schneider et al., 2012), all of which facilitate attraction. People are more attracted to that which is familiar. Hence, familiarity with celebrity endorsers can play a role in consumer buying behavior.

## **iii) Likeability**

Likability pulls people toward you. When we think someone likes us, we tend to like them as well. Hence, celebrities who are liked by consumers are better consumers may buy products only best they care aft the person who doong. Likability virtually always helps boost their reputation among their peers. Likeability can increase conformity among people.

## **c) Emotional Involvement**

Emotional Involvement means the purchase decision of customers is directly proportional to the use and likeness by celebrity (endorser) for the brand that celebrity is endorsing (Cronley et al., 1999; Silvera and Austad, 2004). Adding to this, emotional attachment of viewers with their favorite celebrities becomes more fruitful in terms of their believability for the message given by that celebrity.

## **❖ Emotional Involvement Model**

Endorser likes and uses the item he supported. (Cronley et al., 1999; Silvera & Austad, 2004). When an endorser is accepted to like or utilize the item being supported, the purchaser states of mind towards the brand and promotion enhancement.

#### **d) Meaning Transfer**

(McCracken 1986), he says that in simple terminology we can say that endorsers carry their individual meaning to the product. Every celebrity has their own distinctive set of meaning and lifestyle. It clarifies the adequacy of big name spokespersons in terms of what purchasers connect with the endorser and in the end exchange to the brand.

#### **❖ Meaning Transfer Model**

Process of transferring a concept of a product through an endorser to a customer (McCracken, 1986). The appropriate fit between brand features and advocator's personality brings higher chances of likelihood of consumers observation and purchase intention. There are three stages to it. First stage covers the message transferred by celebrity to the brand, in the second stage a message from the brand gets transferred to the customer and in the third stage that message leaves the impact on the customer's psyche and ultimately on customers' decision to buy that brand.

#### **e) Product Match-Up**

Product match-up is construed as ensuring a similarity between the spokesperson's characteristics and the product attributes so as to enhance the advertisement effectiveness. Product specific associations include the associations that vary in their importance depending on the type of product category. The findings have significant implications for academics, brand managers and celebrity management companies.

#### **❖ The Product Match-Up Hypothesis**

The above model explains that there has to be an almost ideal match between the celebrity characteristics of the personality and the features of the brand. (Erdogan 1999) says that a successful matchup can be determined by the extent of the fitness between the celebrity and the brand endorsed by that celebrity. This same concept is further stated by Michael (1989) who believes the same. Another study done by Ohanian in 1991 reveals that simply such celebrities

should be endorsing who is compatible and the consumers perceive them to possess expertise too.

### **Consumer Buying behavior**

Buying behavior is a process by which a person searches for the product/services they need or want, make a decision to buy the required and most suitable one from different alternatives, use and then dispose of it. For making a marketing decision, the buying process model is playing a very important role for any one. It makes marketers think about each step of this process rather than just purchase decisions because if marketers just consider the purchase decision, it may be too late for a business to influence the choice of customers. According to this model the customer passes through all stages for purchasing every goods or services. However, in more regular purchases, customers often skip some stages (Kirmani & Shiv1998).

### **Stages in Consumer Choice Making**

Process starts by acknowledging a need or problem called the problem recognition stage. Then a person starts searching the information regarding the solution of a problem this is known as the information search stage. Then as a result of the information collected individuals become able to evaluate the alternatives they have to resolve their problem. Then the time comes to make a purchase decision for the most appropriate alternative they have evaluated among all they have in their choice. Then on using the selected alternative, buyers become able to assess the performance of the brand whether it fulfilled the desired expectations or not or whether to buy it again or not.

### **Factors affecting Buying Behavior**

Brewster, Sparrow and Vernon (2007) explain about factors that affect buying behavior and vary from person to person, age to age, and area to area. Every society follows its own norms, culture and values. At different stages of life our preferences change because of our age, needs,

lifestyle, earning and psychological factors. These factors can be Internal (memory and way of thinking) or External (media, word of mouth, publicity and feedback).

There are several factors, which pressure the buying behavior :

**a) Cultural influences**

It has the broadest and the deepest influence on buying behavior. Brewster, Sparrow and Vernon (2007) define culture as a shaping process, ' for a culture to exist, member of a group or society having different values and norms, which vary from time to time. Cultural values can change and have to be watched by marketers. Ignoring this deepest and widest factor can be very costly for a company in terms of image and profit.

