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Face Recognition Using Principal Component Analysis Method

Neelam Mahale[1], Dr. Manoj S. Nagmode[2] and Prajakta S. Ghatol[3th]

E & TC (VLSI & Embedded System)
[1]MIT College of Engineering, Pune,India
[2]MIT College of Engineering, Pune, India
[3]GSMCOE,Balewadi, Pune, India
neelam_mahale@rediff.com, manoj.nagmode@mitcoe.edu.in , prajakta_ghatol@yahoo.co.in

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Abstract— In this paper the method of Face Recognition is presented. Now a day the need of security is increasing. Many methods are using for maintaining the security like as credit cards, pin numbers, smart cards etc. But some times it fails. This paper presents a Face Recognition method using Principal Component Analysis. This method applies on both data base image and input image. By the use of PCA the system finds the Eigen values, Eigen vector and Euclidian distance. After comparing from database it declares the matches.

Keywords— Recognition, PCA, Euclidian distance, Eigen Values, Eigen Vectors.

I. INTRODUCTION

Now a day to maintain security is very important [4]. There are many applications are working in which the face recognition plays very important role. Face recognition is attracting much attention in the society. It is not only makes hackers virtually impossible to steal one's password, but also increase the user friendliness in human computer interaction[11].The main objective of face recognition is to recognize person from pictures or video using databases of face. There are lots of variation to design a face recognition is not an easy task [2]. Due to variation in illumination, facial expression and poses variations it is difficult to do face recognition [7]. A number of defense , security and commercial application demand real time face recognition system, especially when other biometric technique are not feasible [1]. In the face recognition method the still or video images of a scene given to the system and the system has to identify or verify one or more person in the scene using a stored database of face. In general face recognition techniques can be divided in to two groups based on the face representation they use [11]
1- Appearance based and 2- Feature based
In the appearance based holistic texture feature and applied to either whole face or specific region in a face image. In the feature based uses geometric facial feature (eyes, eyebrow, cheeks, and mouth ect.) and geometric relationship between them. Appearance based method gives good results then features based method [11]

Sajid I et al. presented a High performance FPGA based Face recognition system, where they used fixed point technique with software hardware co-design methodology which reduces cycle and provides the flexibility in face recognition [1]. Hau T. Ngo et al. described a flexible and efficient architecture for real-time face recognition system based on modular Principal component Analysis method in an environment of FPGA, they showed that modular PCA improves the accuracy of face Recognition when face images have varying expression and illumination. The architecture was able to perform face recognition in 11ms for a database with 1000 face images [2]. Qui Chen et al. presented face recognition using self organizing maps in which various face recognition approaches using self organizing maps are reviewed, it provides an orderly mapping of an input high dimension space in much lower dimensional space. It shows that SOM can do reduction and feature extraction for face recognition [5]. Sathaporn Visakhasart presented new multipipelined architecture for face recognition system on FPGA. This architecture helps to reduce the recognition time through its pipeline process and also encourage the reduction in hardware resources [3]. Rala M. Ebied describe a method of feature Extraction using PCA and Kernel-PCA for Face Recognition in which they investigates the nonlinear kernel function to improvement the principal component analysis (PCA) for feature extraction. The experiments carried out to investigate the performance of Kernel-PCA by comparing it with the performance of the PCA. Two kernel functions are used with the kernel-PCA, polynomial and Gaussian functions, to check which one achieved a better performance. The k-nearest neighbor classifier with Euclidean distance is used to investigate the performance of the Kernel-PCA and PCA for classification step [6]. Kyungnam Kim presented Face Recognition using Principal Component Analysis study in which Eigen face used in recognition but this cannot useful in real time system[8]. Janarbek Matai et al. presented FPGA-based Real-Time Face Recognition System in which they design full face detection and recognition system on FPGA vertex 5. They used haar data for detection and Eigen

