ISSN:0975-9646
Archna R.C, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 2 (4) , 2011, 1462-1464

Minutiae points Extraction from Iris for Biometric Cryptosystem

ARCHANA.R.C
*COMPUTER ENGINEERING,BVDUCOE,*Pune, Maharashtra, India

***Abstract*— Iris recognition is a proven, accurate means to identify people.An efficient method for personal identification based on the pattern of human iris is proposed in this paper. Crypto-biometrics is an emerging architecture where cryptography and biometrics are merged to achieve high level security systems. Iris recognition is a method for biometric authentication that uses pattern-recognition techniques based on high-resolution images of the irides of an individual. Here we discuss about 'recognizing the iris and comparing the pattern of the iris for reliable authentication.**

Keywords- Biometrics, Cryptography, pattern recognition, Canny edge detection, Hough transform, Hamming Distance

I. INTRODUCTION

In today's world, security is more important than ever. Today, for security needs, detailed researches are organized to set up the most reliable system. Independently both biometrics and cryptography play a vital role in the field of security. A blend of these two technologies can produce a high level security system, known as crypto biometric system that assists the cryptography system to encrypt and decrypt the messages using bio templates. Having an easier life by the help of developing technologies forces people is more complicated technological structure. Iris Recognition Security System is one of the most reliable leading technologies that most people are related [1]. Iris recognition technology combines computer vision, pattern recognition, statistical inference, and optics. Its purpose is real time, high confidence recognition of a person's identity by mathematical analysis of the random patterns that are visible within the iris of an eye from some distance. Because the iris is a protected internal organ whose random texture is stable throughout life, it can serve as a kind of living passport or a living password that one need not remember but can always present. Because the randomness of iris patterns has very high dimensionality, recognition decisions are made with confidence levels high enough to support rapid and reliable exhaustive searches through national-sized databases [2],[3].

II. IRIS IMAGE PROCESSING

Robust representations for pattern recognition must be invariant under transformations in the size, position, and Orientation of the patterns. For the case of iris recognition, this means that we must create a representation that is invariant to the optical size of the iris in the image (which depends upon both the distance to the eye, and the camera optical magnification factor); the size of the pupil within the iris, the location of the iris within the image and the iris orientation, which depends upon head tilt, torsional eye rotation within its socket, and camera angles, compounded with imaging through pan/tilt eye finding mirrors that introduce additional image rotation factors as a function of eye position, camera position, and mirror angles. Fortunately, invariance to all of these factors can readily be achieved. The dilation and constriction of the elastic meshwork of the iris when the pupil changes size is intrinsically modelled by this coordinate system as the stretching of a homogeneous rubber sheet, having the topology of an annulus anchored along its outer perimeter, with tension controlled by an (o,-centred) interior ring of variable radius.

The main functional components of extant iris recognition systems consist of 4 steps:

1. Image acquisition
2. Iris localization and normalisation (pre-processing)
3. Feature extraction
4. Pattern matching.

In evaluating designs for these components, one must consider a wide range of technical issues. Chief among these are the physical nature of the iris, optics, image processing/analysis, and human factors. All these considerations must be combined to yield robust solutions even while incurring modest computational expense and compact design.

Claims that the structure of the iris is unique to an individual and is stable with age come from two main sources. The first source of evidence is clinical observations. During the course of examining large numbers of eyes, ophthalmologists and anatomists have noted that the detailed pattern of an iris, even the left and right iris of a single person, seems to be highly distinctive. Another interesting aspect of the iris from a biometric point of view has to do with its moment-to-moment dynamics. Due to the complex interplay of the iris' muscles, the diameter of the pupil is in a constant state of small oscillation. Potentially, this movement could be monitored to make sure that a live specimen is being evaluated. Further, since the iris reacts very quickly to changes in impinging illumination (e.g., on the order of hundreds of milliseconds for contraction), monitoring the reaction to a controlled illuminant could provide similar evidence.

i. Iris Image Acquisition

We use the iris image database from UBIRIS database. Data base contributes 1877 images collected from 241 eyes in two distinct sessions. Each of the iris images is with resolution 800x600 which is converted to 320x240.

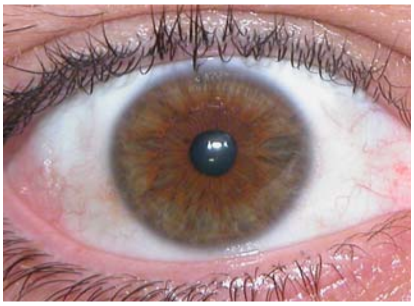

Figure 1. Original Image

ii. Iris Pre-processing

Canny edge detection is performed both in vertical direction and horizontal directions. [4], [5]

The algorithm runs in 5 separate steps:

1. Smoothing: Blurring of the image to remove noise.
2. Finding gradients: The edges should be marked where the gradients of the image has large magnitudes.
3. Non-maximum suppression: Only local maxima should be marked as edges.
4. Double thresholding: Potential edges are determined by thresholding.
5. Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

It is inevitable that all images taken from a camera will contain some amount of noise. To prevent that noise is mistaken for edges, noise must be reduced. Therefore the image is first smoothed by applying a Gaussian filter. The kernel of a Gaussian filter with a standard deviation of σ = 1.4 is shown in figure 2.

