Iris Recognition – A Biometric

Soni B. Bhambar
Dept. of Comp. Science & Engg.
Government College of Engineering,
Aurangabad, India
bhambar.soni03@gmail.com

Shubhangi Sapkal
Dept. of Comp. Science & Engg.
Government College of Engineering,
Aurangabad, India
shubhangi_parde@yahoo.com

***Abstract*—Most accurate biometric technique used nowadays is Iris Recognition. It identifies the unique patterns of iris present between the pupil and the sclera. Its recognition accuracy is very high due to high Degree Of Freedom. The novel algorithm to implement the iris recognition system has been proposed in this paper. The iris recognition system consists of iris localization in which iris is located by calculating the inner and outer iris boundaries occluding eyelids and eyelashes. After the iris localization step, the image is normalized using the Daughman's Rubber sheet model. Then the Gabor filter is adopted for iris feature extraction and matching of the input image with that of the images present in the database is done using the Euclidean Distance method.**

***Keywords*—Iris Recognition, Biometric, Degree of Freedom, Iris Localization, Iris Normalization, Euclidean Distance.**

I. Introduction

Biometrics technology using advanced computer techniques is now widely adopted as a front-line security measure for both identity verification and crime detection, and also offers an effective crime deterrent. Biometric techniques [3] are used for the purpose of identifying individual by using unique characteristics of each person deterrent. A term derived from ancient Greek: 'bios' meaning 'life' and 'metric', 'to measure'.

A biometric system can operate in the following two modes

1. **Verification** (authentication) refers to the problem of confirming or denying a person's claimed identity (Am I who I claim I am?).

2. **Identification** (Who am I?) refers to the problem of establishing a subject's identity - either from a set of already known identities (closed identification problem) or otherwise (open identification problem).

Biometric characteristics can be divided in two main classes

a. Physiological are related to the shape of the body. Examples include fingerprint, face recognition, DNA, Palm print, hand geometry, iris recognition, which has largely replaced retina, and odour/scent.

b. Behavioral are related to the behavior of a person. Examples include, but are not limited to typing rhythm, gait, and voice. Some researchers have coined the term **behaviometrics** for this class of biometrics.

A. *Features of the Iris*

The human iris is rich in features which can be used to quantitatively and positively distinguish one eye from another. The iris contains many collagenous fibers, contraction furrows, coronas, crypts, color, serpentine vasculature, striations, freckles, rifts, and pits. Measuring the patterns of these features and their spatial relationships to each other provides other quantifiable parameters useful to the identification process. In practical terms, statistical analyses indicate that the Iridian Technologies IRT process uses 240 degrees-of-freedom (DOF), or independent measures of variation to distinguish one iris from another.

The availability of this many degrees of freedom allows iris recognition to identify persons with an accuracy that is orders of magnitude greater than other biometric systems.

This paper proposes various steps for iris recognition that include Iris localization, Iris Normalization, Iris feature Extraction, Matching and then Results.

II. Iris Localization

This step is very important for the performance of Iris Recognition. The proposed algorithm for Iris Localization includes three steps viz. inner boundary localization, outer boundary localization and then eyelids and eyelashes detection.

A. *Inner boundary localization*

In order to determine the iris inner boundary, the location of the pupil center is required. First the gray levels histogram for the eye image is plotted and analyzed. Then, a threshold value T is determined as the intensity value associated with the first important peak within histogram. Then, all intensity values in the eye image below or equal T are changed to 0 (black) and above T are changed to 255 (white), as:

$$g(x, y) = 255, \text{ if } I(x, y) > T$$
$$g(x, y) = 0, \text{ otherwise} \quad (1)$$

where, I (x, y) is the intensity value at location (x, y), g (x, y) is the converted pixel value and T represents threshold.

This step converts a gray image to binary image and segments the pupil from the rest of the eye image. Pixels are removed using morphological processing which are located outside the pupil region. Noise is removed by using the dilate operator. Center of pupil is the balance point where there is equal mass in all directions. Then integrodifferential operator is applied for locating iris boundary.

B. *Outer boundary localization*

As both iris boundaries are approximately circular and the intensity of the iris is limited between pupil and sclera, an approach based on image integral projection function is decided to locate the outer iris boundary.

C. *Eyelids and eyelashes detection*

To locate the lower and upper eyelids, Canny edge detector is applied to generate the edge map, then a line is located using Hough transform. After that to isolate the eyelashes, a simple thresholding technique is applied within the segmented iris region [4][5].

III. Iris Normalization

For normalization of iris regions a technique based on Daughman's rubber sheet model is employed. The centre of the pupil is considered as the reference point, and radial vectors pass through the iris region. A number of data points are selected along each radial line and this is defined as the radial resolution. The number of radial lines going around the iris region is defined as the angular resolution. A constant number of points are chosen along each radial line, so that a constant number of radial data points are taken, irrespective of how narrow or wide the radius is at a particular angle. The normalized pattern is created by backtracking to find the Cartesian coordinates of data points from the radial and angular position in the normalized pattern. Normalization produces a 2D array with horizontal dimensions of angular resolution and vertical dimensions of radial resolution.

IV. Iris Feature Extraction

Feature Extraction is implemented by convolving the normalized iris pattern with 1D Log-Gabor wavelets. The 2D normalized pattern is broken up into a number of 1D signals, and then these 1D signals are convolved with 1D Gabor wavelets. The output of filtering is then phase quantized to four levels using the Daughman method with each filter producing two bits of data for each phase. The output of phase quantization is chosen to be a grey code. The extraction process produces a bitwise template containing a number of bits of information and a corresponding noise mask which corresponds to corrupt areas within the iris pattern, and marks bits in the template as corrupt.

V. Matching

For matching, the Hamming distance is chosen as a metric for recognition, since bit-wise comparisons are necessary. The Hamming distance algorithm employed also incorporates noise masking, so that only significant bits are used in calculating the Hamming distance between two iris templates. Now when taking the Hamming distance, only those bits in the iris pattern that corresponds to '0' bits in noise masks of both iris patterns will be used in the calculation.

VI. Conclusion

In this paper, various algorithms for Iris Recognition are presented. For iris localization, a method to find out the inner and outer boundaries of iris is proposed for giving better results. In iris normalization, the normalized pattern is created by backtracking to find the Cartesian coordinates of data points from the radial and angular position in the normalized pattern. The features are extracted using Gabor log filter and matching is done using the method of Hamming distance.

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