Corresponding Author: *Neelam Mahale[1]*

face data for recognition from opencv. They found that the system can runs at 45 frames per second [4]. Neelam Mahale and Dr. M.S. Nagmode uses principal Component Analysis method in to improve the security of an Automated Teller Machine. They used face recognition in one part to access the Automated Teller Machine [12]. Mohammed Alwakeel et al. presented a Face Recognition Based on Haar Wavelet Transform and Principal Component Analysis via Levenberg-Marquardt Backpropagation Neural Network in this the results indicated that the image faces can be recognized by this face recognition system very effectively[7]. Janarbek Matai et al. presented Design and Implementation of an FPGA-based Real-Time Face Recognition System in which they design full face detection and recognition system on FPGA vertex 5. They used haar data for detection and Eigen face data for recognition from opencv. They found that the face recognition system which runs at 45 frames per second [13].
Smt.M.P.Satone et.al compared Euclidian distance measure and city block distance measure using PCA on four leveldecomposition of Daubechies wavelet transforms for facerecognition. ORL database is used for experiments. Recognition experiments were performed using the database containing images of 40 persons (40 x 10=400). Experiments show that the best recognition results were achieved using PCAon subband A3 of db2 wavelet using City blockdistance measure[14].

There are different methods are using in face recognition. Some are according to feature based and on similarity based . Some are listed below:

A. Features:

1-Features from global appearance
- a- Principal Component Analysis (PCA)
- b- Independent Component Analysis (ICA)

2-Features from local regions
- a- Local Feature Analysis (LFA)
- b-Gabor Wavelet

B. Similarity Measure:
- 1-Euclidian Distance
- 2-Neural Networks
- 3-Elastic Graph Matching
- 4-Template Matching

This system uses PCA for face recognition. Advantages of PCA are as follows:
1- Low memory demands
2- Low computational complexity
3- Better recognition accuracy and less execution time
4- Updating the inverse of the within class scatter matrix without calculating its inverse [11][12][13].
PCA performs dimensionality reduction by extracting the features, these feature are principal component. The first principal component is the linear combination of the original dimensions that has the highest variability.

- PCA is a statistical dimensionality reduction method
- PCA is used in application fields like face recognition and image compression
- PCA normally the use of Eigen faces
- Eigenvectors and Eigen values are used to represent face images ie Eigen Face.

This system uses PCA for face Recognition. The input image given to the system, by using Principal Component Analysis the system recognized the face. The block diagram of the system in shown in fig .1.

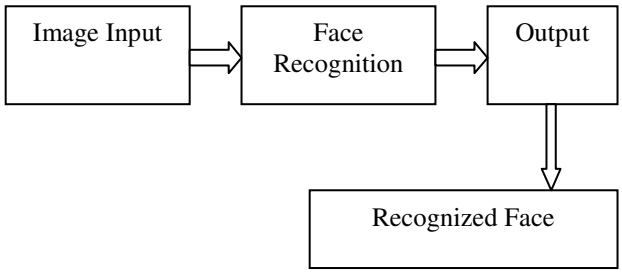

Fig.1 Block Diagram of the system

II. FCAE RECOGNITION

Face recognition systems play an important role in many applications like surveillance, biometrics and security [4]. It is a challenging task in terms of software ie developing algorithmic solutions and hardware ie creating physical implementations [4]. The face recognition system is a set of two tasks one is *Face Identification*: Means to take one image and compares with data base of the person and tell whose image it is and another is *Face Verification*: means to take one image face that is not in data base we need to verify that it is in the data base or not. For Face Recognition Principal Component analysis is very successful technique. It helps to reduce the large dimensionality of the data space in to the smaller intrinsic dimensionality of feature space. This is the case when there is a strong correlation between observed variables [8]. Given an image or a sequence of images of a scene, identify or authenticate one or more people in the scene is not easy one because of under different illumination conditions, facial expressions, facial accessories, aging effects etc. We are using PCA algorithm for recognition. This is one of the most used and cited statistical method is the Principal Component Analysis (PCA). It is a mathematical procedure that performs a dimensionality reduction by extracting the principal components. This principal component belongs from multi-dimensional data [9]. The principal component is the linear combination of the original dimensions that has the highest variability.

