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A Review of Hybrid Approach on Feature Extraction and Classification of Different Methods Used in Iris Recognition System

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ABSTRACT
Iris recognition system is an accurate biometric system. As of late, iris recognition is created to a few dynamic zones of research, for example, Image Acquisition, restoration, quality assessment, image compression, segmentation, noise reduction, normalization, feature extraction, iris code matching, searching large database, applications, evaluation, performance under varying condition and multi-biometrics. This paper surveys a foundation of iris recognition and literature of recent proposed techniques in various fields of iris recognition system.
Keywords: Iris Pattern recognition, Feature Extraction, Iris Biometrics, Iris Enhancement and Iris Normalization.

I. INTRODUCTION

Due to higher need of security in public as well as in personal information aspects, vigorous sand reliable automatic recognition of individuals has been an attractive goal [1], [2],[5],[7],[8]. In public security and information security domain biometrics technology plays an important role. Biometrics is standard of comparison based on either physical or behavioral traits. Fingerprint, iris pattern are physical traits while voice, signature includes in behavioral traits. However, iris recognition is proven to be more beneficial as this accurately identifies each individual and also distinguishes one from another. The human iris is thin and annular region in eye located around pupil and covered by cornea, as shown in Figure 1, which able to provide unique and independent detail information of individual [3]. Random texture of protected iris is mostly stable throughout the life. Iris patterns are too unique even not only differ in between identical twins but also differ in between the right and left eye. Iris recognition requires comparing a register or enrolled iris template against a newly captured iris from eye of individual [9]. The iris recognition is applicable in identification as well as in verification mode. In identification mode recognition system identifies a person from entire register template by searching a database for matching. Identification is 'one to many' matching style [14]. In verification mode recognition system authenticate a person's claimed identity from their previously enrolled patterns. Verification is 'one to one' matching style.

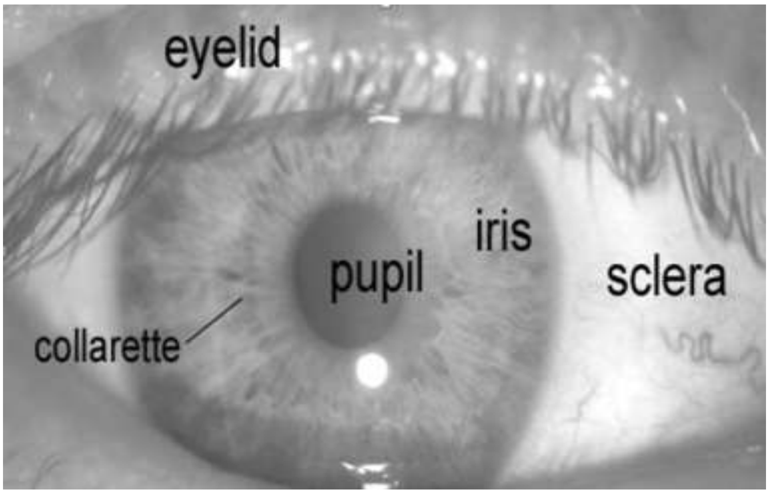

Figure 1: Human Eye.

II. IRIS BIOMETRIC SYSTEM

Among all physical biometrics, iris biometric systems are highly secure biometric systems that work at a low false acceptance rate (FAR) [1]. Applications of iris biometrics technology include: identification cards and passports, border control and other government programs, prison security, database access and computer login, schools, aviation security, hospital security, controlling access to restricted areas, entering to buildings and houses [2]. The United Nations High Commissioner for Refugees (UNHCR) used iris recognition for Afghan refugees [3]. Iris recognition is used in jails for the recognition of prisoners. Airports in U.K. United State [4], Canada [5], United Arab Emirates [6], and Singapore, Germany, and the Netherlands all use iris recognition at their boarders and immigration control [7, 8]. Iris biometrics has a number of benefits which are briefly mentioned below:

2.1 Stability over Time

The iris pattern does not change over time compared to other biometrics. Glasses, contact lenses, and even eye surgery does not corrupt the appearance and characteristics of the iris patterns [9-11]. Voice may change by aging or illness; fingerprint may not work for those individuals with no or few minutia points (e.g. this may be the case for surgeons as they often wash their hands with strong detergents, builders, and people with special skin conditions). In addition, finger ridge patterns can be affected by cuts, dirt, or tear. Finally, the face changes through age, surgery, accidents or make up [12, 13].

