GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

EMOTION RECOGNITION SYSTEM

A Report for the Evaluation 3 of Project 2

Submitted by

VIVEK RAWAT

in Partial fulfilment for the award of the degree

Of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

Under the supervision of

Mr. Sreenarayanan NM

Professor

APRIL/MAY-2020

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

Certified that this project report "EMOTION RECOGNITION SYSTEM" is the bonafide work of "VIVEK RAWAT (1614101193) who carried out the project works under my supervision.

SIGNATURE OF HEAD

Dr. MUNISH SHABARWAL,

PhD (Management), PhD (CS)

PROFESSOR & DEAN,

School of Computing Science & Engineering

SIGNATURE OF THE SUPERVISOR

MR. SREENARAYANAN NM

ASSISTANT PROFESSOR

School of Computer Science & Eng.

ACKNOWLEDGEMENT

This is an excellent opportunity to acknowledge and to thanks, all those persons without whose support and help this project would be impossible. we might prefer to add some heartfelt words for those who were a part of this project in numerous ways.

I would prefer to because of my project guide SREE NARAYANAN NM, for his indefatigable guidance, valuable suggestion, moral support, constant encouragement, and contribution of your time for the successful completion of project work. I'm very grateful to him, for providing all the facilities needed during the project development. At the outset, I sincerely thank all faculty members of my institution GALGOTIAS UNIVERSITY for his extra effort to create our session online and inspire all ideas.

I would prefer to thank all those that helped me directly or indirectly. Last but not the smallest amount, I'd prefer to acknowledge the continuing support of my friends, whose patience and encouragement during these long days and nights are paramount in making this project a reality.

THANK YOU.

DECLARATION

I hereby declare that this submission is my very own work which, to the simplest of my knowledge and belief, it contains no material previously published or written by another person nor material which to a considerable extent has been accepted for the award of the other degree or diploma of the university or other institute of upper learning, except where due acknowledgment has been made within the text.

I inform that every data used in this report if it's taken from any site is clearly referenced under the reference section.

SIGNATURE
VIVEK RAWAT
1614101193

ABSTRACT

Feeling recognition is getting loads of consideration from specialists from a decade ago for illuminating the communication among human and machine. We arranged a framework to characterize different sorts of highlights to naturally identify feeling from facial pictures utilizing activity units (AUs). Proposed framework over and over identifies faces from the taken picture and codes them as for seven degrees like Happy, Sad, shock, Fear, appall, Anger and Neutral. This paper centers around automatic deliberation of highlight focuses and feeling identification from the two-dimensional computerized face photograph. A few upgrades and rearrangements are made based on the past research. This methodology is approved on a presented visual database and a characteristic intelligent database to test the heartiness of the proposed calculation. In this paper, we will clarify outward appearance and contrast among articulation and feelings. This paper additionally centers around past research done on outward appearance acknowledgment, changed procedures for outward appearance acknowledgment and feeling identification. This paper likewise clarifies why outward appearance acknowledgment is significant and what can be future works or upgrades for this framework. This paper closes each reality about outward appearance acknowledgment from its definition to how it attempts to its upgrades.

TABLE OF CONTENT

TITLE

CHAPTER 1
INTRODUCTION

Trying to interpret a person's emotional state in a nonverbal form, usually requires decoding his/her facial expression. Many times, body languages and exclusively facial expressions, explains us more than words about ones' state of mind.

For this project I have performed an experiment which serves multiple purposes:

1. Finding out, once and for all, who "reads" facial expressions better- Men or Women, and if so, suggesting an answer for the question- why do those differences exist?
2. Revealing special structures for recognizing classically defined facial expressions and replying the question- which facial cues help us the most in decoding facial expressions?

1.1 WHAT ARE EMOTIONS

Outward appearances are a distinct advantages of passing on nonverbal data among people, however numerous creature species show outward appearances as well. Despite the fact that people has built up a wide range and intensity of verbal dialects, outward appearance jobs in communications stay fundamental, and some of the time even basic.

Articulations and feelings go connected at the hip, for example exceptional blends of face strong activities mirror a specific feeling. For specific feelings, it is exceptionally hard, and perhaps incomprehensible, to maintain a strategic distance from its fitting outward appearance.

Increasingly viable definitions are as given:

- A strong feeling comes from a particular state of situation, moment, mood or relationship.
- The affective aspect of consciousness.
- Emotion is a state of pleasure or displeasure.
- Emotion is a complex state of feeling which affects our physical or psychological behavior.
- Emotion has universal face expression. It has a duration of seconds or minutes till our behavioral state changes.
- Emotions are easily identifiable. It can be triggered anytime if we know weak points.
- Emotion can’t be faked.

1.2 WHAT IS EMOTION RECOGNITION

Correspondence between the living creatures can be of two significant sorts: Verbal, Non-verbal. Non-verbal correspondence is communicated through outward appearances. Non-verbal correspondence can be characterized by the articulation an individual gives, non-verbal communication and the psychological conduct as watched. Correspondence between people depend upon their outward appearance. Utilizing numerical calculations assumes an immense job and can be utilized to depict the understanding of human facial qualities. Ongoing progression in Machine learning, Artificial knowledge, mechanized face investigation, and example acknowledgment have made it conceivable to create programmed face acknowledgment frameworks to address these applications. Feeling is one of the fundamental and incredible methods for people to convey their belief system and feelings The Emotion Recognition System introduced in this exploration work contributes an extreme face acknowledgment calculation dependent on the mapping of conduct attributes with the physiological biometric qualities. The physical qualities of the human face with shared to different demeanors, for example, satisfaction, trouble, dread, outrage, shock and appall are related with geometrical structures which are reestablished as base comparing formats for the acknowledgment framework. The conduct highlights of this framework partner the perspective behind various articulations as ordered base. The arranged bases are confined as uncovered and concealed classes in hereditary algorithmic qualities. The quality preparing set evaluates the expressional uniqueness of individual faces and gives a solid expressional acknowledgment model.

