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A Mini Project Report on

"FACIAL EMOTION RECOGNITION"

Mini Project Submitted in partial fulfillment of the requirement for the degree of

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In

Information Science and Engineering

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CERTIFICATE

This is to certify that the mini project work entitled **"FACIAL EMOTION RECOGNITION"** is a bonafide work carried out by **Deepasandhya (1DS17IS028), Garima Valecha (1D17IS032), Lakhvinder Singh(1DS17IS044), Mir Taimur (1DS17IS050)** students of 6th semester, Dept. of Information Science and Engineering, **DSCE** in partial fulfillment for award of degree of **Bachelor of Engineering** in **Information Science Engineering,** under the **Visvesvaraya Technological University**, **Belagavi** during the year 2019-20. The mini project has been approved as it satisfies the academic requirements in respect of mini project work prescribed for the bachelor of engineering degree.

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ABSTRACT

Facial Emotion recognition is a technique used in software that allows a program to read the emotions on a human face using advanced image processing. Companies have been experimenting with combining sophisticated algorithms with image processing techniques that have emerged in the past ten years to understand more about what an image or a video of a person's face tells us about how he/she is feeling and not just that but also showing the probabilities of mixed emotions a face could has.

A Convolutional neural network (CNN) is a neural network that has one or more convolutional layers and are used mainly for image processing, classification, segmentation and also for other auto correlated data. For every image, only the square part containing the face is taken, rescaled, and converted to an array with 48x48 grey-scale values.

The architecture of a ConvNet is analogous to that of the connectivity pattern of Neurons in the Human Brain and was inspired by the organization of the Visual Cortex.
One possible application for this lies in the area of surveillance and behavioral analysis by law enforcement. Furthermore, such techniques are used in digital cameras to automatically take pictures when the user smiles. If computers are able to keep track of the mental state of the user, robots can react upon this and behave appropriately. Emotion recognition therefore plays a key-role in improving human machine interaction.

To show the capabilities of the obtained network, an application is developed that can directly process webcam footage through the final model. With use of the **OpenCV** face recognition program, the biggest appearing face from real-time video is tracked, extracted, and scaled to usable 48x48 input. This data is then fed to the input of the neural network model, which in its turn returns the emotion of the user. It encounters problems when shadows are present on the face of the subject. All emotions are easily recognized when acted by the user, and when pointing the camera on the television.

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CHAPTER 1

INTRODUCTION

1.1 Problem Statement

Human facial expressions can be easily classified into 7 basic emotions: happy, sad, surprise, fear, anger, disgust, and neutral. These sometimes subtle, yet complex, signals in an expression often contain an abundant amount of information about our state of mind. Through facial emotion recognition, we are able to measure the effects that content and services have on the audience/users through an easy and low-cost procedure. For example, retailers may use these metrics to evaluate customer interest. Healthcare providers can provide better service by using additional information about patients' emotional state during treatment. Humans are well-trained in reading the emotions of others, in fact, at just 14 months old, babies can already tell the difference between happy and sad. But can computers do a better job than us in accessing emotional states? To answer the question, we designed a deep learning neural network that gives machines the ability to make inferences about our emotional states. In other words, we give them eyes to see what we can see.

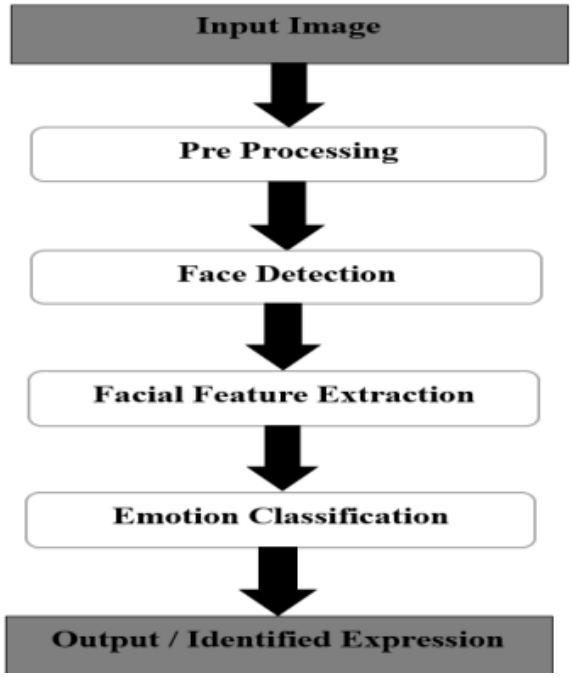


Fig. 1.1basic diagram of Emotion Recognition

Fig1.2. Sample images of human emotions

Facial expression recognition is a process performed by humans or computers, which consists of:

1. Locating faces in the scene (e.g., in an image; this step is also referred to as face detection)
2. Extracting facial features from the detected face region (e.g., detecting the shape of facial components or describing the texture of the skin in a facial area; this step is referred to as facial feature extraction)3.
3. Analyzing the motion of facial features and/or the changes in the appearance of facial features and classifying this information into some facial-expression interpretative categories such as facial muscle activations like smile or frown, emotion (affect)categories like happiness or anger, attitude categories like (dis)liking or ambivalence, etc. (this step is also referred to as facial expression interpretation). Several Projects have already been done in this fields and our goal will not only be to develop an Automatic Facial Expression Recognition System but also improving the accuracy of this system compared to the other available systems.

1.2 Background

A Facial expression is the visible manifestation of the affective state, cognitive activity, intention, personality and psychopathology of a person and plays a communicative role in interpersonal relations. Human facial expressions can be easily classified into 7 basic emotions: happy, sad, surprise, fear, anger, disgust, and neutral. Our facial emotions are expressed through activation of specific sets of facial muscles. These sometimes subtle, yet complex, signals in an expression often contain an abundant amount of information about our state of mind. Automatic recognition of facial expressions can be an important component of natural human-machine interfaces; it may also be used in behavioral science and in clinical practice. It has been studied for a long period of time and obtaining the progress recent decades. Though much progress has been made, recognizing facial expression with a high accuracy remains to be difficult due to the complexity and varieties of facial expressions. On a day to day basics humans commonly recognize emotions by characteristic features, displayed as a part of a facial expression. For instance, happiness is undeniably associated with a smile or an upward movement of the corners of the lips. Similarly, other emotions are characterized by other deformations typical to a particular expression. Research into automatic recognition of facial expressions addresses the problems surrounding the representation and categorization of static or dynamic characteristics of these deformations of face pigmentation.

Furthermore, such techniques are used in digital cameras to automatically take pictures when the user smiles. However, the most promising applications involve the humanization of artificial intelligent systems. If computers are able to keep track of the mental state of the user, robots can react upon this and behave appropriately. Emotion recognition therefore plays a key-role in improving human machine interaction.

1.3 EXISTING SYSTEMS

Research in automatic face recognition has been conducted since the 1960s, but the problem is still largely unsolved. Last decade has provided significant progress in this area owing to advances in face modelling and analysis techniques. Although systems have been developed for face detection and tracking, reliable face recognition still offers a great challenge to computer vision and pattern recognition researchers.

A) Vision-based Facial Expression Recognition

Within the past decade, analysis of human facial expression has attracted interest in machine vision and artificial intelligence areas to build systems that understand and use.

B) Systems that Recognize Prototypic Facial Expressions

Automatic facial expression analysis is done in two different ways: from static images or from video frames. The studies based on facial expression recognition from static images are performed by presenting subjects with photographs of facial expressions and then analyzing the relationship between components of the expressions and judgments made by the observers.

C) Classical face recognition algorithms

Method of supervised and unsupervised multi-linear NPP (MNPP) for face recognition is presented. They operate directly on tonsorial data rather than vectors or matrices and solve problems of tonsorial representation for multidimensional feature extraction and recognition

D) Artificial Neural Network in Face Recognition.

Artificial neural networks are used to solve nonlinear problem. To recognize human faces, a non-convergent chaotic neural network is suggested. Unfortunately, this approach, like other statistical-based methods, is inaccurate to model classes given only a single or a small number of training samples

E) 3D-based face recognition

A method for face recognition across variations in pose, which combines deformable 3D models with a computer graphics simulation of projection and illumination.

