www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 3 Issue 7 July, 2014 Page No. 6825-6834

Face Recognition and Emotion Classification

Ruby Kamboj [1] Sarita Choudhary [2]
[2]Assistant Professor
[1, 2]Computer Science Department
[1,2] Doon Valley Institute of Engineering and Technology Karnal, India

Abstract-Face recognition from image or video is a popular topic in biometrics research. 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 recognition 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. In this field, accuracy and speed of identification is a main issue. The goal of this project is to evaluate various face detection and recognition methods, provide complete solution for image based face detection and recognition with higher accuracy, better response rate as an initial step for video surveillance. Solution is proposed based on performance tests on various face rich databases in terms of different emotions.

Keywords-Biometrics,Eigen Face,Training Set,Testing Set,Covariance Matrix,Principal Component Analysis

1.INTRODUCTION

Biometrics consist of technologies that support automatic identification or verification of identity based on behavioral or physical properties". Biometrics validates originality by calculating unique individual characteristics. The most primary areas of biometrics involve fingerprints, eyes and facial characteristics, hand geometry, retina, voice and touch. They have been consigned to infrequent use in films and in some high - security government or military equipments. Nowadays, Biometrics is increasing it's applications in many outlooks of public and private life. For example, In the computer industry the most conventional personal identification numbers (PIN) and passwords are being replaced by Biometrics. Although these are still the most common verification and identification methods. But they trouble with forgery, theft which raise a very real threat to high security environments which are now turning to biometric technologies to alleviate this potentially dangerous threat. Biometrics is gaining popularity in the protection of restricted areas, both business and household[7].

The history of face recognition dates back to the 1960's when a semi - automated method was used to compare facial properties. First the key properties in the snapshot were marked by hand; key properties included eyes, ears, nose and mouth. Then the distances and ratios between these marks and a common reference point were computed and these values were then compared to reference data of other faces[3]. In the early 1970's Goldstein, Harmon and Lesk created a face recognition system using 21 particular markers e.g. color of hair and thickness of lips etc. This method was less computerized than the previous method because many of the computations had to be made entirely by hand.

The next step in face recognition was made by Fisher and Elshlagerb in the early 1970's. They measured the key properties in a face using templates of the properties of the different parts of the face. Then all the pieces were plotted on to a general template. Even though this method was more computerized than the previous it proved to be too inconclusive as the properties used did not include enough distinctive data to represent a face.

Fingerprints, DNA analysis, geometry of hand, iris screening and to some extent personal signatures are all biometric identifiers. But the one that does not interfere or delay with access is face recognition. Humans identify others by their face and voice and therefore are likely to be more comfortable with a system that uses face and voice recognition[9]. .

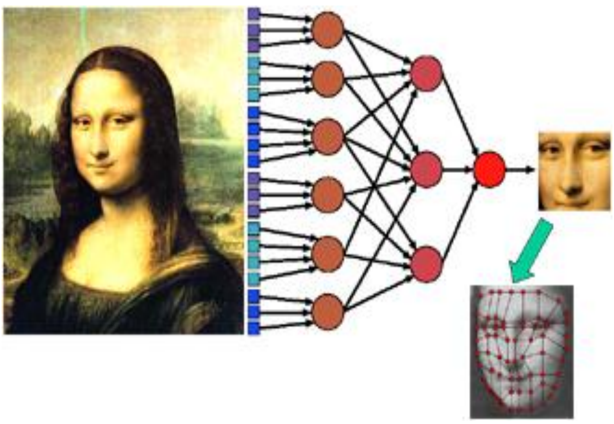

Fig 1 - Example of face recognition[2]

This makes face recognition ultimate for high traffic areas which are open to the general public for e.g. railway stations, airports, ATM's, transportation and all kinds of businesses. Face recognition gives a evidence of who was there. Since the evidence record is stored in a database hence strangers can be detected automatically and known persons can be checked quickly.

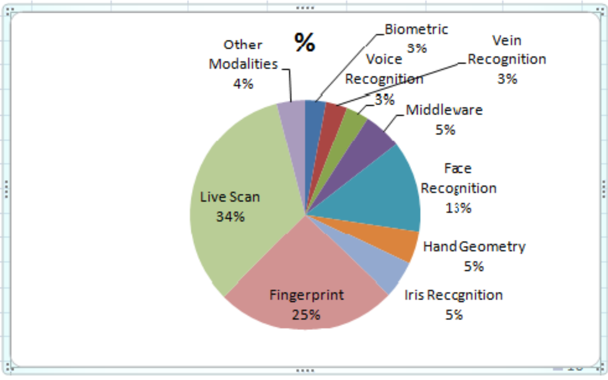

Fig 2 - Biometric Market Technology

However, to compete effectively with alternative biometric technologies, prices of face biometric solutions are to be reduced. A major competitor that matches the face biometric system in terms of accuracy and performance is the non - automated fingerprint identification systems (non - AFIS). A reluctance to lower prices may hamper the adoption of face recognition biometrics[11].