2.2 Ease of Collection

Due to the small size of the iris image, a database of iris image of a large population can be saved on a personal computer or a flash memory stick and carried [11-14].

2.3 Uniqueness

There is a large inter-class variability, which means large differences between individuals. Among all biometrics, the iris biometric is the most unique and robust biometric – even the iris patterns of twins are different [10, 13, 14].

2.4 Large Number of Features

An iris has more than 200 points, such as rings, furrows, freckles, and the corona [11].

2.5 Contactless, Hygienic

One of the advantages of iris recognition is being contactless. Comparing with fingerprint recognition which it is necessary to touch the finger print device, the iris recognition camera takes the image of eye from distance. In fingerprint biometric system which requires the individual to touch or contact the recognition device, the probability of diseases contagion is high. Due to iris recognition is contactless, the probability of diseases contagion is low, and therefore, iris recognition is known as a hygienic biometric system.

2.6 High Speed And Low Recognition Rate

High speed and low recognition rate, Capable of 1:N (identification) and 1:1 (verification) matching [14]. The contents of this paper are outlined as follows: section three provides a survey of proposed iris recognition systems, section four reviews the proposed methods in iris localization, noise reduction and normalization. Section five presents a literature of methods in image enhancement. Section six presents the literature of feature extraction and encoding and iris code matching. Section seven focuses on iris recognition and multibiometrics. The last section is devoted to the conclusion.

III. IRIS LOCALIZATION

Localization is used to detect the outer and the inner iris boundaries. It is an important step for exact iris matches as correct iris portion is required to generate templates [7]. Iris localization is done using different methods by different researchers some of which are given below:

- Propagation Path Loss
- Conventional Method
- Radial Suppression Edge Detection
- Clustering Based Coarse Iris Localization
- K-Mean Clustering Technique

Propagation path loss is the dropping of the signal level due to the terrain and manmade noise (buildings, bridges, etc.). The main drivers of propagation path loss are the distance of the mobile unit from the base station and the frequency of the channel. Co-channel interference involves disturbances occurring from two mobile units operating on the same channel. Another type of channel interference is adjacent channel interference, which occurs when energy from a carrier spills over into another carrier. Solutions to deal with channel interference involve a method of channel schemes either multiplexed or channelized, which was previously discussed. Multipath Fading involves disturbances due to the multiple paths of the signals between the transmitter and the receiver as a result of the terrain and man-made noise. Raleigh Fading are rapid fluctuations in the signal strength that occur in statistical distribution known as Raleigh. Finally, Doppler Shifts are variations in the frequency of the received signal caused by the relative motion of the mobile unit. These problems all bear an effect on the signal strength of the mobile unit.

IV. IRIS RECOGNITION SYSTEM

The concept of iris recognition was proposed as a reliable biometric for the first time in 1987 [3]. Many researchers like John Daugman, K.W.Bowyer, and Wildes etc. proposed many powerful iris recognition algorithms. Table 1 and 2 provide the comparison of algorithms and the evaluations of proposed iris recognition systems.

Method used in Iris Segmentation	Feature Extraction	Matching Process
Integral-Differential Operator	Binary Features Vector Using 2D Gabor Filters.	Hamming Distance
Active Contours And Generalized Coordinates	Iris Code	Hamming Distance
Image Intensity Gradient And Hough Transform	Laplacian Pyramid To Represent The Spatial Characteristics Of Iris Image.	Normalized Correlation
Circular Iris Shape	Zero Crossing And 1D Signals	Two Dissimilarity Functions: The Learning And The Classification
Gray Level Information, Canny Edge Detection And Hough Transform	1D Real-Valued Feature Vector Using Multichannel Spatial Filters With The Length Of 384	Nearest Feature Line
Gray Level Information, Canny Edge Detection And Hough Transform	1D Real-Valued Feature Vector Using Dyadic Wavelet With The Length Of 160	Weighted Euclidean Distance
Hough Transform	Direct Linear Discriminant Analysis (DLDA)	Hamming Distance

Table 1: Comparison of Iris Recognition Methods.

