Volume 4, Issue 5, May 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

A Survey of Various Iris Recognition Methodologies

Gayatri Anand*
M.Tech Scholar, ECE Department
SRMIET, Haryana, India

Sachin Gupta
HOD, ECE Department
SRMIET, Haryana, India

Abstract— Iris recognition, a biometric technique for personal identification, provides one of the most protected methods of verification and recognition. Iris recognition system captures an image of an individuals' eye. The iris in the image is then intended for segmentation and normalized for characteristic extraction procedure. The performance of iris recognition system extremely depends on the segmentation process. Segmentation is used for the localization of the accurate iris region in an eye and it should be done precisely to have a very low false acceptance and rejection rates. This makes the technology very valuable in areas such as information security, physical access protection, ATMs and airport security. In this paper work performance of various feature extraction methods are analyzed for iris recognition.

Keywords—Biometric, iris, localization, recognition, segmentation

I. INTRODUCTION

Iris recognition is a biometrics research that is a broad and rapidly growing field in today's lifestyle due to increased need of security through identification and verification of a personal. Biometric identification techniques are widely used for this purpose. Technologies that utilize biometrics have the potential for identification and verification of personals for controlling access to secured areas or materials. A spacious assortment of biometrics has been introduced in support of this challenge. Resulting systems include those based on automated recognition of retinal vasculature, fingerprints, hand profile, handwritten autograph and tone of voice [1]. The concept of Iris Recognition was first proposed by Dr. Frank Burch in 1939. It was first implemented in 1990 when Dr. John Daugman created the algorithms for it [5]. The algorithms employ methods of pattern recognition and some mathematical calculations for iris recognition [4]. Biometric systems work by first capturing a sample of the feature, such as recording a digital sound signal for voice recognition, or taking a digital color picture for face recognition. The sample is then altered using some sort of mathematical tools into a biometric pattern. The biometric pattern will provide a normalized, efficient and highly discriminating representation of the feature, which can then be independently compared with other templates in order to conclude uniqueness. Most of the biometric based identification technologies such as fingerprints, palm prints, vein patterns etc. require physical contact whereas the iris identification technology patented by Iris Scan shows assurance of meeting this challenge without suffering many of the inadequacies exhibited by others [2].

Iris recognition is a method of biometric authentication that uses pattern-recognition techniques based on high-resolution images of the irises of an individual's eyes.

II. STRUCTURE OF IRIS

The iris is a slim circular diaphragm, which lies between the cornea and the lens of the human eye. The iris is perforated close to its centre by a circular opening known as the pupil. Due to the epigenetic temperament of iris patterns, the two eyes of a human being contain completely independent iris patterns, and alike twins possess uncorrelated iris pattern. A front outlook of iris is shown in Fig. 1. The function of the iris is to control the amount of light entering through the pupil. The average diameter of the iris is 12mm and the pupil dimension can vary from 10% to 80% of the iris diameter [3].

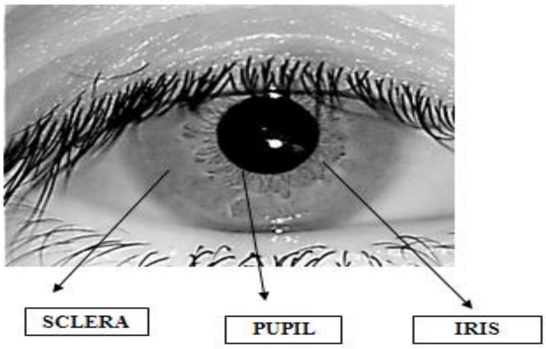

Fig. 1 Human iris

The iris is an outwardly perceptible, so far sheltered organ whose exclusive epigenetic pattern remains unwavering during adult life. This uniqueness makes it very striking for use as a biometric for identifying individuals.

III. Iris Recognition System

The iris recognition system mainly consists of four modules. The block diagram of iris recognition system is shown in Fig. 2.

