

Face Recognition using Image Processing in MATLAB

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Abstract :The paper presents a program for human face recognition. A self prepared database of different faces is used .Task of Recognizing a Face is difficult but with the help of (PCA) Principal Component analysis it is possible. An application that can help you recognize faces in real time can be done by using Principal Component analysis. In this process Eigen values are selected by PCA calculating the nearest value and then displaying result. This Biometric system contains of a real time application.

IndexTerms - Eigenface , Eigenvalues, Detection, PCA, Recognition.

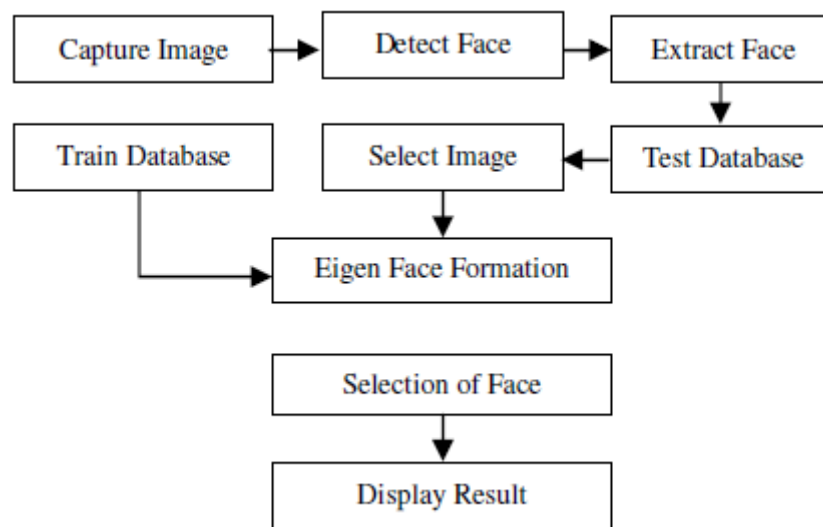
I. INTRODUCTION

In today's world a lots of work is carried on biometrics. Similarly Face detection and Face recognition are also used in a wide way for various work purposes. Over the time for Face Recognition and Face Detection various methods were invented as Face Recognition and Detection is one of the best ways of detecting a person's identification and also doesn't require human cooperation. Principal Component Analysis is an effective algorithm in the world of image processing it is mainly used for face recognition and detection.

In the current paper we have developed an application for face recognition using PCA Algorithm. The overview of the system developed using PCA algorithm is shown in the figure (1).

In this process of face recognition the face is first detected and then recognized using PCA algorithm.

By the help of Eigen Faces stored in the database and the image captured. Recognition or selection of the face for displaying is independent and is done with the nearest values which is generated as a result by the PCA algorithm. Figure (1) shows the process that is carried out in face detection and recognition.



Figure(1) System Overview

There are two different methods for Face Recognition, the first method consist of extraction of the basic parts of the face for example eyes, nose, chin, mouth etc with the one stored in the database . Second method consist of Principal Component analysis. In this method the image that defines more is derived from the face image[1].

In this paper we have developed a recognition system using PCA algorithm. The technique involved is regardless of the expressions or features of human face (eyes open/closed, with or without specs etc.)

PCA algorithm is an information approach in which the extraction of relevant information regarding face is extracted efficiently The following paper discuss about Face Detection method in section II, section III discuss about Face Recognition method, section IV defines PCA algorithm followed by eigen face approach and at the end summarized result and conclusion.

II. LITERATURE REVIEW

2.1 How to Use the Raw and Processed Images for Robust Face Recognition under Varying Illumination

In this paper, a new method is proposed to deal with illumination problem in face recognition. Firstly, we define a score to denote a relative difference of the first and second largest similarities between the query input and the individuals in the gallery classes[2]. Then, according to the score, we choose the appropriate images, raw or processed images, to involve the recognition. Methodology used is modeling and image processing transformation/filtering.

2.2 Face Recognition Using Holistic Based Approach

In holistic based approaches recognition is done based on global features from faces, whereas in feature based faces are recognized using local features from faces. Holistic approach features represent optimal variances of pixel data in facial images used to uniquely identify a person. Whereas features of feature-based approaches represent face features like the eyes, nose and mouth to uniquely identify a person[3]. Methodology used is to recognize a face two image processing steps are available. In the first step face detection process is carried out using Viola Jones face detector.

