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## A Hybrid Feature Extraction Technique for Face Recognition

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**Abstract**— Pervasive work out is the expertise that is elegantly integrated in our everyday life. Form of home automation focuses on making it possible for elderly and for alone person to remain at home, safe and comfortable. The care of elderly could be enhanced through remote monitoring system, sensor technologies and communication systems. A form of home automation focuses on making it possible for elderly and individual people to remain at home safe and comfortable. Face Recognition is a concept under pattern recognition with applications moving towards the use of facial features for authorization and authentication. Hybrid approach has a special status among face recognition systems as they combine different feature extraction approaches to overcome the shortcomings of individual methods. This work uses Feed Forward Neural Network for face recognition and using a combination of PCA and ICA algorithm for feature extraction. Proposed algorithm is implemented in MATLAB and performance evaluation of success rate of proposed algorithm with existing techniques. Results show that proposed system has higher accuracy than face recognition using single feature extractor.

**Keywords**— Face Recognition, PCA and ICA and Neural Network. PCA (Principal Component Analysis), ICA (Independent Component Analysis).

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### I. INTRODUCTION

#### 1.1 Biometrics

Biometrics is the most secure and convenient method to satisfy all the need for an identity recognition of an individual in all the society. For that physiological or the behavioural characteristics of a person that are used for an automatic identification of all an individual [1]. In the field of an Biometrics, the facial recognition is one of the more acceptable biometrics. Because one human face is an always bare and the human beings often use them in all their visual interactions. The automatic recognition of an human face presents a significant challenge for the researcher. The Human faces are very similar in the structure with in the minor difference from all person to person It is a convenient biometric mode for the human identification is more than the two decades. In the past several decades the Face recognition can be a great deal of the attention from all the scientific and the industrial sections that having a wide range of the applications in the information security and the access control. Considerable the research efforts that have been given to the entire face recognition problem. Nowadays; the wavelets that have been used quite frequently in all the image processing. They have been used for the feature extraction, de-noising, compression, face recognition, and the image super-resolution. The wavelet transformations are the method of representing the signals across space and for the frequency [2]. Biometric encryption allows that an individual's biometric data that is to be transformed into the multiple and for varied identifiers for all the different purposes, so that these identifiers that cannot be correlated with any one another [20]. Multi biometric systems that combine information from all the multiple biometric traits. A Single biometric trait that may not be sufficient because that the security needs to be increase and the criminals gain that are more expertise in all the biometric technology [26].

##### 1.1.1 Face Detection

A Face Detection is a part of the wide area of the entire pattern Detection technology. Face Detection and especially for face Detection. A Face Detection is a part of a wide area of the entire pattern Detection technology. It covers all the range of an activity from the many walks of the life. The Face Detection is a something that all the humans are particularly better at the science and technology that have been brought the various similar tasks to us. The Face Detection in the general and in the Detection of all the moving people in all the natural scenes in the entire particular that requires a set of all the visual tasks that has been performed robustly. The process that includes mainly in the three-task acquisition, normalization and for the Detection. In these all terms acquisition that means that the detection and the tracking of all the faces -like image's patches in all the dynamic scenes. Normalizations is a process of all the segmentation, alignment and for the normalization for all the face images [3], and for all the finally Detection that has been representation and for the modelling of all the face images as for the identities, and for the association of the entire novel for the face images with all the known models [7].

##### 1.1.2 Eigen Faces

Eigen faces methods are the kind of all the Principal Component Analysis (that is also called as Karhunen–Loeve transform) which is to be specialized with the face images. In the PCA, every image in all the training set that is to be

identified with the feature vectors that have been provided from the projection of all the images to the entire basis in the image space. Generally the PCA method that classifies images according to the distance between the feature vectors. Standard classifiers that include the nearest distance criterion, Euclidean distance and for the nearest mean classification [18].