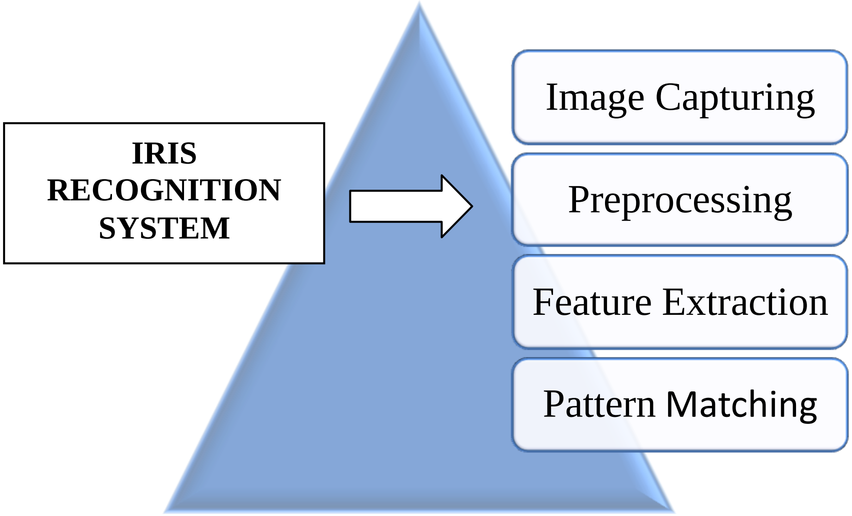

Fig. 2 Iris recognition system

A. Image Acquisition / Capturing

Image capturing module deals with the image capturing process of iris. The captured iris images must be high quality images in terms of resolution and sharpness because these images will be further go through number of operations [4]. These images should clearly show the whole eye, particularly iris and pupil part, and then some preprocessing operation may be applied to improve the quality of image e.g. histogram equalization, filtering noise removal etc [6].

B. Image Preprocessing

In second module various processes such as pupil and iris edge detection have been done. Numerous methods like Hough transformation, integrodifferential operator, gradient based edge detection are used to confine the portions of iris and the pupil from the eye image. The contours of upper and lower eyelids are fit using the parabolic arcs resulting the eyelid exposure and elimination. It is necessary to map the extracted iris region to a normalized structure [7]. Fig. 3 shows preprocessing of iris and pupil boundary.

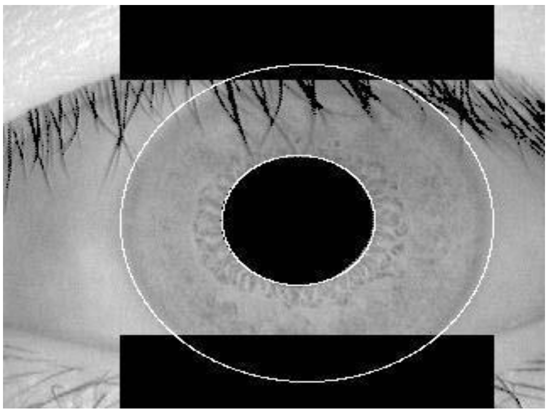

Fig. 3 Iris and pupil detection

C. Feature Extraction

In third module, feature extraction identifies the most important features for categorization. For accurate recognition of personals, the dominating information present in an iris image must be extracted in a precise manner. Only noteworthy features have to be done so that comparisons between patterns can be done [6]. Characteristic encoding was implemented by convolving the normalized iris pattern with 1D Log-Gabor wavelet filters. 2D normalized patterns are broken up into a numbers of 1D Log-wavelets. Each row corresponds to a circular ring on the iris section. The angular direction is taken rather than the radial one, which corresponds to columns of normalized pattern. The features are extracted in codes of 0 and 1 [4].

D. Pattern Matching

Hamming distance was chosen as a metric for recognition for pattern matching. The effect of this calculation is then used as the integrity of match, with smaller values representing better matches. If two patterns are derived from same iris, the hamming distance between them will be close to 0 due to high correlation [4].

IV. RELATED WORK

A lot of work has been done in the field of biometric iris recognition and some of the research articles discussed in this section.

Daugman [5] proposed first working methodology related to iris biometrics. In this work, Daugman makes use of an integro-differential operator for locating the circular iris and pupil regions, and also the arcs of the upper and lower eyelids. The operator searches for the circular path where there is maximum change in pixel values, by varying the radius and centre x and y position of the circular contour. The operator is applied iteratively with the amount of smoothing progressively reduced in order to attain precise localization. Eyelids are localized in a parallel manner, with the path of contour integration changed from circular to an arc. The integro-differential can be seen as a variation of the Hough transform, since it too makes use of first derivatives of the image and performs a search to find geometric parameters. Since it works with raw derivative information, it does not suffer from the thresholding problems of the Hough transform. However, the algorithm can fail where there is noise in the eye image, such as from reflections, since it works only on a local scale. Eq. 1 describe Integro-differential operator.

