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Reliable Human Identification using IRIS as a Biometric

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Abstract:-- **Among various methods of personal identification iris recognition is regarded as the most reliable and accurate system available. The purpose of this paper is to represent iris recognition algorithm so as to prove its reliability as a biometric on the basis of its performance. The images selected for study are from CASIA iris database. The classification is done on the basis of the most repeatedly occurring class using KNN classifier. Euclidian distance metric was employed to check the similarity between two iris images and the two images said to be matched if its value is less than or equal to threshold. The system was tested and shown an overall accuracy of 97.5 % with false rejection rate of 3% and false acceptance rate of 2%.**

Index Terms Iris Recognition, Hough Transform (HT), Euclidean distance(ED)

I. INTRODUCTION

With rapid development of our society more advanced identification systems are in demand. Iris recognition system is gaining highest proportion among all the biometric identification systems. The most important characteristic of iris is its uniqueness in nature which leads to develop more and more accurate identification system. The first working model of iris recognition was implemented by Professor John Daugman Of Cambridge University in the 1990 [1] [2]. The Daugmans system is patented and many commercial developers are using it. A large number of studies have tested the Daugman system as well as commercially it has been used by many users and proved that it has zero failure rate when tested with millions of images. Few years later many other developers have designed the iris recognition system and acquired a great success. The few notable of them are Wildes et al. [3], Boles and Boashash [4]. The Wildes et al. system also has a flawless performance [3], whereas the Lim et al. system achieves an accuracy rate of 98.4 %. Though many developers have developed the algorithm but they could not achieved the accuracy and speed when compared with the Iris recognition system developed by Daugman.

The iris is a dark annular portion of the eye which is surrounded by muscle, tissue, blood vessels , cells and outer boundary within the eye (as shown in fig.1) resulting in random and unique pattern for each iris. Due to this unique combination it is more suitable for biometric identification. In addition it also remains stable over the period of time. This unique pattern contains some redundant features and if utilized directly in the classifier it affects the performance of iris recognition system resulting in low efficiency. The useful features can be extracted from digital eye image with help of developed mathematical algorithms and the results can be stored in the form of code into a biometric template. The biometric template of digital eye image is usually created by the system. A database for different digital eye images is generated in the form of code and stored as biometric template for future comparisons. With the help of developed matching algorithms this biometric template is compared with previously stored template in the database in order to get the identification of the individual. Iris recognition technique consists of three basic stages.

1. Preprocessing
2. Feature Extraction
3. Image Matching

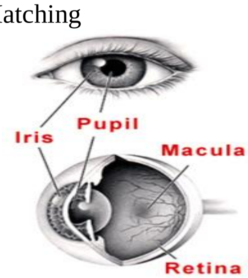

Figure.1 Eye Image

II. PREPROCESSING

a) Segmentation - Iris is an inner portion between pupil and sclera. To separate iris portion from the digital image segmentation is used. A circular Hough Transform based automatic segmentation approach is used for inner and outer boundary location [1]. It removes the redundant regions like eyelashes and eyelids present in lower and upper region of image. Sometimes specular reflections may occur inside the iris region. The segmentation method must be capable to partition these noises and locate inner and an outer boundary of the image. Generally pupil boundary which is an inner boundary of an iris portion is easily located using binarizarion. But it requires a good quality image.

i) Pupil Detection

In Hough method first gradient image is created from intensity image. The iris image is convolved with the sobel filters to convert into intensity image. sobel operator calculate the gradient of the image intensity at each point. Using canny edge detection technique edges of gradient image is found. To obtain the center the given formulas are used.

The accumulator stores the values of xc and yc for a particular value of r. The highest value stored in the accumulator counter is considered as the centre of the pupil as well as the radius.

ii) Outer boundary detection

Using histogram equalization Image is enhanced to have sharp variation at image boundaries and outer boundary can be easily detected. From the pupil center circles of different radius circles of different radius are drawn and their intensities lying over the periphery of the circle are added. Among the iris circles, the circle having a maximum change in intensity with respect to the previous drawn circle is the iris outer boundary.

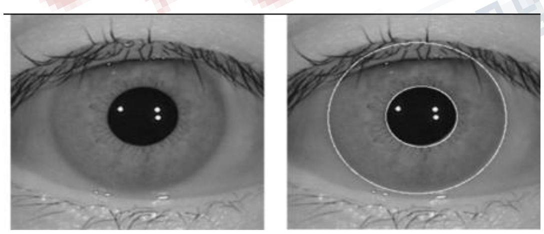

Figure.2 segmentation stages

b) Normalization:

Normalization is the process which converts the segmented iris image into polar form which helps to generate binarized code. This process is known as Unwrapping. Daugman's Rubber sheet model is used for this purpose. Iris boundary and pupil boundary generally does not have concentric circles. This condition gives different reference points for conversion into polar form. Remapping method is used for conversion of Cartesian scale to polar scale considering pupil centre as reference point. This algorithm remaps each point of the iris image to polar coordinates (r, θ).

