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Face Recognition using SIFT, Genetic Algorithm and Neural Networks

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Abstract: Face recognition is one of the most advanced biometric authentication system which is now getting used into several corporate industries and government sector. Some of the previous research work have shown their great enthusiastic interest in different biometric parts of the faces like Iris, Ear, and Tongue. The results have also been great but chances of theft are still there if you are using a single biometric. This research paper proposes a novel scheme of entire Face recognition method which involves SIFT for feature extraction, Genetic Algorithm for feature optimization and Neural Network for classification of the saved features. There are two sections in this research work namely Training and Testing. The training section is processed by two algorithms name SIFT and followed by Genetic Algorithm for the optimization. In the testing section, Neural Network has been utilized.

Keywords: Genetic Algorithm, BPPN, Image Enhancement, Feature Extraction, SIFT.

I. INTRODUCTION

With the advent of electronic medium, society is increasingly dependent on computer for processing. With increasing technology, man becomes involved with computer as the leader of this technological age. It has opened a new age for humankind to enter into world [1]. One of the most important goals of computer vision is to achieve visual recognition. Among many recognition subjects, face recognition has drawn considerable interest and attention from many researchers such as in the areas of surveillance, Closed Circuit Television (CCTV) control, user authentication, HCI human computer interface, intelligent robot and so on [2]. A number of face recognition methods has been proposed for face recognition, which is fast. The proposed approaches have advantages over the other face recognition schemes in its speed and simplicity [3].

The rest of the paper is organized as: Section II presents the outline of the system, Section IIIpresents the brief outline of the methodologies that has been used and section IV shows the implementation result and Section V finally includes the conclusion part.

A. What Is Face Recoganition?:

We focus on image support face recognition. Prearranged a picture taken from a digital camera, we'd like to know if there is any person inside, where his or her face locate at, and who he or she is. Towards this goal, we usuallydivide the face recognition process into three steps:

a. Face Detection
b. Feature Extraction and
c. Face Recognition

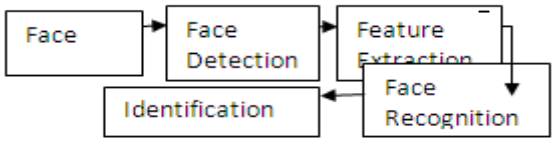

Figure 1: Face recognition structure

a) Face Detection: The major function of this step is to decide (1) whether human faces come into view in a given image, and (2) where these face are situated at. The expected outputs of this step are patches contain each face in the input image. In order to make additional face recognition system more healthy and easy to design, face position are perform to give reason for the scales and orientations of these patches. In addition serving as the pre-processing for face recognition, face detection could be used for region-of-interest detection and image classification, etc [15].

b) Feature Extraction: The following the face detection step, human-face patches are extract from images. Directly with these patch for face detection have some disadvantage, first, each patch more often than notcontain over 1000 pixels, which are too large to build a robust recognition system1. Second, face patch may be taken from different camera alignments, with different face expressions, illuminations, and may suffer from occlusion and clutter. To overcome these drawbacks, feature extraction isperformed [18] to do information packing, dimension reduction, salience extraction, and noise attack.

c) Face Recognition: The following formulizing the symbol of each face, the last step is to recognize the 1 we'llcommence the concept of "curse of dimensionality". Identity of these faces. In order to achieve routine recognition, a face file is required to build. For each being, several imageryis taken and their features are extracting and stored in the database. Then when an input face image comes in, we perform face detection and feature extraction, and compare its feature to each face class store in the database[15, 19].

B. Advantages Of Face Recoganition:

a. Noninterfering
b. Cheap equipment.
c. Can stop card counters, etc from entering casinos
d. Can recognize terrorists, criminals, etc.
e. Prevent voter fraud[16].
f. Targets shoppers.

C. Disadvantages Of Face Recoginition:

1.2D acknowledgment is exaggerated by changes in illumination, the person's hair, the age, and if the person wear glasses.

Require camera gear for user identification; thus, it is not probable to become popular until most PCs include cameras as standard equipment.

Measured an invasion of solitude to be watched [17].

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 and feature extraction.

The SIFT features are extracted from all the faces in the database. Then, given new face, the features extracted from that face are compared against the features from each face in the database. The face in the database with the largest number of features matched is included as nearby face [4].A feature is considered matched with another feature when the distance to that feature is less than a specific fraction of the distance to the next nearest feature. This guarantees that we reduce the number of false matches. This is because in case of a false match, there will be a number of other near features with close distances, due to the high dimensionality of the features. On the other hand, in case of a correct match, it is unlikely to find another feature that is too close due to the highly distinctive nature of SIFT features [5].

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. When, the features are extracted [6]. 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 [7]. 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 [8, 9].