4.3 WHY EMOTIONS ARE IMPORTANT

Human facial expressions are nonverbal aspects of communication and a good way to understand the other people. Facial expression recognition extracts and analyzes audio, video, feed, image etc. to understand the and give outcome data of emotion.

- It is very important for computer-based programs to understand human expression and emotional state to respond to them in that emotion only.
- It is very because of its ability to mimic human emotion and give it a way to understand humans in a better way.
- This approach is helpful for making human friendly robots in the future.
- It helps computer-based programs to set interpersonal relations with other people.
- It makes our life independent of human responses as we can get a good friend in our computer program.
- It is very important in fields of computer vision and artificial intelligence.
- It is also important on human level as well as it increases the understanding level of human to human.
- As considering the human facial expressions the training of expressions has many features, from computer analysis, emotion recognition, lie detectors, big MNCs security, nonverbal communication and even the part of expressions in art.

1.4 HISTORY OF EMOTIONS

Enlightening the skills of reading expressions is an imperative step towards positive relations.

- The marvel of a concise, automatic outward appearance appeared on the essence of people as per feelings experienced is called 'small scale articulation'. Miniaturized scale articulations shows the seven all inclusive feelings: joy, pity, outrage, astounded , disdain, dread and appall. However, Paul Ekman, one of the notable Jewish American analyst who was a trend-setter in the investigation of feelings and his connection to outward appearances, extended the rundown of old style feelings. Ekman has included nine more: beguilement, disgrace, humiliation, energy, pride, blame, alleviation, fulfillment and delight. Small scale articulation keeps going one moment. Regardless, catching it can enlighten one's genuine emotions, whether he needs it or not. That is actually what Paul Ekman did. Harking back to the 80's, Ekman was at that point notable as a master for concentrate in outward appearances, when cutting-edge by a therapist, inquiring as to whether Ekman can distinguish liars. The specialist needed

to distinguish if a patient is lying by threatening to self destruction. Ekman watched a tape of a patient again and again, searching for a piece of information until he found a brief moment of urgency, implying that the patient's danger wasn't vacant. From that point forward, Ekman has discovered those basic part seconds in pretty much every liar's documentation.

- The research of outward appearances and feelings started numerous years prior to Ekman's work. Charles Darwin distributed his book, called "The Expression of the Emotions in Man and Animals" in late 1872. This book was given to nonverbal structures in people and creatures and to the establishment of articulations.

Darwin's two previous books-"The Descent of Man, and Selection in Relation to Sex" and "On the Origin of Species" spoke to the possibility that man didn't appeared in his current condition, however in a continuous procedure Evolution.

This was, obviously, a progressive hypothesis since in the nineteenth century nobody accepted that man and creature "complied with similar principles of nature".

Darwin's work endeavored to discover matches among practices and articulations in creatures and people. The primary thought of "The Expression of the Emotions in Man and Animals" is that the wellspring of nonverbal articulations of man and creatures is utilitarian, and not informative, as we may have suspected.

1.5 EMOTION DETECTION TECHNIQUES

The emotion recognition is basically a way to identify human feelings. The accuracy of emotion recognition improved widely while combining the estimation of facial expression and feature extraction. There are mainly 4 subfields of emotion recognition:

- emotion recognition in audio
- emotion recognition in video
- emotion detection in text
- emotion detection in facial expression

These are subfields by which we can detect human emotions. Emotion detection with facial expression is the field in which we will carry forward our paper. Facial expression is the best way to detect human emotion.

There are three categories in which emotion detection techniques are classified to tell which type of emotion it is:

1.5.1 knowledge-based technique:

This is basically the utilization of domain for semantic and syntactic features of language in order to recognize emotion type. It is basically the process in which we use all our knowledge to gain similarity to determine emotion type.

This is of two types:

1.5.1.1 Dictionary based approach.

1.5.1.2 corpus-based approach.

1.5.2 Statistical Based Technique:

This technique uses some of the machine learning algorithms. Some of the algorithms used for this technique are support vector machine, naive Bayes, maximum entropy, deep learning, artificial neural network, convolutional neural network, long short-term memory, extreme machine learning, computer vision, speech recognition and natural learning processing.

1.5.3 Hybrid Approach:

This is the combination of statistical based technique and knowledge-based technique. It shows computational complexity during the classification process.

CHAPTER 2
LITERATURE SURVEY

In order to contrivance a system that can automatically detect emotion, a series of rational steps have to be developed. The system was divided into 5 main stages/steps. These are as follows :-
first Train dataset, second Face detection, third Detecting features, fourth Extracting features, fifth Comparing the features.

4.3 SEQUENCE OF EVENTS

- Train the dataset having different type of emotions
- Spread over possible point operations on image for better output.
- Face detection algorithm applied to identify facial regions.
- Facial region is cropped.
- HAAR classifier applied on cropped images.
- Real time image is being compared to the trained datasets.
- Separate database of emotion templates is generated.

2.2 FACE DETECTION

The main element assigned appears to accentuation on the property that the area of the eyes is every now and again darker than the district of the nose and cheeks. The subsequent element unquestionably depends on the property that the eyes are darker than the channel of the nose. In any case, similar windows applied to cheeks or some other spot is improper. So how would we select the best highlights out of 160000+ highlights?

