

Comparison of Principal Component Based Advanced Facial Feature Extraction Techniques Applied Over Different Face Databases

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Abstract: *Face is extensively used of biometrics recognition technology because of its worldwide adequacy. In this work one of broadly used feature extraction technique i.e principal component analysis is enhanced. So 2 Dimensional PCA is tried to improve by rotating it across vertical axis. This rotated algorithm is applied over different face databases for performance comparison. This new method is giving performing better as compared to some customary techniques like PCA and 2DPCA.*

Keywords : PCA, R2DPCA, Weighted Summation Fusion Technique Tanh Estimator Normalization.

1. Introduction

Face recognition has been showing universal development in computing environment since last few decades, it has found its applications in electronic gadgets like integrated into cell phones, cabs, biomedical instruments etc. Also it has also been integrated with lots advanced technologies like videos applications, including biometric authentication, human-computer interaction, surveillance and multimedia management. Researchers have been trying hard in this field since the last few year to bring robust computer vision algorithms which can outperform for large database environment. Accuracy of such algorithms has been increased with development of modern and high technology computers. But these researches are performed in laboratory condition which fails in practical and non-controlled situations; face recognition system is having various challenges which are required to be addressed. Thus, FR becomes one of the most fundamental problems in pattern recognition.

1. Face recognition is a dimension of biometric recognition based automatic human recognition technologies. Biometrics can adopt either physiological or behavioral characteristics of any persons. These characteristics are referred as biometric authenticators. Characteristics being used in biometrics are include iris, fingerprints, retina, speech, facial patterns, hand-written, keystroke patterns, signature and gait. These biological or behavioral characteristics remain unique for an individual as they cannot be elapsed, misplaced, copied or lost. Universality, Uniqueness, Permanence, Collectability are some of the characteristics which are deciding factors for performance checking of any system.

2. But in real time environment, there are various problems which are needed to be taken care off like circumvention, performance, availability.
3. Now a day’s faces are finding its use in lots of areas like entertainment, smart cards, information security, video surveillance, recognition and authentication.

2. Literature Review

Principal component analysis is a conventional method which is widely used in which firstly image is transformed into one dimensional vector. But it leads to loss of information. Hence 2DPCA technique is used which overcome earlier problem. 2DPCA method is a matrix based method which is highly accurate and efficient than PCA. But 2DPCA doesn’t extract any directional feature which can be performed by rotated 2DPCA.

Sang-Heon Lee et. al. [2012] proposed an illumination robust face recognition system called differential two-dimensional principal component analysis. Faces are separated into two sub-images to curtail illumination effects, and then D2D-PCA is applied separately to each sub-image.

Yang et. al. [2011] proposed Sequential Row–Column 2DPCA (RC2DPCA) which uses 2DPCA operated in the row direction and alternative 2DPCA operated in column direction. RC2DPCA compress image in row and column direction. It desires fewer coefficients for image illustration than 2DPCA. The experiments on the ORL 96.65% of recognition rate and FERET databases 77.25% of recognize rate.

Oliveira et. al. [2011] intended a feature-selection algorithm based on a multi objective genetic algorithm to analyze and discard irrelevant coefficients offers a solution that considerably reduces the number of coefficients, while also improving recognition rates. Their method was an alternative to PCA and (2D)²PCA for finding 2DPCA’s most discriminant coefficients.

Yang et. al. [2010] extended 2DPCA and Bi-directional PCA (BDPCA) to non Euclidean space i.e. Laplacian BDPCA. It improved the robustness of 2DPCA and BDPCA. 2DPCA requests more coefficients than PCA for image representation and needs more time for classification. BDPCA overcome the drawbacks of 2DPCA which is bidirectional method with both row and column wise extraction of features. Both 2DPCA and BDPCA can work only in Euclidean space and also proposed Laplacian BDPCA (LBDPCA) to enhance the robustness of BDPCA by extending it to non- Euclidean space.

3. Methodology

In this chapter, methodology is being explained for the biometric authentication system by ancient principal element analysis, 2 dimensional principal element analyses and rotated 2 dimensional principal element analyses.