The purpose of this project is to create a observation based biometric authentication system for PCs. Nowadays, to determine access rights most PCs use a password based authentication system. The reason for creating a vision based authentication system is because the password based system -

- Less secure – Anybody may enter anybody else’s password
- Remembering passwords – This may become a problem when a user is accessing a number of different systems
- Tedious – A user has to enter his/her passwords every time the workstation needs to be locked

Because of the improvements done in image processing techniques, particularly in the areas of face detection and face recognition, coupled with the low cost of digital imaging hardware, make a vision based authentication system quite practical[11].

Application of Biometric Systems -

- **Forensics -** The use of biometric in the law enforcement and forensic is more known and from long time, it is used mainly for criminals identification. In particular, the AFIS (automatic fingerprint identification system) has been used for this purpose. Lately the facial - scan technology (mug shots) is being also used for identification of suspects. Another application is the verification of persons of home arrest and an attractive solution for this problem is voice - scan. The typical application are -
  - **Identification of criminals -** collecting the evidence in the scene of crime (e.g., fingerprints) it is possible to compare with data of suspects or make a search in the database of criminals.
  - **Surveillance** - one can monitor the very busy places using cameras such as stadiums, meetings ,airports,etc. Looking in the crowd for suspect based on the face recognition biometric using images (e.g., mug shots) database of wanted persons or criminals.The interest has increased dramatically in biometric surveillance, especially for air travel applications. Currently many cameras are used for monitoring crowds at airports for detecting terrorists.
  - **Corrections -** This refers to the treatment of offenders (criminals) through a system of penal imprisonment,improvement , probation, and trial or the administrative system by which these are accompalished. Is this case a biometric system can avoid the possibility of releasing the wrong prisoner accidentally or to ensure that people leaving the facilities are really visitors and not inmates.
  - **Probation and home arrest -** biometric can also be used for post - release programs (conditional released) to ensure the fulfilment of the probation, parole and home detention terms.
- **Government -** There are many applications of the biometry in the government sector. An AFIS is the central system used for locating duplicates enrolls in benefits systems, electronic voting for elections local or national both, driver's license discharge, etc. The typical application are -
  - **National Identification Cards -** the idea is to include digital biometric information in the national identification card. This is the most desirous biometric program, since the identification has to be performed in a large - scale database, containing hundred of millions samples which correspond to the whole population of a country. This kind of cards are multipurpose as can be used for avoiding duplicates of voter registration, controlling the collection of benefits and drivers license emission etc. All this applications are primarily based on finger - scan and AFIS technology, however it is possible that iris - scan and facial - scan technology could be used in the future.
  - **Voter ID and Elections -** while the biometric national ID card is still in project, biometry is used by many countries for the control of voting and voter registration for the national or regional elections. During the voter registration,the biometric data is captured and stored in the card. Data is also stored in the database for the later use during the voting. The purpose is to check the duplicate registration and voting.
  - **Driver's licenses -** The driver license is also used as identification document in many countries, therefore it is important to prevent the duplicate discharge of the driver license. With the use of biometry this problem can be eliminated. However it is important that the data must be shared among state, because, the license are controlled at the states as opposed to the federal level in some country such as United States.
  - **Benefits Distribution (social service) -** Biometry prevents fraud and abuse of the government benefits programs. It ensures that the legitimate recipients have access to the benefits quickly and convenientiy such as unemployment and, social security.
  - **Military programs -** the military has long been interested in biometrics and the technology has

enjoyed extensive support from the national security community.

- **Commercial -** Banking and financial services represent a large growth areas for biometric technology, with many deployments currently operating and pilot project is announced frequently.Some applications in this sector are -
  - **Account access -** The use of biometric in accessing to the bank account allows to keep auditable and definitive records of account access by customers and employees. Using biometry the customers can access their accounts and employees can log into their workstations.
  - **ATMs –** Biometric allows more security in the ATM transaction.
  - **Expanded Service Kiosks -** Special purpose kiosks offers a more receptive market for biometrics by using biometric verification to allow a greater variety of financial transaction than are currently available though standard ATMs.
  - **Online banking –** Net Banking is already widely used in many places, the inclusion of biometric will make this type of transactions from home more secure. Currently, there are many pilot programs using biometric in home banking.
  - **Telephony transaction -** Voice - scan biometric can be used to make the telephonic transactions more secure. In this type of application, when the costumer places a call for a transaction, a biometric system will authenticate the identity of the customer based on his or her voice.There is no need of any additional device.
  - **PC/Network access -** The Biometric log - in to local PCs or remotely through network keeps valuable information more protected by increasing the security ofoverall system.
  - **Physical access -** The Biometric is widely used for controlling the access to building or restricted areas.
  - **E - commerce -** biometric e - commerce is the use of biometrics to verify of identity of the individual conduction remote transaction for goods or services
  - **Time and attendance monitoring -** The biometrics is used for controlling the presence of the individuals in a determine area. For example,the presence of students at the classroom or for controlling the time sheet of the employees.
  - **Health Care** - The applications in this sector includes the use of biometrics to verify the identity of individuals that are interacting with a health - care entity or acting as a professional or a health - care employee. The main aim of biometrics is to protect the patient information, to prevent fraud and control the selling of pharmaceutical products. Some typical application are -
  - **PC/Network Access -** the biometrics are used to provide a secure access of the employees to the hospital network, primarily, in order to protect the patient information.
  - **Access to personal information -** Using biometrics, the medical patient information may be stored on smart card or secure networks. It will enable the patients to access their personal information.
  - **Patient identification -** In case of emergency, when a patient does not have identification document and is not able to communicate, biometric identification could be a good alternative.
- **Travel and Immigration -** The application in this sector includes the use of biometrics to verify the identity of individual interacting during the course of travel with a travel or immigration entity. Typical application are -
  - **Air travel -** Many airports are already using a biometric system in order to reduce the inspection processing time for authorized travelers.
  - **Border crossing -** The use of biometrics to control the travelers crossing the national or state border is increasing, specially in regions of high volume of travelers or illegal immigrants.
  - **Employee access -** Several airport use biometric to control the physical access of employees to secure areas.
  - **Passports -** Some country already issue passports with biometric information on a barcode or smart chips. The use of biometrics prevent the issuing of multiple passports for the same person and also facilitates the identification at the airports and border controls[11].

