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# Biometric IRIS Recognition System

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***Abstract:*** **Biometrics has gained a lot of attention over recent years as a way to identify individuals. Of all biometrics-based techniques, the iris-pattern-based systems have recently shown very high accuracies in verifying an individual's identity. The richness and the apparent stability of the iris texture make it a robust biometric trait for personal authentication.**
**Iris recognition technology identifies an individual from its iris texture with great precision. A typical iris recognition system comprises eye image acquisition, iris segmentation, feature extraction, and matching. However, the system precision greatly depends on accurate iris localization in the segmentation module. In this paper, we propose a reliable iris localization algorithm. First, we perform Iris Acquisition, an infrared photo or video camera is used at a set distance to capture a high quality image of the iris. Next step is Iris segmentation, which include image quality enhancement, noise reduction, and emphasis of the ridges of the iris, for this Daugman proposed integro-differencial operator is used. Normalization is performed by applying different Gabor filters and using dyadic wavelet transform. Feature Extraction of normalized Iris is performed. Finally Hamming distance matching algorithm has been used for matching extracted image with standard database. The proposed algorithm is tested on public iris databases: CASIA-IrisV2. Experimental results demonstrate superiority of the proposed algorithm over some of the contemporary techniques.**
***Keywords:IRIS,Daugman,Hamming***

## I INTRODUCTION

In recent years, information technology has undergone through enormous developmental phases that caused maturity in both the software and hardware platforms, for instance, cell phones, auto teller machines, and the Google-map are to name a few. Despite of these advances, the life and assets of an individual are not safe. Every day, we hear about the criminal activities, such as cybercrimes, bank frauds, hacking of passwords and personal identification numbers, and so on.

Most often, it is found that such happenings occur because of loopholes present in the traditional security systems [1, 3], which use the knowledge and tokens based techniques (e.g., keys, identity cards, passwords, etc.), which could be shared and/or hacked. Due to these imperfections, traditional security systems are now being replaced by the biometric technology [1, 3]. A typical iris recognition system includes image acquisition, iris segmentation, feature extraction, and matching and recognition [2].
However, among these modules, iris segmentation plays a vital role in the overall system accuracy, because all the subsequent modules follow its results.

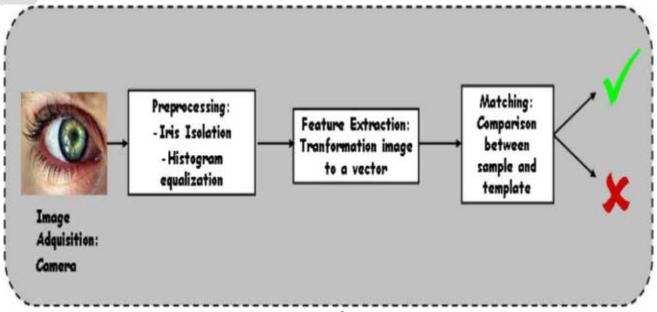


**Fig1. Block diagram of a biometric system**

It localizes the iris inner (pupillary boundary) and outer (limbic boundary) boundaries at the pupil and sclera, respectively; and detects and excludes any other noise, such as eyelids, eyelashes, and/or specular reflections [3, 4]. This study focuses on accurate localization of pupillary and limbic boundaries only (as in [3, 8]).

