



Volume: 2, Issue: 6, 176-189  
June 2015  
www.allsubjectjournal.com  
e-ISSN: 2349-4182  
p-ISSN: 2349-5979  
Impact Factor: 3.762

**Ankita Satish Adhau**  
Department of Electronics,  
AISSMS IOIT, Savitribai  
Phule Pune University,  
Pune, Maharashtra, India.

**D.K. Shedge**  
Department of Electronics,  
AISSMS IOIT, Savitribai  
Phule Pune University,  
Pune, Maharashtra, India

## Iris Feature Extraction of a blinked eye

**Ankita Satish Adhau, D.K. Shedge**

### Abstract

With compare to biometric features, iris recognition has high recognition accuracy. This paper proposed different methods for iris recognition in which condition is partial eye closed or an eye is blinked. All the steps are explained in detail to achieve highest accuracy rate in the recognition system. Most of the iris recognition systems are incapable of providing low false rejection due to wide variety of artifacts. To address this issue, various different methods suitable to work properly are highlighted in this paper. Security related application worth require highest security in genuine images of an iris. This can be achieved by following methods. CASIA, UBIRIS and MMU database can be used for these iris images in the experiment to test the data. In this system implementation high confident images are required to achieve accurate authentic results. Likewise, proposed methods are superior in terms of security, accuracy and consistency.

**Keywords:** *Iris recognition; biometric system; Partial eye; security.*

### 1. Introduction

Every individual is having unique feature or characteristics which are identified by a biometric system. Physical and behavioral characteristics <sup>[1]</sup> of an individual are identify or analyze by biometric methods. Those methods are mainly based on fingerprints, facial features, voice, hand geometry, handwriting, retina and iris. Biometric are characterized by a features which are highly unique so that each person is easily recognize by their identity. These features can be easily captured, convenient to use and they does not change over the time. Next to DNA, Iris is a promising biometric to identify an individual character.

Iris <sup>[2]</sup> is like a diaphragm locates between the pupil and the sclera. Its function is to control the amount of light enters into the eye. It is made up with elastic connective tissue just like trabecular meshwork. Iris is the most stable organ which is formed in the third month of gestation and remains unchanged throughout the lifetime. It is the only organ visible from outside. Iris differs by individual to individual by its color and size. Iris is well recognized biometric by highly randomized appearance. The iris is highly unique that twins also have different irises as well as no two irises are same of a single person. Iris has a data-rich physical structure and intrinsic isolation and protection from the external environment.

As uniqueness and stability are two prominent factors of security, Hence iris is mainly used in application related to security <sup>[13]</sup>. In modern techniques, the fundamental problem in security is to control an access to secured places. These problems can be easily overcome by development in recent and efficient authentication system. In many application areas, earlier methods like key or password are not suitable. These ordinary methods can be easily stolen, forgotten or cracked. New techniques are adopted for security purpose by biometric identification methods. Among all the methods face, fingerprints and speaker are most efficiently studied. But Iris recognition system is the most reliable for authenticity check.

This paper mainly focuses on iris feature extraction when eye is partially closed. The rest of this paper is organized as follows; Section 2 briefly reviews iris recognition techniques previous work; Section 3 highlights the iris recognition main step; Section 4 presents methodology; Section 5 gives the conclusion.

### 2. Previous Work

Recently, a few surveys of iris recognition methods for image processing have been presented. These surveys mainly aim at outlining some characters of different methods and summarizing some popular modules in recognition method with comparison based on different attributes and performances. Lin Ma *et al.* <sup>[1]</sup> focuses on studying the geometrical structure changes in irises and Poursaberi *et al.* <sup>[2]</sup> proposed two different segmentations of iris. Zhi Zhou *et al.* <sup>[3]</sup> proposed method is tested on public databases using in-house recognition algorithms and also

**Correspondence:**  
**Ankita Satish Adhau**  
Department of Electronics,  
AISSMS IOIT, Savitribai  
Phule Pune University,  
Pune, Maharashtra, India.

evaluated using a commercialized system. Zhi Zhou *et al.* [3] proposed method takes into consideration not only the effect of image quality but also the segmentation accuracy. Aly I. Deoky *et al.* [4] proposes an iris recognition algorithm in which a set of iris images of a given eye are fused to generate a final template using the most consistent feature data. Karen Hollingsworth *et al.* [5] presented a metric, called the fragile bit distance, which quantitatively measures the coincidence of the fragile bit patterns in two iris codes.