2.RELATED WORK

Picard, Rosalind Wright. "Affective computing." (1995). This paper presents and discusses key issues in active computing," computing that relates to, arises from, or influences emotions. Models are suggested for computer recognition of human emotion, and new applications are presented for computer - assisted learning, perceptual information retrieval, arts and entertainment, and human health and inter - action. Affective computing, coupled with new wear - able computers, will also provide the ability to gather new data necessary for advances in emotion and cognition theory.

Chibelushi, Claude C., and FabriceBourel. This paper presents a novel method for facial expression classification that employs the combination of two different feature sets in an ensemble approach. A pool of base classifiers is created using two feature sets - Gabor filters and local binary patterns (LBP). Then a multi - objective genetic algorithm is used to search for the best ensemble using as objective functions the accuracy and the size of the ensemble. The experimental results on two databases have shown the efficiency of the proposed strategy by finding powerful ensembles, which improves the recognition rates between 5% and 10%.

Experiment I		Experiment II	
Feature Set	Acc. (%)	Feature Set	Acc. (%)
$LBP_{8,2}$	99.0	$LBP_{8,2}$	84.3
Gabor S:6 M:1×1	98.7	Gabor S:1 M:7×7	78.7
All Classifiers	98.3	All Classifiers	79.2
Ensemble	99.4	Ensemble	88.9

Table 1 - Selected Classifiers - Cohn - Kanade Database[6] The results attained demonstrated efficiency of the proposed strategy by finding powerful ensembles, which succeed in improving the recognition rates from 5 to 10%

.

Littlewort, Gwen, Jacob Whitehill, Tingfan Wu, Ian Fasel, Mark Frank, Javier Movellan, and Marian Bartlett. " In *Automatic Face & Gesture Recognition and Workshops.* In this work, a novel facial feature extraction method is proposed for automatic facial expressions recognition, which detecting local texture information, global texture information and shape information of the face automatically to form the facial features. First, Active Appearance Model (AAM) is used to locate facial feature points automatically. Then, the local texture information in these feature points and the global texture feature information of the whole face area are extracted based on the Local Binary Pattern (LBP) techniques, and also the shape information of the face are detected. Finally, all the information are combined together to form the feature vector. The proposed feature extraction method is tested by the JAFFE database and experimental results show that it is promising.

Fig 3 - Examples of right recognition[9].

3.PROPOSED WORK

Facial expressions are the facial changes in response to a person inner emotional states, intentions, or social interactions. Facial expression analysis has been an vigorous research topic for behavioral scientists. Much growth has been made to build computer systems to assist us understand and use this ordinary form of human communication The facial expression analysis submits to computer systems that attempt to automatically examine and recognize facial motions and facial feature alters from visual information.

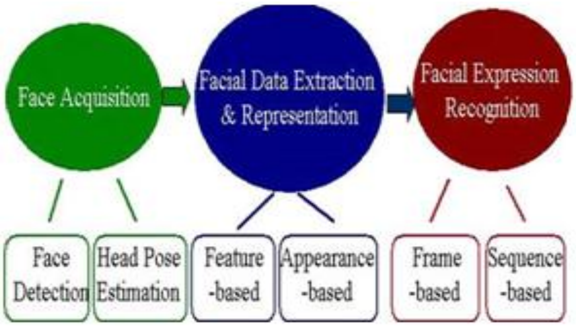

Fig. 4 - Basic structure of facial expression analysis systems[14]

Principles of Facial Expression Analysis

Fundamental Structure of Facial Expression Analysis Systems Facial expression analysis includes both dimension of facial motion and recognitions of expression. The common approach to automatic facial expression analysis (AFEA) comprises of three steps - face acquisition, facial expression recognition and facial data extraction and representation. Face acquisition is a processing stage to repeatedly find the face region for the input descriptions or sequences. It can be a detector to notice face for each frame or just detect face in the first edge and then track the face in the residue of the video sequence. To handle huge head motion, head tracking, the head finder and pose estimation can be useful to a facial expression analysis system.

Once the face is located, the next step is to remove and represent the facial changes. In facial feature extraction for expression analysis, there are mostly two types of approaches - geometric feature based methods and appearance based methods. The geometric facial features represent the shape and locations of facial components (including mouth, brows,eyes, nose, etc.).

