

# Comparitive Study on Face Recognition Using HGPP, PCA, LDA, ICA and SVM

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## Abstract

We are comparing the performance of five algorithms of the face recognition i.e. HGPP, PCA, LDA, ICA and SVM. The basis of the comparison is the rate of accuracy of face recognition. These algorithms are employed on the ATT database and IFD database. We find that HGPP has the highest rate of accuracy of recognition when it is applied on the ATT database whereas LDA outperforms the all other algorithms when it is applied to IFD database.

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**Index terms**— face recognition, PCA, LDA, ICA, HGPP, SVM.

Introduction oday, we have a variety of biometric techniques like fingerprints, iris scans, and speech recognition etc. but among of them face recognition is still most common technique which is in use. It is only due to the fact that it does not require aid or consent from the test subject and easy to install in airports, multiplexers and other places to recognize individuals among the crowd. But face recognition is not perfect and suffers due to various conditions like scale variance, Orientation variance, Illumination variance, Background variance, Emotions variance, Noise variance, etc [15]. Due to these challenges, researchers are very keen to find out the rate of accuracy for face recognition. So they are always trying to evaluate the best algorithm for face recognition.

Various comparisons had been performed by the researchers [1], [3], [4], [5], [10], [11], [16]. Here we are also compare five algorithms like PCA [17], LDA [19], ICA [2], SVM [7], and HGPP [20] on the basis of rate of accuracy of face recognition. The brief description of all above said algorithms are given below:II.

## 1 Face recognition algorithms a) Principal Component Analysis (PCA)

It is an oldest method of face recognition which is based on the Karhunen-Loeve Transform (KLT) as Hotelling Transform and Eigenvector Transform), works on dimensionality reduction in face recognition.

Turk and Pent land used PCA exclusively for face recognition [17]. PCA computes a set of subspace basis vectors for a database of face images. These basis vectors are representation of an images which is correspond to a face.

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-Like structures named Eigen faces. The projection of images in this compressed subspace allows for easy comparison of images with the images from the database. The approach to face recognition involves the following initialization operations [17]:

? Acquire an initial set of N face images (training images). ? Calculate the eigenface from the training set keeping only the M images that correspond to the highest eigenvalues. These M images define the "face space". As new faces are encountered, the "eigenfaces" can be updated or recalculated accordingly. ? Calculate the corresponding distribution in M dimensional weight space for each known individual by projecting their face images onto the "face space". ? Calculate a set of weights projecting the input image to the M "eigenfaces". ? Determine whether the image is a face or not by checking the closeness of the image to the "face space". ? If it is close enough, classify, the weight pattern as either a known person or as an unknown based on the Euclidean distance measured.

? If it is close enough then cite the recognition successful and provide relevant information about the recognized face from the database which contains information about the faces.

b) Linear Discriminant Analysis (LDA)

LDA also known as Fisher's Discriminant Analysis, is another dimensionality reduction technique. It is an example of a class specific method i.e. LDA maximizes the between -class scattering matrix measure while minimizes the within -class scatter matrix measure, which make it more reliable for classification. The ratio of the between -class scatter and within -class scatter must be high [19]. c) Independent Component Analysis (ICA) Generalization View of the PCA is known as ICA. It minimizes the second order and higher order dependencies in the input and determines a set of statistically independent variables or basis vectors. Here The Support Vector Machine is based on VC theory of statistical learning. It is implement structural risk minimization [17]. Initially, it was proposed as per a binary classifier. It computes the support vectors through determining a hyperplane. Support Vectors maximize the distance or margin between the hyperplane and the closest points. e) Histogram of Gabor Phase Patterns (HGPP) HGPP is the combination of spatial histogram and Gabor phase information. Gabor phase information is of two types. These are known as Global Gabor phase pattern (GGPP) and Local Gabor phase pattern (LGPP). Both of the Gabor phase patterns are based on quadrant-bit codes of Gabor real and imaginary parts (Quadrant-bit codes proposed by Daugman for iris recognition [6]. Here GGPP encodes orientation information at each scale whereas LGPP encodes the local neighborhood variations at each orientation and scale. Finally, both of the GPP's are combined with spatial histograms to model the original object image.

Gabor wavelet is well known algorithm for the face recognition. Conventionally, the magnitude of the Gabor coefficients are considered as valuable for face recognition and phase of the Gabor coefficients are considered useless and always discarded. But use of the spatial histograms, encodes the Gabor phases through Local binary.

