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A Survey on Iris Recognition System

Prabhat Kumar[1*], Manish Ahirwar[2], Anjna Deen[3]

[1,2,3]Department of Computer Science, UIT-RGPV, Bhopal, India

[*]*Corresponding Author: prabhat.kumar0197@gmail.com*

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Abstract— Biometric identification makes utilization of physical and behavioral traits to recognize an individual. It really is currently a measurable physical feature which is believed far very much reliable and safer than passwords. It authenticates secure access and helps in gaining access to data through fingerprints or DNA which are the biological information of human beings. Many biometric systems have recently been developed and so are being utilized to authenticate the individual identity. Iris recognition systems are being used broadly and have became efficient at individual recognition with high precision and practically perfect coordination. The features extracted from iris of both eye of the same person varies, this helps it to be more secured method of authentication in comparison to other biometric systems. This paper offers a review of different methods and algorithms utilized by different experts and their undertake performance of iris recognition system along with identification of gap for potential work.

Keywords— Biometric Authentication; Iris recognition system; Iris database; Iris recognition review; segmentation; feature extraction; normalization; localization; matching

I. INTRODUCTION

Security of data has become an important prospect in today's era. In security, authentication takes on a major role. Authentication may be the procedure for verifying if the person's identification is wrong or correct. Authentication really helps to protect us from intruders also. There are of varied types of authentication processes like using with password using cards and using biometric. Many users make use of the username and password for the intended purpose of authentication commonly, but password could be quickly cracked or stolen as a whole lot of techniques can be carried out to decrypt the password or pin of a person. Cards could be accessed and stolen by anyone. Consequently there is lesser protection and certainly there's no integrity if the claimed person may be the actual one. Biometric data is exclusive and connected with a person permanently.

1.1 Biometrics:

A system of biometrics allows automated identification of a person based on the distinctive feature or characteristics possessed by any person. Also, unlike pins and passwords, a biometric identifier can't be lost, shared or forgotten. The identification supplied by biometric technologies is accurate and therefore guarantees secure usage of sensitive information extremely. Biometrics offers a robust option to using pins or passwords.

Most biometric systems enable two modes of procedure. An enrollment setting for adding templates to a data source, and an identification setting, where a template is established for a specific and a match is sought out in the data source which contains the pre-processed templates.

The figure below depicts the various steps involved in a biometric system:

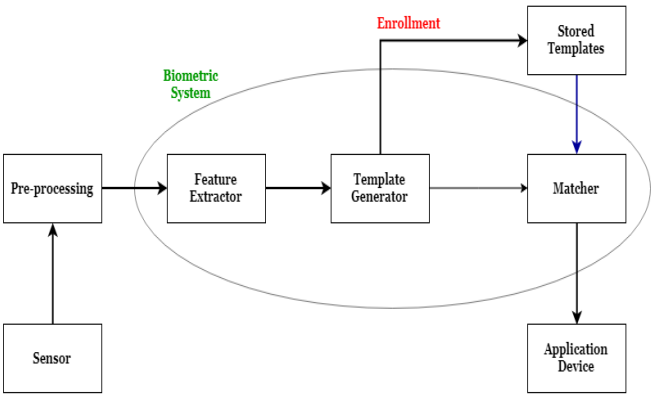

Figure 1. Biometric System

The following are used as performance metrics for biometric systems:

False accept rate (FAR): It calculates the amount of invalid inputs that are incorrectly accepted.

False reject rate (FRR): It calculates the amount of correct inputs that get rejected incorrectly.

1.2 The Human Iris

The iris is permeated near to its middle by a round aperture known to as the pupil. The function of the iris is to control the quantity of light getting into through the pupil, and this can be completed by the sphincter and the dilator muscle groups, which modify the size of the pupil. The typical size of the iris is certainly 12 mm, and the size of the pupil can differ from 10% to 80% of the size of the iris.

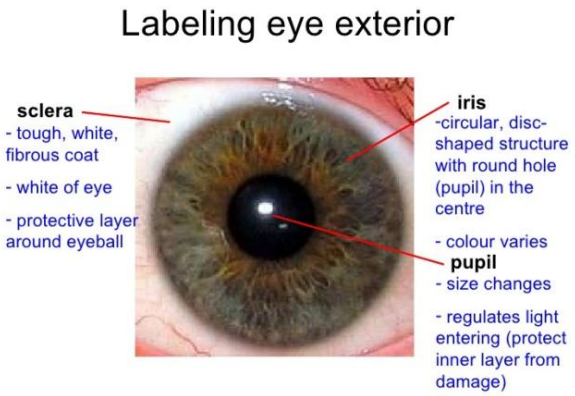

Figure 2.Parts of Human Iris

The initial pattern on the top of iris is formed through the first year of life. Because of the epigenetic character of iris patterns, both eyes of a person include independent patterns for the iris completely, and similar twins have uncorrelated patterns of the iris.