The facial components or facial feature points are taken out to form a feature vector that signifies the face geometry.

Fig. 5 - Emotion : specified facial expression (posed images from database [14]).
1) Disgust; 2) Fear; 3) Joy; 4) Surprise; 5) Sadness; 6) Anger

Eigen Face Algorithm

To know faces, those seen by the system, are saved as collections of weights describing the contribution each eigen face has to that image. When a new face is represented to the system for classification, its own weights are originated by projecting the image onto the collection of eigen faces. This provides a set of weights describing the probe face. These weights are then confidential against all weights in the gallery set to find the closest match. A adjacent neighbour method is a simple approach for finding the Euclidean Distance between two vectors, where the minimum can be classified as the nearby subject[4].

- Prepare a training set of face images. The pictures constituting the training set should have been taken under the same lighting conditions, and must be stabilized to have the eyes and mouths aligned across all images. They must also be all re-sampled to a common pixel resolution ($r \times c$). Each image is delighted as one vector, simply by concatenating the rows of pixels in the original image, resulting in a single row with $r \times c$ elements. For this implementation, it is implicit that all images of the training set are stored in a single matrix **T**, where every column of the matrix is an image.
- Subtract the mean. The average image **a** has to be computed and then subtracted from each original image in **T**.
- Compute the eigen vectors and eigen values of the covariance matrix **S**. Each eigen vector has the similar dimensionality (number of components) as the original images, and thus can itself be seen as an image. The eigen vectors of this covariance matrix are therefore known as eigen faces. They are the guidelines

in which the images change from the mean image. Usually this will be a computationally costly step (if at all possible), but the practical applicability of eigenfaces stems from the possibility to calculate the eigen vectors of **S** efficiently, without ever calculating **S** explicitly.

- Choose the key component. The *D* x *D* covariance matrix will consequence in *D* eigenvectors, each presenting a direction in the $r \times c$ - dimensional image space. The eigen vectors (eigen faces) with largest related eigen value are kept[4].

Calculating Eigenfaces

Let a face image Γ(x,y) be a two - dimensional *N* by *N* array of intensity values. An image may also be measured as a vector of dimension N^2, so that a typical image of same width and height typically 256 pixels, it then turn into a vector of dimension 2^{16}, or equivalently, a point in 2^{16} dimensional gap. An ensemble of images, maps to a collection of points in this large space. Faces Images usually being similar in design, will not be randomly spread in this huge image space and thus can be described by a comparatively low dimensional subspace.
The chief idea of the principal component analysis is to discover the vector that best account for the distribution of face images within the whole image space. These vectors describe the subspace of face images, which we describe "face space".

All vector is of length N^2, describes an *N* by *N* image, and, is a linear arrangement of the original face images. As these vectors are the eigenvectors of the covariance matrix equivalent to the original face images, and because they are face - like in appearance, they are known as "eigenfaces".
Let the training set of face images be $\Gamma_1, \Gamma_2, \Gamma_3, \ldots, \Gamma_M$.
The average face of the set if distinct by $\Psi = \frac{1}{M}\sum_{n=1}^{M}\Gamma_n$.
Each face differs from the average by the vector $\Phi_n = \Gamma_n - \Psi$. An example training set is shown in Figure 1a, by means of the average face Ψ shown in Figure 1b. This set of very huge vectors is then subject to principal component analysis, which seeks a set of *M* ortho normal vectors, μ_n, which greatly describes the distribution of the data. The *k*th vector, μ_k is chosen such that

$$\lambda_k = \frac{1}{M}\sum_{n=1}^{M}(\mu_k^T\Phi_n)^2 \qquad (1)$$

is a maximum, subject to

$$\mu_l^T\mu_k = \begin{cases} 1, l = k \\ 0, otherwise \end{cases} \qquad (2)$$

The vectors μ_k and scalars λ_k are the eigenvectors and eigenvalues, respectively, of the covariance matrix

$$C = \frac{1}{M}\sum_{n=1}^{M}\Phi_n\Phi_n^T = AA^T \qquad (3)$$

where the matrix $A = [\Phi_1\Phi_2 \ldots \Phi_M]$. The matrix *C*, however, is N^2 by N^2, and determining the N^2 eigenvectors and eigenvalues is an inflexible task for typical image sizes. A computationally feasible technique is needed to find these eigenvectors[4].
If the amount of data points in the image space is less than the dimension of the space ($M < N^2$), there will be only $M-1$, rather than N^2, significant eigenvectors (the remaining eigenvectors will have linked eigenvalues of zero). Luckily, we can solve for the N^2 - dimensional eigenvectors in this box by first solving for the eigenvectors of and *M* by *M* matrix—e.g., solving a 16 x 16 matrix relatively a 16,384 x 16,384 matrix—and then taking suitable linear combinations of the face images Φ_n.
Consider the eigenvectors v_n of $A^T A$ such that

$$A^T A v_n = \lambda_n v_n \qquad (4)$$

Premultiplying both sides by *A*, we have

$$AA^T A v_n = \lambda_n A v_n \qquad (5)$$

from which we see that Av_n are the eigenvectors of $C = AA^T$.
Following this analysis, we make the *M* by *M* matrix $L = A^T A$, where $L_{mn} = \Phi_m^T\Phi_n$, and find the *M* eigenvectors v_n of *L*. These vectors decide linear combinations of the *M* training set face images to form the eigenfaces μ_n -

$$\mu_n = \sum_{k=1}^{M} v_{nk}\Phi_k = Av_n, n = 1, \ldots\ldots, M \qquad (6)$$

With this analysis the computations are greatly reduced, from the order of the numeral of pixels in the images (N^2) to the arrangement of the number of images in the training set (*M*). In practice, the training set of face images will be comparatively small ($M < N^2$), and the calculations become fairly manageable. The associated eigen values allow us to rank the eigenvectors according to their worth in characterizeing the variation among the image[17]s.

