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Face Recognition Using Elman Neural Network

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Abstract: - This paper introduce proposed approach for Face recognition to identifier any personal which used in many application. At first that capture images and database images is challenging problem due to the difference of face looks, lighting effect and the complexity background of the image. Face recognition is one of the most active and appropriate applications of biometric systems and image processing. This paper present, the most important step is extract the features extraction of depended to Principal Component Analysis (PCA) also known Karhunen–Loe`ve (KL) transform to calculate the eigenvalues to reduce the input for network. To recognize the person applied artificial neural networks (ANN) using Elman neural work . Practically have (10)image person each one has eight pose(4 to train -4 to test) .Experimental results for ENN classification are calculate the genuine acceptable rate(GAR) is %97 while the false acceptable rate(FAR) is equal %3 . also the artificial neural network is gave a good performance for recognition any person.

I. INTRODUCTION

Face recognition is the process of automatically determining whether two images are the same person. Some of factors create this a challenging difficult for computers. Faces in images can be captured at various quality, resolutions, and lighting environments. Different cameras have different imaging features. Overall, people's facial expressions and as well their pose with detail to the camera can differ broadly, and facial physical appearance can change affectedly as people age over time. Digital images are becoming more important in the multimedia information. The human face is one of the most essential objects in an image. Distinguishing the location of human faces and then extracting the facial feature in an image is an important facility by several uses, such as human face recognition, human computer interfacing, surveillance systems, etc. In this paper, it is applied a human face recognition method by neural network. [1]

Difference in illumination of the part, changes in pose, orientation and expression are cases of some of the issues to be dealt wisely. Recently, technology became available to allow verification of true individual identity. This technology is built in a field called "biometrics". Biometrics is a technique for identifying people by using a exclusive physiological characteristic, such as eye, fingerprint, face, and DNA etc, or behavioral characteristics, *e.g*., voice, walk and signature *etc*. Biometrics is used of computers to recognize people. Face recognition is one of the biometric methods that to have the values of high accuracy.[2]

There are many methods for face recognition. These methods specifically correlation, Template matching, Eigen face and so on. In Template matching method is active when the test images have the same scale, orientation, and training images. But this method is consuming time and not robust. The correlation technique is simplest method for image classification, where the test set is classified.

This technique has some weaknesses. An alternative method for dimension reduction is used. The most broadly used technique for dimension reduction is Principal Component Analysis (PCA) known also as Karhunen–Loe`ve (KL) transform.[3] generally traditional statistical approaches do not give acceptable results. Because of the increasing number of variables related with each observation. The advantage of PCA comes from generalization capability. In order to extract the most important features of the data. PCA look for to reduce the dimension of the data by finding a small number of orthogonal linear combinations of the original variables with the largest variance.[4]

Principal Component Analysis was chosen because it has proved to be a very robust and optimal in pattern recognition tasks and because it is reasonably simple to implement. PCA is special importance because the transformation to face space is depending on the variation of human faces in the training set. The values of the face space vector relate to the amount certain variations are existing in the test image. PCA to determine which 'variables' account for the variance of faces. In face recognition, these variables are called eigenfaces because when plotted show a strange resemblance to human faces. Although PCA is used widely in statistical analysis, the pattern recognition public started to use PCA for classification only reasonably recently.[5]

Automatic feature subset selection distinguishes proposed classification method from other approaches. Facial images are represented in a low dimensional space, spanned by the eigenvectors of the covariance matrix, computed by using that is implemented using an Elman Neural Network (ENN). [6]

II. THEORETICAL ASPECTS

The theoretical aspect includes many categories can be explained in below:

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A. Structure face recognition System

In general Every Biometric system has four main stages which are shown in Fig. 1: face Detection, preprocessing, Feature Extraction, and Face Recognition.

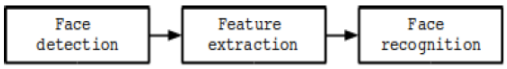

Fig 1. Structure face recognition System

As Fig. 1 shows at first of the face recognition system is capturing image by digital camera or from the database and this image is given to the further step of face recognition system. [2]

B. Face Detection

The major function of this step is to detect the face from capture image or the selected image from the database. This face detection process verifies that weather the given image has face image or not, after detecting the face this output will be further given to the pre-processing step. To detect the face before trying to recognize it keeps a lot of work, as only a limited region of the image is analyzed, differ to many algorithms which work considering the whole image.[7]

C. Pre-processing

The image preprocessing includes smoothing or filtering and gray-level scale conversion at first , normalized with size of all images with (256*256) . The aim of smoothing is to remove noise and improve the visual quality of the image using special low pass filter (order filter size a 3-by-3) because this filter increase the sharpness and the contrast of spatially ordered detail. Usually smoothing is referred to as filtering. For this purpose of filtering we have used Gaussian low pass filter. The equation (1) express Gaussian function. [8]

$$G(v,y) = \frac{1}{2\pi\sigma^2} e^{\frac{x^2+y^2}{2\sigma^1}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where: x :represent distance from horizontal axis,
y: is represent distance from vertical axis,
σ :is the standard deviation of the Gaussian distribution