## 1.2 Biometric system

Biometric system that uses different human body parts for the recognition or for the authentication. Depending upon the characteristic that are classified in the physical and for the behavioural. Physical characteristic that may be face, iris, hand geometry, finger print, and the palm print and for the dental. Behavioural characteristic that may be voice; signature and for the gesture. The biometric characteristic that the data are captured and that processed in the specific manner. The feature is extracted from and that creates template that can be stored in the entire database. The stored data that can be used for the authentication and as well as for the verification purpose. The whole biometric application that has been depicted [1].

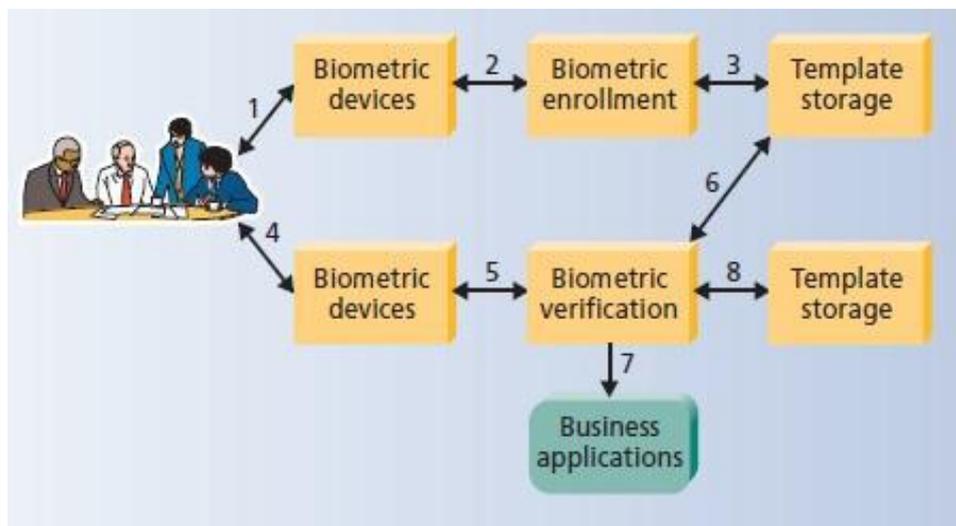


Fig.1.2.1 Complete Biometric Process.

The face recognition, is a priori identity's that was not known: and all the system that can be decide that which of these images that can be stored in all the database and that is to be resembles the most of all these image for the recognizing; and the decision that was no more binary[1]. The Machine recognition of all the human face from all the video images that have become that the active research area in all the communities of all the image processing and for the pattern recognition, and for the neural networks and for all the computer vision. The very most remarkable abilities of all the human vision that are for all the face recognition. It can develops overall years of the childhood, and that can be important for all the various aspects for all our social life, and that can be together with all the related abilities, such that as that estimating all the expression of all the people with all which that can interact, and have been played an important role in the overall course of the evolution[2].

## 1.3 Face recognition

The Face recognition is a typically that can be used for all the verification or for the identification. In the verification of an individual that can be already enrolled in all the reference database or for the gallery i.e. it is an one-to-one matching task whereas in all the identification, a probe image's that matched with all the biometric reference in all the gallery i.e. that can be represents the one-to-many problems [5].The Face Recognition is a inherent capability of all the human beings. An Artificial Neural Networks (ANN) is an attempt that can be simulating all the human brain; hence it's a method that is named as the artificial neural networks. Neural networks, which can be inspired from all the studies of the biological nervous systems, which can have recently, being used for all the various applications, due to the distributed computing fashion over all the large number of a simple processing unit (Neurons). These neurons of all the nodes that are very simple, non-linear computational elements that have been connected by the links with all the variable weights [6]. The Face recognition that have been a popular area of all the research over all the last decade. Face Recognition technology that has been numerous commercial and the law enforcement applications [9]. The purpose of the face recognition is mainly to identify a person, that as a key for the security and a wide variety of the applications such that as identification for the law enforcement, matching of the photographs on passports or the driver's licenses, access control to the secure computer networks and for the facilities such as the government buildings and for the courthouses, authentication for secure banking and for financial transactions, automatic screening at the airports for known terrorists, and for the video surveillance [21].