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Daugman localized these boundaries with a circle approximation. an Integro- differential operator (IDO) is used .Similarly, Wildes [5] used a combination of circular Hough transform (CHT) and the gradient edge-map to localize iris. Following that, numerous researchers proposed different segmentation techniques [2], which are based on these pioneered ideas [4, 5]. However, iris localization techniques [2,3,8] that use CHT and/or IDO consume relatively more time compared to the methods based on the histogram and thresholding based techniques Khan et al. [3] proposed an iterative strategy based on the histogram and eccentricity to localize pupillary boundary in a binary image, which has some flaws; for example, they first convert the eye image to a binary image and, then check eccentricity by considering the whole image as a binary object. However, in case, if an eye image contains other low intensity regions (e.g., eyebrows, eyelashes, and hair), then the resultant binary image may contain multiple objects and this method will face its outage. Similarly, Ibrahim et al. [8] Used standard deviations of the pixels' coordinate of a binary object to localize pupil. However, they also did not propose any method to handle with multiple objects. Thus, to resolve this issue, we propose an iris localization technique that comprises an adaptive threshold, eccentricity, area, and binary object geometry. Moreover, authors in [3,8] localized limbic boundary with a circle approximation. They used radial gradients in horizontal direction to estimate radius of the iris circle. However, to some extent, this technique is quite effective, but they fail to extract the precise center for iris circle. To estimate center coordinates, they compute y-coordinate from the absolute distances of the left and the right boundary points having maximum gradients. Next, they assign x-coordinate of the pupil circle to x-coordinate of the iris circle. Due to this assignment, the iris circle may be either pushed up or down along the $y$-axis. It may cause significant number of iris pixels to be left outside and vice versa. Thus, to resolve this problem too, we propose an effective scheme that does not even need an iris center: first, we extract radius for the circular limbic boundary using radial gradients in two secure regions. Next, we mark circular limbic boundary with its center at the pupil center. Finally, we apply active contours to regularize the pupillary and limbic boundaries. This regularization process effectively compensates for any offset in the pupil and iris' centers.

Rest of the paper is structured as follows: Section 2 details different proposed iris localization method, whereas Section 3 presents Chosen Algorithm and discussion. Experimental Results of the proposed technique are explained in Section 4.
Advantages and limitations explained in section 5.and finally, this study is concluded in Section6.

## II Proposed iris localization method

Previous studies have shown the viability of creating match-on-token solutions by including the comparison algorithm within the token, providing an answer that deals with the matching result in this paper, these studies have been extended to analyze the viability of integrating the feature extraction block within the personal token. With this solution, simplification of the point of service terminal is achieved, and security is improved. The terminal, in the proposed architecture, should perform the following tasks:

• Image Acquisition*:* The iris is captured with an infrared camera, as previously mentioned. The cost and size of the electronics and lens required for this task are not commercially viable for insertion into the personal token [6].

• Image Segmentation*:* This preprocessing block is related to the image acquisition. The non-detection of the iris or the quality of the captured images is typical reasons for rejection of the acquired image, thus, requiring a new capture process. If this block were included in the token, many images would have to be transferred from the terminal to the token, increasing data communication and therefore the verification time.

The personal token should have the following characteristics.

1) It should perform the rest of the biometric processes, i.e., feature extraction, comparison, and the matching result processing.
2) It is highly recommended to be reconfigurable. Possible token robberies or user accidents would require changes in biometric data or internal token processes to avoid security holes.
3) The token should be able to build and handle a secure communication channel with the terminal.
4) The token should be designed as a tamper-proof device.

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5) As it has to be portable, the occupied electronic area should be as small as possible.
6) Although token size is limited, the processing time must be minimal to reduce user waiting time.
7) Finally, the device must be cost effective, as large quantities of these devices will be manufactured.

In order to study different implementation proposals, this section is organized as follows. First, we will center on the chosen algorithm from a signal processing viewpoint. This is followed by the different implementations developed [6].