Amol D. Rahulkar *et al.* [6] presented a shift, scale, and rotation-invariant technique for iris feature-representation and fused post classification at the decision-level to improve the accuracy and speed of the iris-recognition system. Abduljalil Radman *et al.* [9] proposed algorithm accelerates the segmentation process using the traditional integrodifferential operator and Hough transform, and simultaneously improves the segmentation accuracy. Qian Chen *et al.* [12] described a sophisticated method to track irises in a monocular video sequence with a particle filter that uses a newly proposed Iris-Eyelid separability filter (IESF). Izem Hamouchene *et al.* [13] proposed a new iris recognition system using a novel feature extraction method in which neighborhood-based Binary pattern. John Daugman [15] developed by the author for recognizing persons by their iris patterns have now been tested in many field and laboratory trials, producing no false matches in several million comparison tests. Xiao Zhou Chen *et al.* [16] put forward a method that unified noise used to between login iris and sample iris images aiming at the widespread adoption of matching method.

### 3. Iris Recognition System

Iris recognition is mainly divided into three main methods. Those are Texture based extraction, Appearance based extraction and Feature based extraction. Out of them Feature extraction is characterized by the appearance and disappearance of an image structure. A classical method [13] includes a series of steps: image acquisition, image preprocessing, image segmentation, image normalization, feature extraction and matching process.

Iris recognition system for a half iris is different than normal eye [4]. First step belongs to capturing of an image of person's eye at enrollment time. Second step is to segment an iris image from the other non-iris part. Step three is normalization where iris pattern is extracted and scaled to predefined size. Next step extract the features by using filtering process. Last step involves matching of an iris image at training phase with the image at database. These steps are shown schematically in following fig.1.

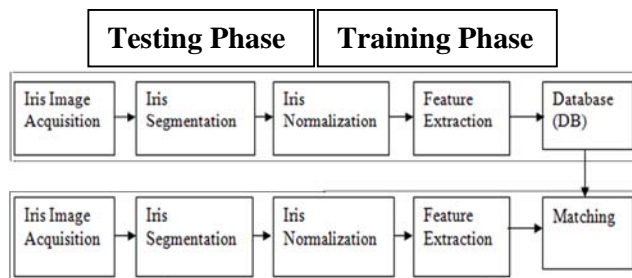


Fig 1: Iris recognition system

The major goal of this paper is to study different involved in recognizing an iris in partially open eye condition. The prominent methods provide compact and significant representation of an iris image with less number of false

rejection capabilities. The method results in artifact free images and matching process. Let's study those methods in the next section 4.

## 4. Methodology

### A. Image Preprocessing

A captured image contains iris as well as non-iris part [2]. This occluded or contaminated part includes some part of eyelids, eyelashes, pupil and sclera which are not desirable. The size of an iris is influenced by the distance between camera to iris and environmental conditions. Hence these images must be preprocessed to overcome occlusion, specular reflection problems. In our system, we use grayscale image of size 700 X 500. Chinese Academy of Sciences Institute of Automation (CASIA) [8] database contains different iris images. We are focusing on iris images when half of the eye is closed.

In the preprocessing [2], an image is first converted to gray color by suitable threshold and the strategy to detect edge of pupil. The process involves two upper and lower thresholds (L,U). For K=1: iteration number do as follows:

- i. See the intensity of each pixel, if it is lower than the smaller L+K, Convert it to 0 and if it is bigger than U-K, convert it to 255.
- ii. Otherwise, filter the intensity to the lower one by scaling factor.

The processed image is converted to a logical image that means a black & white type image will be obtained.

### B. Image Segmentation

Iris segmentation mainly includes following methods; Daugman's Integro-differential operator [4], Edge detector using Hough transforms [9] and Sobel operator [11]. Daugman's method assumes the pupillary and limbic boundaries of the eye as a circle and Integro-differential operator is utilized to detect iris boundary by searching the parameter space. The circular boundary is detected when Integro-differential operator attains its maximum. The iris boundary is described by three parameters: the radius  $r$ , and the coordinates of the circle,  $x_0$  and  $y_0$ .

$$m_a x_r, x_0 y_0 [G_0(r) * \frac{\partial}{\partial r} \oint r x_0 y_0 \frac{I(x,y)}{2\pi r} ds] \dots (1)$$

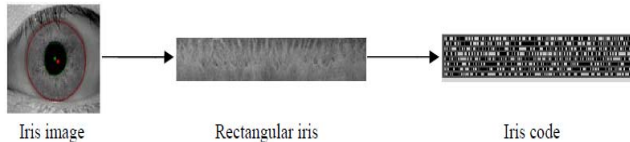
This operator searches over the image domain  $(x,y)$  for the maximum in the blurred ( by the Gaussian kernel  $G_0(r)$ ) partial derivative with respect to increase in radius  $r$  of the normalized contour integral of  $I(x,y)$  along a circular arc  $ds$  of radius  $r$  and coordinates  $(x_0,y_0)$ .

