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IMPROVED BIOMETRIC RECOGNITION AND IDENTIFICATION OF HUMAN IRIS PATTERNS USING NEURAL NETWORKS

[1] M. GOPIKRISHNAN, [2]T. SANTHANAM

[1]Asstt Prof., Department of Master of Computer Applications,

Prathyusha Institute of Technology and Management, Thiruvallure - 602 025, India

[2]Assoc. Prof., & Head PG and Research Dept of Computer Science,

D. G. Vaishmav College, Chennai- 600 106, India

E-mail: [1] mgkc71@yahoo.com , [2]santhanam_dgvc@yahoo.com

ABSTRACT

A biometric system provides automatic identification of an individual based on a unique feature or characteristic possessed by the individual. Iris recognition is regarded as the most reliable and accurate biometric identification system available. An approach for accurate Biometric Recognition and identification of Human Iris Patterns using Neural Network has been illustrated by gopikrishnan etal. It has been concluded by Yingzi Du etal that the partial iris portion of the iris pattern describes the uniqueness and the pupil has no direct effect on the accuracy of the biometric recognition. In this paper the Iris recognition has been carried out employing a template of size 10 X 480 pixels instead of 20 X 480 pixels as employed in the earlier paper. The results of the two sizes of the templates have been compared and it has been observed that the accuracy of the results obtained with the limited template size is comparable with that of the one with the full size. The reason for this is also discussed in this paper. The improved methodology suggested has resulted in the reduction of the space requirement as well as time complexity with no loss in accuracy. This paper also provides results of iris recognition performed applying Hamming distance, Feed forward back propagation, Cascade forward back propagation, Elman forward back propagation and perceptron. It has been established that the method suggested applying perceptron provides the best accuracy in respect of iris recognition with no major additional computational complexity.

Keywords: *Iris recognition, Biometric identification, Pattern recognition, Automatic segmentation.*

1. INTRODUCTION

In this paper after providing brief picture on development of Various techniques for iris recognition, Hamming distance coupled with Neural Network based iris recognition techniques are discussed. Perfect recognition on a set of 150 eye images has been achieved through this approach ; Further, Tests on another set of 801 images resulted in false accept and false reject rates of 0.0005% and 0.187% respectively, providing the reliability and accuracy of the biometric technology. This paper provides results of iris recognition performed on a reduced size template, applying Hamming distance, Feed forward back propagation, Cascade forward back propagation, Elman forward back propagation and perceptron. It has been established that the method suggested applying perceptron provides the best accuracy in respect of iris recognition with no major additional computational complexity. This paper uses the CASIA iris image database collected by Institute of Automation, Chinese Academy of Sciences[8].

Yingzi Du etal [2] in their paper established that the partial iris portion of the iris pattern describes the uniqueness and the pupil has no direct effect on the accuracy of the biometric recognition and identification. Using this concept, in this paper, the size of the template is reduced eliminating the pupil’s portion..

2. IMAGE PREPROCESSING

A sample iris image is shown in Fig. 1. Since it has a circular shape when the iris is orthogonal to the sensor, iris recognition algorithms typically convert the pixels of the iris to polar coordinates for further processing. An important part of this

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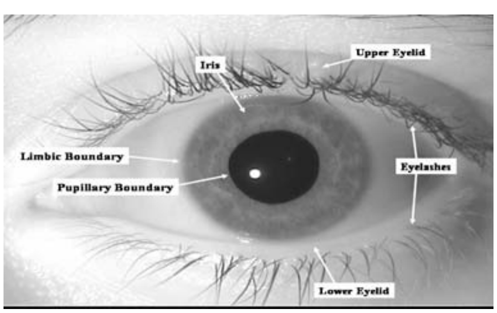
type of algorithm is to determine which pixels are actually on the iris, effectively removing those pixels that represent the pupil, eyelids and eyelashes, as well as those pixels that are the result of reflections.

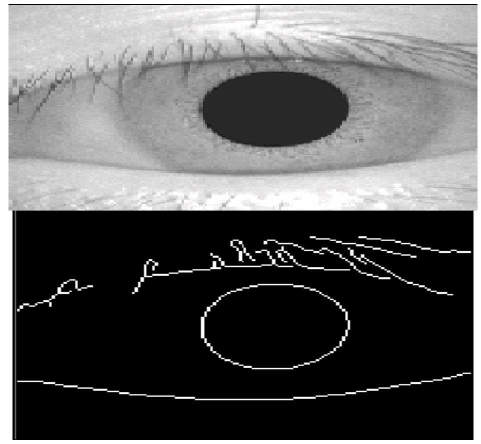
In this algorithm, the locations of the pupil and upper and lower eyelids are determined first using edge detection. This is performed after the original iris image has been down sampled by a factor of two in each direction (to 1/4 size, in order to speed processing). The best edge results came using the Canny method [9]. An example is shown in Fig. 2, where the top is the original iris image and the bottom is the edge detection results. The pupil clearly stands out as a circle, and the upper and lower eyelid areas above and below the pupil are also prominent. A Hough transform is then used to find the center of the pupil and its radius.

