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Comparision of PCA and LDA Techniques for Face Recognition Feature Based Extraction With Accuracy Enhancement

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Abstract - *A Face recognition technology is a most important approach in our day to day life. It is mostly used to identified a human being and provide a security in many aspects of life. It becomes very difficult task for researcher to get a best face recognition rate in a various situation and criteria. The human face is a complicated multidimensional model and it needs a sturdy recognition technique to recognize a human face. The face recognition accuracy is depends on two procedure which are human face detection and a feature extraction method. Many of face recognition feature extraction techniques are used to recognize the face but it needs more enhancements acquire to get optimum outcome. This paper is mainly focus on a comparative analysis of two feature extraction technique of face recognition PCA and LDA on different criteria like facial expression, illumination variant and glass – nonglass for frontal face images. The proposed work selects a suitable method which performs accurately in which criteria.*

Key Words: **Face recognition, PCA, LDA, Eigen value, Covariance, Euclidean distance, Eigen face, Scatter matrix.**

1.INTRODUCTION

The face of the human is a very complex structure and very useful in many of social aspect in purpose of security. It needs a hard work to indentify a face correctly. Now a day Face Recognition becomes very popular research area for the researcher. Human have a very powerful organ brain that can recognize so many faces in a whole life. The researchers are trying to make a system that can recognize the face in all the circumstances. A human faces can modify because of many conditions like increasing age, wearing a glass, have a beard, and change in hair style that generate complexity in recognition process of face. Feature based, holistic and hybrid approach where holistic approach is popular method for face recognition [1].Facial recognition divided into three stage Input the image, process of image and Comparison. Ratio of Yale database is used for face detection and recognition is very less and the face recognition using PCA performed worse on YALE[3] and the accuracy and recognition rate for is not up to mark on Yale database[2]. There are different distance classifiers which are used with feature extraction to improve the face recognition rate and match the feature vector with database and recognition the image. Euclidean distance is one of the simplest and faster classifier as compared to other Classifiers that provide good result for PCA and LDA [4]. Face detection is a very important process of recognition, Haar feature is introduced with the help of viola-Jones which is efficient for frontal face detection but it is not more efficient for different pose of faces [5). The comparing Haar with other techniques give the outcome that haar like feature extraction face detection approach is found as a very good candidate for face detection [6]. The PCA feature extraction technique is a well-known method which is based on eigenfaces approach, which provides more correct outcome for face recognition. This technique is worked better for whole front face but not good enough for more facial expression in face [7]. LDA is basically worked on fisher-face approach; main advantage of this method is a lower-dimensional vector space for data. It provides maximum discrimination using maximized the relational distance among, class and inside sub-class [8]. LDA technique used to resolve the problem which is generated through PCA. PCA provide maximum variance but always maximum variance are not given useful information, so recognition becomes difficult. So after applying PCA on Image data, apply LDA on it and get specific class information and minimize the variance [9]. PCA performed worse on YALE so in future it can improve [10].

1.1 Feature Extraction in Face Recognition Using Principal Component Analysis

PCA is reducing the dimension of the image form 2 dimensional to 1 dimensional vector. It represents in the form of Vector. It computes the mean and average matrix is calculated then subtracts from original face image and stored in variable. The covariance matrix is calculated. After that it calculates the Eigen vector and Eigen values of covariance matrix. After that the Eigen faces are generated. The new Eigen face is stored as Eigen component and after Euclidean distance Classifier measure the weight between two weight vectors and match the vectors with training set and recognition the image.

The proposed system initiates process through Create Training Dataset using face detection technique, the process of Create Training data set is selecting image from database applies face detection on it and store the face in the database. Work Flow of System proposed for Face detection is Load image from Yale database then apply pre-processing on it, pre-processing include rgb to gray conversion and histogram equalization process. Then Haar classifier applies on

processed image to detect face and Detected face is stored in Training database. After completion of first stage the second stage Face recognition based on methods PCA begins. The system Load an image from Yale database then rgb to gray and histogram equalization pre-processing apply on an image. Face detection using Haar classifier is applied to detect the face, on detected face PCA method for feature extraction applied and get important feature of face, after getting the important features from detected face Euclidean distance classifier match this feature to training database., if classifier match with training set image than face is recognized.

