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EFFICIENT METHODS OF IRIS RECOGNITION

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ABSTRACT

Identification by biological features gets tremendous importance with the increasing of security systems in society. Various types of biometrics like face, finger, iris, retina, voice, palm print, ear and hand geometry, in all these characteristics, iris recognition gaining attention because iris of every person is unique, it never changes during human lifetime and highly protected against damage. This unique feature shows that iris can be good security measure. Iris recognition system listed as a high confidence biometric identification system; mostly it is divide into four steps: Acquisition, localization, segmentation and normalization. This work will review various Iris Recognition systems used by different researchers for each recognition step to identify strengths and weakness for each one that could be helpful for future research in this area.

KEY WORDS: Acquisition; biometric; iris recognition; localization; normalization; pattern matching; segmentation.

1. INTRODUCTION

Iris recognition is a method of identifying people based on unique patterns within the ring-shaped region surrounding the pupil of the eye. Iris has complex patterns that used as a biological characteristics, it is consider a form of biometric verification. Iris recognition is proving to be one of the most reliable biometric feature for personal identification. Iris patterns have stable, invariant and distinctive features for personal identification. This kind of system includes computer system security, secure electronic banking, border crossing systems, mobile phones and credit cards. The accuracy of iris recognition systems is proven to be much higher compared to other types of biometric systems like fingerprint, voice recognition and handprint (Sulochana & Ravindra, 2011). Iris recognition security systems are the most appropriate security system nowadays. It is truly a distinctive and easy way to identify a person. In this work, we will give a brief overview of different iris recognition system.

Recognition methods usually require a combination of various techniques, which span across all the four levels that are Image Acquisition, Preprocessing, Feature extraction and Matching. After requiring the eye image contains iris along with pupil and data derived from the surrounding eye region like sclera, eyelid and eyelashes. The acquired eye image has to be segmented to detect the iris, then calculating the features of iris and iris matching, it is very important to accurately segment and localize the iris from acquired eye image because the overall performance of iris recognition system is decided firstly by the fact that how accurate iris is segmented and localized from an eye image and secondly by the resolution of an image.

In this work, we provide background regarding the use and importance of the iris as a biometric in today worlds, the following section discuss briefly the anatomy of the iris, and section 3 discuss the main levels of iris recognition systems which consist; Image Acquisition, Pre-processing, Feature extraction and Matching. Section 4 highlight simulating works in this area and section 5 contains conclusion and plans for future work.

2. STRUCTUE AND FEATURES OF IRIS

The iris is a slim, circular structure in the eye that lies between the cornea and the lens of the human eye. The function of iris is to control the diameter and size of the pupil and thus the amount of light reaching the retina (Irsch & Guyton, 2009) . The average diameter of the iris is 12mm and the pupil dimension can vary from 10% to 80% of the iris diameter. The color and structure of two irises is genetically linked but the details of patterns are not. They have stable and unique features for personal identification. They are stable with age. The iris begins to form in the third month of gestation and the structures creating its pattern are largely complete by the eighth month, although pigment accretion can continue into the first postnatal years (Kronfeld, 1962). Its complex pattern can contain many distinctive features such as arching ligaments, furrows, ridges, crypts, rings, corona, freckles, and a zigzag collarets (Muron & Pospisil, 2000). The iris is a unique that there are no two iris alike, even twins. In addition, the iris patterns in the left and right eyes are different (Jain, 2005). These characteristics make it attractive for use as a biometric feature to identify individuals. Front view of iris seen in Figure1.