**b) Social influences**

Social influences are those influences that clearly mold buying behavior, it affects through reference group, family members and social class (Ahmed & Saeed 2014).

**c) Family influences**

Family life cycle and family decision making has the most influence on one's buying behavior.

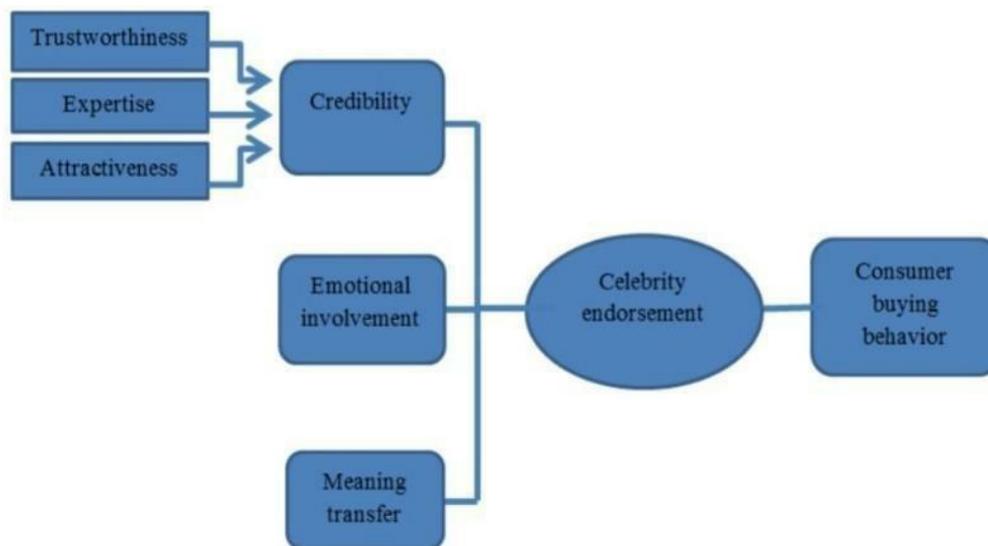
**d) Psychological influences**

These influences are related to our perception, learning, memory and motivation. It changes buying behavior through making the perceived picture of the product in the customer's mind. Customer buying behavior can be influenced by different factors like: perception, beliefs, society, personality, information choices, preferences and communication.

### **Impact of Endorsement on Buying Behavior**

Ranjbarian, Shekarchizade & Momeni (2010) agreed that advertisement is the action that persuades individuals of any particular market to buy services and products or services. Through different ways the advertisement message can be spread like TV ads, radio publicity, print promotion, online advertising, billboard marketing, in-store advertisement, WOM advertising, and endorsement. Now the question arises which category of promotion is best? The best nature

of advertisement depends on the type of industry or firm and its necessities and desires. McCracken (1989) found that celebrities' endorses characterized an effective way of transferring meaning to brands. The common conviction of the marketers is that there is a significant and huge impact of those advertisements, which are endorsed by the famous celebrities comparable with the non-endorsed celebrities.



### Positive Effects of Celebrity Endorsement

(R. Croft) cited that as competition is increasing between the firms to attract more consumers towards their brands, celebrities are increasingly used by the marketers to endorse their products. (Kulkarni and Gaulkar 2005) mentions that featuring a famous personality helps marketers in solving the problem of over communication. Celebrities because of their well knownness can assist advertisements to become more popular and stand out from the clutter and increase communicative ability. Celebrity endorsement helps in improving the brand's image and also polishes the company's image. Celebrity endorsement can also prove to be a powerful tool in entering foreign markets, it helps the company to overcome numerous issues. For instance, L'Oreal uses Ashwariya Rai and Sonam Kapoor in their White Perfect range, Kareena Kapoor in Lakme Eye conic kajal and Kajol in Olay aging cream are all considered popular in India. It is

also seen that those products which are endorsed by celebrities' stand out from other competing products because of their high level of recall and celebrities also create an impact on consumers' minds by making the advertisement memorable so it can be easily retrieved at the time of shopping. Lastly, celebrities who appear in any advertisement for endorsing a product, they are actually capable of breathing life in a falling brand and can help that falling brand to rise, in other words, they create new interest and excitement in consumers. All these arguments point to one conclusion that celebrity endorsement creates a positive impact on consumers' buying behavior (Goldsmith, Lafferty and Newell 2000).

