A Project Report

on

Face Recognition System

Submitted in partial fulfillment of the
requirement for the award of the degree of

Bachelor of Technology

in

Computer Science and Engineering

Under The Supervision of

Dr Bharat Bhushan

Naib
Assistant Professor

Submitted By

Yash pratap Singh(19SCSE1010721)
Himanshu Barach(19SCSE1010775)

SCHOOL OF COMPUTING SCIENCE AND ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
GALGOTIAS UNIVERSITY, GREATER NOIDA INDIA
March, 2023

CANDIDATE'S DECLARATION

I/We hereby certify that the work which is being presented in the thesis/project/dissertation, entitled **"CAPS…."** in partial fulfillment of the requirements for the award of the submitted in the School of Computing Science and Engineering of Galgotias University, Greater Noida, is an original work carried out during the period of month, Year to Month and Year, under the supervision of Dr Bharat Bhushan Naib Designation, Department of Computer Science and Engineering/Computer Application and Information and Science, of School of Computing Science and Engineering , Galgotias University, Greater Noida

The matter presented in the thesis/project/dissertation has not been submitted by me/us for the award of any other degree of this or any other places.

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Dr Bharat Bhushan Naib

Assistant Professor

YASH PRATAP SINGH(19SCSE010721

HIMANSHU BARACH(19SCSE1010775)

CERTIFICATE

The Final Thesis/Project/ Dissertation Viva-Voce examination of YASH PRATAP SINGH(19SCSE1010721) & HIMANSHU BARACH(19SCSE1010775) has been held on 29/03/2023 and his/her work is recommended for the award of B-Tech in Computer Science Engineering.

Signature of Examiner(s) **Signature of Supervisor**

Signature of Project Coordinator **Signature of Dean**

Date: March, 2023

Place: Greater Noida

Abstract

Human face detection has become a major field of interest in current research because there is no deterministic algorithm to find face(s) in a given image, the algorithms that exist are very much specific to the kind of images they would take as input and detect faces. The problem is to detect faces in the given, colored class group photograph and some it didn't detect the image color, Face detection in a real-time setting has an-exciting area and arapidly growing challenge. Many public places usually have surveillance cameras for video capture and these cameras have their significant value for security purpose. It is widely acknowledged that the face detection have played an important role in surveillance system as it doesn't need the object's cooperation.

The actual advantages of face based identification over other biometrics are uniqueness and acceptance. As human face is a dynamic object having high degree of variability in its appearance, that makes face detection a difficult problem in computer vision Facial expressions are the changes occurring on the human face indicating person's internal emotional states, intents or societal communications. Depending on the expressions on the face, human face is the most principal mode of conveying and deducing affective states of human ones. In real-time, facial expression detection has become a prominent research area as it plays an important role in Human Computer Interaction.

The applications of the facial expression detection are computer vision, biometric security, social interaction, emotional intelligence and social intelligence, To detect a facial Expression one system need to come across various variability of human faces such as color, posture, expression, orientation, etc. To detect the expression of a human face first it is required to detect the different facial features such as the movements of eye, nose, lips, etc. and then classify them comparing with trained data using a suitable classifier for expression recognition.

Keyword: Artificial Intelligence, Face Recognition ,Neural Network.

CONTENTS

CHAPTER 1

INTRODUCTION

Face plays an important role in social communication. Face biometric itself is used in many applications like security, forensic and other commercial applications. Similarly facial expressions are the fastest means of communication, while conveying any type of information. In 1978, Ekman and Frisen reported that, Happy, Sad, Anger, Fear, Disgust and Surprise are the six basic expressions which are readily recognized across very different cultures. A system designed for analyzing facial actions automatically through a human computer interaction, is called Automatic Facial Expression Recognition System (AFERS). The robust AFER system can be applied in many areas of science such as emotion detection, clinical psychology and pain assessment.

There are three major steps in an AFERS;

1. To detect the face from the given input image or video,

To extract the facial features like eyes, nose, mouth from the detected face1.2.To

classify the facial expressions into different classes like
Happy, Angry, Sad, Fear, Disgust, and Surprise.

Facial expression plays an important role in smooth communication among individuals. The extraction and recognition of facial expression has been the topic of various researches subject to enable smooth interaction between computer and their users. In this way, computers in the future will be able to offer advice in response to the mood of the user Computer-based recognition of facial expressions goes a long way, and various methods have been proposed. All the method can be classified into two broad-based category : probabilistic approach and feature based approach. The feature-based method utilizes the Facial Action Coding System (FACS) designed by Ekman and Friser . In FACS, the motions of the face are divided into 44 action units (AU), and their combinations may describe any facial expression. More than 7,000 combinations of AU have been observed .random distribution of image intensities and these vectors may differ from each emotion. The vectors are calculated per emotion and classification algorithms like HMM, Neural Network (NN) or a hybrid approach (HMM an NN) are applied. It involves lighting compensation algorithm and morphological operations to retain the face from the input image. To extract the facial features, Active Appearance Model i.e. AAM method is used. Finally, the expressions

are recognized as Happy, Sad, Anger, Fear, Disgust, and Surprise, initially by using simple Euclidean Distance method and then by training the Artificial Neuro-Fuzzy Inference System (ANFIS).

