International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 2 Issue: 10 3243 – 3246

Artificial Neural Network Based Iris Recognition System

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Abstract— This paper deals with biometric personal identification based on iris recognition using artificial neural network. The Iris recognition system includes pupil detection, and the enhancement, region of interest of iris detected from an eye image then, the iris recognition using neural network approach**.** For the localization of the inner and outer boundaries of the iris region is being proposed a fast algorithm by us. Located pupil is detected from an eye image, and, after enhancement, located iris part is detected from an eye image, it is represented by a dataset. In this paper, we proposed a neural network based iris recognition approach by analyzing iris patterns. Hough transforms are used for localizing the part of iris region; then, histogram equalization was applied to the iris an image for making the shapes an image more distinctive. The gray-level iris images, experimented in this work, were obtained from the Institute Automation Chinese Academy of Science (CASIA) iris images database version 1.0.

Keywords*— Biometric, Iris Recognition, Artificial Neural Network, Hough transform*

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I. INTRODUCTION

Biometrics technology plays important role in public security and information security domains. In today's world, security has become very important. Iris Recognition Security System is one of the most reliable leading technologies for user identification. Biometrics accurately identifies each individual and distinguishes one from another. Iris recognition is one of important biometric recognition approach in a human identification is becoming a very active topic in research and practical application [2]. Iris region is the part between the pupil and the white sclera. The human iris is not changeable and is stable. From one year of age until death, the patterns of the iris are relatively constant over a person's lifetime, Because of this uniqueness and stability, iris recognition is a reliable human identification technique. Iris recognition consists of the iris capturing, pre-processing and recognition of the iris region in a digital eye image. The human iris has random texture and it is stable throughout the life [2],[4].

A. WHY THE IRIS?[1]

- Accuracy: Iris recognition has highest proven accuracy and has no false matches in over two million cross comparisons.
- Uniqueness: Uniqueness of iris pattern comes from the richness of texture detail of in the iris image such as freckles, coronas, stripes and furrows. Even twins have a totally different iris.
- High information Content: The amount of information that can be measured in a single iris is much greater than fingerprints.
- Real time: It allows high speed processing and the individual needs to just look into a camera for a few seconds.
- Stability: iris texture is formed during gestation and the main structure of the iris is shaped after 8 months.
- It has also been show that the iris is essentially stable across life time. The iris is stable for each individual through his or her life and do not change with age.
- Flexible: Iris recognition technology easily integrates into an existing security system or operates as a standalone.
- Reliable: A distinctive iris pattern is not susceptible to theft, loss or compromise.

II. IRIS RECOGNITION

A. Structure of the iris recognition system

The architecture flow chart of the iris recognition system is given in Fig:-1.The image recognition system consists iris image acquisition and iris recognition. The iris image acquisition consists the lighting system, the pixel positioning system, and the physical capture system [2].The iris recognition includes preprocessing and Training and testing using neural network. During iris acquisition, the iris image in the input sequence must be clear and sharp. Clarity of the iris's minute characteristics and sharpness of the boundary between the pupil and the iris, and the boundary between the iris and the sclera affects the quality of the iris image. A high quality image must be selected for iris recognition. In iris pre-processing, the iris is detected and extracted from an eye image and enhanced. Enhanced image is represented by the matrix that describes graylevels values of the iris image. This matrix becomes the training data set for the neural network. The iris recognition system works with two operation modes:- training mode and online mode. At first stage, the training of recognition system is carried out using graylevels values of iris images. Neural network is trained with all iris images. After training, in online mode, neural network performs classification and recognizes the patterns that belong to a certain person's iris.