In the Hough transform, gradient of the original image is calculated by the transform of an image [4, 11] and then accumulating each non-zero point from the gradient image into every point i.e. one radius distance away from it. That way, edge points that lie along the outline of a circle of the given radius all contribute to the transform at the center of the circle, and so peaks in the transformed image correspond to the centers of circular features of the given size in the original image. Once a peak is detected and a circle 'found' at a particular point, nearby points (within one-half of the original radius) are excluded as possible circle centers to avoid detecting the same circular feature repeatedly.

### C. Image Normalization

In order to allow comparison, normalization [3] is used to transform the iris region so that fixed dimensions are formed. This normalization process produce iris region which have the same constant dimensions. Hence two photographs of the

same iris under different conditions will have characteristics features at the same spatial location.



**Fig 2:** Iris Normalization

This process is possible by following methods: Daugman's rubber sheet model [4] and eyelid masking. Daugman [3] suggested a method of Cartesian-to-Polar transform that remaps each pixel of an iris image into a polar coordinates  $(r, \theta)$  whereas satisfactory condition is as follows:  $\theta < r < l$  and  $0 < \theta < 2\pi$ . The unwrapping is formulated as following equation:

$$I(x(r, \theta), y(r, \theta)) \rightarrow I(r, \theta) \dots \quad (2)$$

Such that

$$\begin{aligned} x(r, \theta) &= (1 - r)x_p(\theta) + rx_i(\theta), \\ y(r, \theta) &= (1 - r)y_p(\theta) + ry_i(\theta), \end{aligned} \quad (3)$$

where  $I(x, y)$ ,  $(r, \theta)$ ,  $(x_p, y_p)$ ,  $(x_i, y_i)$  are the iris region, Cartesian coordinates, corresponding polar coordinates, coordinates of pupil and iris boundaries respectively. Daugman's rubber sheet model removes the above mentioned deformations. It not only reduces exactly the distortion of the iris caused by pupil movement but also simplifies processing.

Eyelid masking process masks irrelevant eyelid region. This method is particularly used to detect inner boundary and can be used to find boundary between iris and eyelid. In this case, if most of the upper half is occluded by eyelid then lower half is used. Hence region containing noise does not affect matching process. This decreases False Non Match error rate. As experiments are being performed not on complete eye then size of the rectangular box reduced accordingly. By using this method, detection time of upper and lower part of an iris and cost of the polar transformation are saved.

#### D. Feature Extraction

The goal of the feature extraction [13] is to capture relevant information. Information is contrast of an image, mean and standard deviation of pixel values, edges between pupil and iris, gray level of an image and angular momentum. The prominent methods used for this extraction are, Gabor filter [15]; wavelet transform [2].

When directly comparing the pixel intensity of two different iris images then it may cause an error. To alleviate this difficulty, Daugman [15] extracted the features from the normalized iris image by convoluting with 2-D Gabor filters. Filters are multiplied by the raw image pixel data and integrated over their domain of support to generate coefficients. These coefficients describe extracted and encoded image texture information. Wavelet transform is obtained by applying low pass filter to an image and then highpass filter. Finally, stores the result in separate rows and columns.

#### E. Matching

Similarity between two irises is evaluated by matching process. This is achieved by hamming distance [4] method. Hamming distance measures the fraction of bits for which two iris codes disagree.

$$\text{Hamming distance} = \frac{\text{sum of disagreeing bits of two iris templates}}{\text{total number of bits}} \quad (4)$$

A low normalized Hamming distance implies strong matching similarities between two iris images. If parts of the irises are contaminated then the normalized hamming distance is the fraction of bits that disagree in the areas that are not occluded on either image. The circular permutation of the code in the angular coordinates corresponds to comparison between pair of images which computes normalized hamming distance for several different orientations. The minimum distance computed normalized hamming distance results into correct alignment between two images. This matching process also achieved by XOR operator, LVQ neural network, joint of hamming distance of minimum and harmonic mean, normalizes correlation. This selection criteria of matching process depends on quality of images in the database.

#### 5. Conclusion

In this paper, we described an iris recognition methods based on the condition i.e. partial eye is closed or a blinked eye. All the above methods are explained for steps for recognition of an iris. All the steps including iris preprocessing to matching, results into the highest accuracy with the correct segmentation of iris boundary from pupil. The major advantage of these methods is less time consumption and gives high accuracy. Segmentation methods are successful in copying with partial occlusion of the upper half part of the eye, which happens due to eyelid and eyelashes. Mentioned methods are worth using in security related applications. Multiple images can be tested from CASIA database for the certain application.

