



## Comparison of Different Algorithm for Face Recognition

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Hemant Makwana<sup>α</sup> & Taranpreet Singh<sup>ο</sup>

**Abstract-** This paper is about the different algorithms which are used for face recognition. There are so many algorithms which are available for face recognition. There are two approaches by which the face can be recognize i.e. face Geometry based and face appearance based. The appearance based technique is also sub divided into two technique i.e. local feature and global feature based. The technique of local feature based are Discrete Cosine Transform (DCT). In this paper we study the two global features (holistic) appearance based algorithm i.e. Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) in which every face image is converted into 1D, we are using 1D for all the calculation and then compare these two algorithm with the help of FAR (False Acceptance Rate), FRR (False Rejection Rate), Time, Memory and checks which algorithm gives the better result.

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## I. INTRODUCTION

There are so many faces which the any normal human being seen in his daily life, but out of which they remember few of them. The faces which they remember are based on some feature based means they not exactly know the correct face but they know the feature of the particular face of the person. There are some special feature by which a exact person are recognize, like his color of eyes, shape of the ear which are remain same his all life. There are some features which are changes as the age is increase like shape of nose, shape of the lips etc. face Recognition is very complex process that find the exact match or minimum threshold value face to find out because the face image which are coming for recognition may contain noise or may be the light in the face or the color in the face image is not proper. the face which are coming for recognition purpose contain many useful information but using all these information is very much time consuming and consume lots of cost, so we reduce the some data like in this manner by which the useful information are not discarded. For this we are using PCA which is the reduction technique which reduces the parameter of the images. PCA uses Eigenfaces and Euclidean distance for matching the correct face from the database. We also use the LDA algorithm for face recognition, which is quite better then PCA algorithm. We seen later how Ida

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is better then pca? The Face Recognition are used in many places like Air ports, Military bases, Government offices, also use for daily attendance purpose in the multinational companies. Face Recognition has two phases first phase is the training of the faces which the faces are saved in the database and second face is the verification phase in which they have to find the exact match of the face which are present in the database.

## II. OVERVIEW OF THE SYSTEM

The proposed face recognition system consists of two module which are the enrollment and verification phases as depicted in Fig. 1. It consists of several sub modules which are Sensor, Feature, Extraction, Score Generation and the threshold. The Enrollment Module contains the Sensor and Feature Extraction while verification module contains score generation and threshold.

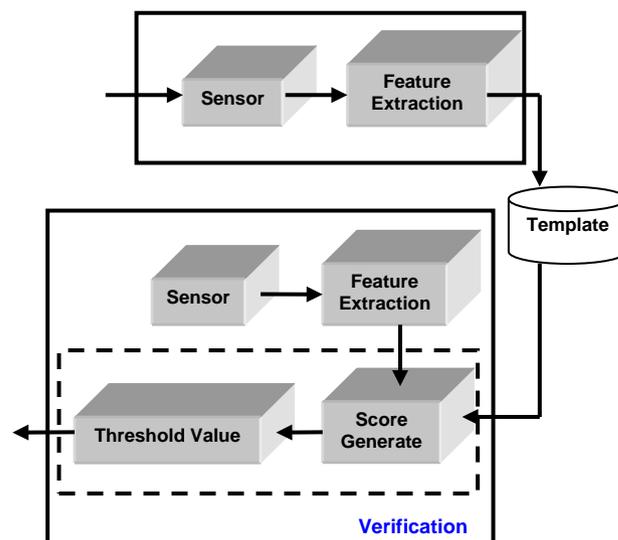


Figure 1 : Block Diagram of Face Recognition System

### a) Enrollment Module

The image is taken using a web camera and stored in a database. Next, the face image is detected and trained. During training, the face image is preprocessed. The features of the face image are extracted using several feature extraction techniques. The features data is then stored together with the user identity in a database.

#### i. Preprocessing

The purpose of the pre-processing module is to reduce or eliminate some of the variations in face due to

illumination. It normalized and enhanced the face image to improve the recognition performance of the system. In preprocessing technique the color image is first converted into gray scale or in black & white image. After that according to the algorithm the steps are apply into the image to store in the database and calculate the threshold value of those images, threshold value is also saved in the database. The first and second steps are completed in the enrollment module. By using the normalization process, system robustness against scaling, posture, facial expression and illumination is increased.[5][6]

#### b) Verification Module

A user's face is once again acquired and system uses this to either identify who the user is, or verify the claimed identity of the user. The input to the face verification module is the face image, which is derived from two sources from the camera or from the database. While identification involves comparing the acquired biometric information against templates corresponding to all users in the database, verification involves comparison with only those templates corresponding to claimed identity. The image are again go for the respective algorithm and generated the score this score is compare with the threshold value which are saved in the database, the third and the fourth step are completed in this module and respective output are shown in front of the user screen.

