Recognition of Face Using PCA Algorithm

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Abstract— **Detection of face from a long database of images of faces with different backgrounds is not an easy task. In the face detection system the colored images are invariant to background and acceptable illumination conditions. To reject the non-human face images and the unknown human images which are not present in the input database face images the threshold level is set. The global extraction of features is done using Principal Component Analysis (PCA) with the help of Eigen face computation method and the detection part is completed using multi-layered feed forward Artificial Neural Network (ANN) with back propagation method. MATLAB software is used to implement this algorithm**

Index Terms— **Principal Component Analysis, multi-layered feed forward Artificial Neural Network**

I. INTRODUCTION

Recognition of faces using machine is emerging an active research area in many disciplines such as recognition of images, recognition of pattern, computer vision and neural networks. Recognition of face technology has several commercial and law enforcement applications. These applications of face recognition system will be ranging from static matching of controlled format Photographs such as credit cards, passports, driver licenses, photo ID"s and mug shot to real time matching of surveillance video images. Most of the recent events like attacks from terrorists has created a serious weakness in the sophisticated security system[1].

To improve the security system depending on behavioral characteristics many government agencies are motivated and this called biometrics. Recognition of face system works with the concept of individual identifier human face. The digital video camera is used to analyze the characteristics of a face image of a person using facerecognition system. The overall structure of face is measured by the distance between eyes, nose, mouth and chicks; depending on input image, the unique characteristics of the recognition of face system will store the template of the face into the database[2]. Badge based authentication procedures are very easy to hack. "Visitors management system" is a new perspective given by face recognition system as shown in Figure 1.1.
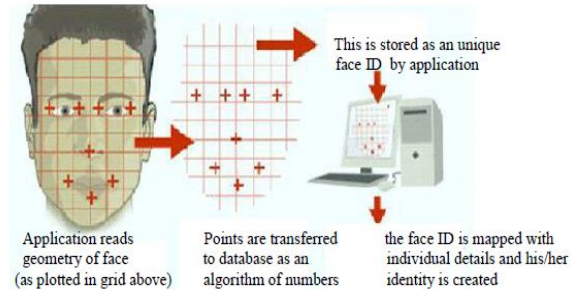
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Figure 1.1: Visitors management system [1]

II. METHODOLOGY

➢ PCA algorithm

In the proposed methodology using Principle Component Analysis (PCA) the features of face are extracted. PCA is used for dimension reduction and it will retain the most of the changes present in the data set. The feature vectors for different points of face are calculated and column matrix of these vectors is formed. Calculating the Eigen face images by using PCA algorithm is shown in Figure 1.2.
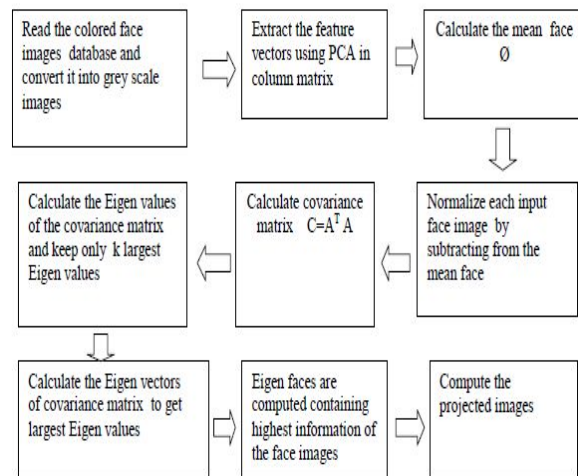

Figure 1.2: Calculating the Eigen face images by using PCA algorithm

Step 1: Consider the M sample images contained in the database as A1, A2, A3……….AM.

Step 2: Average image,$\square$, is calculated.

Step 3: The covariance matrix is calculated as C = ATA where A = [Ø1 ,Ø2,………..ØM].

Step 4: Normalize each input face image by subtracting from the mean face.

Step 5: Calculate the Eigen vectors of covariance matrix to get k largest Eigen values.

Step 6: Eigen faces are computed containing highest information of the face images.

The steps include training the recognizer and then recognizing the unknown face.