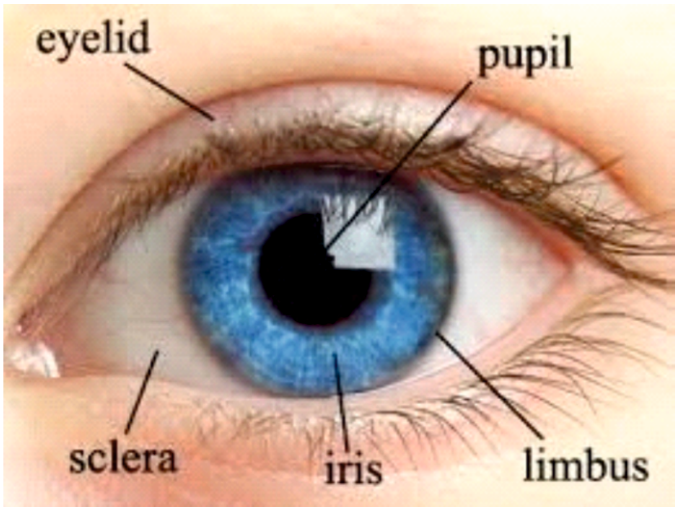

Figure 1. A front view of eye (Laney, 2006)

3. IRIS RECOGNITION SYSTEM

Iris recognition system mainly consists of four steps as shown in figure 2.

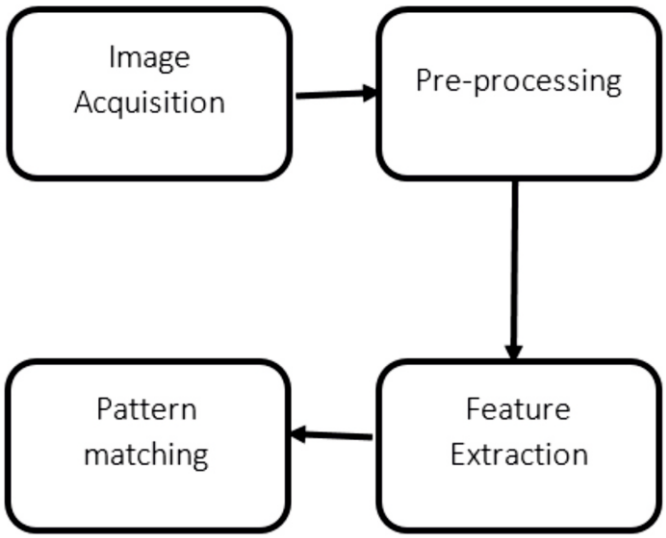

Figure 2. The general block diagram of Iris recognition system

3.1. Image Acquisitioning
The first step of the iris recognition system is image acquisition. This step is very complicated because of Differences in size and colour of the iris from one person to another. The acquisition distance for average capturing is 2 to 3 feet and the average time is 1 to 2 seconds. Sometimes the acquisition process produces different results for the same person due to the different environmental conditions like lighting effect, positioning and different separation of distance.

3.2. Pre-processing
Image pre-processing is a very important step in Iris Recognition System in order to get rid of the image noise, and prepare the iris image to better feature extraction. The captured image contains many parts of the eye not only the region of interest (iris) for that its necessary to implement main step which is localization of iris to isolate the iris region from the rest of the acquired image. Furthermore, the distance between camera and eye may be altered. The brightness also plays an important role, as it may have non-uniform caused by the position of the light source. These may impair the result of the texture analysis, for that it is necessary to pre-process the image and localize the iris to extract the important features to perform matching.

3.3. Feature Extraction
Feature extraction identifies the most distinct features for classification. Some of the features are x -y coordinates, radius, shape and size of the pupil, intensity values, orientation of the pupil ellipse and ratio between average intensity of two pupils. The features encoded to suit a format for recognition (Sheela & Vijaya, 2010).

3.4. Pattern Matching
To match the patterns, do comparison of features between eye image and stored patterns. The inter-class and intra-class variability are used as metrics for pattern classification problems (Sheela & Vijaya, 2010).