Pattern (LBP) and provides the better recognition rate comparable with that of magnitude based methods. It shows that combination of Gabor phase and magnitudes provides the higher classification accuracy. These observation paid more attention towards the Gabor phases for face recognition.

## 2 III.

## 3 Research methodology

We used ATT and IFD database for comparison of different face recognition algorithms such as PCA, LDA, ICA, SVM and HGPP. Based on algorithm, we extract different features from a training set. Using these feature we trained the classifier. We extract features from testing set and find the accuracy of the algorithm.

IV.

## 4 Data analysis

We used ATT and IFD databases for training and testing different algorithms. We took 40 persons images from ATT and IFD database. 5 images of each person are used for training and 5 images of each person are used for testing algorithms. From Fig. ?? it is observed that all algorithms give better result on ATT database then IFD database. HGPP give best result on ATT database and LDA give best result on IFD database.

V.

## 5 Experimental results

Here, two face databases have been employed for comparison of performance. These are -1. ATT face database and 2. Indian face database (IFD). These two databases have been chosen because the ATT contains images with very small changes in orientation of images for each subject involved, whereas the IFD contains a set of 10.

## 6 Performance analysis

Above analysis shows the performance of the five algorithms on the database of the ATT and IFD. Following points we have observed in this experiment.

? It is observed that recognition rate of the ATT database is higher as compare to IFD database. This observation is due to the nature of images contain in the IFD database. In this database, each subject is portrayed with highly varying orientation angles. It also shows that each image has rich background region than the ATT database.

## 7 Conclusion

Here, we have employed five algorithms of face recognition i.e. PCA, LDA, ICA, SVM and HGPP. The performance was calculated in terms of the recognition accuracy. It is observed that recognition rate of the ATT.

Database is higher as compare to IFD database. This observation is due to the nature of images encompassed in the IFD. It is observed that HGPP has 98.99% rate of accuracy of recognition for ATT. It is observed that when five algorithms employed on IFD database then LDA outperform all remaining four algorithms. LDA has highest rate of accuracy of recognition i.e. 86.3%. HGPP is effective but suffers from the local variations that's it has the lowest rate of accuracy when HGPP employed on IFD database.

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100 **8 VIII.**

101 **9 Future scope**

102 Lot of work can be done in field of face recognition such as most of the algorithms give good result on Frontal.

103 Face recognition but at different angles they do not give good result. To recognize a face at an angle we have  
104 to give some 3D face recognition algorithm. We can club other modality with face recognition algorithm for best  
105 results example face-iris, face-fingerprint, faceiris-fingerprint. Face recognition algorithm rate can be improved  
by first detecting the face from image and then crop the detected face and process it for recognition. <sup>1 2</sup>



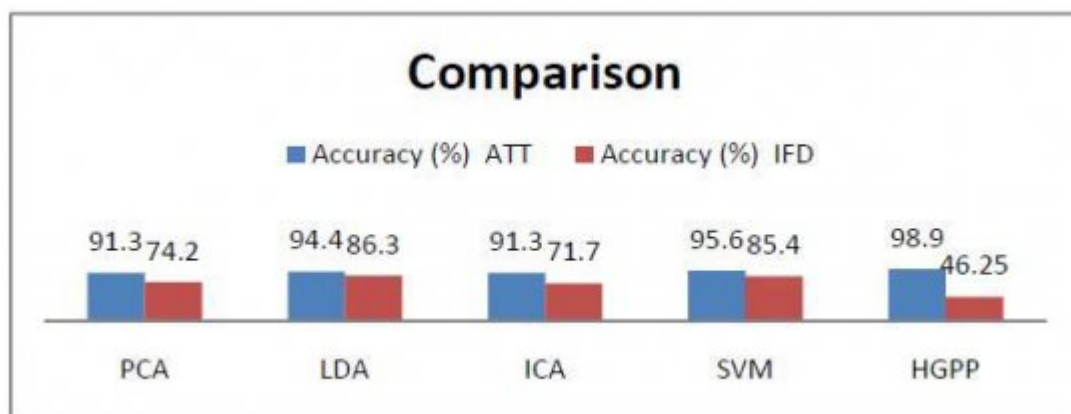
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Figure 1: T © 2012

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Figure 2: Figure :

VII.

