ISSN 2229-5518

Iris Recognition System based on Neural Networks

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Abstract— Our main aim is to develop a secure biometric method to identify individual person other than physical or behavioral characteristics. One such method is iris recognition which is one of the most secure and unique feature of any person. God has created every individual with a unique iris pattern on this earth. It is found that this method for Iris Recognition design offers good class discriminacy. The iris recognition technique consists of iris localization, normalization, feature extraction and matching. Their unique feature are extracted and given to the neural network tool for matching. The match results show that the individual is identified accurately.

Index Terms— Iris recognition, localization, normalization, neural network, person identification, secure biometric.

I. INTRODUCTION

Identity verification and identification is becoming increasingly popular. Biometric measures [1] such as recognizing one's fingerprints, face, iris and voice greatly help in person identification authentication, and authorization. Pair of iris recognition has the high potential and non invasive personal verification. Advances in the field have expanded the options to include biometrics such as iris and retina. Among the large set of options, it has been shown that the iris is the most accurate biometric. The iris is the elastic, pigmented, connective tissue that controls the pupil.

Daugman [2] proposed an iris recognition system representing an iris as a mathematical function. Mayank Vatsa proposed a support-vector-machine-based learning algorithm selects locally enhanced regions from each globally enhanced image and combines these good-quality regions to create a single high-quality iris image.[3] proposes algorithms for iris segmentation, quality enhancement, match score fusion, and indexing to improve both the accuracy and the speed of iris recognition 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[5]. Leila Fallah Araghi used Iris Recognition based on covariance of discrete wavelet using Competitive Neural Network (LVQ). A set of Edge of Iris profiles are used to build a covariance matrix by discrete wavelet transform using Neural Network.[4] A. Murugan pointed out the ways in which iris region can be segmented and used in neural network[9]. Today with the development of Artificial Intelligence algorithm, Iris recognition system may gain speed, hardware simplicity, accuracy and learning ability. The experimental results have shown the effectiveness of the proposed system in comparison with other previous Iris recognition system.

II. IRIS RECOGNITION SYSTEM

Iris images are taken by CASIA iris image database. The feature extraction is done by using wavelet transform. Data sets will be prepared using features obtained by the feature extraction technique. These obtained features are fed to the ANN for the classification.
The images from CASIA iris image database are taken. It contains 7 images of 108 persons of one eye at two sessions. They are of 320 x 280 bitmap images.

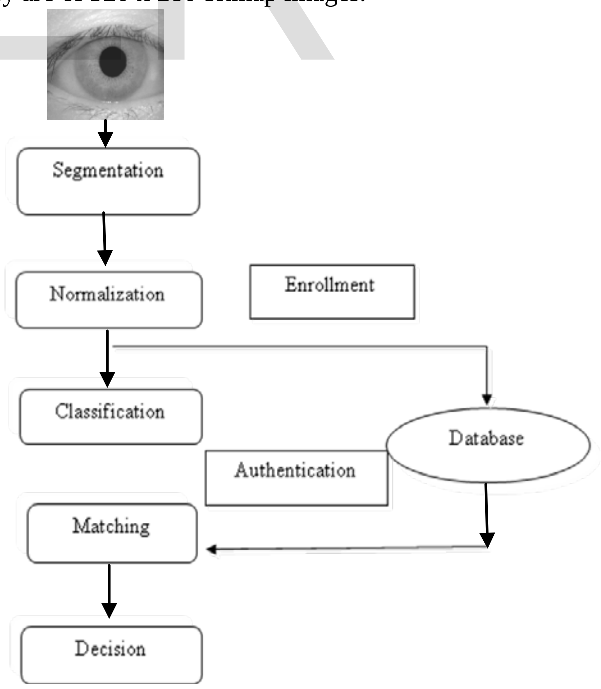
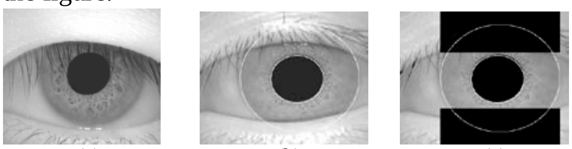