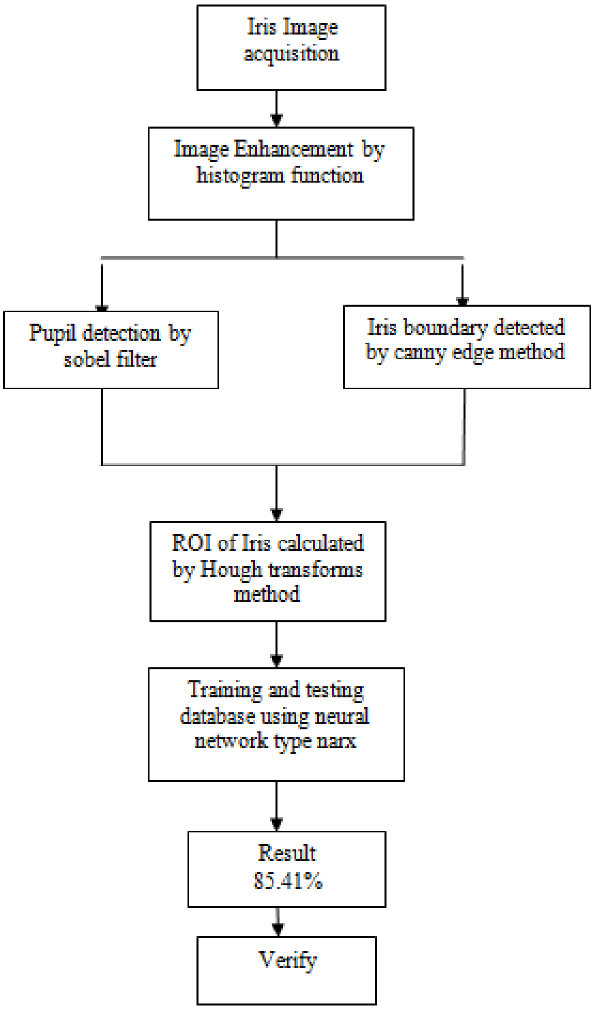

Figure1. Flow chart of Iris recognition system

III. METHODOLOGY

Step 1:- Image acquisition

This step deals with the capturing of a high quality image of the iris. Normally a high resolution camera is used in with infrared illumination facility. Obtain images with sufficient resolution and sharpness. This research paper uses gray level eye images from the CASIA database version 1.0.[2],[6]

Step 2:- Image Enhancement

This step deals with remove high frequency noises and also improves the contrast of projected iris ribbon, histogram equalization (HE) will be used for the iris zone as shown in fig 2. Also the effects of background illumination are removed. The size of the image obtained is large and is unsuitable for giving to neural network. Thus averaging is performed on this image so as to reduce its dimensions[1]. Now this reduced dimension template thus obtained itself will act as feature vector to the artificial neural network. This reduces the computations to a lot extent thereby speeding up the image segmentation stage.

Figure 2:- Enhanced image

Step 2.1:- Pupil Circle Detection

Firstly, the gray scale image is first converted into a binary image by applying a suitable threshold. This is followed by an edge detector algorithm such sobel edge. Finally this algorithm is applied to the edge image for the detection of pupil circle. This results in faster and accurate pupil detection.

Step 2.1.1:- Edge Detection: Some of the edge detection methods present are:
1) Sobel
2) Roberts
3) Prewitt
4) Log
5) Canny

Out of these five edge detection technique. we used Sobel edge detection technique. The Sobel method finds edges using the Sobel approximation to the derivative. It returns edges at those points where the gradient of I is maximum for pupil detection.

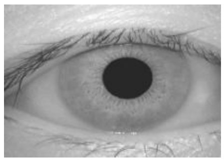

Figure 3:- Captured Image

Figure 4:- Boundary detection by sobel filter

Step 2.1.2:- Finding centre of the pupil

In this paper, we proposed a fast algorithm for detecting the boundaries between pupil and iris and also sclera and iris has been proposed. To find the boundary between the pupil and iris, we must detect the location (centre coordinates and radius) of the pupil. The rectangular area technique is applied in order to localize pupil and detect the inner circle of iris. The pupil is a dark circular area in an eye image. Besides the pupil, eyelids and eyelashes are also characterized by black color. In some cases, the pupil is not located in the middle of an eye image, and this causes difficulties in finding the exact location of the pupil using point-by- point comparison on the base of threshold technique. In this paper, we are looking for the red circle region in an iris image. Choosing the size of the red circle region is important, and this affects the accurate determination of the pupil's position.