Generally, the face offers three different types of signals such as static, slow and rapid signals. The static signals are skin color which includes the several lasting aspects of face skin pigmentation, greasy deposits, face shapes, the constitution of bones, cartilage and shape, location and size of facial features such as brows, eyes, nose, mouth. The slow signals are permanent wrinkles which include the changes in facial appearance such as muscle tone and skin texture changes that happen slowly with time.

The rapid signals are raising the eyebrows which include the face muscles movement, impermanent face appearance changes, impermanent wrinkles and changes in the location and shape of facial features. These flashes on the face remain for a few seconds. These threesignals are altered with individual option while it is very hard to alter static and slow signals.Also, the face is a multi- message system and it is not only a multi-signal system. Messages are transmitted through a face which includes emotion, feel position, age, quality,

intelligence, attractiveness.

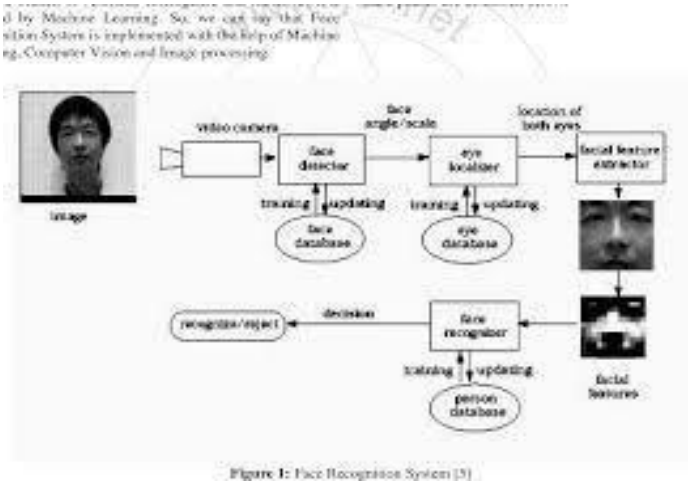


Fig 1.1: facial recognition system

CHAPTER - 2

Literature Reviews/Comparative study

Face detection enables the identification and validation of human faces from images, videos, and other forms of graphics. It traces facial features, contours, and texture to analyze the unique biometric and demographic details of individuals. M.-H. Yang, Kriegman, and Ahuja (2002) proposed some methods for facial detection that included: knowledge-based methods which captures relationship between facial features, Feature-based methods which aims to find the structural features, Template-matching methods use to show standard patternsof a face which are stored to describe the face as a whole or the facial features separately, and Appearance-based models which are learned from a set of training images capturing the representative variability of the facial appearance[10]. Each of the methods applied have their own relative performance outcomes and due to the lack of uniformity in how methods are evaluated it's hard to explicitly declare which methods indeed have the lowest error rates. As an ongoing study research area, more complex algorithms can be introduced for advance accuracy (M.-H. Yang et al., 2002). Humans are capable to express thousands of facial expressions that vary in intensity, complexity and meaning. Kartali, Roglić, Barjaktarović, Đurić- Jovičić, and Janković (2018) proposed algorithms that performs detection, extraction, and evaluation of facial expressions and will allow for real-time emotion recognition. Its aim is to recognize the facial expression stored in a database, then recognize the human emotions in terms of happy, sad, surprise, neutral, disgust, etc. The methods proposed by the authors utilizes three deep learning approaches based on convolutional neural networks (CNN) which are (AlexNet CNN, commercial Affdex CNN solution, and custom-made FER-CNN) , and two conventional approaches for classification of Histogram of Oriented Gradients (HOG) features which are (Support Vector Machine (SVM) of HOG features, and Multilayer Perceptron (MLP) artificial neural network of HOG features)[10]. The concept of face detection has become one of the interesting areas in research that aims to use application of pattern recognition and computer vision. Sharifara, Rahim, and Anisi (2014) proposed an advanced up-to-date method for facial recognition, that aims to increase the accuracy of detecting faces, especially in a complex environment. Some of the face detection methods used were feature-based, appearance-based, knowledge based, and template matching. Also, explained the use of applying Haar-like features and neural networks for facial recognition[10]. Each of the methods applied have increased the efficiencyfor face detection but as an ongoing study research area, more complex algorithms can be introduced for advance accuracy (Sharifara et al., 2014). Feature selection is defined as the process of selecting the subset of the most relevant features from the set of features. Ideally, four