Once the center of the pupil is found, the original image is transformed into resolution invariant polar coordinates using the center of the pupil as the origin. This is done since the pupil is close to circular. Although not always correct, it is assumed that the outer edge of the iris is circular as well, also centered at the center of the pupil. From this geometry, when the original image is transformed into polar coordinates, the outer boundary of the iris will appear as a straight (or near straight)horizontal line segment (see Fig. 3a). This edge is determined using a horizontal Sobel filter.

After determination of the inner and outer boundaries of the iris, the non-iris pixels within these concentric circles must be determined (see Fig. 3b). Thresholding identifies the glare from reflections (bright spots), while edge detection is used to identify eyelashes.



“ Figure 1: Sample Near Infrared Iris Image “



“Figure 2: Iris Image and Its Edges using Canny Method”

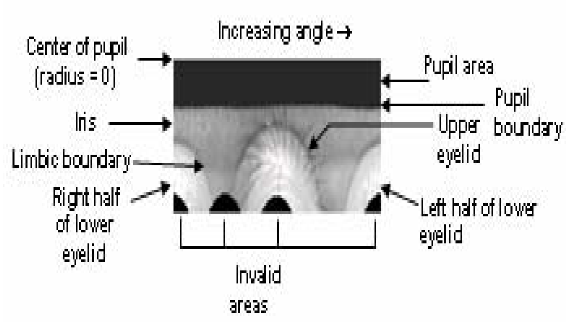
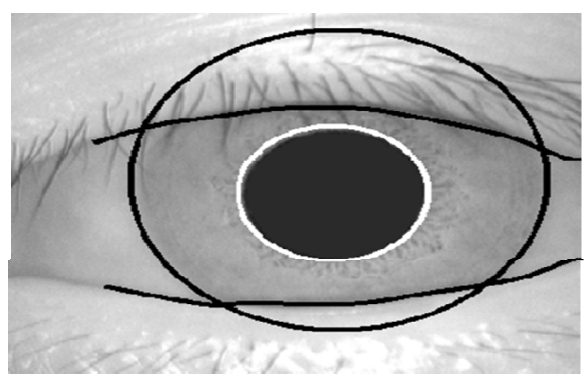


Figure 3a: Iris image in polar coordinates



“ Figure 3 b: Original image after inner and outer edges of iris determined ”

3. ENROLLMENT

Enrollment is the process of generating some representation of the iris that is to be stored in the database for use in identification. Typically, this involves combining several images of the same iris

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in some manner in order to produce a representative sample that has less noise than any individual image. For this system, the normalized iris images and the result stored in the database as the template are compared for identification. The enrollment process includes image acquisition, image preprocessing and the template creation.

4. IDENTIFICATION

The identification process, in which a new iris image, presented to the system, undergoes the same preprocessing like that of the iris images in the enrollment database. The normalized template is then compared to each template in the enrollment database to determine a match.

5. NEURAL NETWORK DISTANCE

Artificial neural networks have been explored for iris identification. Many approaches, such as formulating the identification problem such that the neural network would identify the individual irises (i.e., the neural network contains an output class for each individual iris). This means a neural network that could identify 100 people would have 200 outputs nodes, each representing an individual iris. This architecture is typically useful for small databases, but requires enlarging and retraining of the neural network as the database grows.

In this paper, a neural network is used to identify the statistical pattern present when one iris template matches or does not match another. The neural network can be small (thus fast), and will contain only two output nodes representing a match or a non-match. The neural network need not be retrained as individuals are added to the database. A feed forward back propagation (FFBP) and perceptron artificial neural network, shown in Figs. [5, 6] has been used to form the match decision. The error back-propagation training algorithm is used to adjust the internal neural network weights.

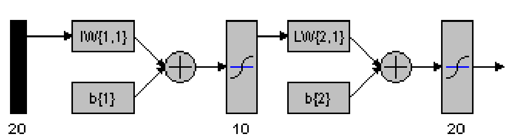

Figure 4: Feed – Forward Back propagation

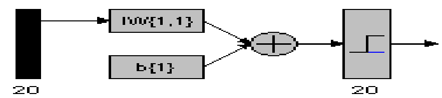

Figure 5: Perceptron

6. EXPERIMENTAL RESULTS

The performance of the proposed improved methodology is evaluated with CASIA database (the institute of Automation, Chinese Academy of Sciences). The CASIA data base contain nearly 4500 iris images at (320X280). The experiments were carried out in Intel Core 2 Duo processor with 1.83 GHz with 1 GB DDR 2 for all iris sample templates. This is a real world application level simulation. The experimentation is conducted in two stages:

1) Performance evaluation of the proposed improved methodology for iris recognition.

