International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 5, May - 2014

Iris Recognition System Using Dct: A Survey

Ms. Sakshi Sharma
Amrit Pal Singh
Asst. Professor (Electronics and Communication)M.tech (Electronics and Communication)
Chandigarh Engineering College, Landran, IndiaChandigarh Engineering College, Landran, India

Abstract **- Iris recognition can be considered as one of the most reliable and accurate method of biometric technology when compared with other biometric technologies such as face, fingerprint and speech recognition. The iris region is visibleexternally, but is considered to be an internal organ because it is so well protected by the eyelid and the cornea from environmental damage and also remains stable throughout the whole life. These characteristics make it very attractive to use as a biometric type for verify the identity of individual person. Different techniques can be employed to extract the unique iris pattern from a digitized eye image, which is further get stored in a database by encoding into a biometric template. The template contains mathematical representation of the unique information of the iris pattern, and further, comparisons can be done between different templates. The biometric template is compared by hamming distance with the other templates stored in a database until a matching template is found and if no match is found then, the subject remains unidentified. In this paper we will discuss about the iris anatomy, history, general process etc.**

Keywords: Iris recognition, Canny Edge Detector, DCT, Hough Circular Transform, Hamming Distance.

1. INTRODUCTION

The need for infallible security systems has become a vital aspect in public security. Iris recognition is one of the important techniques as compared to other biometric features such as signature, voice, hand geometry etc. The iris recognition is reliable and unique technique for identification purposes [1]. Iris recognition is the analysis of colored ring that surrounds the pupil region [1]. The iris has unique structure patterns which are distributed in a random manner along the pupil and can be used to verify the identity of a human being.

Biometrics

Biometrics is derived from Bio (means life) and Metrics (means system used for measurement). This means that biometrics on whole means is a technology of measuring and analyzing physiological or biological characteristics of living body for identification and verification purposes.

Working principle of biometrics

Biometrics device consists of a scanning device and software, that converts the gathered information into digital form, and a database or memory that stores the biometric data for comparison with previous records saved in the system. After converting the biometric input into digital form, the software identifies the match points in the data values. The match points are processed using algorithm into a value that can be compared with biometric data already stored in the data base. All biometric systems require comparing a registered biometric sample against a newly captured biometric sample.

Advantages of Using Biometrics:
• Easier fraud detection.
• Better than password/PIN or smart cards.
• No need to memorize passwords.
• Require physical presence of the person to be identified.
• Physical characteristics are unique.
• It providesaccurate results.

IJERT

TYPES OF BIOMETRICS

Biometric system is broadly categorized in two types: Physiological and behavioral.

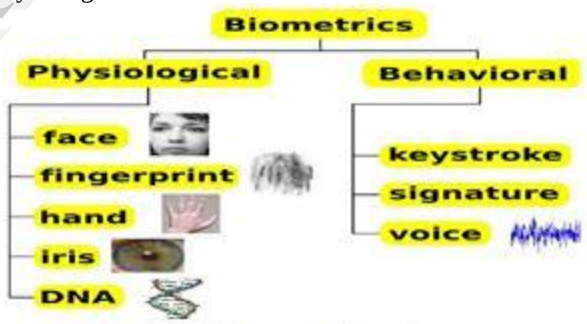

Figure 1: Types of biometrics

Comparison of various biometrics techniques:

Biometrics	Universal	Unique	Performance	Collectable	Potential to fraud
Face	High	Low	Medium	High	Low
Fingerprint	Medium	High	High	Medium	Low
Iris	High	High	High	Medium	Low
Signature	Low	Low	Low	High	High
Voice	Medium	Low	Low	Medium	High
DNA	High	High	High	Low	Low

Human iris

The word Iris(plural: Irises or Irides) is derived from the Greek word "Goddess of the Rainbow" (due to many colors

of the Iris). Iris is the portion between the dark pupil and the white sclera. It is the colored part of the eye that lies behind the cornea, in front of the lens, and is protected by the eyelid. It is a thin circular region present in the eye, which controls the diameter and size of the pupiland thus the amount of light that enters the eye and reaches the retina through the pupil. This is done by the iris sphincter and the dilator muscles, which perform the major function of adjusting the size of the pupil. Iris is the only internal part of the human body which is normally externally visible. When the person is of about eight months or so, his iris is completely developed and remains the same throughout the whole life. The color of the iris is responsible for the color of the eye, so it is often referred to as "eye color". The iris has an average diameter of 12 mm, and the size of pupil can vary from 10% to 80% of the iris diameter.
The iris of each eye is unique. No two irises are alike in their mathematical details. The identical twins and triplets also have different iris patterns. Even one's own left and right eye irises are different. This shows the uniqueness of the iris and hence it can be used for the identification purposes

