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An investigation of IRIS Recognition Techniques: A Literature Survey

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Abstract. Iris is a colored muscle located within the eye that helps to regulate the amount of light that reaches the eye. It has some specific textural details that is not easily altered or manipulated, making it a characteristic that is ideally suited to biometric systems. Iris has been considered in the field of biometric applications for authentication purpose. The main purpose of this study is, due to the stability and unique feature available in Iris region. Iris patterns play a major role in many possible identification or authentication applications due to their uniqueness, durability and stability, universality. Iris recognition techniques have evolved tremendously in biometric identification and authentication systems over the past two decades, since their evolution. The technique of Iris recognition is quantifiable, robust, and highly accurate so that it achieves the fundamental tenant of ideal biometric technology. Purpose of this paper is to include a timeline analysis of different iris recognition techniques and the development of a novel algorithm for the iris recognition system. This paper also discusses various methods used in performing the iris recognition measures involved.

Keywords: Authentication, Biometric, Iris Recognition, Robust, Textural details, Unique feature.

1. INTRODUCTION

Security is becoming more and more critical in today's world. In most of the fields where security is very much essential authentication role becomes significant. Authentication confirms the identity of the specific person. Biometric technology is an automated system based on physiological or behavioral features for identifying a person. Iris is considered as reliable and accurate among the existing biometric traits because of the rich texture of iris patterns[1]. The iris has unique characteristics, like furrows, crypts, coronas, Stripes, freckles etc. Every eye has a distinctive and stable pattern of iris throughout existence of the person. These features will be attractive towards the identification of people to be used as a biometric feature. The extraction of iris region of an eye image is an important activity in the iris biometric system. A typical components of an eye is as shown in fig.1.Enrollment process and matching process are the two important phases in Human iris recognition system. The “enrollment process” is the step that deals extraction of iris feature and store the same as a template in a database. We capture the important feature of an iris from a person during the process of matching and compare them with the stored characteristics in the “matching process”. These steps are challenging task and is thus split into many sub-tasks. The various steps involved in the two stages are shown in Figure 2. As is evident in

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Figure 2, the first four tasks in both stages are common. "Matching features" is an additional task in the process of matching. Among these tasks, iris localization is found to be the computationally more effective during iris recognition.

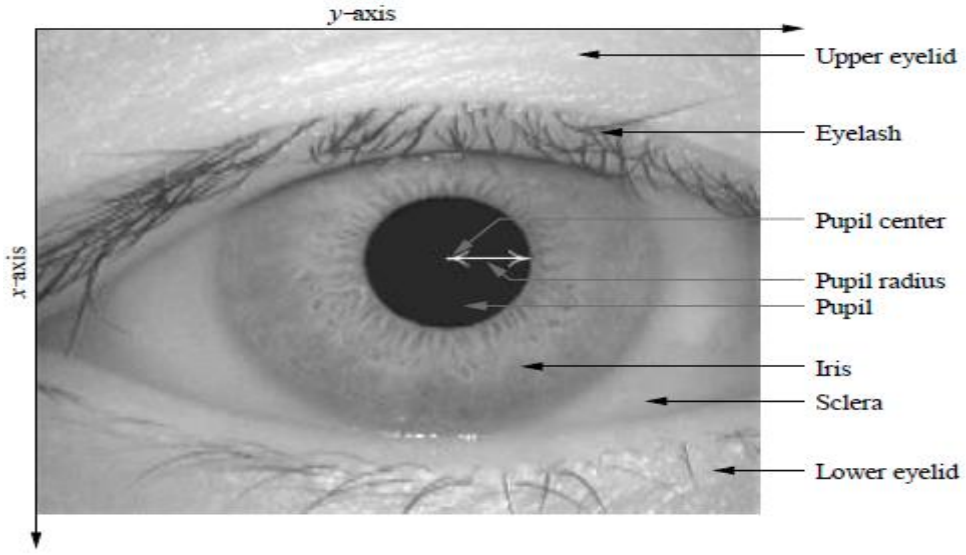

Figure 1. Components of an Eye image.

