Comparative Study on Face Recognition using HGPP, PCA, LDA, ICA and SVM

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Abstract: ***In this paper performance of five face recognition algorithms i.e. HGPP, PCA, LDA, ICA and SVM is compared. 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.***

Keywords: Face Recognition, PCA, LDA, ICA, HGPP, SVM

1. Introduction

Today, 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.

2. Face Recognition Algorithms

2.1. 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 Pentland 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 like structures named Eigenfaces. 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 "facespace". 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.

2.2. 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].

2.3. 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 we are using architecture I which finds statistically independent basis images.

2.4. Support Vector Machines (SVMs)

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.

2.5. 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.

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.

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. 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.

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 images for each subject where each image is oriented in a different angle compared to another The evaluation is carried out using the Face Recognition Evaluator. It is an open source MATLAB interface. Comparison is done on the basis of rate of recognition accuracy. Comparative results obtained by testing the five i.e. PCA, LDA, ICA, SVM and HGPP algorithms on both the IFD and the ATT databases.

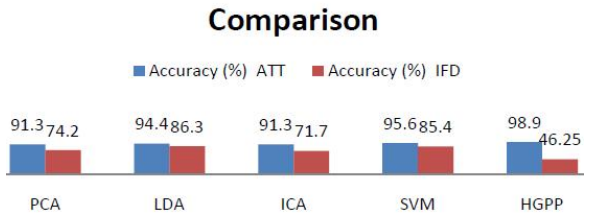

Figure 1: Comparative Study of Five Algorithms On The Basis Of Recognition Accuracy

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 databased. 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.

It is observed that HGPP has 98.9% rate of accuracy of recognition. LDA and SVM have the almost same rate of accuracy of recognition, which outperform the PCA and ICA.

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%. Although LDA has the highest rate but it is marginally higher than SVM i.e. 85.4%. PCA and ICA have the moderate rate of accuracy of recognition i.e. 74.2% and 71.7% respectively. HGPP has the lowest rate of accuracy of recognition i.e. 46.25%. It shows that HGPP is effective but suffers from the local variations.

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 databased. 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.

8. Future Scope

Lot of work can be done in field of face recognition such as most of the algorithms give good result on Frontal Face recognition but at different angles they do not give good result. To recognize a face at an angle we have to give some 3D face recognition algorithm. We can club other modality with face recognition algorithm for best results example face- iris, face-fingerprint, and face iris-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.

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Author Profile

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