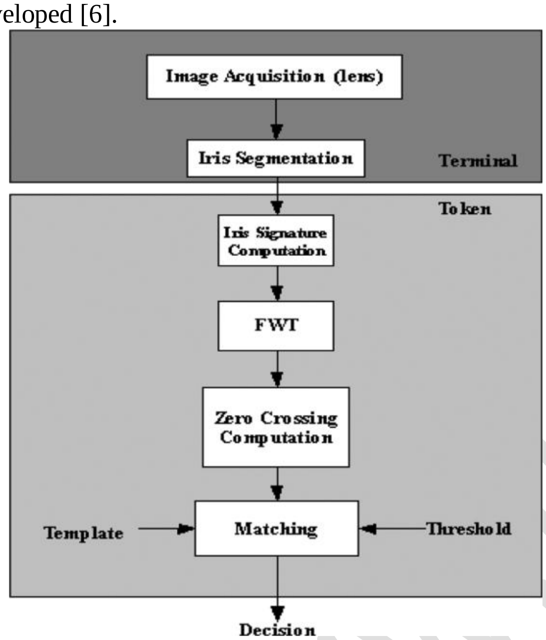


**Fig2. Terminal and Platform functionalities**

## III Chosen Algorithm

### Iris Segmentation

The iris chosen segmentation algorithm is based on the Hough transform. This transformation works on the edge image, as information related to textures or colors is not considered. From all the different edge operators, the canny method is used due to the shape of the edge to be detected. In this application, the Hough transform is used considering a circular shape to detect the iris boundary within the sclera. Once the iris boundary is detected, the pupil boundary is found in a similar way. Finally, eyelid detection is carried out by using a separate Hough transform for elliptical figures. Reflections are eliminated during the first stages of the preprocessing block through erosion and dilation operators. These reflections have to be removed as soon as possible, as they can cause erroneous decisions in the circle detection. After the iris segmentation has been finished, a quality algorithm is applied and rejects images for the following reasons [7]:

1) low quality images;
2) distance between the pupil and the iris is not higher than a percentage of the iris radius; if such distance is lower than the specified threshold, the information contained in the segmented iris is not considered to be enough to obtain a reliable feature vector;
3) pupil parts are not detected within the iris area.
4) Eccentricity between the pupil and iris circumferences is above a certain threshold.

### Feature Extraction

In this paper, the feature extraction method proposed by Sanchez Avila *et al.* in was selected. Here, the iris is first normalized to a virtual circle around the pupil, which is named the iris signature [7]. Thus, the iris signature will represent the gray level values on the contour of a virtual circle, which is centered at the centroid of the pupil, with a fixed radium and considering angular increments of , being , the length of the iris signature (previously fixed); i.e.,

$$Is=IE\ (xc+r\cos\theta, yc+r\sin\theta)$$

being $2n\pi/Ls \leq \theta \leq 2(n+1)\pi/Ls$ , $n\varepsilon IN \cup \{0\}$, r a fixed radium, and (xc, yc) the centroid of the pupil.

Afterwards, a 1-D dyadic wavelet transform is applied to the iris signature. The vector resulting for each scale is concatenated in a unique vector for computation of the zero-crossing representation, which leads to the feature vector. For computation of the wavelet transformation, Mallat’s fast wavelet transform (FWT) approach has been considered.

Unfortunately, the down-sampling stage that follows each filter provides the worst performance results when compared to a zero-insertion in intermediate vectors. Therefore, the resulting vector does not have the same length as the initial vector, wherein its length is the initial length multiplied by the number of levels the transformation performs. Once the dyadic wavelet is computed, the resulting vector is simplified by using its zero-crossing representation. The zero crossing representation converts the vector into a binary

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representation, wherein "1" represents a positive value and "0" represents a negative value, for each vector component. The number of levels used for the wavelet transform is a critical parameter, as it greatly influences the authentication performance results. Eight levels are used in this paper, as a tradeoff among processing time, hardware area, and vector size.

**Matching**

As already mentioned, the Hamming distance is used for comparing vectors. This distance offers the best results for this biometric modality and the selected algorithm.

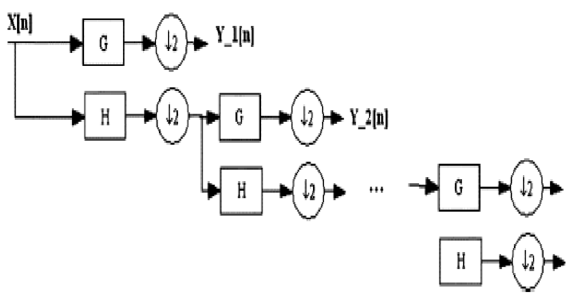


**Fig3. FWT in hierarchical structure**

**Fig2. Terminal and Platform functionalities**

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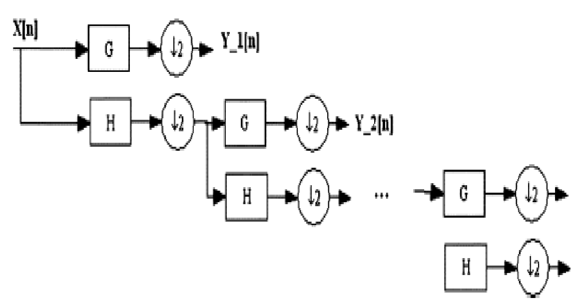