1.4 PROPOSED SYSTEM

This project aims to classify the emotion on a person's face into one of **seven categories**, using deep convolutional neural networks. This repository is an implementation of this research paper. The model is trained on the **FER-2013** dataset which was published on International Conference on Machine Learning (ICML). This dataset consists of 35887 grayscales, 48x48 sized face images with **seven emotions** - angry, disgusted, fearful, happy, neutral, sad and surprised.

Facial Expression Recognition (FER) can be widely applied to various research areas, such as mental diseases diagnosis and human social/physiological interaction detection. With the emerging advanced technologies in hardware and sensors, FER systems have been developed to support real-world application scenes, instead of laboratory environments. Although the laboratory-controlled FER systems achieve very high accuracy, around 97%, the technical transferring from the laboratory to real-world applications faces a great barrier of very low accuracy, approximately 50%.

The System aims at recognizing the emotions of a human being based on real time video, and providing the result on screen as soon as it is matched with the pre-trained dataset which consists of classification over 35887 greyscale 48x48 images. The system will also make sure that the change in emotion is also taken care by providing the appropriate emotional shift of the subject.

FER is widely used in various systems all around the globe, its implementations have been done in systems using various databases like Japanese Female Facial Expressions (JAFFE, 2017), Cohn – Kanade (CK, 2017), Extended Cohn – Kanade (CK+), MMI (MMI, 2017), Multimedia Understanding Group (MUG, 2017), Taiwanese Facial Expression Image Database (TFEID, 2017), Yale (Yale, 2017), AR face database (AR, 2018), Real-time database (Zhao and Pietikäinen, 2009), Own database (Siddiqi et al., 2015) and Karolinska Directed Emotional Faces (KDEF, 2018).

CHAPTER 2
LITERATURE SURVEY

1 "A Literature Survey on Emotion Recognition System Using Facial Expressions" by Rachoori Keerthi, A. Obulesh, Pallam Ravi, Deepika.S:

The analysis of various facial expression recognition systems is as follows. RGB images are replaced by Depth images in A facial expression recognition system using robust face features from depth videos and deep learning to resolve privacy issue and noise due to illumination. As pixel intensities in depth images robust face system remain unchanged even under noisy conditions. Though depth system resolves few issues, it is constrained only to pose based expressions. To obtain, expression dynamics of facial expression sequences, saptio-temporal features "Multi-Objective based Spatio-Temporal Feature Representation Learning Robust to Expression Intensity Variations for Facial Expression Recognition" are utilized as static facial features could cause feature confusion between facial expression features and facial identity features. Inspite of resolving the issue of expression dynamics Spatio-Temporal System has an average performance of about 78%. Multi-pose FER system is addressed in Models for Multipose Facial Expression Recognition as pose invariant FER systems are robust in nature. Models for Multipose Facial Expression Recognition has too many parameters and its performance is about 79%. [9] has optimum recognition rate in various kinds of databases ranging from micro expression dataset. Also "Local Directional Ternary Pattern for Facial Expression Recognition there are too many parameters hence increases the computational complexity. Sparsity "Softmax regression based deep sparse auto encoder network for facial emotion recognition in human-robot interaction is applied to reduce the computational complexity, with recognition rate of about 89%.

2 "Facial Expression Recognition using Global Features" by Vaibhavkumar J. Mistry, Mahesh M. Goyani:

Artificial intelligent based robotics and automated access control. Recognizing facial expression is a complex task to complete and therefore several limitations are existing such as lightning condition, Age, similar expression type. Ekman and Friesen [1] represent 6 basic face expressions (emotions), show in figure 1, which are Happy, Surprise, Disgust, Sad, Angry, Fear. As per Meharabian's "Communication without Words", 55% communicative cues can be judge by facial expression; hence recognition of facial expressions became a major modality. For example, Smart Devices like computer/robots can sense/understand the human's intension from their expression then it will helpful to the system to assist them by giving suggestions or proposals as per their needs. Automatic facial expression and facial AU (Action Unit) recognition have attracted much attention in the recent years due to its potential applications.

Facial Expression recognition can be categorized in to two major approaches.
1) Appearance based
2) Model based recognition techniques

By observing various techniques such as PCA, LDA, Gabor Filter, Local Binary pattern, LEM, Neural Network, ICA, and SVM with the help of appropriate Datasets [Table 1] to detect Human Facial expression and recognize them on the basis of accuracy and computational time. But some of them contain drawbacks in term of recognition rate or timing. The most accurate recognition rate can be achieved though combination of two or more techniques, extract features as per our requirements and final comparison will be performed to evaluate the results. The success of methods depends on pre-processing on the images because of illumination and feature extraction.

3 "Facial expression recognition: A survey" by Jyoti Kumaria , R.Rajesha , KM.Pooja

One of the non-verbal communication method by which one understands the mood/mental state of a person is the expression of face (for e.g. happy, sad, fear, disgust, surprise and anger). Automatic facial expression recognition **(FER)** has become an interesting and challenging area for the computer vision field and its application areas are not limited to mental state identification, security, automatic counseling systems, face expression synthesis, lie detection, music for mood, automated tutoring systems, operator fatigue detection etc.

The changes in the facial expression can be either based on minor deformations in wrinkles/bulges or based on major deformations (in eyes, eye-brow, mouth, nose, etc.) . Some of the feature extraction techniques and facial expression categorization includes, Geometric based and Appearance based, Action Unit (AU) of individual/group of muscles and Non-AU based, Local versus Holistic. The publicly available benchmarking dataset, namely, JAFFE is used to study the performance of various features. There are 213 images of 10 subjects with 7 expressions viz. anger, disgust, fear, happy, neutral, sad and surprise. The number of images for one expression of a subject varies from 3 to 4.

Facial Expression recognition has increasing application areas and requires more accurate and reliable FER system. This paper has presented a survey on facial expression recognition. Recent feature extraction techniques are covered along with comparison. The research is still going on "The expression of emotions in animals and man" to increase the accuracy rate of predicting the expressions," A. Communication without words") to have applications based on dynamic images/sequence of images/videos, "Constants across cultures in the face and emotion" to handle the occlusion.

CHAPTER 3

ANALYSIS

3.1 Introduction

Facial Recognition has gained a lot of popularity in the recent years. But this topic is not of a new era, it's been there for around decades and has been a keen interest of some researchers around the globe. The applications of facial analysis include face recognition, emotion classification, simulations for an artificial model which is a used in a vast industry of new age CGI movies and gaming industry. Big tech companies have their own implementation of this technology e.g. Google has Google VISION API, Facebook has DeepFace etc. This indicates the importance of the Facial Recognition technology and it is continuously growing and Research papers continuously grow in numbers for the area of interest.

CONSTRAINTS:

1. **Latency**: Given an image, the system should be able to predict the expression immediately and transfer the result. Hence, there is a low latency requirement.
2. **Interpretability**: Interpretability is important for still images but not in real time. For still images, probability of predicted expressions can be given.
3. **Accuracy**: Our goal is to predict the expression of a face in the image as accurate as possible. Higher the test accuracy, the better model will perform in real world.

This project aims to classify the emotion on a person's face into one of seven categories, using deep convolutional neural networks. The data consists of 48x48 pixel grayscale images of faces. The faces have been automatically registered so that the face is more or less centered and occupies about the same amount of space in each image. The task is to categorize each face based on the emotion shown in the facial expression in to one of seven categories

- 0=Angry
- 1=Disgust
- 2=Fear
- 3=Happy
- 4=Sad
- 5=Surprise
- 6=Neutral

The model is trained on the FER-2013 dataset which was published on International Conference on Machine Learning (ICML). This model gives an accuracy of 64.1%.

