Human Computer Interface Through Biometric Iris Recognition System

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Abstract— **Biometric recognition system is better reliable, roubst technique than traditional recognition system. Biometric iris recognition system is most secure and reliable than other biometric recognition system. Hence, we use biometric iris recognition system is used to identify the human. In this paper, the proposed new segmentation methods described as: k-means algorithm, edge detection algorithm, hough circle algorithm, upper eyelid and lower eyelid localization, isolate speculare reflections and remove pupil regions. This proposed algorithm has found the recognition rate is 98.76% in minimum time.**
Keywords- **Biometrics, upper eyelid localization, lower eyelid localization, pupil region, segmentation.**

I. INTRODUCTION

For thousands of years, humans have used body characteristics such as face, voice, gait, and so on to recognize each other. In the mid 19th century, Alphonse Bertillon, chief of the criminal identification division of the police department in Paris, developed and then practiced the idea of using various body measurements (for example, height, length of arms, feet, and fingers) to identify criminals. In the late 19th century, just as his idea was gaining popularity, it was eclipsed by a far more significant and practical discovery: the distinctiveness of human fingerprints. Soon after this discovery, many major law-enforcement departments embraced the idea of "booking" criminals' fingerprints and storing them in databases (initially, card files). Later, police gained the ability to "lift" leftover, typically fragmentary, fingerprints from crime scenes (commonly called latents) and match them with fingerprints in the database to determine criminals' identities.

Biometrics [1, 2] can be divided into two main classes: physiological and behavioral. The physiological class is related to the shape of the body including finger print, face recognition, DNA, palm print, hand geometry, and iris recognition. The behavioral class is related to the behavior of a person and includes typing rhythm, gait, and voice. The diagram is shown in Figure 1.

Figure 2, shows the basic block diagram of a biometric system. The first block(sensor) is the interface between the real world and the system; it has to acquire all the necessary data. Most of the times it is an image acquisition system, but it can change according to the characteristics desired. The second block performs all the necessary pre-processing: it has to remove artifacts from the sensor, to enhance the input (e.g. removing background noise), to use some kind of normalization, etc. and finally necessary features are extracted.

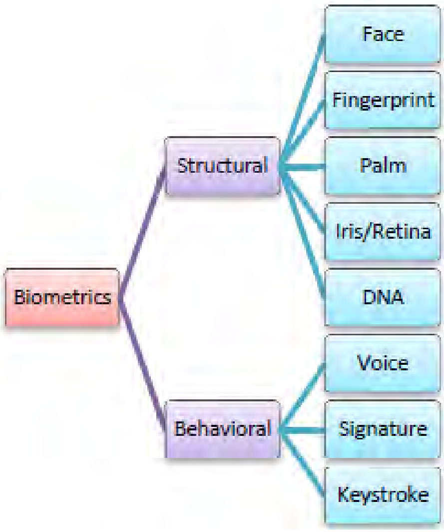

Figure 1 Different type of biometric [11].

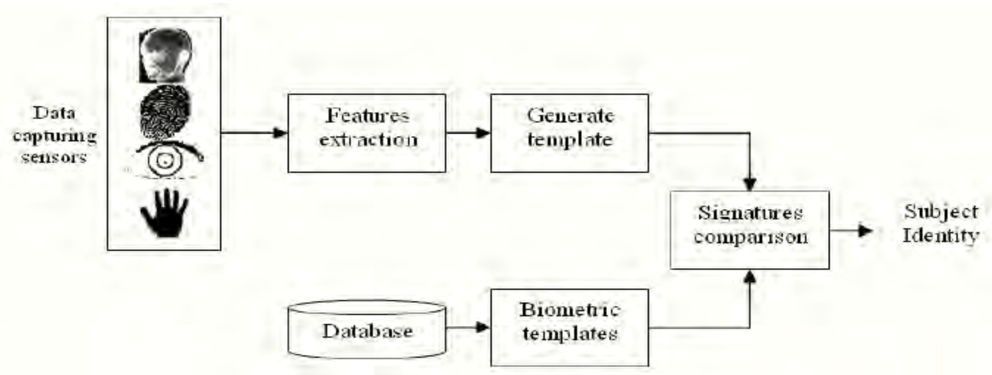

Figure 2 Basic Block Diagram of the Biometric Recognition System.