If the image is not noisy it is not necessary to filtering. Filtering is not suitable for all images. Then convert RGB image into Gray Scale image.[9]

D. Feature Extraction

The essential step is extracted features of face image using feature extraction algorithm. Extractions dimension reduction. Understanding Eigen faces means any grey scale face image I (x,y) consisting of a NxN array of intensity values are consider as a vector of N2. For example, 100x100 image used in this paper have to be transformed into a 10000 dimension vector as shown in Fig. (2).[5]

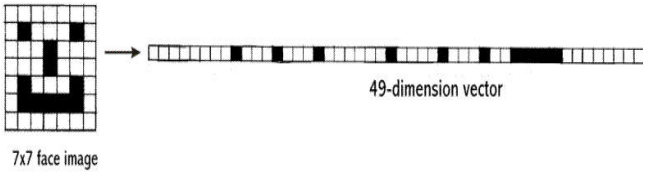

Fig 2. Dimension reduction

E. Principal Component Analysis

One of the most used statistical method is the Principal Component Analysis (PCA). It is a mathematical method that achieves a dimensionality reduction by extracting the principal components of the multi-dimensional data. That's mean two dimension facial image can be considered as one dimensional vector.[10] The covariance matrix of the input data is calculated starting from the algorithmic mean of all vectors $I_1, I_2, \ldots I_i$.

$$\psi = \frac{1}{M}\sum_{i=0}^{M} I_i \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

The difference image vector *Ii* and mean is called with

$$\Phi_i = I_i - \psi \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

The theoretical Covariance matrix C of all i is

$$C = \frac{1}{M}\sum_{i=0}^{M} \Phi_i \Phi_i^T \ldots\ldots\ldots\ldots\ldots(4)$$

All eigenvectors vi and eigenvalues λi of this covariance matrix are derived from the relationship.

$$\lambda_i = \frac{1}{M}\sum_{i=0}^{M} (v_i^T \Phi_i^T)^2 \ldots\ldots\ldots\ldots\ldots(5)$$

The collection of M eigenvectors Vi can be seen as the reduced dimension representation of the original input image. This set of eigenvectors will have a corresponding eigenvalues associated with it, which indicates the distribution of this eigenvector in representing whole dataset. The small set of eigenvalues is enough to build up the whole image characteristic.

$$\varepsilon = \sum_{i=0}^{P} v_i \ldots\ldots\ldots\ldots\ldots\ldots(6)$$

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Where P is number of eigenvalues.[11,12] KL transform is applied to all images. This transformation has showed how KL has been used to reduce the original dimension of the as shown in figure.(3)

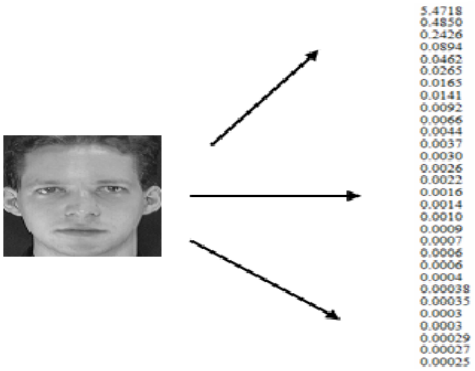

Fig. (3); Eigen value for the face

F. PCA Features Extraction on Data base for suggested face recognition

Since to reduce input vector, when the dimension of input vector is very large, therefore the network can be complex and difficult to train and consume further time for classification. It is necessary to reduce the input vector by using PCA method for dimension reduction for in face recognition.

Face Data Base the face image data base is containing both training (4 face image) and testing (4 face image.[13]

III. VERTIFICATION

In this step identifier the person is genuine or impostor, the algorithm is used neural network a technique which is has been proposed by many researchers in face recognition system. After extracting the features, a recognizer are required to identify the face image from the database neural network can be applied for such problems.

IV. ARTIFICIAL NEURAL NETWORK

The last three decades have observed that artificial neural networks (ANNs) has used in various fields containing, image processing, pattern recognition, fault diagnosis etc.

Elman neural network is considered a Dynamic Neural Network (DNN) can adjust its structure with continuous changes and by no means modifications topology and training not stopped. Elman network differs from conventional two-layer networks in that the first layer has a recurrent connection. Elman network is containing a three layered network with a feedback from hiding layer output to input state. Its help in comparison with whole recurrent structures is that it can be used for network training after scattering, because the links to the context units are sampling cycle interval. The delay happening due the context layer in this connection stores data from the earlier time step, which can be used in the current time step.[14,15]

Elman algorithm is used for training the values and is simulated using the features given from the test set of images. The output from the Elman network is considered as the recognition result. Context layer store in itself a copy of hidden neurons output and environment layer neuron quantities are applied as an added input signal in the hidden layers [15].