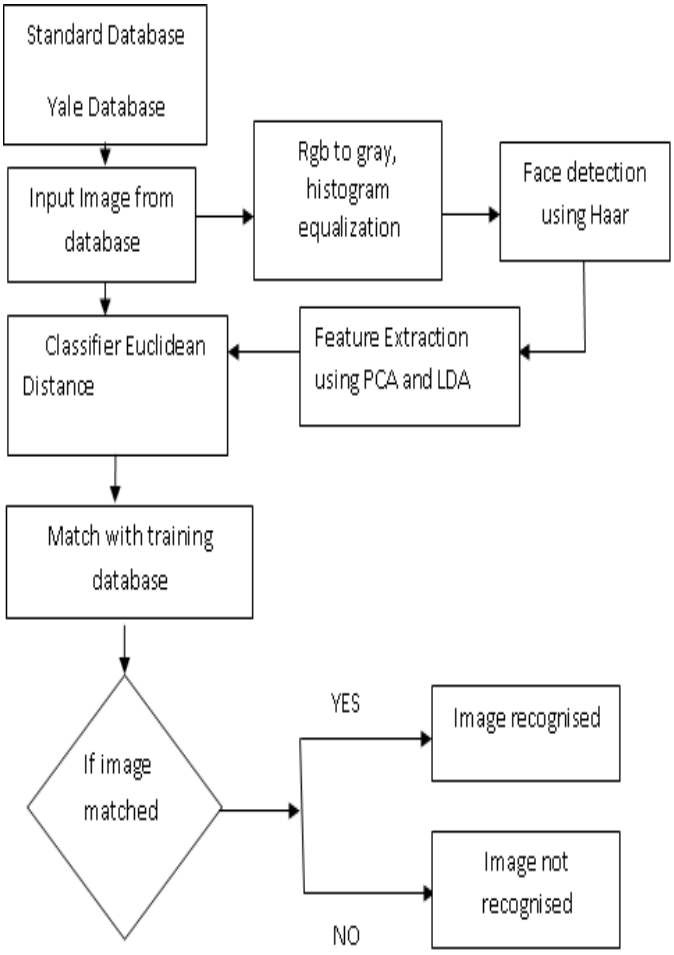

Figure 1 Step by step process of Face recognition Using PCA and LDA

This system is implemented on Yale database and achieves good quality outcome on 3 features class Illumination variant, Glass and non glass and Facial Expression. The system provides result on bases of face Recognition Rate

1.2 Feature Extraction in Face Recognition Using Linear Discriminate Analysis

A PCA is based on Eigen faces which are used to find a linear grouping of features which increase the number of variance in data. The Method PCA for Face recognition is Strong but a major complication of it is loss many discriminative information because of not consider classes and discard important components in the form of information. So the collected features are smeared together and a classification is more difficult. Overcome from this problem the other feature extraction technique LDA is used in system. LDA is used for classification and discrimination. LDA is a technique that used for supervised learning which depends on class labels. It is appearances based method and gives good result for face recognition. LDA used a linear depression for n dimensional data onto one dimensional gap. LDA used to get bunch of features which all divide in a finest way among classes. For increasing overall scattered value features are divided in such a way that increases proportion among classes towards inside sub-classes.

System first select image from database apply preprocessing rgb to gray and histogram equalization. Then the face detection process is applied on it using HAAR classifier. After applying Face detection on detected face LDA feature extraction method is apply. First LDA map the input into classification subspace. After that system find feature vector using LDA and this feature vector is used as input in Euclidian distance classifier for classification and match the feature vector in training database and recognize the face.

This comparative system is applied on Yale database and achieves good result on 3 features class Illumination variant, Glass and non glass and Facial Expression. The system apply PCA feature extraction method and LDA feature extraction method on this three classes and achieve comparative result on bases of face Recognition Rate is discussed in experimental result.

2. Experimental Result

The examination of proposed system is implemented using Emgucv-windows-universal 3.0.0.2157 software tool using C# language. The system analyze both the feature extraction technique PCA and LDA on Yale database. As input, the system used Standard Yale database. The Yale database contains 165 images in GIF format of 15 persons. The images of database are divided into 3 categories 1. Illumination variation 2. Glass and Non-Glass 3. Facial Expression. Dimension of an image of database is 320 x 243 for each. The system starts work from Training a dataset. The Face Detection ratio is for proposed analysis is 98.18% that shown in Table 1.

Table 1 Face Detection On Yale Database

Total No. of Yale Images	No. of Face Detected	Face Detection Ratio in (%)
165	162	98.18

Table 2 Face Recognition results for Illumination variant image with implementing LDA technique and PCA method

Illumination Condition	Total No. Of Images	No. of Face Recognised using PCA	No. of Face Recognized using LDA	Face Recognition Ratio in (%) for PCA	Face Recognition Ratio in (%) for LDA
Center Light	15	10	8	66.66	53.33
Left Light	15	10	8	66.66	53.33
Right Light	15	5	6	33.33	40

The above table 2 shows the recognition rate for PCA and LDA feature extraction techniques for the Center light, left light and right light images. It gives 66.66 percent ratio for PCA in both Center and Left light illumination variant image and 53.33 percent ratio for LDA. It gives poor recognition rate 33.33 percent for PCA in Right light illumination Images and 40 percent ratio for LDA. The Outcome shows for illumination condition of Right light LDA is better, for Leftlight and centre light PCA is much better.

