Himanshu Srivastava / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 3, Issue 3, May-Jun 2013, pp.449-453

# Personal Identification Using Iris Recognition System, a Review

**Himanshu Srivastava**
*Department of Computer Science & Engineering, Roorkee Institute of Technology, Roorkee (U.K.), India*
himanshu.shree@gmail.com

## Abstract
**A biometric system provides automatic identification of an individual based on a unique feature or characteristic possessed by the individual. Unlike other biometric such as fingerprints and face recognition, the distinct aspect of iris comes from randomly distributed features. Iris recognition is regarded as the most reliable and accurate biometric identification system available. In this paper, I describe the novel techniques developed to create an Iris Recognition System available. This paper proposes a personal identification using iris recognition system with the help of six major steps i.e. image acquisition, localization, Isolation, normalization, feature extraction and matching and also these six steps consists a numbers of minor steps to complete each step. The boundaries of the iris, as papillary and limbic boundary, are detected by using Canny Edge Detector & Circular Hough Transformation. We can use masking technique to isolate the iris image form the given eye image, this isolated iris image is transformed from Cartesian to polar co-ordinate. Now finally extract the unique features (feature vector) of the iris after enhancing the iris image and then perform matching process on iris code using Hamming Distance for acceptance and rejectance process. Her I am giving my review after studying a number of research papers and my proposed technique works very well and can be easily implemented.**

**Keywords***:* Biometrics, Iris Code, Edge Detection, Transformation, Masking, Feature Vector, Hamming Distance.

## I. Introduction
Now a days, one of the main threats that IT system and security environment can have, is the possibility of intruders in the system. This is normally solved by user authentication schemes based on passwords, secret codes and identification cards or tokens. Schemes based only on passwords or secret codes can be cracked by intercepting the presentation of such a password or by brute force attacks. On the other hand, an intruder can attack systems based on identification card or token by robbing, copying or simulating them. As it is a well-known, biometric deal with identification of individuals based on their physical and behavioral features.

Biometric solutions, such as identification systems using fingerprint, iris, face, and palm print, hand geometry, signature, etc; have many advantages over the traditional authentication techniques based on what you know or what you possess. Instead of carrying bunk of keys, all those access cards or passwords you carry around with you, your body can be used to uniquely identify you. Among them, iris recognition is tested as the most accurate manner of personal identification. Therefore nowadays many automatic security systems based on iris recognition have been deployed worldwide for border control, restricted access and so on.

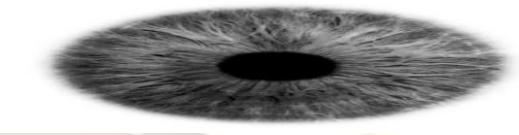

Figure 1: Texture rich iris image [1]

This technique performs better identification than other biometric identification because I am using an iris which has an extraordinary structure and provides many interlacing minute characteristics such as freckles, coronas, strips, furrow, and crypts and so on [2]. These visible characteristics, generally called the texture of the iris, are unique to each subject. The iris patterns of the two eyes of an individual or those of identical twins babies are completely independent and uncorrelated [3]. All biometric systems are suffered from two types of errors as false acceptance and false rejectance. But iris recognition system gives us lesser false acceptance and false rejectance rate than any other personal recognition system because iris is protected behind the eyelid, cornea and aqueous means that, unlike other biometrics such as fingerprints, the likelihood of damage is minimal also the iris is not subject to the effect of aging which means it remains in a stable from about the age of one until death [4] [5] so we do not need to update database again and again over passes time. Thus the entire system is giving us maximum accuracy and less error rate for personal identification in biometric analysis.

***Some current and future Applications:*** There is world wide applications area of iris recognition system. National border controls as living passport, computer login: a password, secure access to bank account at ATM machine, ticketless travel, authentication in networking, permission access control to home, office, laboratory etc, driving licenses, and other personal certificates, tracing missing or wanted persons, anti-terrorism, security at airports, using as any type of password[6].