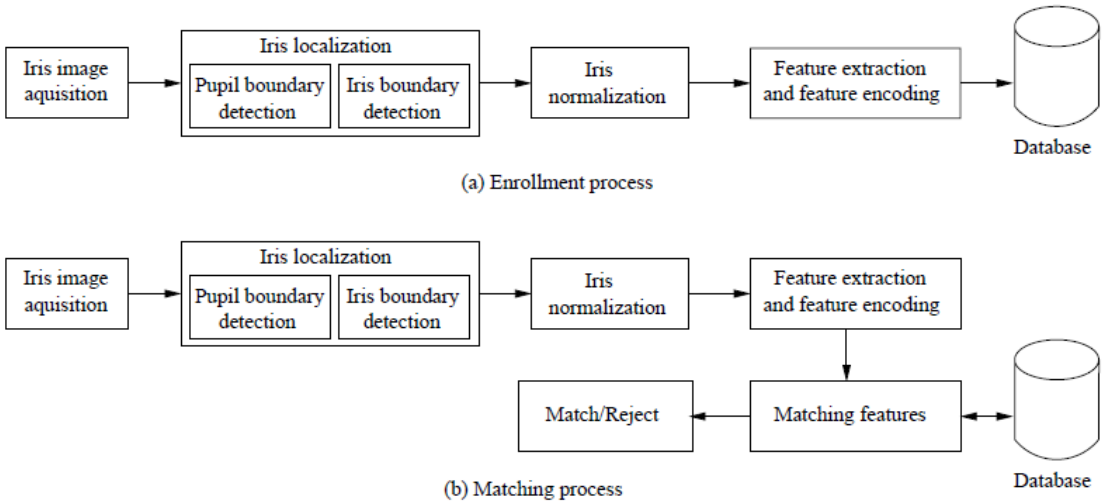

Figure 2. Iris Recognition System.

Iris size will be varies from one person other. In general iris diameter ranges from 10.2 to 13.0 millimeter. An average iris diameter will be 12 millimeter with a circumference of 37 millimeter.

2. NEED FOR THE STUDY

The next decade will be more interesting as many robust spontaneous iris recognition systems will be developed and deployed in various fields, such as border security systems, immigration control systems, access control systems for premises and equipment, maintenance of time and attendance. Degradation of image quality might results from illumination on an eye image. It is therefore necessary to develop an algorithm for automated iris recognition using advanced machine learning approach that can work on iris images acquired under visible or near infrared illumination.

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3. OBJECTIVES OF THE STUDY

The major objective of the research work is:

- To study and analyze the existing algorithms on iris recognition system.
- To develop a novel algorithm for the iris recognition system.

4. LITERATURE SURVEY

Person identification methodologies using of different biometric systems are explored and analyzed in this section. Basically, we are presenting research on techniques for segmentation and feature extraction.

In the proposed method, Juan Wang have implemented a multi level combination of algorithms using gray level co-occurrence matrix (GLCM) and 2D-Gabor filters are used generate a multi-granularity feature vector. Through multi-granularity scheme, extreme learning machine (ELM) is extracted. Using datasets of CASIA V-1 and CASIA V-4 experiments are carried out by the researcher. Results of the proposed work indicate ELM can learn faster due to the 16 fps speed[2].

Sunil S Harakannanavar ,have proposed an iris pattern in which uniqueness feature has been utilized by the author. Hough transform has been used by the researcher for the detection of boundaries of pupil and iris. Normalization is performed by using Dougman's rubber sheet model. Finally features are extracted using block based decomposition of empirical mode to analyze iris images. According to authors it is possible to achieve increased processing speed with great accuracy[3].

Alice Nithya A have proposed a Feature Extraction method to improve accuracy and efficiency of person identification and recognition. In contrast to every other biometric method, only one stable and accurate system is the iris-based biometric system. Authors have implemented the biometric system with different steps involving image segmentation, image normalization, and extraction and matching of image features. Through the results they have concluded improvement in performance, reliability, authentication and accuracy of the system[4].

