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A Novel Iris Recognition System Using Statistical Feature Analysis By Haar Wavelet

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Abstract— **Identity verification becomes a challenging task when it has to be automated with high accuracy and non-repudiability. This task is easily performed by the concept of biometrics. Biometrics deals with identification of individuals based on their biological or behavioural characteristics. Biometric recognition can be used in identification mode, where the biometric system identifies a person from the entire enrolled population by searching a database for a match. In biometrics, recognition of individual may be made on many human traits. Such as face, iris, handprint, signature, voice, watermarking, finger prints, retina, heart beat etc.. Iris recognition is one of the important biometrically based recognition. The biomedical literature suggests that irises are as distinct as fingerprints or patterns of retinal blood vessels. Iris scanning can be used quickly for both identification and verification applications because of its large number of degrees of freedom. This paper includes various concepts, Pre-processing, Segmentation, Normalization, Haar Wavelet Transformation, Statistical Feature Extraction and Feature Matching. In this paper, the matching of the two iris patterns using hamming distance method, which gives an accurate result.**

***Keywords*—preprocessing, segmentation, Haar wavelet, feature extraction, feature matching.**

I.INTRODUCTION

BIOMETRICS deals with identification of individuals based on their biological or behavioral or unique characteristics. Biometric methods are secured and well applicable in many areas. Iris recognition is one of the important biometrically based recognition. Iris recognition is the method of recognition of an individual based on their iris patterns. Iris of the each individual are unique. Even the iris of right eye and left eye of the same person is unique. Hence iris recognition has becoming very secured way of identifying an individual. Iris recognition system is applied in many fields like Immigration system, Military, secure access of back accounts and secure financial transactions.

II. BLOCK DIAGRAM

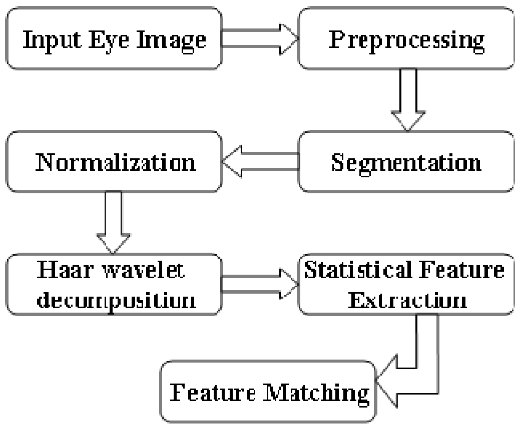


Fig.1. Block diagram of Haar Wavelet method

III.PREPROCESSING

It is the initial stage in the process of the iris recognition. In this process, the histogram graph of the given input eye image is obtained. Histogram graph is the graphical representation of the tonal distribution of the given input eye image. Then to the obtained graph, Histogram Equalization is done. Histogram Equalization is the method of adjusting the contrast of the image, to enhance the image for further process.

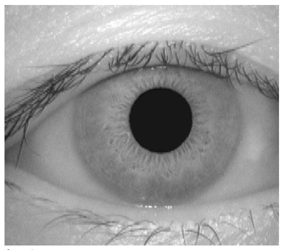
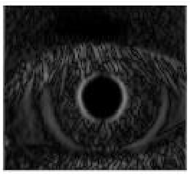


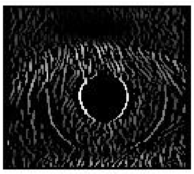
Fig.2. Input Human Eye Image

IV.SEGMENTATION

Segmentation is the process that is done to separate the iris from the other parts of the eye. The inner iris and the outer iris are separated by locating their edges individually using the Canny Edge Detection Method over the obtained histogram graph. The advantage of Canny Edge Detector over other Edge Detectors is that this detector has the high probability of marking the real edges of the iris and eliminating the unwanted edges. It uses a filter based on the first derivative of a Gaussian, which gives a slightly blurred version of the original eye image, which is not affected by any noise signal. Canny Edge Detector involves many steps., Noise reduction, which is done by using the first derivative of a Gaussian. The next stages involve, Finding the intensity gradient of the image, adjust the gamma correction, Non-maximum suppression and the hysteresis threshold.

In the second stage, an edge of the image may point in any direction, so this algorithm uses four filters to detect the edges in horizontal, vertical and diagonal directions in the blurred image. Adjust of the gamma correction is done to control the overall brightness of the image. After detecting the edge directions, non maximum suppression is applied to trace the edges in direction and to suppress any pixel value that is not considered to be an edge. From this stage, a set of edge points, in the form of a binary image, is obtained. These are referred to as "thin edges". Hysteresis thresholding eliminates the weak edge which falls below the lowest threshold value. The threshold values that to be used commonly are 0.19 and 0.2. Once this process is complete we have a binary image where each pixel is marked as either an edge pixel or a non-edge pixel.