### III. ALGORITHM FOR FACE RECOGNITION

There are two approaches by which the face can be recognize i.e. face Geometry based and face appearance based. The appearance based technique is also sub divided into two technique i.e. local feature and global feature based. The technique of local feature based are Discrete Cosine Transform(DCT).In this paper we study the two global features (holistic) appearance based algorithm i.e. Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA).

#### a) Principal Component analysis (PCA)

PCA for face recognition is based on the information theory approach. It extracted the relevant information in a face image and encoded as efficiently as possible. It identifies the subspace of the image space spanned by the training face image data and decorrelates the pixel values. The classical representation of a face image is obtained by projecting it to the coordinate system defined by the principal components. The projection of face images into the principal component subspace achieves information compression, decorrelation and dimensionality reduction to facilitate decision making. In mathematical terms, the principal components of the distribution of faces or the eigenvectors of the covariance matrix of the set of face images, is sought by treating an image as a vector in a very high dimensional face space [7]

[8][9].We apply PCA on this database and get the unique feature vectors using the following method .Suppose there are P patterns and each pattern has t training images of m x n configuration.

- The database is rearranged in the form of a matrix where each column represents an image.
- With the help of Eigen values and Eigen vectors covariance matrix is computed.
- Feature vector for each image is then computed. This feature vector represents the signature of the image. Signature matrix for whole database is then computed.
- Euclidian distance of the image is computed with all the signatures in the database.
- Image is identified as the one which gives least distance with the signature of the image to recognize.

#### Advantage of this Algorithm

- It completely decorrelates any data in the transform domain.
- it packs the most energy (variance) in the fewest number of transform coefficient.
- It minimizes the MSE (mean square error) between the reconstructed and original data for any specified data compression.
- It minimizes the total entropy of the data.

#### Disadvantage of this Algorithm

- There is not fast algorithm for its implementation.
- The PCA is not a fixed transform but has to be generated for each type of data statistics
- There is considerable computational effort are needed for generation of Eigen values and Eigen values of the covariance matrix.

#### b) Linear Discriminant Analysis (LDA)

LDA seeks directions that are efficient for discrimination between the data.LDA maximizes the between-class scatter and minimizes the within-class scatters. This criterion tries to maximize the ratio of the determinant of the between-class scatter matrix of the projected samples to the determinant of the within-class scatter matrix of the projected samples. Fisher discriminants group images of the same class and separates images of different classes. Images are projected from  $N^2$ -dimensional space to  $C$  dimensional space (where  $C$  is the number of classes of images). To identify an input test image, the projected test image is compared to each projected training image, and the test image is identified as the closest training image. The within class scatter matrix represents how face images are distributed closely within classes and between class scatter matrix describes how classes are separated from each other. When face images are projected into the discriminant vectors  $W$ , face images should be distributed closely within classes and should be separated between classes, as much as possible. In

other words, these discriminant vectors minimize the denominator and maximize the numerator. The use of Linear Discriminant Analysis for data classification is applied to classification problem in speech recognition. We decided to implement an algorithm for LDA in hopes of providing better classification compared to Principle Components Analysis.[13].The prime difference between LDA and PCA is that PCA does more of feature classification and LDA does data classification.



Figure 2 : Face Images for the database

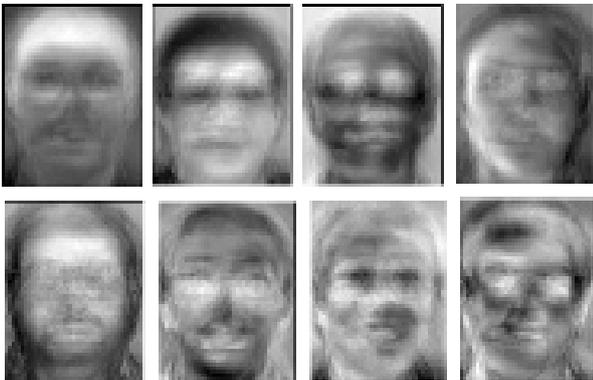


Figure 3 : Calculated Eigen Faces of the person

#### IV. COMPARISON BETWEEN THE ALGORITHMS

We will compare these two algorithms with respect of FAR (False Acceptance Rate), FRR (False Rejection Rate), memory and time.