Figure 2: Traveler using iris scans security system [7]

Figure 3: Mobile Security [8]

Figure 4: Security checking at border [9]

This paper represents the review about identification of a person using iris recognition, after study a number of papers, articles. My paper is organized as follows: background work by a number of authors, researcher are given as related work in section II, in my system, how it works, all the major and minor steps as image capturing, edge detection, finding inner and outer boundary, isolation, Cartesian to Polar Transformation, enhancing the image, extracting features and matching, the entire my system approaches are given as iris recognition system in section III, the entire theme and future work is given as conclusion in section IV, in the last all the papers and websites which I have used to provide this review is given under the heading references in section V.

## II. Related work

Related to this system so many authors present their techniques, in this system I studied most of the good papers in sequence.

Flom and Safir first proposed the concept of automated iris recognition [10]. A report was published by Johansson in 1992 without any experimental results. Since then, iris recognition has been receiving many researchers attention and a great deal of progress has been achieved in the last decade. For instance, Daugman realized an iris recognition system and the identification accuracy is up to 98.9%. Daugman proposed Integro-Differentiation method to find the pupil and iris boundary [11] he assumes pupil and iris boundary to be circular [12]. Daugman's iris recognition algorithm is based on the principle of the failure of a test of statistical independence on iris phase structure encoded by Quadrature Wavelets. Boles and Boas hash [13] calculated Zero-Crossing representation of 1-D Wavelet Transform at various resolution levels of a virtual circle on an iris image to characterize the texture of the iris. Iris matching was based on two dissimilarity functions. Wildes et al. [4] represented the iris texture with a Laplacian Pyramid constructed with four different resolution levels.

## III. Iris Recognition System

When a subject wishes to be identified by iris recognition system, his/her eye is first photographed and then a template (iris code) created for his/her iris region. This template is then compared with the other templates stored in a database until either a matching template is found and the subject is identified or no match is found and the subject remains unidentified. There are several method for accomplishing single task as edge detection I have Sobel Operator, Prewitt Operator, Canny Edge Detection, Roberts method and so on, for boundary detection as Hough Transformation, Circular Hough Transformation, Integro-Differential Operator, Gradient based approach, Clustering algorithms and so on, for feature extraction I have phase based methods, zero crossing and texture analysis based methods.

As per studied by various papers a well defined steps have come in my mind which can be disclose for various readers, researchers and dictated in the form of diagram as shown in figure:5 given below.

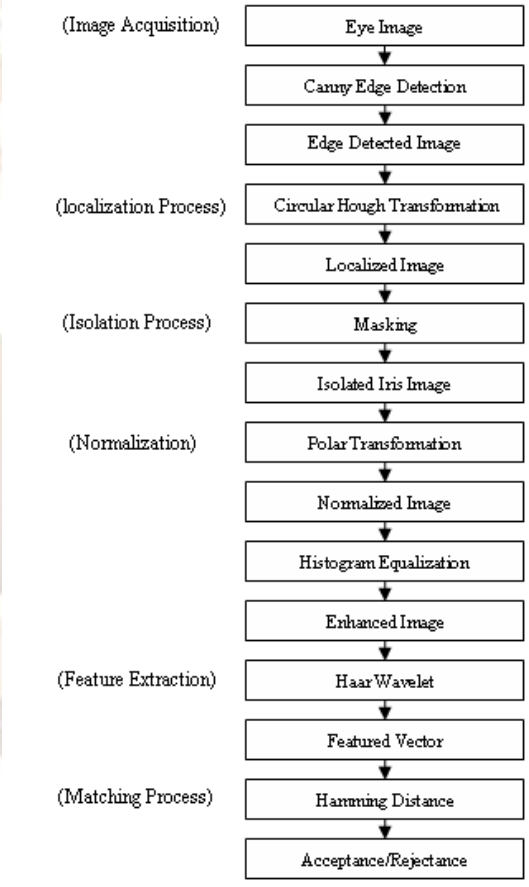


Figure 5: My System

***Image acquisition:*** This is our very first step of the entire process. When a person wishes to be identified by iris recognition system, his/her eye is first photographed. The camera can be positioned between three and a half inches and one meter to

capture the image. In the manual procedure, the user needs to adjust the camera to get the iris in focus and needs to be within six to twelve inches of the camera. This process is much more manually intensive and requires proper user training to be successful. We must consider that the occlusion, lighting, number of pixels on the iris are factors that affect the image quality [14]. A number of researchers have been used Chinese Academy of Sciences' Institute of Automation (CASIA) [15] and Malaysia Multimedia University (MMU) [16] database to perform their research.

