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An Application Based on Security using Image Identification

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ABSTRACT: A great deal of attention has been received by the face recognition technology in the field of image analysis and computer vision. It has been studied by scientists from different areas of psychophysical sciences and those from different areas of computer science. Face recognition studied by Psychologists deal with human perception part while engineers deal with the computational aspects of Face Recognition. Face recognition techniques can be represented through various classifications. Themain classification are image based face recognition and Video based face recognition. The main Objective of this paper is to recognize the unauthorized users entering the lab by matching their faces with the faces in database.

I. INTRODUCTION

Face recognition is to identify a face of an individual from the various images in database by matching the image of that particular individual. The first attempts began in 1960's with a semi-automated system using the features such as eyes, nose and mouth. Though the typical use of face recognition is in security purposes but are increasingly used in variety of other applications. It was demonstrated by Kohonen that face recognition can be performed by simple neural net. He performed the neural net by approximating the eigenvectors of face image. The main objective of our project is to capture the images of the user entering the lab and to match those images with the existing images in the repository, if the image is recognized the user is authorized else the system will give an alert if the user is unauthorized. Also the user should not be aware of the fact that his images are been captured.

II. PCA FACE RECOGNITION

PCA is one of the simplest and most effective face recognition algorithm. Eigen face of each image in the database is created and is compared with the Eigen face of the new image. The new Image is projected in Eigen face subspace and its position is compared with the position of Images in database.

The recognition is done using following steps:

1. Create a database containing set of face images.
2. The lower Eigenvalues are filtered keeping the highest Eigenvalues, by Calculating the Eigen faces from the training database. The number of images 'M' with highest eigenvalues defines the face space.
3. Project the face images onto face space and calculate the distribution of the image in this M-dimensional space.
4. Calculate a set of weights based on the input image and the M Eigen faces by projecting the input image onto each of the Eigen faces.It can be determined whether image is face by approximating the image to a free space.
5. If it is a face, then classify the weight pattern as either a known person or as unknown.

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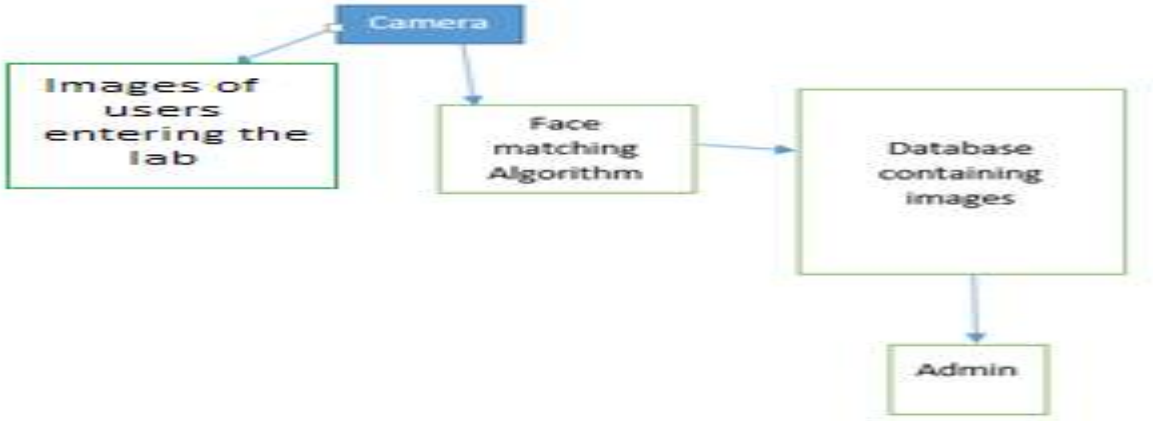