**Fig3. FWT in hierarchical structure**

## IV Experimental Results

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We tested the proposed iris localization algorithm in MATLAB version7.1, installed on a desktop PC with 2.33 GHz CPU and 1.5 GB RAM, and a set of the public iris databases: CASIA- IrisV2.

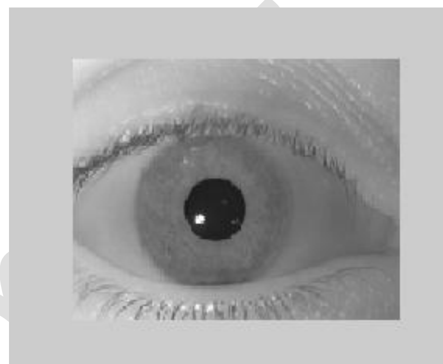
**Iris localization results**

As mentioned earlier, we tested the proposed algorithm on public iris databases. CASIA-IrisV12.which includes number of images of different people.

For user convenience Graphical User Interface is made in MATLAB. The graphical user interface is presented (displayed) on the computer screen. It is the result of processed user input and usually the primary interface for human-machine interaction.Designing the visual composition and temporal behavior of GUI is an important part of software application programming in the area of human-computer interaction. Four blocks are shown in GUI.first block is capture image. if we click on this block, camera get start for capturing the iris image. Second block is for preview and take the image. it ask the user input as 1 for capturing image. if user press 1 button, then suddenly it captures the iris image. Third block is optional block. if we doesn't want to capture image, we want to take it from stored database, then we can take it from stored database by typing image name with.jpg extension. After click on this button it takes the demand image from stored database. Last block is for iris recognition. After click on this block all the iris recognition steps performed automatically. This includes iris segmentation, feature extraction & matching.

And at the end result will be displayed. Following fig shows the snap shot of GUI.the all four blocks we can see in image. The output image after each operation is also shown in following figure.

Fig 1 shows original image. This is resizing in required size. This image is taken from the stored database.fig 2 shows the RGB to gray convert image. Further fig 3 shows compliment of fig 2.spot and flash camera is removed. And this image is converted into the black and white format. Gray image is converted into the double precision format. And this is become suitable for mathematical operation.fig 4 shows the image without camera flash. it is the original image ready for further processing. This above explained all the process comes under the segmentation process.integro differential operator method is used for segmentation process. Next processes are the normalization and localization. In this process center of iris is drawn. Pupil boundary and iris boundary is detected. Segmentation, feature extraction, Normalization, Localization results are given in this paper.



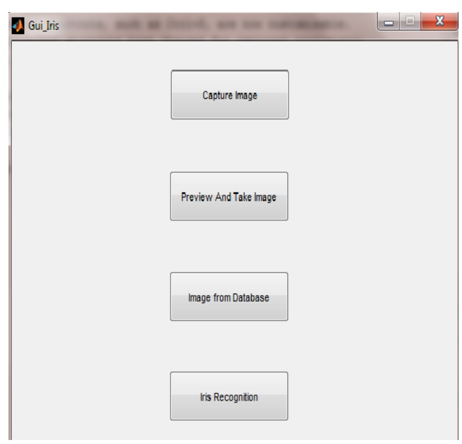



**Fig4 GUI for IRIS recognition**

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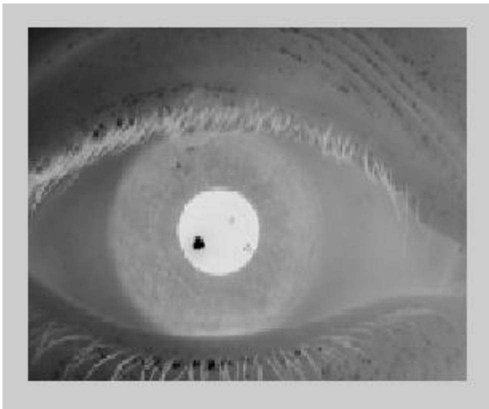