2.3 Facial detection using deep learning

We have observed that Facebook has developed an uncanny ability to recognize people in photographs. Previously, we had to tag people in photos by clicking on them and typing their name. Now as soon as we upload a photo, Facebook tags everyone on its own. Facebook can recognize faces with 98% accuracy which is pretty much as good as humans can do. This technology is called Face Detection[4]. Face detection is a popular topic in biometrics. We have surveillance cameras in public places for video capture as well as security purposes. The main advantages of this algorithm over other are uniqueness and approval.

2.4 Pattern Recognition and Image Processing

Only two-dimensional pictorial patterns and pattern recognition deals with one-dimensional, two-dimensional, and three-dimensional patterns in general. However, in many cases, information about one-dimensional and three-dimensional patterns is easily expressed as two-dimensional pictures, so that they are actually treated as pictorial patterns. Furthermore, many of the basic techniques used for pattern recognition and image processing are very similar in nature. Differences between the two disciplines do exist, but we also see an increasing overlap in interest and a sharing of methodologies between them in the future.

III .IMPLEMENTATION

3.1PCA ALGORITHM:

PCA (Principal Component Analysis) PCA is one of the successful techniques used to the original data with lower dimensional features vectors. This procedure transforms a number of correlated variables into a number of unrelated variables called Principal Components. PCA[9] is a powerful tool for analyzing data. The main advantages of PCA are to find the patterns in the data and reducing the number of dimensions without loss of information's. Purpose of PCA is to reduce the large dimensionality of the data space to the smaller intrinsic dimensionality of feature space.

In arithmetical terms first the transformation matrix is formed of the image, next, the training images in the database are projected onto the formed matrix columns. Finally the image is selected and shown. PCA covers standard deviation covariance, eigenvectors and eigenvalues. There are many applications which can be used for solving the problem of recognition, but out of those the appearance based approach is best. The benefit of using it is can be directly used for two-dimensional patterns[5].

PCA can perform prediction, redundancy removal, feature extraction, data compression, etc. PCA can not only decrease computational complexity with a linear transform, but also make the distribution of face image data more compact for classification, it has become popular feature extraction methods for face recognition. On the other hand, PCA method can not only effectively reduce the dimension of human face images, but also retain its key identifying information. Process followed in PCA Algorithm is illustrated by the following Flow Chart.