Using Eigenfaces to Classify a Face Image

The eigenface images planned from the eigenvectors of *L* span a basis set with which to explain face images. As mentioned before, the usefulness of eigenvectors varies according their associated eigenvalues. This suggests we pick up only the most significant eigenvectors and ignore the rest, in other words, the number of basis functions is further compacted from *M* to *M'* (*M'*<*M*) and the computation is reduced as a result. Experiments have shown that the RMS pixel - by - pixel errors in representing cropped versions of face images are about 2% with *M*=115 and *M'*=40.
In observence, a smaller *M'* is sufficient for recognition, since precisely reconstruction of the image is not a requirement. In this framework, recognition becomes a pattern recognition task. The eigenfaces span an *M'* dimensional subspace of the unique N^2 image space. The *M'* most important eigenvectors of the *L* matrix are preferred as those with the largest associated eigenvalues.
A new face image Γ is altered into its eigenface components (projected onto "face space") by a simple operation

$$\omega_n = \mu_n(\Gamma - \Psi) \qquad (1)$$

for n=1,……,M'. This explains a set of point - by - point image multiplications and summations.

The weights form a vector $\Omega^T = [\omega_1, \omega_2, ..., \omega_{M'}]$ that illustrates the contribution of each eigenface in representing the input face image, treating the eigenfaces as a basis set for face descriptions[4]. The vector may then be utilized in a standard pattern recognition algorithm to discover which of a number of predefined face classes, if any, best explained the face. The simplest technique for determining which face class provides the greatest description of an input face image is to discover the face class k that minimizes the Euclidian distance

$$\varepsilon_k^2 = \left\| (\Omega - \Omega_k)^2 \right\| \qquad (2)$$

where Ω_k is a vector describing the kth face class. The face classes Ω_k are considered by averaging the consequences of the eigenface representation over a small number of face images (as few as one) of each being. A face is confidential as "unknown", and optionally used to produced a new face class.

Because creating the vector of weights is equal to projecting the original face image onto to low - dimensional face space, many images (most of them seems nothing like a face) will project onto a known pattern vector. It is not a problem for the system, since the distance ε between the image and the face space is merely the squared distance between the mean - adjusted input image $\Phi = \Gamma - \Psi$ and $\Phi_f = \sum_{i=1}^{M'} \omega_i \mu_i$, its projection onto face space -

$$\varepsilon^2 = \left\| \Phi - \Phi_f \right\|^2 \qquad (9)$$

Thus there are four promises for an input image and its pattern vector - (1) near face space and near a face class, (2) near face space but not close to a known face class, (3) distant from face space and near a face class, (4) distant from face space and not close to a known face class.

In the first case, a person is recognized and known. In the second case, an unidentified individual is present at that time. The last two cases specifies that the image is not a face image. Case three classically shows up as a false positive in most appreciation systems; in this structure, however, the fake recognition may be detected because of the important distance between the image and the subspace of predictable face images.

4. IMPLEMENTATION

The major goal of the project is to research human behavior and expressions, as sound as robust facial expression recognition. For vigorous automatic expression recognition, and segmentation of input samples, this study work focuses on different classifiers and features and generic image processing methods will be considered for modeling input segments with smooth transitions.

To get high degree of efficiency based on the motivation and stringent requirement of improving exactness and covering all expression classes. This study will try to apply some modifications in terms of feature extraction methods and algorithms for classification. To meet the estimated goals, the purpose of this research is to develop Automatic Facial Expression Recognition System which can take human facial images holding some expression as input and classify and recognize it into correct expression class.

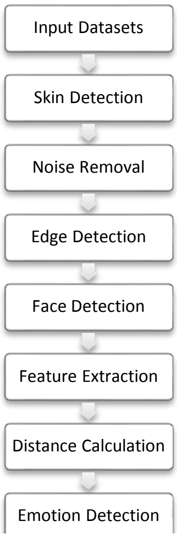

Fig 6 - Proposed Workflow of Automatic Face Expression Classification

Implementation in MATLAB

MATLAB is a powerful language for technical computing. The name MATLAB stands for Matrix Laboratory, because its basic data element is a matrix (array). It is 4th generation of high level programming language for math computations, modeling and simulations, data analysis and processing, visualization and graphics, and algorithm development.