### **Negative Effects of Celebrity Endorsement**

However celebrity endorsement has countless benefits but there are also certain risk factors that are associated with celebrity endorsement as a marketing strategy. Negative publicity regarding the celebrity is a major risk with endorsing a celebrity and there are other factors that can lead to serious consequences like :

- Popularity starts decreasing
- Moral issues
- Over endorsing can lead to losing credibility
- Overshadowing of endorsed products.

Negative publicity about a celebrity endorsing a brand can change the perception of the consumer about that celebrity and it may also damage the brand reputation resulting in marketers to pay a big price over the celebrity's misdeeds and face serious humiliation and embarrassment. (Kumar 2010) mentions that there are times when consumers actually only notice the celebrity appearing rather than the product, hence this idea to promote that brand fails miserably. (Cooper 1984) says that "the product, not the celebrity, must be the star." This overshadowing is also called "vampire effect" because there is a lack of clarity for the consumers because they are found to take more notice and interest in the celebrity rather than the interest. Another issue that arises is overexposure when marketers employ well recognized celebrities to endorse their brands and

it ultimately confuses the consumers and they are unable to correctly recall about that brand which celebrity stands for.

### **Consumer's buying behavior in India**

India is home to a host of languages, climates, and traditions. Defining the target audience is key to understanding consumer behavior in India. While city startups attract major investment, rural villages hail electricity and sanitation. Marketing in this diverse region can be daunting. But the potential is huge. India is set to overtake the US economy by 2030, second only to China. It already has the second-largest internet population – and only 41% of citizens are online. Big brands are already investing in Indian expansion.

India is known as a country of savers, though spending is on the rise. Disposable income is increasing. By 2030, 80% of households will be middle-income, compared to 50% today. This growing middle class is expected to drive consumer spending – buying more and buying better.

Access to credit also plays a key role. Indian millennials still value traditional priorities, like income and home ownership. But they have other goals, too. This shows in their spending priorities. Value for money is an important factor in determining consumer behavior in India. Indian shoppers are well-informed and want to get a good deal – even for luxury products. Moreover, eCommerce is new to many Indians, particularly outside the big cities. Programs like Amazon Easy are connecting traditional stores to the eCommerce sector. Innovative strategies like this help bridge the gap between customers and new technology. It's not surprising personal communication and trust are so highly valued.

Bargaining is a national pastime. Building trust also means ears to the ground. Research your audience carefully and consider expanding one city at a time. Then follow up with great service and a clear returns policy. The Indian family is changing. Traditional, multi-generational households are in decline. This can affect buying behavior. Marriage is still central to most people's lives. It's not unusual for people to spend 20% of their lifetime's earnings on their wedding. This means weddings are a major focus for the apparel, beauty, events, and luxury sectors. Themes of nurture, care, and affection are prominent in advertising – and successful. Hence, consumer behavior in India is complex and fast-changing.

**Celebrities Appearing in Cosmetics Advertisements**

BRANDS	PRODUCTS	NAME OF CELEBRITIES
L'Oreal	White Perfect	Ashwaria Rai
Oriflame	Foundation and Lip Color	Sonali Bendre
Lakme	Eyeconic	Kareena Kapoor
Olay	Aging Cream	Kajol

**CHAPTER 4**  
**RESEARCH AND METHODOLOGY**

## **RESEARCH AND METHODOLOGY**

### **4.1 RESEARCH OBJECTIVES**

The objectives of this research study are to get information about:

- The impact celebrities have on consumers' buying intention in regards of credibility.
- The impact attractiveness of celebrities have on the extent to which consumers convinced.
- The impact celebrity endorsement creates on consumers in terms of product fit match between the product and the celebrity.
- The extent of transfer of meaning to the products endorsed by celebrities in shaping buying intention.

### **4.2 HYPOTHESIS**

Following are the hypothesis of this research:

H1: Celebrity endorsed advertisement is considered to be effective in terms of buying intention in the cosmetic industry, when the celebrity used is credible.

