Rotation Invariant Iris Recognition System for Person Identification

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Abstract

Iris based authentication system is pattern based system uses iris for person identification. Human Iris is a biometric that offers premium performance. Iris pattern is stable and most likely never changes throughout the person's life. Main challenge in iris recognition is in case of images which are captured under non cooperative condition. Under rigid image capture conditions it is possible to obtain good quality images and achieve impressing accuracy, with very low error rates. This approach offers a fine analysis from global characteristics via the generated Radon profiles. The Radon transform has the ability to capture these orientations .A global structural similarity based on these directional features is then derived. In this proposed work our main goal is to develop the rotation-invariant good-quality set of features with compact representation without compromising on the accuracy. The novelty of proposed method is that it extracts the rotation invariant features using radon transform simulation studies is carried out to test the validity of the proposed algorithm. The results obtained are used to calculate CRR of the system.
Keywords: Preprocessing Segmentation, Normalization, Random Transform

I. Introduction

With an increasing emphasis on security, the need for automated personal identification system based on biometrics has increased. Existing methods of authentication like passwords and electronic cards have the risk of fraud and theft. Biometric refers to personal physiological and behavioral characteristics that can be used to authenticate a person's identity. Fingerprints, faces, retinas, and irises are some examples of the physiological characteristics whereas voice, signatures, and gaits, the behavioral characteristics [1]

Daugman [6] proposed an iris recognition system representing an iris as a mathematical function. Wildes [7] proposed different recognition algorithms. With a sophisticated iris capture setup, users are required to look into the camera from a fixed distance, and the image is captured. Iris images captured in an uncontrolled environment produce nonideal iris images with varying image quality. If the eyes are not properly opened, certain regions of the iris cannot be captured due to Manuscript received November 29, 2006; revised July 19, 2007 and February 25, 2008. This paper was recommended by Associate Editor S. Sarkar. The authors are with Lane Department of Computer Science and Electrical Engineering, West Virginia University, Morgantown, WV 26506-6109O.

II. Previous work

Reliable biometric identification and verification techniques based upon iris presented by Daugman [6], Boles .Wildes et al[7]. Boles Daugman [6] uses the 2D Gabor wavelets to generate the iris codes. The algorithm gives the accuracy of more than 99.99%. Wildes [7] in its work, presents a new well-known iris recognition algorithm. The Wildes' algorithm locates the iris boundaries by creating a binary edge map using gradient-based edge detection, and then finds the centers and radii of these circles via a Hough Transform. A Laplacian pyramid is constructed at four different resolution levels to encode the image data. Matching is achieved via an application of normalized correlation and Fisher's linear discriminant.

Kamal Hajari, Ujwalla Gawande used two algorithms, first, a novel method for removing noise from the iris image and second, a texture feature extraction method using a combined approach of Local Binary Pattern (LBP) and Gray Level Co-occurrence Matrix (GLCM).

III. Proposed work

The steps in the recognition are pre-processing, segmentation, feature extraction and classification so it is desirable to explore representation methods to capture information in the iris. The proposed system architecture is shown in Fig 3.1. Proposed framework is divided into four main steps,

1) Image acquisition: (standard iris databases CASIA is used).
2) Iris preprocessing, here different steps has been performed such as noise detection and removal, iris localization, eye lid and eye lashes removal and iris normalization.

3) Feature extraction, here linear rectangular transformed image has been given as input and texture features has been extracted using texture properties.
4) Classification is the last step. The two classifiers are used, which classifier gives better performance in terms of recognition rate, for the proposed system .In this Euclidean distance and neural network based classifier will be implemented for human identification.