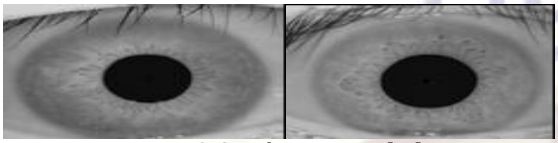

Figure 6: Sample iris images [17]

***Localization:*** The acquired iris image has to be preprocessed to detect the iris, which is an annular portion between the pupil (inner boundary) and the sclera (outer boundary). The first step in iris localization is to detect pupil which is the black circular part surrounded by iris tissues. The center of pupil can be used to detect the outer radius of iris patterns. The important steps involved are:

1. Pupil detection
2. Outer iris localization

Well-known methods such as the Integro-Differential Operator, Hough Transform and Active Contour models have been successful techniques in detecting the boundaries. The iris localization proposed by Tisse et al. is a combination of the Integro-Differential Operator and the Hough Transform. The Hough Transform is used for a quick guess of the pupil center and then the Integro-Differential Operator is used to accurately locate pupil and limbus using a smaller search space [18]. But in this paper I am using Canny Edge Detection for detecting edges in the entire eye image after that applying Circular Hough Transformation for detecting outer boundary of iris by using pupil center and inner boundary of iris.

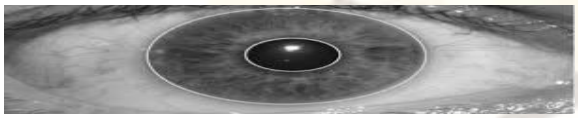

Figure 7: localized iris image [15]

***Isolation:*** Now the task is to isolate the iris. In the images used, there is some presence of the white of the eye. This was done by using a masking technique as here I am choosing best technique among other so I will use Gaussian Mask and then cropping the image to minimize the area that does not contain any edge data. The mask is a circular one which has the same radius as the iris. It thus passes all pixels that are contained in the circle which are all the pixels forming the iris. By making use of the center and the radius which are calculated in advanced step, we set the polar coordinate system. In this coordinate system, the feature of the iris is extracted.

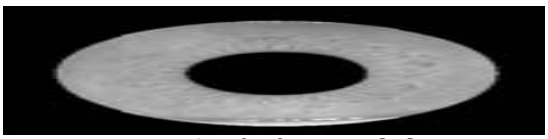

Figure 8: Isolated iris image [17]

***Normalization:*** For the purpose of accurate texture analysis, it is necessary to compensate this deformation. Since both the inner and outer boundaries of the iris have been detected so it is easy to map the iris ring to a rectangular block of texture of a fixed size. The Cartesian to polar reference transform suggested by Daugman [12] authorizes equivalent rectangular representation of the zone of interest as shown figure. In this way I compensate the stretching of the iris texture as the pupil changes in size, and unfold the frequency information contained in the circular texture in order to facilitate next feature extraction. Also this process is very necessary because feature extraction and matching process becomes easy.

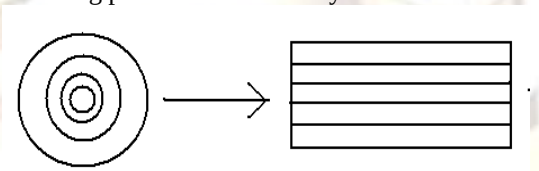

Figure 9: Depicted how iris image is converted to Polar Coordinate

Thus the following set of equations [4] is used to transform the annular region of iris into polar equivalent.

$I(x(\rho, \theta), y(\rho, \theta) => I(\rho,\theta)$

With

$x_p(\rho,\theta)=x_{p0}(\theta)+r_p*\cos(\theta)$

$y_p(\rho,\theta)=y_{p0}(\theta)+r_p*\sin(\theta)$

$x_i(\rho,\theta)=x_{i0}(\theta)+r_i*\cos(\theta)$

$y_i(\rho,\theta)=y_{i0}(\theta)+ri*\sin(\theta)$

Where, $r_p$ and $r_i$ are respectively the radius of pupil and the iris, while $(x_p(\theta), y_p(\theta))$ and $(x_i(\theta), y_i(\theta))$ are the coordinates of the pupillary and limbic boundaries in the direction $\theta$. The value of $\theta$ belongs to $[0; 2\pi]$, $\rho$ belongs to $[0; 1]$.

