Face Recognition using PCA and Eigen Face Approach

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Abstract - This paper mainly presents face recognition system based on principal component analysis. The goal is to implement the system which is able to distinguish a single face from the larger database. System consists of two levels of authentication first is the face recognition stage and second is the password verification stage. Password is send to person's mobile number through GSM. Proposed algorithm is implemented using MATLAB software. A number of experiments were done to evaluate the performance o the system.

Key Words: Face Recognition, Principle Component Analysis, Eign Values, GSM Modem, Person Authentication,Verification.

1. INTRODUCTION

Over the last decade, face recognition has become important research area in computer vision and it has wide range of applications such as Information Security, Access Management, Biometrics, Law Enforcement, Personal Security, and Entertainment –Leisure. Face recognition could be done under variety of conditions like front view, 45 degree view, faces with spectacles, scaled front view [1].

In any face recognition system, feature extraction and classification are two fundamental stages. It is necessary to enhance these stages for improving performance of the ace recognition system. Feature extraction reduces the dimensionality of the image by using linear or non-linear transformations of the images with its successive selected feature, so that representation of exacted feature is possible. There are variations with feature extraction of human face as there are some problems such as various backgrounds, aging, illumination, and lightning condition. In this paper PCA is used for identification and pattern recognition [2].

This paper discusses about the face recognition process in section 2. Proposed system block diagram and system flow is given in section 3 Principal Component Analysis and its implementation given in section 4. Results of the system are given in section 5. Finally the work is concluded in section 6.

2. FACE RECOGNITION SYSTEM

One of the easy and effective PCA approaches used in face recognition systems is eigen face approach. In this approach faces are transformed into a small set of essential characteristics, called as eigen faces. Eigen faces are the main components of the training set. In classification process, a new image is projected in the Eigen face subspace, and then the person is classified by comparing its position in eigen face space with the position of known individuals.

Recognition process involves two stages

1.   Initialization Process

The Initialization process consists of following steps

a. Prepare training set of face images

b. Calculate eigen faces from training set by taking only highest values These M number of images will define the face space. As newly added faces are experienced, eigen faces for these images can be recalculated or updated.

c. Calculate distribution of this M-dimensional space for the known person by projecting face images onto the face-space [3].

2. Recognition process

The recognition process consists of following steps

a. Find weight vectors from the input image and also calculate the M number of eigen faces by projecting the input image on the Eigen faces.

b. Determine if all the images are of face whether its known or unknown, by checking if the image is sufficiently close to a—free space [3].
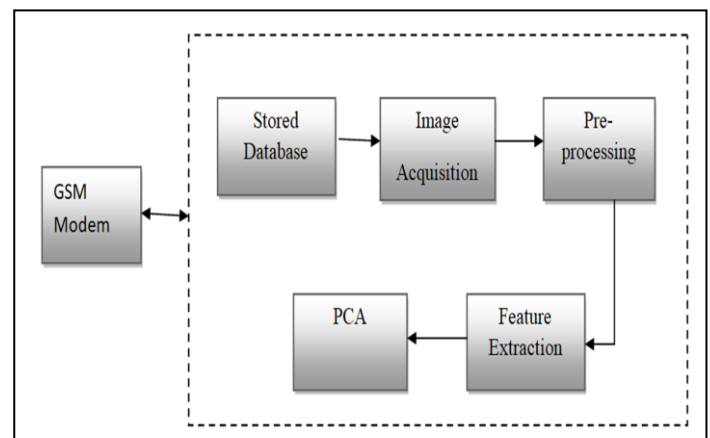

Fig -1: Block Diagram of the proposed system

c. If it is a face is detected, then classify its weight pattern as known person or as unknown person.

d. Update the obtained eigen faces or weights as either a known person or unknown person.

3. PROPOSED SYSTEM

3.1 Block Diagram of the system:

Block diagram of the proposed system is shown in figure 2.In proposed system we have implemented face recognition algorithm based on principal component analysis. First, We have created the data base of the face images in which extract features of these stored images which a recognition takes place. We extract color and shape of the eyes, nose etc. Then, we capture image which we need to recognize. Perform preprocessing of the image like noise removal.RGB to Gray conversion of image. Then, perform feature extraction of the desired face image. Then, apply Principal Component Analysis which recognize and gives decision as person is authorized. MATLAB creates one time password and send it to mobile number of the registered person. If the person enters valid OTP person gets authorization. Two level authorizations is done in proposed face recognition system.

3.1 Modules of the system:

A. Acquisition Module

This is the first part of the face recognition process. The user gives the input to face recognition system in this module.

B. Pre-Processing Module

In this face images are normalized to improve the recognition of the system. The pre-processing steps consists of following:

Grayscale conversion: It converts the color image into a gray image. This method is based on different color transform. According to the R, G, B contents in the image, it calculates the corresponding value of gray value, and obtains the gray image at the same time.

C. The Feature Extraction Module

After the pre-processing face image is given as input to the feature extraction module which module composes a feature vector and also represent the face image.

D. The Classification Module

With the help of principal component analysis, the extracted features are compared with the stored in the face database. Then face images are classified as known or unknown [4].