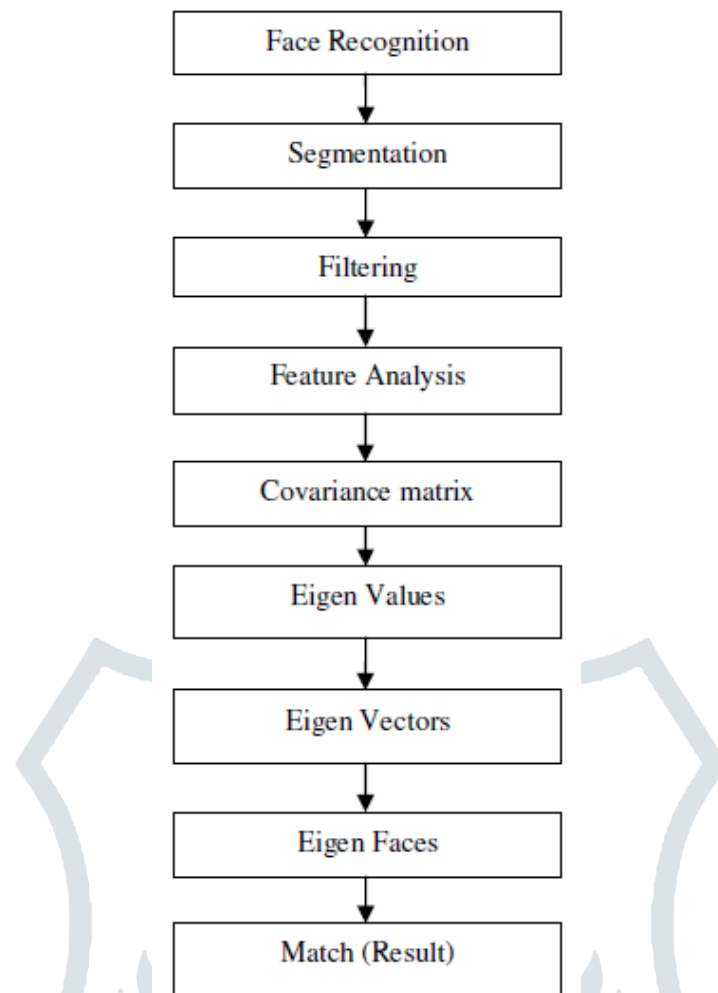


Fig. 3-Flow chart of PCA Algorithm.

I. Let a face image $X(x_1, x_2)$ be a 2-dimensional $M \times N$ array of intensity values of face image(s). Image can also be considering by the vectors of dimension of image mn . Let the training set of images $\{X_1, X_2, X_3, \dots, X_N\}$. The average face of the images in the set is defined by

$$\bar{X} = \frac{1}{N} \sum_{i=1}^N X_i$$

II. Calculate the Covariance matrix to represent the scatter degree of all characteristic vectors related to the average vector. The Covariance matrix C is defined by

$$C = \frac{1}{N} \sum_{i=1}^N (X_i - \bar{X})(X_i - \bar{X})^T$$

III. The Eigenvectors and corresponding eigenvalues are computed by using

$$CV = \lambda V$$

Where V is the set of eigenvectors associated with its eigenvalue λ .

IV. Sort the eigenvector according to their corresponding eigenvalues from high to low.

V. Each of the mean centered image project into eigenspace using the below equation:

$$W_i = V_i^T (X_i - \bar{X})$$

VI. In the initial phase each test image should be mean centered, now by projecting the test image into the same eigenspace as defined during the training phase. This projected image is now compared with project training image in eigenspace. Images are compared with similarity measures. The training image that is closest to the image will be matched as used to identify.

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3.2 EIGEN FACE APPROACH:

In Information theory, the data that is used for extraction of the features from the face image, encode the data and then compare it with the data in the database. When it comes to pattern detection Human Face detection becomes difficult and has practical problems. In this we need to get the principal component of the faces or eigenvectors of the set of images in mathematical terms. It is done by considering the image a point vector in a very high dimensional space.

Eigen vector can be considered as a set of facial appearance that together characterizes the deviation between face images. Each image is used for defining the eigenvector, so an eigenface i.e. arrangement of various eigenvectors. Every face can be represented in terms of a linear combination of eigenfaces accurately and we can approximate the face using only the best eigenfaces[6].

In order to calculate the eigenfaces and eigenvalues in MATLAB we have to use the command eig. The syntax of the command is

```
d = eig(A)
V,D = eig(A)
V,D = eig(A,'nobalance')
d = eig(A,B)
V,D = eig(A,B)
d = eig(A) will return a vector of eigenvalues matrix A.
```

$V,D = \text{eig}(A)$ produces matrices of eigenvalues (D) and eigenvectors (V) of matrix A , so that $A*V = V*D$. Matrix D will be the canonical form of A , a diagonal matrix with A 's eigenvalues on the main diagonal. The matrix ' V ' is the modal matrix, and its columns are the eigenvectors of A .

In order to compute the left eigenvectors we use $W, D = \text{eig}(A')$; $W = W'$ in order to compute the left eigenvectors, which satisfy $W*A = D*W$. $V,D = \text{eig}(A, \text{'nobalance'})$ finds eigenvalues and eigenvectors without a preliminary balancing step. Mainly when balancing is used it improves the conditioning of the input matrix, enabling more accurate computation of the eigenvectors and eigenvalues[7].

The generalized eigenvalues return in a vector $d = \text{eig}(A,B)$, if A and B are square matrices. $V,D = \text{eig}(A,B)$ produces a diagonal matrix D of general eigenvalues and a full matrix V whose columns are the corresponding eigenvectors so that $A*V = B*V*D$.

3.3 SOFTWARE USED:

The software used for developing is MATLAB. The project is completely based on MATLAB. In our case we have used it for the purpose of face recognition. We used it in such a way that it is able to match the faces from the predefined database or from the input image from camera or webcam and generate result using MATLAB. We have used MATLAB 2012 and its image acquisition and image processing toolbox is used.