3.2 System Requirements Specification

1. Hardware:

1. A computer running an Operating System that supports Python.
2. A camera, for emotion detection.

2. Software:

1. Python Distribution:

Python is an interpreted, high-level, general-purpose programming language. Python has a large set of supported libraries. Since, python has a large selection of libraries, it's a tedious task to manage and assemble each module to be used and imported, solution to such problems are to use a distribution package, one such package is **Anaconda.** It is a free and open-source distribution of the Python and R programming languages for scientific computing, that aims to simplify package management and deployment. The distribution includes data-science packages suitable for consumer end systems.
Some of the packages used in the Project are:

1. NumPy:
   NumPy is a library for the Python programming language, adding support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays.
2. Matplotlib:
   Matplotlib is a plotting library available for the Python programming language as a component of NumPy, a big data numerical handling resource. Matplotlib uses an object oriented API to embed plots in Python applications.
3. OpenCV:
   OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products.
4. TensorFlow:
   TensorFlow is a free and open-source software library for dataflow and differentiable programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural networks.
5. Keras:
   Keras is an open-source neural-network library written in Python. It is capable of running on top of TensorFlow, Microsoft Cognitive Toolkit, R, Theano, or PlaidML. Designed to enable fast experimentation with deep neural networks, it focuses on being user-friendly, modular, and extensible.

2. FERC-2013 DATASET:

Neural networks, and deep networks in particular, are known for their need for large amounts of training data. Moreover, the choice of images used for training are responsible for a big part of the performance of the eventual model. This implies the need for a both high qualitative and quantitative dataset. For emotion recognition, several datasets are available for research, varying from a few hundred high resolution photos to tens of thousands smaller images.

The pictures from the FERC-2013 set are harder to interpret, but given the large size of dataset, the diversity can be beneficial for the robustness of a model. Training will be done using 9000 samples from the FER-2013 data (see figure below) with another 1000 new samples for validation

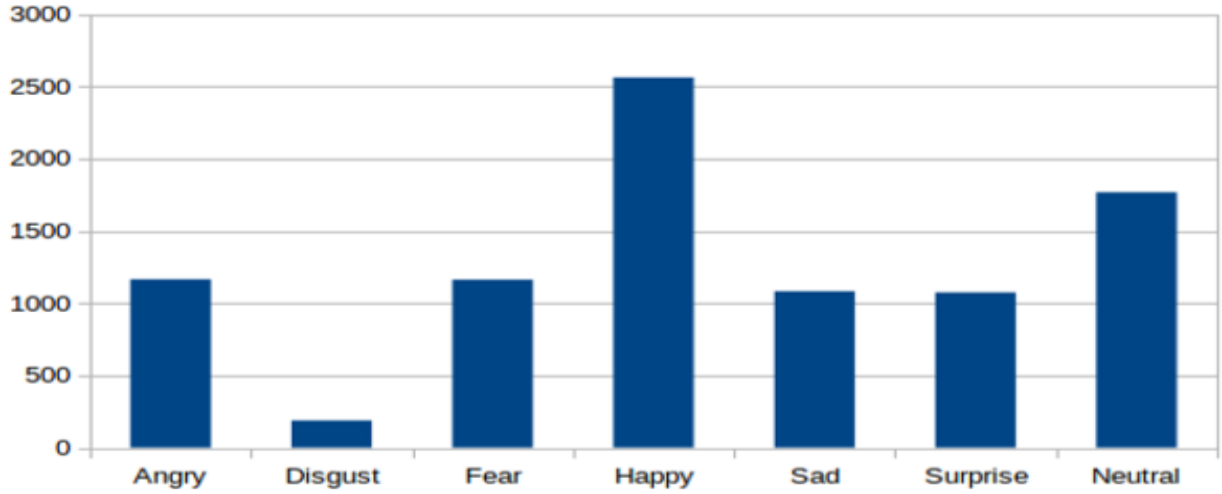


Fig.3.1 Number of images per emotion in the training set

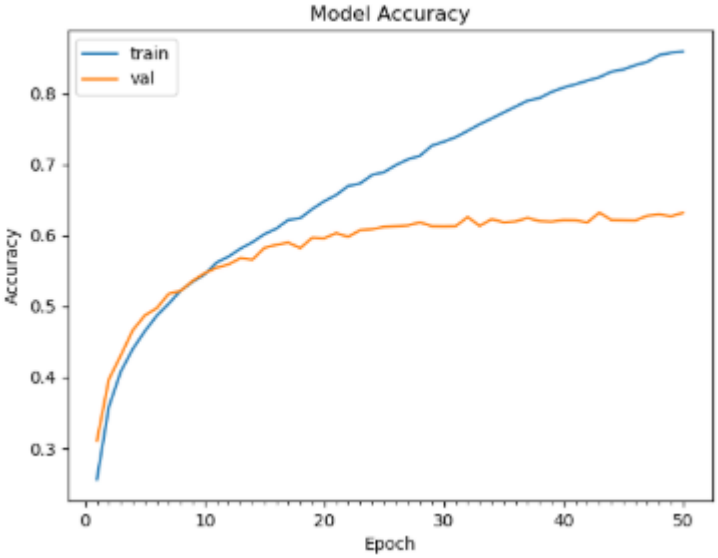


Fig.3.2 Accuracy of the trained dataset

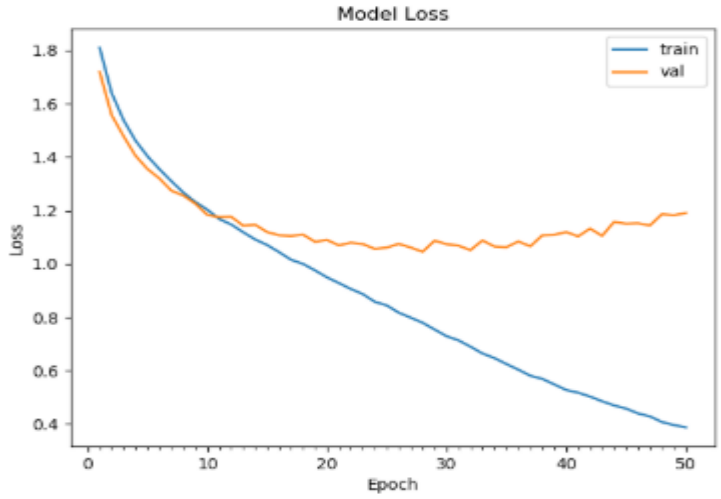


Fig.3.3 Loss of the trained dataset

CHAPTER 4

SYSTEM DESIGN

4.1 Introduction

1. Preprocessing

Preprocessing is a process which can be used to improve the performance of the FER system and it can be carried out before feature extraction process. Image preprocessing includes different types of processes such as image clarity and scaling, contrast adjustment, and additional enhancement processes to improve the expression frames. The normalization method also used for the extraction of eye positions which make more robust to personality differences for the FER system and it provides more clarity to the input images. ROI (Region of Interest) segmentation is one of the important type of preprocessing method which includes three important functions such as regulating the face dimensions by dividing the color components and of face image, eye or forehead and mouth regions segmentation.

2. Feature Extraction

Feature extraction process is the next stage of FER system. Feature extraction is finding and depicting of positive features of concern within an image for further processing. In image processing computer vision feature extraction is a significant stage, whereas it spots the move from graphic to implicit data depiction. Then these data depictions can be used as an input to the classification. The feature extraction methods are categorized into five types such as texture feature-based method, edge based method, global and local feature-based method, geometric feature-based method and patch-based method.

3. Classification

Classification is the final stage of FER system in which the classifier categorizes the expression such as smile, sad, surprise, anger, fear, disgust and neutral. The KNN (k – Nearest Neighbors) algorithm is a classification method in which the relationship among the assessment models and the other models are estimated during the training stage. Support Vector Machine (SVM) is one of the classification techniques in which two types of approaches are involved. They are one against one and one against all approaches. One against all classification means it constructs one sample for each class. One against one classification means it constructs one class for each pair of classes and SVM is one of the strongest classification methods for advanced dimensionality troubles. SVM is the supervised machine learning technique and it uses four types of kernels for its better performance. They are linear, polynomial, Radial Basis Function (RBF) and sigmoid. According to several classifiers SVM classifier gives better recognition accuracy and it provides better classification. The neural network based classifier CNN gives better accuracy than the other neural network based classifiers. In FER, SVM classifier is more exploitable comparing with other classifiers for recognition of expressions.