conditions should be met by a feature selection algorithm that include reliable extraction of relevant feature, identifying non-linear feature interactions, scaling linearly with the number of features and dimensions, and to allow the incorporation of known sparsity structure. In Liu and Yu (2007), the authors proposed a gradient-based feature selection for online boosting that primarily focuses on in person detection and person tracking. This method provides a distinctive scheme of learning discriminative features compared to the common way of searching the feature hypothesis space exhaustively (Liu & Yu, 2007). Jang and Kim (2008), proposed one of the most efficient stochastic search methods known as evolutionary algorithms (EAs) mainly that focuses on evolutionary pruning method. Evolutionary algorithms have been applied in many classifier training tasks such as facial detection, facial recognition and car detection (Jang & Kim, 2008)[10].These algorithms are known to have robust performance despite domain-specific heuristics. The main objective of this proposed method was being able to construct an efficient cascade structure to minimize the number of classifiers in AdaBoost-based cascade detector without degrading the detection accuracy. The total number of weak classifiers in the proposed structure was reduced to 58.7% of that constructed from the AdaBoost method (Jang & Kim, 2008).This algorithm was able to detect between 90.1% and 94.7% of the faces based on the database under acceptable number of false positives (Jang & Kim, 2008). Viola and Jones (2001) proposed three main object detection framework which included integral image that allows for very fast feature evaluation, second method included construction of classifier by selecting a small number of important features using AdaBoost, and final method includes combining complex classifiers in a cascade structure which dramatically increases the speed of the detector The presented approach for object detection in this paper minimizes computation time while achieving high detection accuracy P. Yang, Liu, and Metaxas (2007) proposed a novel approach of facial action units and expression recognition based on coded dynamical features. It utilizes the concept of Haar-like feature for facial representation, then uses the coded dynamic feature to further detect facial expressions. Their proposed method constructs a weak learner for AdaBoost learning with one feature and uses binary coding based on statistical distribution of training samples, to make it robust to noiseMatsugu et al. [1] developed the first facial ER model. This developed system claimed to be robust in appearance and independent of the subject. They used a CNN model, which was used to find local differences between neutral and emotional face. A single structure CNN was used to experiment in spite of two CNN models, which was similar to the Fasel's model [11]. Fasel's model had two CNNs that were independent, one was used for facial expression, and the other was used for face identity recognition. Furthermore, an MLP was used to combine them. The experiment was performed with images of various types and achieved a performance rate of 97.6% for 5600 still images of 10 subjects. Tanaya et al. [12] applied a Curvelet-based feature extraction. Here, they took advantage of the discontinuities in 2D functions, which were represented by Curvelet. In their work, they converted the images to grayscale. These images were then exploited to the 256 resolution further to 16 and then to 8 and 4 resolution, respectively. Later in his work, curvelet was used for training the algorithm. The reason to follow this flow was that the person image would be recognized by bigger curves, which are present at the lower bit resolution if initially

a person's face is not recognized in the 8-bit image. Finally, the One-Against-All (OAA) SVM method was performed, and the results of wavelet and curvelet-based methods were compared on various known databases in which curvelet method proved to have a higher performance than wavelet methods.

Li et al. [13] mentioned that recognition of emotion is completely based on visual information. He conducted an experiment that was based on the recognition of smiles. The subjects were made to depict the smiles. The comparison was made between 3D and 2D emotion recognition. To complete the test, symmetric property of the face method was used for registration. The cubic spline interpolation method was used to overcome holes in the image which were caused due to dark hair on the face. Feature extraction was done by using Principal Component Analysis (PCA); along with that, a LIBSVM (library for SVM) package was used in accordance and it is quite more helpful for the detection of the image.

Computationally this means that it is not necessary to consult the complete set of database images (denoted model images below) in order to verify a claim. An incoming image (referred to as a probe image) is thus compared to a small number of model images of the person whose identity is claimed and not, as in the recognition scenario, with every image (or some descriptorof an image) in a potentially large database.

Second, an automatic authentication system must operate in near-real time to be acceptable to users. Finally, in recognition experiments, only images of people from the training database are presented to the system, whereas the case of an imposter (most likely a previously unseen person) is of outmost importance for authentication.

Face recognition is a biometric approach that employs automated methods to verify orrecognize the identity of a living person based on his/her physiological characteristics.

In general, abiometric identification system makes use of either physiological characteristics (such as a fingerprint, iris pattern, or face) or behaviour patterns (such as hand-writing, voice, or key stroke pattern) to identify a person. Because of human inherent protectiveness of his/her eyes, some people are reluctant to use eye identification systems.

Face recognition has the benefit of being a passive, non intrusive system to verify personal identity in a "natural" and friendly way.