For the recent surveys on all the face detection, the different approaches that has been used such as the principal component analysis (PCA), the neural networks, the machine learning, the information theory, the geometrical modeling, and for the template matching.[28]. The eigenvectors are the ordered, that each one accounting for all the different amount of all the variation among all the face images [27].



Fig 1.31: Face Recognition System [30].

### 1.3.1 Reason of Choosing Face Recognition System

There are multiple reasons that make us to choose Face Recognition System from all the kinds of the biometric, and these are:

1. It doesn't need any Physical interaction from the entire user.
2. It is a very accurate and a more secure.
3. We can use any cameras or the image capture device [25].

### 1.3.2 Applications of Face Recognition

There are the numerous application areas in which the face recognition that can be exploited for these the two purposes, and a few of which of these are:-

- Security (access control to the buildings, airports/seaports, and the ATM machines and for the border checkpoints Computer/network security; and the email authentication on the multimedia workstations).
- Image database investigations (searching image databases of the licensed drivers, benefit of the recipients, missing Children, immigrants and the police bookings).
- Multi-media environments with the adaptive human computer interfaces (part of the ubiquitous or the context-aware Systems, behavior monitoring at the childcare or for the old people's centers, recognizing a customer and for assessing his Needs).
- Video indexing (labeling faces in the video).
- For the witness faces reconstruction [19].

## 1.4 Techniques for Feature Extraction

There are numerous techniques [29] that can be used to accomplish all the implementation of a given Face recognition that are as follows:

### 1.4.1 Principal Component Analysis (PCA)

A traditional way for extracting the features that can be used for the PCA technique. In a set of the  $N$   $d$ -dimensional image's for the learning set ( $d$  being to all the number of the pixels in the each and in every image), the PCA method extracting that are known as *principal components* as to be the eigenvectors of all the covariance matrix of the overall data. By the perceptive, that we mean's that the features that can be used by all the various human being for the discriminate between or to the describer's of the faces [8].

It is the mathematical procedure that can performs all the dimensionality reduction by all the extracting the principal components of all the multi-dimensional data. The first principal component is a linear combination of all the original dimensions that have been over the highest variability. Finally, all the recognition threshold is a computed by using all the maximum distance between the any two face projections .In all the recognition phase, that a subject face is the normalized with all the respect to all the average face and then the projected onto the face space by using the eigenvector matrix. Next, all the Euclidean distance is a computed between this the projection and all are known projections. The minimum value of all these comparisons is the selected and compared with all the threshold value that are calculated during all the training phase. Based on these, if all the value is a greater than the entire threshold, than the face is a new. Otherwise, it is a called as face [19].PCA also called as Karhunen-Loeve method that is one of all the popular methods for the feature selection and for the dimension reduction. The Recognition of the human faces by using PCA was the first done by the Turk and by the Pentland and was the reconstruction of the human faces that was done by the Kirby and Sirovich .This limitation is a overcome by the Linear Discriminant Analysis (LDA). LDA is a most dominant algorithm for the feature selection in all the appearance based methods. But all the many LDA based on the face recognition system that was first used the PCA to reduce all the dimensions and then the LDA can be used to maximize all the discriminating power of the feature selection. The reason is that the LDA that has been the small sample size problem in which the dataset selected should have been larger samples as per class for the good discriminating the features extraction. Thus the implementing of the LDA that are directly resulted in the poor extraction of the discriminating features. In all the proposed method the Gabor filter can be used to filter the frontal face images and for the PCA that can be used to reduce [29].

