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Iris Recognition Based on Extreme Point Identification using Feature Extraction

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Abstract: The use of human identification has become increasingly in demand in today's society. The human iris is one of the most unique biometrics available to use in the identification of an individual. A biometric is characteristic of human body that can be used to uniquely identify a person.The common iris biometric algorithm represents the texture of an iris using a binary iris code. This paper proposes, Iris recognition consist of pre-processing by eyelash occlusion based on extreme point identification, feature extraction by mean thresholding and mean by median thresholding and matching of iris code by fusion of hamming distance and fragile bit distance. Proposed method will achieve good recognition rate.

Keywords: occlusion, extreme point, feature extraction, mean thresholding, mean by median thresholding.

I. INTRODUCTION

A biometric is trait or characteristic of human body that can be used to uniquely identify a person [1]. Biometrics has been put into practice for a variety of application. The most common ones used include fingerprint, voice patterns or iris pattern [2]. The objective of biometric system is to be able to represent this unique trait or characteristic into a template. The template is then compared with others in order to identify a match. Iris recognition is an automated method of biometric identification that uses mathematical pattern-recognition techniques on one or both of the irises of an individual's eyes, whose complex random patterns are unique, stable, and can be seen from some distance. The texture of an iris is very stable, complex, and unique throughout life. Iris patterns have a high degree of randomness in their structure. This makes them unique. The iris is a protected internal organ and it can be used as an identity document or a password offering a very high degree of acceptance. The human iris is immutable over time.

It has been observed that eye is rich source of information; it has many discriminative features, which can be used for user identification. The unique iris patterns of digitized image of the eye is extracted from some of the image processing technique and encode into a biometric feature vector, which can be stored in a reference database. The mathematical representation of the unique information of iris is contained from the biometric template, these template are made comparisons to authenticate. In this paper, we are describing the overall process of iris recognition. The process of recognizing a human iris is split into three steps. These steps are preprocessing, feature extraction and matching. Preprocessing includes detection of iris boundary, removal of occluded part of iris. In the next step of iris recognition features of iris are extracted. Using extracted features binary code is generated and matching of iris is done by fusion of hamming distance and fragile bit distance.

This paper is organized as follows: Section II presents the literature survey. Section III shows proposed technique. Section IV describes pre-processing step. In Section 5, we present feature extraction methods. In section 6, we are discussing about matching/authentication of the iris.

II. LITERATURE SURVEY

There are two main eyelash occlusions detection methods: Daugman [3] used the sector of iris with the angle from $\pi/4$ to $3\pi/4$ as the eyelash occlusions region, Libor [4] used two lines located in the upper and lower pupil to cut iris images, and the upper region is the eyelash occlusions region.

It has been observed that eye is rich source of information; it has many unique features, which can be used for user identification. Lin and Lu [5] have used image normalization techniques on iris image as preprocessing to reduce the image size. Lin [6] proposed iris recognition method in which features like eyelashes were removed.

Iris features are first extracted by Dr. John Daugman [7]. Daugman observed that 2D Gabor filters showed similar frequency and orientation to those of the human visual system [8, 9]. Other work in iris recognition was Zero-crossings of the 1D wavelet are extracted when a signal is decomposed into a set of signals. They are represented using sets of complex numbers to create a feature vector [10]. For matching of iris code hamming distance was used which gives high EER (Equal Error Rate).

III. PROPOSED TECHNIQUE

Fig.1. Shows process of iris recognition consists of pre-processing eyelash occlusion detection based on extreme identification, feature extraction, Iris matching.

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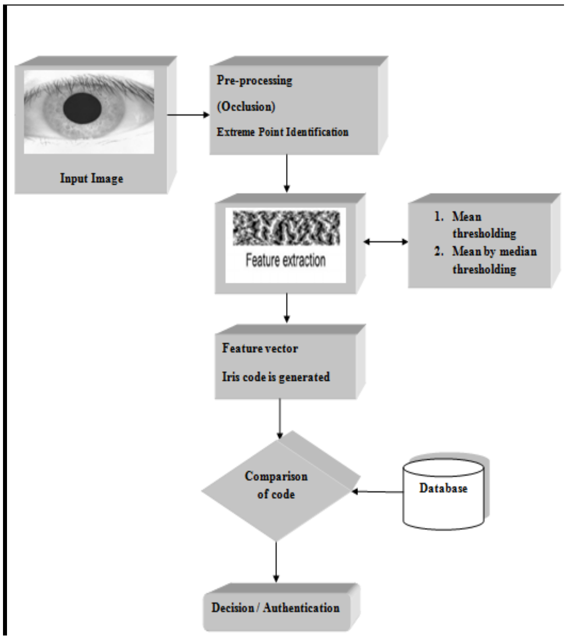

Fig.1. Process of iris recognition

i. Pre-processing

By analyzing the structural characteristics of eyelashes, here a method for eyelash occlusion detection based on extreme point identification has been explained [11].

A. The Outer Circularity Region of Iris

By using location method inner and outer boundary of iris is determined. In order to get the outer circularity region of iris, the useless area needs to be eliminated.

B. Image Binarization

Binarization is the process of converting pixel image into binary image. By using, Median filters which is one of effectively noise suppression method. Noise will be removed.

$g(x, y) = \text{med} \{ f (x-k, y-1),(k,1 \in W)\}$

C. Image Thinning

Thinning is a morphological operation that is used to remove selected foreground pixels from binary image. Basic idea of all is using a structure element to delete the boundary points until the skeleton is obtained.

D. Extreme point Identification

By using, feature points identification method extreme points of eyelashes will be identified. Feature points extraction method can be simply divided into feature extraction directly from gray-scale image and extraction from thinning binary image [11].

