Geometric Face Recognition Approach Based on Neural Network

Kadhem Mahdi Hashem

Thi-Qar University – Education College

Dept. of Computer Science

Abstract:

In this paper, we present a technique to recognize a query person whose human face image is given w.r.t. a specified database. The main idea of our approach is to use the most important geometric feature positions on the half face image.

We construct vector of measures between chosen essential features points of the face such as eyes, nose, chin, mouth, face boundaries and so on, and then reduced to vector of measures.

The information taken from frontal view images, yet profile view face images are with small rotation degree to different directions. We used the ANN technique to determine whether or not the query person is recognized.

We applied 64 human face images taken from the ORL database and 160 real human face images concerned some Iraqi persons. The recognition results show that the recognition rate is 100% for images taken from both databases.

Key words:

Face recognition, Geometric features, Half face image,

Neural network.

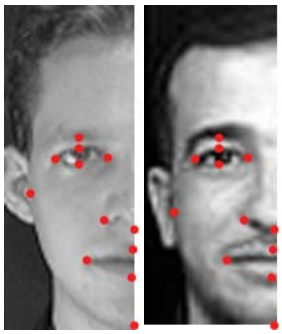
1. Introduction:

Face recognition is a popular research area, and there are many practical applications of face recognition system. For example, we

can imagine facial recognition systems that allow access to secure building, credit-card verification, notice criminal identification, and so on. [1,2]. The challenges that the facial recognition pose are numerous, for example, changes in lighting, pose, expression, age, and skin color can all effect the performance of face recognition algorithms.

During the latest years, there has been a growing interest in the identification of human face images based on geometric features and soft biometric.[3]. Automatic recognition of human faces is one of the most difficult and important problems in the area of pattern recognition and computer vision. On the theoretical side, face recognition is specific and hard case object recognition. [4]

database with certain fault tolerance.



(a) (b)

Figure 1: Important feature points

2. Data preparation:

Since the human face frontal image is symmetric w.r.t. the vertical axis passing through the middle of the nose. In this paper we use only the half face image in order to decrease the storage space and the execution time.

We use the most important features such as eye, nose, mouth,... on the half face image as shown in figure 1. The Euclidean distance between determined points will present a vector of features for that person.

The multilayer perceptron artificial neural network is used to recognize the query half face human face image w.r,t, the specific

a : image from ORL database

b : image from real database

The recognition rate of our approach is 100% when we applied it on the ORL database and real database which we constructed in our laboratory.

For robust work of our approach, the used human face images must satisfy the following conditions:

1. The images stored in database are with half of human face images.
2. The images are in the gray scale mode and with same size.
3. The Euclidean distances measured among determined points are in the same order for all images (training and tested images).

3. Artificial Neural Networks (ANN):

ANN is an information processing system that has certain performance characteristics in common with biological neural networks. A neural network element (neuron) is the smallest processing unit of the whole network essentially forming a weighted sum and transforming it by activation function to obtain the output in order to gain sufficient computing power, several neurons are interconnected together. ANNs have parallel distributed architecture with large number of nodes and connections.

Construction of neural network involves the following tasks [5].

1. Determination of network architecture.
2. Determination of system (activation and synaptic) dynamics.

3.1 Multilayer Perceptron N.N:

Multilayer perceptron consists of a set of sensory units that constitute the input layer, one or more associative layers of computation nodes, and a response layer of computation nodes, this input signal propagates through the network in forward direction, on a layer-by-layer basis. Figure (2) shows a multilayer perceptron. Multilayer perceptron has been applied successfully to solve number of divers, and difficult, problems by training them in supervised manner with highly popular algorithm known as the back-propagation algorithm