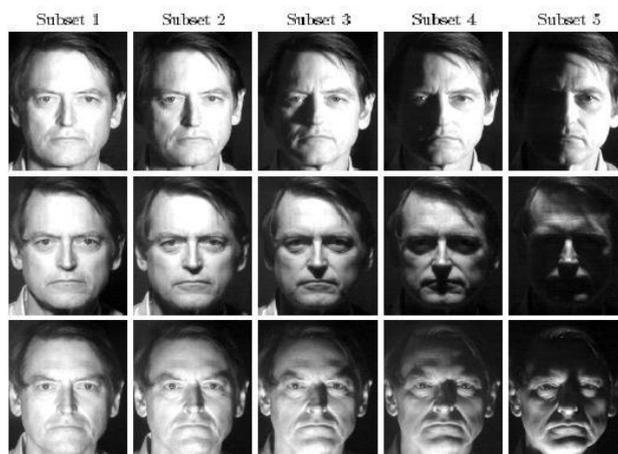


Figure 1.4: The same person that can be seen under varying light conditions can appear in the dramatically different [19].  
 (©1997 IEEE)

#### 1.4.1.1 Advantages of PCA

- The Recognition is a simple and efficient compared to all other matching approaches.
- Data compression can be achieved by all the low dimensional subspace for the representation.
- The Raw intensity data that can be used directly for the learning and for the recognition without any significant low-level or for the mid-level processing.
- No knowledge of the geometry and the reflectance of the faces that are required [19].

#### 1.4.1.2 Disadvantages of PCA

- The method is a very sensitive to the scale; therefore, it is a low-level preprocessing that is still necessary for the scale normalization.
- The Eigen face representation is, in a least squared sense, faithful to all the original images, its recognition rate that can be Decreases for the recognition under the varying pose and for the illumination.
- Though all the Eigen face approach can be shown that can be robust when dealing with the expression and for the glasses, these Experiments that were made only with the frontal views. The problem that can be far and more difficult when there exists in extreme Change in the pose as well as in the expression and for the disguise.
- Due to its the “appearance-based” the nature, learning is a very time-consuming, which makes it can be difficult to update all the Face database [19].

#### 1.4.2 Independent Component Analysis (ICA)

The ICA technique that can be a data analysis tool that derived from all the "source separation “as all the signal processing techniques. The algorithmic techniques by making all these entire task possible that are often Known as ICA, as these factorise all the observations for the combination of all the original source’s [1]. In the Independent component analysis (ICA) is the method for finding all the underlying factors or all the components from all the multivariate (multidimensional) statistical data. There are needs that can be implement the face recognition system by using ICA for the facial images that having the face orientations and for the different illumination conditions, which will gives the better results as compared with all the existing systems. What distinguishes ICA from the other methods is that, it looks for all the components that are both statistically independent and for the non-Gaussian. The Face recognition using the ICA with the large rotation angles with all the poses and for the variations in the illumination conditions that was proposed in. A novel subspace method that are called as sequential row column independent component analysis for the face recognition [29].

### 1.5 Classification

#### 1.5.1 Neural Network

The Neural Network based on all the face recognition approaches that include as that the use of the convolutional Neural Networks, as all the radial basis neural’s networks, and all the other types of all the Neural Networks. . All of these focus on that the recognition performance of all the leading to all the complex learning algorithms and for all of the non-linear neurons. In all the several works, the Neural Networks that act as a classifiers. The Separate feature’s extraction algorithms that can be extract all the relevant features for the extraction that can be fed to all the Neural Network classifiers. The complexity of all the learning algorithms and all the feature extraction algorithms that makes us e of all the existing Neural Network-based on all the face recognition methods in a inefficient for all the hardware mapping [3].

#### 1.5.2 Applications for Neural Networks

- An Artificial neural network application that have been used in all the field of the solar energy for the modeling and for design of a solar steam generating plant.
- They are more useful in the system modeling, such that as implementing the complex mapping and the system identification.

- An ANN can be used for the estimation of the heating-loads of the buildings; parabolic-trough collectors intercept the factor and the local concentration ratio [19].