Fig 1 Block Diagram of Proposed System

III. Segmentation

The segmentation module detects the pupillary and limbus boundaries and identifies the regions where the eyelids and eyelashes interrupt the limbus boundary's contour. After detecting the pupil edge, the iris/ sclera border is detected. The iris/sclera is low in contrast and may be partly occluded by eyelids and eyelashes. The contrast of the iris region is increased by first applying Gaussian smoothing and then Histogram equalization. The boundary of the enhanced iris image is found by using canny edge detector. The Canny operator is optimum even for noisy images as the method bridge the gap between strong and weak edges of the image by connecting the weak edges in the output only if they are connected to strong images. Hence the edges are more likely to be the actual ones. Therefore compared to other detection method, this Canny operator is less fooled by spurious noise. [4].

The main objective here is to remove non useful information, namely the pupil segment and the part outside the iris [6]. The technique used is canny edge detection method for detecting the iris and pupil boundary as shown in the figure.



(a) (b) (c)

Fig 2. a) Sample image b) Localized image c) Noise Reduced image

IV. Feature Extraction

The feature extraction part is very important part for the entire iris recognition process. To provide accurate recognition of individuals, the most discriminating information present in an iris pattern must be extracted. The iris images thus obtained are then used for feature extraction.

$$G(x,y;\theta,\omega) = e^{\left\{-\frac{1}{2\left[\frac{x'^2}{\delta x'^2}+\frac{y'^2}{\delta y'^2}\right]}\right\}} e^{(i\omega(x+y))} \quad (1)$$

Where,

$$x' = x\cos\theta + y\sin\theta$$

$$y' = y\cos\theta - x\sin\theta$$

Gabor filter is used to provide the optimal resolution in both the domains [12]. The information about time is lost and it's hard to tell where a certain frequency occurs in Fourier Transform .Gabor function best analytical resolution in both domains.

Another method used for feature extraction PCA is used to reduce the dimensionality of the data set containing large number of inter related variables, although retaining the variations in the data sets as much as possible [13]. It can be thought of a mathematical procedure that uses an orthogonal transform to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components [13]. PCA is the simplest of the true eigenvector-based multivariate analyses. Often, its operation can be thought of as revealing the internal structure of the data in a way that best explains the variance in the data. Factor analysis typically incorporates more domain specific assumptions about the underlying structure and solves eigenvectors of a slightly different matrix. These values are also known as Eigen values and set of these values form the Eigen vector [14]. Thus a Neural network tool is used to calculate the best validation performance and plot a graph of mean square error Vs number of epochs.

V. Classification

For classification we have used **artificial neural network (ANN)**, often just called a "neural network" (NN),which is a mathematical model or computational model based on biological neural network [5]. It consists of an interconnected group of artificial network and processes information using a connectionist approach to computation.

VI. BPNN based iris recognition

Back Propagation Neural Network (BPNN) is a systematic method for training multi-layer artificial neural network [9]. It is a multi-layer forward network using extend gradient descent based delta-learning rule known as back propagation (of errors) rule [10]. The network is trained by supervised learning method.

The basic structure of the BPNN includes one input layer, at least one hidden layer (single layer / multiple layers), followed by output layer. Neural network works by adjusting the weight values during training in order to reduce the error between the actual and desire output pattern [9].

The algorithm for Iris recognition using BPNN [11] is as follows:

(i) Load normalized Iris data set (contains feature vector values ranges from 0 to 1 for different subjects).

(ii) Use this normalized data for training set and testing set by randomly drawing out the data for training and testing.

(iii) Create an initial NN architecture consisting of three layers, an input, an output and a hidden layer. The number of nodes in the input layer is equal to dimension of the feature vector that characterizes the iris image information. Randomly initialize the nodes of the hidden layer. The output layer contains one node. Randomly initialize all connection weights within a certain range.

(iv) Train the network on the training set by using Back Propagation algorithm until the error is minimum for a certain number of training epochs specified by the user.

(v) Present the test data to the trained network and evaluate the performance.