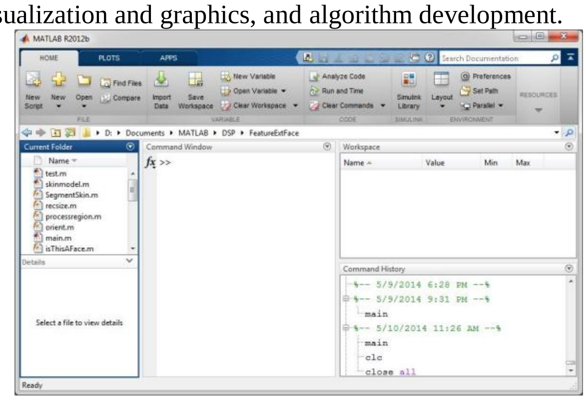

Fig. 6-Screenshot of Matlab environment 2000B

It allow matrix manipulations, plotting of function and data, implementation of algorithm

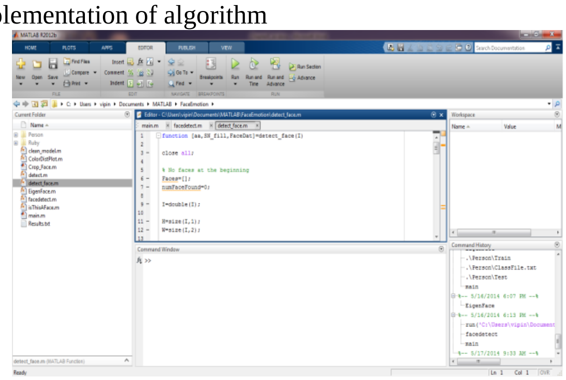

Fig. 7- Matlab script editor showing detect Face algorithm

A.Skin Detection

Skin detection is the process of finding skin-colored pixels and regions in an image or a video. This process is typically used as a preprocessing step to find regions that potentially have human faces and limbs in images. Several computer vision approaches have been developed for skin detection.

Algorithm transforms a given pixel into an appropriate color space and then use a skin classifier to label the pixel whether it is a skin or a non-skin pixel.

It is the process of finding skin-colored pixels or regions in an image. It is used as a preprocessing step to find regions that potentially have human faces or limbs in image.

A skin detector transforms a given pixel into an appropriate color space or a skin classifier to label the pixel ,whether it is a skin type or non skin type pixel.

In this skin and non skin regions are differently highlighted.

If skin pixels are correctly labeled then it is referred to as true positivity. And if non-skin type pixel is correctly labeled,it is true negativity.

Fig. 8 - Lightning Compensation

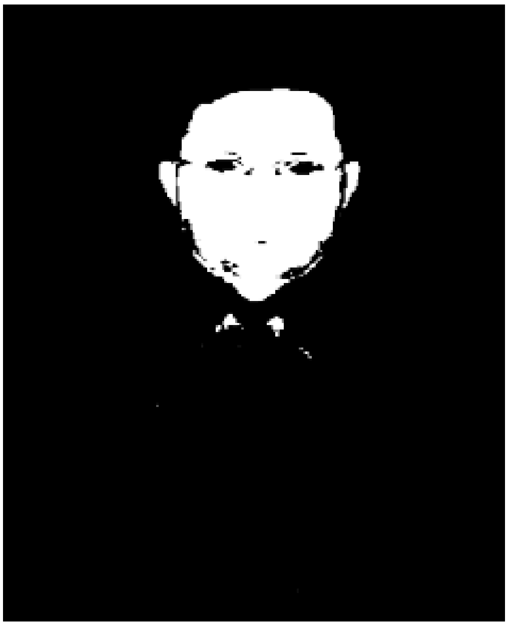

Fig. 9- Skin Detection

B.Face Candidates

The figure depicts various face candidates obtained after the application of image skin modeling and noise removal.

The candidates(shown in dark blue)indicate where the presence of human skin is highest.