### 1.5.3 Advantages and Disadvantages of Neural Network.

#### Advantages

- A neural network that we can perform tasks in which all the linear program that cannot perform.
- When an element of all the neural network fails, it can be continue without any other problem with their parallel nature.
- A neural network doesn't need to be reprogrammed as it can be learns itself.
- It can be implemented in a very easy way without having any problem.
- It can be implemented in all the any application [31].

#### Disadvantages

- The neural network that requires training to operate.
- It requires the high processing time for the large neural networks [31].

## II. RELATED WORK

The research work performed in this field by different researchers is presented as follows:

**Sukhvinder Singh, Meenakshi Sharma and Dr. N Suresh Rao (2011)**, Face recognition from all the images is an sub-area of the general objects to recognize the entire problem. It is a particular the interest in an wide variety of all the applications. The proposed algorithm is based upon all the measure of the principal components (PCA) of all these faces and it is also finds the shortest distance between them. The experimental results of that demonstrate this arithmetic that can be used to improve the face recognition's rate. The Experimental results on all the ORL face databases that show all these method that has a higher correct recognition rate and the higher recognition speed than all the traditional PCA algorithms [7].

**Alaa Eleyan and Hasan Demire (2006)**, In this the Principal component analysis (PCA) and the Linear Discriminant Analysis (LDA) techniques that are among all the most commonly for extracting features that can be used for the recognition of the all faces images. In other, the recognition performance of the LDA-NN is higher or greater than the other techniques which are PCA-NN method among all the other proposed systems [8].

**C. Havran, L. Hupet (2002)**, describes that the Independent Component Analysis (ICA) was presented as an alternative feature extraction algorithm for the Principal Component Analysis (PCA) that can be widely used in all the automatic recognition/authentication tasks. In this we can show that the entire promising for ICA algorithm that an extracts from all the faces features which are relevant and are efficient for the authentication. This leads to improve all the success rates and to reduce all the client model size over an PCA based feature's extraction technique [1].

**Manal Abdullah<sup>1</sup>, Majda Wazzan<sup>1</sup> and Sahar Bo-saeed (2012)**, In this the Principle Component Analysis (PCA) is used for the feature extraction and for representing the data technique that can be widely used for the pattern recognition. It is one of the most successful and powerful techniques in all the face recognition technique. The Experimental results that show a recognition time that can be reduced by 35% by applying all the proposed enhanced algorithm techniques. DET Curves that can be used to illustrate all the experimental results of the recognition [5].

**Shukanya Roychowdhary, Sharavari Govilkar (2013)**, describes that the face recognition system that are works best in all the ideal condition. But it can be a very sensitive in all the real time. The proposed system that are tested on all the 165 images from the entire Yale face database. The Test results that gives the recognition rate above all the 97% [1].

**M.Saraswathi, Dr. S. Sivakumari (2015)**, presents that the face recognition system that can be identifying the person from a given input image, for the authentication purposes .The database consists of the 400 images of the 40 persons within 10 different poses for each individual. In the end, of the experimental results that show a high recognition rate of 93.7% that can be obtained by the use of the LDA feature set [4].

**Naresh Babu N T, Annis Fathima A (2011)**, describes the multiresolution representations and the Subspace analysis that has been widely accepted in all the face recognition systems. The DWT provides multiresolution representations and that are effective in the analyzing information content of the image and to generate the feature sets for the images from an individual wavelet sub bands. It was observed that the proposed methods that classifies the images with the better accuracy and the outperforms with the existing methods. [10].

**Kishor S Kinage and S. G. Bhirud (2010)**, In this paper the new face recognition technique that can depend upon on the Independent Component Analysis (ICA) for the Gabor Jet (Gabor Jet-ICA) that is proposed. In the existing face recognition systems by using all the Gabor wavelets that can be convolve the whole face image with a set of all the 40 Gabor wavelets. The results that show the maximum accuracy of 82.25% and 84.5% for all the Gabor Jet-PCA and the Gabor Jet-ICA respectively.[11]

**Karande Kailash et al (2012)**, this paper proves that the difference in the performance between ICA and PCA that is 2.25%, which is an insignificant [11].The problem of the face recognition by using Laplacian pyramids with the different orientations and the independent components is addressed. The Euclidean distance (L2) classifier is used for testing of the images. The algorithm is tested on the two different databases of the face images for the variation in the illumination, facial expressions and for the facial poses up to the 1800rotation angle [12].