H2: Celebrities who are attractive, create a positive impact on consumer's buying intention.

H3: The celebrity/product match-up positively influence consumers to purchase the celebrity endorsed product.

H4: Celebrity endorsed products transfer meanings which positively affect consumers buying intention.

### **4.3 RESEARCH DESIGN**

The research design of this study is also cross-sectional as it takes place at a single point in time. The participants are selected based on particular variables of interest. It considers numerous characteristics at once and can provide information about the current population.

#### **4.4 SOURCES OF DATA**

**Primary Data:** Primary data will be gathered through the distribution of questionnaires to the respondents and their answers will be recorded, which will be the primary data.

**Secondary Data:** Secondary data would be collected through information given in reports, newspapers, magazines, articles and textbooks.

**Software Used:** SPSS, Excel and spreadsheets would be used.

#### **4.5 SAMPLE DESIGN**

The population involves the desired sample size of 303 females aged between 18 to 30 years from Ernakulam district. The method of selecting the sample was done by using the snowball sampling. The respondents were required to be regular purchasers of cosmetic products.

#### **4.6 SAMPLE SIZE**

The sample size is 303 respondents from the adult female population aged between 18 to 30 years.

#### **4.7 SAMPLING METHOD**

The sampling method of snowball sampling has been used in the study. It is a form of non-probability sampling. The participants selected were all females within the age group of 18-30. In the present study, the selected participants recommended potential participants, who themselves were observed and asked to nominate others and so on until a sufficient number of participants were obtained.

#### **4.8 METHOD OF DATA COLLECTION**

The data in the present study has been collected from the population by giving out an online questionnaire through Google Forms. A consent form was provided at the beginning of the questionnaire to make sure that the confidentiality of the participant's data will be maintained. This was followed by a few questions that collected the demographic details of the participants. The participants took about 10 to 15 minutes to complete the questionnaire and it was ensured that they filled every item of the questionnaire. The questionnaire involves a number of questionnaire items that asks a question and provides a set of response options for participants to choose from. From this, the highest responses given in each item is considered for further analysis and the final results are to be obtained using the SPSS software version 28.0.

#### **4.9 DRAFTING QUESTIONNAIRE**

The questionnaire used in this study is used to assess the impact of celebrity endorsements on consumer buying behavior. The first three questions were scored based on a four point, two point and three point likert scale respectively. The fifth question was scored based on a choice scale of preference. The remaining questions were scored based on rating scales.

#### **4.10 DATA ANALYSIS TECHNIQUE**

##### **CORRELATION**

The data analysis technique of correlation is to be used in the present study. A correlation is a statistical measurement of the relationship between two variables. Correlation means association - more precisely it is a measure of the extent to which two variables are related. There are three possible results of a correlational study: a positive correlation, a negative correlation, and no correlation. Possible correlations range from +1 to -1. A zero correlation indicates that there is no relationship between the variables.

A positive correlation is a relationship between two variables in which both variables move in the same direction. Therefore, when one variable increases as the other variable increases, or one variable decreases while the other decreases. A negative correlation (inverse correlation) is a relationship between two variables in which an increase in one variable is associated with a

decrease in the other. A zero correlation exists when there is no relationship between two variables.

There are four types of correlations in statistics;

- a) Pearson correlation
- b) Kendall rank correlation
- c) Spearman correlation
- d) Point-Biserial correlation.

→ **Spearman correlation**

Spearman's rank correlation coefficient or Spearman's  $\rho$ , named after Charles Spearman and often denoted by the Greek letter rho, is a nonparametric measure of rank correlation (statistical dependence between the rankings of two variables). It assesses how well the relationship between two variables can be described using a monotonic function.

## **REGRESSION**

Regression is a statistical technique that is used to measure and describe the strength and shape of the relationship between two or more variables. It is a set of statistical methods used for the estimation of relationships between a dependent variable and one or more independent variables. It can be utilized to assess the strength of the relationship between variables and for modeling the future relationship between them. Regression analysis includes several variations, such as linear, multiple linear, and nonlinear. The most common models are simple linear and multiple linear. Nonlinear regression analysis is commonly used for more complicated data sets in which the dependent and independent variables show a nonlinear relationship. Regression analysis offers numerous applications in various disciplines, including finance.

