International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 3.45 (SJIF-2015), e-ISSN: 2455-2585
Volume 4, Issue 5, May-2018

Performance comparison of KPCA and LDA using Gabor filters Based Face Recognition System

Bhavani.B[1], Hemantha Kumar Kalluri[2]
[1]*PG Student, Department of computer engineering, Vignan's deemed to beuniversity,bhavanibandlamudi777@gmail.com*
[2]*Professor, Department of computer engineering, Vignan's deemed to be university, khkcsevignan@gmail.com*

Abstract—Face recognition is one of the standout among the most essential areas in research over from the past to present. Feature extraction is very important and it plays a major role in improving the recognition rate of the face biometric system. In my project, I have mainly focused on Gabor filter feature extraction technique and performed comparison on the linear Gabor LDA with the Gabor KPCA which is a non-linear technique to analyze which technique is better suitable for face identification environment. These procedures, admirablyfunctions well under robust conditions like complex variations in picture quality, distinctive face positions and different lightening conditions. These calculations give diverse rates of exactness under various conditions as tentatively watched.

These algorithms work well for ORL face dataset which have a particular appearance changing under certain range. We have taken a face picture database and successfully performed the calculations in MATLAB effectively.

Keywords— Gabor, LDA, KPCA, Face Recognition,ORL Database.

I. INTRODUCTION

Face identification is a standout amongst the most vital areas in biometrics. Besides that there are different biometric areas of research, They are palmprint, iris and fingerprint recognition compared to all recognition systems Face identification is the one which gives good results [1]. It is very easy to recognize the face of the humans by seeing,but for computer it is exceptionally hard to distinguish because computers can't understand the human language. It can understand only binary language, sowith a specific end goal to perform face recognition they are of two different types. They are Geometric and Photometric where as geometric is concerned,it takes the different points which are unchangeable on the face, for example, eyes, nose, mouth, etc. And calculate the detachment between the points based on that we perform the identification and verification [2]. However photometric is concerned system will identify by seeing the picture shapes. In face recognition the main important part is the feature extractions; during feature extraction we use different pre-processing techniques in view to remove the noise from the pictures to get better accuracy. There are a different variety of face identification algorithms which work well in both linear and nonlinear sub-space [3]. Kalluri et al., [4-6] proposed palmprint identification algorithms. Kumar et al., proposed face recognition using LDP. Basavaraj et al., [11] used Kernel PCA. Chelali et al., [11] used LDA for face recognition.

The face identification system operates in two ways they are identification and verification. As far as identification is concerned, we have to perform one to many matching (1: M) by which we have to recognize a person from a whole database. Whereas verification is concerned, we have to perform one to one match (1:1) which means we have to identify a person between two images.

In this paper, we used LDA (linear) and a nonlinear technique that is KPCA is used to identify which technique is best for face identification system and performs dimensionality reduction using Gabor filters.

II. METHODOLOGY

Different steps that have been in the proposed methodology are illustrated as

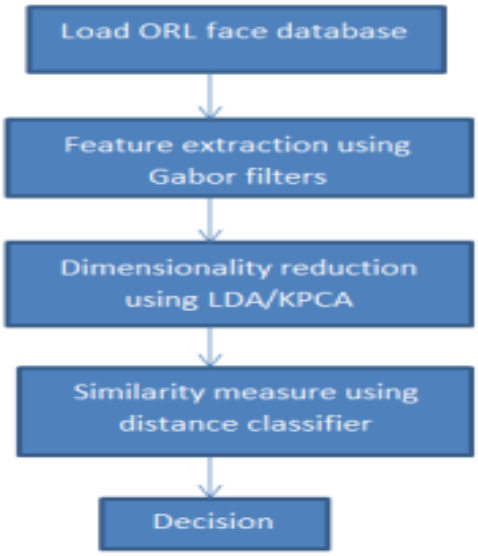

Fig 2.1 proposed methodology

A. *Database*

The task of my project is by using ORL Face Dataset.It contains total of 400 images of 40 distinct people 10 pictures of every individual with various facial appearances and different angles from which 120 pictures are taken for training and remaining 280 pictures for testing.