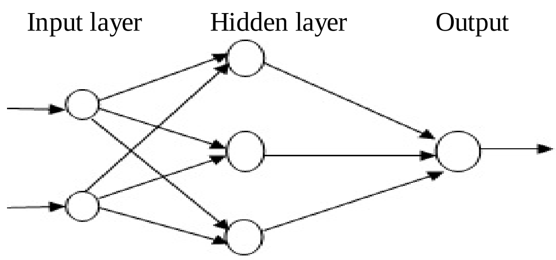


Fig.3 Back Propagation Neural Network Model

An input image is compared with the CASIA database and taken for evaluation in which we calculate the best validation performance Vs the mean square error using neural network toolbox

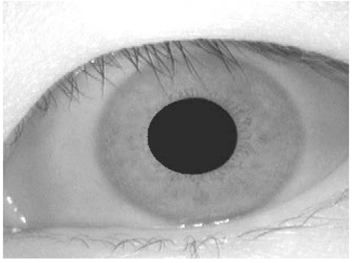


Fig.4 Input test image chosen

The result is found by the algorithm and we can get the number of epochs used and which epoch yielded the best results as shown in fig.5. Here a plot of epochs (MSE) has been plotted, the epochs gets the best validation performance at epoch no. 2, the MSE is the lowest at this point, and hereafter no significant change takes place and no further decrease takes place. Hence this is the best validation performance.

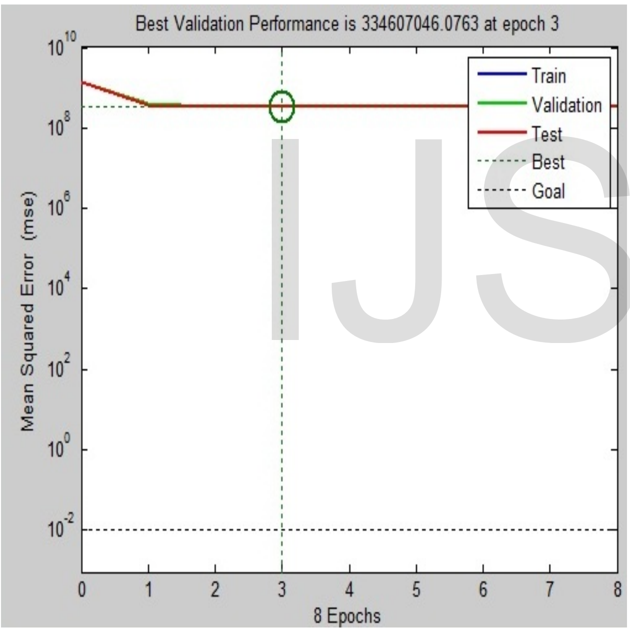


Fig.5 Plot of Epochs Vs MSE

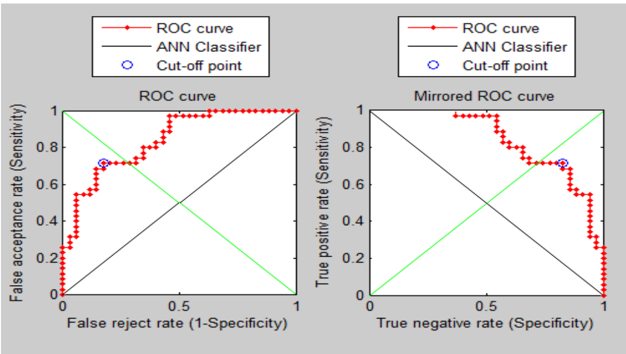


Fig 6 Plot of FRR & FAR for NN

The ROC line away from the diagonal line the less is the rejection rate

Table 1

Images	Accuracy%	FAR	Time(sec)
002_2_3	74.571	0.72	13.9809
009_1_2	70.122	0.58	14.8408
009_2_3	73.469	0.59	20.0326

The above table shows FAR (False Acceptance Rate), accuracy and time taken but the network.

IX Conclusion

The proposed methodology uses canny edge detection with Hough transform to segment iris images for locating the iris and remove noise. Normalization method is used for unwrapping of iris to obtain polar coordinates if the image. Results of feature extraction will used for feature matching. Supervised learning Neural Network tool which will used in order to increase the matching accuracy and compares these results with the traditional results. Classification using Neural Network gave the best results as described in [5], [8], [12] and this method high accuracy rate.

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