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

where * shows convolution and $G_{\sigma}(r)$ is a smoothing function such as Gaussian of scale σ.

Daouk et al. [8] proposed iris recognition schemes which involves a fusion mechanism that amalgamates both, a Canny Edge Detection scheme and a Circular Hough Transform, to detect the iris' boundaries in the eye's digital image. Then Haar wavelet is used in order to pull out the deterministic patterns in a person's iris in the form of a feature vector. The images used in this work were captured by CCD camera with resolution 640x480. Wavelet tree was utilized for image coefficient's mapping. A database of 60 pictures was used and average correct recognition rate is 93%. The limitation of this work is that this methodology does not perform well in the occurrence of bad lighting, occlusion by eyelids, noises or inappropriate eye positioning.

Noh et al. [9] introduced a new technique of feature extraction. In this work instead of using wavelet transform an adaptive method of feature extraction was introduced in which two types of Global and Local features were extracted from wavelet coefficient. Polar coordinates system was used for mathematical modeling of the system. Global features are invariant to the eye image rotation and the imprecise iris localization. The customized geometric moment is used for representing global iris feature. The introduction of the global attribute has taken strengths of declining the computation require for local matching and compensating the error in localizing iris region. Local features provide precise information regarding iris. The main reason to introduce this approach was the absence of shift-invariant property in Discrete Wavelet Transform (DWT) and the methodology which does not include shift-invariant property can't provide exact texture analysis.

Ives et al. [10] proposed histogram analysis based iris recognition mechanism in which instead of using two dimensional Gabor wavelets proposed by Daugman, one dimensional histogram were used for registration and identification. This work considered CASIA iris image database composed by Institute of Automation, Chinese Academy of Sciences. After the iris image segmentation one dimensional histogram computed and on the basis of histogram peaks irises were recognized. The threshold for detection varies from 0.01 to 0.3. Two parameters named False Acceptance Rate (FAR) and False Rejection Rate (FRR) were considered to measure the performance of algorithm. The mathematical expressions for FAR and FRR are given in Eq. 2 and 3.

$$FAR(\%) = \frac{No.of\ \ false\, matches}{No.of\ \ imposter\ attempts} \quad (2)$$

$$FAR(\%) = \frac{No.of\ \ false\, matches}{No.of\ \ imposter\ attempts} \quad (3)$$

In this work FAR was achieved up to 5%. Performance also measure on the basis of error rate when FAR is equal to FRR.

Xu et al. [11] proposed an improved iris recognition system which deals with eyelids and eyelashes detection and an alternative image enhancement method. The main reason for considering eyelids and eyelashes detection is that the presence of these affects the iris image and produce noise that results in the degradation of system performance. Sub-block of eyelids/eyelashes models compared for detection purpose. For enhancement of iris image subtraction of background was done and then filtering is performed by histogram equalizing and viener filtering. For eyelids/eyelashes detection summary derivate was used. The iris location finding rate is 98.42% in case of CASIA database.

Daugman [12] demonstrate an improved version of Daugman [5] method in term of four aspects. The proposed method is more disciplined technique for iris detection using active contour. Further it utilizes Fourier transform for detecting the rotational effects. Eyelashes were excluded using statistical inference methods. In this work doubly dimensionless pseudo-polar coordinates were used for iris mapping for inner and outer margins. Normally, iris outer boundary occluded by eyelids and by inner reflection from illumination. Thus, active contours are a solution for describing iris boundaries in a better manner. Fourier expressions of coordinates are used for detecting pupil shape. Gaze deviation parameter was used which express relation between real and imaginary coefficients.

Azizi et al. [13] proposed efficient iris recognition using features extraction and subset selection. Iris features were extracted using contourlet transform; it captures the intrinsic geometrical structures of iris image. Iris image was further decomposed into sub-blocks that contain all texture information. This technique utilizes Support Vector Machine (SVM) for matching the iris templates. Gabor filter and Haar wavelet were used in this work for analysis. Iris vector was created using Principal Component Analysis (PCA). The performance of the proposed system was checked against CASIA image database.