B. *Feature extraction by using Gabor filters*

The Gabor filters are mainly utilized for feature extraction from a face image. Gabor filters are about 40 different types with 8 different types of orientations and 5different scales they are 0,22.5,45,67.5,90,112.5,135,157.5 and 0,1,2,3,4 respectively to separate the Gabor magnitude features[8].

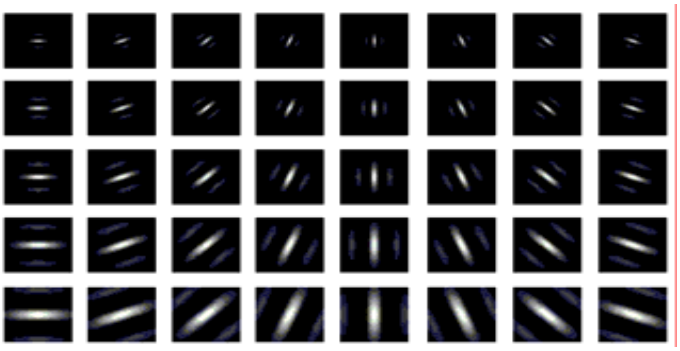

Fig 2.2 Gabor Filters with 8 Orientations and 5 Scales

C. *Data Sets for training, testing and evaluation*

We separate the information into Training, Testing and Evaluation sets. The initial three pictures of each set are taken for training and next three for evaluation and the pictures which are remaining are taken for testing after partitioning the data. We generate a feature vector for all the three sets, Such as Training, Testing and Evaluation set and use this feature vector for reducing the number of dimensions using LDA/KPCA. We consider an aggregate of 120 pictures for training of size 10240 pixels and 280 for testing[9].

D. LDA (Linear Discriminant Analysis)

LDA is a linear technique in which class labels are defined and it is supervised learning technique. LDA is mainly used to minimize within class likeness and increase between class likenesses. LDA is mainly used to generate fisher faces and by using these fisher faces, we perform dimensionality reduction. LDA is the extension of PCA. It is too hard to recognize the adjustments in the face picture such as different lightening conditions, different angles and different expressions. By making use of LDA, we can overcome these disadvantages. LDA takes less storage space in comparison to other algorithms [9].

Suppose if we consider a dataset of images $\{I_1, I_2, I_3 \ldots I_n\}$ and their feature vectors of size $\{F_1, F_2, F_3 \ldots F_n\}$After feature extraction by utilizing Gabor filters projecting the data to a f-dimensional vector space. Then after, by utilizing LDA we perform dimensionality decrease and project data to a s-dimensional vector space. As compared to f-dimensional vector space s-dimensional vector space is having less features and less complex[10].

E. KPCA (Kernel Principal Component Analysis)

KPCA is a non-linear technique and is an unsupervised learning method for which class labels are not defined. By using KPCA it is necessary to compute the eigenvectors for all the pictures and uses various types of kernel functions mainly I used polynomial kernel to compute the kernel function. After computation of the kernel function to apply PCA to the data set and generate Eigenvalues. The main aim of KPCA is to project the data from a linear space into non-linear space [2].

The disadvantage of this algorithm is that we need to store the original sample images in view to calculate kernel function which takes a huge amount of storage space and high computation cost because we have to compute a kernel function. After that calculate Eigenvalues takes a very large amount of time[1].

F. Similarity Measures

Remembering that the objective is to compute the difference between the face features we use different distance measures such as Euclidean Distance, City Block distance, Cosine Distance and Mahalanobis Cosine Distance measures.

In our experiments, we used Mahalanobis cosine distance measure to compute the similarity between the query and database facial features.

