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Neural Network Based Face Recognition Using PCA

Ganesh Linge, Meenakshi Pawar

Department of Electronics & Telecommunication,
SVERI's College of Engineering, Pandharpur, India

***Abstract*—Human face is contexture multidimensional point of vision model and by creating computational model for human face recognition is too hard. The paper present two methodologies for the face recognition, the first one is feature extraction and second is the feed forward back propagation neural network. The feature extraction is with Principal Component Analysis and classification with the help of neural network. Eigenfaces are applied to taken out the remedial information in an image, which are persistent for identification. For image recognition the Eigen face approach uses Principal Component Analysis (PCA) algorithm. The proposed algorithm has been tested on 165 images from Yale face database. Test results gave a recognition rate above the 97%.**

Keywords— Face Recognition, Eigenface, Principal Component Analysis, Artificial Neural Network, MATLAB

I. INTRODUCTION

A face recognition system [1] is a computer vision and it automatically identifies a human face from the face image present in the database. The face recognition is a method operates on intensity and the face images are used by human beings for the purpose of personal identification. The facial images are complicated objects with features that can vary over time. The human have skill to identify the faces and identity of human at the incentive of the second. This paper is presents face recognition based on Neural Network and Principal Component Analysis based algorithm for systematic and tough face recognition.

II. RELATED WORK

The face recognition is by two criteria's first is the Principal Component Analysis and second is the feed forward neural network. The three main processes for the face recognition as shown below:

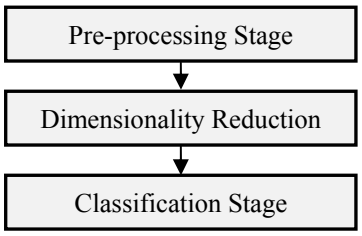

Fig. 1. Three main processes for face recognition

Feature extraction, also called dimensionality reduction, is done by PCA for a three main purposes like to reduce extension time of the data to more manageable boundary, to taken salient class-specific features of the data and to release redundancy. The face recognition is by two methods. The first method is based on taken out feature vectors from facial information like eyes, nose, mouth and chin with the help of capable of being reshaped templates and substantial mathematics. The basic information is collected and transferred into a feature vector. Yullie and Cohen [2] used capable of being reshaped templates in contour extraction of face images.

The second method is based on information theory concepts namely Principal Component Analysis method. In this method, the information that represent a face that draw from the entire face image. Based on the Karhunen-Loeve expansion in pattern recognition, Kirby and Sirovich [3], [4] have shown that any particular face can be represented in terms of a best coordinate system termed a "Eigenfaces". These are the Eigen functions of the average covariance of the ensemble of faces. Later, Turk and Pentland [5] proposed a face recognition method based on the eigenfaces approach.

The unsupervised face recognition presents in this paper which is independent of excessive geometry and mathematical calculation [6]. The face recognition is implemented based on Eigenface, Principal Component Analysis and Artificial Neural Network. The Principal Component Analysis is for the extracted relevant information efficiently as possible based on the information theory approach. Further Artificial Neural Network was used for the classification purpose. The Neural Network has the ability to learn from the input data because of this purpose it is used

A. Principal Component Analysis

The Principal Component Analysis or PCA is used to taken out the features from very high degree quality image of human frontal face. All the training models of same size and aspects are described as the basic face database. In this paper, the Yale face database used for recognition of images [7].

The partial face can be economically represented along the eigenfaces coordinate space and with near approach to accuracy converted using a small collection of eigenfaces. The partial face can be economically represented along the eigenfaces coordinate space, and with near approach to accuracy converted using a small collection of eigenfaces. The human face is purposed to separate face templates called eigenfaces which can be considered as a group of features that to engrave the difference between face images. Once a set of Eigen face is calculated, a face image can be with near to approach accuracy reconstructed using a weighted combination of the Eigen-faces. The impulsion weights form a feature vector for face

representation and recognition. The systematic distribution is then described by comparing the distances between the weight vectors of the input image and the images from the database.