Table 3 Face Recognition results for Glass and Non-Glass image by means of PCA procedure and LDA methodology

Glass and Non-Glass	Total No. Of Images	No.of Face Recognised using PCA	No. of Face Recognised using LDA	Face Recognition Ratio in (%) for PCA	Face Recognition Ratio in (%) for LDA
Glass	15	12	13	80	86.66
Non-Glass	15	13	15	86.66	100

The above table 3 shows that PCA and LDA feature extraction techniques are recognize the image of the both Wearing glass condition and without wearing gasses image. It gives 80 percent face recognition ratio for wearing glass condition and 86.66 for without wearing glass condition for PCA and LDA provides 86.6 percent ratio for With glass and 100 percent for non-glass images. For glass and non-class phases of implementation suggest that LDA is better to recognition face effectively compare to PCA.

The table 4 shows that PCA and LDA feature extraction techniques recognition ratio for the image of Facial expression. For Happy facial expression it PCA gives 93.33 percent recognition rate and LDA gives 86.66 percent , Sad facial expression with PCA gives 60 percent recognition rate and LDA provides 68.75 percent , sleepy facial expression gives 73.33 percent recognition rate for PCA and LDA gives 86.66 percent, surprised facial expression gives 80 percent recognition rate using PCA and LDA provides 80 percent , Wink facial expression with PCA gives 78.57 percent recognition rate and LDA outcome is 78.57 percent and normal facial expression gives 86.66 percent recognition rate using PCA and LDA provides 86.66 percent. For happy facial expression PCA is achieved higher accuracy , LDA is achieved higher accuracy for sad and sleepy expression , remaining expression such as surprised , wink and normal recognize equally with PCA and LDA.

Table 4 Face Recognition results for Yale database Facial Expression images using PCA and LDA technique

Facial Expression	Total No. Of Test Images	No. of Face Recognized using PCA	No. of Face Recognised using LDA	FRR for PCA Ratio in (%)	FRR for LDA Ratio in (%)
Happy	15	14	13	93.33	86.66
Sad	16	9	11	60	68.75
Sleepy	15	11	13	73.33	86.66
Surprised	15	12	12	80	80
Wink	14	11	11	78.57	78.57
Normal	15	13	13	86.66	86.66

The experimental result is used Face recognition rate as parameter. This parameter shows how many images are recognition form total numbers of images. Table 2, 3, 4 show the individual criteria's experimental result. Table 5 shows the average face recognition rate of the criteria. The average face recognition ratio is 55.55 % for Illumination condition, 83.33 for glass-non glass images, 77.77% for Facial expression n images and total face recognition rate on Yale database using PCA technique is 72.72% and for LDA average face recognition ratio is 48.88 % for Illumination condition, 93.33 for glass-non glass images, 81.21% for Facial expression n images and total face recognition rate on Yale database using PCA technique is 74.47% .

Table 5 Face Recognition results for Yale database using PCA and LDA technique

Category of images	Total No. Of Test Images	No. of Face Recognized PCA	No. of Face Recognized LDA	Face Recognition Ratio in PCA (%)	Face Recognition Ratio in LDA (%)
Illumination Condition	45	25	22	55.55	48.88
Glass-Non Glass	30	25	28	83.33	93.33
Facial Expression	90	70	70	77.77	81.21
All Images	165	120	123	72.72	74.47