G. Mahalanobis Cosine Distance (MAHCOS)

Mahalanobis Cosine Distance is used to identify the similarity between two groups of images such as Testing and Training sets. Suppose consider that $\{Y_1, Y_2 \ldots Y_N\}$ be the diminished vectors after extracting features and dimensionality reduction, then compute average face picture such as $\theta = \frac{1}{n}\sum_{i=1}^{n} y_i$ And also compute average subtracted face picture is given as $\emptyset = Y_N - \theta$. Then calculate the Eigenvectors of two sets u and v

Mahalanobis Cosine Distance is mainly used to figure the Cosine Angle among two setv and u in a reduced Mahalanobis space[3 - 2].

The Mahalanobis Cosine Distance can be formulated as follows:

$$D_{mahCosine}(u, v) = \frac{uv}{|u||v|}$$

III. EXPERIMENT AND RESULTS

The procedures have been looked at database utilizing three particular sets Training set, Evaluation set and the Testing set. The initial three pictures of each and every set were utilized for the training set. Subsequently, the next three pictures are used for the Evaluation data set finally the remaining pictures were used for the testing set. The experimentations were done on the freely available ORL Face Dataset to analyse the execution of the Gabor-LDA and Gabor-KPCA techniques.

A. Gabor-LDA Results

1) Using Mahcos Distance

During identification by using GABOR LDA the recognition rate is given as 93.33%. The verification stage we need to compute the following: The HTER (Half Total Error Rate) was 1.56%, the EER (Equal Error Rate)on the evaluation test set data was 2.51% and verification rates at different FAR(False Acceptance Rates) such as 0.01%, 0.1% and 1% was given as 0.83%,93.33%,97.50%, respectively. At a particular threshold the verification rates of the test data are given as: At a FAR of 0.1% and 1% the results on the test set is given as 91.88% and 99.38% respectively.

The results are evaluated by using ROC, CMC and EPC curves on the freely available ORL Face dataset.