A Feature Based Approach This approach relies on extraction of facial features to detect face.

1. Low Level Analysis: It uses the concept of pixel analysis, edge detection in image (using Sobel or Canny) and gray scale. It also uses the concept of finding local maxima (to detect nose) and local minima (to detect eyebrows pupils and lips)

2. Feature Analysis: It improves the result of Low Level Analysis. It incorporates the fact that all the parts of face (eyes, nose, mouth, chin, head-top) are at somewhat at relative positions with respect to each other. Prominent features (mentioned above) are determined and they in result help in identifying potential face.

B. Geometry Based Detection It too uses the concept of Edge Detection using the concept of Canny filter and gradient analysis. All the predominant features/specific location of image is divided into block and each block has a corresponding pixel at centre. All the central pixels of blocks are connected to nearby central pixels with an aim to span the face.

C. Appearance Based Approach This approach relies on extraction of facial features to detect face. In this method entire image is processed in two dimensions. All the extracted characteristics are termed as features. In order to identify the face from the given image we would be required to match only those above features that correspond to the features of human face (nose, eyes, mouth etc.). To extract the feature vector, Principal Component analysis (PCA) and Independent Component Analysis (ICA) is used. We are using PCA because as the name suggest it would only compute or retain important/predominant vectors/variables and would reject the ones that don not contribute to any new information. This results in reducing computing and Time Complexity.

D. Haar Like Features Initially to detect a face we were directly computing pixels. This features though exhaustive is also computationally not viable as in an HD image it would result in 1920*1080 = 2*10^6 pixels. Thus we moved on to feature extraction from pixel computation. Entire human race possess face that has similar properties. The properties we refer to here are the positioning of eyes, nose, mouth etc., the relative size of them and the contrast/intensity of them. This uniformity of features can be replicated using features known as Haar-like Features. A Haar-like feature consists of adjacent rectangular windows at specific location.

The output value is categorizes this specific location. For example, Region of Eyes is darker then cheeks. Thus, the Haar feature for it would incorporate two adjacent rectangles. One on eyes and another below it, on cheeks. Then the summation of intensities is done for each rectangular and then value of summation of rectangle on cheeks is subtracted from the sum of values in rectangle on eyes. The same concept is used for identification of eyes, mouth and bridge of nose.

Adaboost Features computation using the concept of Haarlike features helps identify specific region. But, there are vast numbers of features for example there are about 1,80,000 features in 24*24 pixel window. [5] This would undoubtedly result in large scale computation and ultimately in high time complexity. But, of these lakhs of features there are only selected features that would help predict face with better accuracy. In general terms, there are only selected features that are necessary to build a model/algorithm that detects the face with required accuracy. Adaboost is used for this very purpose. It selects the few necessary features which when combined together/amalgamated provides a classifier that is effective for the classification of face/required object in an image. What makes Adaboost applicable in different scenarios is the fact that it is adaptive in nature. Subsequent classifiersare built so as to modify and improve on those cases that were misclassified by previous classifier.

FER2013 dataset (facial expression recognition) consists of 48*48 pixel grayscale face images. The images are centered and occupy an equal amount of space. This dataset consist of facial emotions of following categories:

0:angry
1:disgust
2:feat
3:happy
4:sad
5:surprise
6:natural

AffectNet

AffectNet is one of the largest datasets for facial affect in still images which covers both categorical and dimensional models. The dataset is collected by using 1250 emotion-related tags in six different languages, that are English, German, Spanish,
Portuguese, Arabic, and Farsi. The dataset contains more than one million images with faces and extracted facial landmark points.
To meet this need, we have created **AffectNet**, a new database of facial expressions in the wild, by collecting and annotating facial images. **AffectNet** contains more than 1M facial images collected from the Internet by querying three major search engines using 1250 emotion related keywords in six different languages.

About half of the retrieved images (~440K) **were manually annotated for the presence of** seven discrete facial expressions **(categorial model) and the intensity of valence and arousal (dimensional model)**.

AffectNet is by far the largest database of facial expressions, valence, and arousal in the wild enabling research in automated facial expression recognition in two different emotion models. Two baseline deep neural networks are used to classify images in the categorical model and predict the intensity of valence and arousal.

Various evaluation metrics show that our deep neural network baselines can perform better than conventional machine learning methods and off-the-shelf facial expression recognition systems.

Ascertain

Ascertain is a multimodal database for impliCit pERsonaliTy and Affect recognitIoN that can be used for detecting personality traits and emotional states via physiological responses. The dataset contains big-five personality scales and emotional self-ratings of 58 users along with synchronously recorded Electroencephalogram (EEG), Electrocardiogram (ECG), Galvanic Skin Response (GSR) and facial activity data, recorded using off-the-shelf sensors while viewing affective movie clips.