(a)


(b)

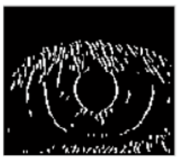
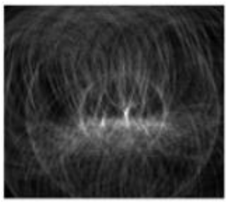

(c)

Fig.3 (a) Adjust gamma correction, (b) Non-maximum suppression, (c) Canny edge image

V.HOUGH TRANSFORM

The HOUGH Transform is considered as a very powerful tool in edge linking for line extraction. Its main advantages are its Insensitivity to noise and its capability to extract lines even in areas with pixel absence. The circular hough transform is applied to deduce the radius and the center coordinates of the iris and pupil regions of the eye. Here the edge pixels, X and Y are considered as the center coordinates and considering the desired radius as 'r', circles are drawn according to the equation,

$$X^2 + Y^2 = r^2$$


(a)

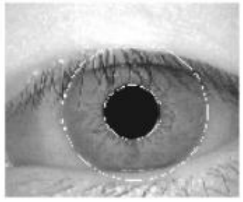

(b)

Fig.4. (a) Hough circle, (b) Segmented iris

VI.NORMALIZATION

Normalization is the process that converts the pixel intensity value. This process is mainly done her is to improve the precision of matching the two iris patterns. The segmented iris image is now converted into the polar coordinates for further processing.

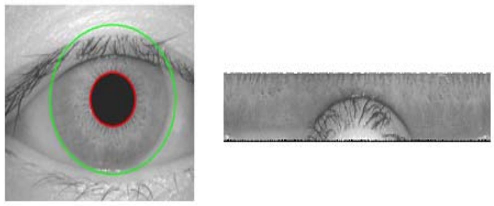


Fig.5. Normalized Iris

VII.HAAR WAVELET TRANSFORMATION

Haar Wavelet is a image compression technique. This technique is mainly used to achieve the high compression ratio in images by applying different compression thresholds for the wavelet coefficients. The Haar wavelet has many advantages. It shows best performance in terms of the computational time and computational speed of this is high. It is very simple and also very efficient image compression method. It is also memory efficient, since it can be calculated in place without any temporary array.

PROCEDURE FOR HAAR WAVELET TRANSFORM:

To calculate the Haar transform of an array of *n* samples,

1. Find the average of each pair of samples (*n*/2 averages).
2. Find the difference between each average and the samples, it was calculated from. (*n*/2 differences).
3. Fill the first half of the array with averages.
4. Fill the second half of the array with differences.

5. Repeat the process on the first half of the array (The array length should be a power of two).

Each image is represented mathematically by a matrix of numbers. Haar wavelet transform uses a method for manipulating the matrices, called averaging and differencing. On the entire row this methods are applied. Later, after applying this method on all the rows of the matrix, this process is applied on the columns of the matrix. This process is continued until the matrix is reduced to the power of two. For an input represented by a list of 2^n numbers, the Haar wavelet transform pairs up the input values, stores the difference and passes the sum. Consider a 1-D image with a resolution of 4, having values [6 4 5 7]. First, the pixels are paired together [(6 4) (5 7)] and the average is obtained as [5 6] (lower resolution image). The detailed coefficient is obtained by differencing the paired values, hence it is obtained as [1 -1]. Thus the transformed matrix will be of [5 6 1 -1]. Now, let us consider a 2-D image, and then the process will be as follows:

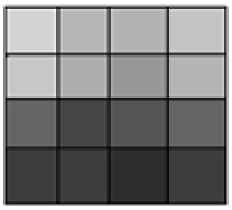


Fig.6.4 X 4 Image

$$\begin{pmatrix} 210 & 230 & 220 & 235 \\ 200 & 220 & 210 & 235 \\ 120 & 97 & 117 & 120 \\ 99 & 97 & 93 & 100 \end{pmatrix}$$

Fig.7. Array representation of 2-D image

By transforming the rows of the matrix, the following array is obtained.

$$\begin{pmatrix} 223 & 3 & 10 & 7 \\ 216 & -6 & -10 & -12 \\ 113 & -5 & -11 & -1 \\ 97 & 1 & 1 & -3 \end{pmatrix}$$

Fig.8. Array after each row transformation.

By transforming the columns of the matrix, the following array is obtained.

$$\begin{pmatrix} 162 & -3 & -8 & -5 \\ 57 & -1 & -2 & -3 \\ 3 & 1 & 0 & 2 \\ 8 & -3 & -5 & 1 \end{pmatrix}$$

Fig.9. Array after each column transformation

Thus the left top element i.e. 162 is the overall average of all elements of the original matrix and the rest of the elements are the detailed coefficients. Finally, the decomposed image using Haar wavelet is obtained.

Fig.10. Decomposed image

VIII.STATISTICAL FEATURE EXTRACTION

In this stage, on the decomposed image obtained, statistical features like mean, median, variance and standard deviations are determined. Mean is the ratio of the sum of the energies to the number of energies. Median is the middle term when all the energies are arranged in ascending order. Variance is the difference between the mean of the squares and the square of means. Standard deviation is the square root of the variance. These values are stored in the database for identification of the image. Using these values, an image can be viewed as a feature vector.