**CHAPTER 5**  
**DATA ANALYSIS**

## DATA ANALYSIS

The aim of the present study was to investigate the impact of celebrity endorsements in consumer buying behavior. Spearman's correlation and linear regression was used to find the degree of relation as well as the prediction level.

The normality test between the independent and dependent variables didn't follow normal distribution. Hence the test used in the analysis of the data is non-parametric

## CORRELATION

**TABLE 4.1:** Correlation coefficient between Celebrity Endorsement and Consumer Buying Behavior (Spearman's rho)

Independent Variable N	Dependent Variable	r	p (2 tailed)
Celebrity Endorsement 303	Consumer Buying Behavior	.266**	.001

\*\* Correlation is significance at 0.01 level (2 tailed)

Spearman's correlation coefficient was computed to assess the relationship between celebrity endorsements and consumer buying behavior. From Table 4.1, the p-value is less than 0.001. This indicates that there is a statistically highly significant low positive relationship between celebrity endorsements and consumer buying behavior ( $p = .001$ ,  $r = 0.266$ ). In other words, we can infer that there is a weak relationship between the two variables.

## REGRESSION

**TABLE 4.2:** Regression Analysis Model Summary table between Celebrity Endorsement and Consumer Buying Behavior

<b>Model</b>	<b>R</b>	<b>R Square</b>	<b>Adjusted R Square</b>	<b>Std. Error of the Estimate</b>
1	.217	0.047	0.024	2.18651

a. Predictors: (Constant), Celebrity Endorsement

In table 4.2, R value represents the simple correlation between the variables. It points out the linear relationship between two variables (celebrity endorsement and consumer buying behavior) which is .217. This indicates a low degree of correlation. R Square is the coefficient of determination. The R square value indicates how much of the total variation in the dependent variable (consumer buying behavior), can be explained by the independent variable (celebrity endorsement). In this case, 4.7% of variance in consumer buying behavior is accounted for by celebrity endorsement. It shows that there is a positive weak relationship between the two variables

**TABLE 4.3:** Regression Analysis ANOVA table.

<b>Model</b>		<b>Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig</b>
1	Regression	69.642	7	9.949	2.081	.045
	Residual	1410.345	295	4.781		
	Total	1479.987	302			

a. Dependent Variable: Consumer Buying Behavior

## b. Predictors: (Constant), Celebrity Endorsement

The ANOVA table predicts how well the regression equation fits the data (ie. predicts the dependent variable). It shows whether the overall model has been accepted or not, which is determined by the significance value. In table 4.3, the significance level is 0.45 which is greater than the p value. This indicates that there is stronger evidence in favor of the alternative hypothesis. Also, p value is less than 0.001 which is less than 0.05. This indicates that the regression model statistically significantly predicts the outcome variable (ie., it is a good fit for data).

**TABLE 4.4:** Regression Analysis Coefficients table

<b>Model</b>		<b>Unstandardized B</b>	<b>Standardized Coefficients Beta</b>	<b>t</b>	<b>Sig.</b>
1	<b>Constant</b>	9.950		24.591	<.001
	<b>Expertise of the celebrity</b>	0.164	0.105	1.143	0.254
	<b>Trustworthiness of the celebrity</b>	0.219	0.131	1.318	0.188
	<b>Similarity between the endorser and consumer</b>	0.060	0.031	0.398	0.188

0.280	<b>Familiarity of the celebrity</b>	0.182	0.100	1.083
0.944	<b>Likeability of the celebrity</b>	-0.011	-0.006	-0.070
0.910	<b>Product-celebrity matchup</b>	-0.019	-0.010	-0.113
	<b>Meaning transferred to the product</b>	0.317	0.188	2.117 0.035

a. Dependent Variable: Consumer Buying Behavior

Table 4.4 shows the regression analysis coefficients obtained for each dimension of celebrity endorsement and consumer buying behavior. A linear regression was calculated to predict consumer buying behavior based on celebrity endorsement. Results of the linear regression indicated that there was a collective significant effect between celebrity endorsement and consumer buying behavior.

From table 4.4, it was found that the impact the expertise and trustworthiness of the celebrities have on consumer buying behavior had a significant level which was more than 0.001. These two factors are the subsequent properties of one of the dimensions measured in celebrity endorsement, which is credibility. This indicates that the credibility of the celebrity has no effect on consumer buying intention. Hence, hypothesis 1 is rejected.