Fig-1: Basic working of face recognition system

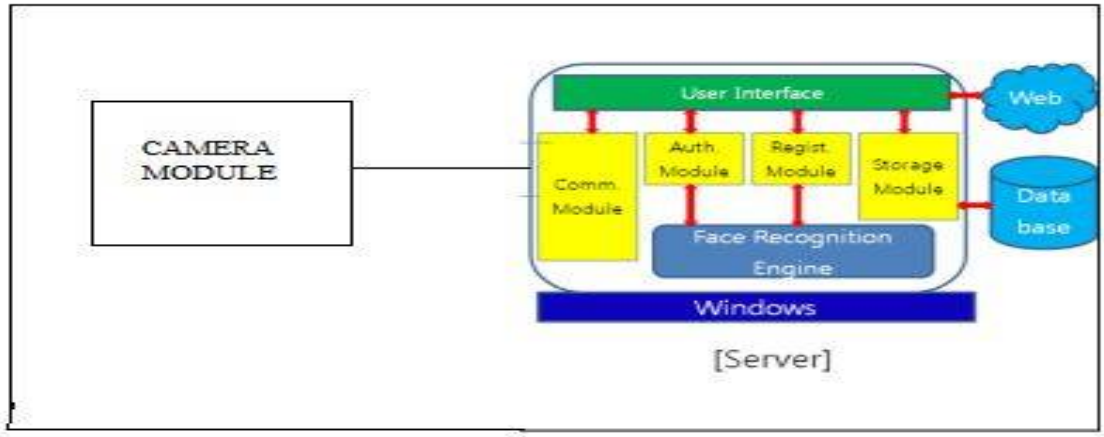

Fig-2: Block diagram of system.

III. PCA ALGORITHM

Let $\Gamma(x, y)$ be 2D M*N array of intensity values.

1. Convert each M*N image it in to MN*1 vector.
2. If there are P images of same size in database, then T will be a 2D matrix such that T= MN x P
3. Calculate the average face vector

$$\Psi = \frac{1}{M}\sum_{n=1}^{M} \Gamma_n$$

4.Subtract the average face vector from the original faces and store the result in **Φ**, this is known as normalized face vector.

$$\Phi_i = \Gamma_i - \Psi$$

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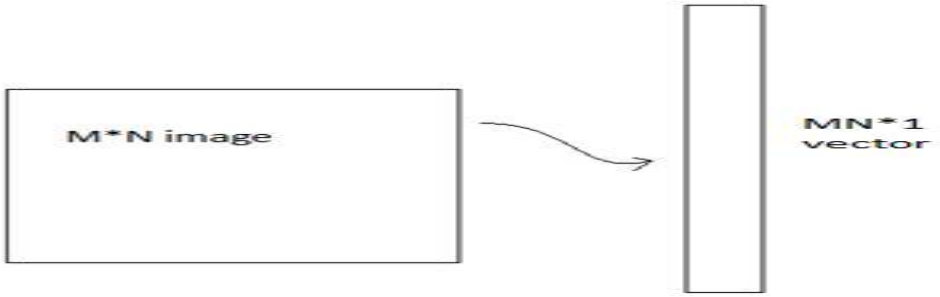

Fig-3: Conversion of M*N image into MN*1 vector

5. Compute covariance matrix which is given by

$$C = \frac{1}{M}\sum_{n=1}^{M} \Phi_n \Phi_n^T$$

6. Calculate the eigenvalues and eigenvectors of the covariance matrix.

6.1 Calculate eigenvectors u_i of AA^T

Since the matrix AA^T is very large, which is practically not possible.

That means size of AA^T is $N^2 \times N^2$, which is computationally very tough and lengthy.

6.2 Hence we calculate,

$$L = A^T A$$

Whose size is M*M, which is relatively easier to calculate.

Now we compute eigenvectors v_i ofL=$A^T A$

$A^T A\, v_i = \mu_i v_i$

The relationship between them is given by

$$A^T A\, v_i = \mu_i v_i$$
$$A\, A^T A\, v_i = \mu_i A v_i$$
$$CA\, v_i = \mu_i A v_i \quad [\text{since } C = A\, A^T]$$
$$C\, u_i = \mu_i A v_i \quad \text{where, } u_i = A\, v_i$$

Thus, C and L have the same eigenvalues and their eigenvectors are related as

$u_i = A\, v_i$

Now we calculate,

$$u_i = \sum_{i=1}^{M} v_i \Phi_i$$

Where u_i gives the eigenvectors i.e Eigenfaces.

7. Keep eigenvectors having largest Eigen values as they explain large part of characteristic features of the faces and the eigenvectors having smaller eigenvalues can be omitted.