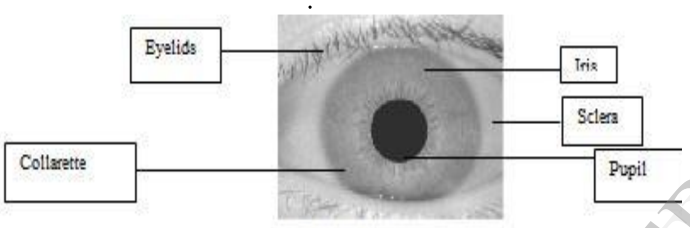

Figure 2: Human eye

II. RELATED WORK

This section provides a brief review of the work carried out by various researchers in this field. Various aspects of the problem were studied.

RESEARCHER NAME	YEAR	ALGORITHM USED	DRAWBACKS
John G. Daugman	1994	Integro-Differential, Daugman Rubber Sheet Model, 2-D Gabor Filter, XOR operator Hamming Distance.	Integro-differential operator fails in case of noise and total execution time is also very high.
W. W. Boles and B. Boashash	1998	1-D wavelet transforms, Edge detection technique, Zero crossing representation.	Algorithms are tested on few number of Iris images, Correct recognition rate is 92%, Equal Error rate is 8.13%.
Zhonghua Lin and Bibo Lu	2010	Morlet wavelet transforms Polar co-ordinate transform.	Recognition rate is low of the system.
Bimi Jain, Dr. M.K. Gupta and Prof. Jyoti Bharti	2012	Fast Fourier transform, Euclidean distance for matching.	Algorithm tested only on 10 images, FAR and FRR are also not declared and Euclidean distance technique make computational slow.
Mohd. T. Khan	2013	1-D Log Gabor filter, K-dimensional tree technique for matching.	Search efficiency is decreased by large tree size and FAR, FRR, ERR are not mentioned in results.

III. IRIS RECOGNITION AND ITS METHODOLOGY

The iris is a well-protected organ that is externally visible and whose epigenetic patterns are very unique and remain stable throughout most of a person's life [4]. Its high uniqueness and stability makes it a good biometrics that can be used for identifying individuals. The stages involved in most iris recognition systems consist of five basic modules leading to a decision as shown in Figure 3.

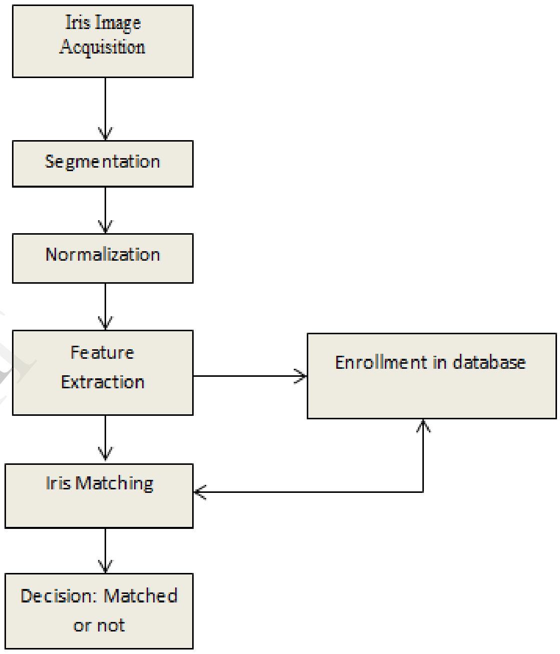

Figure 3: Methodology

IJERT

SEGMENTATION

The color image is firstly converted into gray scale image; it means that the luminance of colored image is converted into gray shade. The first stage of iris recognition is to isolate the actual iris region in a digital eye image. The iris region, shown in Figure 4, can be approximated by two circles, first one is for the iris boundary region and second one is for the pupil boundary region. The eyelids and eyelashes cover the upper and lower parts of the iris region. Specular reflections can also occur within the iris region resulting into corrupting the iris pattern.