**Fig 4.1 Original image**

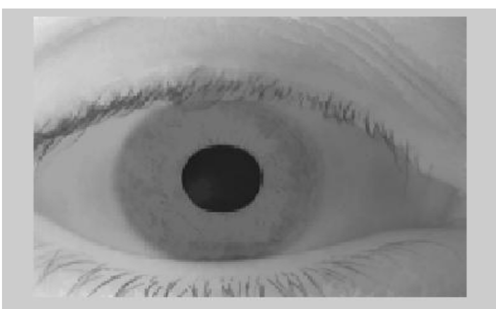

**Fig 4.2 RGB to grey image**

**Fig 4.3 Compliment image**

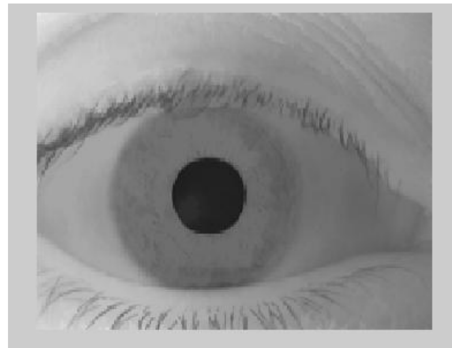

**Fig 4.4 black and white image**

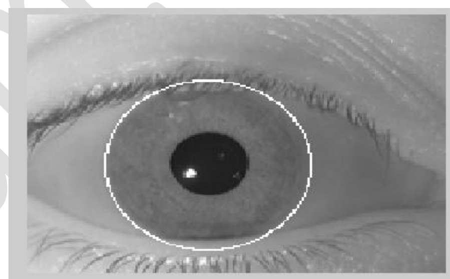

**Fig 4.5 Center of Pupil**

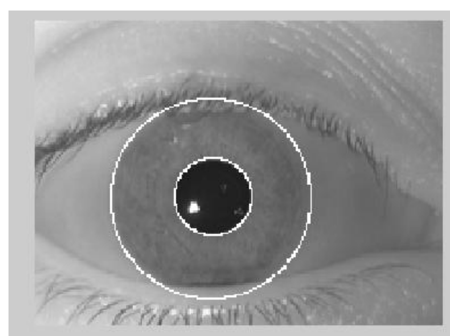

**Fig 4.6 circle of Pupil & Iris**

## V Advantages and Disadvantages

### Advantages

1) The iris is an internal organ that is largely protected by damage and wear by the cornea.

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2) Iris is unique, easy to detect.
3) Simple processing technique than fingerprints.
4) Technically greater certainty of verification of person.
5) Non-invasive technique.
6) Patterns apparently stable throughout life
7) Even iris patterns of identical twins differ

**Disadvantages**

1) Iris scanners are significantly more expensive than some other forms of biometrics.
2) More user cooperation.
3) Attempt at Fraud.
4) Relatively small target.
5) Eyelashes, eyelids & lenses can also
6) Obscure iris.
7) Small target (1 cm) to acquire from a distance (1m)

## VI Conclusion

In conclusion, this study proposes a robust iris localization technique. Fast processing integro differential operator method used in segmentation. In proposed system Daugman differential and Gabor filter method is used. For matching Hamming distance method is proposed.

As, on average, it takes less than a second to localize an iris in the eye image, therefore, it can safely be applied in real time systems. Besides, it is tolerant to off-axis eye images, specular reflections, non-uniform illumination; contact lenses, eyelashes, eyelids, and the hair occlusions. The proposed algorithm is tested on the public databases: CASIA-IirsV2. Experimental and accuracy comparison results with other state of the art contemporary techniques show satisfactory performance of the proposed algorithm.

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