- Read the image which is to be tested and separate face from the image.
- The feature vector of that test face is then calculated.

$$\omega_{test} = u_i^T (\Gamma_{test} - \Psi)$$

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- Calculate the minimum Euclidian distance ε_k that is the minimum average distance between the test face vector and the faces vectors of those images which are stored in the database.

Mathematically, recognition is finding the minimum Euclidean distance, between a testing point and a training point given in the following equation

$$\varepsilon_k = \sqrt{\|\Omega_{test} - \Omega_i\|^2}$$

Where

Ω_{test} is testing point

Ω_i is training point

Where, i = 1, 2, 3. . . . . K. Euclidean distance between two weight vectors thus provides a measurement of similarity between the corresponding images.

This will provide the measurement of similarity between the corresponding images.

IV. SCHEMATIC DIAGRAM AND FLOWCHART

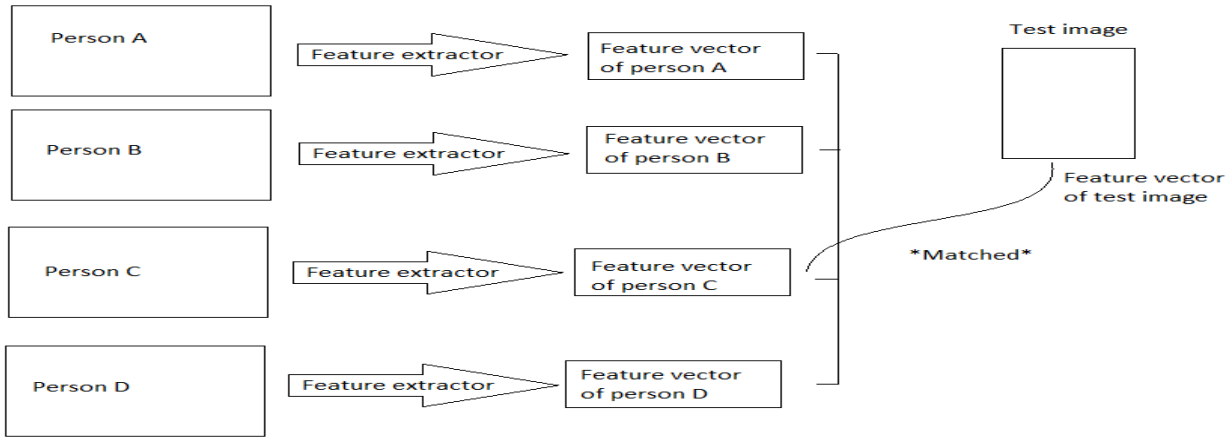

Fig-4: Schematic diagram

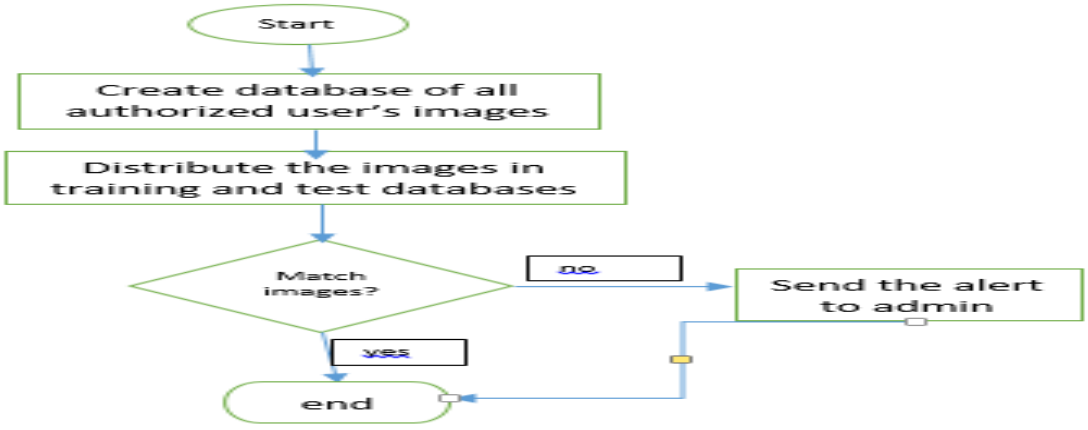

Fig-5: Design Flowchart

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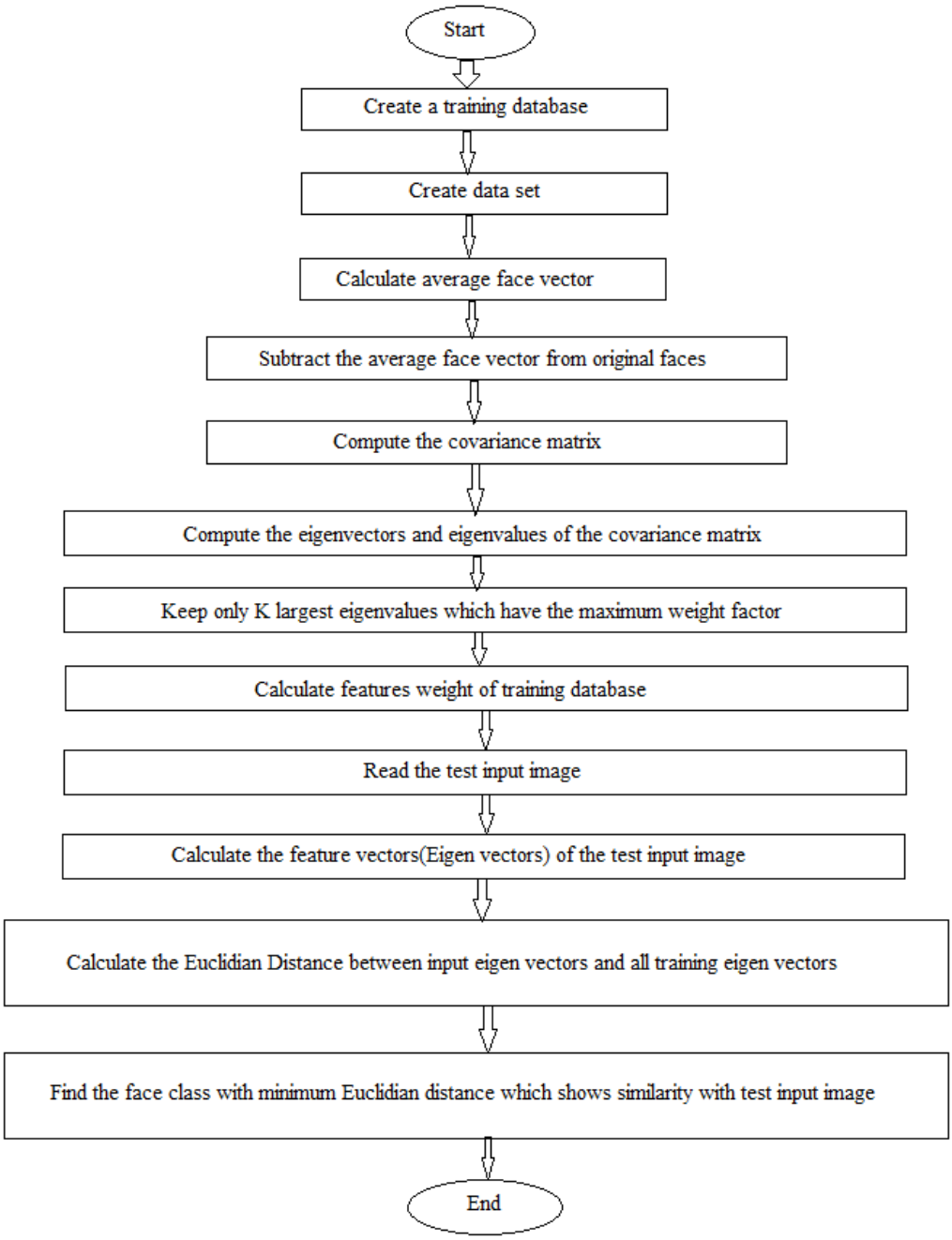

Fig-6: Algorithm Flowchart:

V. EXPERIMENTAL RESULTS

The Experimental Result-1 shows the average face vector of test image. The Experimental Result-2 shows Eigen vectors having largest Eigen values. In Experimental Result-3 and Experimental Result-4, both the test image in different pose and expression with the image which is equivalent to it stored in database match.