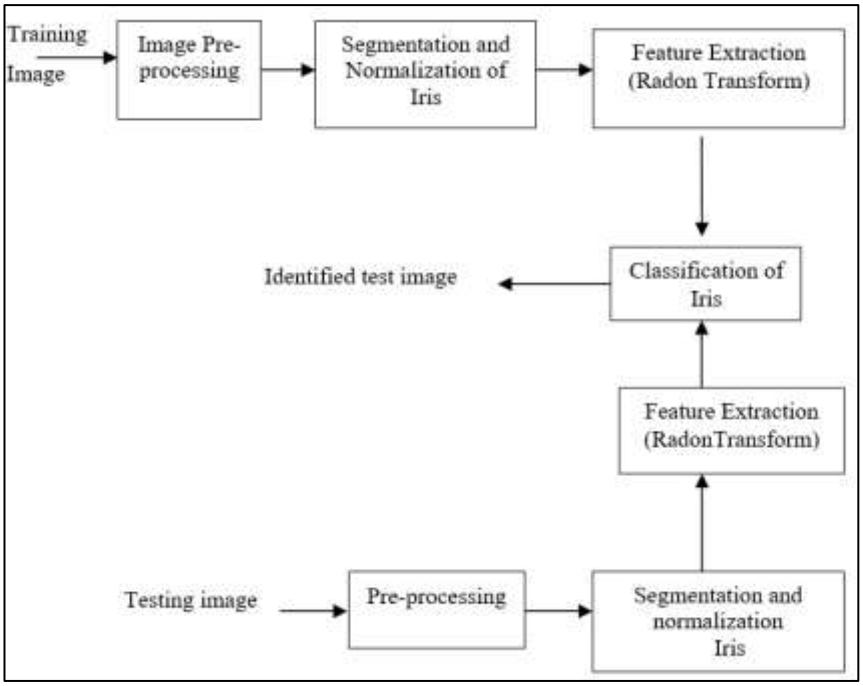

Fig. 1: System Architecture of Proposed System

A. Database Collection

Different iris databases of different universities / institutes have been used for testing the proposed methods. Databases of Chinese Academy of Sciences, Institute of Automation (CASIA) Iris Database.

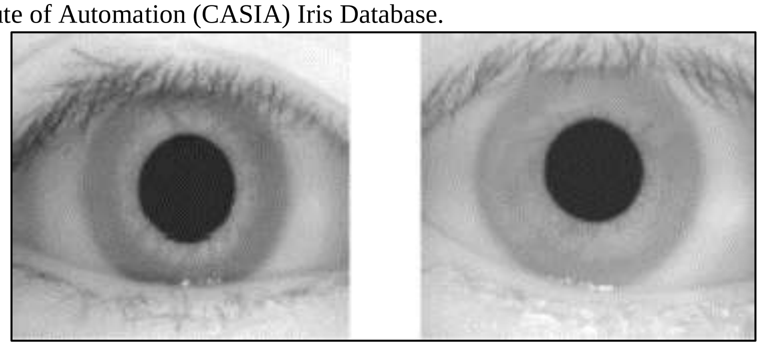

Fig. 2: Iris Images from CASIA

B. Pre-Processing

Pre-processing of the acquired iris image involves detection of specular reflections and the stage must remove these noise elements that can affect the feature extraction process. We used 2-D median filtering, and in painting, if specular reflections in the image is present.

C. Segmentation

Iris segmentation plays a key role in the performance of an iris recognition system. This is because improper segmentation can lead to incorrect feature extraction from less discriminative regions (e.g., sclera, eyelids, eyelashes, pupil, etc.), thereby reducing the recognition performance. The circular Hough transform can be employed to deduce the radius and centre coordinates of the pupil and iris regions.

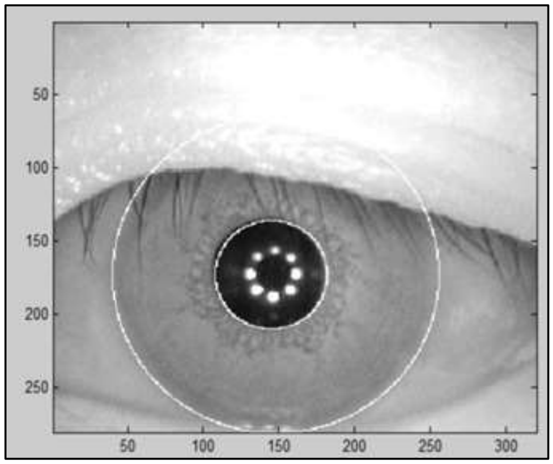

Fig. 3: Segmentation Output using Hough Transform of Image

D. Normalization of Iris

Once the iris region is successfully segmented from an eye image, the next step is to transform the iris region so that it has fixed dimensions for doing the comparisons of templates. Normalization used Daugman's Rubber Sheet Model.