Features of biometric iris recognition

When it comes to durable and reliable biometric system for identity management solutions, the features of iris stands out away from other biometric traits.

- Irises will vary for identical twins also.
- An iris provides a lot more than 266 levels of freedom (the amount of structure adjustable that may vary simultaneously to create iris exclusive between any two people).
- Likelihood of mistakes will there be in the event of various other biometric characteristics such as for example fingerprints. But iris is normally well covered behind the eyelid, cornea and aqueous humor which will make it extremely less vulnerable to damage.
- Iris does not change during the course of life as the person grows there is no effect on the iris.
- When the reading of the iris takes place during the recognition process, the spectacles or the contact lenses have no effect on the processing.
- Ideal for usage in big enterprises with large number of enrollments as it is highly scalable and ideal for handling large databases.
- It is not possible to generate a fake iris match practically.

There have been a lot of applications of biometric systems and iris recognition being one of the most accurate biometrics has proved to be an important biometric system in today's world.

Some of the major target areas of this system are:

- Finance and Banking
- Healthcare and Welfare
- Immigration and Border Control
- Bank ATMs
- Public Safety

1.3 Iris Recognition:

Lately, different types of iris recognition approaches are available that can be used in various platforms. With the help of iris recognition one can determine or verify the identity of a person by analyzing the exclusive patterns inside the ring-shaped region encircling the pupil of the eye. There are usually brown, blue or green colour of irises found in humans which have intricate patterns on them.

During iris recognition, the identification method is done by means of acquiring numerous extensive pictures of the focus with a high-resolution camera at recognizable or infrared (IR), through utilizing a specific computer system program called a matching technique to compare the subject's iris pattern with images kept in a databases. The matching technique analyzes the significant range of pictures per second with an efficient degree of precision. There should not be much reflections in the cornea due to lighting problems as this leads to further problems during the processing.

After the capturing of image, techniques of image processing are performed for extracting the iris features and encode it into a template or code[1]. This code consists of a target mathematical representation of the initial information kept in the iris, and enables comparisons to be produced between templates.

The figure below depicts the steps involved in the recognition of iris:

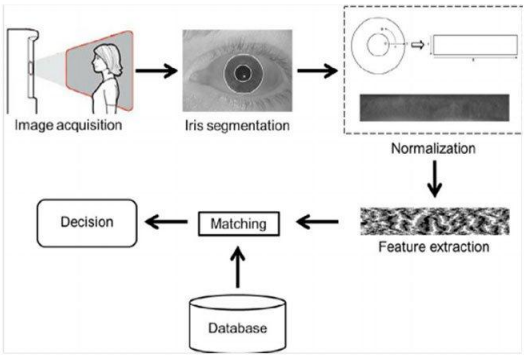

Figure 3.Steps in Iris Recognition

Iris recognition process consists of five distinct steps:

Image Acquisition: The first step includes acquiring the image of the iris of the person whose identification has to be validated. The image capture could be manual or computerized but it has to be ascertained that the iris is in appropriate focus and that the image is shot with clearness.

Iris Segmentation: Second stage is to find the iris area in the eye picture. This requires choosing the interior borderline between the pupil, the small aperture, and the iris region and the external borderline involving the iris and the sclera, the bright white portion which the eye contains. [2]

Normalization: After the iris area is detected from an eye picture successfully, next step is to remodel the iris area to ensure that it has fixed measurement, this will indirectly help during the evaluation process. The dimensional incongruencies between eyes images are generally because of the stretching out of the iris due to pupil dilation from differing degrees of lighting.

Feature Extraction: To be able to offer exact identification of people, some of the most distinguishing details within an iris design should be extracted. Just the critical top features of the iris should be encoded to ensure that comparisons among templates could be made.

Matching: This is actually the finalized part of the recognition of iris. Matching assists us to verify the authenticated person. The user is compared by the template matching template with the template from database utilizing a matching metric. [3]

The organization of rest of the paper is as follows: Section II presents the detailed study of various techniques that have already been implemented for performing Iris recognition and analyzing the various methods and algorithms reported in various publication and research works.
The various observations were made by the review of different techniques. These observations have been discussed in Section III. Section IV discusses the conclusion describing about the iris recognition system.

