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Retina Based Biometric Identification System using Artificial Neural Network

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ABSTRACT: Artificial neural network has gained wide acceptance all over the world in the field of medical, technical ,scientific, research etc .,the artificial neural network using retinal features has been designed which consist of image acquisition, processing, feature extraction and authentication . Earlier biometrics such as fingerprint recognition, vein scanning, and face recognition exposed many drawbacks because of its level of precision and security. Retinal recognition system has gain wide acceptance over other recognition systems because of its uniqueness and high level of security. Retina is unique from person to person and not even identical twins have the same retinal features hence it can be used for the authentication purpose in the field where high security isneeded.In this system the high resolution images are taken through series of enhancement process before feature extraction is done and the templates are created for template matching and authentication purpose and these templates can also be used for future reference. The feature extraction is done using fast feature algorithm.

KEYWORDS*:* Artificial neural network;fast feature algorithm; retina;

I. INTRODUCTION

Biometric recognition refers to the automated recognition or identification of individuals based on their physiological and behavioral characteristics. There are two principles behind the development of biometrics.
1. Phrenology:This is the study of the structure of the skull, it was used to determine the character of a person and the mental capacity.
2. Anthropometry:This is the study of human body measurements for the use of anthropological classification and comparison it was mainly used for classifying potential criminals by facial characteristics.
There are various biometrics such as fingerprint recognition, facial scanning, vein scanning, iris, handwriting recognition system among which retinal recognition system has gained wide acceptance.
Retina is a sensory tissue which consists of multiple layers it also consists of millions of photoreceptors whose function is to gather the light rays that are sent to it and transform that light into electrical impulses that travel through the optic nerve into the brain which will be then converted into images. The two photoreceptors in the retina are rods and cones. Retina consist of blood vessels which are continuous patterns with little curvature, branch from optical disk and have tree shape on the surface of retina. The mean diameter of the blood vessels is about 250 micrometer (1/40 of retina diameter)

Retinal recognition system is more advantageous over other biometric system because the blood vessel pattern of the retina hardly ever changes over the life time of an individual and the retina is not exposed to external environment threats. Retinal recognition is robust against imposture due to inaccessibility of the retina.The actual average feature vector size is very small compared to other biometric vectors. The rich and unique features can be extracted from the retinal blood vessels.

Artificial neural networks are the efficient means of optimization, recognition and prediction. An ANN can be configured and trained to observe the variations in the texture of the retina if the ANN is configured properly it can tackle variations in the retinal images and provides the way for developing a system which requires samples for verification and authorization. a system designed to provide authentication decision using the input samples can be a reliable means of verification. System designed using ANN and retina input is described here.

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II. MATERIALS

The proposed method is as shown in the figure. Five hundred and eighty fundus images which comprise 58 image pairs for same person were used in this process .these fundus images were obtained using fundus camera. These retinal samples were stored in compressed jpeg format. The obtained samples from the individual persons' left and right eyes and they were fovea centered by the fixation of the eye position using an internal LED.

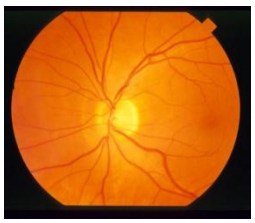

Fig. 2. Retina

III. METHODOLOGY

The methodology consists of two sections one is testing part and the other one is training part .The same process is carried out in both the sections .In the training part the retinal samples are trained and stored in the database, the retinal sample to be tested is loaded to the testing part and processed and matched with database of the training part and authentication is done. In this work an artificial neural network is build which enhance the efficiency of the biometric system and plots the results.The process involved in both the sections is explained below briefly,

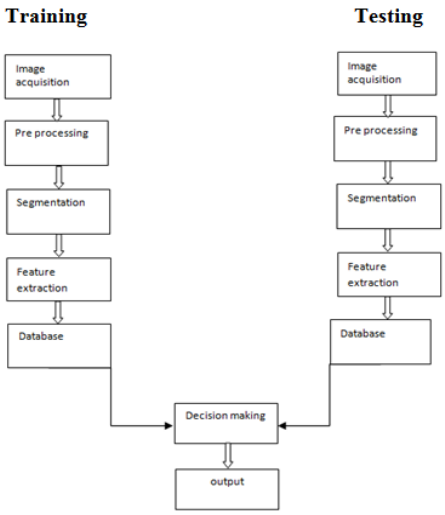

Fig. 2.block diagram

Image acquisition is the process of obtaining image from the source. The source is usually hardware source like digital camera or mobile phone. In this work the color image of the retina is converted into grayscale image and then the feature extraction is done. MATLAB provides image acquisition toolbox which helps reading and preparing image for preprocessing.