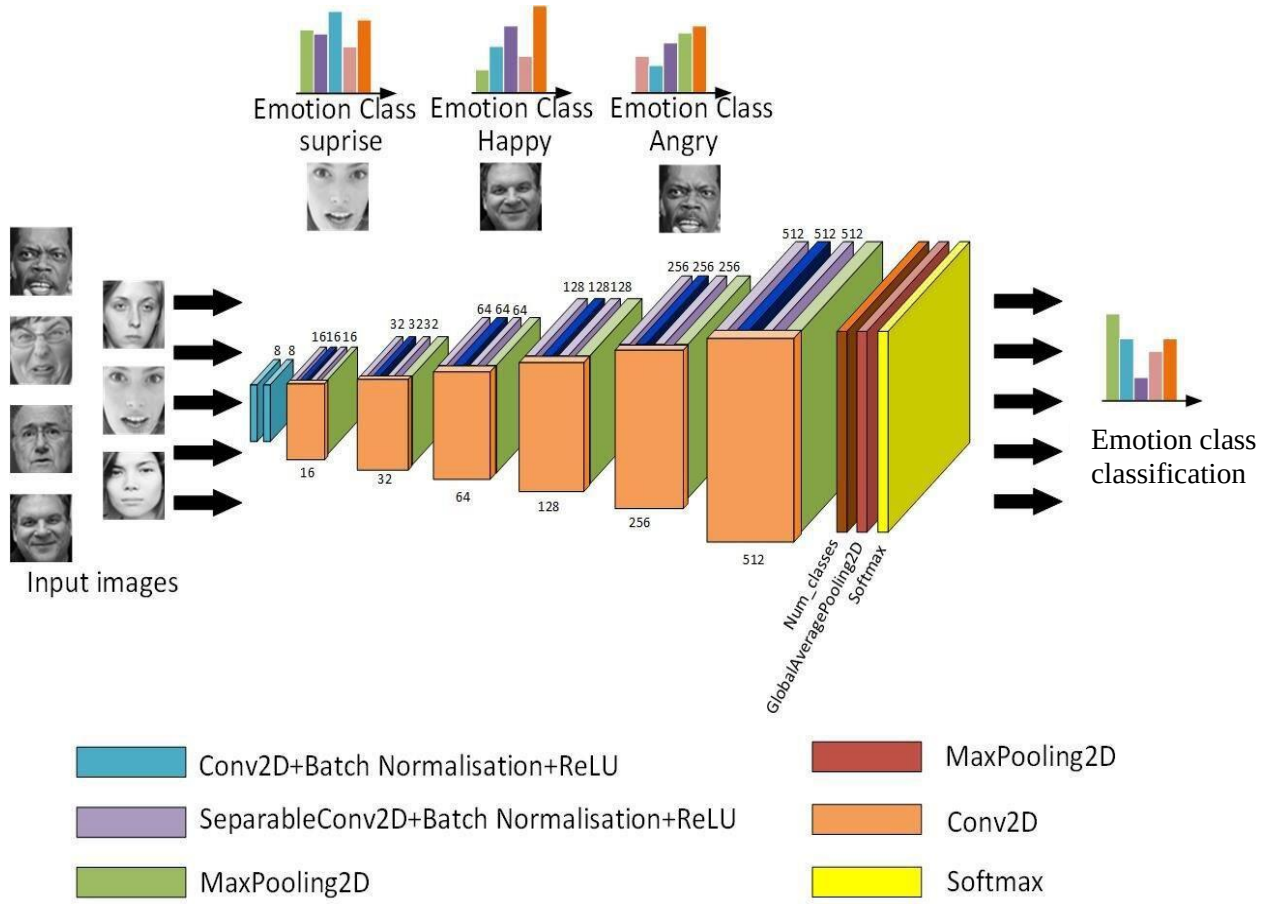


Fig.4.1 System Design Diagram

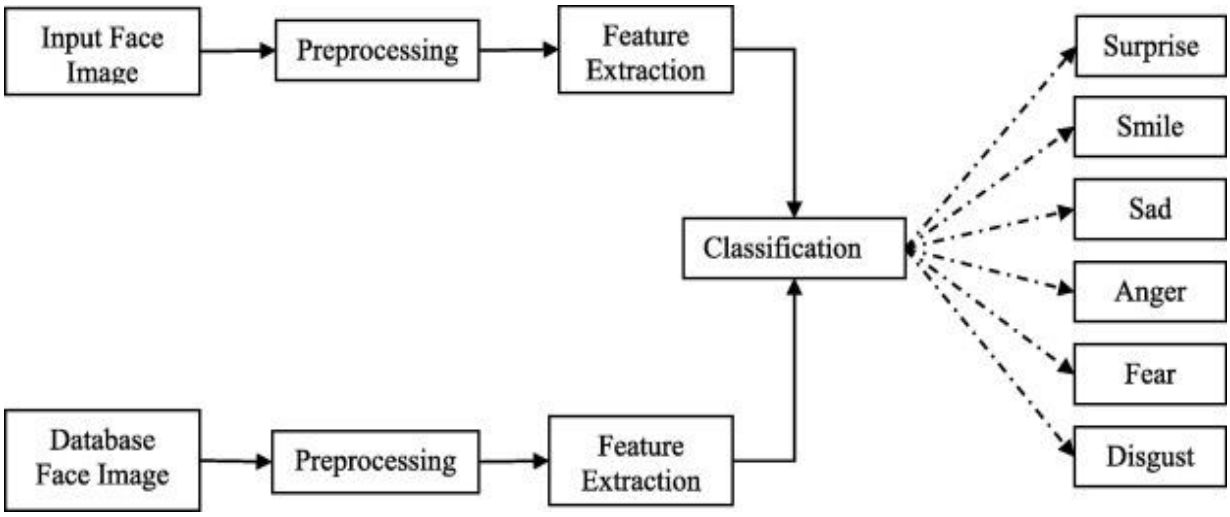


Fig.4.2 Overview of FER System

4.2 Data Flow Diagram

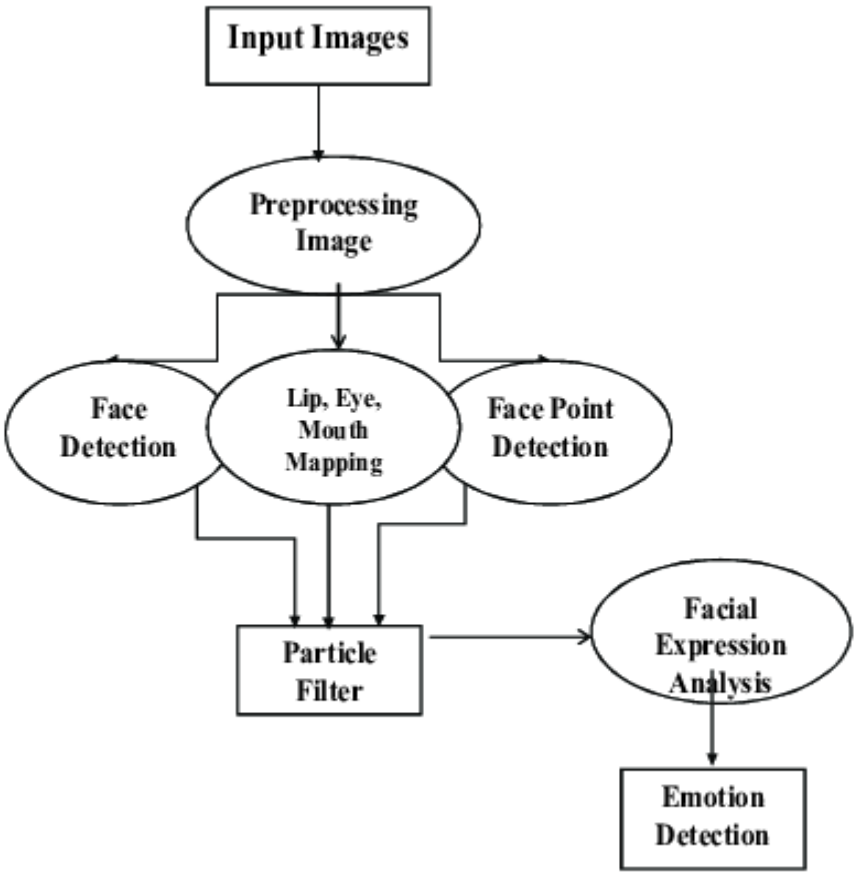


Fig.4.3 Data Flow Diagram

CHAPTER 5

PLANNING

5.1 Introduction

Since developing a software is a larger task as compared to just writing a script that can be done by a single developer. A software development is to be chosen. For our Project on "Facial Emotion Recognition", we opted for a Waterfall model. The reason being:

1. No frequent changes are required
2. The objective of the Problem statement and final product is Fixed.
3. Even though software development life cycle being small which points against Waterfall model, the project is not distributed and doesn't have a lot of components that need to be tied together which require individual teams for each feature.

