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# Efficient Iris Recognition by Improving Acceptance Rate

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***Abstract*— Now a days, many applications require authentication to identify human before giving access to the resources. With new advances in technology, Biometric system provides automatic identification and authentication based on a certain unique features or characteristics possessed by the individual. Iris recognition is a biometric identification technique that uses pattern recognition on the images of the iris of an individual. Recognition from Iris can be considered as the most accurate biometric methods available due to the unique epigenetic patterns of the iris. Iris recognition stands out as its error rates are lowest. Iris recognition includes eye imaging, localization, normalization, verification etc. This paper presents an overview of the fundamentals of biometric identification and tries to find out the effect of isolation of Eyelid and Eyelash of the normalized iris image on recognition rates.**

***Index Terms*—Biometrics; Iris; Authentication; FRR, FAR.**

## I. INTRODUCTION

Through the advancement in technology, danger of security breach has also increased. To overcome this, there is a need to design a security system which is fast and very accurate. This system can be designed on two bases: first is data based in which user has to carry some cards or remember passwords, second is biometric based in which identification is done on the basis of physiological, behavioral or chemical characteristics of human body. Systems designed on the basis of human traits like fingerprint, iris, retina etc are known as Biometric Systems. Working of such systems is based on signal and image processing techniques. Biometrics provides more security, as they are difficult to replicate and steal. With the increasing demands of personal/private security iris recognition has become one of the highly reliable biometric technologies as compared to others due to its benefits like less operational time, simplicity in handling and accuracy. The basic of every biometric system is to extract the prominent features from the input signature via image with the application of some wavelet transform, fuzzy logic, neural network etc like algorithms. Biometric system uses two processes namely enrollment and verification to authenticate the identity. During enrolment step, an image is captured by the system and a template is created. These templates are then stored collectively in database. During the verification or authentication step, when a user gives a sample of its biometric data, it is compared with stored template and on the basis of matching score a decision is made. So Iris based biometric security system consists of various steps, that make up an architectural framework, namely Image Acquisition, Localization, Normalization, and De-noising, Feature Extraction, Encoding and matching process respectively.

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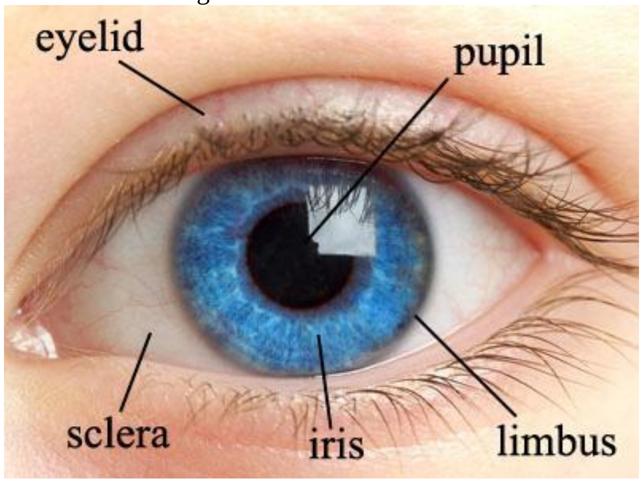
## II. IRIS SYSTEM

### *A.* Iris Structure

It is believed that that the word iris is taken from the Latin word for rainbow. In some text it also appears that this term was first used in the 16th century, with reference to the colourful part of the eye [4]. The iris is the disk shaped region of the eye bounded by the pupil and the sclera on either side. The pupil is located slightly nasally and inferiorly [2]. Both Iris, which is extremely data-rich physical structure and pupil are covered by a transparent layer known as cornea. Cornea provides physical protection and also limits the amount of light to pass through it after filtering. Iris size varies from person to person but its diameter generally lies between 11mm to 14mm. Formation of iris starts during fatal development, the structures responsible for its pattern are mostly complete by the eight month and in the two years of life it stabilizes completely [2]. Complex Iris pattern can have many unique features such as ridges, crypts, rings, arching ligaments, furrows , corona and a zigzag collarets which makes it inimitable, at the same time it not only differ between right and left eye, but also between the identical twins [1][3]. So it has much distinctive information useful for personal identification. A careful balance of light, focus, resolution and contrast is essential during the extraction of feature vector from localized image.




It is extremely difficult to tamper the texture of the iris surgically and Iris also provides higher degrees of freedom.
Artificial irises or designer contact lenses can be easily detected as comparisons of measurements taken after few seconds interval will notice a slight change in area of iris region, if the light conditions are adjusted while a contact lens will exhibit zero change and indicate a fake input. These features make Iris recognition system most accurate and problem [1-3]. In early days, iris-based systems required more

user participation and were costly too but the newer systems have incorporated many new features and so they are more user-friendly and cost has also gone down.

## III. LOCALIZATION

Iris location is the key part in iris recognition, and it directly influences the accuracy of iris recognition. To get a useful iris part both inner and outer boundaries are calculated [8]. Localization consists following sub-steps:

- Locate the Iris in compete Eye image.
- Construct two circles having centre at the pupil's central part.
- In this way Iris comes out in Disc format.