**Peter N. Belhumeur et al (1997)**, describes that a pattern classification approach that we consider in each pixel of an image as a coordinate of high-dimensional space. Our projection method is based upon on the Fisher's Linear

Discriminant and that produces a well separated classes in an all low-dimensional subspace, even in an under severe variation in all the lighting and in all the facial expressions. The Eigen face techniques, and the another method based upon linearly projecting all the image space to a very low dimensional subspace, that has similar computational requirements. Yet in an extensive experimental result demonstrate that the proposed “Fisher face” method that has number of error rates that are lower than those of the Eigen face technique for the tests of the Harvard and Yale Face Databases [13].

**Ming-Hsuan Yang et al (2002)**, describes that the images that containing the faces that are essential to the intelligent vision-based upon human computer interaction, and for the research efforts in the face processing that include all the face recognition, face tracking, pose estimation, and the expression recognition. However, many reported methods that assume all the faces in an image or in an image sequence that have been identified and to be localized. We also discuss the relevant issues such as a data collection, evaluation metrics, and the benchmarking. After analysing all these algorithms and to identifying their limitations and we conclude with the several promising directions for the future research [16].

**Yon sheng Gao et al, (2002)**, describes that the automatic recognition of a human faces that presents a significant challenge to all the pattern recognition research community. The human faces are very similar in a structure with the minor differences from a person to person. This research demonstrates that the LEM together with all the proposed generic line segments Hausdorff distance that measure to provide a new way for the face coding and for the recognition [14].

**Kumari Ramnika Kailash J.Karande (2014)**, in this paper the Principle Component of an Edge Information approach for the face recognition is discussed and to be analysed. This Edge information of all the PCA algorithms for the face recognition is a new approach and that provides a different way for analysing the results for face recognition. In this experimentation we have to explore LOG edge detector with the Eigen images for the face recognition under the variation of a pose, illumination and for the facial expressions [15].

**Chhahat eta al (2013)**, describes that the image Restoration means to restore all the degraded/distorted images to its original content and for the quality. If recovery probability of a corrupted pixel is >60%, then the matching of the pixel will be done with all the remaining part of all that particular pixels. The research will be providing a better quality of the entire image after the recovery [17].

**Ergun Gumus, Niyazi Kilic (2010)**, describes that an evaluation of using various methods for face recognition. As feature extracting techniques we benefit from wavelet decomposition and Eigen faces method which is based on Principal Component Analysis (PCA). As the test set us can used ORL face database which is called as a standard face database for the face recognition applications including 400 images of 40 peoples. At the end of all the overall separation tasks, we can obtained the classification accuracy as 98.1% with the Wavelet–SVM approach for the 240 image training set [18].

**Deepali H. Shah, Dr. J. S. Shah (2014)**, describes the Face recognition systems that have gained a great deal of all the popularity due to the wide range of an application that they have proved to be useful. Another application of the face recognition is for the protection of privacy, obviating the need for exchanging the sensitive personal information. In this paper, we have explored all the different techniques of all the face recognition technique [19].

**Prajakta Patil et al (2016)**, describes that all the diplomatic environment, for all the personal authentication, the iris recognition is the most attentive techniques among all the various biometric techniques. Some techniques specified that also improve all the efficiency of all the face recognition under all the various illuminations and all the expression condition of all the face images [22].

**Deepali H. Shah1, Tejas V. Shah2, J. S. Shah3 (2015)**, describes that all identifying the attackers is a major apprehension to both the organizations as well as the governments. The most used applications for all the prevention or the detection of all the intrusion are based on the biometric systems. In this paper provides an overview of all the different biometric techniques with their respective inherent features [23].