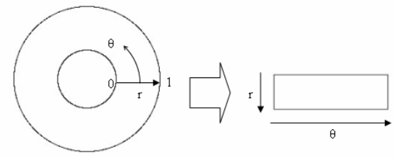

Figure. 3 Daugman's rubber sheet model

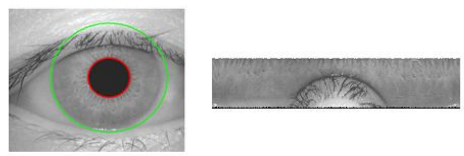

Figure 4. Normalized Iris into polar form

III. FEATURE EXTRACTION

To extract the texture information from an iris image wavelet transform algorithm is used. The important characteristic of wavelet function is that it extracts the local frequency information of an image, eliminates the redundant information, reduces the noise from the image and reconstructs the iris image in the form of binary vector. The input image is decomposed using wavelet transform. This is carried out in four levels with high pass and low pass filters. When wavelet function is applied the image is divided in to four sub regions. These components are approximation image component (LL), horizontal detail component (HL), vertical detail component (LH), diagonal detail component (HH). The forth level component contains higher energy level therefore it is selected as an input image for the next level. The output of the DWT is then encoded into biometric template with phase quantization method and the iris code is generated as shown in figure 5 which is saved in a database for comparison between iris templates.

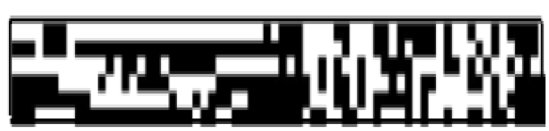

Figure 5. Iris code

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IV. IMAGE MATCHING

a) Classification Phase:

KNN algorithm is preferred particularly for dimensionally high input data. KNN algorithm has lower error rate compared to other classifiers. It is a simplest form for classification and calculation among the others. In dimensional space the training patterns are plotted according to their observed feature values and labeling is done by their known class. [8] Within the same space an unlabelled test pattern is also plotted. The classification is done on the basis of the most repeatedly occurring class among its training patterns and its nearest neighbor patterns. Euclidian distance metric is the most popular for KNN classification which measures similarity between feature vectors.

b) Matching algorithm

In matching algorithm the degree of similarity between two feature vectors is determined. For distances comparison and computation of feature vectors Euclidean distance algorithm is used in our system which decreases the computational cost.

$$ED = \frac{1}{N}\left(\sqrt{\sum_{i=1}^{N}\left(Iris\ code\ A(i) - Iris\ code\ B(i)\right)^2}\right)$$

There may not be 100% matching Even if the same iris images are compared, with the samples of iris images present in the database. Similarly, the matching score will have exactly the same value even if two very different iris images are compared. Solution to this problem is the decision of correct value of reference threshold value which basically differentiates the same iris images from different iris database. The user is genuine if the matching score is less than or equal to reference threshold.

V. EXPERIMENTAL RESULTS

The database used for study was taken from CASIA database and the performance verification of the system was carried out with two set of images in two intervals of 100 and 250 images respectively. It is observed that Hough transform performs better as compared to other localization techniques and system has efficiently detected inner and outer boundaries of all images. The result shows that the iris recognition system performed perfect recognition with 100 eye images with zero percent false registration. The results are plotted with false acceptance rate and false rejection rate and found overall accuracy of 97.5 % with FRR of 3% and FAR 2% as shown in figure 6 and figure 7.

We compared the system with other systems on the basis of accuracy. The results show that the proposed algorithm has improved the recognition rate when compared with other systems proposed by Ma [6], Boles [7], Daugman [2].They obtained 89.37%,92.64 and 99.99 accuracy respectively.

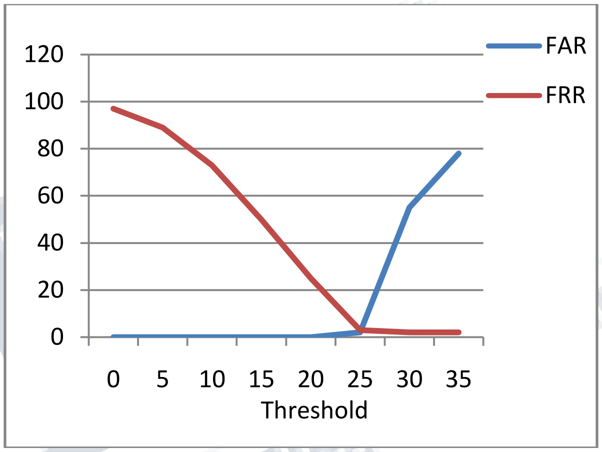

Figure 6. FAR/FRR – Threshold plot

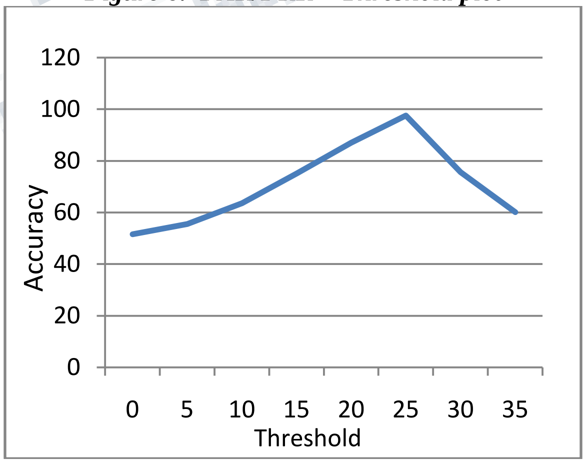

Figure 7. Accuracy-Threshold plot

VI. CONCLUSION

The iris recognition system that was developed proved to be a highly accurate and efficient system that can be used as a biometric. It is proved that iris recognition is one of the most reliable methods available today in the

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biometrics field. The accuracy achieved by the system was very good.

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