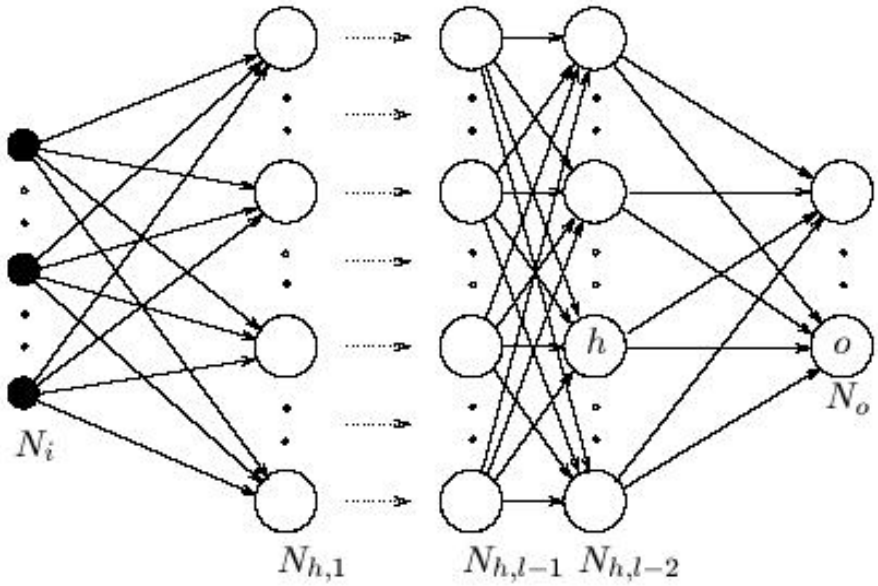


Figure (2): general multilayer perceptron neural network

This algorithm is based on the error- correction learning rule. The algorithm consists of two passes through the different of the network: a forward pass and a backward pass. In the forward pass, an activity pattern (input vector) is applied to the sensory nodes of the network, and its effect propagated through the network layer by layer. Next, a set of outputs is produced as the actual response of the network. During the forward pass the synaptic weights of the networks are all fixed. During the backward pass, on the other hand, the synaptic weights are all adjusted in

accordance with an error-correction rule. Specifically, the actual response of the network is subtracted from a desired response to produce an error signal. The error signal is then propagated backward through the network against the direction of synaptic connections-hence the name "error back-propagation". The synaptic weights are adjusted to make the actual response of the network move closer to the desired response in a statistical sense.[6]

<u>Related works</u>:

In the literature, we note that there are many researchers in the field of face recognition using geometric features and there are another researches in the pattern recognition applied the neural network. We can list some of them as follows:

- Konstantinos M., used a novel framework for gait recognition augmented with soft biometric information. Geometric gait analysis is based on random transforms and on gait energy images for the detection of soft biometric features of substantial discrimination power.[7]
- Starovoitov V. and Samal D., explored geometric features like distances between some facial points. First a set of fiducial points for every face image was detected and then approximately k1 image close to query face was selected w.r.t. some geometric features based upon the points.[8]
- Razvan Daniel A., presented novel hybrid face recognition approach based on convolutional neural architecture, designed to robustly detect highly variable face patterns. This approach extracted successively larger

features in hierarchical set of layers with weights of the trailed neural networks.[9]

- Javad Haddadni at al. , introduced a novel method for human face recognition that employs a set of different kind of features from the face image with Radial Basis Function (RBF) neural network called Hybrid N-Feature network (HNFNN). The output of RBF classifiers are fused together to make a decision.[10]

- Chinhsiun L. et al., proposed a system consists of two main parts. The first part is to search the potential face regions that are gotten from the triangle based on the rules " the combination of two eyes and one mouth" , the second part of proposed system is to perform the face verification task.[11]

5- The proposed approach:

In practice, geometric facial recognition is difficult problem to solve [1]. First the facial features must identify in the image without identifying the target features, work to compare faces cannot begin. Second, a set of features must be chosen as to provide a robust set of data values for comparison. But what features should be chosen? Choosing the best facial feature set is an important task in designing a geometric facial recognition system.

In this paper, we use the following algorithm to determine the half face image for each input image.

Algorithm 1(Determination of the half face for each input image)

Step1: Input a gray scale image.

Step2: Apply the Sobel operator to find edges of input image.

Step3: Compute the horizontal and vertical integral projections.

Step4: Determine the vertical face center.

Step5: Take the vertically half face image.