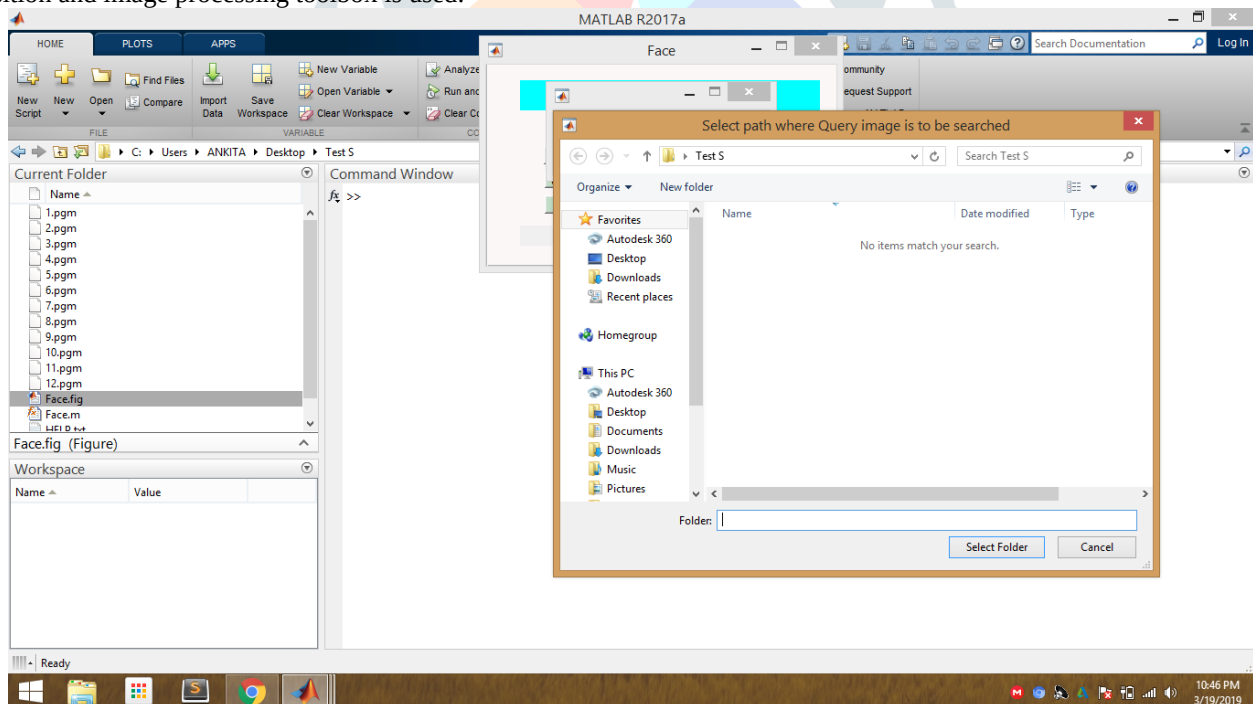


Fig.4-Matlab Screen

IV. RESULTS AND DISCUSSION

In PCA based face recognition, by increasing the number of images of faces in the database increases the recognition rate of system. But the recognition rate starts saturating after a definite sum of increase in eigen value. This is because increasing the images in the database increases the recognition rate but however this increase is compensated by noisy images which decrease the recognition accuracy. Figure below shows the implementation of the system.

Firstly the image is given as input to system from train database folder, and then it is matched with the mean eigenface formed of the images in the database. The one which has the value or eigen value nearest to the eigen face value of the images in database it is shown as the result at output. The image on the left side is the input to the system and image at the right side is the output which is shown after matching. These images are stored in the train and test database.