$\frac{1}{115}$

2	4	5	4	2
4	9	12	9	4
5	12	15	12	5
4	9	12	9	4
2	4	5	4	2

Figure 2: Gaussian filter with a standard deviation of σ = 1.4

After smoothing the image and eliminating the noise, the next step is to find the edge strength by taking the gradient of the image.

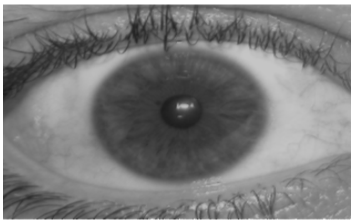

Figure 3: iris after smoothing

The Sobel operator performs a 2-D spatial gradient measurement on an image. Then, the approximate absolute gradient magnitude (edge strength) at each point can be found. The Sobel operator uses a pair of 3x3 convolution masks, one estimating the gradient in the x-direction (columns) and the other estimating the gradient in the y-direction (rows). They are shown below:

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

The magnitude, or edge strength, of the gradient is then approximated using the formula:

$$|G| = |Gx| + |Gy|$$

Whenever the gradient in the x direction is equal to zero, the edge direction has to be equal to 90 degrees or 0 degrees, depending on what the value of the gradient in the y-direction is equal to. If GY has a value of zero, the edge direction will equal 0 degrees. Otherwise the edge direction will equal 90 degrees. The formula for finding the edge direction is just:

Theta = invtan (Gy / Gx)

Once the edge direction is known, the next step is to relate the edge direction to a direction that can be traced in an image. So if the pixels of a 5x5 image are aligned as follows:

x	x	x	x	x
x	x	x	x	x
x	x	a	x	x
x	x	x	x	x
x	x	x	x	x

Then, it can be seen by looking at pixel "**a**", there are only four possible directions when describing the surrounding pixels - **0 degrees** (in the horizontal direction), **45 degrees** (along the positive diagonal), **90 degrees** (in the vertical direction), or **135 degrees** (along the negative diagonal). So now the edge orientation has to be resolved into one of these four directions depending on which direction it is closest to (e.g. if the orientation angle is found to be 3 degrees, make it zero degrees).

The edge-pixels remaining after the non-maximum suppression step are marked with their strength pixel-by-pixel. Many of these will probably be true edges in the image, but some may be caused by noise or color variations for instance due to rough surfaces. The simplest way to discern between these would be to use a threshold, so that only edges stronger that a certain value would be preserved. The Canny edge detection algorithm uses double thresholding. Edge pixels stronger than the high threshold are marked as strong; edge pixels weaker than the low threshold are suppressed and edge pixels between the two thresholds are marked as weak.

Finally, hysteresis is used as a means of eliminating streaking. Streaking is the breaking up of an edge contour caused by the operator output fluctuating above and below the threshold. If a single threshold, T1 is applied to an image, and an edge has an average strength equal to T1, then due to noise, there will be instances where the edge dips below the threshold. Equally it will also extend above the threshold making an edge look like a dashed line. To avoid this, hysteresis uses 2 thresholds, a high and a low. Any pixel in the image that has a value greater than T1 is presumed to be an edge pixel, and is marked as such immediately. Then, any pixels that are connected to this edge pixel and that have a value greater than T2 are also selected as edge pixels. If you think of following an edge, you need a gradient of T2 to start but you don't stop till you hit a gradient below T1.

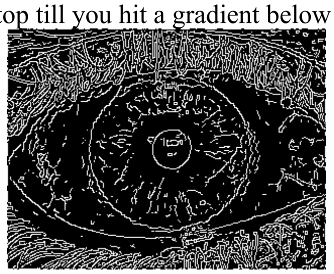

Figure 4: iris after Canny Edge Detection

The iris images in UBIRIS database has iris radius 60 to 100 pixels, which were found manually and given to the Hough transform. If we apply Hough transform first for iris/sclera boundary and then to iris/pupil boundary then the results are accurate. The purpose of the Hough transform is to address this problem by making it possible to perform groupings of edge points into object candidates by performing an explicit voting procedure over a set of parameterized image objects. The output of this step results in storing the radius and x, y parameters of inner and outer circles. In the image space, the circle can be described as $r^2=x^2+y^2$ where r is the radius and can be graphically plotted for each pair of image points (*x*, *y*). [6],[7]