After that we used the following technique (ANN Technique):

Multilayer perceptron with one hidden layer is applied successfully to recognize and identify the input half face images by training and testing it. The back-propagation algorithm (supervised manner) used to learn the network. The input layer consists of 12 neurons (node) which represents the Euclidean distances between the chosen feature points on the half face image. The hidden layer consists of 5 neurons (node). The number of neurons at the output layer is depending on the number of different stored persons in the database. For example, when the number of persons is less than or equal to 16, the number of nodes in the output layer must be 4, that is because the resulted value is computed from the binary output vector. This value represents the index of the person in the stored database.

The following figure shows the architecture of used ANN

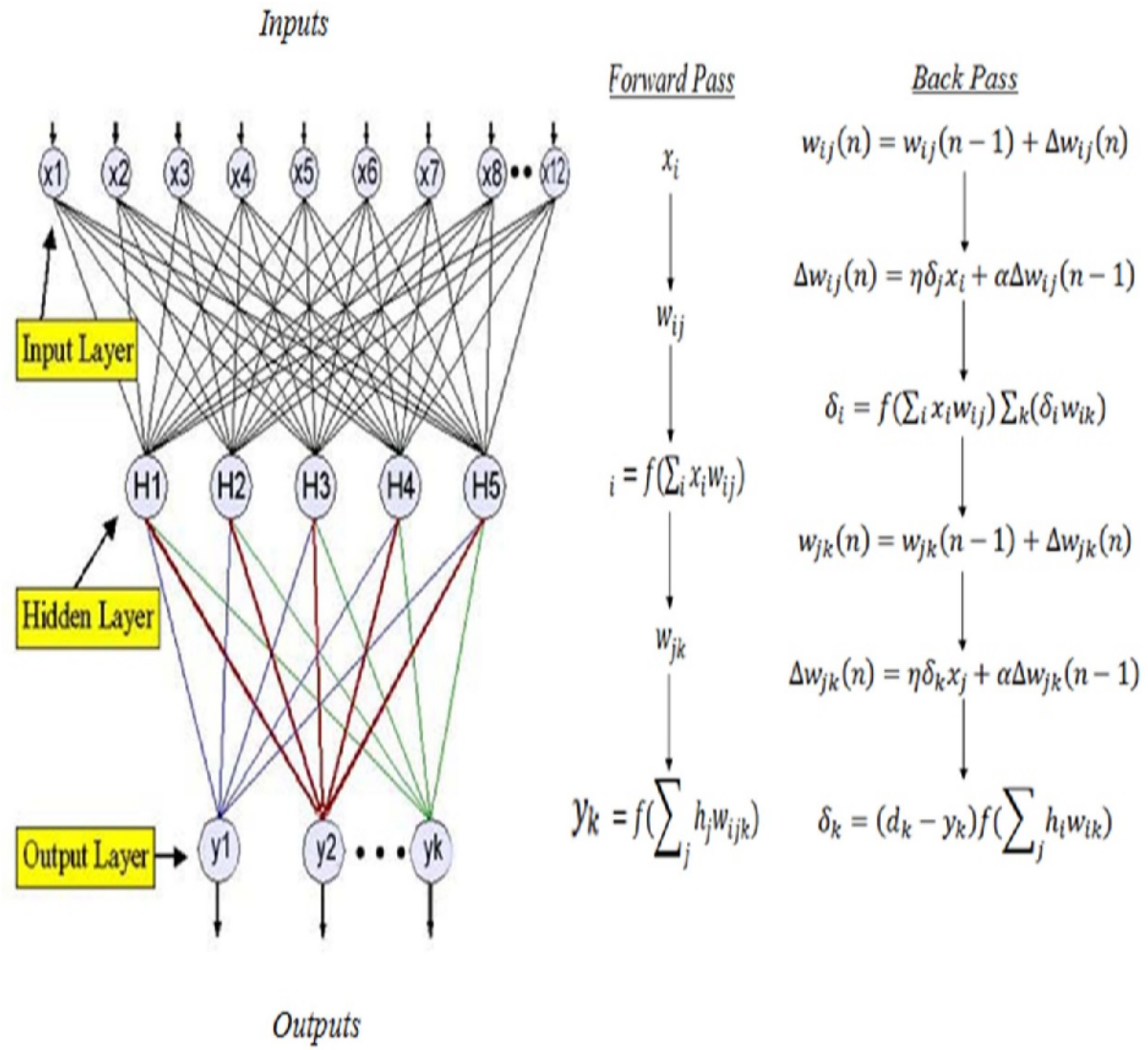
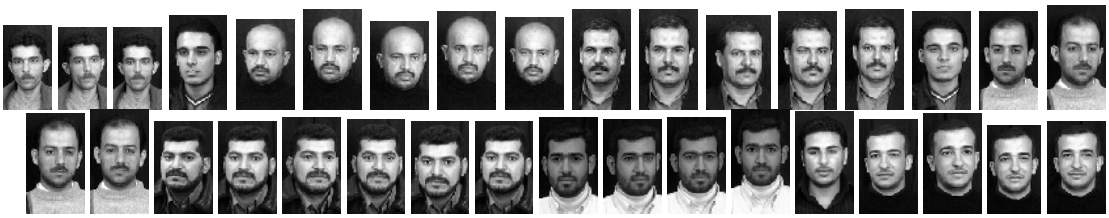