4. SYSTEM IMPLEMENTATION

4.1Principal Component Analysis:

Principal components analysis is a algorithm which identifies smaller number of uncorrelated variables, these uncorrelated variables are called as "principal components", from a large set of data. This method gives high amount of variance with the less number of principal components. PCA is mostly for data analysis. In Principal Component Analysis, we do eigen value decomposition of a data correlation matrix [5].
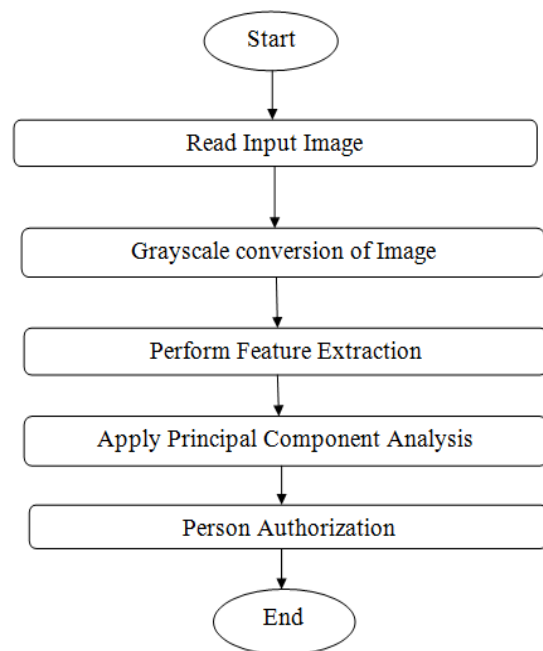

Fig -2: Proposed System Flow

Steps in the Principal Component Analysis

1) Get set of database images and then find mean of the images.

2) Find the difference between mean desired image and each image in the database.

3) Find covariance matrix of the matrix which we obtained in step 2.

4) Find Eigen vectors and Eigen values then find the Eigen faces which has larger eigen values.

5)From eigen Eigen faces find weight vector

6) Similarly find the weight vector for the desired image which is to be tested.

7) Measure Euclidian distance between weight vectors of desired image and database images.

8) If the euclidean distance is less than threshold defined then desired test image is considered as authorized image [6].

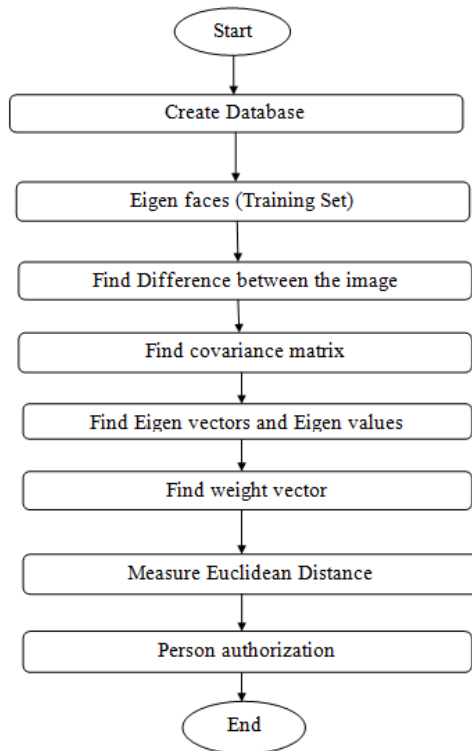**Fig -3**: Flow diagram of the principal component analysis

5. IMPLEMENTATION RESULTS

5.1 Image Pre-processing Results:

Input face image is the RGB image we convert RGB image to grayscale image.RGB to grayscale image is shown in figure 5.

Fig -4: RGB Input Image   **Fig -5**: Grayscale Input Image
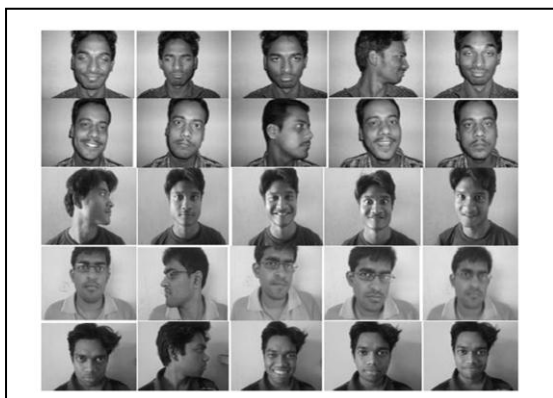
5.2 Training Set:

Fig -6: Training Set

5.3 PCA Results:
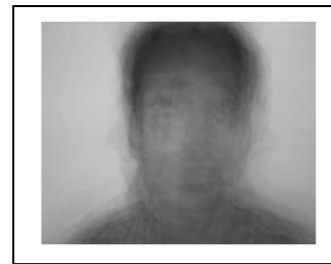
1. Mean Face Image

Fig -7: Mean Face Image

Fig -8: Eigenface ranked according to usefulness

6. CONCLUSION

This paper presents the face recognition system based on principal component analysis and eigen face approach. Proposed algorithm is implemented using MATLAB software.GSM is also interfaced to send password on person's mobile number which allows two levels of person authentication. Advantages of using PCA are data can be compressed without loss. This approach is preferred due to its speed, simplicity, learning capability. Further, this system can be extended to recognize the gender of a person or to interpret the facial expression of a person.

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