Principal element Analysis- PCA may be a one dimensional technique that reduces dimension of space by considering the variance of input data for representing the structure of the input data. Projected face space provide most quantity of data that is nonheritable in a very tiny dimension of feature space. A subspace is constructed by the eigenvector from the information for image projection. A flow chart of PCA is shown in figure 1.

2 Dimensional Principal element Analysis- Yang et. al. planned 2DPCA for image based feature extraction. Fig. a pair of is giving flow chart of 2DPCA based mostly face recognition system. second PCA doesn't perform the matrix to vector operation, however directly method image matrixes. 2DPCA directly computes chemist vector of the image co-variance matrixes while not matrix to vector variance. It evaluates the image variance matrix a lot of accurately & corresponding chemist vectors a lot of with efficiency than PCA.

Rotated 2 Dimensional Principal Component Analysis- In R2DPCA eigen features of the rotated images are obtained.. This variance is used for obtaining the eigenvectors of the covariance matrix of all the images. The eigenface space is obtained by applying the eigen face technique to the training images, rotated in six t different directions. Then all training images are projected into the eigenface space. Similarly test image is projected into this eigenface space and therefore the distance of the projected check image to the training images is calculated to classify the training image. Figure 3 show the diagram of Rotated 2 Dimensional PCA.

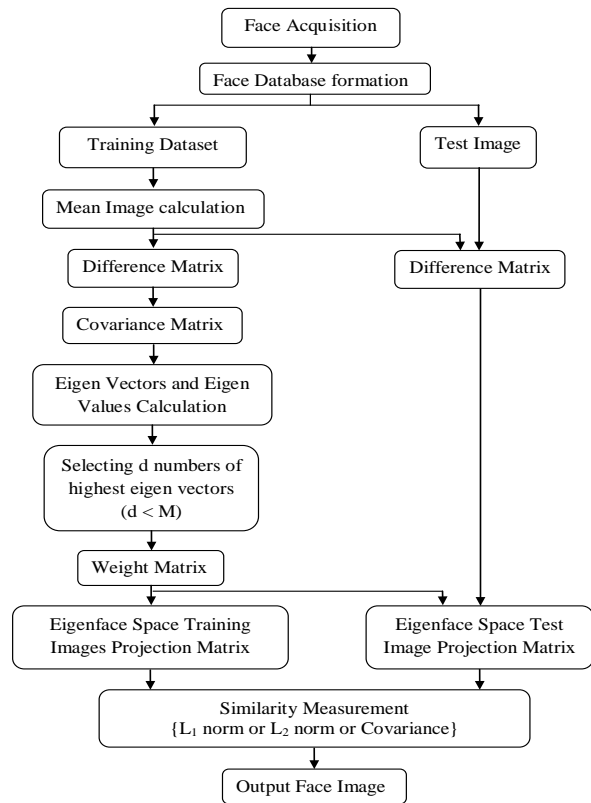


Figure 1 : Flowchart of Principal Component Analysis

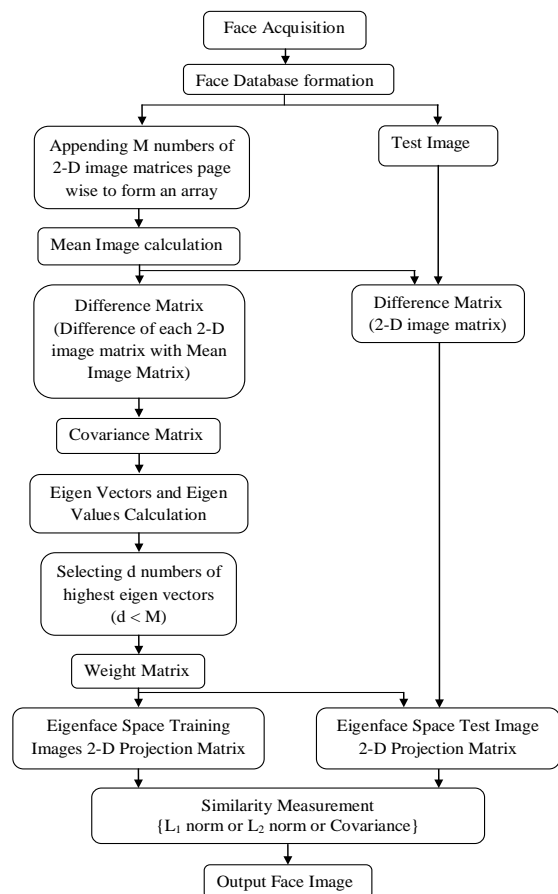


Figure 2. Flowchart of Two Dimensional Face Recognition System.