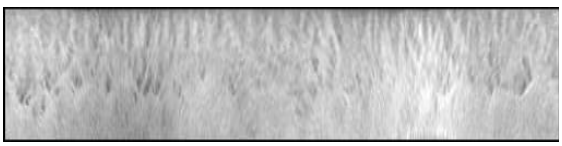

Figure 10: Unwrapped image [17]

***Enhancement and denoising:*** The normalized iris image still has low contrast and may have non-uniform illumination caused by the position of light sources. In order to obtain more well-distributed

texture image, we enhance iris image by means of local histogram equalization and remove high frequency noises by filtering the image with an appropriate filter.

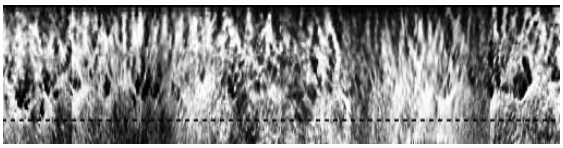

Figure 11: Iris image after enhancement and denoising [17]

***Feature Extraction:*** Lim et al. [19] also use the Wavelet Transform to extract features from the iris region. Both the Gabor Transform and the Haar Wavelet are considered as the Mother Wavelet. Laplacian of Gaussian (LoG) is also used in previous papers. In my paper, using Haar Wavelet, decomposing upto $4^{th}$ level a feature vector with 87 dimensions is computed. Since each dimension has a real value ranging from -1.0 to +1.0, the feature vector is sign quantized so that any positive value is represented by 1 and negative value as 0. This results in a compact biometric template consisting of only 87 bits.

***Storing and Matching:*** Now this is our final phase for completing our system. Here we will store the 87 bit iris code or template in our database for future matching and this matching is done with the help of an efficient matching algorithm here we are using Hamming Distance algorithm for the recognition of two samples that is reference template and enrollment template. It is basically uses an exclusive OR (XOR) function between two bit patterns. Hamming Distance is a measure, which delineate the differences, of iris codes. Every bit of presented iris code is compared to the every bit of referenced iris code, 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 and if the two bits are different, the system assigns a value '1' to that comparison. The formula for iris matching is
shown as follows:
$HD = 1/N \sum (Pi \oplus Ri)$ [13]
where N is the dimension of feature vector, Pi is the ith component of the presented feature vector while Ri is the ith component of the referenced feature vector.

Here we can set the threshold value if the resultant value is greater than threshold value, then reject the iris else accepted the user iris.

As per review I am giving my thought in matching process which can be represented by a diagram named storing and matching process in figure: 12.

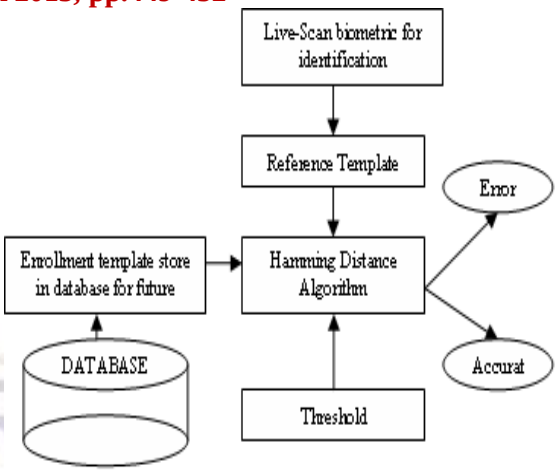


Figure 12: Storing and matching process

## IV. Conclusion

In this review paper I show how a person can be identified by a number of ways but instead of carrying bunk of keys or remembering things as passwords we can use us as living password, which is called biometric recognition technology it uses physical characteristics or habits of any person for identification. In biometrics we have a number of characteristics which we are using in our recognition technology as fingerprint, palm print, signature, face, iris recognition, thumb impression and so on but among these irises recognition is best technology for identification of a person. I can say that this technology is not completely developed and we need a number of scientists, researchers and developer who can work on this technology and can complete the dream of Mr. Daugman by applying the uses of iris recognition in each and every field where security is needed by the human being.

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