

# Emotion Analysis for Personality Inference from EEG Signals

Aparna Ramesh<sup>1</sup>, Arthy. U<sup>2</sup>, Janish Lifra.J<sup>3</sup>, Ms. Sathiya. V

<sup>1,2,3</sup>Student, Dept. of Computer Science and Engineering, Panimalar Engineering College, Tamil Nadu, India

<sup>4</sup>Associate Professor, Dept. of Computer Science and Engineering, Panimalar Engineering College, Tamil Nadu, India

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**Abstract** – The Emotion plays an important role in our daily life and work. Real-time assessment and regulation of emotion will improve people’s life and make it better. For example, in the communication of human-machine-interaction, emotion recognition will make the process more easy and natural. Another example, in the treatment of patients, especially those with expression problems, the real emotion state of patients will help doctors to provide more appropriate medical care. In recent years, emotion recognition from EEG has gained mass attention. Also it is a very important factor in brain computer interface (BCI) systems, which will effectively improve the communication between human and machines. Various features and extraction methods have been proposed for emotion recognition from EEG signals, including time domain techniques, frequency domain techniques, joint time-frequency analysis techniques, and other strategies. Reliable method which efficient in detection of individual’s health are proposed. The design can detect the condition of the individual person using image classifier and EEG analyzer using adaptive threshold detection method.

**Key Words:** EEG Sampling Quantization Personality inference Emotion analysis

## 1. INTRODUCTION

This EMOTION is a psycho-physiological process triggered by conscious and/or unconscious perception of an object or situation and is often associated with mood, temperament, personality and disposition, and motivation. Emotions play an important role in human communication and can be expressed either verbally through emotional vocabulary, or by expressing non-verbal cues such as intonation of voice, facial expressions and gestures. Most of the contemporary human-computer interaction (HCI) systems are deficient in interpreting this information and suffer from the lack of emotional intelligence.

### 1.1 ELECTROENCEPHALOGRAPHY(EEG)

Emotion is a subjective experience characterized by psycho-physiological expressions, biological reactions, and mental states. From a psychological point of view, an emotion is a complex psychological state that involves three distinct components: a subjective experience, a physiological response, and a behavioural or expressive response Basic emotions exist and are culturally independent. These basic emotions can be read literally from people's facial expressions.

Regarding systems that can help studying the affective processes in the human brain, EEG, PET scans, or fMRI stand out. EEG can detect changes in brain activity over milliseconds, which is excellent considering an action potential takes ~0.5–130 ms to propagate across a single neuron, depending on the type of neuron. Nevertheless, EEG measures the brain's electrical activity directly, while fMRI and PET record changes in blood flow or metabolic activity, which are indirect markers of brain electrical activity.

**TABLE 1.1 FIVE TYPES OF EEG SIGNALS**

Wave	Frequency (Hz)	Too much	Too low	Extremely good
Delta	0 to 4	Learning problem, inability to think	No sound sleep	Natural healing
Theta	4 to 8	Depression, hyperactive	Anxiety, stress	Creativity, Emotional connection
Alpha	8 to 12	Day dreaming, too relaxed	High stress, insomnia	Relaxation
Beta	12 to 40	High arousal, inability to relax	Day dreaming, Depression	Memory, Problem Solving
Gamma	40 to 100	High arousal, Stress	Depression, Learning disabilities	Information processing, Learning

EEG signals in the acquisition process can easily be contaminated with noise signals. We pre-process the data by the removal of artifacts in the process of EEG recording to maintain signal stability and retain the effective data segments. Continuous EEG data are filtered with a bandpass (1-45Hz) filter to remove linear trends and minimise the introduction of artifacts. We made use of standard statistical techniques for feature extraction. It is found that when people are exposed to specific emotion like happiness or sadness, higher frequency signals are more prominently seen as compared to lower frequency signals, in particular regions of the brain. During intense emotional activity, changes were noticed in the alpha signal in occipital and frontal regions of the brain. In case of very intense sad emotion display, Beta signals were also seen over Temporal and Frontal regions. For classification of data we have used Linear Discriminant Analysis (LDA). The classification rate in case of sad emotions is 84.37%, for happiness it is 78.12% and for relaxed state it is found to be 92.70%.