Dreamer

Dreamer is a multi-modal database consisting of electroencephalogram (EEG) and electrocardiogram (ECG) signals recorded during affect elicitation by means of audio-visual stimuli. In this dataset, signals from 23 participants were recorded along with the participants' self-assessment of their affective state after each stimulus, in terms of valence, arousal, and dominance.

Extended Cohn-Kanade Dataset (CK+)

The Extended Cohn-Kanade Dataset (CK+) is a public benchmark dataset for action units and emotion recognition. The dataset comprises a total of 5,876 labelled images of 123 individuals, where the sequences range from neutral to peak expression. Images in the CK+ dataset are all posed with similar backgrounds, mostly grayscale, and 640×490 pixels.

EMOTIC

EMOTIC or EMOTIon recognition in Context is a database of images with people in real environments, annotated with their apparent emotions. The EMOTIC dataset combines two different types of emotion representation, that includes a set of 26 discrete categories, and the continuous dimensions valence, arousal, and dominance. The dataset contains 23, 571 images and 34, 320 annotated people. In fact, some of the images were manually collected from the internet using the Google search engine.

Google Facial Expression Comparison Dataset

Google Facial Expression Comparison Dataset is a large-scale facial expression dataset that consists of face image triplets along with human annotations. The dataset helps in specifying which two faces in each triplet form the most similar pair in terms of facial expression. The dataset is intended to help on topics related to facial expression analysis such as expression-based image retrieval, expression- based photo album summarisation, emotion classification, expression synthesis, etc.

1. Feature selection: This stage refers to attribute selection for the training of the

machine learning algorithm. The process includes the selection of predictors for construction of the learning system. It helps in improving prediction rate, efficiency, and cost-effectiveness. Many tools such as Weka and sci-kit-learn have inbuilt tools for automated feature selection.

2. Feature classification: When it comes to supervised learning algorithms, classification consists of two stages. Training and classification, where training helps in discovering which features are helpful in classification. Classification is where one comes up with new examples and, hence, assigning them to the classes that are already made through training the features.

3. Feature extraction: Machine learning requires numerical data for learning and training. During feature extraction, processing is done to transform arbitrary data, text or images, to gather the numerical data. Algorithms used in this step include principal component analysis, local binary patterns, linear discriminant analysis, independent component analysis, etc.

4. Classifiers: This is the final step in this process. Based on the inference from the features, the algorithm performs data classification. It comprises classifying the emotions into a set of predefined emotion categories or mapping to a continuous space where each point corresponds to an expressive trait. It uses various algorithms such as Support Vector Machine (SVM), Neural Networks, and Random Forest Search.

FEATURE EXTRACTION:-

A. Histogram of Oriented Gradient :- HOG may be a descripter of feature which is used in many field where object shape is matters. When need of object detection in field of computer vision then histogram of oriented gradient is playing a very important role.basicallyits count the number of occurrence of gradient orientedin localizede portioon of an image.in histogram of oriented gradient try to find out the a bar chart of gradient direction for doing this input(image) is devided into the tiny connection parts which refers to the cell and pixel inside the every cells. Sincee totally pictures might have different contrast thus, distinction standardization is critical to boost performance.this standardization leads to higher unchangeability to change inillumination

B. Geometric Features :- Geometric features are basically used for solving visual related problems. Its(geometric) the combo of both machine learning and computer vision. The primary focous of this technique is to search out a group of representtive options of geommetrickind to repreesent Associate in Nursing object by grouping geometric options from pictures andlearning them mistreatment economical machine learrning strategies. It(geometric) options don’t seems to be affecteed by lightingg condition. there are no any troublesome to perform anyaction. Ghimire and le[21] they extract some method of geometric features mechanically from

video frame victimization displacements supported by elasticity bunchh graph matchhing displacment estimation

C. Local Binary Pattern:- Local Binary Pattern (LBP) may be a straightforward nonetheless terribly economical texture operator that label the components of a picture by threholding the neighborhood of every pixels and consider the result as a binary range.local binary pattern uses (3x3) pixel that contains grey scale values and threshhold each Neighbour element P(0 to7) with the middle element R(1) to come up with a binarry sequence employing a binary threholding perform given in 1 and then cypher the deciimal equivalentt for the middle element with 2. figure 3 show is procedure: Suppose general practitioner is that the gray values in constituent P(0 to 7) and rate is the gray value of the middle constituent R(1), we are able to extract the bar chart of every region as follows: As we've got a picture in gray- scale, every bar chart (from every grid) can contain solely 0 to 255 = 256 position represent the occurrencces of every picture element intensity. so, we want to concatenate every bar chart to form a brand new and larger bar chart. Suppose we've got 8x8 grid[16], we'll have (8x 8 x 256)=(16.38) position within the final bar chart. the ultimate bar chart represents the characteristis of the original image.like this administrated a small research study on local binary pattern with linear programming options victiization (JAFFE) information. According to study it shows the results that median accuracy of ninety-three.8percentage was achieved. LBP really have challenges with some factors like; rotation, will increase in procedure qualitybecause the size of options will increase in term of your TIme and house, lower sampled size and restricted info illustration, cause it doesn't take into account magnitude info however component difference. These de-merit Leads to its variants, used one of Local binary pattern variant referred to as (CLBP) that thought of the sign and magntude info of the variations between the middle and therefore the neighboaur grey values

