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# Performance Evaluation of Iris Region Detection and Localization for Biometric Identification System

Chit Su Htwe, Win Htay



***Abstract*—**The iris recognition technology is the most accurate, fast and less invasive one compared to other biometric techniques using for example fingerprints, face, retina, hand geometry, voice or signature patterns. The system developed in this study has the potential to play a key role in areas of high-risk security and can enable organizations with means allowing only to the authorized personnel a fast and secure way to gain access to such areas. The paper aim is to perform the iris region detection and iris inner and outer boundaries localization. The system was implemented on windows platform using Visual C# programming language. It is easy and efficient tool for image processing to get great performance accuracy. In particular, the system includes two main parts. The first is to preprocess the iris images by using Canny edge detection methods, segments the iris region from the rest of the image and determine the location of the iris boundaries by applying Hough transform. The proposed system tested on 756 iris images from 60 eyes of CASIA iris database images.

***Keywords*—**Canny, C#, hough transform, image preprocessing.

## I. INTRODUCTION

A biometric is the measurement of a physical characteristic or personal trait [1]. Biometric based methods are the most reliable solutions for authentication and identification applications where traditional passwords (knowledge-based security) and ID cards (token-based security) have been used so far to access restricted systems. Whenever people log onto computers, access an ATM, pass through airport security, use credit cards, or enter high-security areas, they need to verify their identities. People typically use user names, passwords, and identification cards to prove that they are who they claim to be. However, passwords can be forgotten, and identification cards can be lost or stolen. Thus, there is tremendous interest in improved methods of reliable and secure identification of people. Biometric methods, which identify people based on physical or behavioral characteristics, are of interest because people cannot forget or lose their physical characteristics in the way that they can lose passwords or identity cards. Biometric methods based on the spatial pattern of the iris are believed to allow very high accuracy, and there has been an explosion of interest in iris biometrics in recent years. This paper is intended to provide a secure identification system of the use of the iris as a biometric feature.

Unlike other biometrics such as fingerprints and face, the iris has a great advantage in that there is huge variability of the pattern between individuals. They are also believed to be different between persons and between the left and right eye of the same person. The color of the iris can change as the amount of pigment in the iris increases during childhood. Nevertheless, for most of a human's lifespan, the appearance of the iris is relatively constant. Iris recognition relies on unique patterns of the human iris to identify or verify an individual which remains stable throughout life. Thus iris recognition has received a extensive attention over last decade and is reputed to be most reliable and accurate person identification system [2].

An identification can lead to a record, a description of a person's past. If the person has been previously arrested, the arrest information can be retrieved. Biometric identification does not need to rely on spoken information from the subject in question; even amnesia victims and the dead can be identified. Once the necessary information has been entered into a biometric database, future inquiries require only the successful comparison and matching of the biometric for confirmation of identity. Biometrics can be used in at least two different types of applications. In a verification scenario, a person claims a particular identity and the biometric system is used to verify or reject the claim. In an identification scenario, a biometric sample is acquired without any associated identity claim. The task is to identify the unknown sample as matching one of a set of previously enrolled known samples.

For reliable iris recognition, it is necessary to develop an efficient method for preprocessing the iris image, segmentation and locating the iris region. Various methods have been proposed by different researchers. But this paper describes accurate iris preprocessing using canny edge detection, segments the iris region from the rest of the image and determine the location of the iris boundaries by applying Hough transform. The system implemented visual C#.net 2008 environment based on CASIA iris database images to test the performance.

The rest of this paper is organized as follows. Section II presents the proposed system flow procedure. Section III briefly discussed the detail description of image preprocessing stage to support a secure biometric identification system. Next iris localization stage described in Section IV and Section V

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presented iris region detection. The performance evaluation based on test results described in section VI Finally, to conclude the paper, some final remarks about the strengths of this type of approach are presented in Section VII, as well as an outline of the envisioned future developments.

## II. Proposed System

This section presents the proposed system architecture intending to biometric iris identification system. The method consists of three major components such as image preprocessing, iris region detection and localization. The flow diagram of the proposed system is shown in "Fig. 1".

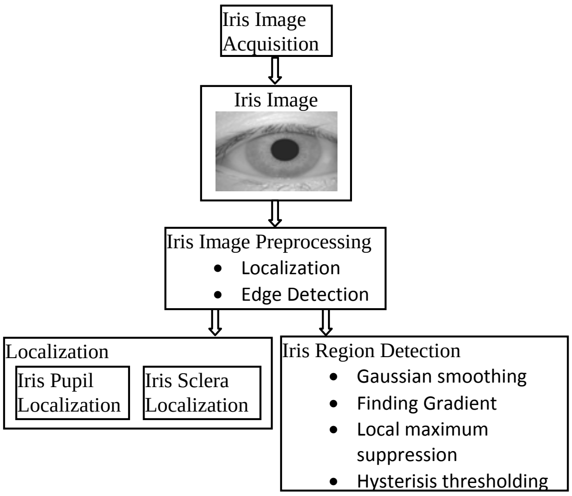



Fig. 1 Flow diagram of the proposed system

When an imaging system captures an eye image, the image contains many pixels outside of the iris region which do not define the pattern of interest. CASIA iris image database (ver 1) includes 756 iris images from 108 eyes [8]. For each eye, 7 images are captured in two sessions, where three samples are collected in the first session and four in the second session. These database images are presented different position for different people. This section presents the overall proposed system architecture intending to biometric iris identification system. For reliable iris recognition, it is necessary to develop an efficient method for preprocessing the iris image. The proposed system consists of two major components such as data collection and image preprocessing.