2) Comparison with the existing approaches in the field of iris recognition.

In the first stage of the experimentation, emphasis is on the performance evaluation of the current approach based on the matching accuracy. Evaluation of the proposed method is by comparing its recognition accuracy with the matching strategies. The performance of the proposed genetic process is demonstrated in Tables 1 and 2, through selection of optimum features as well as increase in the overall system accuracy. The verification performance of the proposed approach is shown in Figures 6 and 8 using a receiver operator characteristics (ROCs) curve and Figures 7 and 9 using a 3D Column chart. The effect of performance evaluation on different security requirements is obtained by changing the values of weightages. The experimental results measure the probability of accepting an imposter as an authorized subject, and the probability of rejecting an authorized subject incorrectly. During the second stage, through a series of experimentation, a comparative analysis of the suggested method with the existing methods, in respect of recognition accuracy and computational complexity, is provided.

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Table 1 : Comparison between experimental Results.

Neural Network Tools	**Template**	Exp Result Analysis 1	Exp Result Analysis 2	Exp Result Analysis 3	Exp Result Analysis 4	Exp Result Analysis 5	Exp Result Analysis 6
Hammington Distance	**20 X 480 pixels**	0.3418	0.2509	0.2822	0.2427	0.2480	0.4154
	10 X 480 pixels	0.2655	0.2910	0.2356	0.2769	0.3025	0.3704
Feed forward back propagation	**20 X 480 pixels**	0.0740	0.0562	0.1083	0.1590	0.0401	0.0522
	10 X 480 pixels	0.0903	0.1135	0.1317	0.0777	0.1066	0.1333
Cascade forward back propagation	**20 X 480 pixels**	0.1592	0.0777	0.2091	0.1060	0.1761	0.2082
	10 X 480 pixels	0.0704	0.0953	0.1103	0.0665	0.0858	0.1002
Elman forward back propagation	**20 X 480 pixels**	0.0740	0.0562	0.0569	0.9013	0.0403	0.0512
	10 X 480 pixels	0.0907	0.1162	0.1322	0.0709	0.1017	0.1280
Perceptron	**20 X 480 pixels**	0.0083	0.0045	0.0056	0.0085	0.0083	0.0022
	10 X 480 pixels	0.0023	0.0029	0.0032	0.0025	0.0025	0.0029

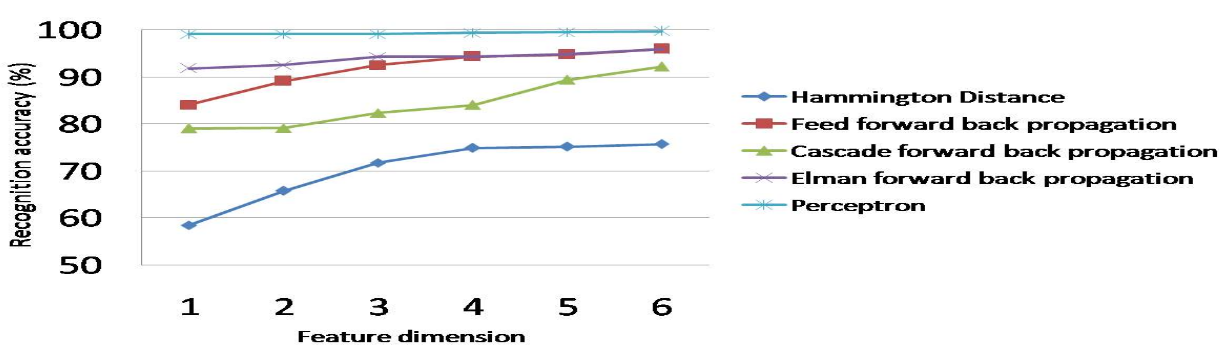

Figure 6 : Verification of Performance using ROC Curves (Template 20 X 480 pixels size)

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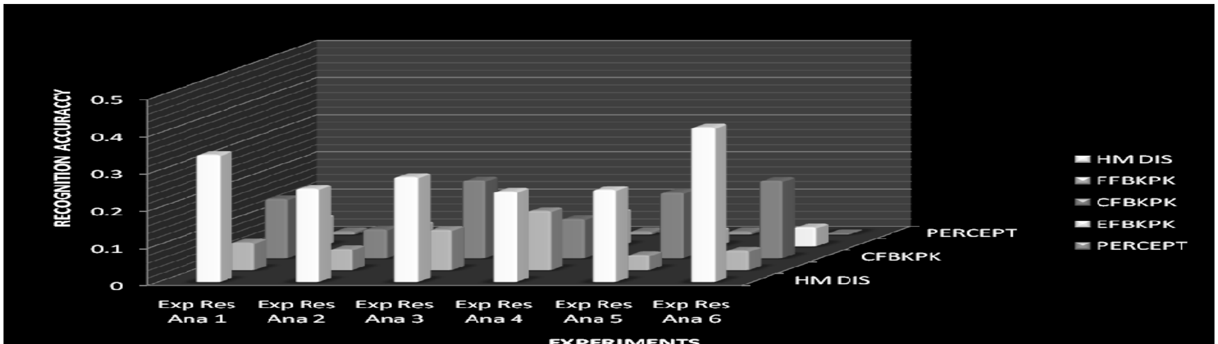