For this, we apply every single element on all the preparation pictures. For each element, it finds the best methodology which will order the appearances to positive and negative. Plainly, there will be blunders or mis-groupings. We select the highlights with least mistake rate, which implies they are the highlights that most precisely group the face and nonface pictures. The closing classifier is an inclined whole of these powerless classifiers. It is called weak in light of the fact that only it can't arrange the picture, yet along with others frames a solid 6 classifier. The paper says even 200 highlights furnish recognition with 95 percent precision. Their last arrangement had around 6000 highlights. In a picture, most extreme of the picture is non-face territory. So it is a superior plan to have a humble technique to check if a window isn't a face area. In the event that it isn't, dispose of it in a solitary shot, and don't process it

once more. Rather, center around districts where there can be a face. Along these lines, we invest more energy checking conceivable locale.

2.3 HAAR CLASSIFIER

Article Detection utilizing Haar highlight based course classifiers is a successful item discovery strategy proposed by Paul Viola and Michael Jones. It is an AI based methodology where a course work is prepared from a ton of positive and negative pictures. It is then used to recognize protests in different pictures. Here we will work with face location. At first, the calculation needs a great deal of positive (pictures of appearances) and negative (pictures without faces) to prepare the classifier. At that point we have to remove highlights from it. For this, Haar highlights appeared in the beneath picture are utilized. They are much the same as our convolutional piece. Each component is a solitary worth acquired by taking away aggregate of pixels under the white square shape from whole of pixels under the dark square shape.

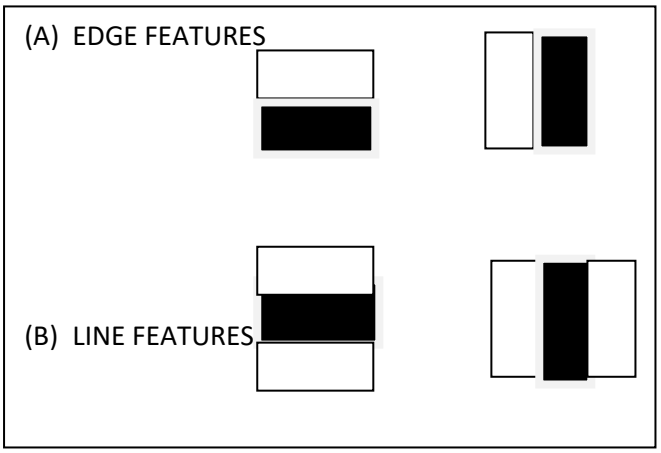

Fig. 1

CHAPTER 3
PROPOSED WORK

Our entire project is divided into the following parts :

1. Visualization of facial landmarks and implementing facial recognition on the frames obtained by the web-cam or on sample images. We have two approaches for it :
    - OpenCV library
    - HAAR classifier
    - Dlib library

2. Emotion Detection to myriad of emotions ranging from happy to sad, disgusted, surprised, fear, angry and neutral. We have used the following technique to obtain a high degree of accuracy:
    - Fisherface
    - dlib

3.1 OPENCV LIBRARY

OpenCV (Open Source Computer Vision Library) is an open source PC vision and AI programming library. OpenCV is written in C++ and its basic interface is in C++, anyway it notwithstanding everything holds a less expansive anyway wide progressively settled C interface. There are ties in Python, Java and MATLAB/OCTAVE. OpenCV was attempted to give a regular structure to PC vision applications and to enliven the usage of machine acknowledgment in the business things. Being a BSD-approved thing, OpenCV makes it straightforward for associations to utilize and modify the code. The library has 4 in excess of 2500 improved figurings, which joins a thorough plan of both commendable and forefront PC vision and AI counts. These figurings can be used to recognize and see faces, perceive objects, request human exercises in accounts, track camera advancements, track moving things, remove 3D models of articles, produce 3D point fogs from sound framework cameras, consolidate pictures to convey a significant standards image of an entire scene, discover near pictures from an image database, oust red eyes from pictures taken using streak, follow eye improvements, see scene and set up markers to overlay it with extended reality, etc. The library is used broadly in associations, look at gatherings and by

governmental bodies. OpenCV was designed for computational efficiency with a strong focus on real-time applications.The library can take advantage of multi-core processing. Enabled with OpenCL, it can take advantage of the hardware acceleration of the underlying heterogeneous computing platform. To be able to recognize emotions on images we will use OpenCV. OpenCV has a few face recognizer classes that we can also use for emotion recognition. They use different techniques, of which we will mostly use the Fisher Face one.

3.2 HAAR CLASSIFIER

OpenCV accompanies a mentor just as identifier. In the event that you need to prepare your own classifier for any article like vehicle, planes and so forth you can utilize OpenCV to make one. Its full subtleties are given here: Cascade Classifier Training.

Here we will manage identification. OpenCV as of now contains numerous pre-prepared classifiers for face, eyes, grin and so forth. How about we make face and eye locator with OpenCV.

First we have to stack the required XML classifiers. At that point load our info picture (or video) in grayscale mode.

```
Import numpy as np
import cv2

face_cascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')
eye_cascade = cv2.CascadeClassifier('haarcascade_eye.xml')

img = cv2.imread('sachin.jpg')
gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
```