➢ **Recognizing theUnknown Faces**

Figure 1.3 shows the steps which include training the recognizer and then recognizing the unknown face.
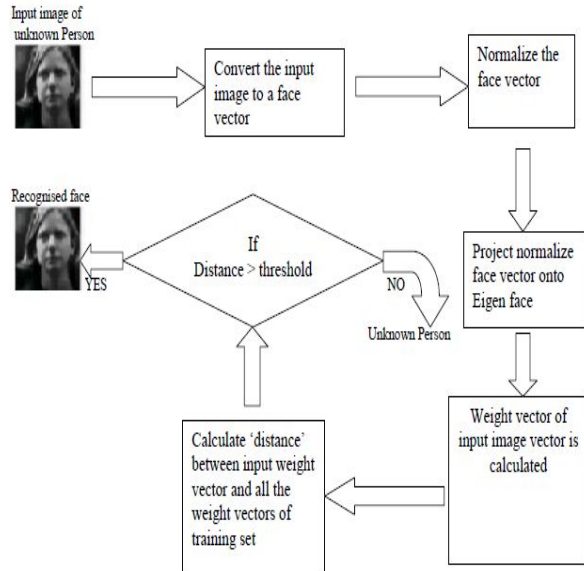

Figure 1.3: Recognizing unknown face

PCA method calculates the variations in data with converts high dimension to low dimension. These extracted features of face image are processed to Artificial Neural Network (ANN) for training and testing[5].

III. ARTIFICIAL NEURAL NETWORKS

The human brain performs different tasks by complex interconnected neurons. These neurons work independently. Artificial Neural Network (ANN) can solve any of the complex and noisy data problems.

Input to Feed Forward Network: Selection of number of input layers, hidden layers and output layers. The input neurons get the input from the training data. Input signal has its own weights.

Back Propagation and Weight Adjustment: The data from the input layer is passed to the hidden layer and calculates the data and passes it to the output layer. The data from output layer is compared with the target value and error signals are obtained. The obtained error spinals are fed back to adjust the weights of hidden layer to reduce the error as shown in the figure 1.4.
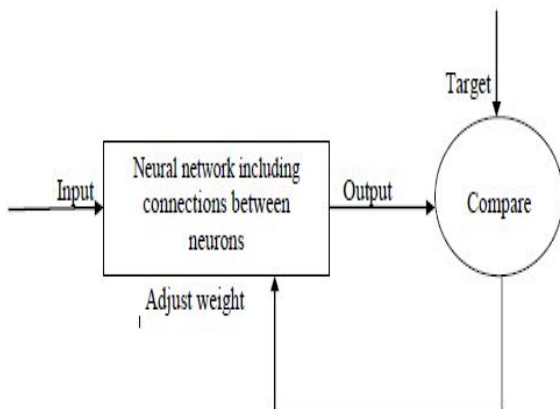

Figure 1.4 : Back Propagation of multilayered ANN

Mathematical Function: The operations performed are threshold function, log-sigmoid and Tangent hyperbolic function. If the output value is same as the output value of tested face then it is known face.

IV. DESIGN IMPLEMENTATION

Figure 1.5 shows The basic blocks of face recognition. The extracted features using PCA calculates the Eigen faces. These Eigen faces are given as input to the ANN and neural networks are trained.
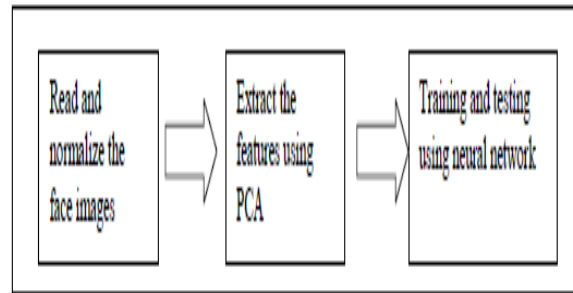

Figure 1.5: Basic blocks for face recognition

For the testing purpose, the Eigen face of the tested image is given as input to the neural networks which is trained depending on threshold value non-human and unknown face images are rejected.

Training of Neural Networks

Neural networks are trained to perform complex functions in various fields of application such as
pattern recognition, identification, classification, speech, and vision and control systems. Back propagation multilayered ANN is used for training the input face images. The Eigen faces obtained by the PCA algorithm are given as input to the neural networks[7]. The number of neural network taken is depending on number of input face images. Distance between the Eigen face images is compared with each other. The Eigen face image of same person has zero distance between them and output is taken as 1 otherwise output is taken as 0 as shown in the figure 1.6.
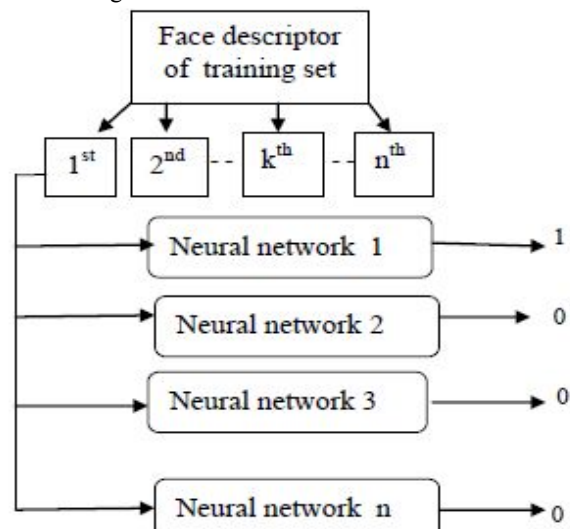