For face recognition we need a database. One image we will select one input image from database and apply PCA on database image and input image. The flow of PCA is

shown in fig 2. Following steps are using for the face recognition:

1- Preprocessing: Preprocessing of face image prior to the face detection and classification is essential. The input image is converted in gray image. The RGB to gray scale image and then resized in to by pixel.

2- Mean Image: For PCA work properly we need to calculate the mean image.

3- Covariance Matrix: Since the data is two dimensional, so we calculate covariance matrix.

4- Eigen value and Eigen vector: We calculate the Eigen value and Eigen vector of covariance matrix.

5- Euclidian Distance: The Euclidian distance measure between two values. The Euclidian distance calculates between Eigen values of input image and database image.

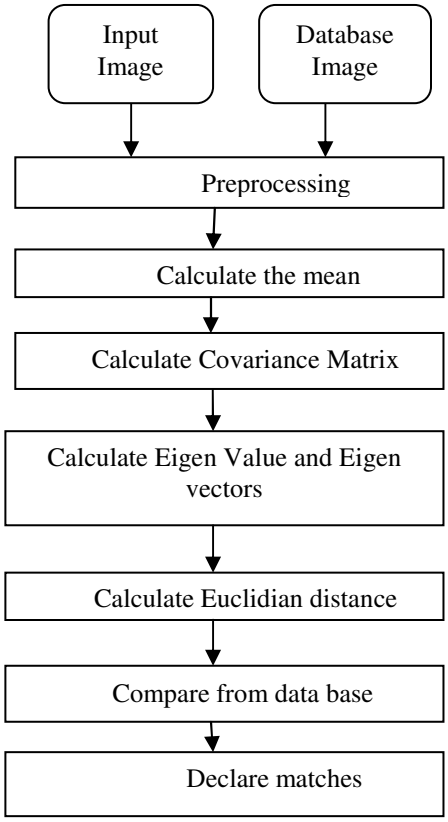

Fig. 2 Flow of PCA

When the Euclidian distance calculated we compares from database and declare the match weather the person present in data base or not.

First we give one image in input, after that preprocessing is done. When the preprocessing is completed the next process is to extract the features, and then we calculate the value of Eigen value and Eigen vectors. And calculate the Euclidian distance of input image and database image.

After calculating the Euclidian distance the system recognizes the face and name of the person. If the Euclidian distance of input image matches then the person is authorized otherwise it is not authorized. If the match is found the message comes that person is authorized and if the match is not found it display not authorized.

III. EXPERIMENTATION AND RESULT

a) Face Recognition in the database for image:
The experimentation is carried out using PCA technique. The purpose of the experiment is to verify the person from the database and to know his or her identity. This system used database of 5 persons and each person's 10 images are available in database. Input image and recognized face shown in fig 3. Mean image value, covariance image matrix and Euclidian distance shown in fig 4.

b) Face Recognition for out of database image:
The next experiment carried out on image which is not from database image. An image is given as input which is not belong from database. The output shown in fig 4. The Mean image value, covariance image matrix and Euclidian distance of image are shown in fig 5.