5.2 Waterfall Model

Within the waterfall project management methodology, projects move along a linear and defined trajectory, like water gushing down a waterfall. It begins with planning, where project requirements, scope, budget and task timelines are discussed and fixed. Then comes the execution, where success is measured on how closely the project outcomes match the initial requirements. The steps we followed while developing this project are:

1. Analysis of the problem statement.
2. Gathering of the requirement specification
3. Analyzation of the feasibility of the project.
4. Development of a general layout.
5. Going by the journals regarding the previous related works on this field.
6. Choosing the method for developing the algorithm.
7. Analyzing the various pros and cons.
8. Starting the development of the project
9. Installation of software like ANACONDA.
10. Analyzation of algorithm by guide.
11. Coding as per the developed algorithm in PYTHON.

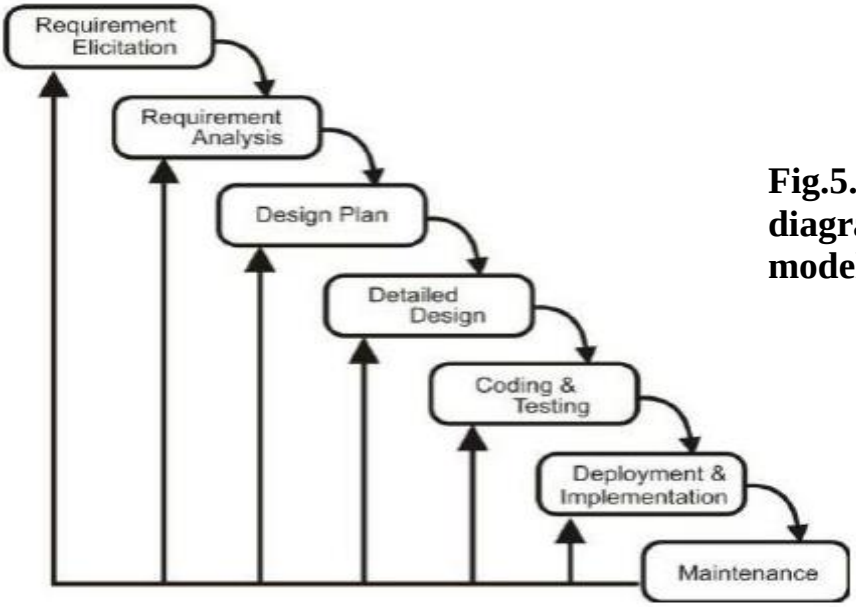


Fig.5.1 General diagram of Waterfall model

CHAPTER 6

IMPLEMENTATION

6.1 Details of Components Used

1.Dataset

The dataset, used for training the model is from a Kaggle Facial Expression Recognition Challenge a few years back (FER2013). The data consists of 48x48 pixel grayscale images of faces. The faces have been automatically registered so that the face is more or less centered and occupies about the same amount of space in each image. The task is to categorize each face based on the emotion shown in the facial expression in to one of seven categories (0=Angry, 1=Disgust, 2=Fear, 3=Happy, 4=Sad, 5=Surprise, 6=Neutral).

The training set consists of 28,709 examples. The public test set used for the leaderboard consists of 3,589 examples. The final test set, which was used to determine the winner of the competition, consists of another 3,589 examples.

Emotion labels in the dataset:

0: -4593 images- Angry
1: -547 images- Disgust
2: -5121 images- Fear
3: -8989 images- Happy
4: -6077 images- Sad
5: -4002 images- Surprise
6: -6198 images- Neutral

2.Library & Package

1.OpenCV:

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library.

2.NumPy:

NumPy is an acronym for "Numeric Python" or "Numerical Python". It is an open source extension module for Python, which provides fast precompiled functions for mathematical and numerical routines. A numpy array is a grid of values, all of the same type, and is indexed by a tuple of nonnegative integers. The number of dimensions is the rank of the array; the shape of an array is a tuple of integers giving the size of the array along each dimension.

3.SciPy:

SciPy (Scientific Python) is often mentioned in the same breath with NumPy. SciPy extends the capabilities of NumPy with further useful functions for minimization, regression, Fourier-transformation and many others.

4.TensorFlow:

TensorFlow is a Python library for fast numerical computing created and released by Google. It is a foundation library that can be used to create Deep Learning models directly or by using wrapper libraries that simplify the process built on top of TensorFlow. Keras is a high-level neural networks API, written in Python and capable of running on top of TensorFlow, CNTK, or Theano. It was developed with a focus on enabling fast experimentation. Keras contains numerous implementations of commonly used neural network building blocks such as layers, objectives, activation functions, optimizers, and a host of tools to make working with image and text data easier.

6.2 Algorithm

OVERVIEW OF ALGORITHM

1. Haar cascade is used to detect object in the video or image.
2. The object or face to be detected is limited to 48*48 and is fed as an input to CNN.
3. The output is a list of scores of seven different emotions.
4. The emotion label with the maximum score is displayed on the screen

STEPS INVOLVED

Step 1: Collection of a data set of images. (In this case we are using FER2013 database of 35887 pre-cropped, 48-by-48-pixel grayscale images of faces each labeled with one of the 7 emotion classes: anger, disgust, fear, happiness, sadness, surprise, and neutral.

Step 2: Pre-processing of images.

Step 3: Detection of a face from each image.

Step 4: The cropped face is converted into grayscale images.

Step 5: The pipeline ensures every image can be fed into the input layer as a (1, 48,48) numpy array.

Step 5: The numpy array gets passed into the Convolution2D layer.

Step 6: Convolution generates feature maps.

Step 7: Pooling method called MaxPooling2D that uses (2, 2) windows across the feature map only keeping the maximum pixel value.

Step 8: During training, Neural network Forward propagation and Backward propagation performed on the pixel values.

Step 9: The model is able to show the detail probability composition of the emotions in the face

6.3 Directory Structure

The directory structure depicts, how the files and folders are arranged in system for the proper functioning of the project. Below is the listed files and folders with their short description of their functionality.

1. The folder named **"data"** contains the FER-2013 the dataset for the model trained. It consists of 35887 48x48 grayscale images.
2. "**dataset_prepare.py**" is a Python file that has the functionality for preparing and training the model using files inside folder data.
3. "**emotions.py**" is a Python file that has the functionality of comparing the image form the image source to the trained model and classifying it by giving it a score from 0 to 6. The output is shown alongside with the image of the person denoting the emotion of the subject.
4. "**haarcascade_frontalface_default**" is a XML document. It is a haar cascade designed by OpenCV to detect the frontal face. A Haar Cascade works by training the cascade on thousands of negative images with the positive image superimposed on it.
5. "**model.h5**" is a file generated after training the model over thousands of test images, it is trained model that is used by emotion.py file to classify subject emotions as per score.

