

Feature Extraction Technique of PCA for Face Recognition With Accuracy Enhancement

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Abstract— Face recognition is a very complex task in the area of image processing and computer vision. This becomes important because it applies on many real life applications like Security, identification, crowd surveillance, Video surveillance etc. This paper is proposed the PCA based Face recognition. PCA is a holistic based Statistical method which is used to extract the feature from face image and to decrease the large dimensionality of the data to the smaller dimensionality of feature space, then classification is done using Euclidian distance classifier to recognize the face. The proposed method is worked on Yale Database and evaluate under varying conditions like Illumination variant for Center, Left and Right, Different Facial Expression like Happy, Sad, Normal, Wink, Surprised and Sleepy, Wearing spectacles and without it for Frontal Face View. The proposed work demonstrates the recognition rate for given Dataset.

Keywords- Face recognition, PCA, Eigen value, Eigenvector, Covariance, Euclidean distance, Eigen face.

I. INTRODUCTION

Face recognition is playing a vital role in today's life and used in such a way that reduced the complexity what we suffered during social life. The main goal of face recognition is to identify the people's identity that we naturally deed. The face recognition system learn computer to do the same. Face recognition technique is divided into three categories. Feature based, holistic and hybrid approach where holistic approach is very popular approach for face recognition[1]. Facial recognition is a categorized into three process Image Input, Image process and Comparison. Image input means to take the input in system that can achieved using Standard database, camera image, laser scanner etc. In image processing the face is pre-processed, Face is detected and represents the face region. In comparison phase the feature is extracted and matches the face feature against database.]. Ratio of Yale database is used for face detection and recognition is very less and the face recognition using PCA performed worse on YALE[4] and the accuracy and recognition rate for is not up to mark on Yale database[3]. There are different distance classifiers which are used with feature extraction to improve the face recognition rate and match the feature vector with database and recognition the image. Euclidean distance is one of the simplest and faster classifier as compared to other Classifiers. Euclidean distance is defined as the straight-line distance between two points and provides better result with PCA [5]. Organization of paper is as follow: Section 2 Algorithmic description of PCA. Sections 3 Face Recognition by PCA. Section 4 Experimental results are shown. Section 5 Using the template Section 6 Conclusion.

II. PRINCIPAL COMPONENT ANALYSIS

PCA is reducing the dimension of the image form 2 dimensional to 1 dimensional vector. It combines row or column in at vector. It computes the mean and average matrix is calculated then subtracts from original face image

and stored in variable. The covariance matrix is calculated. After that it calculates the Eigen vector and Eigen values of covariance matrix. After that the Eigen faces are generated. The new Eigen face is stored as Eigen component and after Euclidean distance Classifier measure the weight between two weight vectors and match the vectors with training set and recognition the image. The algorithmic description of PCA is shown in following step

Step 1 consider $X = \{x_1, x_2, \dots, x_n\}$ be a random vector with observations $x_i \in \mathbb{R}^d$.

Step 2 Compute the mean μ

Step 3 Compute the Covariance Matrix S

Step 4 Compute the Eigen values λ_i and eigenvectors v_i of S

Step 5 Order the eigenvectors descending by their Eigen value. The K

The proposed system is categorized into two sections:

1. Create Training Dataset using face detection technique.
2. Face recognition based on methods PCA.

1. Create Training Dataset using face detection technique. The Face Detection process is the initial yet an important step in the direction of automatic face recognition. The process of Create Training data set is selecting image from database applies face detection on it and store the face in the database. Work Flow of System proposed for Face detection is as below:

Step 1 Load image from Yale database

Step 2 Apply pre-processing on loaded image

Step 3 Apply rgb to gray conversion and histogram equalization on selected image

Step 4 Apply Haar classifier on processed image to detect face.

Step 5 Detected face is stored in Training database.

2. Face recognition based on methods PCA.

Face recognition is process is begin after the Training data set is ready in system. Work flow of Face recognition process in proposed system is as below.

- Step 1 Load image from Yale database
- Step 2 Apply rgb to gray and histogram equalization pre-processing on selected image
- Step 3 Apply Face detection using Haar classifier and detect the face
- Step 4 on detected face apply PCA method for feature extraction and get important feature of face
- Step 5 after getting the important features from detected face Euclidean distance classifier match this feature to training database.
- Step 6 if classifier match with training set image than face is recognized.

This system is applied on Yale database and achieves good result on 3 features class Illumination variant, Glass and non glass and Facial Expression. The system achieves result on bases of face Recognition Rate that is discussed in experimental result.

III. EXPERIMENTAL RESULT

This analysis of proposed system is implemented using Emgucv-windows-universal 3.0.0.2157 software tool using C# language. As input, the system used Standard Yale database. The Yale database contains 165 images in GIF format of 15 persons. The images of database are divided into 3 categories 1. Illumination variation 2. Glass and Non-Glass 3. Facial Expression. Dimension of an image of database is 320 x 243 for each. The system starts work from Training a dataset. The Face Detection ratio is 98.18% using proposed system is shown

A. Abbreviations and Acronyms

The Abbreviations are PCA – Principal Component Analysis, FRR – Face Recognition Rate, JPEG – Joint Photographic Experts Group, GIF – Graphics Interchange Format, RGB – Red Green Blue

IV. USING THE TEMPLATE

A. Figures and Tables

Total 68 images are stored in Training dataset. From 165 images of database 162 image faces are detected that shown.