**TABLE 1.2 IMPROVE SIGNAL STIMULATION**

Wave	Way to increase waves	Brain speed
Delta	Sleep	Very slow
Theta	Depressants	Slow
Alpha	Alcohol	Moderate
Beta	Coffee, energy drink	High
Gamma	Meditation	Very high

## 1.2. IMAGE PROCESSING

Image processing is a physical process used to convert an image signal into a physical image. The image signal can be either digital or analog. The actual output itself can be an actual physical image or the characteristics of an image. The most common type of image processing is photography.

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analysing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction.

### 1.2.1 Sampling and Quantization

The sampling rate determines the spatial resolution of the digitized image, while the quantization level determines the number of grey levels in the digitized image. A magnitude of the sampled image is expressed as a digital value in image processing. The transition between continuous values of the image function and its digital equivalent is called quantization.

## 2. SYSTEM ANALYSIS

### 2.1 EXISTING SCHEME

In the existing system a network architecture especially for EEG feature extraction, one that adopts hidden unit clustering with added pooling neuron per cluster is realized. The classification accuracy with features extracted by our proposed method is benchmarked against that with standard power features. Experimental results show that our proposed feature extraction method achieves accuracy ranging from 44% to 59% for three-emotion classification.

### 2.2 PROPOSED SCHEME

In this system, emotions are predicted by EEG signal acquired from brain waves. These waves are grouped in the form of alpha, beta, delta, and so on. Later this are splited and processed to find feelings of individuality. Then if suppose person is in depressed state are relaxed by playing music and in joy state person are maintained in that state for prolonged time.

### 2.3 ADVANTAGES OF PROPOSED SYSTEM

- Three dimensional condition detection
- Emotion recognition will help us to get accurate info

### 3. REQUIREMENT SPECIFICATIONS

The requirements specification is a technical specification of requirements for the software products. It is the first step in the requirements analysis process it lists the requirements of a particular software system including functional, performance and security requirements. The requirements also provide usage scenarios from a user, an operational and an administrative perspective. The purpose of software requirements specification is to provide a detailed overview of the software project, its parameters and goals. This describes the project target audience and its user interface, hardware and software requirements. It defines how the client, team and audience see the project and its functionality.

#### 3.1 HARDWARE REQUIREMENTS

- Hard Disk : 40GB and Above
  - RAM : 512MB and Above
  - Processor : Pentium III and Above

#### 3.2 SOFTWARE REQUIREMENTS

- Windows Operating System XP and Above
- MATLAB 7.6.0(R2008)

### 4. FEASIBILITY STUDY

#### 4.1 TECHNICAL FEASIBILITY

It is evident that necessary hardware and software are available for development and implementation of proposed system It uses MATLAB

#### 4.2 ECONOMICAL FEASIBILITY

The cost for the proposed system is comparatively less to other medical software's.

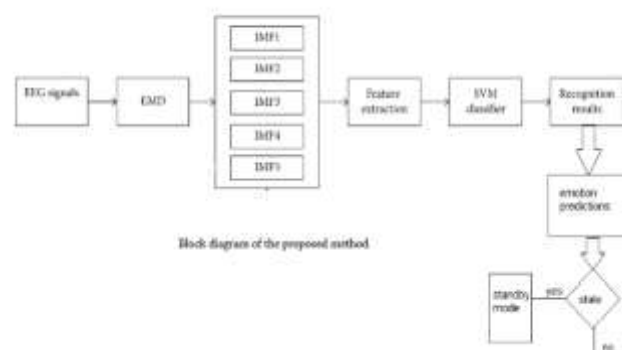
#### 4.3 OPERATIONAL FEASIBILITY

In this project it requires to configure the software and technical background is necessary to work on the microcontroller and software.

### 5. SYSTEM ARCHITECTURE

#### 5.1 MODULE DESIGN SPECIFICATION

#### OVERALL ARCHITECTURE OF THE SYSTEM



**Figure 1 - ARCHITECTURE OF THE PROPOSED SYSTEM DESCRIPTION**

The EEG (Electroencephalogram) signals generated using the programmable

Microcontroller is given as input to the EMD (Empirical Mode Decomposition) which decomposes the signals into IMF (Intrinsic Mode Functions) along with a trend, and obtain instantaneous frequency data. Here the EMD decomposes the EEG signals into five intrinsic mode functions namely IMF1, IMF2, IMF3, IMF4, IMF5 for five types of signals alpha, beta, gamma, delta, theta respectively.