4. RELATED WORK
The concept of iris recognition was first proposed by Dr. Frank Burch in 1939 who use iris patterns as a method to recognize an individual (individual biometric: iris scan, 2002). In 1985, Leonard Flom and Aran Safir proposed the concept that no two iris are alike, and awarded a patent for the iris identification concept in 1987 (individual biometric: iris scan, 2002). Leonard Flom and Aran Safir approached John Daugman to develop an algorithm to automate identification of human iris. Since then a lot of work has been done in the field of iris recognition and usually recognition algorithms need a combination of various techniques. This work will review different substantial methods.

Daugman proposed an Integra-differential operator that finds the circles in image where the intensity is changing most rapidly with respect to changes in the radius. Once located, the iris image is converted to a Cartesian form by projecting it to onto a dimensionless pseudo-polar coordinate system. The features of iris are encoded and a signature is created using a 2-D complex-valued Gabor filter, where the real and imaginary parts of each outcome are assigned a value of 0 or 1 according to whether they are negative or positive. Then the two images are said to be independent if their fractional Hamming distance (Hd) is above a certain threshold, about .33. Otherwise, they are a match. Hamming distance (Hd) equals number of mismatching bits divided by number of compared bits (Daugman, 1993) (Daugman, 2003) (Daugman, 2004). This algorithm has been essentially error-free when applied to a very large database (Daugman, 2003).

Wildes et al. proposed recognition system consists of an image acquisition rig (low light video camera, lens, frame grabber, diffuse polarized illuminator, and reticle for operator positioning) interface to a Sun SPARCstation20. This system apply Laplacian pyramid and hierarchical gradient-based image registration algorithm in pattern matching to grab the images of iris and make routine procedures of iris recognition system efficient (Wildes, 1997).

Daouk et al. proposed iris recognition system, which involve a fusion mechanism of both a Canny Edge Detection and a Circular Hough Transform to detect iris boundaries. Then use Haar wavelet in order to pull out the deterministic patterns in a person's iris in the form of a feature vector. Wavelet tree was utilized for image coefficient's mapping. They use a database of 60 pictures and average correct recognition rate is 93%. The limitation of this work is that this methodology does not perform well in the occurrence of bad lighting, occlusion by eyelids, noises or inappropriate eye positioning (C.H. Daouk et al., 2002).

Boles and Boashash proposed an algorithm that locates the pupil center using an edge detection method, records grey level values on virtual concentric circles, and then constructs the zero-crossing representation on these virtual circles based on a one-dimensional dyadic wavelet transform. Corresponding virtual circles in different images are determined by rescaling the images to have a common iris diameter. They create two dissimilarity functions for the purposes of matching, one using every point of the representation and the other using only the zero crossing points. The algorithm has been tested successfully on a small database of iris images, with and without noise (Boles & Boashash, 1998).

Xu et al. proposed an improved system deals with eyelids and eyelashes detection and an alternative image enhancement method because the eyelids and eyelashes detection affects the iris image and produce noise which degrades the system performance. Subblock of eyelids/eyelashes models compared for detection purpose. To enhance the iris image, they subtract background and then filter the image by histogram equalizing and viener filtering. Derivation used for eyelids/eyelashes detection. The iris location finding rate is 98.42% in case of CASIA database (G.Xu, Z. Zhang , & Y. Ma, 2006).

5. CONCLUSION
Iris recognition systems have been an active area of research since long time and its applications are increasing day by day. It is used for security purpose in different areas like points of entry or exit in a building, tracing criminals, terrorist and missing children.

Accuracy of iris recognition is distressed by blurred, defocused and occluded images. This work review different methods applied in this area. These different iris segmentation and feature extraction methods each one having its own advantages and disadvantages. They use wavelets for iris localization and segmentation and use Gabor filters for coding. Comparison between Canny edge detection and other edge detection techniques proved that canny edge detector performance is much better. Finally, for template matching hamming distance method perform well.

We have recapitulated an overview of the latest research methodology available in iris biometric recognition. The survey of various existing techniques provides a platform for the development of the novel techniques in this area as future work.

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