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A Review on: Iris Recognition

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Abstract- Iris recognition, a biometric technique used in high profile applications such as border crossing systems, single factor identity verification for the ATM users, India's Aadhaar project, Airport security. Its robustness and unobtrusiveness make it superior entrant to reinstate most of the security system around. Iris recognition is listed as a high confidence biometric identification system as the recognized delicate texture stays the same for several decades. It's not possible for two irises to produce the same code. In this review paper, here examine steps involved in Iris Recognition system and to evaluate various Iris Recognition techniques used by different researchers for each recognition step.

Keywords-- Iris, Biometric, segmentation, template matching

I. INTRODUCTION

Iris recognition replaces the traditional system like one need to remember PIN, password or to posses tokens (identity cards, keys etc.). Identification through Iris recognition is an emerging issue in civilized societies. A person is an authorized user before entering confidential area, committing transactions. In the biometric world, identification of human being deals with their physiological and /or behavioural characteristics [1]. Fingerprints, face, retina scanning, ear shape, hand geometry are physiological characteristics based biometric and behavioural characteristics based biometric deals with attitude of a person like voice, gait, signature etc. Iris deals in identification of human being based on their physiological characteristics. Furthermore, the quality, universality, permanence, collectability and unique information measured in a single iris are much greater than other biometric information [1, 5].

Iris is the coloured round shaped internal organ that controls the pupil's size which serve to regulate how much light can penetrate the eye [2]. The structure creating iris patterns are largely completed by the time a human is about eight month old. The iris patterns formed are unique as much as no two Irises are alike even if they are from identical twins or the left to right eye in the same person.

A front outlook of iris is shown in Fig. 1.

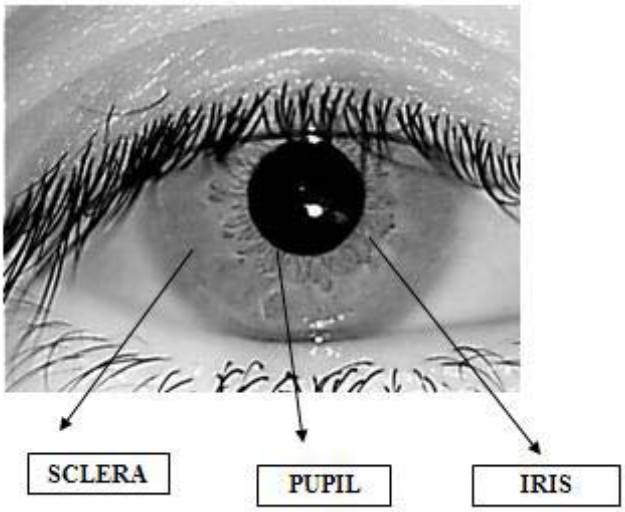

Fig. 1 Human iris

II. RELATED WORK

A lot of work has been done in the field of biometric iris recognition and some of the research articles discussed in this section.

Daugman [5] proposed first working methodology related to the iris biometrics. In this, Daugman makes use of an integro-differential operator for locating the circular iris and pupil region, and also the arcs of the upper and lower eyelids. The operator searches for the circular path where there is maximum change in pixel values, by varying the radius and centre x and y position of the circular contour. The operator is applied iteratively with the amount of smoothing progressively reduced in order to attain precise localization. Eyelids are localized in a parallel manner. The integro-differential can be seen as a variation of the Hough transform, since it too use of first derivatives of the image and performs a search to find geometric parameters. Since it works with raw derivative information, it does not suffer from thresholding problems of the Hough transform. However, the algorithm can fail where there is noise in the eye image, such as from reflections, since it works only on a local scale.

Daouk et al. [2] proposed iris recognition schemes which involve a fusion mechanism of both a Canny Edge Detection scheme and a Circular Hough Transform, to detect the iris's boundaries in digital image of an eye. Then Haar wavelet is used 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 where a database of 60 pictures was used 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.

Noh et al. [3] introduced a new technique of feature extraction where in this instead of using wavelet transform an adaptive method of feature extraction was introduced in which two types of Global and Local features were extracted from wavelet coefficient. Polar coordinates system was used for the mathematical modeling of the system. Global features are invariant to the eye image rotation and the imprecise iris localization. The customized geometric moment is used for representing global iris feature. Local features provide precise information regarding iris. The main reason to introduce this approach was the absence of shift-invariant property in Discrete Wavelet Transform (DWT) and the methodology Which does not include shift-invariant property can't provide exact texture analysis.

Xu et al. [4] proposed an improved iris recognition system which deals with the eyelids and eyelashes detection and an alternative image enhancement method. The main reason for considering eyelids and eyelashes detection is that the presence of these affects the iris image and produce noise that results in the degradation of system performance. Sub-block of eyelids/eyelashes models compared for detection purpose. For enhancement of iris image subtraction of background was done. Filtering is performed by histogram equalizing and viener filtering. For eyelids/eyelashes detection summary derivate was used. The iris location finding rate is 98.42% in case of CASIA database.