Figure 1.6: Training of neural networks

Testing of Neural Networks

In recognition of face process, the Eigen faces of the test face image are calculated by extracting the features shown in figure 1.7. This Eigen face image is given to each of the neural network which is trained[9]. The Eigen face which is tested is compared with the Eigen faces of neural network which is trained. Comparison is done by using log sigmoid function values. The threshold value is set unto 25% of the best distance. If the distance between the tested Eigen faces and the trained input Eigen face is less than the threshold value, then the output of specific network 1 and the trained Eigen face is selected as an output image and it is recognized as a known image otherwise the test face image is unknown face.
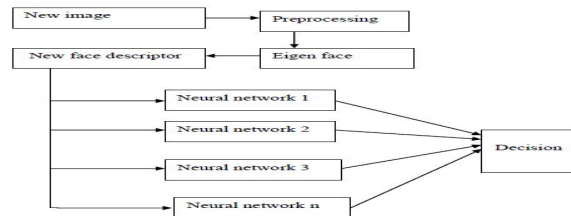

Figure 1.7: Testing of neural networks

V. EXPERIMENTAL RESULTS AND ANALYSIS

Figure 1.8 to Figure 1.10 shows the creation of database of 5 people. In the database each person"s different angles images is present.

Figure 1.8: Database of Person 1 and Single face image for 10 different angles of different Person
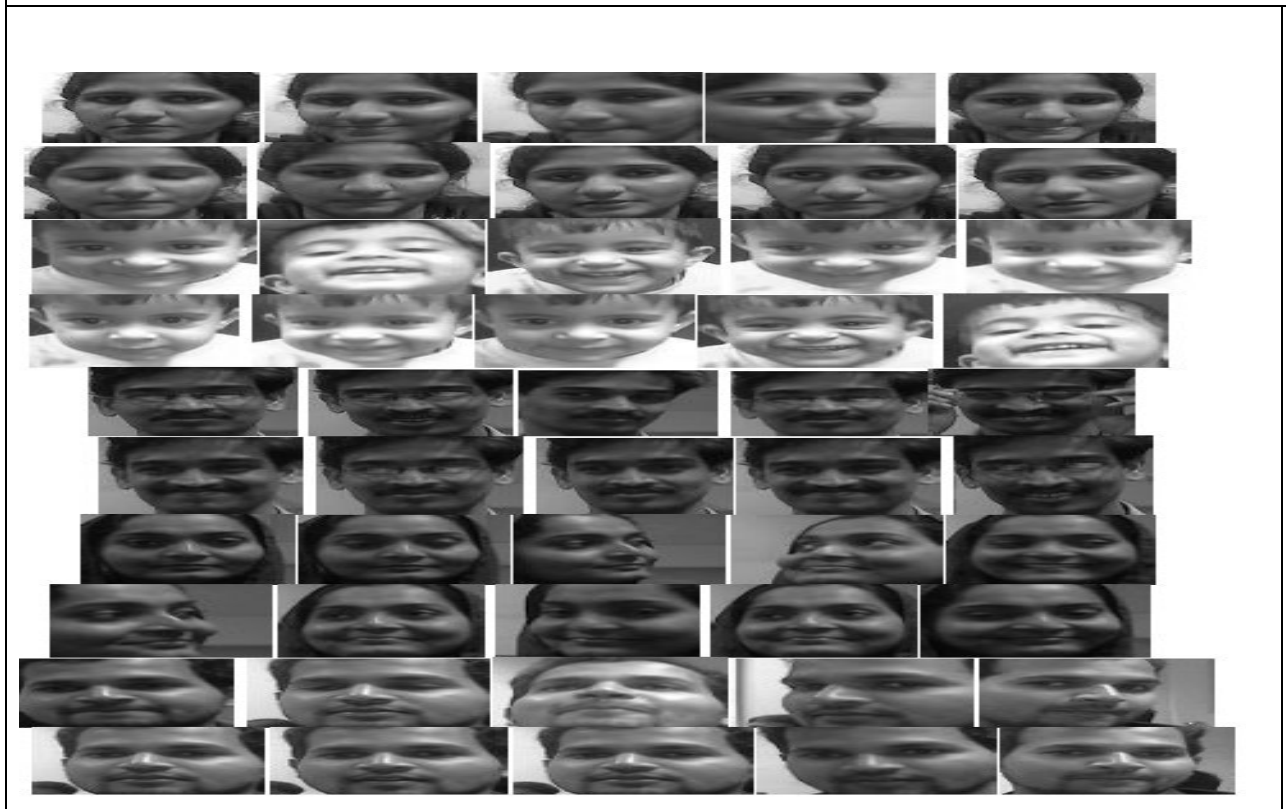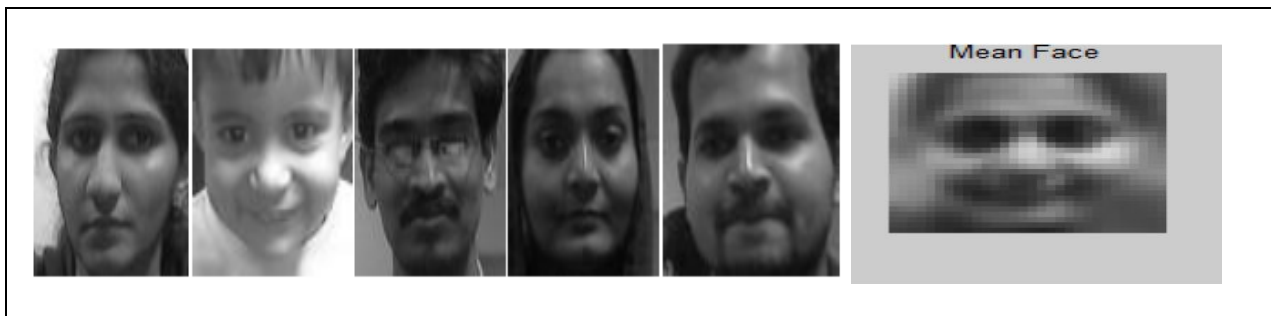

