Iris Recognition System: A Survey

Mr Nithin Kumar Heraje[1], Mr John Prakash Veigas[2]
[1, 2] Dept of CS & Engg
[1, 2] A.J. Institute of Engineering & Technology, India.

Abstract- *Biometrics Iris recognition biometric method is one of the accurate and best compared to other biometric methods like face, palm or fingerprint recognition. Iris is protected with eyelids and cornea from environmental damages. It is stable for the lifetime and unique for each person. Hence this technique is more preferable to identify an individual. There are many methods to extract the iris pattern and store it as a biometric template in the database. Many processing stages an iris pattern has to undergo before the template is ready. The template will undergo comparison with the different biometric templates in the database and if it matches with any then the individual will be identified. We will discuss about iris anatomy, different processing stages and different iris recognition techniques.*

Keywords- Iris recognition, segmentation, feature extraction, normalization, Hough transform, canny edge detection, matching texture.

I. INTRODUCTION

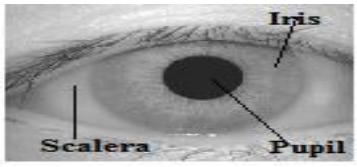
Security is the most concerned matter these days. The most efficient biometric technique is Iris recognition method which is more reliable and unique for recognition purpose [1]. Iris is recognized using the colored ring surrounding pupil which has unique texture that identifies the individual [1].
The two main categories of biometrics are: Physiological Biometric and Behavioural Biometric. Figure 1 shows the different types of biometric recognition techniques.

Types of Biometrics.

II. BACKGROUND CONCEPTS

A. Anatomy of Iris

The Cornea and Sclera are the front view regions of the eye. Pupil and iris both are covered by cornea. The dark portion in the central aperture of the iris is pupil. Sclera comprises of pale white or white color fibres. Figure 2 shows the human eye front view.

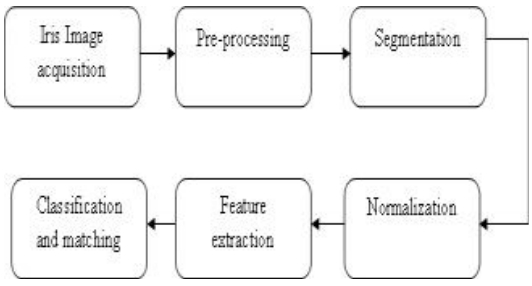


Front view of a human eye.

B. Different stages in Iris Recognition

The different stages in the iris recognition techniques are:

- Image acquisition: This captures a photo of the eye of an individual.
- Pre-processing: This stage basically consists of reducing the noise, contrast adjustment, eyelid and eyelash occlusion.
- Segmentation: In this stage it performs identification of iris inner and outer boundaries.
- Normalization: This stage includes polar transformation to Cartesian coordinates of the iris image.
- Feature extraction: Here it determines the unique texture for individual identification.
- Matching: Compares with the matching of iris code being saved in the database.



Stages of Iris Recognition System

III. SUMMARY OF RELATED WORK

Here we provide with the summary of the related work carried out by many researchers in this area. Different aspects like the efficiency of the algorithms in various stages, pros and cons were studied.

Name of the Researcher & year	Algorithms used	Pros	Cons
Daugman J [2] 1994	Integro differential operator Homogenous rubber sheet 2-D Gabor filter Hamming distance	Hamming distance algorithm is easy to compare the templates	Noise was not dealt
Richard P. Wildes [3] 1997	Gradient binary edge detection Circular Hough transform Laplacian of Gausian	Eye lid detection dealt	Comparatively low performance
J. Huang et al. [4] 2004	Rough localization by simple filtering 2-D Log Gabor Independent component analysis Euclidian distance classifier	Better speed and accuracy	Euclidian distance classifier involves complex processing
Proença et al. [5] 2006	Proposed Segmentation algorithm Fuzzy clustering algorithm Hamming distance	Improved performance rate	Slow processing compared to Daugman
G. Sathish et al. [6] 2012	Gaussian smoothing function Canny edge detection Circular Hough transform 2-D Gabor filter Hamming distance	Works well for the disturbed iris images.	Speed rate comparatively slow
Rai et al. [7] 2014	Hough transformation Trimmed median filter Haar wavelet Support vector machine Hamming distance	Excellent recognition rate	Support vector machine requires more processing time
Parthasarathi et al. [8] 2016	Canny edge detection Circular Hough transform Log Gabor filter Euclidian distance classifier	More accurate	Euclidian distance classifier involves complex processing

IV. OBSERVATIONS

Following observations are made by studying the above papers:

- Preprocessing is performed using Canny operator, Hough Transform, histogram equalization, threshold function for eyelid occlusion & to detect reflection.
- Iris segmentation is mostly performed using Integro differential operator, Canny edge detector, Circular Hough Transform, 2-D log Gabor filter and many more methods.
- Iris Normalization is performed using Daughman's rubber sheet model
- Feature extraction is performed by using Haar wavelet Transforms, 2D Gabor wavelets, 1D Log-Gabor wavelets and 2D Log- Gabor wavelets, Local Binary Pattern, Discrete Wavelet transform, Principal component Analysis.
- Matching is performed by using Hamming distance, elastic graph matching, Support Vector Machines.

The performance rate of various existing algorithms for iris recognition system [2] given in Table 3.1. The accuracy of algorithms are tested using MATLAB and CASIA Iris Image Database. CASIA Iris Image Database is a public domain dataset. The database contains 758 iris images from 106 persons for testing. For 8 images of eye captured with 4 samples as training and remaining 4 samples taken for testing the accuracy is obtained by the error rates which are EER (Equal Error Rate), FAR (False Acceptance rate), FRR (False Rejection Rate).

Table 3.1 Performance rate of Iris algorithms

GROUP	EER	FAR/FRR	ACCURACY
Daugman	0.95	0.01/0.09	99.9
Hamed	2.4	1.6/1.2	98.1
Li Ma	4.74	0.02/1.98	98.00
Avila	3.36	0.03/2.0	97.89
Tisse	5.95	1.84/8.79	96.61
Wilde's et al.	1.77	2.4/2.9	95.10

V. CONCLUSION

Iris biometric system has gained a larger popularity because of its unique, stable nature over the years and difficulty in forging the Iris texture. This paper exhibits the review of different existing approaches for iris recognition system. The Iris recognition method is one of the best and secure technique for authentication. Also the tampering of iris is very low and even the twins cannot have the same iris texture which makes iris recognition more secured.

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