III. PROPOSED ALGORITHM

As mentioned even earlier, the proposed algorithm is divided into two sections namely the training and testing section. The training section includes two algorithm, first for the feature extraction and another is for feature optimization. The details are as follows.

a. Scale Invarient Feature Transform (Sift) [10]: **S**cale Invariant Feature Transform is used to find out key points for the image. Per key point is treated as a feature. It is called Scale Invariant because if you enlarge the image, even though it would provide you almost similar set of features i.e. Key Points. Another benefit if using this algorithm is if the image is rotated, it would even provide you almost the similar key points.

b. Genetic Algorithm: **G**enetic Algorithm is used for the optimization of the extracted features as any feature extraction algorithm cannot figure out all the set features. Hence to reduce the its relevant features optimization algorithms can be utilized and here Genetic Algorithm is utilized [11]. The following points are considered in the Genetic Algorithm.

a) **[Start]** Generate random population of *n* chromosomes (suitable solutions for the problem)
b) **[Fitness]** Evaluate the fitness *f(x)* of each chromosome *x* in the population
c) **[New population]** Create a new population by repeating following steps until the new population is complete
d) **[Selection]** Select two parent chromosomes from a population according to their fitness (the better fitness, the bigger chance to be selected)
e) **[Crossover]** With a crossover probability cross over the parents to form a new offspring (children). If no crossover was performed, offspring is an exact copy of parents.
f) **[Mutation]** With a mutation probability mutate new offspring at each locus (position in chromosome).
g) **[Accepting]** Place new offspring in a new population
h) **[Replace]** Use new generated population for a further run of algorithm
i) **[Test]** If the end condition is satisfied, **stop**, and return the best solution in current population
j) **[Loop]** Go to step **2**

Population Size	Here the extracted key points through SIFT algorithm will be considered as Population Size
Mutation	Mutation is the change in State
Cross Over	Linear
Fitness Function	1 if fs>ft **0** **if ft>fs**

b. Neural Network (Feed Forward Back Propagation Neural Network) [12]: **N**eural Network is used for the classification of the Network. There are three layers in this section.

a) Input Layer: Input Layer concerns the Sift Key features followed by the Genetic Algorithm Optimization.
b) Hidden Layer : Hidden Layer is concerned with N number of hidden neurons and the input data is processed in the Hidden Layer
c) Output Layer: The output layer provides the trained Neural Object which is used for the classification.

IV. SYSTEM DEVELOPMENT METHODOLIGIES

As discussed earlier, the system starts with acquisition of the image and then recognition is done at output end. Various step series flowed as image pre-processing, feature extraction, feature reduction and recognition method [13].

A. Face Image acquisition:

To collect the face images, phone has been used. Afterscanning, the image can be saved into various formats suchas Bitmap, JPEG, GIF and TIFF. This FRS can process faceimages of any format.

B. Feature Reduction:

To extract features [14] of a face at first the image is convertedinto a binary. E.g. From the binary image the centroid (X, Y) ofthe face image is calculated using equation 1 and 2.

$X = \sum mx / m$ ……. (1)

$Y = \sum my / m$ ……. (2)

Where x, y is the co-ordinate values and m=f(x,y)=0 or 1

C. Recognition:

Extracted features of the face images have been fed in tothe Genetic algorithm for further features reduction and Back-propagation Neural Network for recognition. The unknown input face image has been recognized by Back-propagation Neural Network

V. EXPERIMENT RESULTS

The experiment has been carried out over MATLAB 2010 and the results are as follows

Uploaded Image

Figure 2: SIFT KEY points mapped

0.0037	0.0447	0.1240	0	0	0.1240	0.0447	0.0037	0	0.0090	0.1787	8.2033e-04	8.2033e-04
0	0	0	0.3953	0.3953	0	0	0	1.2241	0.8448	0.0017	0.8971	0.8971
0	4.8554e-04	3.9223e-04	1.2935e-04	1.2935e-04	6.2651e-04	2.5126e-04	0	0	4.0345e-04	1.5336e-04	7.2431e-05	7.2431e-05
0	0	0.0474	0.0329	0.0265	0.0474	0	0	0	0	0.0611	0.0176	0.0176
0	0.0030	0.0058	0.0034	0.0034	0.0058	0.0030	0	0.0078	0.0055	0	0	0
0	0	0	0.0213	0.0213	0	0	0	0.0039	0.0069	0.0023	0.0037	0.0037
0	0	0.0021	0.0084	0.0084	0.0021	0	0	3.3141e-04	0.0030	0.0028	0.0028	0.0028
0	0	0.0704	0	0	0.0704	0	0	0	0	0.0972	0	0
1.3530e-04	0.0826	0.0015	4.5937e-05	4.5937e-05	0.0015	0.0826	1.3530e-04	9.7377e-05	0.0850	0.0011	0	0
1.3478	0.9526	0.0011	0.9529	0.9529	0.0011	0.9526	1.3478	0.0014	9.8462e-04	0.0072	0	0
0	1.9050e-04	0.0045	0.0021	0.0021	0.0045	1.9050e-04	0	0.0044	0.0010	3.6231e-04	6.7992e-05	6.7992e-05
0	0	0	0.0181	0.0181	0	0	0	0	0.0030	0.0139	0	0
0	0.0728	0.0149	0	0	0.0149	0.0728	0	0.0743	0.0248	0	0	0
0	0	0.0355	0.0049	0.0049	0.0355	0	0	0	0	0.0479	0.0165	0.0165
0	0.1020	0.0895	0	0	0.0895	0.1020	0	0	0.1424	0.0605	0	0
0.0012	0.0111	0.0012	2.8648e-04	2.8648e-04	0.0012	0.0111	0.0012	0.0025	0.0036	0.0012	0	0
0.0109	0	0	4.2186e-04	4.2186e-04	0	0	0.0109	0.0011	0	0	0.0040	0.0040
0.0091	0	0	0	0	0	0	0.0091	0.0014	0.0283	3.8289e-05	0.0016	0.0016
0	0	0.0037	0.0309	0.0309	0.0037	0	0	0	0	0.0732	0.0219	0.0219
0	0	0.1434	0	0	0.1434	0	0	0	0	0.1225	0	0
0.0037	0.0447	0.1240	0	0	0.1240	0.0447	0.0037	0	0.0090	0.1787	8.2033e-04	8.2033e-04
0	0	0	0.3953	0.3953	0	0	0	1.2241	0.8448	0.0017	0.8971	0.8971
0	4.8554e-04	3.9223e-04	1.2935e-04	1.2935e-04	6.2651e-04	2.5126e-04	0	0	4.0345e-04	1.5336e-04	7.2431e-05	7.2431e-05