Similarly, the impact the similarity between the endorser and consumer, familiarity of the celebrity and likeability of the celebrity have on consumer buying behaviour also had a significant level which was more than 0.001. Since these three factors are the subsequent properties of another of the dimensions measured in celebrity endorsement, which is attractiveness, it can be interpreted that the attractiveness of the celebrity has no effect on consumer buying intention. Hence, hypothesis 2 is rejected.

It was also found that the factor of product-celebrity matchup also had a significance level of more than 0.001. Which can again be interpreted that product-celebrity matchup had no significant effect on consumer buying intention. Hence, hypothesis 3 is rejected.

However, the aspect of meaning transfer to the product of celebrity endorsement on consumer buying behavior was found to have a significance level less than 0.001. This indicates that the property of meaning transfer in celebrity endorsement does have a positive effect on consumer buying behavior. Therefore, hypothesis 4 is accepted. That is celebrity endorsed products do transfer meanings which positively affect consumers buying intention.

## **CHAPTER 6**

### **FINDINGS**

## FINDINGS

The findings show that celebrity endorsement is effective and a relationship is one between four elements of celebrity endorsement with consumer's purchase intention.

The first attribute of celebrity endorsement is "credibility" which comprises two factors namely expertise and trustworthiness. As the research suggests, consumers, in the field of cosmetics, frame their purchase intention which is not necessarily in favor of those cosmetics which are endorsed by such celebrities who have some expertise in that field and are considered to be trustworthy. This might be an indication of the consequence in the recent loss of trust in celebrities due to a lack of perceived genuinity and expertise in them as perceived by consumers, especially young female consumers. Young females in the current generation are becoming less impressionable and seem to value other aspects of an endorser when it comes to their evaluation process in decision making and their ultimate choice of decision.

The second attribute of celebrity endorsement is "attractiveness", which is further divided into three factors namely similarity, familiarity and likeability. Since the domain of cosmetics is very fragile therefore attractiveness of a celebrity here doesn't play a very vital role because liking a celebrity wouldn't mean that a cosmetic will actually produce the desired result to the consumer or their skin as it did to the celebrity endorsing it. The research may also imply that young females, while making a decision regarding the purchasing of cosmetics, are very selective since the purchasing of cosmetics is highly subjective in its use and benefits. That is, the superficial qualities of the celebrity doesn't play a significant role in consumers' buying intention. Hence, the study suggests that attractiveness of a celebrity has no relationship with purchase intention.

The third attribute of celebrity endorsement is "product celebrity match-up", which means that the celebrity endorsing a product has an image that goes with the product he/she is endorsing. This attribute implies that the product should match with the celebrities in different ways including personality, passion and career. In other words, the products endorsed by the celebrity must show some level of relevance with them. The study suggests it has no relationship with the purchase intention. This might indicate that even if the product does match-up with the celebrity, female consumers of cosmetics still, for some reasons, find it a good enough reason to

purchase cosmetic items. This can again come down to the perceived genuinity of the celebrity and also likeness and need for the endorsed products.

The fourth and the last attribute of celebrity endorsement is “meaning that is transferred to the product by the celebrity”. The study found it has a positive relationship with the purchase intention because often consumers think that using such celebrity endorsed cosmetics will make them look more glamorous and classy. In other words, female consumers at the end of the day, buy cosmetics goods for the perceived appeal of not the celebrity, but what it brings to them. It also depends on how much the products resonate and can meet their needs and wants. It can also depend on the effectiveness in the transference of meaning of the product to the consumers by the endorser. It can also be what the seeming product value and brand name brings for the consumer.

Therefore “meaning transferred” positively impacts the purchase intention of female consumers in the field of cosmetics. That is, even if the celebrity endorser is credible, attractive and has a relevant matchup with the product endorsed, it ultimately depends upon the impact the product or the celebrity endorser has on the consumers' psyche which ultimately comes down to the consumer's decision why or why not to buy a particular brand or product.