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Image preprocessing is the process in which the acquired images are prepared for image enhancement. Image resizing is the major process carried out .The resized image is then subjected to digital image processing. It enabled the MATLAB application to display the full image instead of reduced size of the image as witnessed before resizing .resizing the image was shown at 67% instead of normal 100%

Image enhancement is the process which involves removing low frequency background noise that arise during image acquisition process, normalizing the intensity of the various parts of image this process highlights the area of interest. In this work the process of making the image characteristic more visible and highlighting the blood vessels for feature extraction it involves four process,

a. RGB to gray conversion
b. histogram equalization
c. noise removal and filtering
d. image sharpening and smoothing

There are 3 types of filters, linear filtering, adaptive filtering and median filtering. In this work we are using adaptive filters and median filters. The feature extraction process involves two process morphological structuring and feature detection.

FAST (features from accelerated segment test) feature algorithm:

This algorithm uses corners as the basis for feature extraction. The extracted features can be used in mapping object and matching features in similar images. This algorithm is efficient and high speed of operation while still maintaining high level of accuracy. This is the fastest detection method compared to others such as SIFT and MSER. It takes less time and less memory during computational process. This method is highly recommended for video processing because of its high performance.

A. Abbreviations and Acronyms

FAST (features from accelerated segment test) feature algorithm,true positive(TP), true negatives(TN) ,false positives(FP) and false negatives(FN),SIFT(Scale-invariant feature transform),MSER(Maximally stable external regions)

IV. EXPERIMENT AND RESULTS

The similarities between the images are calculated by comparing with the remaining images in the database. Hence the similarities of all sample images are obtained. Error histogram gives information about the errors of instances and performance graph provides information about best validation performance.

The artificial neural network yields the error histogram which is the graphical representation of numerical data and estimation of probability distribution of the constant variable.

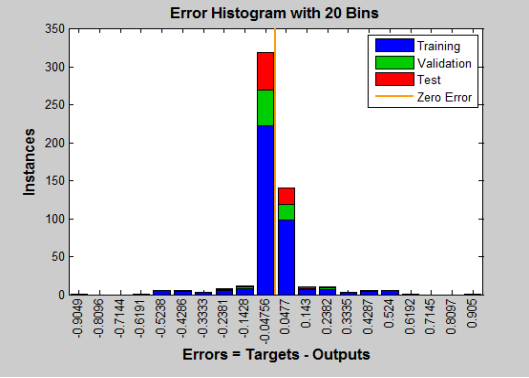

Fig. 3. Error histogram

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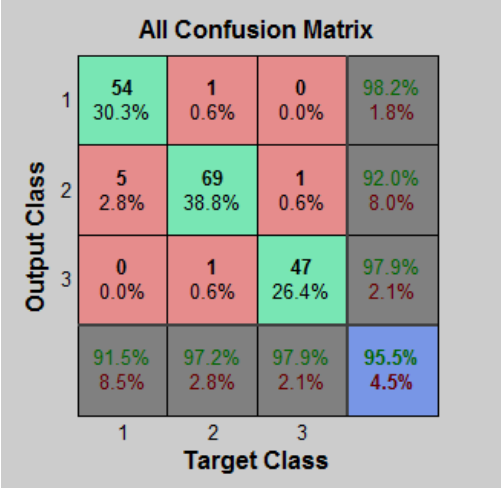

Fig.4 .Confusion matrix

Fig.4 shows the confusion matrix,A confusion matrix is a table that is often used to describe the performance of a classification in our model on a set of test data for which the true values are known the confusion matrix is simple to understand but the related terminology is confusing "quick reference guide" for confusion matrix terminology is created because it could not find an existing resource that is suited for the requirements and is explained both in formulas and sentences. There are two positive predicted classes YES or NO.
The results obtained are true positive(TP), true negatives (TN) ,false positives(FP) and false negatives(FN). Accuracy is calculated using formula (TP+TN)/TOTAL,Misclassification rate is calculated using FP+FN/TOTAL. Using all theseattributes authentication is done and similarities or dissimilarities of the retinal images are known.

A. Discussion

The samples of same person image pairs has high rate of similarities compared to samples of different person's image pairs .The results obtained from the experiment will confirm the individual characteristic. Since adaptive filters and median filters are used rate of errors will be reduced. The matching of individual blood vessel features are done in a efficient manner and hence the authentication is achieved.

V.CONCLUSION

This paper has presented a new PI method by using the BV regions of retinal fundus images. In this work a number of challenges were encountered during implementation phase to implement it efficiently retinal scanners are to be used but these scanners are expensive hence we used samples from fundus camera. The feature extraction of retinal scan has been shown to be unique and therefore gives high level of security for safe guarding information. The system can be incorporated in areas that require high security.

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