Based on the type of IMF signal the feature is extracted. And the extracted feature is given to the SVM classifier. The SVM classifier classifies each feature using the kernel function(x,y) to recognize the emotion. The recognized results are used to predict emotion

## 6. SYSTEM MODULES

### 6.1 MODULE DESCRIPTION

#### 6.1.1 MODULE 1: Pre - processing

The input RGB image is resized to a height of 320 pixels. The resized image undergoes two separate processing pipelines: a saturation-based one, and a color texture one. In the first one, the image is firstly gamma corrected and then the RGB values are converted to HSV to extract the saturation channel. These values are automatically threshold and morphological operations are applied to clean up the obtained binary image. A second processing based on the segmentation algorithm that works on both color and texture features.

#### 6.1.2 MODULE 2: EEG dataset Creation and Group Segmentation

This module consists of methods involved in getting the EEG data sets which matches with mood swings. The EEG data set is processed in the MATLAB environment to segment it better by their alpha, beta, Gama, theta ranges.

#### 6.1.3 MODULE 3: Classification

This module is used to classify the EEG info with respect to wave region to provide the individual's emotional status like normal or abnormal, happy or Sad etc. These features are further used for analysis purpose of the individual's emotional conditions and mood swings for psychological analysis.

## 7. APPENDICES

### 7.1 SAMPLE SCREENSHOTS FROM THE PROJECT

#### 7.1.1 IN HAPPY MOOD

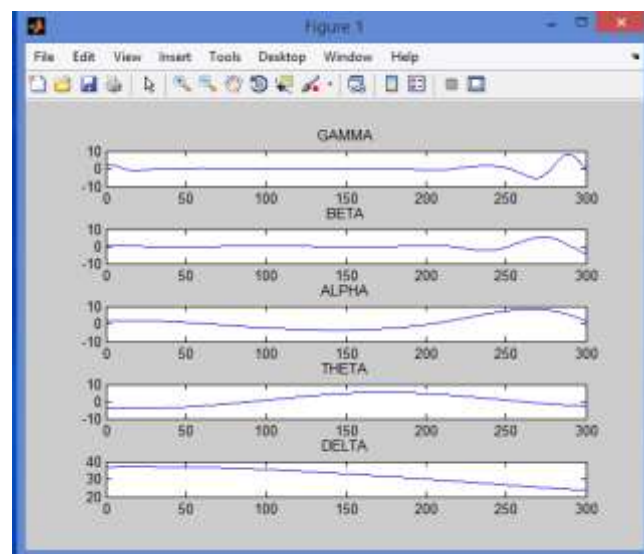


Figure 2 Stemming ranges of the discovered signals for 300 samples

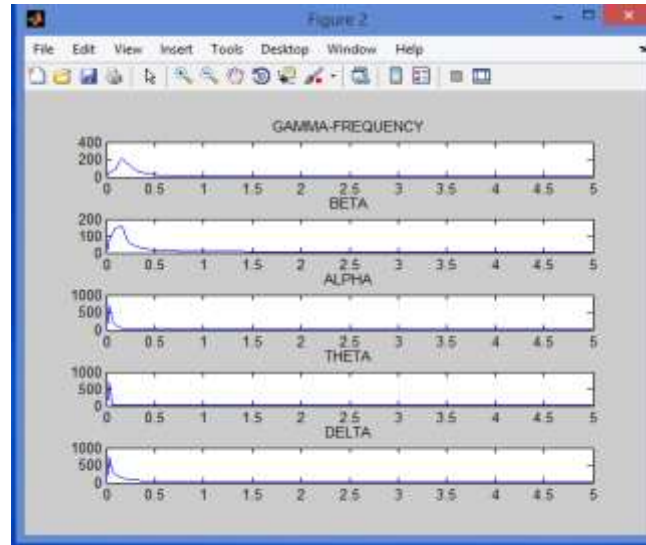


Figure 3 Frequency graph of classified signals for 1000 samples

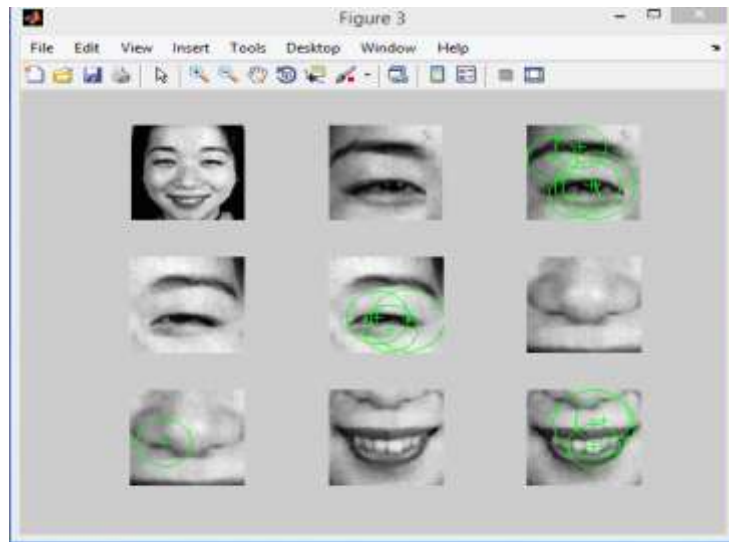


Figure 4 Face is recognized and classified based on the kernel axis. The expression is detected using the classification