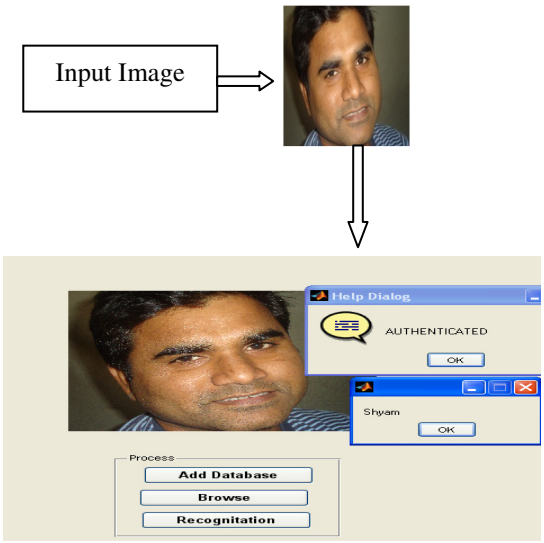

Fig 3 Input image and output Recognized face

```
mean_image:91.777443
A:-10.777443A:-12.777443A:-11.777443A:-10.777443A:-9.777443A:-10.777443.
  Columns 1 through 7

    0.0049    0.0059    0.0004    0.0039    0.0062    0.0060    0.0064

  Columns 8 through 14

    0.0046    0.0062         0    0.0045    0.0061    0.0058    0.0051

  Columns 15 through 21

    0.0049    0.0063    0.0063    0.0061    0.0064    0.0049    0.0033

  Columns 22 through 28

    0.0064    0.0054    0.0067    0.0029    0.0062    0.0050    0.0050
```

Fig 4 Mean image value, covariance image matrix and Euclidian distance

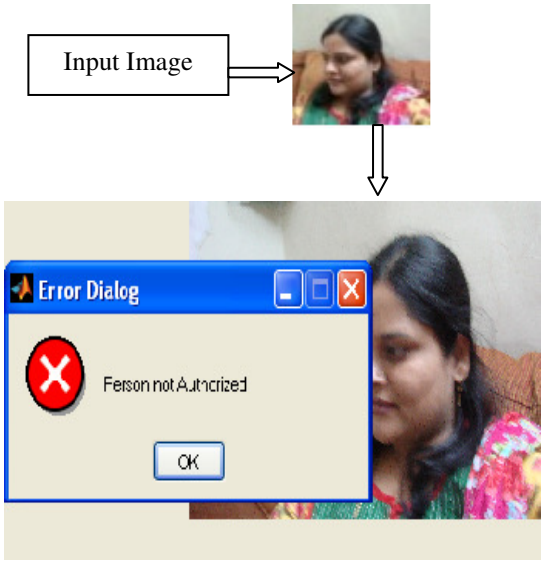

Fig 5 Image not in the database and output

```
mean_image:155.232777
A:50.767223A:51.767223A:52.767223A:52.767223A:53.767223A:53.767223A:52.
  Columns 1 through 7

    0.0012    0.0003    0.0058    0.0022    0.0001    0.0001    0.0003

  Columns 8 through 14

    0.0015    0.0000    0.0061    0.0016    0.0000    0.0003    0.0011

  Columns 15 through 21

    0.0012    0.0002    0.0002    0.0001    0.0003    0.0012    0.0028

  Columns 22 through 28

    0.0003    0.0007    0.0128    0.0090    0.0001    0.0011    0.0011
```

Fig 6 Mean image value, covariance image matrix and Euclidian distance of image

IV. CONCLUSION

In this paper the method of Face Recognition presented which can use in the security purposes. We done face recognition successfully. We used Principal component Analysis method for face recognition. We get matrix the of image and calculated the Eigen values and Eigen vectors. Then find the Euclidian distance, and declare the person is authorized or not. This face recognition application we can use for improve security.

V. FUTURE WORK

This time only database images were taken but in future real time system can be designed.

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AUTHORS PROFILE

Neelam Mahale, ME VLSI & Embedded Systems, MITCOE Pune, Pune University
Teaching Experience 2 years

Dr. Manoj S. Nagmode,

Working as professor in MITCOE Pune in E & TC Department. He has 18 years of teaching experience. His area of intrest in image and vedio processing

Prajakt S Ghatol
ME student
ME VLSI & Embedded Systems, GSMCOE,Balewadi, Pune, Pune University