D. Gabor Filter Texture In computer vision field Gabor is very popular for extracting the features. GFT uses the linear filter which is commonly used for texture analysis[20]. The main work of it is to analyze that any particular freq. Contain in the data (input image) in specific direction in a localized part around the region of analysis. Gabor filter is generally outlined

E. Hybrid Features Hybrid options provide space to the analysis some ques. of however great will options be merge for aftmost performance. According to Liu et al.[24] they usedthe feature extraction mixture of local binary pattern and histogram of oriented gradient from (CK+) and (JAFFE) information and its reduce the extracte options spatial property with (PCA) aftear permutation the mixture on many classifeer he find that the mixed options on soft-max classifier created ninty eight.3percentage on (ck+) and nintieth on (JAFFE) information. So for this we can conclude that if we use a perfect(proper) hybrid options that can improve our system performance

CHAPTER -3

Modules Description

Project Prerequisites

Below are the prerequisites for this project:

Python (3.7.4 used)

IDE (Jupyter used)

Required frameworks are

Numpy
cv2 (openCV)
Keras
Tensorflow (Keras uses TensorFlow in backend and for some image preprocessing)
Matplotlib Pandas

Download Dataset

The dataset for this project contains 372450 images of alphabets of 28×28, all present in the form of a CSV file

Kaggle Dataset

FER2013 dataset (facial expression recognition) consists of 48*48 pixel grayscale face images. The images are centered and occupy an equal amount of space. This dataset consist of facial emotions.

1. Importing required library cv2, for face and eye detection in cv2.
2. In this line, we are creating a Haar-cascade object to detect faces in the frame.
3. In this line, we are creating a Haar-cascade object to detect eyes in the frame.
4. Creating a Video-Capture object to access the webcam. Argument 0 is passed when we want to use the inbuilt webcam of PC/Laptop, use 1 if you want to use any external

camera.

5. Let’s set ret=True (just a formality to start the infinite loop).

6. We are using cam.read() to read the current frame from the webcam.

7. This if statement says that if we are getting frames from the webcam without any error, then proceed further, because in that case, ret would be True.

8. Convert the image from BGR to grayscale because Haar Cascades detect faces in grayscale images efficiently.

9. Now we have our face coordinates as (x,y,w,h) where (x,y) are the coordinates of the top-left of the rectangle around the face, w is the width and h is the height of the rectangle.

10. Let’s traverse through the faces and draw rectangles around them.

11. Let’s just extract the face.

12. Detect eyes just in the same way as we did above for faces.

13. Let’s traverse through the eyes and draw rectangles around them.

14 .If someone hits the ESC key, break the code.

Release the cam object to close the webcam and destroy all open windows.

CHAPTER – 4

Use Case , Data Flow Diagram, Architectural Diagram

USECASE DIAGRAM

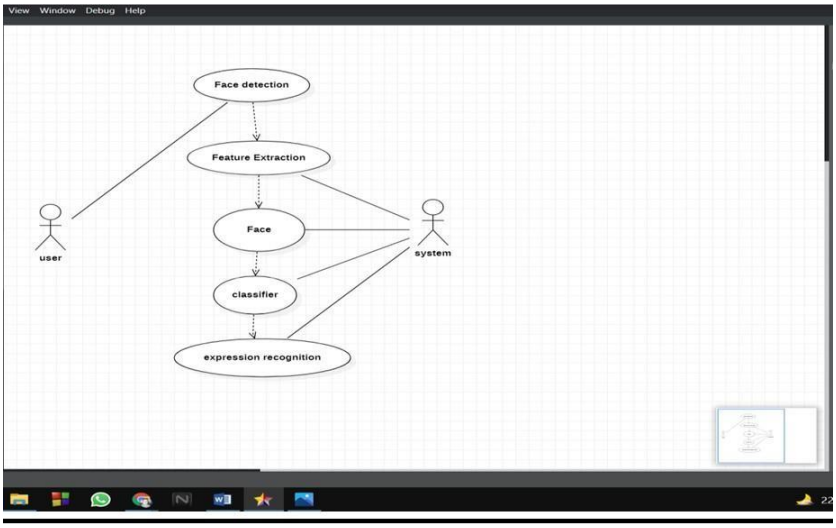
In the Unified Modeling Language (UML), a use case diagram can summarize the details of your system's users (also known as actors) and their interactions with the system. To build one, you'll use a set of specialized symbols and connectors.