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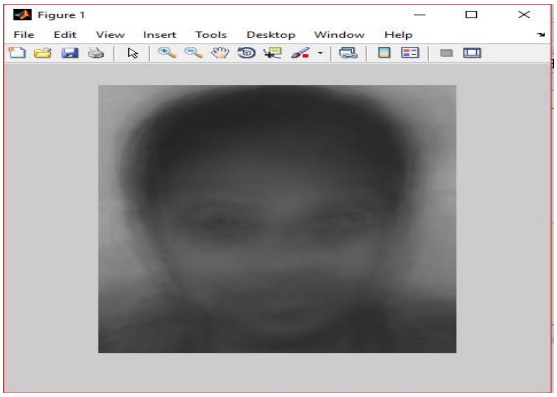
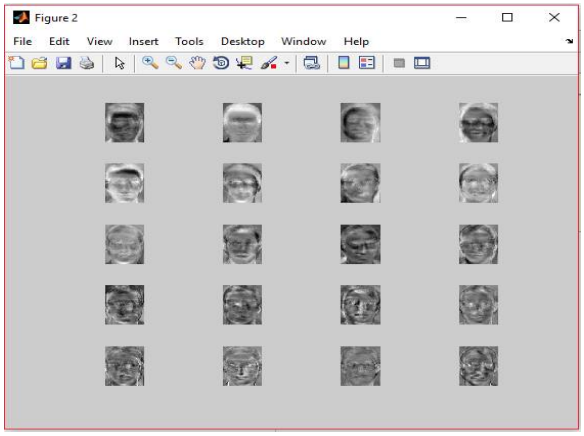
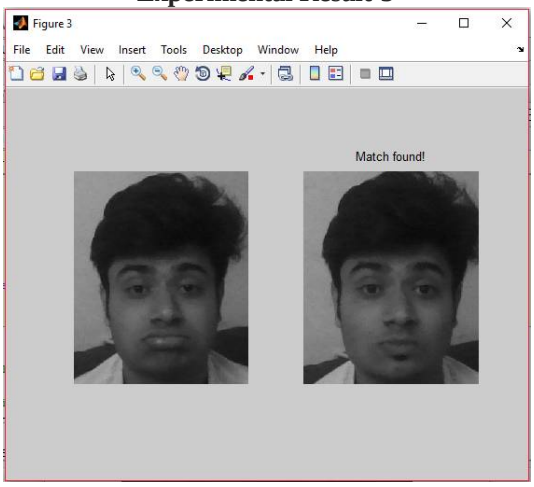
Experimental Result-1



Experimental Result-2



Experimental Result-3



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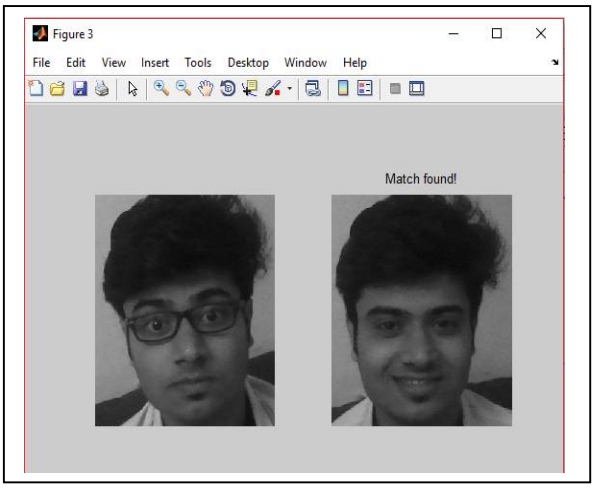
Experimental Result-4



VI. CONCLUSION

In this thesis principal component analysis (PCA) for face recognition system was studied and an attempt was made to match the faces using Eigen face approach. Face recognition is successful approach in many applications like matching digital images of person which can be used as password. Our project can be efficiently used in Hi-tech labs and offices to identify the unauthorized users.

FUTURE PLAN

Although PCA is an efficient algorithm for face matching but it cannot match the images from some weird angles, to make our project more efficient and to save the memory we would convert a 2-D image to 3-D image by using 2-D images from different angles and save them in database, so that image taken from any angle can be compared easily.

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BIOGRAPHY

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