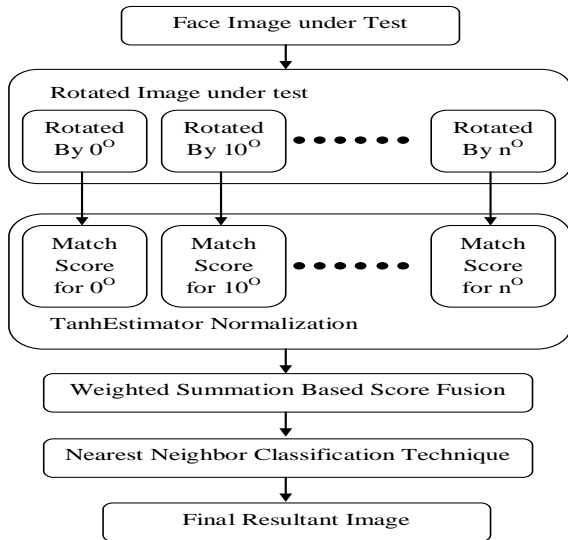


Figure 3. Block Diagram of Rotated 2 Dimensional PCA Algorithm

Rotated Two Dimensional Two Dimensional Principal Component Analysis- R2DPCA, eigen features of the rotated images are obtained by looking for the maximum deviation of each image from the mean image. This variance

4. Experimental Results

These algorithms square measure enforced over a 2.67 GHz PC with three.2 GB RAM and code tool used is MATLAB version R2010a.

Face recognition system is applied with feature extraction techniques, Principal part Analysis, 2 Dimensional Principal Component Analysis and Rotated 2 Dimensional Principal Component Analysis, for checking its performance in 3 databases.

By taking a test image as input to the face recognition system, it calculates image based mostly options on Manfred Eigen face area and thus the system compares this feature with options of all different pictures that were used for training of the system. Figure 4 is showing rotated facial images in six completely different angles which is able to be accustomed extract options. Fig. 5 is showing one such output.



Fig 4 Facial Image rotations by $0^{\circ}, 10^{\circ}, 20^{\circ}, 30^{\circ}, 40^{\circ}, 50^{\circ}$.



Fig 5 Output of rotated 2DPCA on AR Face Database

A. RESULTS ON ORL FACE DATABASE

ORL information is providing 400 images of 40 persons that square measure divided into 320 images for training and 80 images for testing purpose. Graph in figure 6 is comparing recognition rates by PCA, 2DPCA & Rotated 2DPCA algorithms with varied Eigen features from 1 to 64.

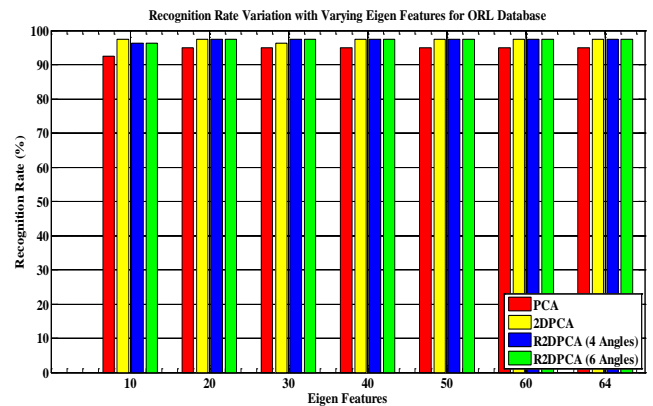


Fig 6 Comparison of Recognition Rates in ORL Face Database with varying eigen features

Best Recognition Rate obtained in PCA, 2DPCA, R2DPCA (4 angles), and R2DPCA (6 angles) are 96.25%, 97.5%, 97.5%, and 97.5% respectively.