Now we discover the faces in the image. If faces are initiated, it returns the positions of detected faces as Rect(x,y,w,h). Once we get these positions, we can create a ROI for the face and spread on eye detection on this ROI (since eyes are always on the face !!!).

```
Faces = face_cascade.detectMultiScale(gray, 1.3, 5)
for (x,y,w,h) in faces:
   img = cv2.rectangle(img,(x,y),(x+w,y+h),(255,0,0),2)
   roi_gray = gray[y:y+h, x:x+w]
   roi_color = img[y:y+h, x:x+w]
```

```
    eyes = eye_cascade.detectMultiScale(roi_gray)
    for (ex,ey,ew,eh) in eyes:
        cv2.rectangle(roi_color,(ex,ey),(ex+ew,ey+eh),(0,255,0),2)

cv2.imshow('img',img)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

From the above model we get the result as.

Fig. 2

3.3 DLIB LIBRARY

Dlib is a cuttingedge C++ toolbox containing AI calculations and apparatuses for making complex programming in C++ to take care of certifiable issues. Its structure is vigorously affected by thoughts from configuration by agreement and part based programming building. In this way it is, above all else, a lot of autonomous programming segments. It is open-source programming discharged under a Boost Software License. Dlib contains programming segments for managing organizing, strings, graphical UIs, information structures, straight variable based math, AI, picture preparing, information mining, XML and content parsing, numerical streamlining, Bayesian systems, and numerous different assignments. The facial milestone locator actualized inside dlib produces 68 (x, y)- organizes that guide to explicit facial structures. In less difficult manner the dlib library is commonly liable for the giving adjoining focuses on the key highlights of a picture continuously.

Fig. 3

While observing the image, we can conclude that facial regions can be accessed via simple Python indexing.

• The mouth can be accessed through points [58, 68].

• The right eyebrow through points [27, 25].

• The left eyebrow through points [25, 27].

• The right eye using [36, 42].

• The left eye with [43, 49].

• The nose using [28, 35].

• And the jaw via [0, 17].

These mappings are encoded inside the FACIAL LANDMARKS IDXS dictionary inside face utils of the imutils library.Using this dictionary we can easily extract the indexes into the facial landmarks array and extract numerous facial structures simply by providing a string as a key.

FACIAL LANDMARKS IDXS = OrderedDict([(“mouth”, (58, 68)), (“right eyebrow”, 8 (27, 25)), (“left eyebrow”, (25, 27)), (“right eye”, (36, 42)), (“left eye”, (43, 49)), (“nose”, (28, 35)), (“jaw”, (0, 17))])

3.4 FISHERFACE RECOGNISER

A key reprobate in PC vision, design acknowledgment and AI is to portray an adept information outline for the job needing to be done. One approach to speak to the information is by finding a subspace which speaks to the greater part of the information difference. This can be gotten with the utilization of Principal Components Analysis (PCA). At the point when applied to confront pictures, PCA produces a lot of eigenfaces. These eigenfaces are the eigenvectors identified with the significant eigenvalues of the covariance network of the preparation information. The eigenvectors therefore discovered compare to the least-squares (LS) arrangement. This is in fact an incredible manner to speak to the information since it guarantees the information change is kept up while dispensing with pointless existing connections among the first highlights (measurements) in the example vectors. At the point when the objective is game plan as opposed to delineation, the LS arrangement may not deliver the most required outcomes. In such cases, one wishes to discover a subspace that maps the example vectors of a similar class in a solitary spot of the element portrayal and those of different classes as far isolated from each other as could be normal in light of the current