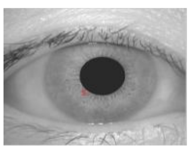

Figure 5:- pixel position of pupil

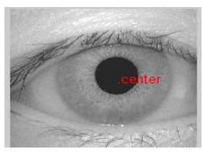

Figure 6:- Findin center of pupil

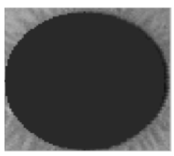

Figure 7:- Detect the pupil

ISSN: 2321-8169
3243 – 3246

Hough transform is the most widely used method for iris boundary detection. But this method was failed, if edge detector algorithms are not accurately detected edge of the iris. The most important and challenging stage of segmentation is detecting the boundary of iris and sclera. Firstly, because there is usually no specific boundary in this area and illumination intensity distinction between iris and sclera is very low at the border. Secondly, there are other edge points in eye image in which illumination intensity distinction is much more than that of the boundary of iris and sclera. As a result, we proposed canny edge detection algorithms which are able to detect outer iris edges identify those points as edge. Therefore, in order to detect iris outer boundary, these points have to be identified and eliminated. In this paper, available boundaries are initially enhanced and then extra edge points are identified and eliminated. At the end, through Hough transform, outer iris boundary is obtained. In order to enhance iris outer boundary edges, canny edge detection is performed on eye image in preprocessing stage. By performing such edge detection, a matrix is obtained with the same dimensions as of the image itself which its elements are high in areas where there is a definite boundary and the elements are low in areas where there is no perfectly definite boundary, such as iris boundary.
Through multiplying of 2.76 in the matrix of pixel values of iris image and intensifying light in eye image, the edges are enhanced. Applying canny edge detection and multiplying that to the constant value of 2.76 result in better revelation of iris outer boundary edge points.

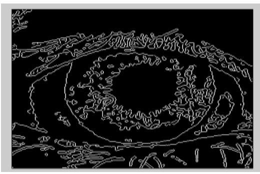

Figure 8:- Iris boundary detected by canny edge method

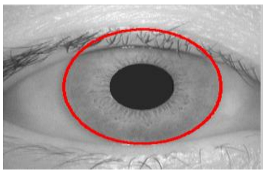

Figure 9:- Detect Iris boundary

Step 3:- Determine region of interest of the iris

A region of interest (ROI) is a portion of an image that we want to filter or perform some other operation on. We define an ROI by creating a binary mask, which is a binary image that is the same size as the image we want to process with pixel that defines the ROI set to 1and all other pixel set to 0.And in this paper, we detect the some part of iris from an eye image for trained the database.

Figure 10:- ROI of Iris

IV. Training and testing neural network

The Artificial Neural network is used which involves training and testing of the extracted feature vectors from the iris images. In the CASIA database version 1.0 each person's eye had 6 images, of which 4 were used for training and 2 for testing. These images were preprocessed as mentioned in the image processing section. The final result was a strip of data for each image which was fed to the neural network. All the neural networks in this paper consist of two hidden layer. Accuracy is calculated using the formula;

Accuracy = (No. of correct classification/ total number of testing images) *100

These networks classify 120 images and were trained using nonlinear autoregressive network with exogenous inputs (NARX) algorithm.A total of 120 images were given for testing. The nonlinear autoregressive network with exogenous inputs (NARX) is a recurrent dynamic network, with feedback connections enclosing several layers of the network. The NARX model is based on the linear ARX model, which is commonly used in time-series modeling. There are many applications for the NARX network. It can be used as a predictor, to predict the next value of the input signal. It can also be used for nonlinear filtering, in which the target output is a noise-free version of the input signal. The use of the NARX network is demonstrated in another important application, the modeling of nonlinear dynamic systems.

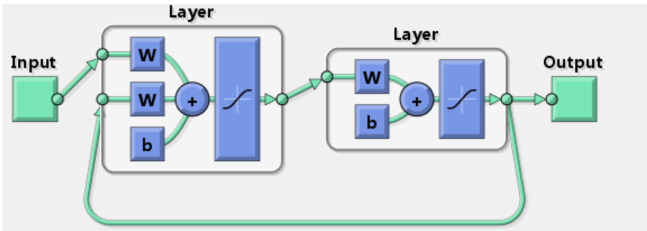

Figure 11:- Narx neural network model

V. Result

The algorithms have been implemented in Matlab 7.10. In order to evaluate the iris recognition algorithms, the CASIA iris image database version 1.0 is used. Currently this is largest iris database available in the public domain. This image database contains 756 eye images from 108 different persons. Experiments are performed in 120 images of person. Experiment is performed in three stages: iris segmentation and for database storage training and testing using neural network approach and verification. The accuracy rate was 85.41%.