**Gagandeep Kaur, and Paramjit Kaur (2014)**, describe that the Image restoration is also known as the recovery of images. Generally with the operation such as the noise and the transmission of the images make it corrupted and it is to be difficult to recover. The color image restoration algorithm is put forward based upon filling in the technique and the RBF neural network. In this paper, we used the HSV methods to restore all the images after applying the filling in techniques [24].

### III. PROPOSED WORK

#### 3.1 Problem Formulation

Face Recognition is a concept under pattern recognition with applications moving towards the use of facial features for authorization and authentication. There are number of algorithms for face recognition. PCA was invented in 1901 by Karl Pearson. It is mostly used as a tool in explore data analysis. PCA with ICA is used for feature extraction and Feed forward Neural Network is used for face recognition. The origin of PCA is from Eigen Vectors.

The Eigen vector that encompasses the major features of any input was considered as principle component. PCA belongs to linear transforms based on the statistical techniques. This method provides a powerful tool for data analysis and pattern recognition which is often used in signal and image processing as a technique for data dimension reduction or their de-correlation as well. It is a way of analyzing, identifying patterns in data and expresses it in a way that highlights the similarities and differences. Its advantage is that it can be used as a compression method of data without any loss of information. ICA is a statistical technique very useful in systems involving multivariable data.

### 3.2 Proposed Work

In the paper, an improvised Face recognition technique has been developed that employs different techniques like PCA and ICA for more accuracy and recognition the image more efficiently. Pre-processing Database containing front view and side view of face images taken in 512 \*512 pixels.

## IV. RESULTS AND ANALYSIS

**Mark Features** It comes under preprocessing technique when applied to a system it takes images of size 512\*512. In this, we will mark right eye, left eye and mouth we will get a matrix Labels. Mat of size 40\*6.



Figure 4.1: Marking Features

From the above figure, we can mark three features like eyes and teeth.

**Align Faces** This module aligns the mouth and eye positions of a directory of face images reads in Labels. Mat.

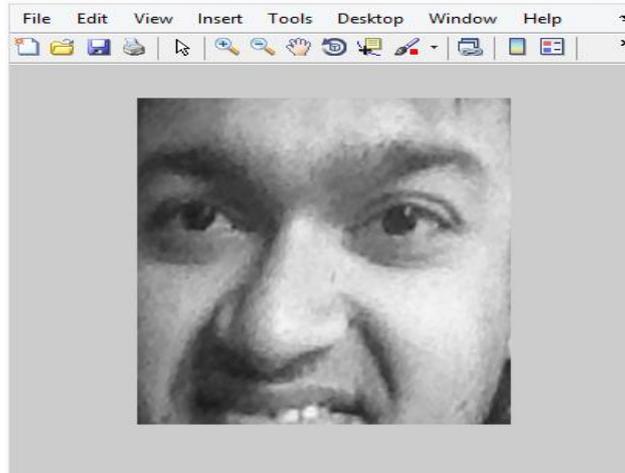


Figure 4.2: Align Features

From the above figure or in this feature factor can be made into pgm format .It convert the jpg image into pgm format.

**Load Faces** This module loads aligned faces into a matrix C. We have 40 rows and 70613 columns.

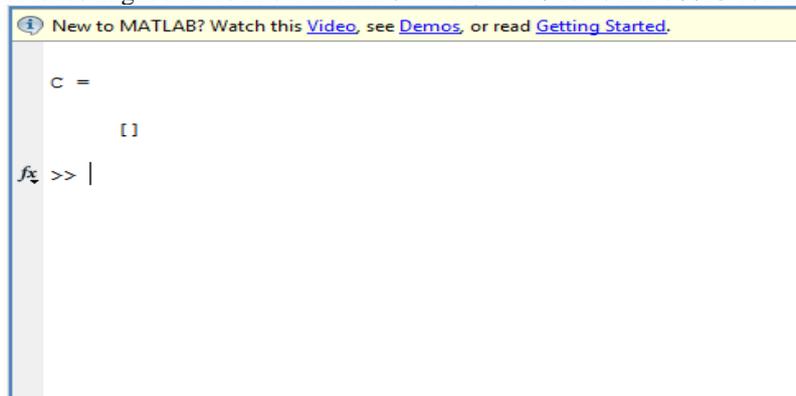


Figure 4.3: Load Faces.