Maryam Soltanali Khalili have described an approach using Segmentation and Feature Extraction method for iris Recognition. The iris has been the most important thing for researchers in the last few years. In order to guarantee the system's counteraction to error factors, researchers explore to build and provide effective solutions. They attempt to use a mask on the image in this research to eliminate unexpected factors affecting the iris location. Ocalization of pupils can be quicker and more robust. Finally the precise location of the iris can be found more easily. A simple canny edge detector method has been implemented in the proposed method to detect radius of the iris. The extraction of the iris features involves the use of DSWT2 (discrete stationary wavelets transform 2-D) to obtain the distinctive texture characteristics of the iris. Distinctive features are extracted using the DSWT2 tool and Symlet-4wavelet. Here authors have obtained the features by introducing the wavelet application and applying the feature selection method using criteria of similarity[5].

Abhishek Verma have implemented about a new iris recognition technique focused on a rigorous approach to iris segmentation to enhance the efficiency of iris recognition. In this paper, to increase the accuracy of the pupil area, the robust iris segmentation method on power-low transformation is used to significantly decrease the limbic boundary search region of people to increase accuracy and performance. The limbic circle has a detected centre with a near range of the pupil centre[6].

Here the authors T.Rajesh. A.Rajesh have introduced a novel methodology for iris recognition system. The techniques of automated iris recognition detection used in different phases are compared. Many techniques such as iris image acquisition, segmentation, normalization, feature encoding and matching were studied and compared in it. Here authors proposed transformation method to achieve robust system in normalization and segmentation. Authors have removed the iris image from the acquired image during segmentation. Here authors have described about a large set of data resources needed for segmentation[7].

Shaaban A. Sahmoud have presented their research contribution using Circular Hough remodel, as a different approach for pupil segmentation. Non-cooperative environments have gained enormous interest in the recognition of an iris. Here, proposed methods offer best outcome for the images taken under ideal conditions using near-infrared cameras. System accuracy decreases dramatically if the iris

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images are taken under non-ideal imaging conditions at visible wavelength. To discover and isolate the higher eyelids, a recent successful algorithm has been proposed by the authors. The proposed algorithm from the authors shows improved accuracy[8].

A. Radman have developed a high speed and accurate iris recognition technique for developing a system for restricted images. This novel algorithm is one of the important mechanisms for iris segmentation. The proposed system consumes a significant amount of time to locate and compute the rough location of the iris centre and eyelid borders. They have used the live-wire technique to extract the upper and lower eyelid boundaries. Experimental findings shows that proposed technique substantially minimises total time needed to segmentation process with high precision. To test the performance of the suggested algorithm, the UBIRIS, v1 iris image database has been used by the authors[9].

Lee Luan Ling have introduced the segmentation of Iris in this research. The segmentation of the iris is a main process involved in iris recognition. Subsequent feature extraction and identification has been done to achieve a greater accuracy in the propose system. In the proposed system, iris segmentation approaches are used by the authors to prevent their impact on real-time systems and make the device robust towards noise. It is deliberately designed to avoid unnecessary and redundant image processing and most importantly, to protect the integrity of details about the iris texture. The proposed system is able in recognize with greater accuracy compared to other methods[10].

F. Jan have projected the n-stage structure for iris segmentation. Proposed method was used for localization of human eye images of papillary and limbic boundaries. Here authors have presented an iterative approach instead of using time-consuming systematic search methods, such as conventional circular Hough Transform. It improves processing speed and module speed using decoupling coarse centre identification and finally locates the boundary. According to authors is possible to achieve increased processing speed and modular design. The proposed technique was tested on several datasets and compared with existing algorithms[11].

Maria Frucci have proposed a method using Watershed transform on noisy images acquired in visible wavelength for recognition of iris. Key points of the method proposed by the authors are i. preprocessing phase of the color-illumination correction. ii. Consideration of the parameters of transformation for accurate iris identification. iii. Implementation of a novel cost function in order to determine the radius described as potentially restricting limbs and pupils. Through this analysis authors identified that; segmentation process of iris has a beneficial effect on the iris code, which results in a more precise measurement, so that iris recognition efficiency is also enhanced. Accessing and comparing the performance of proposed method with other techniques are illustrated by the authors using UBIRIS 1 and 2 datasets[12].