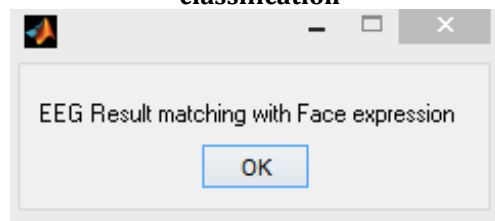


Figure 5 EEG results matches with the face expression

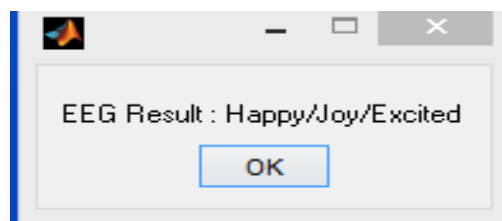


Figure 6 Kind of emotion is detected

### 7.1.2 ANGRY/ABNORMAL

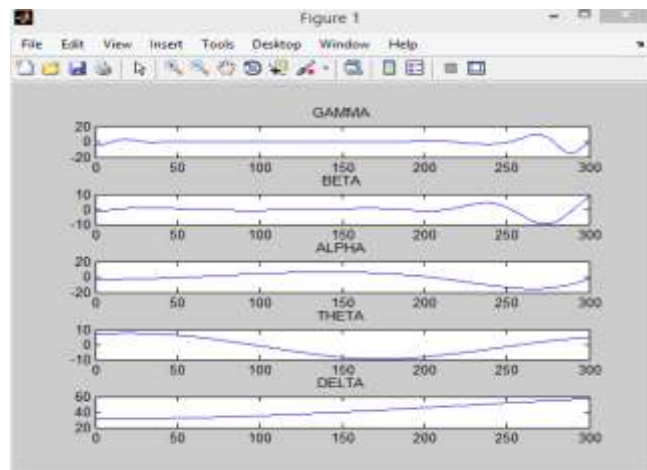


Figure 7 Frequency graph of 300 samples

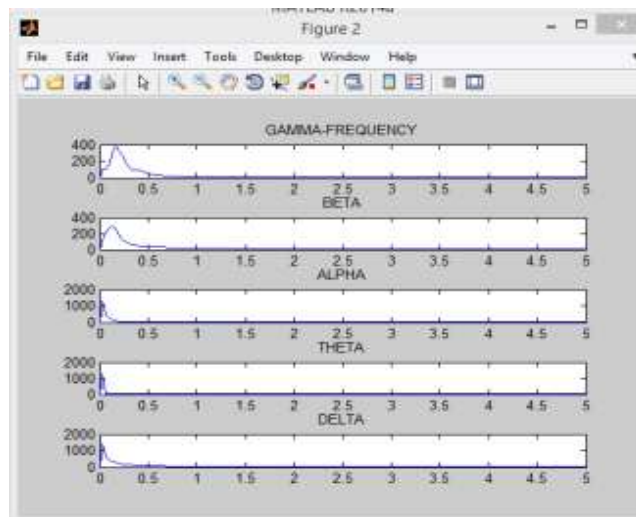


Figure 8 Frequency graph for 1000 samples

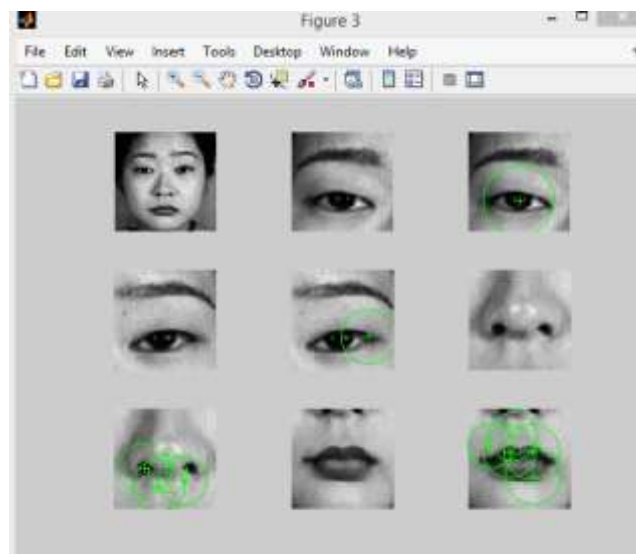


Figure 9 Face is recognized and classified based on the kernel axis. The expression is detected as sad expression using this classification