#### 6. References

1. Lin Ma, David Zhang, Naimin Li, Yan Cai, Wangmeng Zuo, Kuanquan Wang, "Iris-Based Medical Analysis by Geometric Deformation Features", IEEE journal of biomedical and health informatics, Vol.17, No.1, pp.226-228, January 2013.
2. A. Poursaberi and B. N. Araabi, "Iris Recognition for Partially Occluded Images: Methodology and Sensitivity Analysis", EURASIP Journal on Advances in Signal Processing Volume 2007, pp.1-5, March 2007.
3. Zhi Zhou, Yingzi Du, and Craig Belcher, "Transforming Traditional Iris Recognition Systemsto Work in Nonideal Situations", IEEE transaction on Industrial Electronics, Vol. 56, No. 8, pp. 3205-3210 August 2009.
4. Aly I. Deoky, Hesham A. Ali, Nahla B. Abel-Hamid. "Enhancing iris recognition system performance using templates fusion", ELSEVIER, Vol.3, Issue 2, pp. 134-138, June 2012.
5. Karen P. Hollingsworth, Kevin W. Bowyer, Patrick J. Flynn, "Improved Iris Recognition through Fusion of Hamming Distance and Fragile Bit Distance", IEEE transaction on pattern analysis and machine intelligence, Vol.33, No.12, pp. 2469-2472, December 2011.
6. Amol D. Rahulkar and Raghunath S. Holambe, "Half-Iris Feature Extraction and Recognition Using a New Class of Biorthogonal Triplet Half-Band Filter Bank and Flexible  $k$ -out-of- $n$ :A Postclassifier", IEEE transactions on Information Forensics and security, Vol. 7, no. 1, pp.230-238, February 2012.
7. Byung Jun Kang and Kang Ryoung Park, "Real-Time Image Restoration for Iris Recognition Systems", IEEE transaction on systems, Man and Cybernetics—Part B:

- Cybernetics, Vol. 37, No. 6, pp. 442-443, December 2007.
8. CASIA Iris Image Database, Inst. Automation, Chinese Academy of Sciences, <http://www.sinobiometrics.com/2014>.
  9. Abduljalil Radman, Kasmiran Jumari, Nasharuddin Zainal, "Iris Segmentation in Visible Wavelength Environment", ELSEVIER, International Symposium on Robotics and Intelligent Sensors, pp.744-747, October 2012.
  10. Yung-Hui Li and Marios Savvides, "An Automatic Iris Occlusion Estimation Method Based on High-Dimensional Density Estimation", IEEE transactions on pattern analysis and machine intelligence, Vol. 35, no. 4, pp. 781-791, April 2013.
  11. Guowei Yang, Fengchang Xu, "Research and analysis of Image edge detection algorithm Based on the MATLAB", ELSEVIER, Advanced in control Engineering and Information Science, pp.1313-1316, August 2011.
  12. Qian Chen, Kohei Mastumoto, Haiyuan Wu, "Iris-Eyelid Separability Filter for Irises Tracking", 17th International Conference in Knowledge Based and Intelligent Information and Engineering Systems – KES, pp. 1030-1032, September 2013.
  13. Izem Hamouchene, Sahila Aouat, "A new texture analysis approach for Iris Recognition", ELSEVIER, AASRI conference on circuit and signal processing, CSP, pp. 3-6, 2014.
  14. Faisal Mohammad, Jyoti Anarase, Milan Shingote, Pratik Ghanwat, "Optical Character Recognition Implementation Using Pattern Matching", International Journal of Computer Science and Information Technologies, Vol. 5, No.2, pp.2088-2089, 2014.
  15. John Daugman, "New methods in iris recognition", IEEE Transaction on circuits and Systems for video Technology, Vol.14, No.1, pp.22-28, January 2004.
  16. XiaoZhou Chen, Fan Yang, ChangYin Wu, LiangLin Xiong, "A Novel Unified-Noise Algorithm for Iris Recognition", International Conference on Future Energy, Environment, and Materials, pp.870-872, January 2012.
  17. Mohammed A. M. Abdullah, F. H. A. Al-Dulaimi, Waleed Al-Nuaimy, Ali Al- Ataby, "Smart card with iris recognition for high security access environment", Department of Electrical Engineering and Electronics, niversity of Liverpool, IEEE 2011.