TABLE 1 FACE DETECTION ON YALE DATABASE

Total No. of Yale Images	No. of Face Detected	Face Detection Ratio in (%)
165	162	98.18

First the Recognition is based on Illumination Variant which is Center light, left light and right light. The recognized image is display with of the name of display with of the name of the person



FIGURE.1 Show the Illumination Variant face recognition using PCA

TABLE 2FACE RECOGNITION RESULTS FOR YALE DATABASE ILLUMINATION VARIANT IMAGES USING PCA

Illumination Condition	Total No. Of Images	No. of Face Recognized	Face Recognition Ratio in (%)
Center Light	15	10	66.66
Left Light	15	10	66.66
Right Light	15	5	33.33

The above table 2 show that PCA feature extraction technique is recognition the image of the Center light left light and right light images. It gives 66.66 percent ratio in both Center and Left light illumination variant image. It gives poor recognition rate in Right light illumination problem. . This experimental result is shown in Fig. 1

TABLE 3 FACE RECOGNITION RESULTS FOR YALE DATABASE GLASS AND NON-GLASS IMAGES USING PCA TECHNIQUE

Glass and Non-Glass	Total No. Of Images	No. of Face Recognized	Face Recognition Ratio in (%)
Glass	15	12	80
Non-Glass	15	13	86.66

The above table 3 shows that PCA feature extraction technique is recognition the image of the both Wearing glass condition and without wearing gasses image. It gives 80 percent face recognition ratio for wearing glass condition and 86.66 for without wearing glass condition. So it has less recognition rate in wearing glass condition that shown in figure 2.

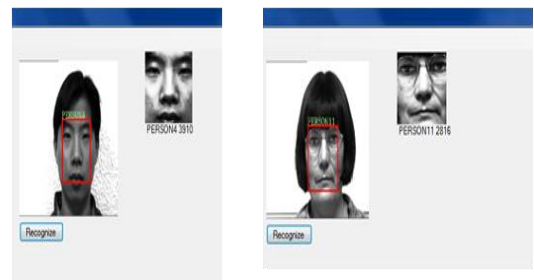


Figure 2. Show the Detected Face and recognition the person with name for Glass and Non Glass

After the completion of two criteria now the Recognition is based on Facial Expression. The Yale database has a six types of facial expression happy, sad, sleepy, surprised, wink and normal. That shown in figure 3.



Figure 3. The Detected Face and recognition the person with name for Facial Expression

TABLE 4 FACE RECOGNITION RESULTS FOR YALE DATABASE FACIAL EXPRESSION IMAGES USING PCA TECHNIQUE

Facial Expression	Total No. Of Test Images	No. of Face Recognised	Face Recognition Ratio in (%)
Happy	15	14	93.33
Sad	16	9	60
Sleepy	15	11	73.33
Surprised	15	12	80
Wink	14	11	78.57
Normal	15	13	86.66

The above table 4 shows that PCA feature extraction technique is recognition the image of Facial expression with good Face recognition rate. For Happy facial expression it gives 93.33 percent recognition rate, Sad facial expression gives 60 percent recognition rate, sleepy facial expression gives 73.33 percent recognition rate, surprised facial expression gives 80 percent recognition rate. , Wink facial expression gives 78.57 percent recognition rate and normal facial expression gives 86.66 percent recognition rate. This shows it has less recognition rate in sad facial expression. The experimental result is used Face recognition rate as parameter. This parameter shows how many images are recognition form total numbers of images. From Table 2, 3, 4 and figure 4 show the individual criteria’s experimental result. Table 5 shows the average face recognition rate of the criteria. The average face recognition ratio is 55.55 % for Illumination condition, 83.33 for glass-non glass images, 77.77% for Facial expression n images and total face recognition rate on Yale database using PCA technique is 72.72%.

TABLE 5 FACE RECOGNITION RESULTS FOR YALE DATABASE USING PCA TECHNIQUE

Category of images	Total No. Of Test Images	No. of Face Recognised	Face Recognition Ratio in (%)
Illumination Condition	45	25	55.55
Glass-Non Glass	30	25	83.33
Facial Expression	90	70	77.77
All Images	165	120	72.72

V. CONCLUSION

The paper presents a face recognition system using PCA and Euclidian Distance Classifier. For Face Detection Phase system used Haar Classifier that provides accurate result. The System is mainly used for face recognition purpose for Yale Database in three criteria Illumination Conditions, Facial Expression and Wearing Glass and Non-Glass. From experimental result it is proved that PCA method for feature extraction is work effectively for glass and non-glass criteria of Yale database, better for facial expression and need improvement in Illumination variant. In future instead of using PCA Feature Extraction method researcher use LDA feature extraction method for three different criteria of Yale database and improve recognition

rate. Researcher can also compare existing method with LDA and find which method is efficient for face recognition.

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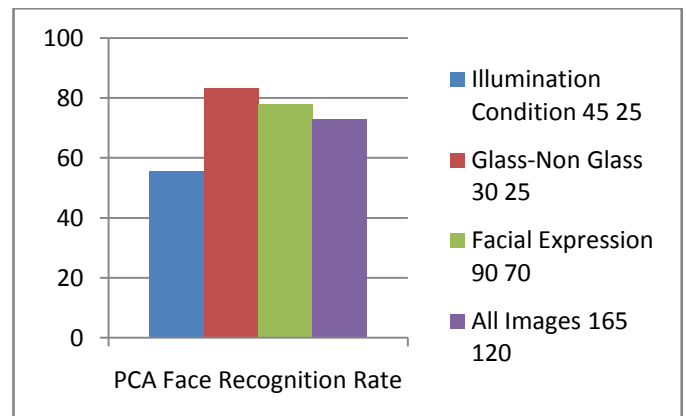


Figure 4 Shows PCA Face recognition rate different Criteria