An Effective and Fast IRIS Recognition System based on a Combination of PCA and Neural Network

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Abstract **-** In this paper, we have developed a system that can recognize human iris patterns and an analysis of the results is done. A novel mechanism has been used for implementation of the system. Iris localization and segmentation has been done using HCT. Feature training has been used to extract the most discriminating features of the iris and is done using PCA scheme. And finally the biometric templates are matched using neural network which tells us whether the two iris images are same or not and on the basis of that performance metric are evaluated like FAR, FRR, Error rate and Accuracy. The whole simulation is taken place in the MATLAB 7.10 environment.

Keywords **-** PCA, Iris Recognition, Canny Edge Detection, Neural Network**.**

I. INTRODUCTION

Identification and authentication of any individual is becoming more important in recent days. In the modern world where computers and electronics devices are more extensively used and the population of the world is increasing, there is a need for highly accurate and secured practical authentication technology [1]. Traditional techniques such as user name, passwords, keys, ID cards, hardware token based systems are not reliable and secure in many of the security zones. Thus there is an increasing need for automatic reliable authentication process in modern society [2, 3] In the recent few years biometric identification has proven to be more reliable means of verifying the human identity [4].. Biometric refers to a science of analyzing human physiological or behavioral characteristics for security purposes and the word is derived from the Greek words bios means life and metrikos means measure. The Biometric [5] characteristics cannot be faked, forged, guessed and stolen easily. One need not remember his/her biometric traits.

There are many iris recognition systems and the first automatic system was developed by Daugmanusing efficient integro differential operator, which is still popular in today's most of the iris recognition systems [6].

In recent years many work has been done on iris recognition using PCA, ICA, GA, and DWT. But proposed work will focus on the usage of PCA in combination with neural network to enhance the performance of the system.

II. RELATED WORK

TABLE: 1 RELATED WORK

Author	Title Name	Implementation
LeninaBirgale and M. Kokare, 2010 [7]	Iris Recognition without Iris Normalization	Proposed a method to enhance the reliability of the system. Different masks and filters has been used to get the image of an eye.
D. Garje1, Prof. S. S. Agrawal, 2012 [8]	Multibiometric Identification System Based On Score Level Fusion	In this research paper, PCA established on iris recognition utilizing DWT (PIRDWT) is recommended. The upper plus lower part of the iris that is obstructed via eyelids as well as eyelashes is detached by utilizing morphological procedure.. Then DWT method is applied on particularly histogram balanced iris template so that it acquire DWT coefficients. Several classifiers for instance KNN, RF as well as SVM are utilized which are intended for matching. The suggested procedure has a way enhanced performance parameters compared to existing algorithm.
Sanjay R. Ganorkar, Mirza Shujaur Rahman [9]	Iris Recognition System And Analysis Using Neural Networks	The proposed methodology uses canny edge detection with Hough transform to segment iris images for locating the iris and remove noise. Results of feature extraction will used for feature matching

III. PROPOSED WORK

Iris recognition is done In MATLAB 7.10 environment using HCT. PCA and NN method. The following process will describe the iris recognition process [10].

1.1 Training Panel

1.1.1 Upload Image

The images from UCI Machine learning algorithms iris image database are taken. It contains 8 images of one eye at two sessions. They are of 200kb .jpeg images.

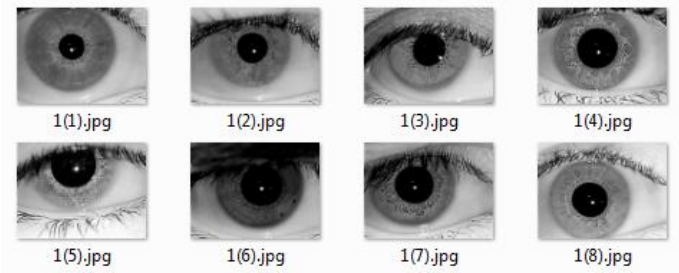

Fig.1: Iris Training Samples

1.1.2 Edge Detection

In this phase gray scale conversion has been done and edge detection. Edges characterize boundaries and are therefore a problem of fundamental importance in image processing [11]. Edges in images are areas with strong intensity contrasts – a jump in intensity from one pixel to the next. Edge detecting an image significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. The Canny edge detection algorithm is known to many as the optimal edge detector.