## III. Image Preprocessing

The acquired image always contains not only the 'useful' parts but also some 'irrelevant' parts. Under some conditions, the brightness is not uniformly distributed. In addition, different eye-to-eye camera may result in different image sizes of the same eye. For the purpose of analysis, the original image needs to be preprocessed. Input image is preprocessed to reduce noise as much as possible to improve the quality of the image. The two main functions in image pre-processing procedure are iris boundary localization and iris region detection.

### A. Data Collection

The first stage of my work is to acquire input images to test the system. Therefore it is need to collect a large database consisting of several iris images from various individuals. In this system, the input image is used from the CASIA image. All images in the database are stored in bitmap format. "Fig. 2" show the example of CASIA iris images.

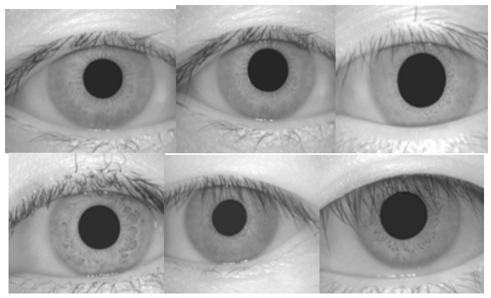
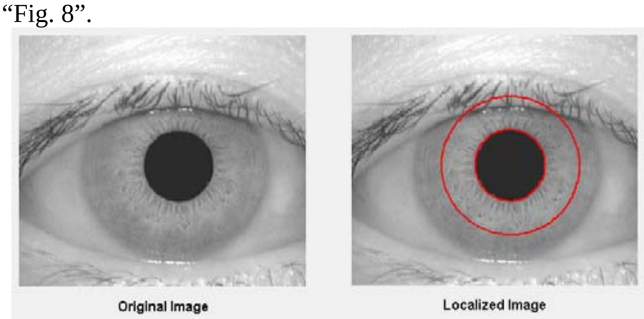


Fig. 2 Example of CASIA iris images

## IV. Iris Localization Scheme

CASIA iris image database includes 756 iris images from 60 eyes [3]. For each eye, 7 images are captured in two sessions, where three samples are collected in the first session and four in the second session. These database images are presented different position for different people. The pupil size and iris pattern are change based on the images that are taken with the camera position because of the light reflection and illumination.

The iris is an annular portion between the pupil (inner boundary) and the sclera (outer boundary). Both the inner boundary and the outer boundary of a typical iris can approximately be taken as circles. However, the two circles are usually not concentric [4]. The system first roughly determine the iris region in the original image, and then use edge detection and Hough transform to exactly compute the parameters of the two circles in the determined region. The iris region can be approximated by two circles, one for the iris/sclera boundary and another interior to the first for the iris/pupil boundary. Hough Transform applied in certain region detection to determine iris inner and outer boundaries. And then this approach tested on visual C#.NET shown in "Fig. 8".



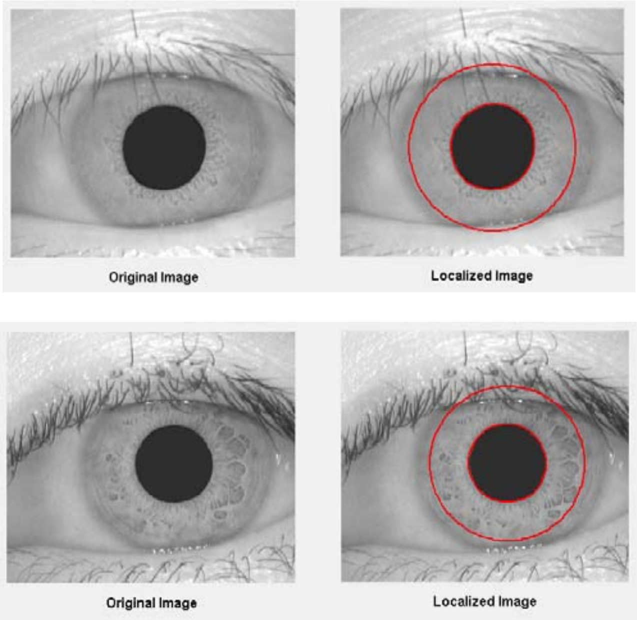



Fig. 3 Localization result of iris images

## V. Edge Region Detection

Edges characterize boundaries and are therefore a problem of fundamental importance in image processing. Edges in images are areas with strong intensity contrasts. Edge detecting an image significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. The purpose of edge detection in general is to significantly reduce the amount of data in an image, while preserving the structural properties to be used for further image processing. Several algorithms exists, and this work sheet focuses on a particular one developed by John F. Canny (JFC) in 1986 [5]. Even though it is quite old, it has become one of the standard edge detection methods and it is still used in research.