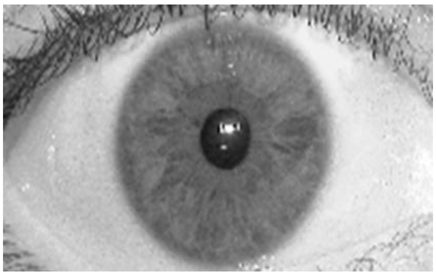

Figure 4:Grayscale iris image

NORMALIZATION

Once the segmentation module has estimated the iris's boundary, the normalization process will transform the circular iris region into another shape which will have the same constant dimensions [8]. We can be using Daugman's Rubber Sheet Model for normalization. This model transforms the iris texture from Cartesian to polar coordinates. This process is called as iris unwrapping, which have a rectangular entity that is used for further subsequent processing. The transformation of normal Cartesian to polar coordinates is recommended which maps the entire pixels in the iris area into a pair of polar coordinates (r, θ), where r and θ represents the intervals of [0 1] and[0 2π] as shown in figure 5.

Daugman's Rubber Sheet Model:

For normalization Daugman has invented the Rubber Sheet Model in which he remaps each point within the iris region to a pair of polar coordinates (r,θ) where r is on the interval [0,1] and θ is angle [0,2π]. Normalisation accounts for variations in pupil size due to changes in external illumination that might influence iris size, it also ensures that the irises of different individuals are mapped onto a common image domain in spite of the variations in pupil size across subjects etc.

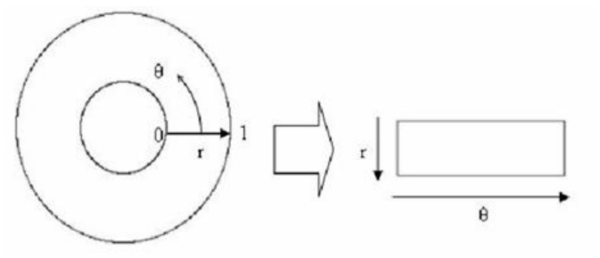

Figure 5: Normalized Iris

FEATURE EXTRACTION

After the iris is normalized, it is compressed by using mathematical functions and converted in to binary forms. Each isolated iris pattern is then encoded using DCT method to extract its binary information

.

Discrete Cosine Transform:A discrete cosine transform (DCT) expresses a finite sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. DCT algorithm is very efficient in image compression applications which makes further computational easy in the system. Discrete cosine transform provides the output in the form of matrix.

$$T_{ij} = \begin{cases} \frac{1}{\sqrt{n}} & if\ i = 1 \\ \sqrt{\frac{2}{n}} cos\left[\frac{(2j+1)i\pi}{2n}\right] & if\ i > 1 \end{cases}$$

Example of DCT output:

$$T = \begin{bmatrix} 0.5000 & 0.5000 & 0.5000 & 0.5000 \\ 0.6533 & 0.2706 & -0.2706 & -0.6533 \\ 0.5000 & -0.5000 & -0.5000 & 0.5000 \\ 0.2706 & -0.6533 & 0.6533 & -0.2706 \end{bmatrix}$$

Where, the first row i=1 has all entries equal to $1/\sqrt{4}$. In the matrix 'i' is the number of row and 'j' is the number of column. In this case, the input images are divided into a set of 4-by-4 blocks and thereafter the two dimensional DCT is employed to each block of the normalized image for obtaining the DCT coefficients. The obtained DCT coefficients are then transformed into binary form by the binarisation process to form the templates of the image to store in the database. For binarisation, the value of positive coefficient is assumed as one and the value of negative coefficient is discarded.

IJERT

MATCHING

The matching algorithm consists of all the image processing steps that are carried out at the time of enrolling the encoded iris template in database. Once the bit encrypted bit pattern B' corresponding to binary image formed is extracted, it is tried to match with all stored encrypted bit patterns B using simple Boolean XOR operation[2]. The dissimilarity measure between any two iris bit patterns is computed using Hamming Distance (HD) which is given as,

$$HD = \frac{1}{N} \sum_{j=1}^{N} X_j \oplus Y_j$$

Where, N=total number of bits in each bit pattern. As HD is a fractional measure of dissimilarity with 0 representinga perfect match, a low normalized HD implies strong similarity of iris codes.

CONCLUSION

The iris recognition system that was developed proved to be a highly accurate and efficient system that can be used for biometric identification. It is one of the most reliable methods available today in biometrics field. The accuracy achieved by the system was very good and can be increased by the use of more stable equipment and conditions in which the iris image is taken. The applications of the iris recognition system are innumerable and have already been deployed at a large number of places that require security or access control. In this paper we have described iris recognition and its methodology such as normalization, segmentation, feature extraction etc. and also comparison of its related work.