1.1.3 HCT For Localization

The Hough transform can be applied to detect the presence of a circular shape in a given image. It is being utilized to discover any figure or else to find the iris in the human being's face. The characteristic equation of a circle of radius r and centre (a, b) is given by [12]:

$$(x-a)^2 + (y-b)^2 = r^2$$

This circle can be described by the two following equations:

$$x = a + r \cos(Q)$$

$$y = b + r \sin(Q)$$

1.1.4 PCA For Feature Extraction

PCA has been applied to an image to get feature points. PCA in actual reduces the dimensionality of mage.

Various steps of PCA are discussed below:

- The DWT Coefficient is converted into 1 column matrix vector.
- The mean of each vector has been evaluated.
- Then the mean is subtracted from all vectors.
- Then Eigen values and matrix has been generated.
- Each Eigen value is multiplied to Zero mean.
- Then calculation of signature of image. Using formula

$$S\% = [Xz)]f\%$$

1.1.5 GA For Features set Reduction

GA feature reduction is done in following steps:

Step 1: Set up a arbitrarily generated population of N L-bit chromosomes.

Step 2: Calculate the Fitness F(x) of each chromosome x in the population.

Step 3: Repeat the following steps until N offspring have been created:

(a) Choose a pair of parent chromosomes from the present population, with the probability of selection being an increasing function of fitness. The same chromosome can be selected more than once to become a parent.
(b) With probability pc (the crossover probability), cross over the pair at a arbitrarily chosen point to form two offspring or to make the copies of their parent's offspring.
(c) Change the two offspring at each locus with probability pm (the mutation probability) and put the resultant chromosomes in the original population.

Step 4: Change the current population with the new population.

Every repetition of this process is known as Generation. A GA is usually iterated for wherever from 50 to 500 or more generations known as Run. With the ending, there are frequently one or more extremely fit chromosomes in the population. Since arbitrariness plays a huge role in every run, different behavior can be produced when the random number seeds.

1.1.6 Neural Network for training

Back Propagation Neural Network (BPNN) is a systematic method for training multi-layer artificial neural network. The algorithm for Iris recognition using BPNN [11] is as follows:

- Create NN architecture having input, hidden and output layers. Predefined.
- Randomly initialize input layer.
- Train the network using ftt function.

1.2 Testing Panel

1.2.1 Upload testing image

The images from UCI Machine learning algorithms iris image database are taken for testing. It contains 4 images of one eye at two sessions. They are of 200kb .jpeg images [13].