situation. The techniques resolved to achieve this goal are known as Discriminant examination (DA). The most acknowledged DA is Linear Discriminant Analysis (LDA), which can be gotten from an idea proposed by R.A. Fisher in 1936. When LDA is used to find the subspace depiction of a great deal of face pictures, the resulting premise vectors describing that space are known as Fisherfaces. Fisherface estimation ponders the extent between the assortment of one individual and that of another person. At the end of the day, it enhances the determinant of between-class scatter cross section simultaneously, constraining the determinant of inside class disperse organize. Fisherface procedure is as the going with. May there be full scale N pictures and outright c individuals. Expect the amount of pictures from one individual is K. From PCA we can get N1 eigenfaces. To constrain the determinant of inside class scatter system and enlarge that of between-class disperse network, we contain the Sw - 1 sb structure and get Fisherfaces. The

importance of Sw and sb is as following:

$$S_w = \sum_{i=1}^{c} \sum_{j=1}^{K} (y_j - M_i)(y_j - M_i)^T$$

$$S_b = \sum_{i=1}^{c} (M_i - M)(M_i - M)^T$$

Fig. 4

where Mi is the mean vector of ith class and M is the mean vector of all classes. The cl dimensional feature vectors are obtained by projecting feature vectors of PCA onto the Fisherface matrix. And then, we recognize face by using predetermined feature vectors.

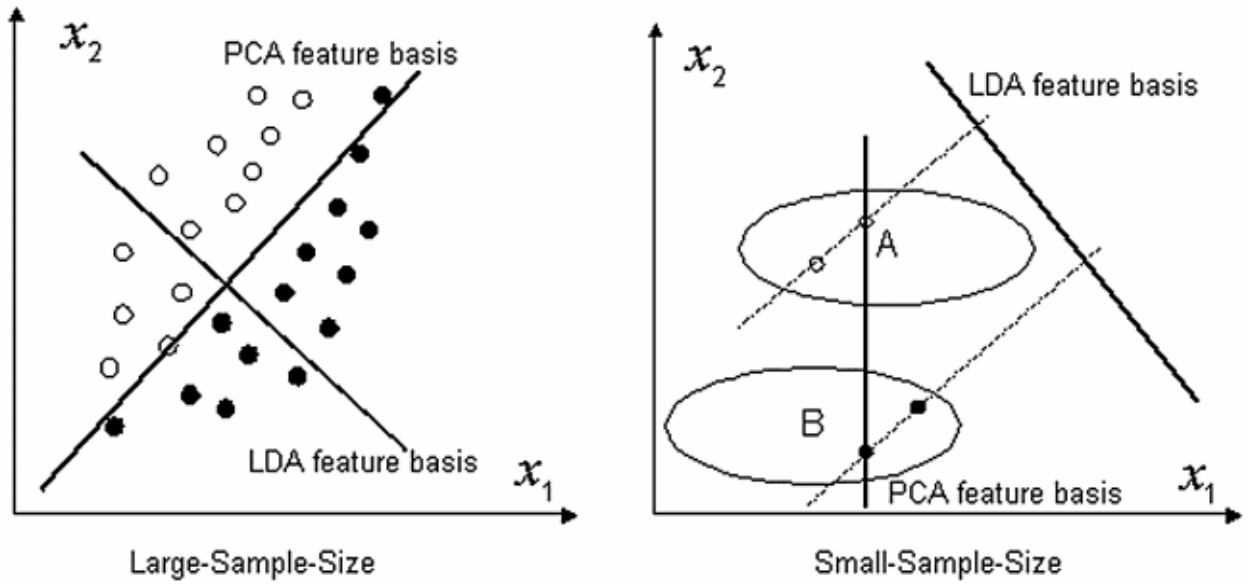

Fig. 5

These are the two graphs showing the comparison between the displacements proceeding in PCA and LDA respectively & how the dimension are being minimised in the meanwhile process.

CHAPTER 4

METHODOLOGY

4.1 FISHERFACE ALGORITHM

Fisherface is one of the notable computations used in face affirmation, and is commonly acknowledged to be superior to various methodology, for instance, eigenface considering the push to enhance the segment between classes in the arrangement technique. The explanation behind this assessment is to set up a program of face affirmation application using fisherface method by utilizing GUI applications and databases that are used as a Papuan facial picture. Picture affirmation using fisherface methodology relies upon the lessening of face space estimation using Principal Component Analysis (PCA) procedure, by then apply Fisher's Linear Discriminant (FDL) system or in any case called Linear Discriminant Analysis (LDA) strategy to get feature of picture trademark. The calculation utilized in the process for picture acknowledgment is fisherfaces calculation while for recognizable proof or coordinating face picture utilizing least uclidean. Following are the means that will make it simpler for you to comprehend fisherface calculation:

4.1.1 Data Retrieval Process : This procedure expects to gather information in the images.Collection of tests is finished with photo straightforwardly the face picture. The situation of the face is looking toward the front and upstanding position and not obstructed by different items.

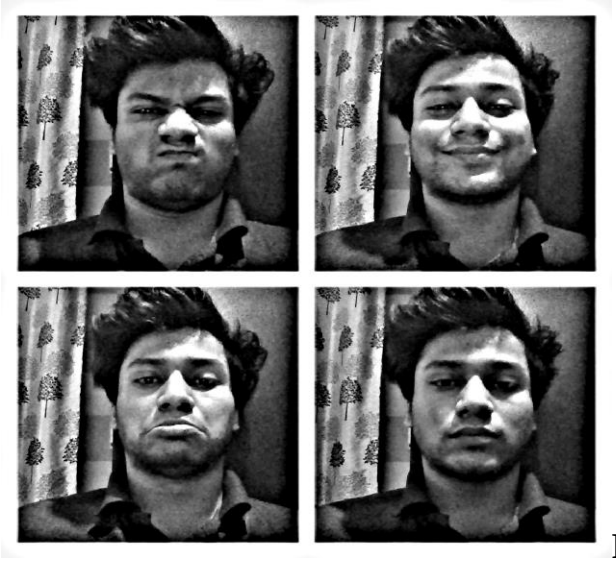

Fig. 6

4.1.2 The Design System : Face acknowledgment framework utilizing fisherface technique is intended to perceive the face picture by coordinating the consequences of its element extraction. The framework is required to decide if the picture to be tried is perceived effectively or not.

4.1.3 Image Processing : At this stage the fisherface technique will be applied to produce highlight vector of the facial picture information utilized by the framework and afterward to coordinate the vector highlights of the prepared information picture utilizing the Euclidean separation equation.

4.1.4 Feature Generation Process : In this fisherface method is used as a merger between PCA and LDA methods which generates the featuring points ad that compares it to the trained images in the model.