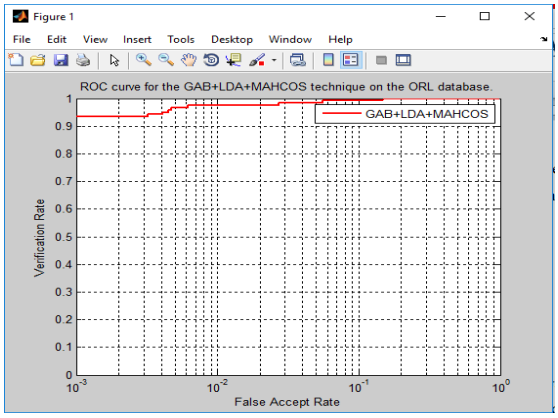

Fig 3.1 ROC Curve for Gabor LDA on ORL Database

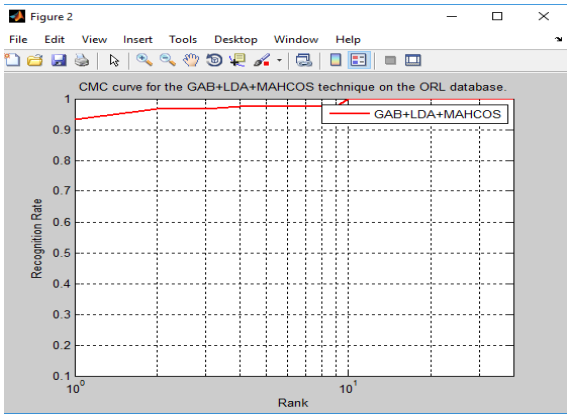

Fig 3.2 CMC Curve for Gabor LDA on ORL Database

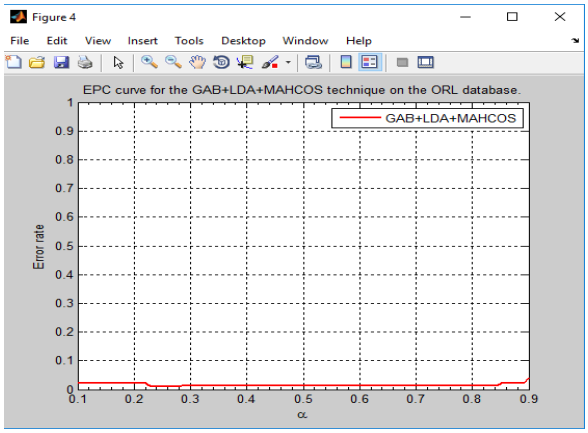

Fig 3.3 EPC Curve for Gabor LDA on ORL Database

B. Gabor-KPCA Results

1) Using Mahcos Distance

The GABOR-KPCA identification rate was given as 80.00%. The verification rates are given as follows: The minimal HTER (Half Total Error Rate) was 2.68% and EER (Equal Error Rate)was given as 4.17% and the verification rate at different FAR(false acceptance rate) such as 0.01%, 0.1% and 1% was given as 0.83%,92.0% and 95.00% respectively. At last the verification of the test data at a particular threshold: At 0.1% and 1%FAR (False Acceptance Rate) on the test set data we get an accuracy of 56.88% and 71.88% and respectively.

The results are evaluated by using ROC, CMC and EPC curves on the freely available ORL Face dataset