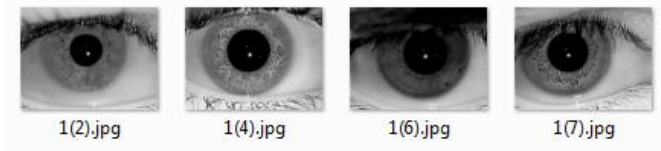

Fig.2 Iris Testing Samples

1.2.2 PCA and GA based Testing

PCA Based Testing	GA Based Testing

Begin. Initialize W1 to the identity matrix.
W1 ← In1.
Deflation approach: estimate each source sequentially.
For i1 ← 1 to n1 do.
Iterate for the i-th source
Fort ← 1 to τ1 do.
Set the current angle variation.
α1← πβt .
For each perpendicular direction.
for j1 ← i+1 to n1 do .
Determine best contrast value.
if C1(wi↑jz) > C1(wiz) and C1(wi↑jz) > C1(wi↓jz) then .
Rotate the i-th and j-th rows of W accordingly (+α). wi,wj ← wi↑j,wj↓i else if C1(wi↓jz) > C1(wiz) and C1(wi↓jz) > C1(wi↑jz) then .
Rotate the i-th and j-th rows of W accordingly (−α).
wi,wj ← wi↓j,wj↑i
end if
end for
end for
end for
Return W 1
End
	Initialise generation 0:
	k := 0;
	Pk := a population of n randomly-generated individuals;
	// Evaluate Pk:
	Compute fitness (i)
	for each i∈Pk; do
	{ // Create generation k + 1:
	// 1. Copy: Select (1 − χ) × n members of Pk and insert into Pk+1;
	// 2. Crossover: Select χ × n members of Pk; pair them up; produce offspring; insert the offspring into Pk+1;
	// 3. Mutate: Select μ × n members of Pk+1;
	invert a randomly-selected bit in each;
	// Evaluate Pk+1:
	Compute fitness(i) for each i∈Pk;
	// Increment: k := k + 1; } while fitness of fittest individual in Pk is not high enough;
	return the fittest individual from Pk

1.2.3 Matching using Neural Network

The features of the test image are compared with the features of images in the database for match or non-match using NN classifier.

1.3 Parameter Evaluation

1.3.1 FAR

Total Number of Samples in the database=x
Number of Sample that falsely accepted=y
FAR=Total Number of Samples−Number of Samples that falsely accepted

1.3.2 FRR

Total Number of Samples in the database=x
Number of Sample that falsely accepted=z

FRR=Total Number of Samples−Number of Samples that Falsely Rejected

3.3.3 Error Rate

Error rate is the total number of false acceptance or rejection iris samples.

3.3.4 Applied Accuracy

100− (FAR+FRR) %

IV. FLOWCHART

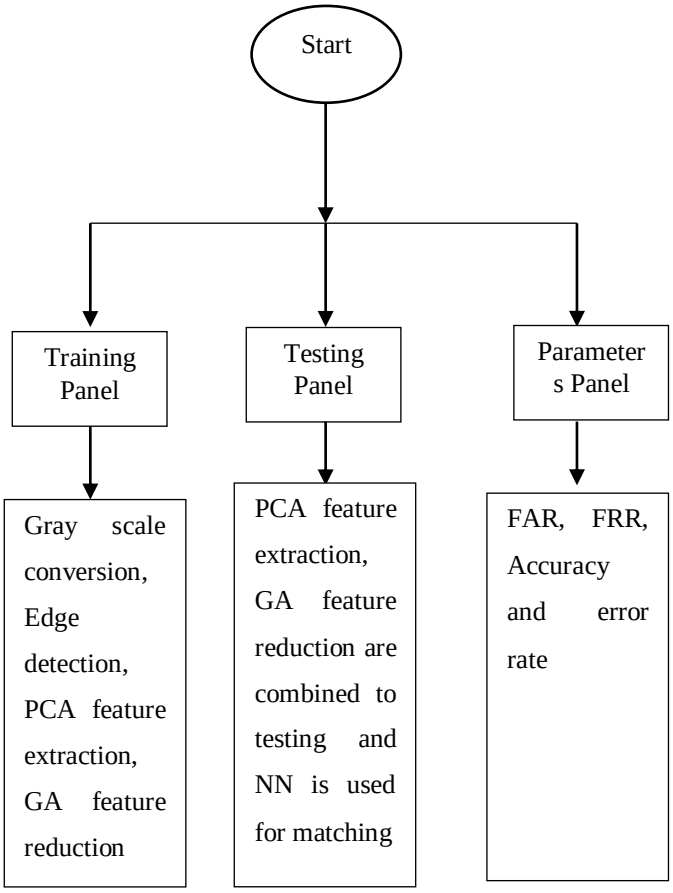

Fig.3 Proposed Work Model

V. RESULT AND ANALYSIS

The whole implementation has been done in MATLAB 7.10 using PCA and neural network.