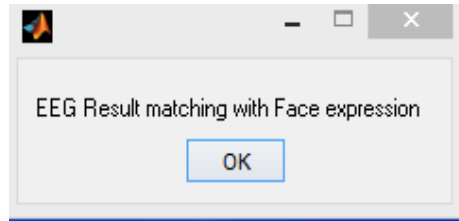


Figure 10 EEG results matches with the face expression

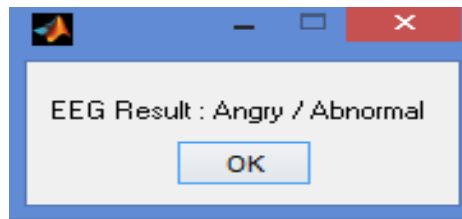


Figure 11 EEG result is shown as angry/abnormal obtained using EEG signal

### 7.1.3 NOT MATCHING

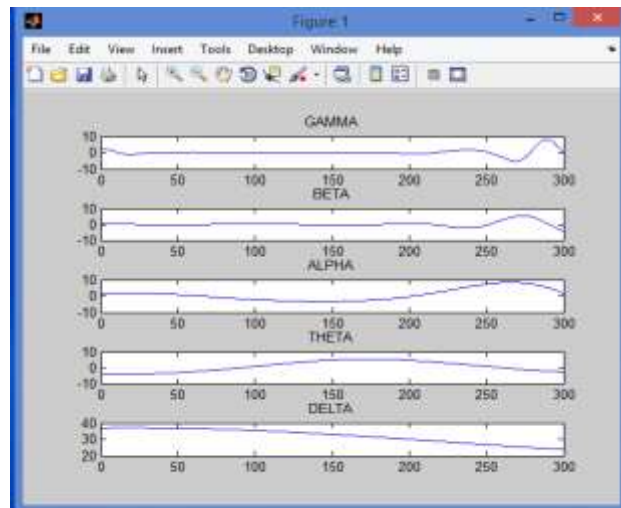


Figure 12 Frequency signals for 300 samples

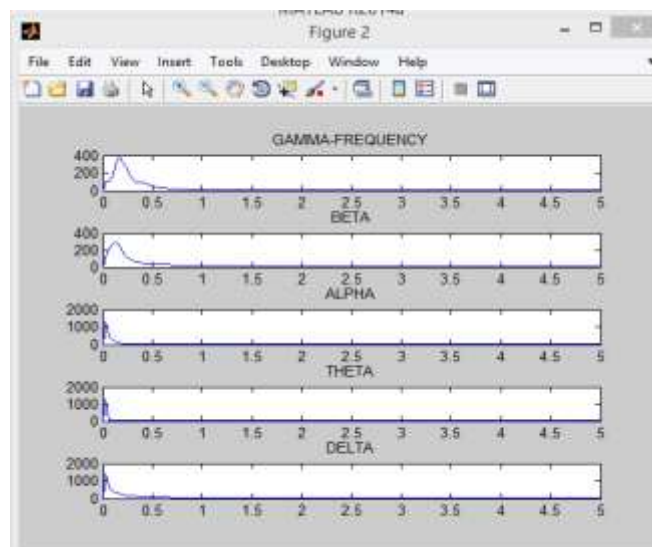
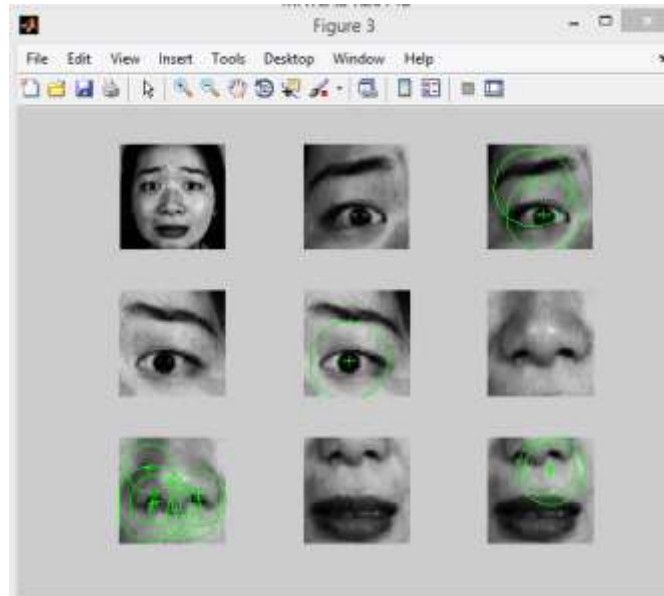
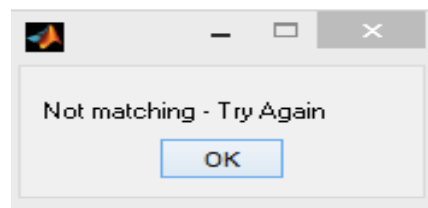


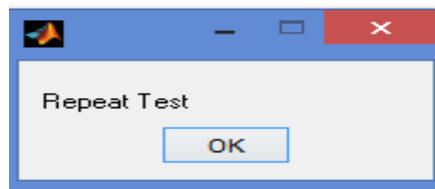
Figure 13 Frequency signals for 1000 samples



**Figure 14 Face is recognized and classified based on the kernel axis. The expression is detected and resulted as Not Matching**



**Figure 15 EEG result does not match with the facial expression**



**Figure 15 Denotes EEG result as Repeat Test as signals do not match with the Face expression**

## 8. CONCLUSIONS

Three basic steps in the performance analysis process: data collection, data transformation, and data visualization. Data collection is the process by which data about program performance are obtained from an executing program. Data are normally collected in a file, either during or after execution, although in some situations it may be presented to the user in real time. Three basic data collection techniques can be distinguished:

The raw data produced by profiles, counters, or traces are rarely in the form required to answer performance questions. Hence, data transformations are applied, often with the goal of reducing total data volume. Transformations can be used to determine mean values or other higher-order statistics or to extract profile and counter data from traces. For example, a profile recording the time spent in each subroutine on each processor might be transformed to determine the mean time spent in each subroutine on each processor, and the standard deviation from this mean. Similarly, a trace can be processed to produce a histogram giving the distribution of message sizes. Each of the various performance tools described in subsequent sections incorporates some set of built-in transformations; more specialized transformation can also be coded by the programmer. Parallel performance data are inherently multidimensional, consisting of execution times, communication costs, and so on, for multiple program components, on different processors, and for different problem sizes. Although data reduction techniques can be used in some situations to compress performance data to scalar values, it is often necessary to be able to explore the raw multidimensional data.



As it is well known in computational science and engineering, this process can benefit enormously from the use of data visualization techniques. Both conventional and more specialized display techniques can be applied to performance data. Therefore it is concluded that our project can be done with more enhancements and cost efficient components. The extra added features may be done with sensors on LIVE such that it can identify the mentality of the persons. The Facial Recognition can be done on-live without pixel training using Machine Learning as the Future Enhancement.

For now it is deducted that the two types of Emotions such as ABNORMAL and HAPPY, which can be further enhanced for finding other emotions irrespective of any users.

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