The Elman network is a two layer network. It has feedback from the first-layer output to the first layer input. Elman network has neurons and purelin neurons in the hidden layer and output layer correspondingly. This is the special combination, in that two-layer networks with these transfer functions can estimated any function with accuracy. The only necessity is that the hidden layer must have enough neurons. More hidden neurons are required as the complex functions. [14]

The first layer has weights coming from the input. Each later layer has a weight coming from the previous layer. All layers not including the last have a recurrent weight. All layers need biases. The last layer is the network output. [16] In the proposed system, the Elman network trained as shown in fig (4).

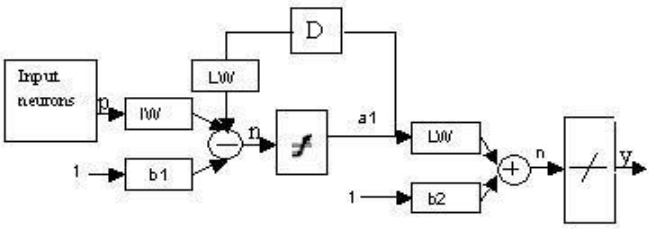

Fig.(4) Elman Neural Network

V.EXPERIMENTAL RESULT

In figure. (5) outlines the proposed system to classifier

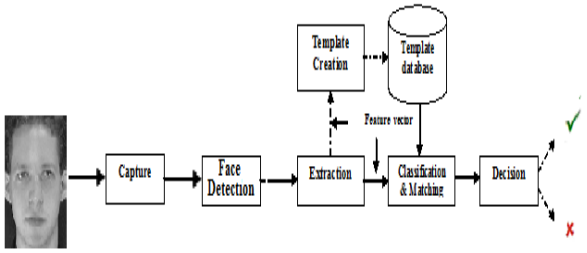

Fig.5 Classified as "Match" or "Not Match"

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This section is illustrated the approach is implement using Matlab-15 and when test any image for recognized it if match one of them in database shown genuine image shown in fig. (6)

Fig.6 Two face is matching

Otherwise classify rejects the claimer and return "no matching" as shown in Fig. (7) Which means that the image is not stored and not accepted?

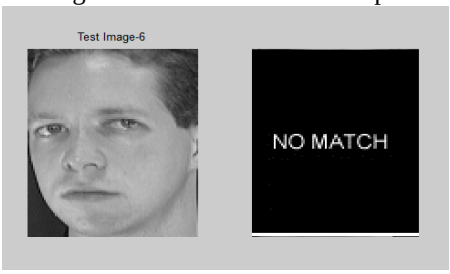

Fig. (7) Two face is not matching

To measure the performance of this system that used the following measurement:

- The false rejection rate (**FRR**): is the probability that an authorized individual is inappropriate rejected.

- False Acceptance Rate (**FAR**): which represents the ratio of impostors accepted by the system.

- Equal Error Rate (**EER**): It is the value is the rate when FAR equals the FRR of the biometric system. Common threshold used to evaluate the performance.

- Genuine Accept Rate (**GAR**): is used to measure the accuracy of a biometric system illustrate in equation (7).It is measured as the fraction of genuine score exceeding the predefined threshold

$$GAR = 1 - FAR \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Recognition Rate (RR):The estimation of recognition rates (or error rates) for a classifier. This inside-test result is usually overly optimistically since all data is used for training and the test is also based on the same data. The RR calculates for equation 8.

$$RR = 1 - (FAR + FRR) \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

[17,18]

The system used face approach by training Elman neural network in many epochs as shown in Table (1).

Table (1): Measurement of the face using ENN

Epoch	GAR (%)	FAR (%)	FRR (%)	RR (%)
0	91	9	2	89
40	93	7	5	88
50	95	5	6	89
60	96	4	7	89
80	96	4	8	88
90	97	3	8	89

VI.CONCLUSION

In this research, an approach is presented to authenticate individuals by using face recognition. Propose verification mechanisms based on Elman neural network to verify the face images. The results are noticeable when increased number of neural network's epochs lead to increase GAR and decrease FAR. As the same time, increase number of non-authorizer's person's cans entire system which lead to stop at epochs. The above 97% accuracy rate. Experimental results reveal that proposed approach is feasible and effective in personal authentication using face features.

Experimentally, the samples are verified by Elman neural network. For future work, the researchers suggest the design of an automated biometrics system based on 3D face matching, and using dynamic leaning rate values for neural network to compare to have best recognition.

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