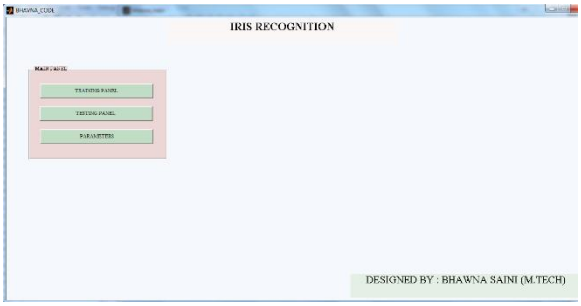

Fig.4 Main GUI

In above figure we have shown main GUI central panel which have two panel first is training and second is testing. As shown above in these panel there are given some buttons.

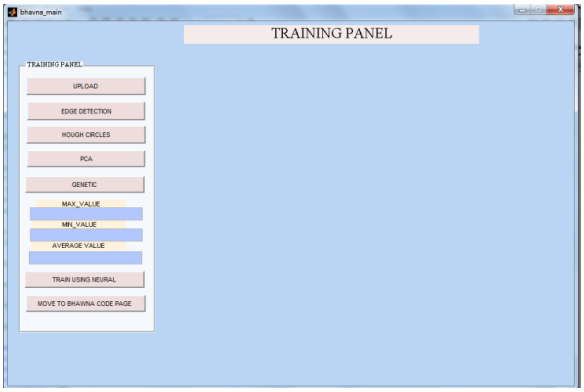

Fig.5: Training Panel

When main GUI appear we first train the components so we will click on the button given in it. Once we pressed that button above GUI will appear.

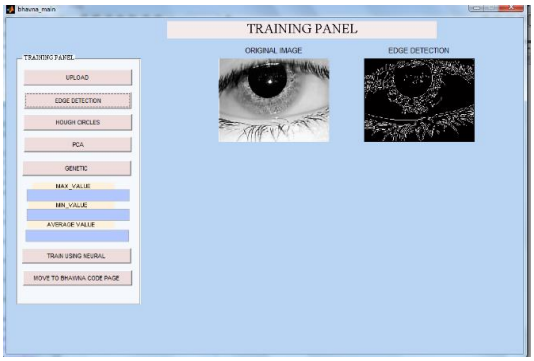

Fig.6: Edge Detection

In above figure it shows edge detection process is executed on uploaded image of iris edge, which is used to find the number of edges using canny edge detector. The canny edge detector is one of the major edge detection techniques.

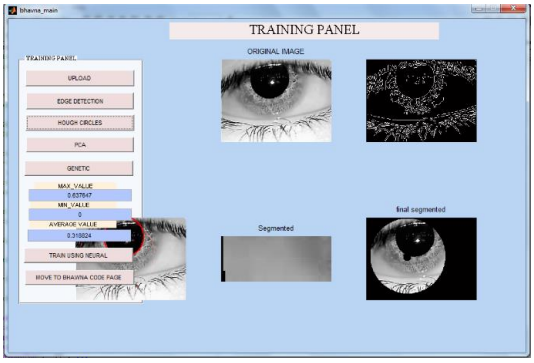

Fig.7: HCT Localization

As above figure shows segmentation process which is executed after applying Hough circular transform to find the inner and outer radius of the pupil. On segmentation we get three values max value is 0.637, min value is 0 and avg value is 0.31.

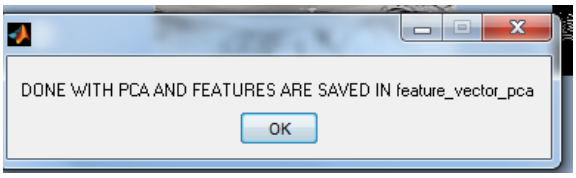

Fig.8: PCA Feature Extraction

Above figure shows the vector points obtained using PCA. These are the key features that are used for the feature vector that are saved in the database of MATLAB. That database file is having .mat extension.

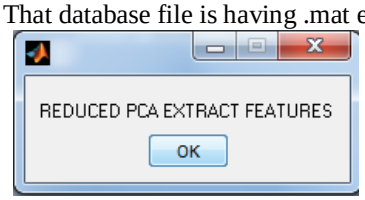

Fig.9: GA Optimization

In above figure we apply genetic algorithm which is used for optimizing features extracted PCA.