4.2 PCA ALGORITHM

The principle thought of head segment examination (PCA) is to decrease the dimensionality of an informational collection comprising of various factors related with one another, either vigorously or gently, while remembering the variety present in the dataset, up to the greatest degree. The proportionate is finished by adjusting the factors to another arrangement of factors, which are known as the essential segments (or basically, the PCs) and are symmetrical, efficient to such an extent that the conservation of variety present in the special factors diminishes as we descend in the request. Along these lines, thusly, the first head segment holds greatest inconsistency that was available in the first segments. The key parts are the eigenvectors of a covariance grid, and subsequently they are symmetrical. To

make it all the more clear after are some steps involving the entire procedure.

- Convert the training image 1 , 2 , . .. m with the size n x n into the vector form with length size n^2.

{a1,a2,a3,a4} **{b1,b2,b3,b4}** **{c1,c2,c3,c4}** **{d1,d2,d3,d4}**

- Now, calculate the average of all faces.

$$\vec{m} = \frac{1}{M}\begin{pmatrix} a_1 + b_1 + \cdots + h_1 \\ a_2 + b_2 + \cdots + h_2 \\ \vdots \quad \vdots \quad \vdots \\ a_{N^2} + b_{N^2} + \cdots + h_{N^2} \end{pmatrix}, \quad where\ M = 8$$

Fig. 7

Also written as….

m = (a + b + c + d ……n) / M

- Calculate matrix A with formula

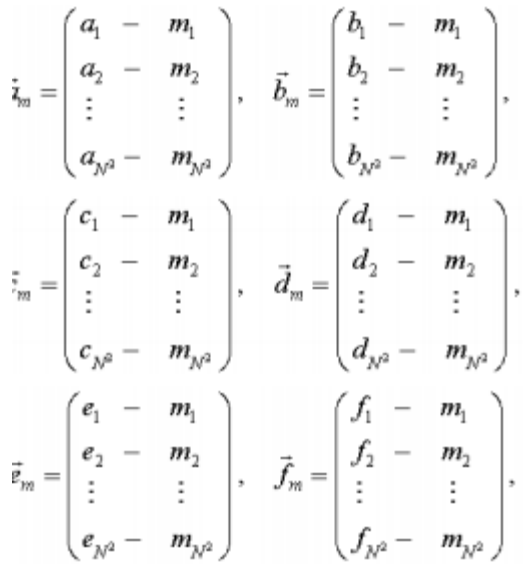

Fig. 8

Or also written as….
[A] = [a-m, b-m, c-m, ……]

- Compute vector eigen (eigVecs) and value eigen (eigenVals) by using the method svd of the matrix A. Sort eigvecs then decrease with the PCA method, pe. Pe is eigenfaces.

4.3 LDA ALGORITHM

With regards to taking care of issues of example grouping, LDA-based calculations outflank PCA-based ones, since the previous streamlines the low-dimensional portrayal of the articles with center around the most discriminant include extraction while the last accomplishes basically object reproduction. In any case, the order execution of customary LDA is regularly corrupted by the way that their distinguishableness rules are not legitimately identified with their grouping exactness in the yield space.

- We going to calculate the average of the each person/class.

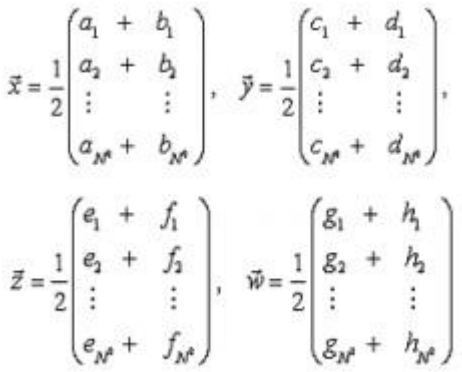

Fig. 9

- The scatter matrix S_1,S_2,S_3,S_4 will then be given by
  $S_1 = (a_m a_m^T + b_m b_m^T)$
  $S_2 = (c_m c_m^T + d_m d_m^T)$
  $S_3 = (e_m e_m^T + f_m f_{Mt})$
  $S_4 = (g_m g_m^T + h_m h_m^T)$
  and matrix in class scatter (Scatw = $S_1 + S_2 + S_3 + S_4$)

- The idea of matrix between class scatter, *(ScatB)*

  $(ScatB = 2(x - m)(x - m)^T + 2(y - m)(y - m)^T + 2(z - m)(z - m)^T + 2(w - m)(w - m)^T)$

- Analyze the multiplication of matrices transpose of pe ***, (PeT),*** with ***ScatW*** and ***ScatB*** until obtain :

  Sww = PeT*ScatW*Pe

  Sbb = PeT*ScatB*Pe

  - Then we calculate the eigenvector (VeSbb) and generalized eigenvalues **(*NeSww*)** of **(*Sbb, Sww*)** and then sort it in ascending order.

  - Evaluate back VeSbb with Pe eigenfaces then formed

(Pe * VeSbb) → *Output as* ***Fisherfase.***

- Normalization Fisherface ***Pe*VeSbb*N***
- Find the transpose of the standardized Fisherfaces, ***Pe*VeSbb*Nt***
- Calculate Weights for each training image into a normalized fisherface, U = Pe * VeSbb * Nt * A.

The aftereffect of the above procedure is the mass of each preparation picture as eigen vector which will be utilized to dicover comparability with face picture which will be known by utilizing Euclidean separation equation.

CHAPTER 5

RESULT AND ANALYSIS

5.1 TRAINING DATASET

The extreme mutual setup for machine learning data is CSV files. There are various number of ways to load a CSV file in Python. The Python API offers the module *CSV* and the function **reader()** that can be castoff to load CSV files.