Figure 3:

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- 107 [Baochang ()] ‘A Novel Object Representation Approach for Face Recognition’. Zhang Baochang . *IEEE*  
108 *Transactions on Image Processing* 2007. 16 (1) p. . (Histogram of Gabor Phase Patterns (HGPP))
- 109 [Navarrete and Ruiz-Del-Solar ()] ‘Analysis and Comparison of Eigenspace -Based Face Recognition Approaches’.  
110 P Navarrete , J Ruiz-Del-Solar . *International Journal of Pattern Recognition and Artificial Intelligence* 2002.  
111 16 (7) p. .
- 112 [Kirby and Sirovich ()] ‘Application of the Karhunen Loeve procedure for the Characterization of human face’.  
113 M Kirby , L Sirovich . *IEEE Trans. Pattern Analysis and Machine Intelligence* 1990. 12 (1) p. .
- 114 [Belhumeur et al. ()] ‘Eigenfaces vs. Fisherfaces: Recognition Using Class Specific Linear Projection’. P N  
115 Belhumeur , J P Hespanha , D Kriegman . *IEEE TPAMI*, 1997. 19 p. .
- 116 [Becker and Ortiz ()] ‘Evaluation of Face Recognition Techniques for Application Facebook’. B C Becker , E G  
117 Ortiz . *Proceedings of the 8th IEEE International Automatic Face and Gesture Recognition Conference*, (the  
118 8th IEEE International Automatic Face and Gesture Recognition Conference) 2008.
- 119 [Bartlett et al. ()] ‘Face Recognition by Independent Component Analysis’. M S Bartlett , J R Movellan , T J  
120 Sejnowski . *IEEE Transactions on Neural Networks* 2002. 13 p. .
- 121 [Guo and Li ()] ‘Face Recognition by Support Vector Machines’. G Guo , S Z Li , ChanK . *Image and Vision*  
122 *Computing* 2001. 19 p. .
- 123 [Toygar Onsen and Adnan ()] ‘Face recognition using PCA, LDA and ICA approaches on colored images’. Toygar  
124 Onsen , Adnan . *Journal of electrical and Electronics Engineering* 2003. 3 (1) p. .
- 125 [Liu and Wechsler (2002)] ‘Gabor feature based classification using the enhanced Fisher linear discriminant  
126 model for face recognition’. C Liu , H Wechsler . *IEEE Trans. Image Process* Apr. 2002. 11 (4) p. .
- 127 [Li and Jain ()] *handbook of face recognition*, Stan Z Li , Anil K Jain . 2004. Springer. p. . (chapter)
- 128 [Daugman (1993)] ‘High confidence visual recognition of persons by a test of Statistical Independence’. J G  
129 Daugman . *IEEE Trans. Pattern Anal. Mach. Intell* Nov. 1993. 15 (11) p. .
- 130 [Baek ()] ‘ICA: A Comparison on the FERET Data Set’. K Baek . *Proc. of the Fourth International Conference*  
131 *on Computer Vision, Pattern Recognition and Image Processing*, (of the Fourth International Conference on  
132 Computer Vision, Pattern Recognition and Image essing) 2002. p. . (PCA vs)
- 133 [Delac et al. ()] ‘Independent Comparative Study of PCA, ICA, and LDA on the FERET Data Set’. K Delac ,  
134 M Grgic , S Grgic . *International Journal of Imaging Systems and Technology* 2002. 15 (5) p. .
- 135 [Schmid and Mohr (1997)] ‘Local grey value invariants for image retrieval’. C Schmid , R Mohr . *IEEE Trans.*  
136 *Pattern Anal. Mach. Intell* May, 1997. 19 (5) .
- 137 [Martinez and Kak ()] ‘PCA versus LDA’. A M Martinez , A C Kak . *IEEE Trans. Patt. Anal. Mach. Intell*  
138 2001. 23 (2) p. .
- 139 [Jan ()] ‘Support Vector Machines, PCA and LDA in face recognition’. Mazanec Jan . *Journal of Electrical*  
140 *engineering* 2008. 59 (4) p. .
- 141 [Turk and Pentland ()] M A Turk , A P Pentland . *Face Recognition Using Eigenfaces, IEEE CVPR*, 1991. p. .
- 142 [Vapnik ()] N Vapnik . *The Nature of Statistical Learning Theory*, 1995. Springer.
- 143 [Yang et al. ()] J Yang , Y Yu , W Kunz . *An Efficient LDA Algorithm for Face Recognition, the Sixth*  
144 *International Conference on Control, Automation, Robotics and Vision (ICARCV2000)*, 2000.