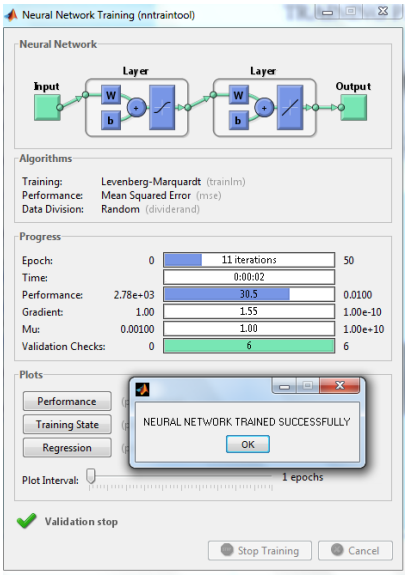

Fig.10: Neural network Training

Above figure shows the neural network for training having 50 epochs and 6 validation checks.

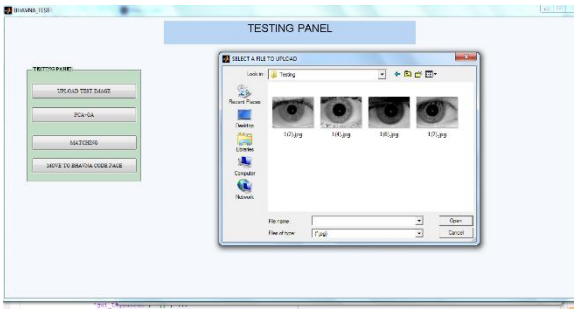

Fig.11: Testing images uploading

In above figure it shows the uploaded image which is manually selected for testing purpose.

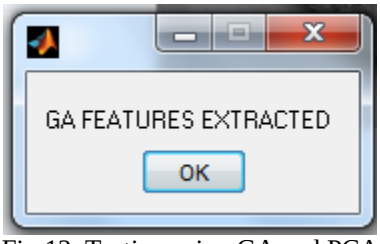

Fig.12: Testing using GA and PCA

As shown in above image, we applied the combination of PCA and GA on the system. And also the dialog box will appear on completing execution of combination of PCA and GA.

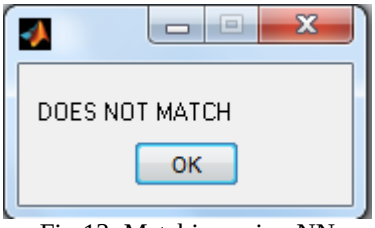

Fig.13: Matching using NN

Above figure shows the matching of template using neural network.

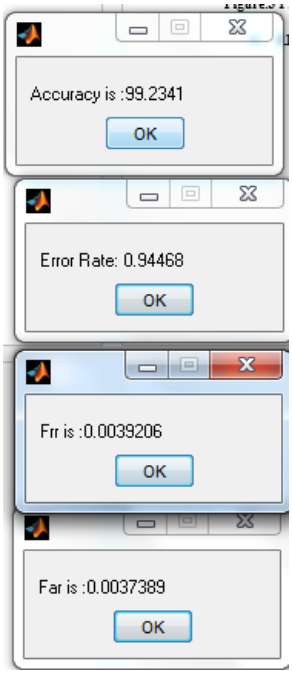

Fig.14: Parameter Evaluation

As shown in above figure four dialog boxes are appeared and shows various parameter values which are used given as accuracy is 99.97%, FAR is .0037% , error rate is .94 % and FRR is .00039%.

VI. CONCLUSION

In the proposed system a new technique is generated for feature extraction and matching of iris templates increase the accuracy of the authentication systems using PCA and Neural network. In this work PCA features are extracted for iris and this proposed method decreased the FAR as well as FRR, & has increases the system performance on the given data set. Having less error rate. Future works could go in the direction of using more robust modeling techniques against forgeries and hybrid fusion level can be used. Multimodal modalities can be used together to make forgeries more difficult. Also, the system should be tested on a larger database to validate the robustness of the model.

VII. REFERENCES

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