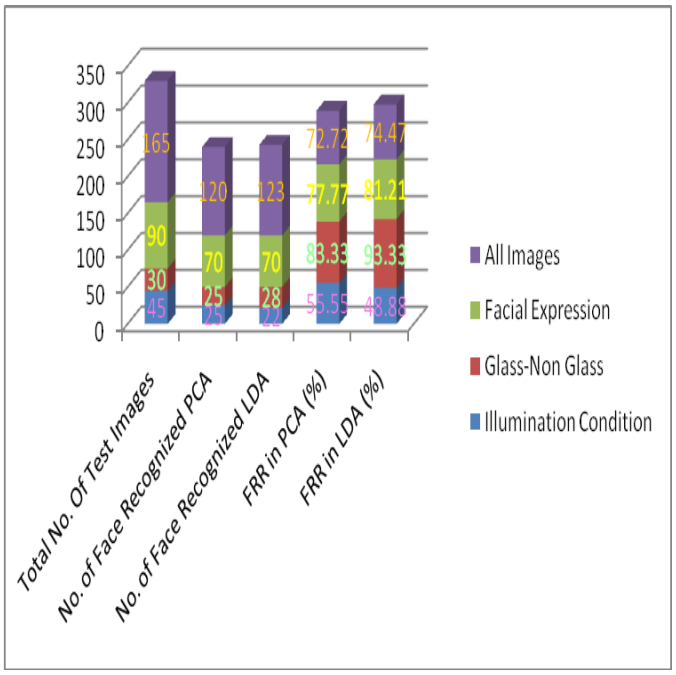

Chart -1: Comparison between PCA and LDA

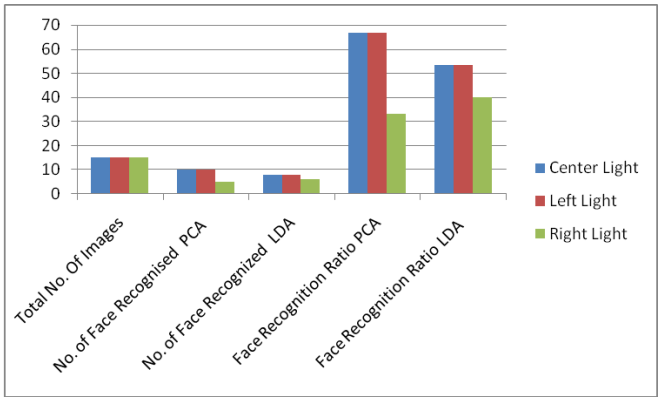

Chart -2: Illumination variant image with implementing LDA technique and PCA method

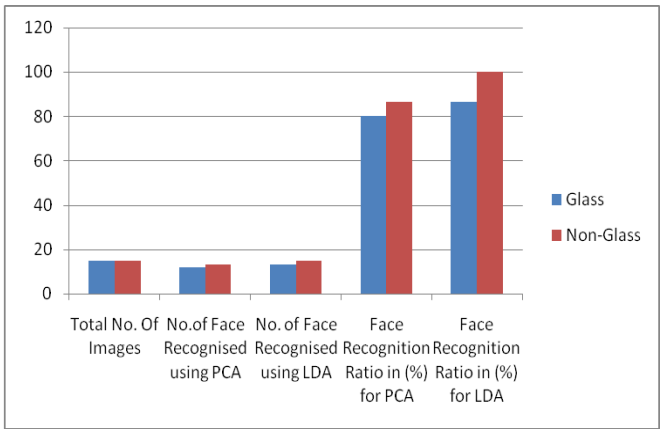

Chart -3: Glass-Nonglass image with implementing LDA technique and PCA method

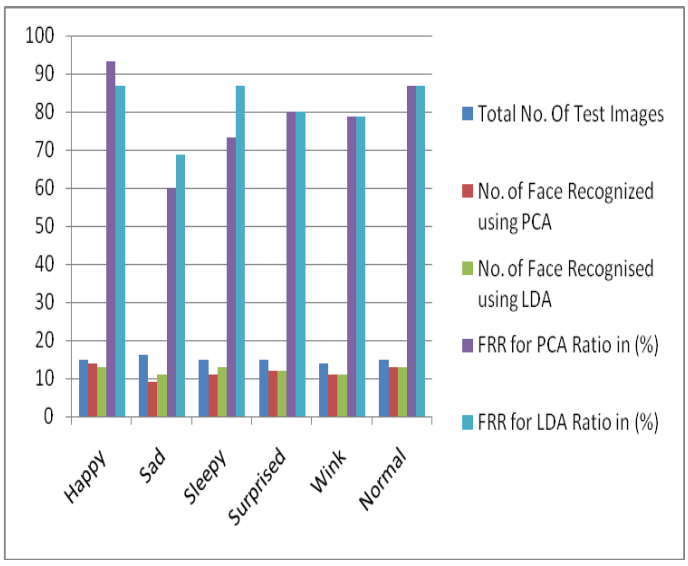

Chart -4: Facial Expression Image with implementing LDA technique and PCA method

3. CONCLUSIONS

A feature extraction is a quite tricky phase in a process of Recognition. To get better rate of face recognition the correct choice of algorithm from many for feature extraction is extremely significant and that plays significant role in face recognition process. Before selecting the feature extraction techniques you must have knowledge of it and which one performs accurately in which criteria. In this comparative analysis, it is provided which Feature extraction technique is performs accurate in different criteria. From individual conclusion it is clear and proves that LDA is efficient for facial recognition method for images of Yale database, comparative study mention that LDA achieved 74.47 % recognition rate with training set of 68 images and out of 165 images total 123 images are recognized with higher accuracy. In future Face Recognition rate can be improved that includes the full frontal face with facial expression using PCA and LDA. Face recognition Rate can be improved with hybrid preprocessing technique for PCA and LDA. Both feature extraction technique cannot give satisfied recognition rate for Illumination problem so it can be improved. PCA and LDA can be combining with other techniques DWT, DCT, LBP etc can improve the face recognition rate.

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