Face Recognition Using Genetic Algorithm and Back Propagation Neural Network

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Abstract— **In this paper, a face recognition system for personal identification and verification using Genetic algorithm and Back-propagation Neural Network is proposed. The system consists of three steps. At the very outset some pre-processing are applied on the input image. Secondly face features are extracted, which will be taken as the input of the Back-propagation Neural Network (BPN) and Genetic Algorithm (GA) in the third step and classification is carried out by using BPN and GA. The proposed approaches are tested on a number of face images. Experimental results demonstrate the higher degree performance of these algorithms.**

Index Terms— **Genetic Algorithm, BPN, Image Enhancement, Feature Extraction.**

I. Introduction

With the advent of electronic medium, especially computer, society is increasingly dependent on computer for processing, storage and transmission of information**.** Computer plays an important role in every parts of today life and society in modern civilization. With increasing technology, man becomes involved with computer as the leader of this technological age and the technological revolution has taken place all over the world based on it. It has opened a new age for humankind to enter into a new world, commonly known as the technological world. Computer vision is a part of every day life. One of the most important goals of computer vision is to achieve visual recognition ability comparable to that of human [9],[10],[11].

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Among many recognition subjects, face recognition has drawn considerable interest and attention from many researchers for the last two decades because of its potential applications, such as in the areas of surveillance, secure trading terminals, Closed Circuit Television (CCTV) control, user authentication, HCI Human Computer Interface, intelligent robot and so on. A number of face recognition methods have been proposed [12][13] and some related face recognition systems have been developed.

In this paper we proposed a computational model of face recognition, which is fast, reasonably simple, and accurate in constrained environments such as an office or a household. The proposed approaches have advantages over the other face recognition schemes in its speed and simplicity, learning capacity and relative insensitivity to small or gradual changes in the face image.

II. Outline of the System

The issues of the design and implementation of the Face Recognition System (FRS) can be subdivided into two main parts. The first part is *image processing* and the second part is *recognition techniques*. The image processing part consists of Face image acquisition through scanning, Image enhancement, Image clipping, Filtering, Edge detection and Feature extraction. The second part consists of the artificial intelligence which is composed by Genetic Algorithm and Back Propagation Neural Network.

The first part of FRS consists of several image processing techniques. Firstly, face's image acquisition is achieved by web cam, digital camera or using scanner. Then image clipping is performed using start-point and end-point detection algorithm. Then the edges are detected using high-pass filter, high-boost filter, median filter or several edge detection methods. Finally, the features are extracted. These extracted features of image are then fed into Genetic algorithm and Back-propagation Neural Network.

In the second part two techniques are used one is based on Genetic algorithm and another one is based on Back propagation neural network. In the first techniques, the extracted features are saved into memory and using genetic algorithm; the recognition of unknown face image is performed by comparing this special pattern to the pattern for which an image module is already built. A special advantage of the proposed technique is that there is no extra learning process included here, only by saving the face information of the person and appending the person's name in the learned database completes the learning process. In the second, extracted features are fed into the input of the multilayer

Neural Network and the network is trained to create a knowledge base for recognition which is then used for recognition.

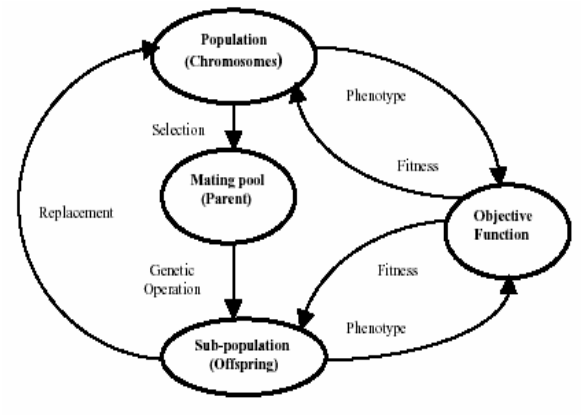

Fig.1. Cycle of Genetic Algorithm

In recognition by Genetic Algorithm, matrix crossover, crossover rate 5 and generation 10 have been used. Outline of the system is given in fig.1.