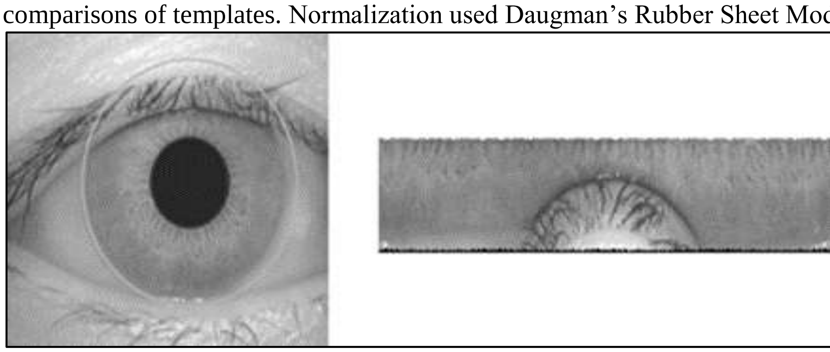
Fig. 4: Normalization Output: (A) Unwrapped Iris, (B) With the Zones of Analysis on the Image from CASIA Database

E. Feature Extraction

Radon transform is used for feature extraction as in equations (3.3). Radon transform is a transform that is the projection of an image along specified direction [9].

Radon transform computes the line integral along parallel paths in a certain direction. Radon transform effectively captures the intensity variations in an eye image, which helps in extracting genuine directional features in the localized iris image.

$$R(\theta, p) = \sum_{y=0}^{M-1} \sum_{x=0}^{N-1} f(x, y)\, \delta(x\cos\theta + y\sin\theta - p) \quad (1)$$

Where δ is the Dirac distribution.

f (x, y) is image, and R(θ,p) is Radon transform (projection) of image in θ direction

1) In Case of Image with 256x100, 8-bit Grayscale Image

Radon transform capture directional information through projection of their image at different orientations. Feature vector is generated from all the projections. Projections are oriented at theta degrees counter clockwise from the x-axis.

IV. CLASSIFICATION

There are many template matching methods used in pattern recognition. For this work, distance metric methods such as Euclidean distance and Manhattan distance are used. Query image and database images are compared. A small distance between the database image and query image shows that the query image is close to the database image, and if distance is large the then is no matching. Euclidean distance is the square root equation given by equation

$$\text{Euclidean distance- (ED)} = \sqrt{\sum_{p=0}^{N-1}\left(q(\theta,p) - t(\theta,p)\right)^2} \quad (2)$$

For different projection angle θ.

q(θ,p) are the feature of database image

t(θ,p) are the feature of test image

V. RESULT

Iris database contain iris images collected from CASIA database, which contain all types images. Features are extracted for different projection angles. These features are used for classification. Equal error rate and correct recognition rate are calculated for performance measurement. Table 1 shows the performance of a system for different number of projection angles.

Table – 1
Results of EER & CRR for Various Projection Angle

Number of Projection angle (Randon transform)	*EER (%)*	*CRR (%)*
05	*12.95*	*87.05*
10	*9.97*	*90.03*
15	*9.24*	*90.76*
20	*10.10*	*89.9*

VI. CONCLUSION

Accuracy of the system increases with increase in number of projection but after 20 remains almost constant. Duo to number of projection angle system becomes rotation invariant.

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REFERENCES

[1] P.W. Hallinan, “Recognizing Human Eyes”, Geomtric Methods Computer Vision, vol. 1570, pp.214-226, 1991.
[2] Shideh Homayon “Iris Recognition for Personal Identification Using Lamstar Neural Network” International Journal of Computer Science & Information Technology (IJCSIT) Vol 7, No 1, February 2015.
[3] CASIA iris database. Institute of Automation, Chinese Academy of Sciences.http://sinobiometrics.com/casiairis.h
[4] Kamal Hajaria, Ujwalla Gawandeb, Yogesh Golharc “Neural Network Approach To Iris Recognition in Noisy” Environment International Conference on Information Security & Privacy (Icisp2015), 11-12 December 2015, Nagpur, India.
[5] Diwakar Tiwary1, K Srinivasulu2, Anveshraj “Fingerprint Identification Using Radon Transform”International Refereed Journal of Engineering and Science (IRJES) ISSN (Online) 2319-183X, (Print) 2319-1821 Volume 3, Issue 10 (October 2014), PP.106-110
[6] John Daugman, “Biometric personal identification system based on iris analysis”, U.S. Patent No. 5,291,560, 1994.
[7] Richard P. Wildes, “Iris recognition. In Biometric Systems: Technology, Design and Performance Evaluation”, pp. 63–95. Spring-Verlag, 2005.