```
This converts the CSV data to a NumPy array
i mport cv2, sys, numpy, os, time
count = 0
size = 4
fn_haar = 'haarcascade_frontalface_default.xml'
fn_dir = 'database'
fn_name = sys.argv[ 1 ]  # name of the file
path = os.path.join ( fn_dir, fn_name )
if not os.path.isdir ( path ):
    os.mkdir ( path )
(im_width, im_height) =(224,224)
    #(112, 92)
haar_cascade = cv2.CascadeClassifier ( fn_haar )
#for laptop camera the value is 0
webcam = cv2.VideoCapture (0)
print ( "----------------------Taking pictures----------------------" )
```

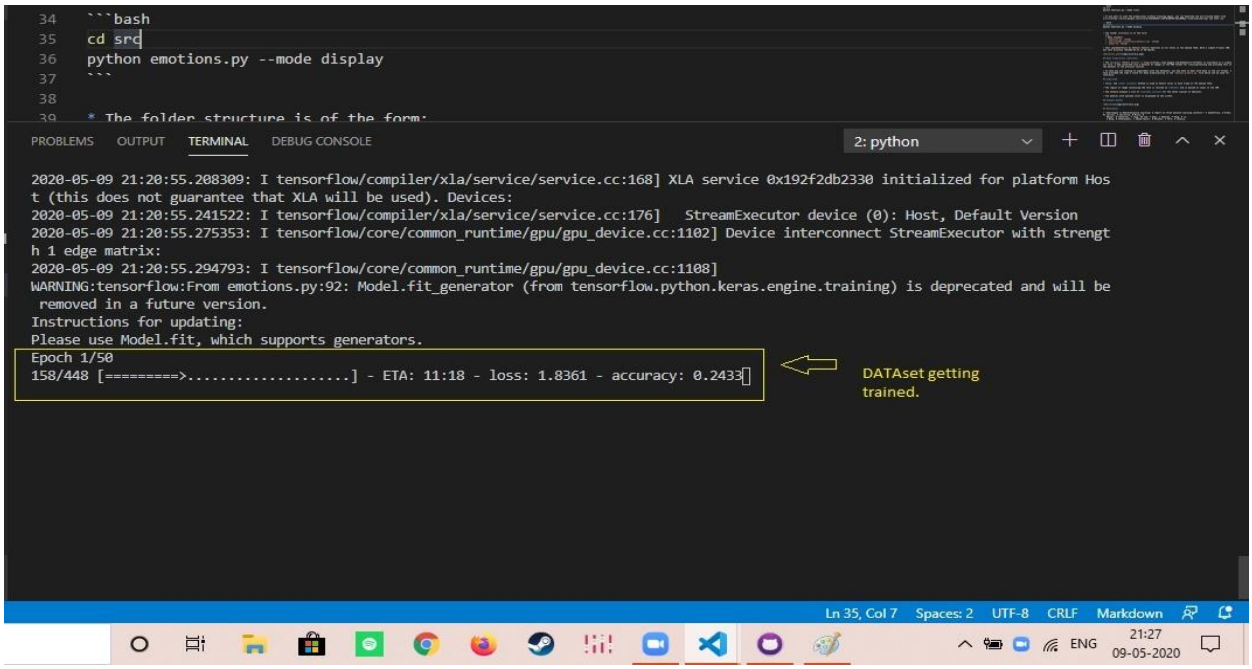

Fig. 10

The above **fig.10** demonstrate the data being trained with epoch 50 where each set contains about 448 raw data with each time there will be an increase in accuracy and decrease in loss.

5.2 FACE DETECTION

Face discovery utilizing Haar falls is an AI based methodology where a course work is prepared with a lot of information. OpenCV as of now contains numerous pre-prepared classifiers for face, eyes, grins, and so forth.

Here is the code of the face detection.