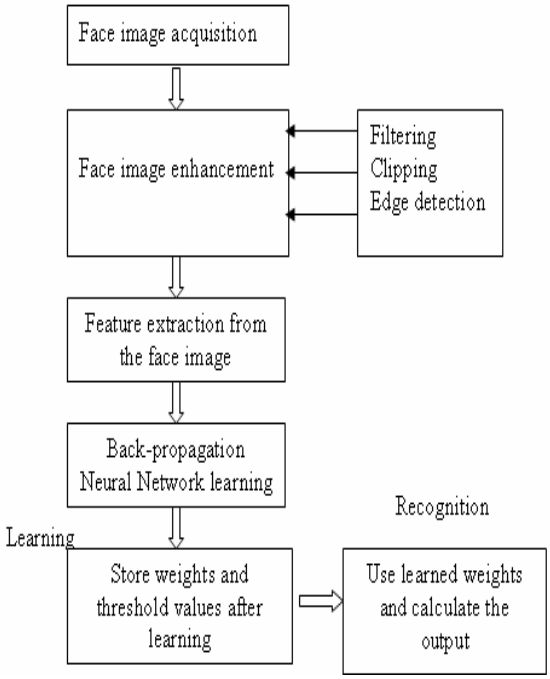

Fig.2. Outline of Face Recognition System by using Back-propagation Neural Network

As the recognition machine of the system; a three layer neural network has been used that was trained with Error Back-propagation learning technique with an error tolerance of 0.001. Outline of the complete system is given in fig.2.

III. System Development Methodologies

As discussed in the previous section, the system starts with acquisition of face image and ends with successful recognition. This successful notation comes through the application of a set of image processing, feature extraction and recognition techniques which have been discussed details in the subsequent subsections.

A. Face Image Acquisition

To collect the face images, a scanner has been used. After scanning, the image can be saved into various formats such as Bitmap, JPEG, GIF and TIFF. This FRS can process face images of any format. The face images in the fig.3 have been taken as sample.

Fig.3. Sample of Face Images

B. Filtering and Clipping

The input face of the system may contain noise and garbage data that must be removed. Filter has been used for fixing these problems. For this purpose median filtering technique has been used. After filtering, the image is clipped to obtain the necessary data that is required for removing the unnecessary background that surrounded the image. This is done by detecting the window co-ordinates (Xmin, Ymin) and (Xmax, Ymax). The clipped form of the previous sample image is shown in fig.4.

Fig.4. Clipped form of the sample Face Images

C. Edge detection

Several methods of edge detection exits in practical. The procedure for determining edges of an image is similar everywhere but only difference is the use of masks. Different types of masks can be applied such as Sobel, Prewitt, Kirsch, quick mask to obtain the edge of a face image. The performance of different masks has a negligible discrepancy. But here quick mask has been used as this is smaller than any

others. It is also applied in only one direction for an image; on the other hand others are applied in eight direction of an image. So, the quick mask is eight times faster than other masks. The detected edge of a face after applying quick mask is shown in fig.5.

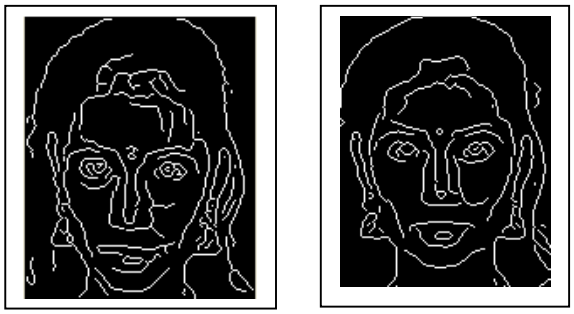

Fig.5. Edges of Face Images

D. Image Scaling

There are various techniques for scaling of the image. Here shrinking technique has been used to get the image 30X30. After scaling, the images are:

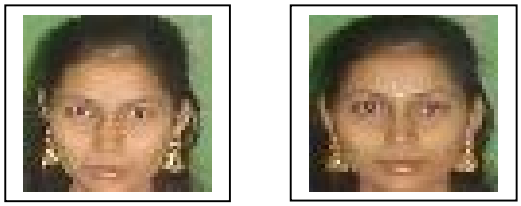

Fig.6. Scaling images (30X30)

E. Features Extraction

To extract features of a face at first the image is converted into a binary. From this binary image the centroid (X,Y) of the face image is calculated using equation 1 and 2.

$$X = \frac{\sum mx}{\sum m} \quad \ldots\ldots (1)$$

$$Y = \frac{\sum my}{\sum m} \quad \ldots\ldots (2)$$

*Where x, y is the co-ordinate values and m=f(x,y)=0 or 1.*Then from the centroid, only face has been cropped and converted into the gray level and the features have been collected.