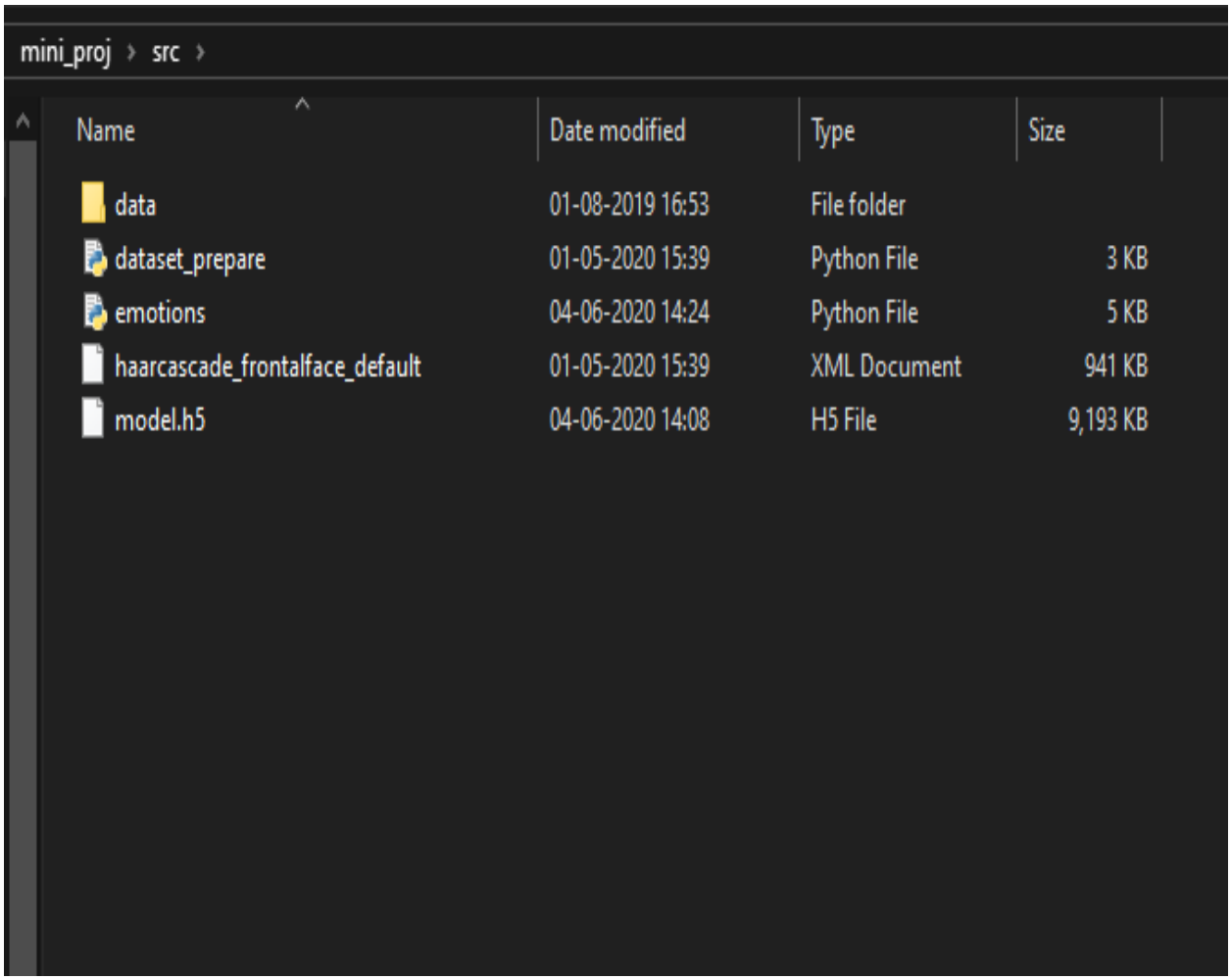


Fig.6.1 The directory overview of files and folders

CHAPTER 7

EXECUTION

7.1 Execution Steps

1. Open Anaconda Navigator

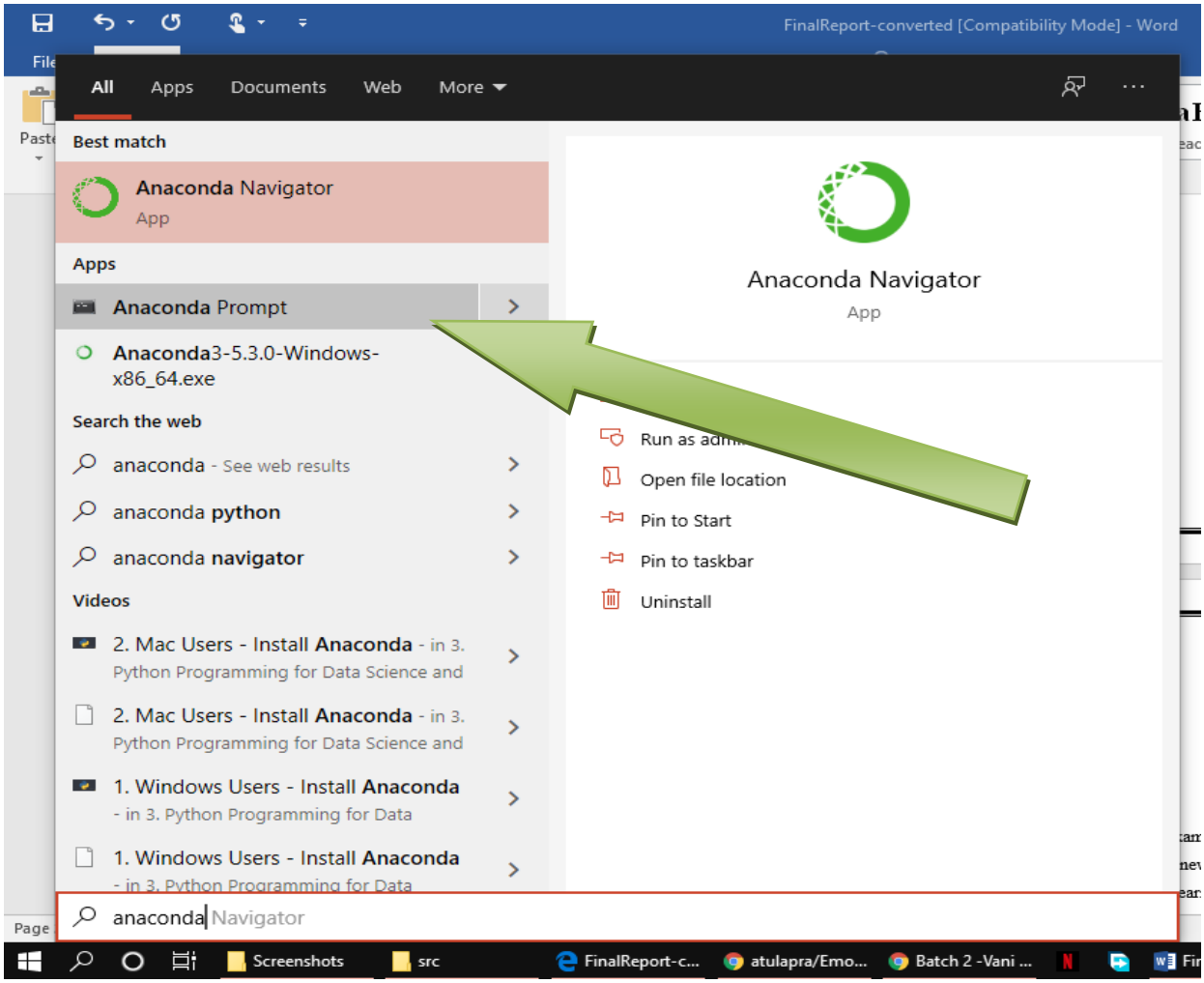


Fig.7.1 Finding Anaconda Prompt in Search

2. Activate Environment where all the required modules and packages are installed.
   If any error exists of a form module not found, install it using the following command "conda install <package_name>"
   For the project we made an environment named **test1** and installed all modules and libraries required using
   conda install numpy
   conda install matplotlib
   conda install tensorflow
   conda install pandas
   conda install -c anaconda opencv