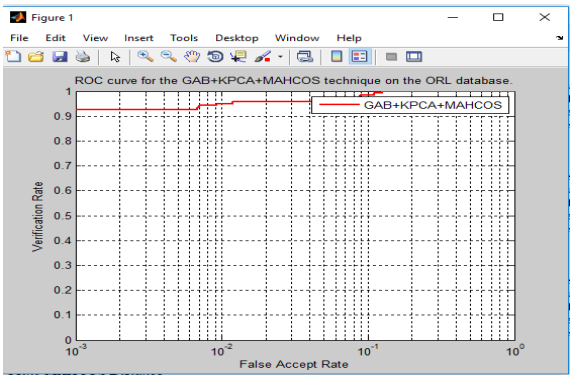

Fig 3.4 ROC Curve for Gabor KPCA on ORL Database

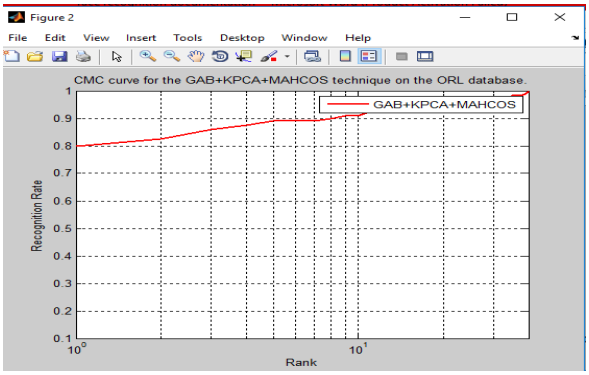

Fig 3.5 CMC Curve for Gabor KPCA on ORL Database

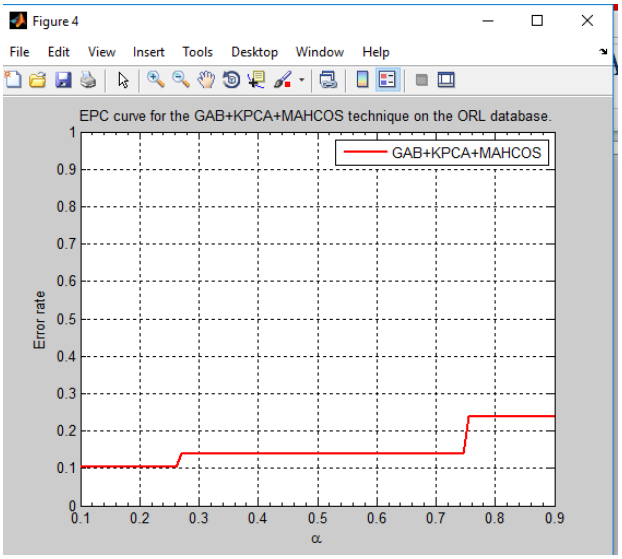

Fig 3.6 EPC Curve for Gabor KPCA on ORL Database

IV. CONCLUSION

We have performed comparatively on the GABOR-LDA and GABOR-KPCA to analyze which technique gives better results. We have performed our experiment on the freely available ORL face database and performed comparison by using ROC, CMC and EPC curves. The GABOR-LDA strategy performed all around compared with GABOR-KPCA utilizing MAHCOS distance. GABOR-LDA has a recognition rate of 93.33%, whereas GABOR-KPCA has a recognition rate of 80.00%.The GABOR-LDA has an equivalent error rate of 2.50%, whereas GABOR-KPCA has an equivalent error rate of 4.18%.There is a little variation in execution among two techniques but somehow GABOR-LDA is better compared with GABOR-KPCA.

REFERENCES

[1]**Li, Jun-Boa, Shu-Chuan Chu, and Jeng-Shyang Pan**. "Kernel Principal Component Analysis (KPCA)-Based Face Recognition" Kernel Learning Algorithms for Face Recognition. Springer, New York, NY, 2014, 71-99.

[2] **Nitin Prakash, Prathviraj Shetty, Kiran Kedilaya, Nithesh, Sunil** "Comparative Study of PCA,KPCA,KFA and LDA Algorithms for Face Recognition" *International Research Journal of Engineering and Technology Mar-2018.*

[3] **Shah, Jamal Husain, Muhammad Sharif, Madrassa Raze and Aisha Abeam** " A Survey on linear and non-linear PCA Based Face Recognition Techniques" *Int Arab J.Inf.Techno1.10,no.6(2013):536-545*.

[4] **HK Kalluri, MVNK Prasad, A Agarwal,**Dynamic ROI extraction algorithm for palmprints, International Conference in Swarm Intelligence, 217-227, 2012

[5] **HK Kalluri, MVNK Prasad,**Palmprint Identification Using Gabor and Wide Principal Line Features, Procedia Computer Science 93, 706-712, 2016

[6] **HK Kalluri, MVNK Prasad, A Agarwal,**Palmprint identification and verification based on wide principal lines through dynamic ROI, International Journal of Biometrics 7 (1), 1-30, 2015

[7] **S V P Kumar, K V K Kishore, K H Kumar,** Hybrid face recognition with locally discriminating projection, ICSAP, 2010.

[8] **Meshgini Saeed, Ali Aghagolzadeh and Hadi Seyedarabi** "face recognition using a Gabor filter bank, kernel principal component analysis and support vector machine" *International Journal of Computer Theory and Engineering4,no,5(2012)*.

[9] **Vinay.A, S.Shekhar, K.N.Balasubramanya Murthy, S.Natarajan** "Performance Study of LDA and KFA for Gabor Based Face Recognition System" *3rd International Conference on Recent Trends in Computing 2015.*

[10] **Bhattacharyya, Sudan Kumar, and Kumar Rahul**. "Face recognition by linear discriminant analysis." *International Journal of Communication Network Security 2.2 (2013): 31-35.*

[11**]** **Mr. G. D. Basavaraj, Dr. G. Umamaheswara Reddy**"An Improved Face Recognition Using Neighborhood Defined Modular Phase Congruency Based Kernel PCA" *International Journal of Engineering Research and Applications (IJERA) Mar-Apr 2012*.

[12] **Chelali, Fatma Zohra, A. Djeradi**" Linear discriminant analysis for face recognition" *Multimedia computing and Systems, 2009. ICMCS'09. International Conference on IEEE, 2009.*