```
# Load the cascade
face_cascade =
cv2.CascadeClassifier('haarcascade_frontalface_default.xml')
# Read the input image
img = cv2.imread('test.jpg')
# Convert into grayscale
gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
# Detect faces
faces = face_cascade.detectMultiScale(gray, 1.1, 4)
# Draw rectangle around the faces
```

```
for (x, y, w, h) in faces:
cv2.rectangle(img, (x, y), (x+w, y+h), (255, 0, 0), 2)
# Display the output
cv2.imshow('img', img)
cv2.waitKey()
```

Here are the couple of things that we have to take in control :

• detectMultiScale(image, scaleFactor, minNeighbors): This is a general ability to distinguish objects, for this circumstance, it will perceive faces since we acquired the face course. If it finds a face, it reestablishes a summary of spots of said face in the structure Rect(x,y,w,h)., if not, by then brings None back.

• Image: The primary data is the grayscale picture. So guarantee the image is in grayscale.

• scaleFactor: This limit compensates a false perception in size that happens when one face emits an impression of being more prominent than the other fundamentally considering the way that it is closer to the camera.

• minNeighbors:This is a recognizable proof computation that uses a moving window to recognize objects, it does as such by portraying what number of things are discovered near the current one going before it can announce the face found.

From the above functionalities we got the result as follow :

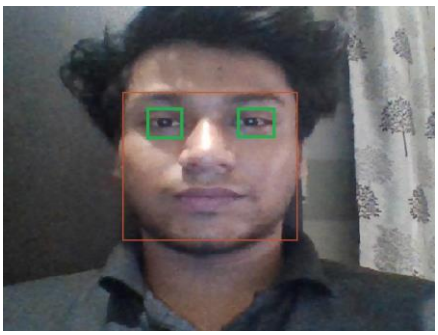

Fig.11 face detection using haar classifier

5.3 EMOTION DETECTION

For emotion detection in open cv we already have the following command which is used to detect the emotion from the classifiers itself without losing the variance in its accuracy.

Import cv2

Import glob

Import numpy as np

Emotions = [“neutral”, “sad”, “angry”, “happy”, “surprise”,]

Fisherface = cv2.face.FisherfaceRecognizer_create() #which initialises the fisher face classifier.

Here, there are 5 emotion that are being read by the machine using model that we have loaded previously. By running the code in the terminal we get the following accuracy test.

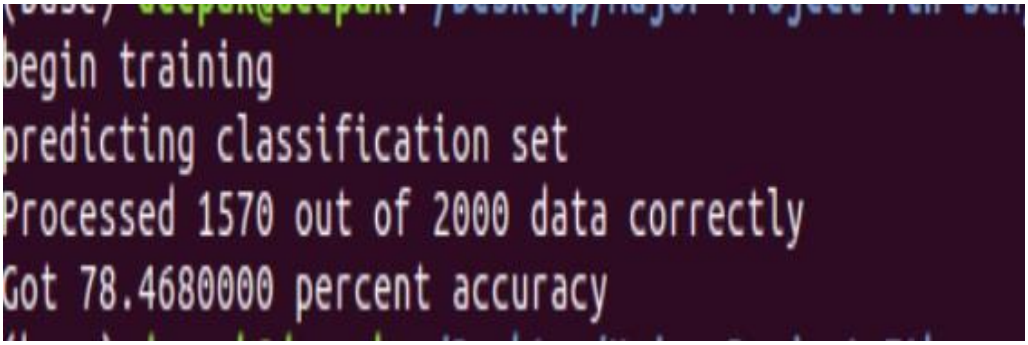

Fig.12

Accuracy score on training FisherFace Recognizer for emotion detection using 1000 images.

And following are the results showing emotions

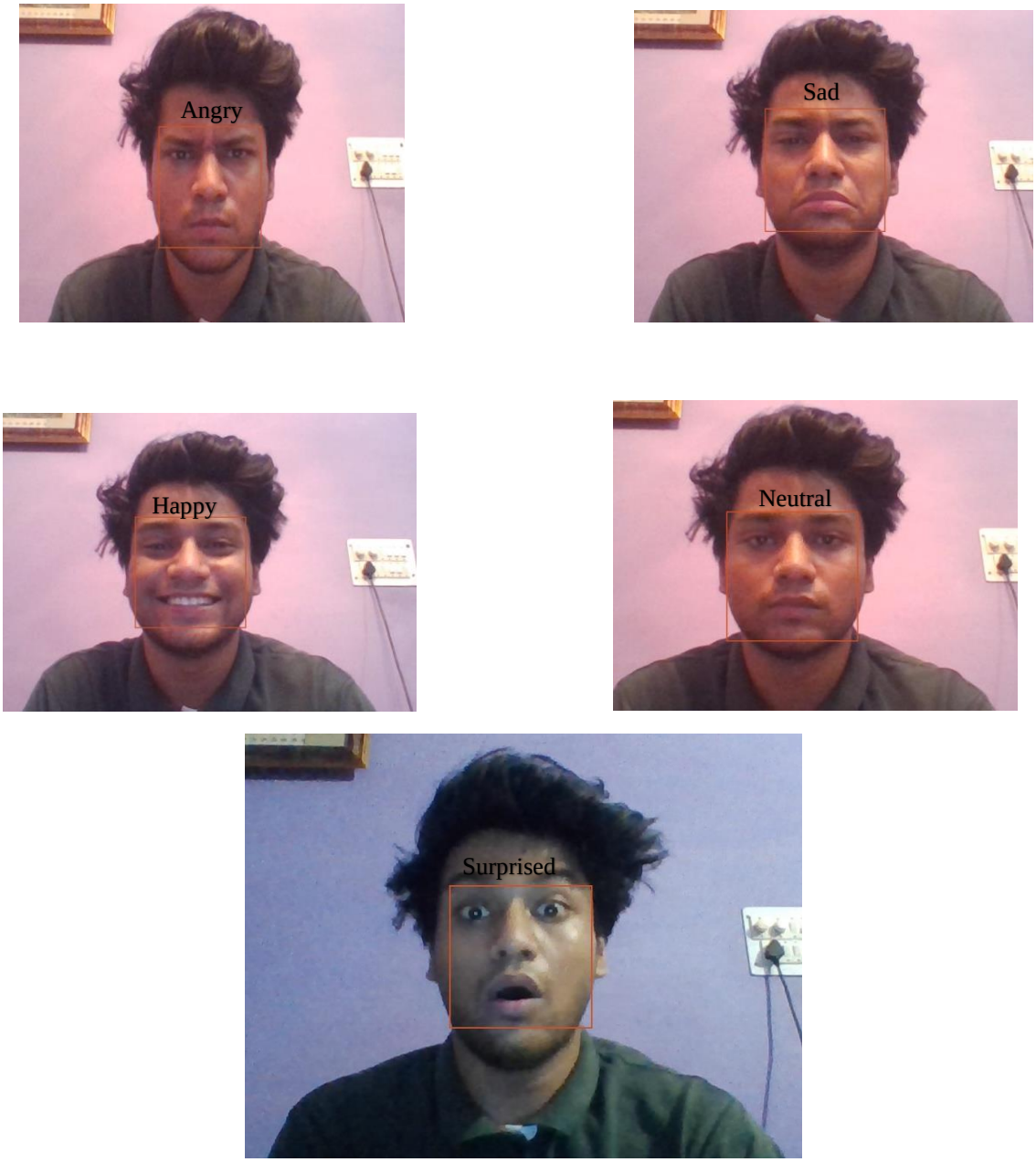

Fig.17

Above figure shows the respective emotions resulting from the real time data.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

The physiological presences of the human face with significance to various looks, for instance, ecstasy, inconvenience, fear, shock, stun and upset are connected with geometrical structures which restored as base organizing format for the affirmation system. With the fast increment of the PC impact and size of information, it has become increasingly more attainable to separate feelings, recognize individuals and check trustworthiness dependent on sound, video or picture, taking an enormous advancement towards human PC interface, yet additionally in psychosis discovery also.

6.2 FUTURE SCOPE

Facial affirmation is getting more distending in our overall population. Over the span of ongoing years, we have seen huge progressions to facial affirmation advancement. We have common ground level work for sexual direction similarly as feeling revelation. I wish to incorporate "name", "sex" and conceivably the paces of various emotions revealed in an identical person. For eg. an individual crying because of euphoria or an individual chipping tears while being perky. This endeavor can be facilitated with it and the person with visual impedance can utilize it to appreciate the sentiments and sex of the individual they are tending to. In like manner, our undertaking can be rehearsed in various habits for aides of customers using it.

6.3 REFERENCES

[1] Li Cuimei,Qi Zhiliang,Jia Nan,Wu Jianhua , "Human face discovery calculation by means of Haar course classifier joined with three extra classifiers" 2017 thirteenth IEEE International Conference on Electronic Measurement Instruments (ICEMI).

[2] Chung-Hua Chu and Yu-Kai Feng,Member of IEEE, "Investigation of Eye Blinking to Improve Face Recognition for Screen Unlock on Mobile Devices ," J Electr Eng Technol.2017.

[3]Face Recognition Using Fisherface Method To refer to this article: Mustamin Anggo and La Arapu 2018 J. Phys.: Conf. Ser. 1028 012119.

[4] Al Fatta, Hanif 2009 Rekayasa Sistem Pengenalan Wajah : Membangun Sistem Presensi Karyawan Menggunakan Microsoft Visual Basic 6.0 dan Micrososft Access, Yogyakarta: Penerbit Andi.

[5] Turk M and Pentland A 1991. Eigenfaces for acknowledgment Journal of intellectual neuroscience, 3(1), 71-86.

[6] Supiyanto 2009 Implementasi Metode Eigenface pada Pengenalan Wajah untuk berbagai Variasi Ekspresi dan Posisi

[7] Sanjay Kr Singh, A Tripathi, A Mahajan, S Prabhakaran 2012 Analysis of Face Recognition in MATLAB International Journal of Scientific and Engineering Research, 3(2).