REFERENCES

[1] A. K Jain, P. Flynn, and A. Ross, Handbook of Biometrics, New York: Springer, 2008.

[2] Sunita V. Dhavale "DWT and DCT based Robust Iris Feature Extraction and Recognition Algorithm for Biometric Personal Identification", International Journal of Computer Applications (0975 – 8887), Volume 40– No.7, February 2012.

[3] J. Daugman"How iris recognition works", Proceedings of 2002 International Conference on Image Processing, Vol.1, 2002.

[4] S. Sanderson, J. Erbetta "Authentication for secure environments based on iris scanning technology", IEEE Colloquium on Visual Biometrics, 2000.

[5] J. Daugman. "Biometric personal identification system based on iris analysis" United States International Journal of Advanced Trends in Computer Science and Engineering, Vol.2, No.1, Pages : 93-97 (2013) Special Issue of ICACSE 2013 - Held on 7-8 January, 2013 in Lords Institute of Engineering and Technology, Hyderabad.

[6] Human eye. "Encyclopedia Britannica" from Encyclopedia Britannica Ultimate Reference Suite DVD, 2006.

[7] Libor Masek, "Recognition of Human Iris Patterns for Biometric Identification", The University of Western Australia, 2003.

[8] Bowyer K.W., Kranenburg C., Dougherty S. "Edge Detector Evaluation using Empirical ROC Curves", IEEE Conference on Computer Vision and Pattern Recognition(CVPR), pp. 354-359,1999.

[9]B.Sabarigiri1, T.Karthikeyan2, "Acquisition of Iris Images, Iris Localization, Normalization and Quality Enhancement for Personal Identification", International Journal of Emerging Trends &Technology in Computer Science (IJETTCS),Volume 1, Issue 2, July – August 2012.

[10] Jain, A., Hong, L., & Pankanti, S. (2000). "Biometric Identification". Communications of the ACM,43(2), p. 91-98. DOI 10.1145/328236.328110.

[11] Mayuri Memane, Sanjay Ganorkar, "DWT Based Iris Recognition", International Journal of Engineering Science and Technology (IJEST),Vol. 4 No.08 August 2012.

[12] John G. Daugman, (1994), "Biometric Personal Identification System based on Iris Analysis", U.S. Patent no. 5291560 A, publish date 1 march, 1994.

[13] Boles and Boashash, (1998), "A Human Identification Technique Using Images of the Iris and Wavelet Transform", IEEE Transactions on Signal Processing, vol. 46, no. 4, pp. 1185-1188.

[14] Zhonghua Lin and Bibo Lu, (2010), "Iris recognition method Based on the Imaginary Coefficients of Morlet Wavelet Transform", 7th International Conference on Fuzzy Systems and Knowledge Discovery, vol. 2, pp. 573- 577.

[15] Bimi Jain, Dr. M.K. Gupta and Prof. Jyoti Bharti, (2012), "Efficient Iris Recognition Algorithm Using Method Of Moments", International Journal of Artificial Intelligence & Applications, vol. 3, pp. 93- 105.

[16] Steve Zhou and Junping Sun, (2013), "A Novel Approach for Code Match in Iris Recognition", 12th International Conference on Computer and Information Science (ICIS), IEEE/ACIS, pp. 123-128.

[17] R. Meenakshi Sundaram and Bibhas Chandra Dhara, (2011), "Neural Network Based Iris Recognition System using Haralic Features", 3rd International Conference on Electronics Computer Technology (ICECT), vol. 3, pp.19-23.

[18] Mohd. Tariq Khan, Dr. Deepak Arora and Shashwat Shukla, (2013), " Feature Extraction through Iris Images using 1-D Gabor Filter on Different Iris Datasets", 6th International Conference on Contemporary Computing (IC3), date of conference 8-10 Aug, 2013, pp. 445-450.

[19] Marry Dunker, (2003), "Donot Blink: Iris Recognition for Biometric Identification", SANS Institute InfoSec Reading Room.

[20] B. Thiyaneswaran, S. Padma, (2012), "Iris Recognition using Left and Right Iris Feature of the Human Eye for Bio-Metric Security System", International Journal of Computer Applications, vol. 50, no. 12, pp. 37-41.

IJERT