Method	Performance Evaluation
Integral-Differential Operator	Good recognition rate and provides a faster iris/pupil detection process on ideal iris images, not working on non-ideal images
Active Contours And Generalized Coordinates	Gaze deviation has been estimated, low time complexity
Image Intensity Gradient And Hough Transform	Matching process is time consuming. It may be suitable for identification phase not for recognition, not suitable for implementation
Circular Iris Shape	Relatively low recognition rate, faster matching process but high EER, simple 1D feature vector
Gray Level Information, Canny Edge Detection And Hough Transform	Relatively slow feature extraction process
Gray Level Information, Canny Edge Detection And Hough Transform	local features are used for recognition
Hough Transform	Improved performance on non-ideal dataset

Table 2: Comparison of Performance Evaluations of Method.

The degrees of freedom determine the biometric suitability with more independent dimensions of variations which provide much distinctive biometric. It has been found that iris has 266 degrees of freedom which is the highest among all the facial organs [4]. There is a large interest in improved, authentic, secure and genuine identification methods which are more useful. Biometric is the term given to the use of physical and behavioral characteristics to identify an individual. So it is more secure and reliable as one may lose identity card or password but not physical characteristics [5]. Human Iris is externally-visible part of the human eye.

V. IMAGE ENHANCEMENT

The process of improving the quality and contrast of an image is known as image enhancement. Usually normalized image is of low contrast and thus it needs to be enhanced so as it does not affect further processing and matching stages. Intensity variation is approximated across the whole image to get well distributed texture image [13]. Further processing is done by histogram equalization to enhance the lightening corrected image [7, 13]. This processing improves the contrast of the image which is then used for feature extraction and template matching [13].

VI. FEATURE EXTRACTION

Feature extraction technique is an important part of iris recognition used to determine iris representation that is inconsiderate to intra-class variations between image capture sessions [10].

- Wavelet Demodulation
- Log Gabor Filter
- Dynamic Wavelet Transform
- Discrete Cosine Transform

VII. MULTIBIOMETRICS

It applied a posterior union model (PUM) to provide face- iris multibiometrics. The XM2VTS or AR face database and CASIA iris database were used in this work. They divided the normalized face image into 16 regions and the iris region into 4 parts. It proposed a method based on a discrete wavelet transform and a kernel Fisher discriminant analysis using ORL face database and CASIA V1 iris database. It presented iris-face fusion method at the feature level using complex feature vector of iris and face feature vectors. Then, they applied complex Fisher discriminate analysis to increase the between-class scatter using CASIA V1 iris database and ORL and Yale face databases. It implemented a multimodal biometric system based on face and both irises fusion using a support vector machine.

VIII. HYBRID APPROACH

Recently, genetic algorithms (GA) and particle swarm optimization (PSO) technique have attracted considerable attention among various modern heuristic optimization techniques.[26] The GA has been popular in academia and the industry mainly because of its intuitiveness, ease of implementation, and the ability to effectively solve highly non-linear, mixed integer optimization problems that are typical of complex engineering systems. PSO technique is a relatively recent heuristic search method whose mechanics are inspired by the swarming or collaborative behavior of biological populations. Since the two approaches are supposed to find a solution to a given objective function but employ different strategies and computational effort, it is appropriate to compare their performance [25].

IX. CONCLUSIONS

This paper provides literature review of iris in several active areas of research, such as; image acquisition, restoration, quality assessment, image compression, segmentation, noise reduction, normalization, feature extraction, feature encoding, iris code matching, searching large database, applications, evaluation, performance under varying condition and multibiometrics. Iris recognition is a reliable biometric system and currently it is used in several real time user applications such as ATM machines, prisoner authentication, banking, border controls, and airport. Many new approaches with respect to image matching factor can be presented for iris detection and recognition system.

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