IX.FEATURE MATCHING

In this stage, the input image is converted into the statistical features and these features are used to compare with the features which are present in the database. The method used here is hamming distance method. The Hamming distance gives a measure of how many bits are the same between two bit patterns. Using the Hamming distance of two bit patterns, decision can be made as to whether the two patterns were generated from different irises or from the same one. In comparing the bit patterns *X* and *Y*, the Hamming distance, *HD*, is defined as the sum of disagreeing bits (sum of the exclusive-OR between *X* and *Y*) over *N*, the total number of bits in the bit pattern.

$$HD=(1/N)\sum X(XOR)Y$$

If the hamming distance is zero, then the two images are generated from the same.

X.BIOMETRIC ERROR ANALYSIS

All biometric systems suffer from two types of error: Type-1 is a false acceptance and Type-2 is a false rejection. Type-1 happens when biometric system authenticates an imposter. Type-2 means that the system has rejected a valid user. A biometric system's accuracy is determined by combining the rates of false acceptance and rejection. A system that is highly calibrated to reduce the false acceptances may also increase the false rejection, resulting in more help desk calls and administrator intervention. Each error presents a unique administrative challenge. Therefore, administrators must

Clearly understand the value of the information or system to be protected, and then find balance between acceptances and rejection rates appropriates to that value. A poorly created enrollment template can compound false acceptance and rejection.

XI.FUTURE WORKS

We are currently studied the analysis of the requirements for the physical implementation of the non-cooperative prototype system. This has revealed, specially the planning of the optical framework, as a task with higher difficulty than we initially thought. Simultaneously, adapting and improving, algorithms for the real-time human iris detection must be done. Our purpose demands algorithms with high performance, which decreased the number of potential alternatives. The evaluated types of errors should be the subject of further work. This will obviously introduce new challenges to the recognition that must be overcome, and predictably demand the adjustment of some of our methods to these new constraints.

XII.SAMPLE RESULTS

The experiment was done using hundred eye images from CASIA iris database. The normalized iris image is decomposed using Haar wavelet and the statistical features like mean, median, variance and standard deviation are computed. Sample results using three eye images from the database and two images that are not in the database are shown in the following tables.

TABLE1 . STATISTICAL FEATURE VALUES OF DATABASE IMAGE

Database Image	**Mean**	**Median**	**Varianc e**	**Standard deviation**
1.bmp	0.01566 4	0.026614	25.8985	5.0891
2.bmp	0.01565 6	0.032188	30.8418	5.5535
3.bmp	0.01568 3	0.064244	29.7123	5.4509

TABLE 2. VALUES OF IMAGE NOT IN DATABASE

Image not in database	**Mean**	**Median**	**Varianc e**	**Standard deviation**
4.bmp	0.01567 6	0.053731	22.791	4.774
5.bmp	0.01565 8	0.031275	24.9356	4.9936

The hamming distance calculated for the eye images that are in the database are found to be 0. Thus it is authenticated. The hamming distance value for the eye images that are not in the database are as follows.

Minimum Hamming distance, 4.bmp = 0.063166
Minimum Hamming distance, 5.bmp = 0.045013

Since the values are not equal to 0, it is unauthenticated.

XIII.CONCLUSION

In this paper, the study of an iris recognition system using an effective edge detection method has been presented. Automatic segmentation was achieved by canny edge detection through the use of the Hough transform for localizing the iris and pupil regions. Next, normalized iris is decomposed using Haar wavelet decomposition and statistical features were computed. Finally the two irises were matched using hamming distance method.

Some of the applications require a fast image compression technique but most of the existing technique requires considerable time. So this proposed algorithm developed to compress the image so fast.

XIV.REFERENCES

[1] Kamrul Hasan Talukder and Koichi Harada (2007), “Haar Wavelet Based Approach for Image Compression and Quality Assessment of Compressed Image”, IAENG International Journal of Applied Mathematics, 36:1, IJAM_36_1_9.
[2] Tisse C.L.;Martin L.;Torres L.;Robert M. (2003), ”Person Identification Technique Using Human Iris Recognition”, St Journal of System Research, Vol.4,pp.67_75.
[3]Yong-zeng Shen, Min-jie Zhang, Jie-wei Yue and Hong-min Ye Zhejiang,”A New Iris Locating Algorithm”, University of Technology, Hangzhou 310032, China.
[4] Padma Polash Paul “Human iris recognition for biometric identification”, Md. Maruf Monwar, Ahsanullah university of science and technology.
[5] Daugman. J (2001), “High Confidence Visual Recognition of Persons by a Test of Statistical Independence”, IEEE Transactions on pattern analysis and Machine intelligence, vol. 15, no. 11, November 2, June 2001, pp. 1148-1161.
[6] Farid Benhammadi & Nassima Kihal (2008), “Personal Authentication Based on Iris Texture Analysis”, M. P. School, Laboratory of Computer Science, BP 17 Bordj El Bahri Alger, ALGERIA.