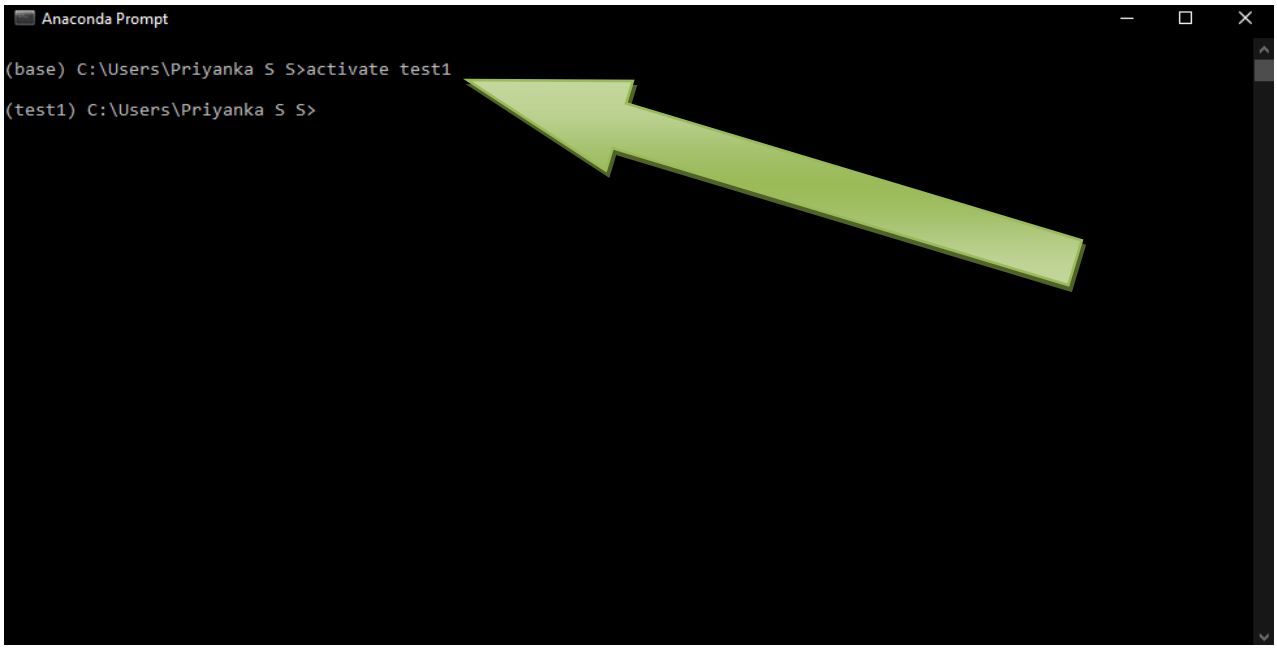


Fig.7.2 Activating Environment named test1

3. Navigate to the directory consisting of folder with emotion.py

Fig7.3 Locating directory with emotion.py and trained model

4. Running the command "**python emotions.py --mode display**" will display
Found 28709 images belonging to 7 classes.
Found 7178 images belonging to 7 classes.
Which is the number of images through which the classification is done.
This will result in the opening of the camera hardware which is ready for emotion detection via classifying the emotion detected among 7 classes.

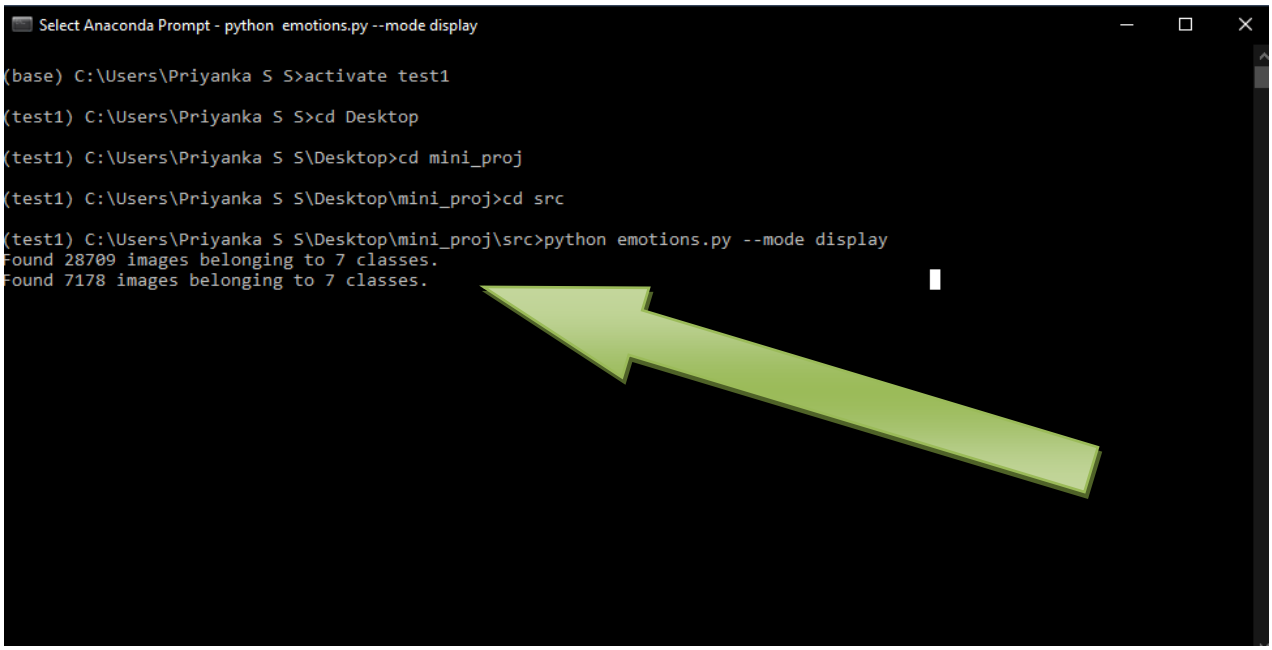
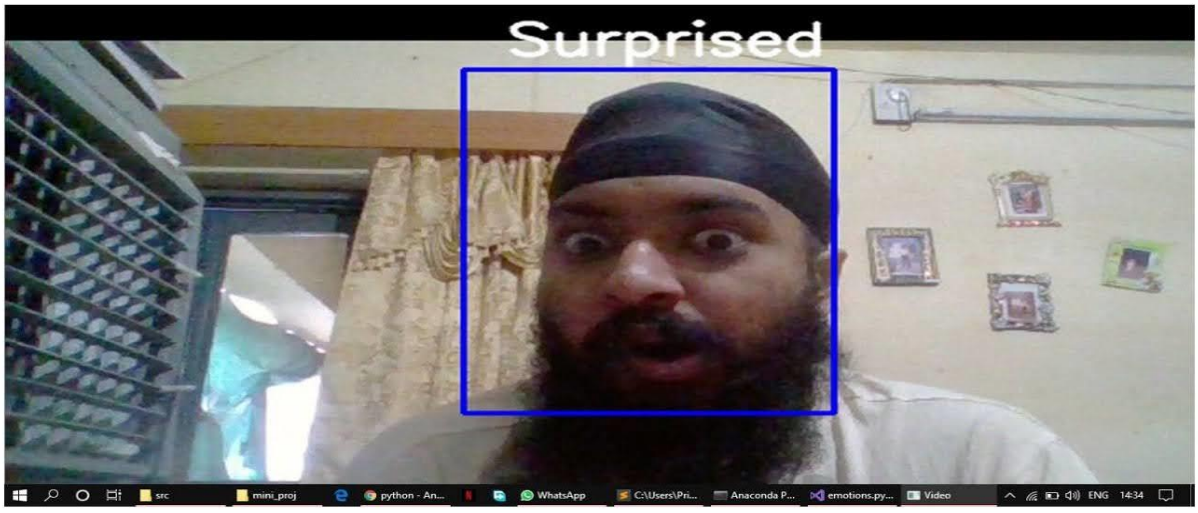
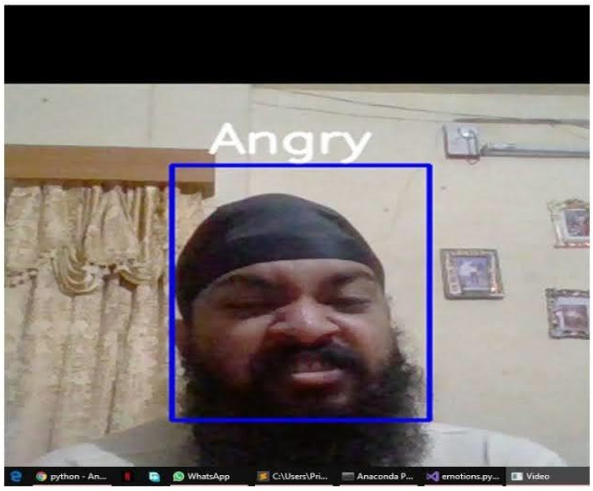
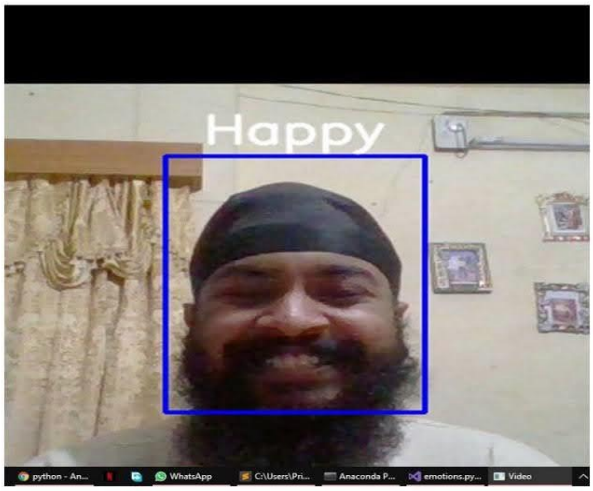