Conversely, using all of the Eigen-faces extracted from the original images, one can reconstruct the original image from the Eigen-faces so that it matches the original image exactly [8].

B. Method for Recognition

Principal Component Analysis applied directly to face images with Euclidian distance as a classification measure, as shown in figure bellow. The correlation matrix was computed from 8 training faces and for classification first 8 eigenvectors of the correlation matrix are used above 96% of test faces was recognized successfully. This result corresponds to method as shown in figure bellow.

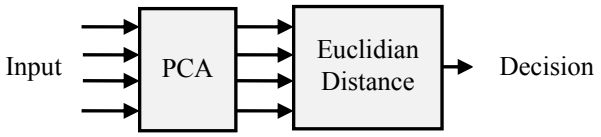

Fig. 2. Method for Recognition

C. Algorithm

Traditional Principal Component Analysis (PCA) was also called Eigenface [5]. The following steps summarize the process:

a) Let a face image Z(x, y) be a two dimensional m × n array (8-bit gray scale) of intensity values. An image may also considering the vector of dimension mn, so that a typical image of size 320 × 243 becomes a vector of dimension 77760. Let the training set of images {Z1, Z2, Z3……Zn}. The average face of the set is defined by,

$$\overline{Z} = \frac{1}{N}\sum_{i=1}^{N} Z_i$$

b) Calculate the covariance matrix to represent the scatter degree of all feature vectors related to the average vector. The covariance matrix C_m is defined by

$$C_m = \frac{1}{N}\sum_{i=1}^{N}(Z_i - \overline{Z})(Z_i - \overline{Z})^T$$

c) The Eigenvectors and corresponding eigenvalues are computed by using, $C_m V = V\lambda$, Where V is the set of Eigenvectors associated with its eigenvalues λ.

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

e) Each of the mean centered image project into eigenspace using,

$$W_i = V_i^T (Z_i - \overline{Z})$$

f) In the testing phase each test image should be mean centered, now project the test image into the same eigenspace as defined during the training phase.

g) This projected image is now compared with projected training image in eigenspace. Images are compared with similarly measures. The training image that is closest to the test image will be matched and used to identify [9].

D. Neural Network

The Neural Network based face recognition approaches include the use of convolutional Neural Networks [10], radial basis neural networks [11], and other types of Neural Networks. All of these focus on recognition performance leading to complex learning algorithms and non-linear neurons. In several of these works, the Neural Networks act as classifiers. Separate feature extraction algorithms extract relevant features that are fed to the Neural Network classifiers. The complexity of learning algorithms and feature extraction algorithms make the existing Neural Network-based face recognition methods inefficient for hardware mapping [12].

For the effective performance of feed forward neural network it is essential for the suitable selection of the parameters used for training. The initial weight will impact whether the net attains global or local minima of the error and if so how rapidly it intersects. To get the best result the initial weights are set to random numbers between -1 and 1. The reason for applying Neural Network is to accomplish a balance between memorization and generalization. The weight appearances are based on training models. Since error for the validation falling off training continues. Each time the error commences to increase, the net is starting to remember the training models. The main benefit of this algorithm is that it can recognize the input image as a face image or non face image and then identity the given input image. Thus the feed forward neural network classifies the input face as recognized face [8].

E. Face Database

The Yale face database used, it contains 165 grayscale images in GIF format of 15 individuals. There are 11 images per subject, one per different facial expression or configuration: center-light, w/glasses, happy, left-right, w/no glasses, normal, right-left, sad, sleepy, surprised, and wink.