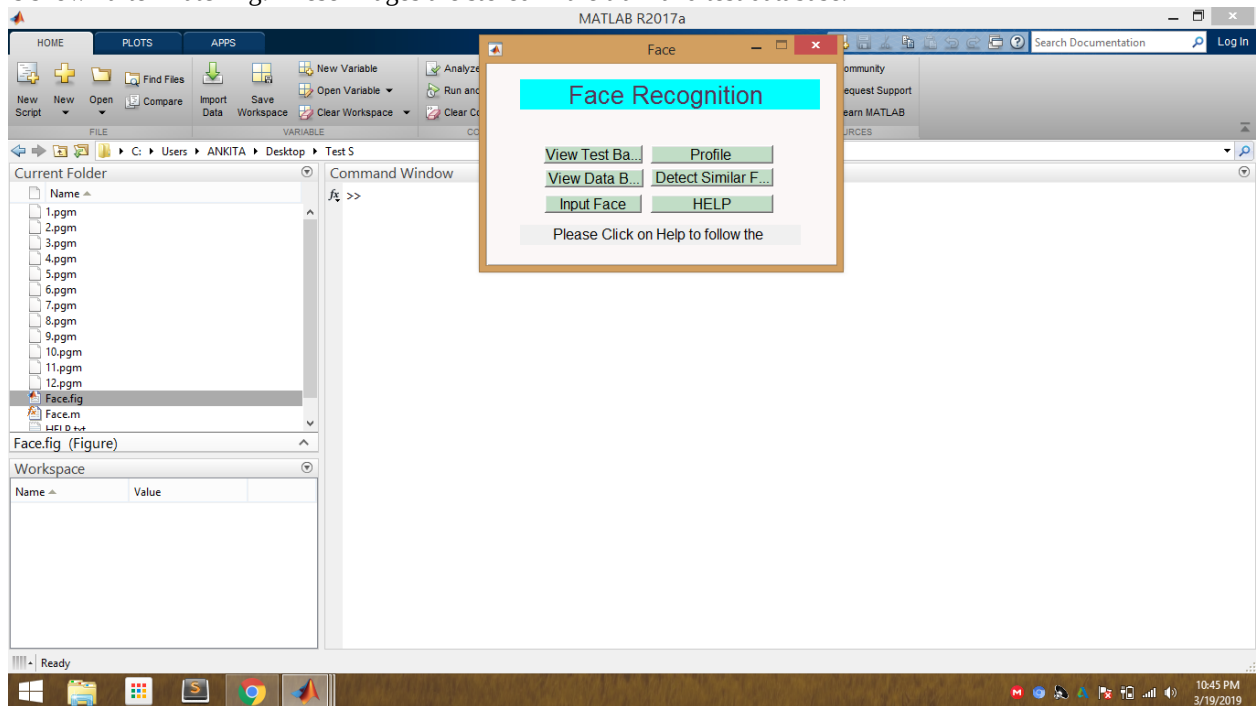


Fig.5- GUI

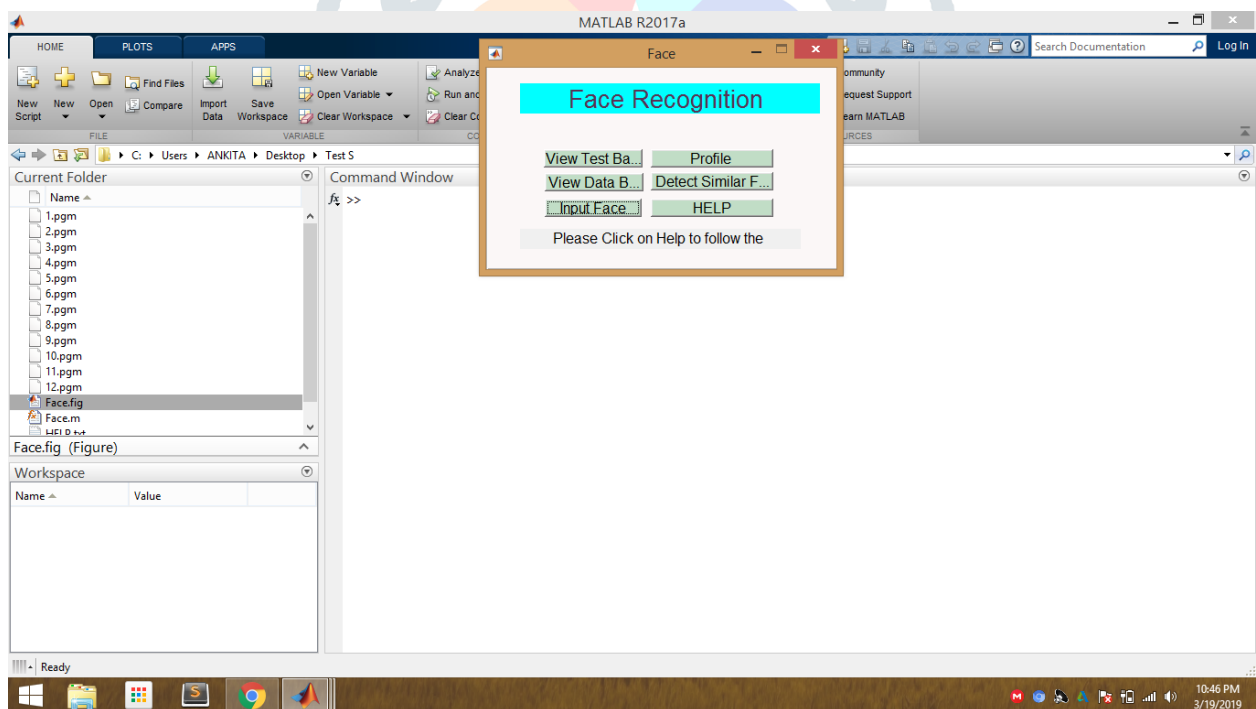


Fig.6-takes input from user