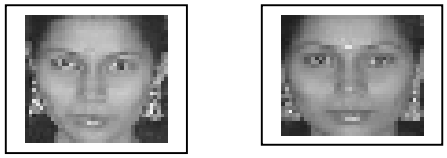

Fig.7. Features of the faces

F. Recognition

Extracted features of the face images have been fed in to the Genetic algorithm and Back-propagation Neural Network for recognition. The unknown input face image has been recognized by Genetic Algorithm and Back-propagation Neural Network. This is outlined in fig. 8(a).

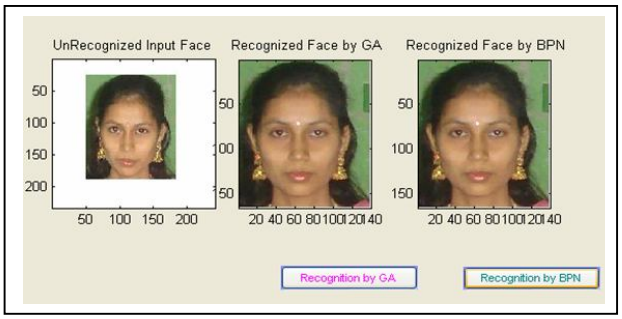

Fig.8 (a). Recognition phase

The unknown input face image has been recognized by Genetic Algorithm, but has not been recognized by Back-propagation Neural Network. This is outlined in fig.8(b).

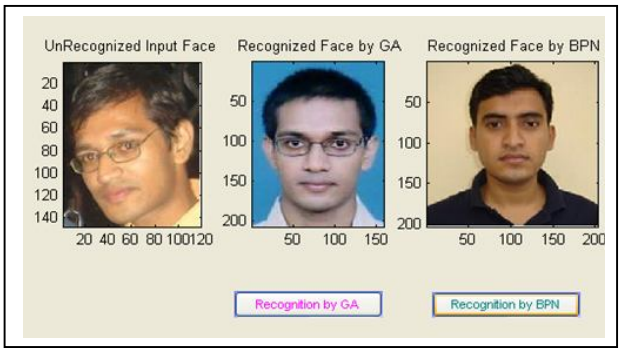

Fig.8 (b). Recognition phase

The unknown input face image has been recognized by Back-propagation Neural Network, but has not been recognized by Genetic Algorithm. This is outlined in fig.8(c).

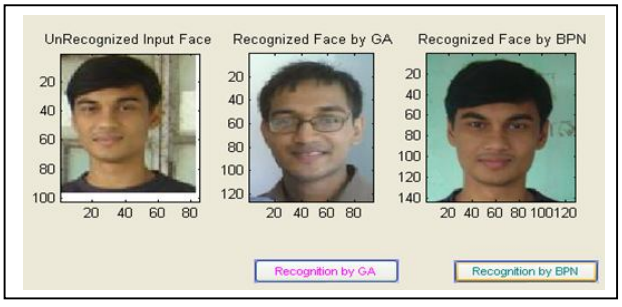

Fig.8(c). Recognition phase

IV. Experimental Result

Table I Results for GA

No. of Face Image	Successfully Recognized Face Image	Unrecognized Face Image	Efficiency (%)
5	4	1	80%
13	11	2	84.62%
20	18	2	90%
22	17	5	77.27%
25	22	3	88%
30	23	7	76.67%

Therefore the efficiency of the Face Recognition System by using Genetic Algorithm is 82.61%.

Table II Results for BPN

No. of Face Image	Successfully Recognized Face Image	Unrecognized Face Image	Efficiency (%)
5	3	2	60%
13	12	1	92.31%
20	19	1	95%
22	19	3	86.36%
25	24	1	96%
30	28	2	93.33%

Therefore the efficiency of the Face Recognition System by using Back-propagation Algorithm is 91.30% and that is why BPN is better than GA as depicted in fig.9.

V. Conclusion

In this present thesis, a model of Face Recognition System using the concept of Genetic algorithm and Step Error Tolerance Back-propagation Neural Network and digital image processing has been discussed. Here a static Face Recognition system has been developed. The maximum efficiency is 82.61% for Face Recognition System by using Genetic algorithm and the maximum efficiency is 91.30% for Face Recognition System by using SET-BPN. The efficiency can be increased by using better face scanner, better technique of scaling, efficient technique of edge detection such as advanced edge detection technique and feature extraction of the face image.

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