B. RESULTS ON AR FACE DATABASE

AR database is providing 2600 pictures of a 100 persons that area unit divided into 1300 pictures for training and 1300 pictures for testing purpose. Graph in figure 7 is comparing recognition rates by PCA, 2DPCA & Rotated 2DPCA algorithms with varying eigen feature from 1 to 64.

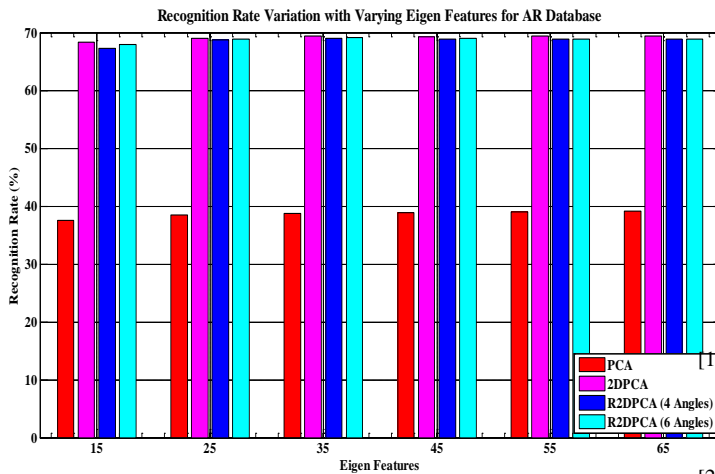


Fig 7 Comparison of Recognition Rates in AR Face Database with varying eigen features

Highest Recognition Rate obtained in PCA, 2DPCA, R2DPCA (4 angles), and R2DPCA (6 angles) are 39.07%, 69.38%, 68.92%, and 69.15% respectively.

C. Results on feret face database

FERET database is providing 1500 images of 300 persons which are divided into 900 images for training and 600 images for testing purpose. Graph in figure 8 is comparing recognition rates by PCA, 2DPCA & Rotated 2DPCA algorithms with varying eigen features from 1 to 64.

Highest recognition results in PCA, 2DPCA & R2DPCA (4 and 6 Direction) are 50.17%, 52.5%, 53.17% and 53.3% respectively.

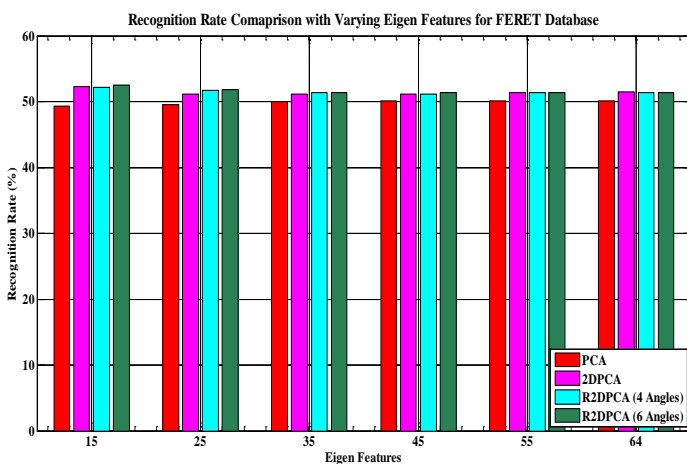


Fig 8 Comparison of Recognition Rates in FERET Face Database with varying eigen features

5. Conclusion

In this work, a face recognition system is designed in which principal component analysis, two dimensional principal component analysis and rotated two dimensional principal component analysis algorithms are

implemented. Their results are compared with varying eigen features. Rotated 2DPCA is best for features extraction and gives more recognition rate than PCA and 2DPCA. On comparing with previous work of Zhu et. al.[11], recognition rate for AR database was 64.67% and in this work it is 69.15%. However for FERET database highest recognition rate achieved by Zhu et. al. [11] was 57.60% and in this work it is 53.3%.

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