Fig. 3. Sample Database

III. PROPOSED SYSTEM

Step 1: Prepare the data-training set of faces
Step 2: Original faces transformed in to Eigenfaces
Step 3: Eigenfaces are calculated for each image of the training set and stored in the set W
Step 4: Calculate the covariance matrix, eigenvectors and Eigen values of the covariance matrix
Step 5: Select the Principal components
Step 6: Classification of image

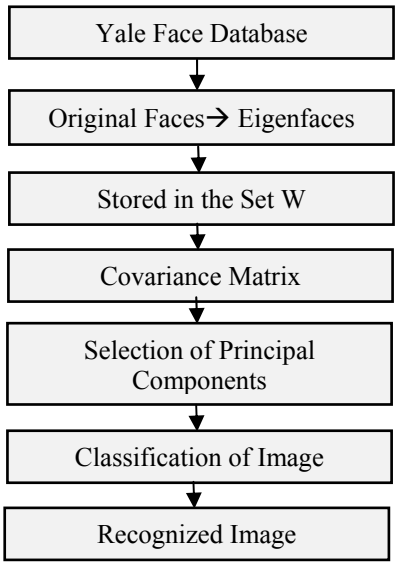

Fig 3. Proposed Algorithm

IV. RESULTS

In this paper for experimentation, 165 images from Yale database are taken and a sample database is shown in figure 3. The calculated Eigenfaces are shown in figure 3.