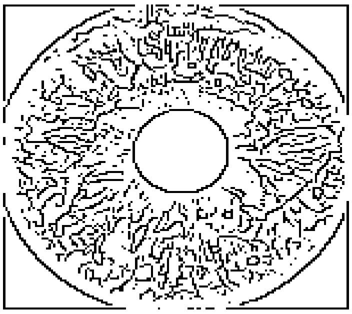

Figure 5: Iris after Hough Transform

iii. Iris Feature Extraction

Iris minutiae are defined as the nodes and end points of textures. The feature set is constructed from (x, y) coordinates of each minutia. The coordinates of minutiae (x, y) Є N x N space. The effect of shifting and rotating the position of the minutiae features is not ignorable and will result in difficulty of matching. To overcome this problem the minutiae in the Cartesian coordinate system are converted into polar coordinate system (r and θ).

$r = \sqrt{(x^2+y^2)}$ and $\theta = \tan^{-1}(y/x)$

If the origin of the polar coordinate system is correctly selected, these coordinates are independent of rotation of the input image. The basic principle of the algorithm is similar to the operation hit or miss, which is calculated by translating the origin of mask to each possible pixel in the image. The centre of the window is calculated to find the centre of the pupil circle and is taken as origin of the polar coordinate system. Iris is divided into sectors of 10 degrees and coordinates of minutiae points are marked inside the sectors.

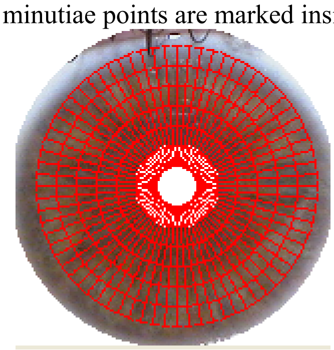

Figure 6.sectors marked inside iris

iv. Iris Matching

When the foreground and background pixels in mask exactly match with the pixels in the image, the pixel to be modified is the image pixel underneath the origin of mask. Finally, the iris code generated at the feature extraction phase is now used for matching the two irises. We have applied a Hamming Distance matching algorithm for the recognition of the two samples. It is basically an Exclusive OR (XOR) function between two patterns. Hamming Distance is a measure, which delineates the differences, of iris codes. Every pixel of an iris code is compared to every pixel of a referenced iris code, therefore if the two bits are the same e.g. two 1's or two 0's, the system assigns a value '0' to that comparison (if the two bits are different, the system assigns a value '1'). The Formula for iris matching is given as follows:

$$HD = \frac{1}{N} \sum_{j=1}^{N} C_A(j) \oplus C_B(j) \quad [8]$$

where, *CA* and *CB* are the coefficients of two iris images and N is the size of the feature vector. The ⊕is the XOR operator.

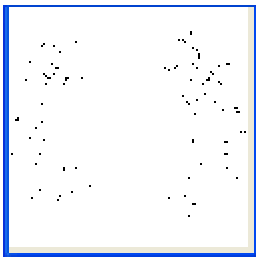

Figure 7. Minutiae points

III CONCLUSION

This paper discusses about the iris recognition system and the basic components involved in the system. The Minutiae points' extraction is done through canny edge detection and Hough transform. We tested the comparison of two iris patterns by using Hamming distance. We have successfully developed this new Iris Recognition system capable of comparing two iris images. This identification system is quite simple and the results obtained clearly show that our system is reliable, secure and can be easily implemented at critical places for the identification of persons by their irises.

IV REFERENCES

[1]Iris Recognition: An Emerging Biometric Technology,Richard P.Wildes Proceedings of ieee, VOL. 85, NO. 9, september 1997

[2].Daugman, "How iris recognition Works," in IEEE Transactions on Circuits and Systems for video Technology, vol.14, no.1, pp21-30, January 2004.

[3] H. Heijmans, Morphological Image Operators, Academy Press, 1994.

[4] Canny Edge Detection,09gr820,March 23, 2009

[5] Thomas B. Moeslund. Image and Video Processing. August 2008.

[6] Duda, R. O. and P. E. Hart, "Use of the Hough Transformation to Detect Lines and Curves in Pictures," *Comm. ACM, Vol. 15*, pp. 11–15 (January, 1972)

[7]Hough Transform ,Wikipedia

[8] Iris Recognition System using statistical features for Biometric Identification ,Khin Sint Sint Kyaw Department of Engineering Physics, Mandalay Technological University Mandalay, Myanmar. 978-0-7695-3559-3/09 $25.00 © 2009 IEEE,DOI 10.1109/ICECT.2009.129.