Figure 1.2 : Overall database

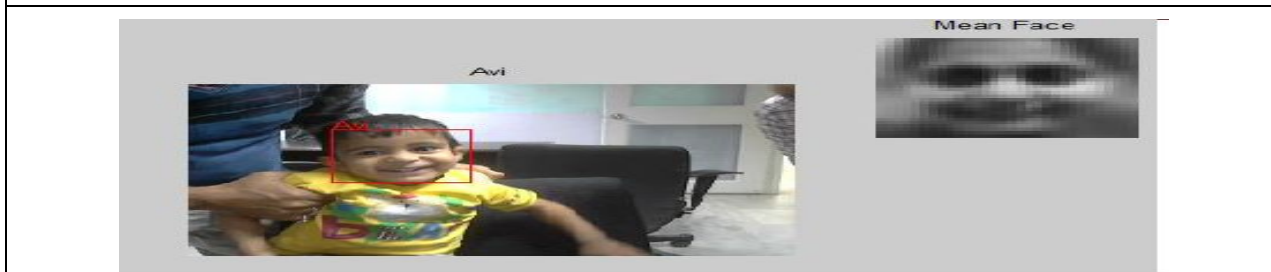**Figure 1.9: Overall test dataset and Mean face**

Figure 1.10: Recognition of face with mean face (a) Person 1 (b) Person 2

CONCLUSION AND FUTURE SCOPE

Recognition of face technology has come a long way in the last twenty years. Nowadays, machines automatically verify the identityinformation for secure movement, for surveillance and security tasks, and for access control to buildings etc. These recognition of face applications mostly works in an environment which can be controlled and recognition of face algorithms has the advantage of the environmental restricts to get high recognition accuracy. The back propagation feed forward artificial neural networks with features extracted using PCA is proposed for the face recognition. The proposed face recognition system works with high accuracy and provides better success rates even for the noisy face channel. The performance of recognition of face of the proposed method by any means, and it can be improved further with few modifications and small pre-processing of face images. This improvement can be done by using Random Forest Algorithm. It is used for implementing multiple processors and taking full advantage of data structure. This algorithm can be used to identify the identical twins which is very good advantage.

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