Figure 7 : Verification of Performance using 3D Column(Template 20 X 480 pixels size)

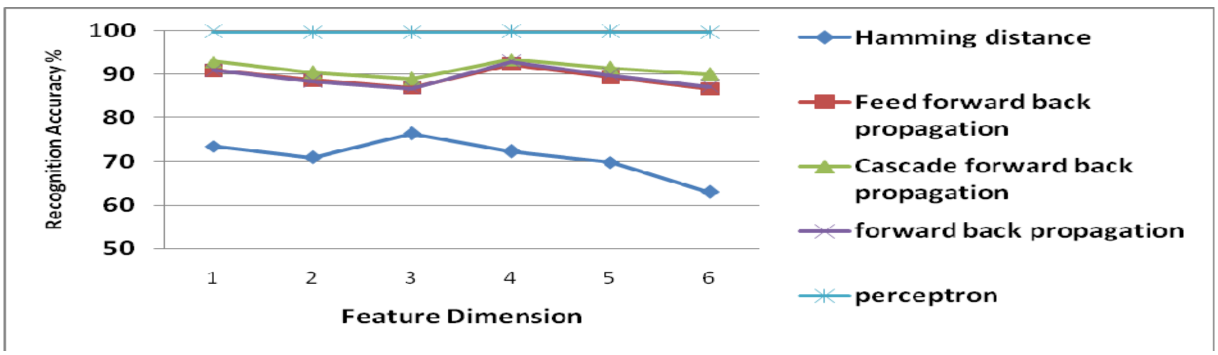

Figure 8 : Verification of Performance using ROC Curves (Template 10 X 240 pixels size)

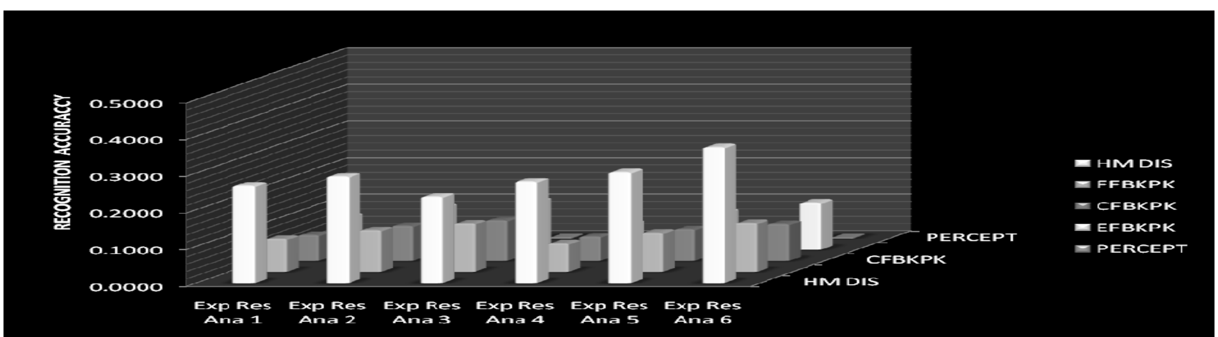

Figure 9 : Verification of Performance using 3D Column(Template 10 X 480 pixels size)

7. CONCLUSIONS

In this paper, an improved iris recognition method is proposed using an efficient iris segmentation approach, based on the collarette area localization, with the incorporation of the eyelashes and the eyelids detection techniques. The 1D log-Gabor filters are used to extract the discriminating features. In order to increase the matching accuracy neural network tools have been applied. Since it has been established that the pupil has no direct effect on the accuracy of the identification, in this paper, a reduced size of template is used and the identification carried out. A comparison of results obtained for the two templates namely 20 X 480 and 10 X 480 pixels size has been performed. Experimental results of the improved method exhibit an encouraging performance as for as the accuracy is concerned especially on the CASIA data set. The performance evaluation and comparisons indicate that the proposed method is a viable and very efficient method for iris recognition resulting in lesser time complexity and space requirement.

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8. ACKNOWLEDGMENTS

The iris CASIA dataset is available on the web at http:// www. sinobiometrics.com / english/ Iris%20Data bases.asp[8]

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