Azizi et al. [6] proposed a work which deals with using features extraction and subset selection. Iris features were extracted using contourlet transform; it captures the intrinsic geometrical structures of iris image. Iris image was further decomposed into sub-blocks that contain all texture information. This technique utilizes Support Vector Machine (SVM) for matching the iris templates. Gabor filter and Haar wavelet were used in this work for coding purpose. Iris vector was created using Principal Component Analysis (PCA). The performance of the proposed system was checked against CASIA image database.

Gupta and Saini [**8**] evaluated the existing performance of iris recognition systems by using Matlab Image Processing Toolbox. The proposed technique consisted of several basic step including image acquisition, segmentation (to detect circles of pupil and iris boundary through Daugman's filter), normalization (for creating rectangular block of fixed size through rubber sheet model), image enhancement (to convert low contrast image to high contrast image and minimize non-uniform illumination by applying Gabor filter) and image matching (to perform template matching region and different iris images are represented as with the help of Hamming distance). The main advantage of the proposed technique is that promise accuracy and performance can be achieved even if images are taken from a distance.

III. IRIS RECOGNITION SYSTEM

Image Capturing/Acquisition:

The first stage is one of the major challenges of automated iris recognition since we need to get the iris images series from human using specially designed cameras. Iris and pupil part should be clearly visible in these images but sometimes it depends upon images taken in which environment condition [1]. Also, several free databases exist on the internet and image can be taken from, for the testing usage and a well known database is the CASIA Iris Image database. Other database exists, such as the LEI and the UPOL.

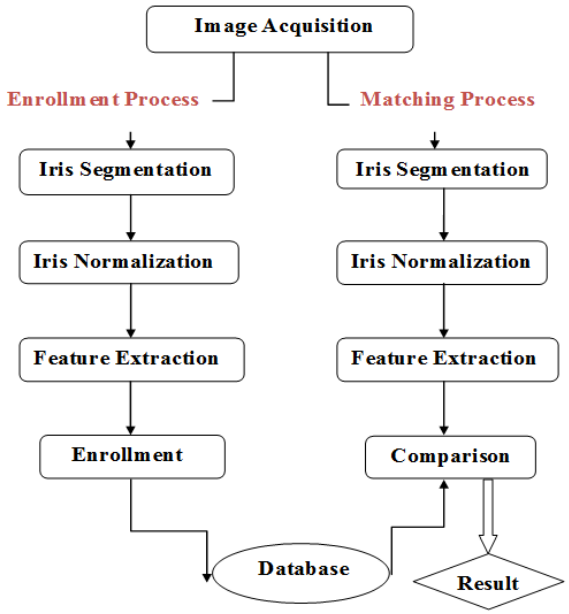

Fig. 2- Steps in Iris Recognition Process

Iris Segmentation and Location:

Iris recognition is based on the fact that iris contains unique features that are completely distinguishing a person; the actual information we are looking for is found within the iris patterns [10]. So, necessary to isolate the iris region from the other parts of image and to detect outer and inner contours of the iris boundary as well [4].

Algorithm Used:-

- To convert the input image into binary edge map using feature detection operators [2].
- Applies the Hough Transform to find a circumference in image to describe the iris contour and pupil contour.
- Defined a three- dimensional centre coordinates (cx, cy) and radius r of circle passing through each edge point.

- Hough Transform for circular boundary is defined as

$$(x - xc)2 + (y - yc)2 = r2$$

Three dimensional generalized Hough space.

Given an edge point (x,y),

1. Loop over all values of (xc, yc),
2. Compute r
3. Increment H (xc, yc, r)

Normalization Stage:

This technique is based on transforming the iris in polar coordinates to make it persistent and unvarying in nature against the effect of variation in size of the pupil. Normalization process is carried out by unwrapping of iris region into rectangular strip. Daugman's Rubber Sheet model is commonly used.

Feature Coding:

Feature coding identifies the most important feature for categorization. For accurate recognition of personals, the dominating information present in an iris image must be extracted in a precise manner [8]. The iris region is encoded using wavelets to construct the iris code [6]. Gabor wavelet, 1D Log-Gabor wavelet filters used for coding process.

Matching Algorithm:

After generate of iris code, need to compare this iris template with stored template in database during enrollment and see if any matches occurs [10]. Hamming distance is used for compares between bits. It is measured as difference in the number of bits between two templates. If comparison gives score zero, then both iris templates are exactly same that is irises matches and a score one represent exactly opposite irises. Another matching technique can be used is Weighted Euclidean distance.

IV. CONCLUSION

Iris recognition is one of most effective method for identification of human being. This paper provides review on various existing methods proposed by different researchers from time to time for iris recognition. Most of the time for iris segmentation and localize, wavelets are effective solution and for coding purpose Gabor filters are used. Canny edge detector with Hough Transform performance is much better compare to other edge detection techniques. And finally for template matching hamming distance method perform well**.**

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