II. EASE OF USE

Recently, iris recognition is becoming one of the most important biometrics used in recognition when imaging can be done at distances of less than two meters. This importance is due to its high reliability for personal identification [3, 4, 5]. Human iris has great mathematical advantage that its pattern variability among different persons is enormous [6] , because iris patterns possess a high degree of randomness. In addition, iris is very stable over time [7, 8]. Since the concept of automated iris recognition was proposed in 1987 [7], many researchers worked in this rang and proposed many powerful algorithms. These algorithms were based on the texture variations of the iris and can be divided into many approaches [9], phase-based methods [3, 10, 4], zero-crossing representation [12], texture analysis [13, 14], and intensity variations [15] . The most relevant algorithms and widely used in current real applications are the algorithms developed by Daugman.

A. Daugman Method

Daugman's method [1] is the most cited in the iris segmentation literature. Iridian Technologies turned it into the basis of 99.5% of the commercial iris recognition systems. It was proposed in 1993 and was the first method effectively implemented in a working biometric system. The author assumes both pupil and iris with circular form and applies the following operator

$$max_{r,x0,y0} \left| G_{\sigma}(r) * \frac{\delta}{\delta_r} \oint_{r,x0,y0} \frac{I(x,y)}{2\pi r} ds \right| \quad (1)$$

Where, I (x, y) is an image; the operator searches over the image domain (x, y) for the maximum in the blurred partial derivative with respect to increasing radius r , of the normalized contour integral I (x, y) along a circular arc ds of radius r and center coordinates (x0, y0). The symbol * denotes convolution and G_{σ} (r) is a smoothing function such as a Gaussian of scale 'δ'.

B. Camus and Wilds Method

Camus and Wildes [2] presented a robust, real-time algorithm for localizing the iris and pupil boundaries of an eye in a close-up image. It uses a multi-resolution approach to detect the boundary contours of interest quickly and reliably, even in cases of very low contrast, specular reflections and oblique views. This algorithm used for both the pupil and iris boundaries a component-goodness-of-fit metric for candidate boundary parameters being considered with respect to a given center for the polar coordinate system. The component-goodness-of-fit is defined as

$$C = \sum_{\theta=1}^{n}\left((n-1)\|g_{\theta},r\| - \sum_{\phi=\theta+1}^{n}(\|g_{\theta},r - g_{\phi},r\|) - \frac{I_{\theta},r}{n}\right) \quad (2)$$

Where, n is the total number of directions and I_{θ}, r and g_{θ}, r are respectively the image intensity and derivatives with respect to the radius in the polar coordinate system.

III. EXPERIMENTAL SETUP

Dataset: UBIRIS V1 [16] database are used for this experiment, this databases contains 1877 images collected from 241 eyes during September, 2004 in two distinct sessions. It simulates less constrained imaging conditions. The images in this database were saved as TIFF format in RGB color representation. Nikon E5700 camera was used to capture this database and it's the first iris database captured in visible wavelength.

Many of researchers are following main steps are: iris segmentation, iris normalization, feature extraction and feature comparison. The first category applies a certain type of operators like Daugman's Integro-Differential operator, and usually these operators are affected by noises and separability between iris and sclera. The second category uses one type of edge detection filters like Canny or Sobel edge detection followed by circular Hough transform, and these methods are usually very expensive in time. Our main purpose in this section is to develop a robust iris segmentation method that is not affected by types of noises and at the same time is not expensive in time. Figure 3, shows the proposed iris recognition system, it contains following steps: k-means algorithm, edge detection algorithm, circular hough transform, upper and lower eyelids localization, isolate specular reflections and remove pupil regions.