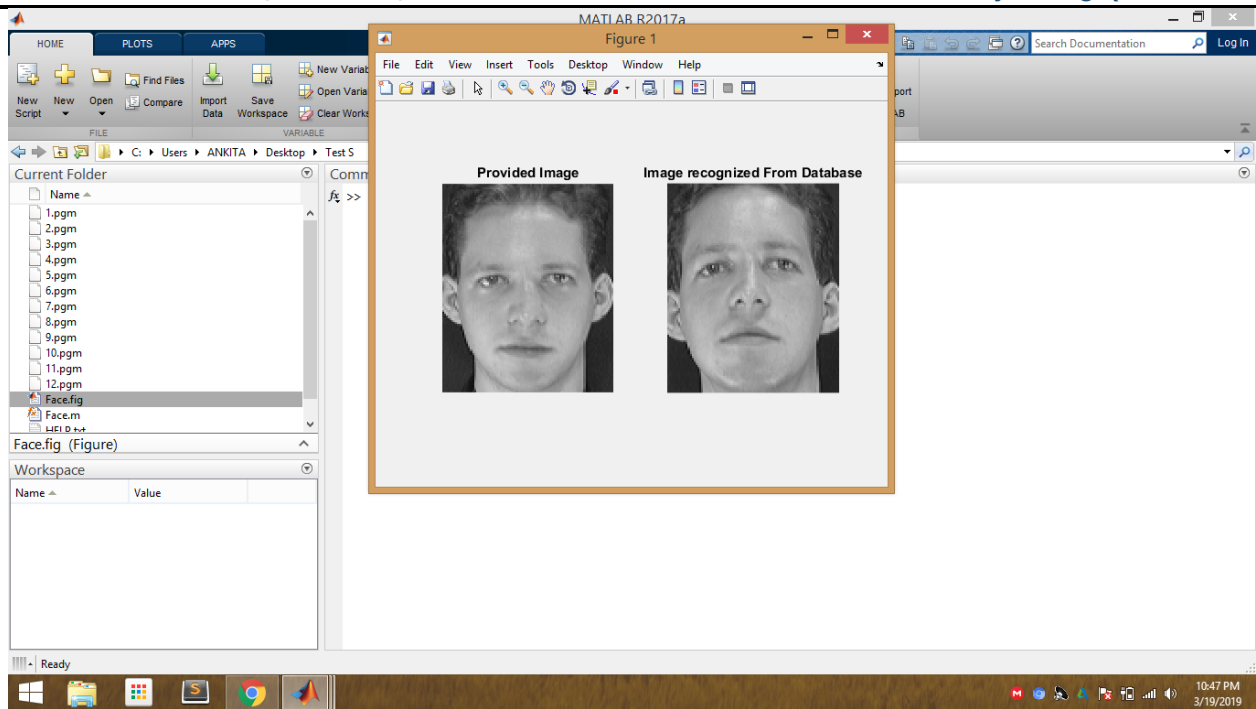


Fig.7-Input image and output image is matched

III. ACKNOWLEDGMENT

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