The Canny edge detector is a very popular and effective edge feature detector that is used as a pre-processing step in many computer vision algorithms. It is a multi-step detector which performs smoothing and filtering, non-maxima suppression, followed by a connected-component analysis stage to detect “true” edges, while suppressing “false” non edge filter responses. The algorithm runs in the following stages.

These are worked out that:

1) 5x5 Gaussian filter mask size is used to remove noise.
2) Sobel edge detector performed to compute the gradient magnitude and the angle of the gradient.
3) Non-maximal suppression with three pixels around (x,y) are examined with (0,45, 90 and 135).
4) Two threshold values as low and high for solving the problem that happens the image region where the edge’s magnitude fluctuate between above and below the thresholding.
5) Final edges are used by Hysteresis thresholding.

The following “Fig.4”, “Fig. 5”, “Fig. 6”, “Fig. 7” and “Fig.8” show the experimental result of tested iris image by using the four steps of Canny’s algorithm. The different steps are shown in the following.

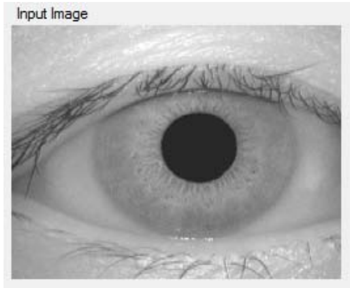



Fig. 4 Original Image

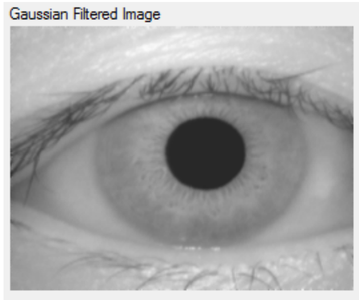



Fig. 5 Gaussian Filter Image (N=5, sigma=1.4)


Fig. 6 Non Maximum Suppressed image

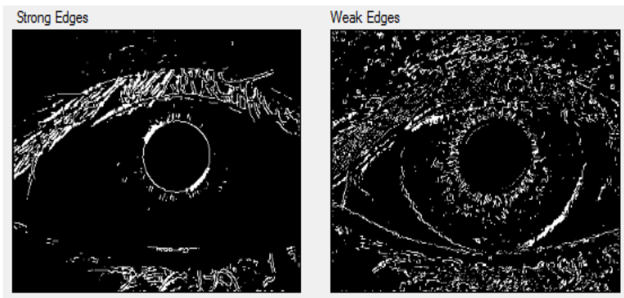



Fig. 7 Strong and Weak Edges detected

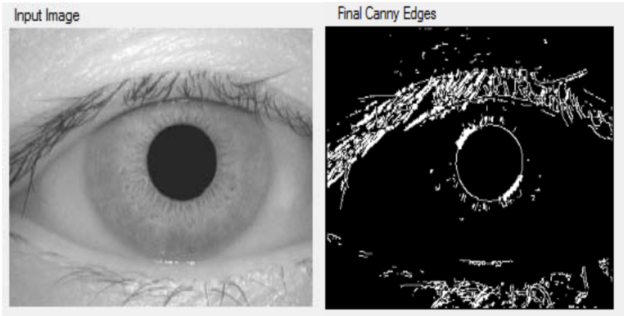



Fig. 8 Final Edges – Hysteresis thresholding by TH=40, TL=20

## VI. System Performance

To evaluate the performance of the proposed method, the system needs to compare the other methods. For the purpose of comparison, we implemented the three methods according to the related papers [6]–[7], [8], [9] (in our current implementations of the methods by Daugman [10] and Wildes *et al.* [11], system did not carry out their schemes for eyelid and eyelash detection. Nevertheless, this should not invalidate our comparison experiments and the resulting conclusions.

TABLE I
Performance Evaluation of Iris Region Detection and Localization

| Process | Performance Evaluation (%) | | |
|---|---|---|---|
| | Method | Accuracy | Time |
| Localization result | Daugman<br>Wildes<br>Proposed | 98.6%<br>99.5%<br>99.7% | 6.56 s<br>8.28 s<br>0.25 s |
| Edge region detection | Proposed (N=5 and σ = 1.0)<br>(HT=20, LT=10)<br>(HT=40, LT=20)<br>(HT=80, LT =40) | 75.5%<br>85.5%<br>95.5% | 16.9 s<br>16.0 s<br>17.1s |

## VII. Conclusion

In this paper, the art of iris edge detection and boundary localization are presented for providing the human iris identification system based on CASIA iris image database. This system is suitable for reliable and secure personal identification and can also be used for a variety of security related purposes. C# language could also make the improvement in the speed of the system. The system performance calculated according to the test result with the comparison of the other research. Later on this work will be helping to identify an individual by comparing the feature obtained from the feature extraction algorithm with the previously stored feature by producing a similarity score. The identification stage and the result of classification for different input iris image that are worked out by using above mentioned image processing methods will continue to study for future work.

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