II. LITERATURE SURVEY

The noticeable changes and advancements in the technology has resulted in various innovations in iris recognition systems. Many researchers and authors proposed different techniques and solutions to overcome the loopholes of traditional iris verification system. The patented algorithm produced by John Daugman[3] is now being currently used by a lot of commercial iris recognition systems. Daugman proposed the algorithm to identify outer and internal boundaries of iris using integro-differential operator, the boundaries of top and lower eyelid had been detected. The operator assumes that the pupil can be circular in character and behaves just like a circular advantage detector. The circular route is normally detected where there is generally optimum modification in pixel well worth by varying the radius of circular contour. The upper and low eyelids are detected through the utilization of parabolic curve as path for contour. Normalization is carried out using Daugman's rubber sheet model where in the circular iris region is normally unwrapped into rectangular block of arranged dimension. Features are encoded using 2-D Gabor wavelet and Hamming distance is utilized for template matching.

2.1 Iris recognition by Daugman's method [4]

A.J Dixit and K.S Kazi proposed the iris recognition system based on the Daugman's algorithm. The proposed method extracts the unique iris patterns of both the eyes and generates code for each pattern extracted. Then comparison of codes of different eyes is done for recognition. They have used the histogram equalization and Daugman integro-differential operator as the iris segmentation technique from the eye. Hamming distance is selected as the method for the matching purpose. Right here, the proposed function was applied on the data source of 50 pictures chosen out of 756 pictures from the CASIA data source. The system became effective against thresholding complications but it additionally was unreliable when there have been sounds in the picture.

2.2 Neural Network Approach to Iris Recognition in Noisy Environment [5]

Kamal Hazari et al proposed a recognition system that could work in a noisy imaging environment and improved the iris recognition price in CASIA and MMU iris datasets. This comprehensive research paper proposed two algorithms, first, an ground breaking way for removing noise from the iris picture and a combination of Local Binary Patterns (LBP) and Gray Level Co-occurrence Matrix (GLCM) which makes up a powerful feature extraction method.

Proposed framework provides been split into four primary steps, first may be the picture acquisition (regular iris databases CASIA and MMU are utilized), second one may be the iris preprocessing, here different steps have already been performed such as for example noise removal and recognition, iris localization, eyes and eyelid lashes removal and iris normalization. Following this comes the 3rd stage of feature extraction, right here linear rectangular changed picture (result of step two 2) provides been provided as insight and texture features provides been extracted using mixed strategy of LBP and GLCM structured texture properties. 4) Classification may be the last stage, in this two neural network structured classifier radial basis kernel and probabilistic neural network have been applied. Both classifiers are accustomed to discover which classifier provides better performance with regards to recognition rate,

for the proposed approach of noise reduction and feature extraction. The proposed strategy gave high recognition rate of 96.5% and low error rate and required much less execution time.

2.3 Iris recognition using combined support vector machine and Hamming distance approach [6]
Himanshu Rai and Anamika Yadav proposed a novel way for detection of iris patterns through the use of a combined mix of support vector machine and Hamming length. The proposed technique made use of the median filtering and then the parabola detection for the intended purpose of eyelid and eyelash detection and removal. They used circular Hough transformation for segmentation.

1D log Gabor wavelet the feature vector can be ideal for hamming distance nonetheless it is not really perfect for SVM centered classification. Predicated on intensive tests of different systems, mixed SVM and Hamming distance based classification strategy is finally chosen as the mixture of SVM and Hamming distance has a much better recognition precision than utilizing a single technique. These are the most important factors of applying different feature extraction methods and two classification methods. Experimental result demonstrates precision of the proposed technique is excellent for the CASIA when it comes to FRR & FAR.

2.4 Iris Recognition Based on GLCM and FFT Feature Set Fusion [7]
A. Alice Nithya et al has proposed something predicated on the GLCM algorithm when a fused feature set attained from Grey-Level Co-occurrence Matrix (GLCM) and this leads to the generation of Fast Fourier Transforms. GLCM is certainly a non-filter-structured technique, utilized to extract information regarding both distribution of pixel intensities and also the relative placement of community pixel values. FFT can be used to extract the phase frequency and elements domain magnitude information. This fused feature established helps to raise the overall program efficiency. Multi- course Support Devices (SVM) can be used for classification. A novel feature extraction technique provides been created which gives good recognition price with minimal feature vector size which will take benefits of both stage structured and texture structured top features of iris pictures. Iris images obtained in near infrared lighting reveals texture details to a larger level making texture evaluation based feature ways to offer higher reputation rate. Likewise, FFT really helps to recognize normalized cross correlation which assists to find the very best match between any two pictures.