Jain et al. [14] proposed efficient iris recognition system using 2-D Gabor wavelet transform. In this work, for feature extraction wavelet transform is used as its performance is fast for gray scale images in time and frequency domain. For matching reason Canny-Edge detection was used that was discovered by J.F. Canny in 1986. Gabor wavelet transform was used in this work as this transform has multi-orientation and resolution properties. For matching hamming distance was measured to indicate how many bits are same in two patterns. For two bit patterns X and Y, the Hamming Distance (HD) can be calculated using Eq. 4.

$$HD = \frac{1}{N} \sum_{j=1}^{N} X_j (XOR) Y_j \tag{4}$$

V. CONCLUSIONS

This paper presents a literature review on the various iris recognition techniques. This paper emphasizes on biometric identification scheme that utilizes iris image as verification source because this organ's characteristics do not vary so much with ageing effect. Most of the time for iris localization and segmentation wavelets are effective solution and for coding purpose Gabor filters are used. Canny edge detector's performance is much better compare to other edge detection techniques. Finally, for template matching hamming distance method perform well.

ACKNOWLEDGMENT

The authors are very thankful to the management of SRMIET, Haryana, India for their guidance and support. We are also thankful to ECE department of Shree Ram Mulkh Institute of Engineering and Technology, Haryana, India for their invaluable detailed advices on grammar, organization, and the theme of the paper. Last but not the least we are greatly indebted to our family who always encouraged us to attain our goal.

REFERENCES

[1] [R.P. Wilders, "Iris Recognition: An Emerging Biometric Technology", *Proceeding of the IEEE,* Vol. 85, No. 9, pp. 1348-1363, September 1997.

[2] G.O. Williams, "Iris Recognition Technology", *Proceeding of the IEEE,* pp. 46-59.

[3] A.G. Gale and S.S. Salankar, "A Review On Advance Methods Of Feature Extraction In Iris Recognition System", *IOSR Journal of Electrical and Electronics Engineering,* e-ISSN: 2278-1676, p-ISSN: 2320-3331, pp. 65-70, 2014.

[4] P. Verma et al., " Daughman's Algorithmmethod For Iris Recognition-A Biometric Approach", *International Journal of Emerging Technology and Advanced Engineering,* Vol. 2, Issue 6, pp. 177-185, June 2012.

[5] J. G. Daugman, "High confidence visual recognition of persons by a test of statistical independence", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. 15, No. 11, pp. 1148–1161, 1993.

[6] D. Choudhary, S. Tiwari and A.K. Singh, "A Survey: Feature Extraction Methods for Iris Recognition", *International Journal of Electronics Communication and Computer Technology,* Vol. 2, Issue 6, pp. 275-279, November 2012.

[7] S.V. Sheela and P.A. Vijaya, "Iris Recognition Methods – Survey", *International Journal of Computer Applications,* Vol. 3, No. 5, pp. 19-25, June 2010.

[8] C.H. Daouk et al., "IRIS RECOGNITION", *Proceeding of the IEEE ISSPIT, Marrakesh,* pp. 558-562, 2002.

[9] S.I. Noh et al., "A Novel Method to Extract Features for Iris Recognition System*", Audio- and Video-Based Biometric Person Authentication, Springer,* pp. 862-868, 2003.

[10] R.W. Ives, A.J. Guidry and D.M. Etter, "Iris Recognition using Histogram Analysis", *Proceeding of the IEEE International Conference on Signals, Systems and Computers,* Vol. 1, pp. 562-566, 2004.

[11] G. Xu, Z. Zhang and Y. Ma, "Improving The Performance Of Iris Recognition System Using Eyelids And Eyelashes Detection And Iris Image Enhancement", *Proceeding of the IEEE International Conference on Cognitive Informatics,* pp. 871-876, 2006.

[12] J. Daugman, "New Methods in Iris Recognition", *IEEE Transactions on Systems, Man and Cybernetics,* Vol. 37, No. 5, pp. 1167-1175, 2007.

[13] A. Azizi and H.R. Pourreza, "Efficient IRIS Recognition Through Improvement of Feature Extraction and subset Selection", *International Journal of Computer Science and Information Security,* Vol. 2, No. 1, June 2009.