**CHAPTER 7**  
**RECOMMENDATIONS**

## RECOMMENDATIONS

According to the study, marketers while using celebrities to endorse their cosmetics products, and subsequently their brand, should make sure that they fulfill the criteria of the following:

- Celebrities, while transferring meaning to the product they are endorsing, should depict reality. Unrealistic beauty standards and goals do not sit well with the current generation, especially in females. Moreover, inclusivity is a huge factor in the industry of cosmetics, especially nowadays. Marketers while using celebrities in endorsements must aim at setting a realistic example without coming off as fake or biased. The consumers must in turn find the endorsement genuine, relevant and meaningful.
- Celebrities with any kind of negative publicity should not endorse products. This holds true for any business, not just in cosmetics. One of the most important things a brand/business can do is to show their hands on commitment towards customer satisfaction and commitment. If consumers find the endorsement meaningless or even disregarding or disrespectful in any way through the use of an infamous celebrity, it can come off as extremely ignorant and distasteful. It can even lead to the defamation of the brand indefinitely.
- Marketers must always concentrate on what their brand stands for when thinking of potential endorsers. It will not generate sales and revenue to have a celebrity conflicting with brand identity just to capitalize on a current “it” person. If marketers are unsure of their brand’s identity with consumers, conduct initial research to see what consumers associate with your brand. In this age of social media, having a celebrity endorser who is ‘off brand’ could potentially hurt a company’s identity. In other words, celebrity endorsement should not come off as a "PR stunt".
- Celebrities, who possess a good name and profile in the field of cosmetics and in general, should endorse cosmetics as consumers get influenced by such appeal and more importantly, their reputation. With the ongoing "jumping on the bandwagon" trend, consumers might as well buy products just because it is popular to do so. Hence, marketers must be highly selective and adequate in choosing and employing celebrity endorsers. A consumer may buy the product because it might give them some sort of status or recognition that is tied with the celebrity endorsing the product.

**CHAPTER 8**  
**CONCLUSION**

## **CONCLUSION**

The study at hand was primarily conducted to examine the relationship between and the impact of celebrity endorsements on consumer buying behavior. It has been concluded that there is a statistically highly significant low positive relationship between celebrity endorsements and consumer buying behavior. The attribute "meaning transfer to the product" of celebrity endorsement is found to have a significant impact on behavior and intention of buying cosmetics among females in the young adult population of Ernakulam district. That is, female consumers may be interested to buy cosmetics goods for reasons other than the celebrity endorsement. These reasons may be the price, availability, quality and quantity of the product. Moreover, celebrity endorsement and consumer buying behavior was found to have a weak correlation.

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## APPENDIX

### Impact of Celebrity Endorsement on Consumers' Buying Behavior

1) How frequently do you encounter celebrity endorsed advertisements?

- Very often
- Occasionally
- Hardly
- Never

2) Which advertisement catches your attention the most?

- Celebrity endorsed advertisement
- Non celebrity endorsed advertisement

3) Do you trust celebrity endorsed advertisements?

- Yes always
- No, not at all
- Sometimes only

4A) Do you purchase cosmetics based on celebrity endorsed advertisements?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

4B) Will your purchase intention be negative to purchase cosmetics which has side effects

but are endorsed by a celebrity?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

## Impact of Celebrity Endorsement on Consumer Buying Behaviour

5) Which of the factor listed below influence you to purchase celebrity endorsed cosmetics product?

- Credibility of the celebrity
- Attractiveness of the celebrity
- Product celebrity match up
- Meaning that are transferred to the product

9) Rate these factors based on their importance and effectiveness that celebrities in the cosmetics field should possess (1 being the lowest and 5 being the highest)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Celebrities in ads help me recall products more promptly					
I perceive celebrity endorsement as very effective					
Celebrity endorsements are very influential					
Expertise of the celebrity influence my purchase decision					
Trustworthiness of celebrity influence mu purchase decision					
Familiarity of the celebrity influence my purchase decision					

## Impact of Celebrity Endorsement on Consumer Buying Behaviour

Likeability of the celebrity influence my purchase decision					
Product and celebrity match influence my purchase decision					
Celebrities can provide or transfer meaning to the product and this influences my purchase decision					
Negative publicity of the celebrity also impact my purchase decision					
I find celebrity endorsed product more classy, desirable and a symbol of status					
Using celebrity endorsed product makes me feel more glamorous and I feel more confident about myself					
I also recommend my friends to use celebrity endorsed products					