A. Upper eyelid localization

Let the coordinates of the upper eyelid on the first rectangle be (x1, y1), and coordinates of the upper eyelid on the second rectangle be (x2, y2). The line passing through the two coordinates of the upper eyelid on each rectangle is given by the equation:

$$ax + by + C_{hort} = 0 \quad (3)$$

Where,

$$a = y2 - y1,$$

$$b = x1 - x2,$$

$$C_{hort} = x2y1 - x1y2$$

Let (p, q) be the midpoint of the horizontal line joining (x1, y1) and (x2, y2). Then the equation of the perpendicular to the horizontal line at midpoint of the two points (x1, y1) and (x2, y2) is:

$$bx - ay + c_{vert} = 0 \quad (4)$$

Where,

$$c_{vert} = aq - bp$$

B. Lower eyelid localization

To localize the lower eyelid of the iris, we use the Line Hough transform, because most of the occlusions of the lower eyelid are approximately linear. We first, apply the canny edge detection to the lowest half of the iris, and then the best line fit using Line Hough transform is found. If the vote of the line is less than a certain value, then we assume no lower eyelid occlusions occur.

C. *Removing pupil region*

Pupil removal is left to be performed in the last step, because one of the major differences between the eye's images in the noisy databases were captured under visible wavelengths, and with those images taken under **N**ear **I**nfra**R**ed (NIR) illumination is that the intensity contrast of the iris and the pupil are be very low, especially for heavily pigmented (dark) irises.

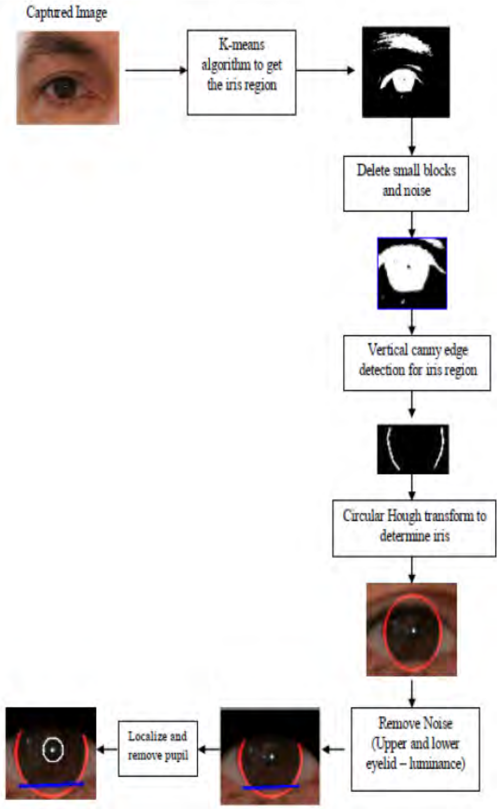

Figure 3 Block Diagram of Proposed Iris Segmentation algorithms.

Step 1: Determine the expected region of the iris using K-means algorithm.
Step 2: Apply the edge detection algorithm.
Step 3: Apply circular Hough transform
Step 4: Upper eyelid localization
Step 5: Lower eyelid localization
Step 6: Isolate specular reflections
Step 7: Remove pupil regions
Experiment: This experiment has been performed with minimum hardware and software requirement as follows: Core 2 duo intel Pentium processor (2.0 GHz), 1 GB RAM, MATLAB 7.0, Windows 7, operating system,

IV. RESULTS AND CONCLUSION

Table 1, shows the results of proposed method and some previous methods. As the results shown, the proposed algorithm accuracy is better than Daugman and Wildes algorithms. At the same time the execution time of our segmentation algorithm is the lowest one, because the different proposed steps that applied to reduce the searching areas in circular Hough transform.

TABLE 1 COMPARISON BETWEEN THE ACCURACY OF PROPOSED ALGORITHM WITH SOME PREVIOUS ALGORITHMS

Method	Accuracy	Time(s)
Daugman	95.22%	2.73
Camus and Wildes	98.68%	1.95
Martin-Roche	77.18%	2.91
Proposed	98.76%	1.49

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