Data Flow Diagram

A **data-flow diagram** is a way of representing a flow of data through a process or a system (usually an information system). The DFD also provides information about the outputs and inputs of each entity and the process itself. A data-flow diagram has no control flow — there are no decision rules and no loops. Specific operations based on the data can be represented by a flowchart.

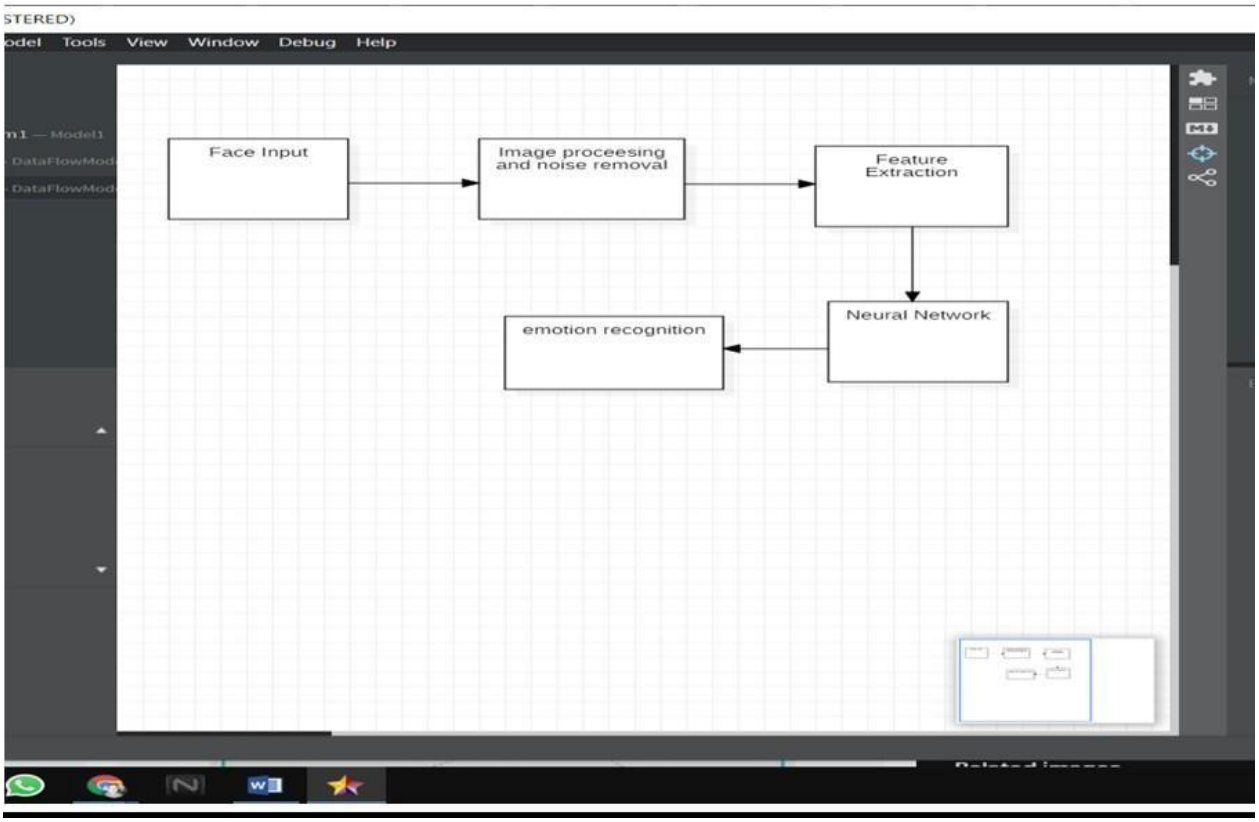
Architectural Diagram

An architectural diagram is a diagram of a system that is used to abstract the overall outline of the software system and the relationships, constraints, and boundaries between components. It is an important tool as it provides an overall view of the physical deployment ofthe software systemand its evolution roadmap.