**False Rejection Rate:** The probability that system will fail to identify an enrollee. This is also called type I error rate.

$$FRR = \frac{NFR}{NEIA}$$

Where

NFR= Number of false rejection rates

NEIA= Number of enrollee identification attempt.

**False Acceptance RATE (FAR):** The probability that system will incorrectly identify an individual or fail to reject an imposter. It is also called type II error type.

$$FAR = \frac{NFR}{NIIA}$$

Where

NFR= Number of false rejection rates

NIIA= Number of imposter identification attempt.

Feature Extractor	No. of Images	FAR = FRR (%)	
		FAR	FRR
PCA	8	15	85
	12	17	83
	15	20	80
LDA	8	13	83
	12	12	88
	15	07	92.33

Figure 4 : Comparison of FAR &FRR of different Images

In Fig-5, 6 we calculate how much time is spend in recognizing the face which is coming for recognizing process in the individual algorithm.fig-5 show the result of PCA algorithm & fig-6 show the result of LDA algorithm. With the help of below figures we conclude that PCA consumes more time than LDA algorithm for recognizing the face.

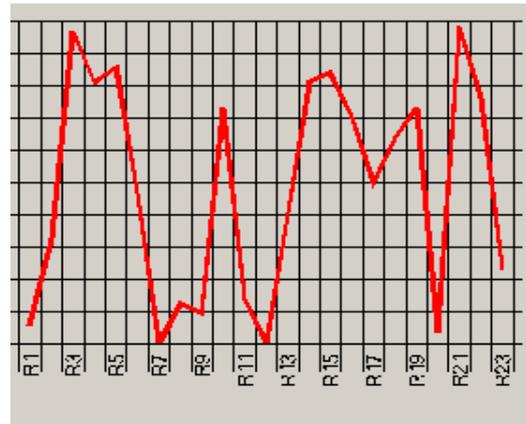


Figure 5 : Calculate time for Calculating the PCA Result

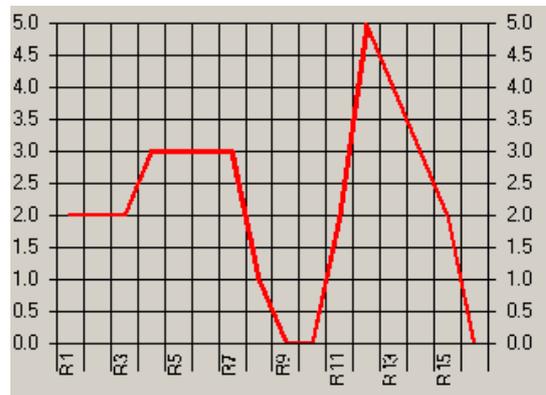


Figure 6 : Calculate time for Calculating the LDA Result

In Fig-7, 8 we calculate how much memory is spend in recognizing the face which is coming for recognizing process in the individual algorithm.fig-7 show the result of PCA algorithm & fig-8 show the result of LDA algorithm. With the help of below figures we conclude that PCA occupies more memory than LDA algorithm.