From the above figure, we can read the numerical values in the MATLAB.

**Train** This module extracts ICA and PCA features from matrix C and these features are used to train the network by using feed forward neural network.

**Test** To recognize face image and find the category from which image belongs and then send messages to all the persons who belong to one's category. We have three categories as Family, Friend and unknown. As we can compare the image with all the other images we can conclude that the image is belong to what category if the image is matched and result is friend than  $fr=1$  and if the output message is family than  $f=1$  this shows that the person is a family member and if the person is not matched to any category than the output message is neighbor and the value of  $n=1$ .



Figure 4.4: Train the persons.

From the above figure, shows that in this module we can extract all 41 person features and also read all features of images for further testing process.



Figure 4.5: Test the person.



Figure 4.6: Test the person.

From the above figure, we can check the person which is matched or not or if matched is related to which category like friend, family or unknown.

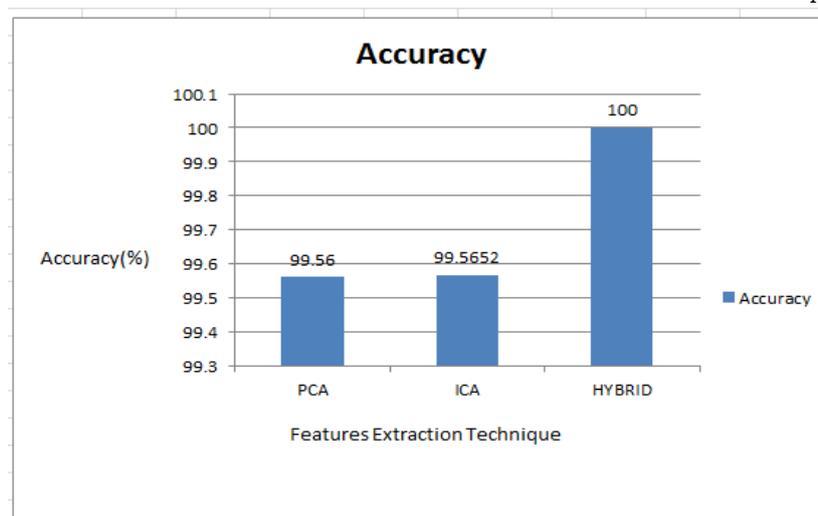


Figure 4.7: Comparisons of various recognition techniques like PCA and ICA and combination of both techniques.

From the above figure, we can conclude that hybrid has highest or more accuracy than the technique PCA and ICA separately.

#### V. CONCLUSIONS

In this thesis, we have addressed the face recognition techniques that can be used for recognizing the person by using different techniques like PCA and ICA. For this purpose, we have defined the techniques for recognizing based on MATLAB. In this, we can use PCA and ICA technique for more accurately recognizing the person. Rather than we can use the PCA and ICA technique separately, we can use a hybrid which is a combination of PCA and ICA technique. With the help of hybrid, we can find or recognize the person more accurately than both techniques separately. As the graph shows, the PCA technique recognizes the person as 99.56% and the ICA technique can recognize the person as 99.5652%. If we combine both techniques as named, that is known as hybrid, that can recognize the person as 100%. In the future, a main research issue of vehicular ad hoc networks focuses on designing an integrated system architecture that can make use of different techniques for recognition. Through this, we can recognize easily. In the future, our target is to further improve the performance of recognizing with other techniques such as LDA.

#### ACKNOWLEDGMENT

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