Fig.7.4 Executing command to launch the camera for detection

7.2 Result Screenshots







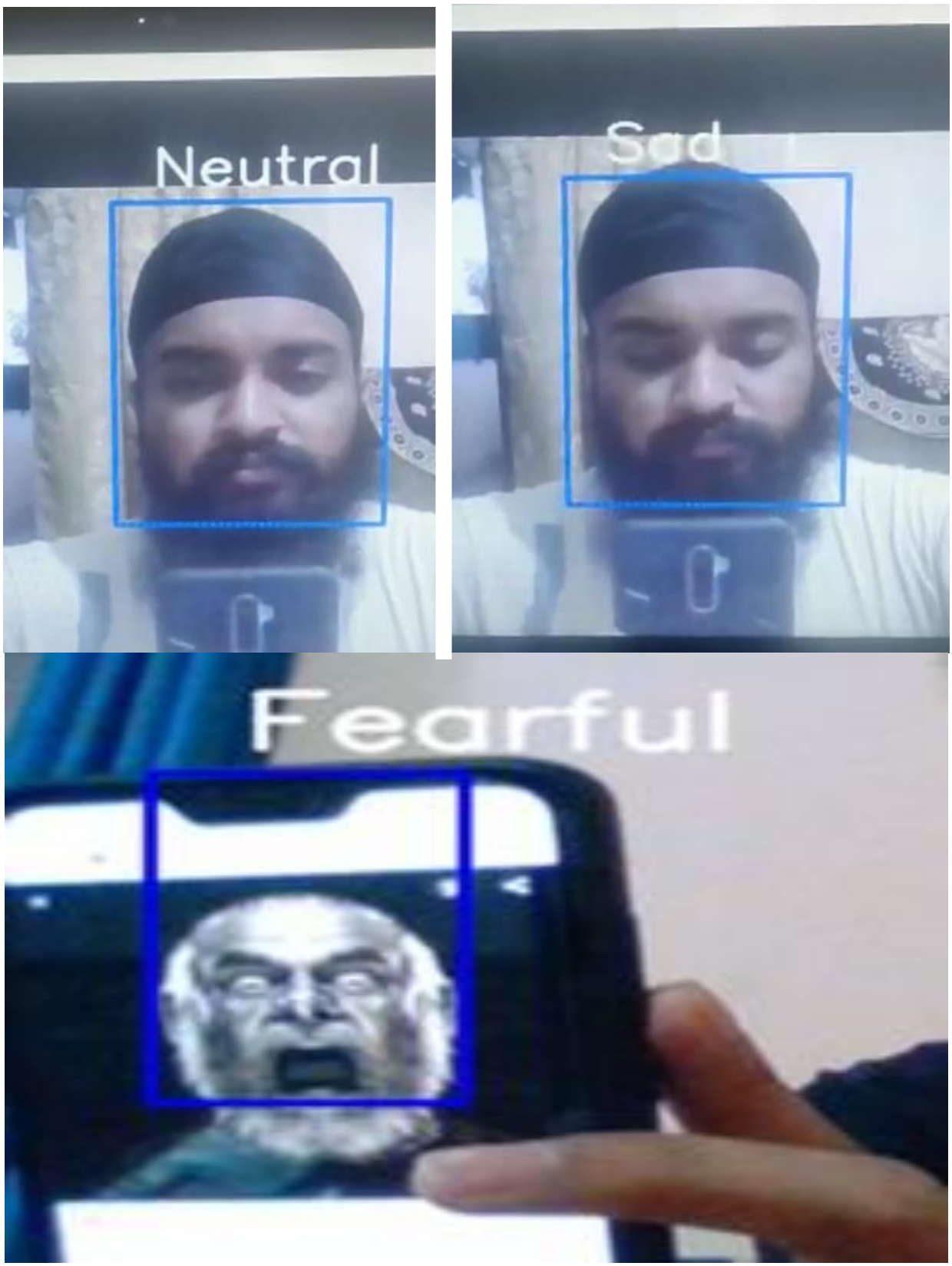


Fig.7.5 Screenshots Demonstrations of Model's working state

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

This project proposes an approach for recognizing the category of facial expressions. Face Detection and Extraction of expressions from facial images is useful in many applications, such as robotics vision, video surveillance, digital cameras, security and human-computer interaction. This project's objective was to develop a facial expression recognition system using supervised learning. In this project, seven different facial expressions of different person's images from different datasets have been analyzed.

High correct recognition rate (CRR), significant performance improvements in our system. Promising results are obtained under face registration errors, fast processing time. It is able to recognize spontaneous expressions. Our system can be used in Digital Cameras where in the image is captured only when the person smiles, or if the person doesn't blink his eyes. In security systems which can identify a person, in any form of expression he presents himself. Rooms in homes can set the lights, television to a person's taste when they enter the room. Doctors can use the system to understand the intensity of pain or illness of a deaf patient. The system can also be used for educational purpose such as one can get feedback on how the student is reacting during the class.

The system can be used in mini-marts, shopping center to view the feedback of the customers to enhance the business. The system can be installed at busy places like airport, railway station or bus station for detecting human faces and facial expressions of each person. If there are any faces that appeared suspicious like angry or fearful, the system might sedan internal alarm. This system can be used for lie detection amongst criminal suspects during interrogation.

CHAPTER 9

REFERENCES

9.1 Article links

1. https://github.com/atulapra/Emotion-detection
2. https://www.researchgate.net/publication/322103128_Facial_Expression_Recognition_System_using_Convolutional_Neural_Network
3. https://www.academia.edu/6811887/A_Project_Report_On_FACIAL_EXPRESSION_RECOGNITION_USING_IMAGE_PROCESSING
4. https://www.intechopen.com/books/face-recognition-semisupervised-classification-subspace-projection-and-evaluation-methods/face-recognition-issues-methods-and-alternative-applications
5. https://www.sciencedirect.com/science/article/pii/S1319157818303379
6. https://ieeexplore.ieee.org/document/7530173
7. https://www.academia.edu/6761678/A_literature_survey_on_Facial_Expression_Recognition_using_Global_Features
8. https://www.sciencedirect.com/science/article/pii/S1877050915021225
9. https://github.com/atulapra/Emotion-detection/blob/master/ResearchPaper.pdf
10. https://towardsdatascience.com/a-comprehensive-guide-to-convolutional-neural-networks- the-eli5-way-3bd2b1164a53
11. https://www.kaggle.com/c/challenges-in-representation-learning-facial-expression-recognition-challenge/data
12. https://www.kaggle.com/deadskull7/fer2013

9.2 Project GitHub link

https://github.com/RaGE1/Emotion-detection