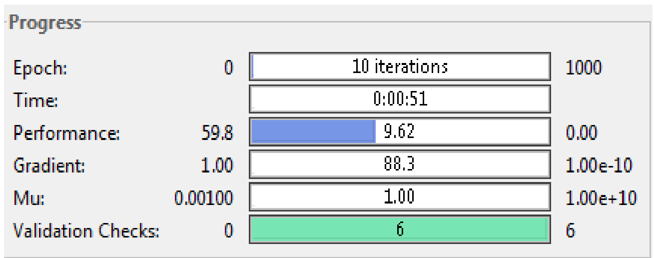

Figure 12:- learning progress of neural network

ISSN: 2321-8169
3243 – 3246

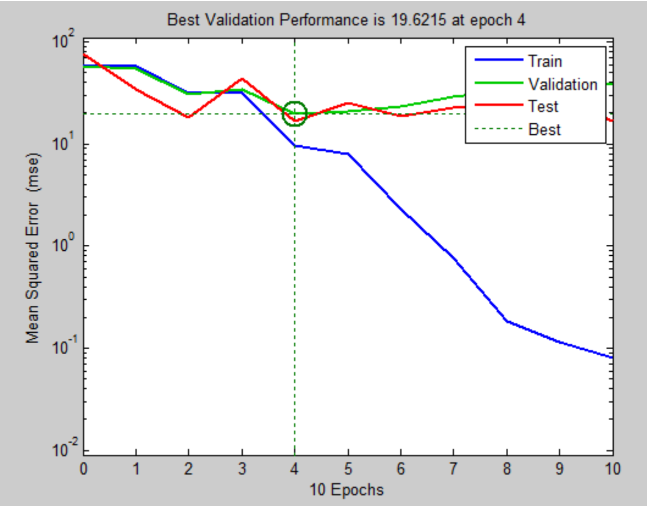

Fig 13:- performance of neural network model

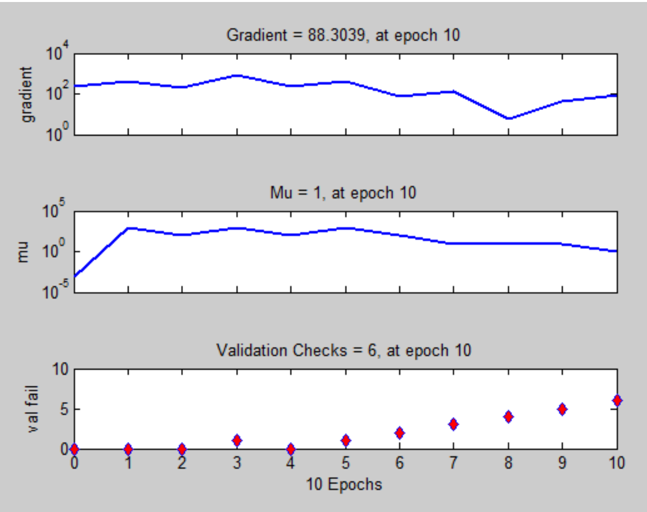

Fig 14:- training state of neural network model

VI. Conclusion

This paper deals with biometric system. This system is based on Iris using Neural Network was Presented. The Iris preprocessing method proposed uses edge detection sobel algorithm only for pupil circle detection after then Hough transform method is used for iris circle detection. Before applying Hough transform algorithm for iris circle detection, the image is converted to black and white. For recognition neural network type nonlinear autoregressive network with exogenous inputs (NARX) is used. The network is trained for using 64 train images. Testing was carried out using 96 test images and it was found that nonlinear autoregressive network with exogenous inputs (Narx) algorithm gave best results. The accuracy rate was 85.41%.

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