Alaa Hilal have presents the segmentation of Iris in this paper as their major contribution. In an iris recognition scheme, segmentation is a basic step and difficult process in this scheme. When two circles approximate iris borders, the methods more precisely describe the iris, with better result. Authors have proposed an algorithm using Hough transform for accurate detection along with active contour for identification of iris boundary using circular approximation approach. Using Daugman's method, the normalisation, encoding and matching methods are applied. Here authors utilized CASIA-V3 database for testing and for Daugman's iris recognition system. Here performance of the method is measured using Region of Convergence curves, accuracy and Equal Error Rate. Finally authors conclude that they have proposed segmentation model for a better iris recognition system[13].

Using a representation scheme called Hierarchy Visual Codebook (HVC), Chun-Wei Tan, proposed image classification based method on texture knowledge. In order to sparsely represent iris textures, Vocabulary Tree (VT) and Locality-constrained Linear Coding (LLC) techniques are used. Results of HVC indicate that this technique helps to get improved image outcome for classification of ethnicity, iris vitality detection, and methods of recognition of coarse-to-fine iris. To extract characteristics from the segmented iris images, Gabor filters and ordinal filters are used[14].

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5. Comparative analysis

Table.1 describes the list of different methodologies used for iris recognition system along with the description including advantages, disadvantages, accuracy and performance study among these methods.

Table 1. Recent methodology in Iris recognition system.

No.	Method	Description	Advantage	Disadvantage
1	Random walker algorithm	It produces segmentation where the image is structured as graph to recognize similarities in pixels.	Simple to use, Easily handle flows around Complicated Boundaries.	Simple to use, Easily handle flows around Complicated boundaries.
2	Circular hough transform	Object edges are directly identified by making use of important features of global image and region of the iris.	Tolerant to the existence of differences in boundary definitions of features, This strategy is a robust towards noise.	High computational cost, Huge calculation, Substantial quantity of storage.
3	Region based active contour	Boundary or region of an iris is detected using deformation of an initial contour towards iris image.	Implementation of self adaptation towards detection of dynamic objects.	Higher accuracies Require longer Computation time.
4	Geometric key based iris encoding	Geometric key is for feature encoding	Fast and efficient encoding.	Influenced by Noise.
5	Canny edge detector	Used for detecting edges.	Detects edges, Low error rate	Sensitive to noise, Results in loss or additional edges for complex Images.
6	ZMs phase encoding	It is based on the orthogonal moments	Robust against different types of noise.	Computational complexity
7	SIFT - Scale invariant feature Transform	Identification of an image will be done using its Local features.	Robust against rotation and distortion	Additional steps are required for the transformation purpose
8	Power-law transformations.	Segmentation and enhancement of iris will be robust.	Improve and Increasing detection Accuracy and Efficiency.	Complicated system. Computational time need to be evaluated.

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6. CONCLUSION

After reviewing recent methods and their current limitations, research challenges for future work are highlighted in this section. For the current scenario, Iris recognition and its applications are very much essential hence it must be accurate and robust. Recently most of the researchers worked to provide the best possible outcome in images for person identification, but through our analysis we had the following observations. In the biometric recognition system Iris has proved its importance for the purpose of identifying a person. By considering few metrics like precision, accuracy and complexity, biometric systems are discussed during the evaluation purpose. This paper provides a study of emerging iris recognition technologies proposed by different researchers. Depending on the application suitable methods are used impressively for Iris localization, segmentation and filters for encoding purpose.

Due to the rapid growth of digitized information, the literature review stressed the need for Iris recognition in order to provide protection. Based on this work, it is concluded that while this field has seen considerable growth in the past two decades, there are still more potential domain areas available in which few approaches can be changed to use it for the current technology. The comparison of the result as in Table 1 shows the specific segmentation method towards better result for iris image segmentation with high accuracy and efficiency that preserves the required image quality. The next decade will be more interesting as many robust spontaneous iris recognition systems will be developed and deployed in various fields, such as border security systems, immigration control systems, access control systems for premises and equipment, maintenance of time and attendance. Degradation of image quality might results from illumination on an eye image. It is therefore necessary to develop an algorithm for iris recognition that can work on iris images acquired under visible or near infrared illumination. Along with this researchers can develop methods of deep learning to analyse and enhance the performance.

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