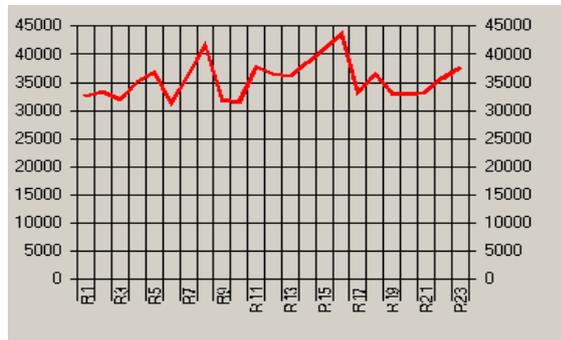


Figure 7 : Calculate memory for Calculating the PCA Result

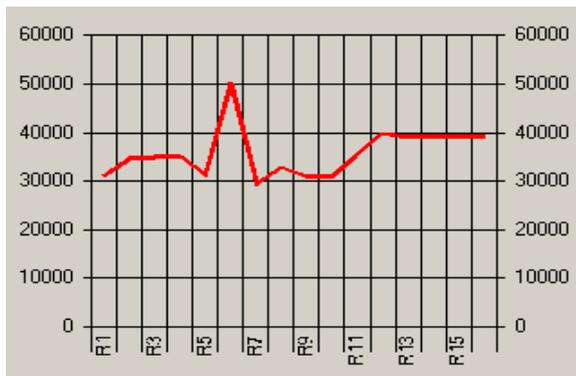


Figure 8 : Calculate memory for Calculating the LDA Result

#### Principal Component Analysis (PCA)

- Project faces onto a lower dimensional sub-space.
- No distinction between inter- and intra-class variability
- Reduce the dimension of the data from  $N^2$  to  $M$
- Verify if the image is a face at all.
- Problems with illumination, head pose, etc.
- Optimal for representation but not for discrimination.

#### Linear Discriminant Analysis (LDA)

- Find a sub-space which maximizes the ratio of inter class and intra-class variability.
- Same intra-class variability for all classes.
- Work also with various illuminations, etc
- Reduce dimension of the data from  $N^2$  to  $P-1$
- Can only classify a face which is "known" to the database.

## V. CONCLUSION

The paper has presented a comparison of different type of face recognition algorithm like PCA, LDA algorithm. The overall performance for verification of image by using these two algorithm we concluded that the LDA gives the better performance as comparison with the PCA algorithm. The main difference between these algorithm when we perform Analysis and experimental results indicates that the PCA works well when the lightening variation is small. LDA works gives better accuracy in facial expression. We also notice that

PCA are time consuming as compare with the LDA algorithm. Also we test with the help of FAR&FRR term than we concluded that LDA shows better result than PCA.

## REFERENCES RÉFÉRENCES REFERENCIAS

1. Matthew Turk and Alex Pentland, " Eigenfaces for Recognition," SPIE Vol.1192 IRCWIn (i989), 22-32.
2. Kirby and Sirovich, 1990. Application of Karhunen-Loeve procedure for the characterization of human faces. IEEE Trans. pattern analysis and machine intelligence, 12:103-108.
3. Turk, M.A. and A.L. Pentland, 1991. Face recognition using Eigen faces. Proc. IEEE computer society Conf Computer Vision and pattern recognition, pp: 586-591.
4. Kyungim Baek, Bruce A. Draper, J. Ross Beveridge, Kai She, "PCA vs. ICA: A Comparison on the FERET Data Set", Proceedings of the 6th Joint Conference on Information Science (JCIS), 2002, pp. 824-827.
5. T. Chen, W.Yin, X.-S. Zhou, D. Comaniciu, T. S. Huang, Total Variation Models for Variable Lighting Face Recognition and Uneven Background Correction", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 28(9), 2006, pp.1519-1524.
6. Longin Jan Latecki, Venugopal Rajagopal, Ari Gross, "Image Retrieval and Reversible Illumination Normalization", SPIEIS&T Internet Imaging VI, vol. 5670, 2005.
7. P. J. B. Hancock, V. Bruce and A. M. Burton, "Testing Principal Component Representations for Faces", Proc. of 4<sup>th</sup> Neural Computation and Psychology Workshop, 1997.
8. Jonathon Shlens, "A Tutorial on Principal Component Analysis", Systems Neurobiology Laboratory, Ver.2, 2005.
9. Zhuji, Y.L.Y., 1994. Face recognition with Eigen faces. Proc. IEEE Intl. Conf. Industrial Technol. Pp: 434-438.
10. Debipers and, S.C. and A.D Broadhurst, 1997. Face recognition using neural networks. Proc. IEEE Commun. Signal Processing (COMSIG'97), pp: 33-36.
11. Nazish, 2001. Face recognition using neural networks. Proc.IEEE INMIC 2001, pp: 277-281.
12. D.E Rumelhart, G.E. Hinton and R.J. Williams, Learning internal representation by error propagation, In D.E. Rumelhart and J.L. McClelland, eds, parallel distributed processing. Exploration in microstructure in cognition.1 pp:318-362.
13. MIT press, Cambridge, Massachusetts, (1986). Kilian Q. Weinberger, John Blitzer and Lawrence K. Saul, "Distance Metric Learning for Large Margin Nearest Neighbor Classification", Neural Information Processing Systems (NIPS), 2005.