E. The Outer Circularity of Iris

In this the upper intersection region of the eyelash occlusions region will be generated.

ii. Feature Extraction

Feature extraction is the process of obtaining useful information from iris which is helpful for authenticating the person [16]. To create feature vectors, mathematical operations are performed on the input image and the results are used to create the feature vector when image is normalized [12]. In our methods, the top right part of the iris is used by unwrapping using Daugman's Rubber Sheet model for normalization [9]. A feature vector needs to be compared to the database in order to identify the person whom it belongs to.

The proposed methods use sliding windows technique [12]. The methods used are as follows:

A. Method 1: Mean Thresholding

The normalized image section taken is 5x130. A 1x11 sliding window is used on each row, beginning with column 6 up to column 125.

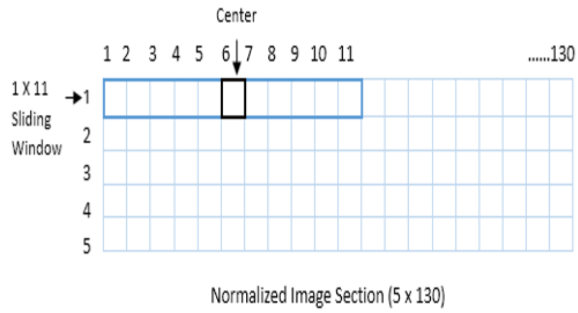

Fig 2. Mean Thresholding

The procedure of performing this method includes the following steps in sequence:

1. Centre the window at column 6 in the first row. Take the 5 preceding pixels and 5 succeeding pixels.
2. Find the mean value of these pixels and set as threshold.
3. Test the centered pixel. If the value of the pixel is greater or equal to the threshold, set the pixel as 1, else set it to 0.
4. Repeat the steps until column 125.

The size of the resulting binary feature vector is 5x120.

B. Method 2: Mean-by-Median Thresholding

The section taken from the normalized image is 5x130. A 1x25 sliding window is used from the first column to the last.

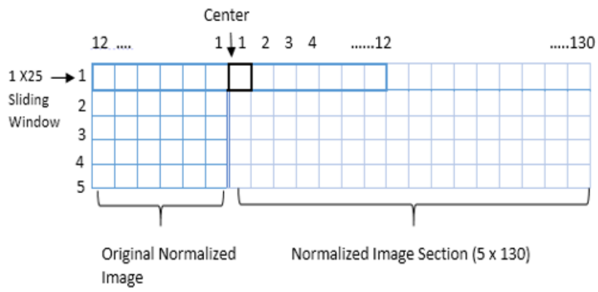

Fig 3. Mean-by-Median Thresholding

The following steps summarize how this method works:

1. Centre the window at the first pixel in the first row. Concatenate last 12 columns from the original normalized iris image to the beginning of the section.
2. Calculate the mean and median of the 12 preceding and succeeding pixels.
3. Calculate the threshold using the equation:

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$$\text{Threshold} = \sqrt{\text{Mean X Median}}$$

4. If the centered pixel is greater than the threshold, set it as 1, else set it as 0.
5. Shift the window to the next pixel and repeat steps until pixel 130 is reached in the row.
6. Concatenate the first 12 columns from the original normalized iris image to the end of the section taken.
7. Begin with the next row and repeat steps until all rows are complete.

The resulting binary feature vector size is 5x130.Table I shows recognition rate and size of feature vectors produced by proposed methods without applying above preprocessing methods.

TABLE I Recognition Rates and Feature Vector Sizes

Methods	Recognition Rates	Feature Vector Size
Mean Thresholding	98.3264 %	600
Mean-by-Median Thresholding	98.3264 %	650

iii. Iris Matching/Authentication

A. fragile bit distance:

The iris biometric algorithm represents the texture of an iris using a binary iris code. Not all bits in an iris code are equally consistent [13]. The concept that some bits in the iris code are less consistent than others was first published by Bolle et al [14]. A bit is fragile if its value changes across iris codes created from different images of the same iris. By masking fragile bits iris recognition performance improved. Rather than ignoring fragile bits completely, by considering beneficial information obtained from the fragile bits performance can be improved. Fragile bit distance is metric which quantitatively measures the coincidence of the fragile bit pattern in two iris code. Score fusion of fragile bit distance and Hamming distance works better for recognition than Hamming distance alone. Bolle et al. suggested that …"perhaps not all bits are equally likely to flip there are some particularly fragile bits."[13]. Steps for the generation of fragile bits [15].

1. Compare iris codes from the multiple aligned images of the same eye.
2. Aligned and compare this iris code to find average value for each bit.
3. Fragile bits come from the coarse quantization of the filter response.

Even though FBD is not powerful as HD, we can combine the features to create a better classifier than HD alone. For Combine HD and FBD weighted average technique is used. In these technique each item is being averaged is multiplied by some number based on relatively importance. We combine two scores using the equation [13].

$$score_w = \alpha \times HD + (1-\alpha) \times FBD.$$

The proposed fusion between Hamming distance (HD) and fragile bit distance (FBD) works well than of Hamming distance alone.

IV. OBSERVATION

Many papers implemented iris matching/authentication using hamming distance or fragile bit distance, but fragile bit distance is less powerful than hamming distance, combine the two parameters and it do better than Hamming Distance alone [15] called as equal error rate (EER). The EER decrease to 8.45×10^{-2}.

TABLE II EER RATE

Method	Equal Error Rate
HD(baseline)	9.23×10^{-2}
HD × FBD	8.45×10^{-2}

V. CONCLUSION

In this paper, we discussed occlusion detection based on extreme point which will work as pre-processing of iris image, feature extraction and iris matching for the iris recognition. By using these techniques we can improve overall performance of the iris recognition system.

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