2.5 IRIS Recognition using hybrid Technique, Methods of Moment and K Means Algorithm [8]
M. Afifa Afreen et al proposed a hybrid technique to import an iris image from the database and enhance the image using histogram equalization and 2D - DWT technique, method of moments is used to segment and extract the features of iris and then k means algorithm is used to cluster those segmented images and find the match between the resulting image and the image available in database using Euclidean distance formula. After calculating all of the moments initially of the image, it gets changed into grayscale and histogram equalization is performed then segmentation is performed and clustered using k means and Euclidean distance is used to discover the nearest matching picture from the data source, it offers great results with better precision and accuracy.

2.6 A Robust Iris Recognition Approach Using Fuzzy Edge Processing Technique [9]
Onkar Kaudki et al proposed an approach for iris recognition by extraction of edges by applying fuzzy logic along with iris detection by circular Hough transform. The proposed strategy results into improved robustness of iris detection due to the efficient edge detection. CHT is able to identify even the iris that is partially visible which ultimately helps to improve localization. The simpler iris feature extraction and template matching also helps to improve the computation speed. The algorithm presented in this work deals with the computational complexity for practical implementation of an iris recognition system using fuzzy set theoretic approach. The techniques and the approach implemented have proved beneficial in reducing computational time and achieving greater accuracy, with distinct and simple methodology.

2.8 IRIS RECOGNITION SYSTEM [10]
Shubhika Ranjan et al proposed a system in which the database of eyes obtained from standard camera is surveyed, the most imperative issue areas recognized, and the overall general recognition performance measured. The main point of the project is to review the initial pattern of the iris in the eye. From the paper, it was concluded that by using standard equipments, an iris recognition system can be constructed, and the performance of such a system depends largely on the characteristics of the acquired image.

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Table 1: Comparison of Methods for iris recognition

Paper	A.J Dixit and K.S Kazi	Kamal Hazari et al	Himanshu Rai and Anamika Yadav	Alice Nithya and Rani Krithiga	Afifa Afreen and I. Diana

Objective	Extraction of the unique iris patterns and generation of code for each pattern extracted.	Formation of dependable iris identification system that may function in a boisterous imaging environment.	Recognition of iris patterns is considered by using a mixture of support vector machine and Hamming distance.	Use of a fused feature set generated from Gray Level Co-occurrence matrix (GLCM).	Use of method of moments to segment and extract the features of iris.
Algorithm	Daugman's Algorithm	Neural Network Approach	SVM and Hamming Distance	GLCM Algorithm	K-Means Algorithm
Image Segmentation Technique	Histogram Equalization and Daugman's Integro-Differential Operator	Hough Transform along with noise removal	Circular Hough Transform and parabolic Hough transform	Circular Hough Transform	Histogram Equalization and 2D-DWT
Feature Extraction Method	Filtering the normalized image by Gabor Filters	Combined approach of LBP and GLCM	Haar wavelet decomposition and 1D Log Gabor Filtering	GLCM and Fast Fourier Transform	Method of Moments
Comparison Method	Hamming Distance	Classification using Possibilistic Neural Network	SVM along with Hamming Distance	Multi-class Support Vector Machine	K-Means Algorithm & Euclidean Distance
Size of Database	50 Images	400 Images	400 Images	80 Images	NA
Implementation	NA	MATLAB	MATLAB 7.8.0	MATLAB 2015a	MATLAB
Results	FAR – 0% FRR – 1% RR – 98.9%	FAR – 0% FRR – 3.5% RR – 96.5%	FAR – 0.09% FRR – 0.2% RR – 99.91%	FRR – 2.44% RR – 90%	FRR – 0.30% RR – 99.3%
Reliability	Medium	Medium	High	High	Low
Speed	Medium	High	Medium	Medium	Medium
Advantages	Maximum Efficiency and does not suffer from thresholding problems	Enhanced system performance in noisy imaging environments	Better recognition rate and efficient in case of identification and verification.	Classification accuracy is improved and provides rotational invariance.	Simple to implement and invariant to intensity of the picture
Disadvantages	Not reliable and usually fail when there are noises like reflection in the image	Calculation is very large and high cost in computation due to classification	Sensitive to the noise occurred during image acquisition	Frequently combines big sets of features	Quality is not comparable to the desirable optimal properties.