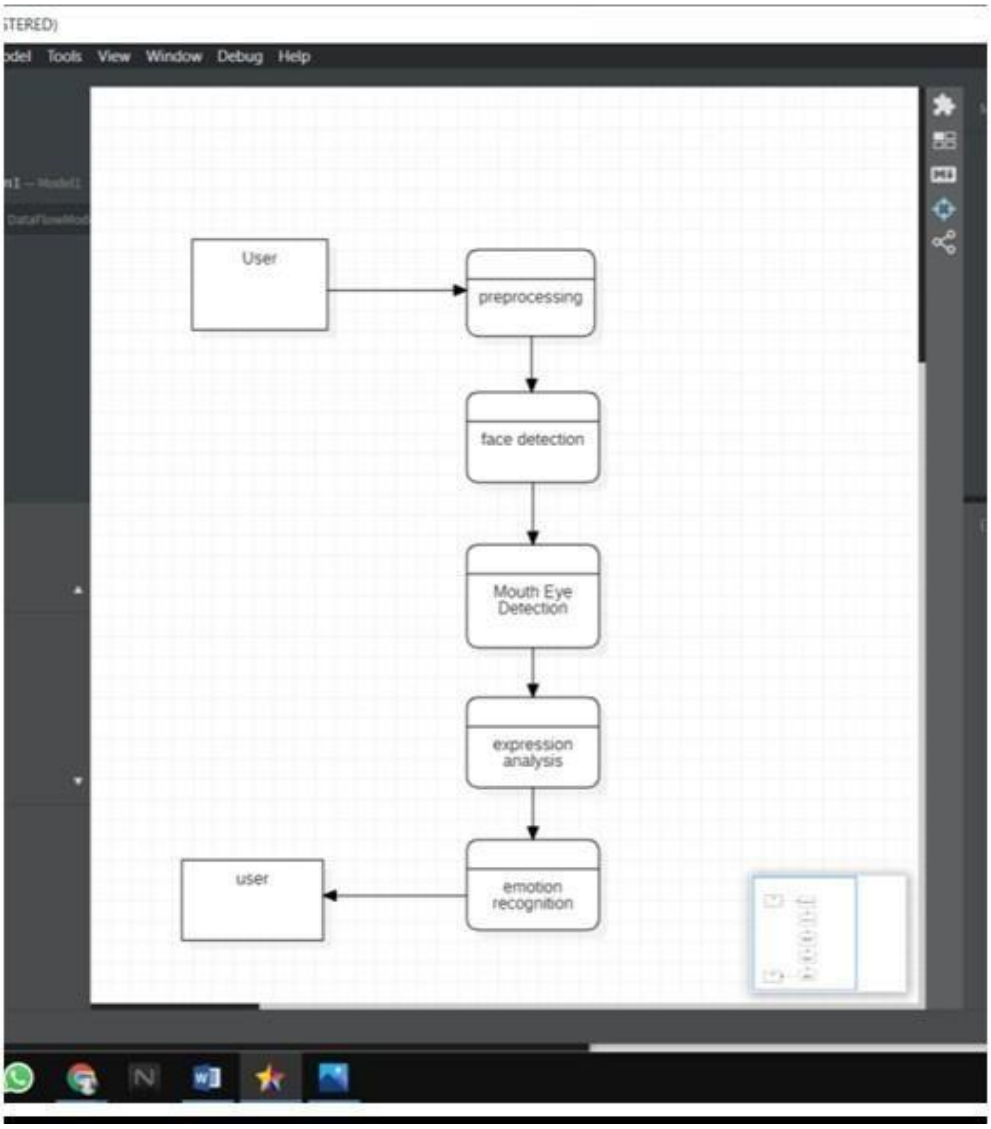


DATA FLOW DIAGRAM

ARCHITECTURAL DIAGRAM



DATA FLOW DIAGRAM



References

[1].Murari Mandal, Shashi Poddar, Amitava Das,"Compari -son of Human and Machine based Facial Expression Classification", IEEE,2015

[2]S L Happy and Aurobinda Routray,"Robust Facial Expression Classification Using Shape and Appearance Features", IEEE, 2015.

[3] Prarinya Siritanawan and Kazunori Kotani,"Facial expression classification by temporal template features",SICE,2014

[4] Sina Mohseni,Niloofar Zarei,Saba Ramazani,"Facial expression recognition using anatomy based facial graph",IEEE,2014.

[5]S.S. Bavkar , J.S. Rangole, V.U. Deshmukh,"Geometric Approach For Human Emotion Recognition using facial expression",IJCA,2015

[6]U. Bakshi, R. Singhal, A Survey of Face Detection Methods and Feature Extraction Techniques of Face Recognition IJETTCS, Volume-3, Issue-3, 2014

[7]O. Rezq, A. Al-Sayed, Geometrical Approach for Face Detection and Recognition

9. [8]. N. Saini, S. Kaur, H. Singh, A Review: Face Detection Methods And Algorithms IJERT, Volume-2, Issue-6, 2013

[9].Annu George, Georgia, Hayden Wimmer, Carl M. Rebman Jr" ARTIFICAL INTELLIGENCE FACIAL EXPRESSION RECOGNITION FOR EMOTION DETECTION: PERFORMANCE AND ACCEPTANCE" Volume 21, Issue 4, pp. 81-91, 2020