Figure4: Reduced Images extracted

The above tabular structure represents the extracted features. Like 23 Images has been processed and per image around 1000 features has been selected and then Genetic Algorithm reduces it to around 100 features

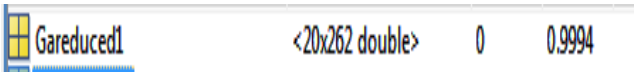

Figure5:Images reduced after Genetic Algorithm

The above set of figure2 represents the Uploaded image and processed Key Points.The back end of this processing looks like following figure3

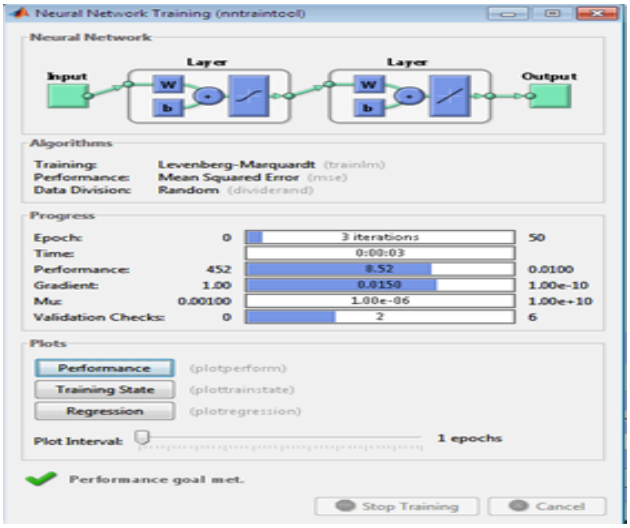

Figure6: Neural Network

The above figure 6represent the Architecture of the Neural Network in which 3 epochs gets the trained sample of 6 validation checks.

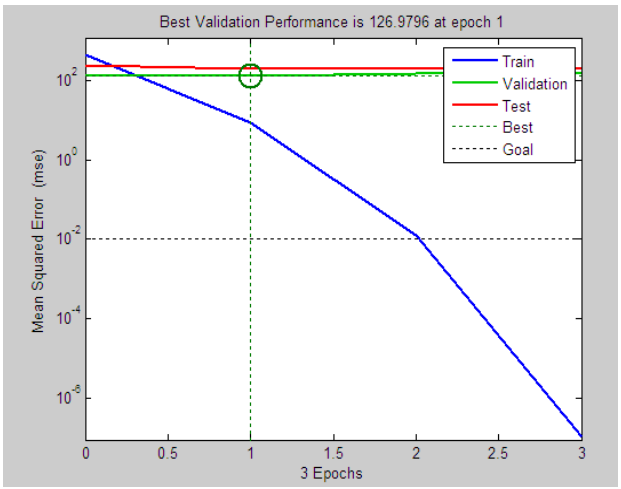

Figure7: Validation states

The above figure7 represent the training, testing and validation states of the uploaded data.

VI. CONCLUSION

A model of face recognition System using SIFT, Genetic Algorithm and neural network has been discussed.

Here a static face recognition system has been developed. Firstly 23 images has been taken and then feature extraction is done in which large number of features has been extracted. After that validation check has been implemented using Neural Network in which accuracy has been obtained of 126.97 %. In proposed work SIFT and NN has been used because unlike rule based systems or programmed systems neural networks are flexible in changing environment. If the situation changes they are unable to operate in changed environment. Though neural may take time to learn to a sudden change, they are good at adapting to changing situations. SIFT use four octaves or scales which are made by resizing the original image to compress image .The efficiency can be increased by using better face scanner, bettertechnique of scaling, and efficient technique of edge detectionsuch as advanced edge detection technique and feature extraction of the face image.

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