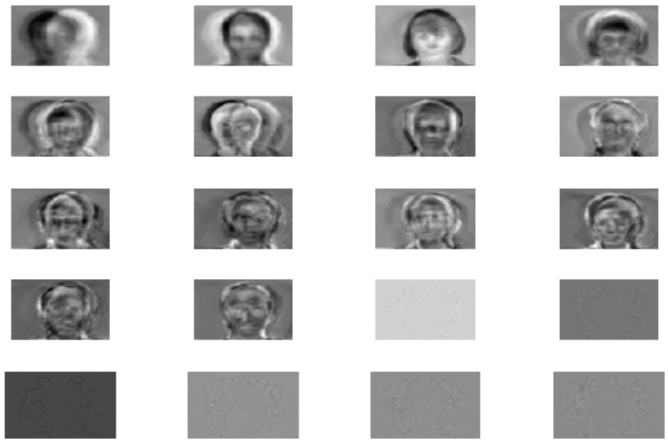

Fig 4. The 20 Eigenfaces

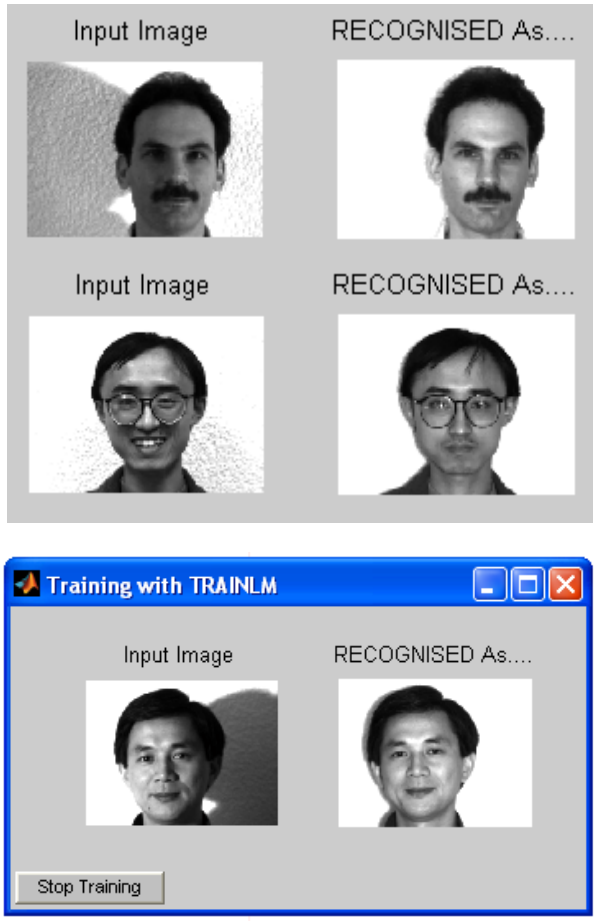

Fig. 5. Input image & recognized image

TABLE I
RECOGNITION RATIO

Sr. No.	Total images	Recognition ratio-PCA (%)
1.	165	85.45

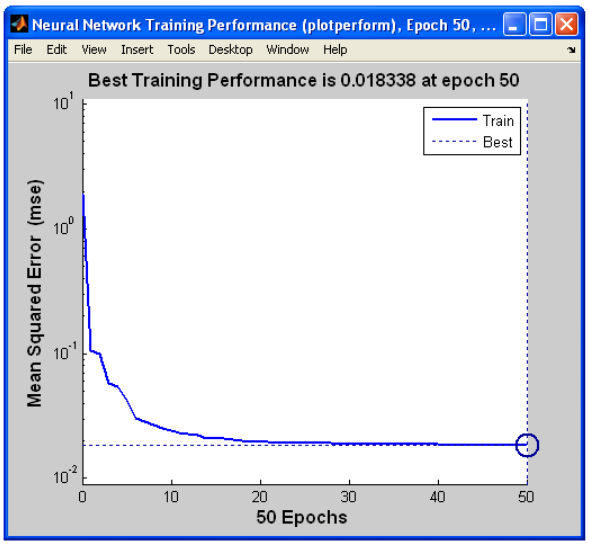

Fig. 6. The training performance for 50 Epochs

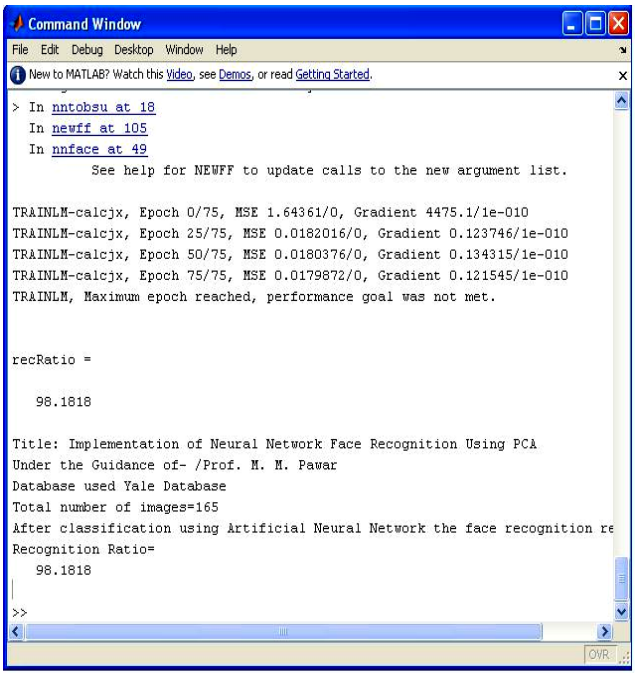

Fig. 7. Face Recognition Result for for 75 Epoch & Mean Square Error is 0.0179872

TABLE II

RECOGNITION RATIO USING PRINCIPAL COMPONENT ANALYSIS WITH NEURAL NETWORK

Sr. No.	Epoch	Recognition Ratio (%)
1	25	98.7879
2	50	98.1818
3	**75**	**98.7879**
4	**100**	**98.7879**
5	150	98.1818

The above Table I and II show the comparative result of PCA and PCA with Neural Network. The recognition ratio by using Principal Component Analysis is 85.45% that is improved by using the Principal Component Analysis with Neural Network, the recognition ratio is 98.78%.

V. CONCLUSION

The paper presents a face recognition approach using PCA and Neural Network techniques. The result is compared with PCA and proposed technique gives a better recognition rate then the other. In the Table I one can see the recognition rate by using Principal Component Analysis is 85.45% and the maximum recognition rate obtained by using Principal Component Analysis with Neural Network is 98.78%.

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