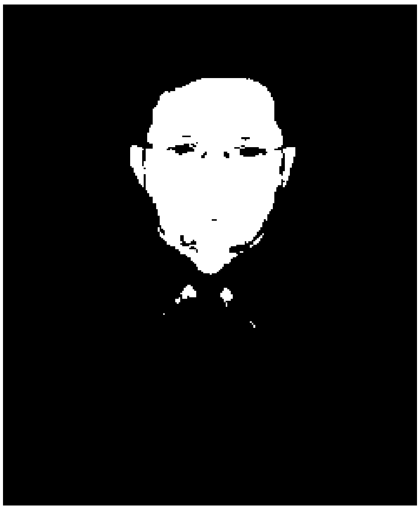

Fig. 8- Skin with noise removal

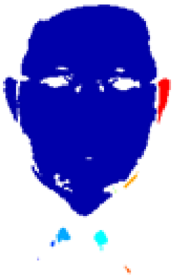

Fig. 9- Face Candidates

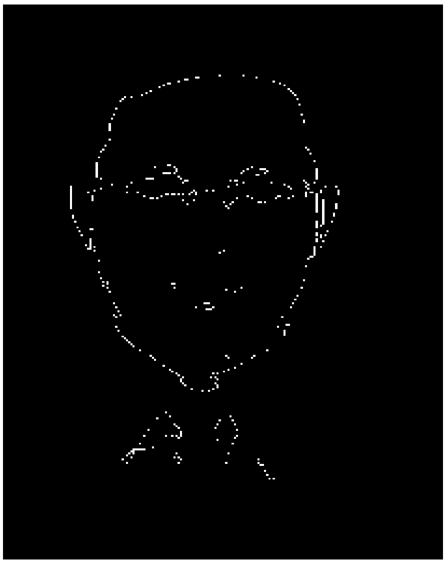

Fig. 10 - Detected Face Boundaries

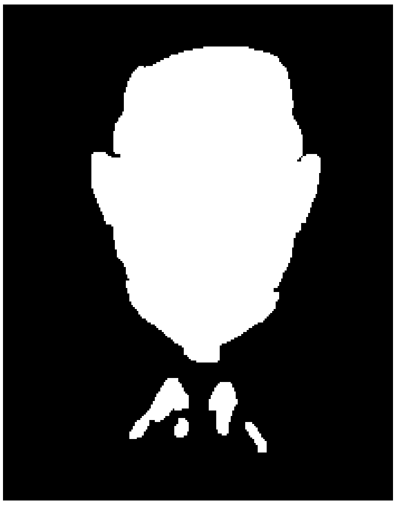

Fig. 11 - Normalized Face Boundaries

Figures above describe the Detected Face boundaries after face candidate selection and noise smoothing, the normalized Face boundaries are weight adjusted boundaries for better recognition.

Fig. 12 - Detected face R channel

The figure above shows the R Channel after Face detection has selected major Face candidate for feature Extraction.

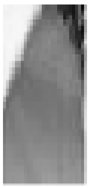

Fig. 13 - Possible face R channel

Fig. 14 - Detected Mouth Map after Feature Selection.

Mouth Map of given image is shown in above figure. As the figure taken was neutral and therefore, mean values of collection of Features (For example, mouth map) is calculated to be subtracted in training phase.

5.RESULT AND DISCUSSION

Dataset for Training

A dataset of various images was taken for training of the Face emotion detector, the training information is stored in a comma separated value of FACET classes,

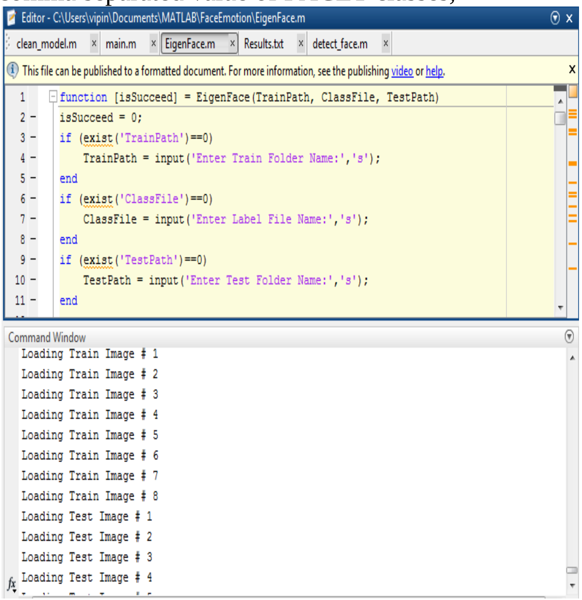

Fig. 15 - Execution of Eigen Face Emotion Algorithm in MATLAB

Training

Image ID	FACET Classes
Train 001	Happy
Train 002	Happy
….	…..
Train 014	Disgust
Train 015	Disgust
Train 016	Disgust
….	….
Train 025	Anger
Train 026	Anger
…	…
Train 035	Sad
Train 036	Sad
…	….
Train 044	Neutral
Train 045	Neutral

Table-2 Dataset

Test Image	Distance From Neutral	Expression	Best Match
Test _ 6.jpg	10580	Sad	Train_6. jpg
Test _1.jpg	466	Neutral	Train_1. jpg
Test _10.jpg	8091	Anger	Train_7. jpg
Test _11.jpg	7083	Happy	Train_4. jpg
Test _2.jpg	9702	Happy	Train_2. jpg
Test _3.jpg	8512	Contem pt	Train_3. jpg
Test _4.jpg	9643	Happy	Train_4. jpg
Test _5.jpg	10957	Happy	Train_5. jpg
Test _7.jpg	10964	Anger	Train_7. jpg
Test _8.jpg	10478	Sad	Train_8. jpg
Test _9.jpg	9469	Sad	Train_8. jpg
Correct result			**81.8181818**

Table 3-List of Test images and their distance from neutral image

The Emotion Classification result indicate that the system is able to produce 81.8% of results, at any given dataset only about 18% images are wrongly classified. Below fig elaborates the results in a pie chart.

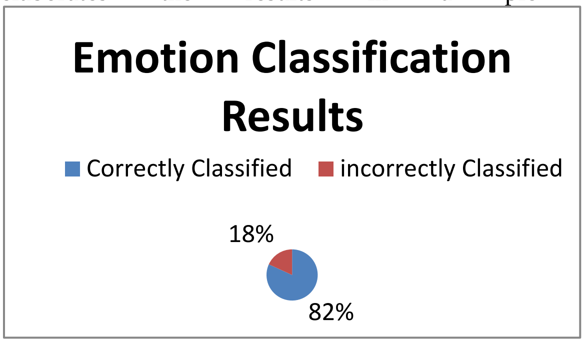

Fig. 17- Emotion Classification Results, with about 82% success rate.