III. SUMMARY

After studying the above papers, various observations have been made. Some of the major observations are:

- Iris localization is performed using edge detection method such as integro- differential operator, Circular Hough transform and Sobel operator. For edge detection, threshold values need to be chosen to perform circular Hough transform. The thresholding problem is solved in integro- differential method but in that case there might be a failure of system if there occurs noise in eye image.
- Iris normalization can be performed using Daugman's rubber sheet model by resizing the image to a image of fixed dimensions so that it can be used for comparison and also the use of moments for normalization.
- Iris features are extracted using Gabor wavelets, drawing concentric circle on the iris image and extracting the intensity data at various points and extracting the statistical features.
- Feature matching can be performed by making use of Hamming distance and Euclidean distance. The bits generated from the iris are then evaluated with the help of Hamming Distance. Euclidean distance is used when template consist of integer values while elastic similarity is based on similarity measures. SVM classification can also be used for matching purpose.

IV. CONCLUSION

The review presented by this paper presents various methods proposed by different authors. The majority of the proposed methods follow the 5 basic measures - localization of eye, picture segmentation, normalization, feature extraction and matching. The Iris recognition program is among the best secure ways of authentication. The uniqueness of the Iris and low possibility of a fake acceptance or fake rejection all donate to the advantages of using Iris acknowledgement technology. Out of this survey it really is figured that iris recognition for images which are obtained from under much less constrained environments impose many problems, for the images acquired using noticeable imaging especially. After analyzing different techniques, it was also noticed that there is a need to build up recognition algorithms that can work for the iris pictures acquired under noticeable or near infrared lighting.

REFERENCES

[1] M. Singh and S. K. Sharma, "Review Paper A Review on Implementation of Biometric Iris Recognition," *IJCSE*, vol. 6, no. 5, pp. 630–635, 2018.

[2] N. Taneja, M. Shabaz, and V. Khajuria, "Iris Detection Using Segmentation Techniques," *Int. J. Comput. Sci. Eng.*, vol. 6, no. 9, pp. 442–444, 2018.

[3] J. Daugman, "How Iris Recognition Works," *IEEE Trans. Circuits Syst. Video Technol.*, vol. 14, no. 1, pp. 21–30, Jan. 2004.

[4] A. J. Dixit and K. S. Kazi, "IRIS Recognition by Daugman ‟ s Method," vol. IV, no. Vii, pp. 90–93, 2015.

[5] K. Hajari, U. Gawande, and Y. Golhar, "Neural Network Approach to Iris Recognition in Noisy Environment," *Phys. Procedia*, vol. 78, no. December 2015, pp. 675–682, 2016.

[6] H. Rai and A. Yadav, "Iris recognition using combined support vector machine and Hamming distance approach," *Expert Syst. Appl.*, vol. 41, no. 2, pp. 588–593, 2014.

[7] A. Nithya and R. Krithiga, "Iris Recognition Based on GLCM and FFT Feature Set Fusion," *Int. J. Pure Appl. Math.*, vol. 113, no. January, pp. 57–66, 2017.

[8] M. A. Afreen and I. D. Judith, "IRIS Recognition using hybrid Technique , Methods of Moment and K Means Algorithm," no. February, pp. 2–5, 2018.

[9] O. Kaudki and K. Bhurchandi, "Edge Processing Technique," *2018 9th Int. Conf. Comput. Commun. Netw. Technol.*, pp. 1–6, 2018.

[10] R. S. Shubhika Ranjan, Prabu Sevugan, P.Swarnalatha, Magesh Gopu, "Iris Recognition System," vol. 4, no. 12, pp. 354–356, 2017.

Authors Profile

Mr. Prabhat Kumar is currently pursuing Bachelor of Engineering + Master of Technology (Integrated dual degree) course in the field of Computer Science and Engineering from University Institute of Technology, RGPV, Bhopal. He has done several projects during the course. Currently, he is working on the project "Iris Recognition System for the thesis. He has won first prize in the Savishkar-iFast held at MANIT, Bhopal for the project WiBin. He has also participated in various national level innovation model competitions and technical events.

Mr. Manish Kumar Ahirwar is currently working as an Assistant Professor in Department of Computer Science, University Institute of Technology, RGPV, Bhopal. He has work experience of several years in the field of teaching. His research interests include Data Mining Algorithms, Internet of Things (IoT), Machine Learning and Cyber Security. He is a member of IEEE, ACM, IACSIT, IAENG. He has published more than 30 research papers in various International and National Journals and Conferences, including 4 papers in SCIE Journals and more than 10 papers in Scopus Journals. He has also published two Indian patents and two copyrights.

Mrs. Anjna Deen is currently working as an Assistant Professor in Department of Computer Science, University Institute of Technology, RGPV, Bhopal. She has work experience of several years in the field of teaching. Her research interests include machine learning and bioinformatics. She has published several research papers in various International and National Journals and Conferences.