Figure (3): Algorithm Proposed for multilayer perceptron neural network

6- Experiments:

In our experiments, we construct two databases of images. The images of first one are for 8 persons taken from ORL database [12]. While the images of second one are for 20 persons taken from population of Thi-Qar University. Figure below shows some images which stored in both databases.

a:images taken form ORL database



b:images taken form real database

c:Half face images obtained from group a

d:Half face images obtained from group b

In fact, we take (8) frontal and profile view images for each person in two databases. Four of these (8) images are used to train the ANN and the other images used to test the network.

The proposed ANN is trained by using the back-propagation algorithm. After that the ANN is tested by any query input image. The obtained results give 100% matches.

In comparison with other results, we can say that our approach give optimal and good results in pattern recognition and identification fields.

We can certify the main difficulty through the design of our experiments is the determination of feature position which must be in same order w.r.t. the input information vector. While the training time of the proposed ANN does not represent any difficulty because it is trained only on the half face image. Then the resulted weights are fixed on the links between any two nodes in different

layers. So we can recognize rapidly the query person.

7- Conclusions:

1. From the experimental results, we can conclude that geometric features of human face image give good results in the recognition and identification. Choosing the important feature positions for each image will effect on the final recognition results. So it must taken carefully.
2. We note that, the using of ANN can give a high accuracy results. Using the half face image offer a good chance to get fast results.

8- References:

[1] Sean fredericksen and Nathaniel Kemmer "Techniques for Facial Recognition: A Survay" University of Northern lowa 2009.

[2] Moe Ma Ma Tin "An Automatic face recognition system based on 3D geometric face features" university of Computer studies, Yangon , 1999.

[3] Jain A.,Dass S., and Nadakumar, "Soft Biometric traits for personal Recognition Systems", Hong Kong, july 2004.

[4] "Face Recognition from Theory to Application", proceeding of the NATO advanced study institute, vol. 163. 1998.

[5] Sukumar, Kamalasadan, "Application of Artificial Intelligence Technique in power system", Special Study Report, Asian Institute of Technology, Bangkok, Thailand, 1998. http://www.uwf.edu/skamalasadan/specialstudymasters.pdf.

[6] Al-samer, Fadhel A. Jumea, "Intelligent Techniques for Incipient fault Diagnosis ",Ph.D Thesis, University of technology, Baghdad, 2006.

[7] Konstantinos M., "Gait Recognition using Geometric Features and Soft Biometric", IEEE, 2008.

[8] Storovoitov and samel ,"A geometric Approach to face Recognition", Institute of Engendering Cybernetics, Belarus, 1999.

[9] Razvan-Daniel A.," Human Face Recognition using convolution Neural Network", department of Electronics University of Oradea, 2004.

[10] Javed H.,Karim F. and Majid A.,"N- Feature Neural Network Human Face Recognition", University of Windsor, Windsor, Ontario, 2002.

[11] Chainshsium L.and Kuo-chin F.,"Human Face detection using Geometric triangle Relationship", IEEE, 2000.