6.CONCLUSION

Facial Expression gives vital information about emotion of a person. Face emotion recognition is one of the main applications of machine idea that generally attended in current years. It can be used in regions of security, human machine interface (HMI) and entertainment. Emotion recognition usually uses of science image processing, speech processing, physiological signal processing, gesture signal processing.

The major goal of the project is to research human behavior and expressions, as sound as robust facial expression recognition. For vigorous automatic expression recognition, and segmentation of input samples, this study work focuses on different classifiers and features and generic image processing methods will be considered for modeling input segments with smooth transitions.

In order to judge if it corresponds to a face or not, each test image needs to be matched with eigenimage which is simply called from the data base which were already built in. After eigenimage matching process, the test images can be ordered from the most - like facial piece to the least - like facial piece. At this point, an absolute criterion or threshold is needed to filter out the non - facial images. However, due to the inconsistency of the condition of each picture, it is concluded that there does not exist such an absolute number. Therefore, statistical approach has been taken so that the test images which belong to the least - like facial group are rejected. The number of the rejected files totally depends on the histogram results of the eigenimage matching results. This approach works satisfactorily for the training images with higher than 81.8% of hit rate, and less than 18% of false detection rate. The algorithm has been tested for a general image which was used for the last year's project, and the performance was satisfactory

REFERENCES

1. Santhanaganesh, A. S., and P. S. Rajakumar. "Facial Expression Recognition in Various Illuminous Environment." Digital Image Processing 6.3 (2014): 127-130.
2. Mittal, Hemant Singh, and Harpreet Kaur. "Face recognition using PCA and neural network." Int. J. Emerg. Sci. Eng 1 (2013): 71-75.

3. Alakkari, Salaheddin, and John James Collins. "Eigenfaces for Face Detection: A Novel Study." Machine Learning and Applications (ICMLA), 2013 12th International Conference on. Vol. 1. IEEE, 2013.
4. Hou, Yi-Fu, et al. "Eigenface-based sparse representation for face recognition." Intelligent Computing Theories and Technology. Springer Berlin Heidelberg, 2013. 457-465.
5. Zhao, Xinyue, et al. "Robust face recognition using the GAP feature." Pattern Recognition 46.10 (2013): 2647-2657.
6. Turk, Matthew. "Over twenty years of eigenfaces." ACM Transactions on Multimedia Computing, Communications, and Applications (TOMCCAP) 9.1s (2013): 45.
7. Pandya, Jigar M., Devang Rathod, and Jigna J. Jadav. "A survey of face recognition approach." International Journal of Engineering Research and Applications (IJERA) 3.1 (2013): 632-635.
8. Shemi, P. M., and M. A. Ali. "A Principal Component Analysis Method for Recognition of Human Faces: Eigenfaces Approach." International Journal of Electronics Communication and Computer Technology (IJECCT) 2.3 (2012).
9. Bettadapura, Vinay. "Face expression recognition and analysis: the state of the art." arXiv preprint arXiv:1203.6722 (2012).
10. Long, Fei, Tingfan Wu, Javier R. Movellan, Marian S. Bartlett, and Gwen Littlewort."Learning spatiotemporal features by using independent component analysis with application to facial expression recognition."Neurocomputing 93 (2012): 126-132.
11. Valstar, Michel F., and MajaPantic."Fully automatic recognition of the temporal phases of facial actions."Systems, Man, and Cybernetics, Part B: Cybernetics, IEEE Transactions on 42, no. 1 (2012): 28-43.
12. Hafiz, Fadhlan, Amir A. Shafie, and Yasir Mohd Mustafah. "Face recognition from single sample per person by learning of generic discriminant vectors." Procedia Engineering 41 (2012): 465-472.
13. Zhu, Xiangxin, and Deva Ramanan. "Face detection, pose estimation, and landmark localization in the wild." Computer Vision and Pattern Recognition (CVPR), 2012 IEEE Conference on. IEEE, 2012.
14. Nakata, R., R. Tamura, and S. Eifuku. "What facial information is important for rapid detection of the face?: Comparative cognitive studies between humans and monkeys." 35th European Conference on Visual Perception (ECVP2012). Vol. 9. 2012.
15. Jain, Anil K., Brendan Klare, and Unsang Park. "Face recognition: Some challenges in forensics." Automatic Face & Gesture Recognition and Workshops (FG 2011), 2011 IEEE International Conference on. IEEE, 2011.
16. Tian, Yingli, Takeo Kanade, and Jeffrey F. Cohn."Facial expression recognition."In Handbook of face recognition, pp. 487-519.Springer London, 2011.
17. Zavaschi, Thiago HH, Alessandro L. Koerich, and L. E. S. Oliveira."Facial expression recognition using ensemble of classifiers." In Acoustics, Speech and Signal Processing (ICASSP), 2011 IEEE International Conference on, pp. 1489-1492. IEEE, 2011.
18. Littlewort, Gwen, Jacob Whitehill, Tingfan Wu, Ian Fasel, Mark Frank, Javier Movellan, and Marian Bartlett."The computer expression recognition toolbox (CERT)."