This process can be done by applying any one of the edge detection operator and then circular Hough transform to segment the iris. This method is discussed below-

Geometric objects present in an image like lines, circles etc are defined by some set of parameters. Hough transform is a standard algorithm that can be used to find out these parameters. Visual inspection of eye indicates that the pupil and iris regions are of circular shape. Theses shapes can be traced by getting centre coordinates and radius value for both the regions. Many authors have employed circular Hough transform (CHT) based automatic segmentation algorithm to localize the iris. First of all an edge image is generated by using one of the edge detecting techniques. From the edge image, votes are cast in Hough space for the parameters centre coordinates $(x_c, y_c)$ and the radius 'r' of circles passing through each edge point. These parameters are able to define any circle according (1).

$$x_c^2 + y_c^2 + r^2 = 0 \qquad (1)$$

Where

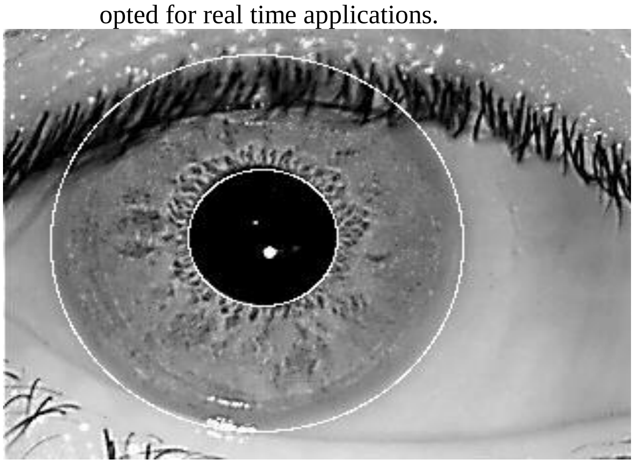
$x_c = X - r*\cos\theta$

$y_c = Y - r*\sin\theta$

A maximum point among casted votes in the Hough space will correspond to the centre coordinates and radius of the best circle defined by the edge points.

CHT technique has some problems too, they are-

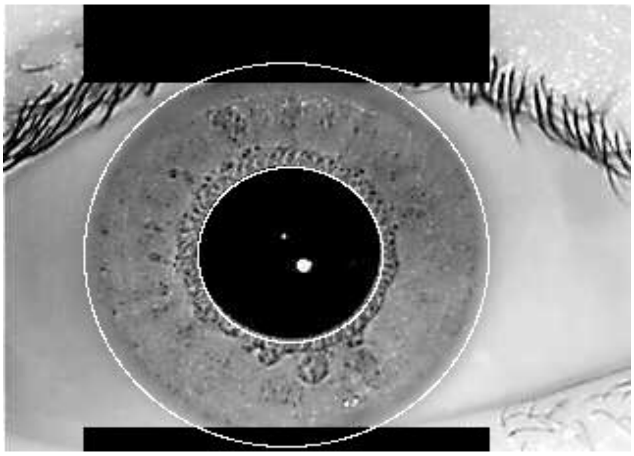
- During edge detection threshold values are defined, this fixed value may result in removal of some critical edge points; further causing failure to detect circles or arcs.
- It is computationally expensive since it uses brute-force or exhaustive search also know as generate and test" approach, and so generally not opted for real time applications.



## IV. EYELASH AND NOISE DETECTION

When Iris image is acquired by Iris scanner, it will contain Iris along with the surrounding eye region as eyelashes etc. Therefore, prior to iris matching, it is important to localize that portion of the images.

Eyelids were isolated by first fitting a line to the upper and lower eyelid using the linear Hough transform. A second horizontal line is then drawn, which intersects with the first line at the iris edge that is closest to the pupil and is done for both the top and bottom eyelids. The second horizontal line allows maximum isolation of eyelid regions. Canny edge detection is used to create an edge map, and only horizontal gradient information is taken. If the maximum in Hough space is lower than a set threshold, then no line is fitted, since this corresponds to non-occluding eyelids. Also, the lines are restricted to lie exterior to the pupil region, and interior to the iris region. For isolating eyelashes, a simple thresholding technique was used, since analysis reveals that eyelashes are quite dark when compared with the rest of the eye image.



## V. NORMALIZATION

Captured Irides of different people may be of different size, even there is a chance of getting different size iris images for the same person because of the variation in illumination, distance of eye from camera and other factors. So normalization of the Iris is done to get them in same size. For this the iris image scaled to have the same constant diameter to allow accurate comparisons regardless of the Original size in Image. In this paper Daugman"s Rubber Sheet Model is used for normalization [2].

The rubber sheet model proposed by Daugman remaps each point in the iris region to a pair of dimensionless real coordinates. In this process (unwrapping process), iris pixels (iris textures) are mapped from Cartesian co-ordinate (x, y) to polar co-ordinate (r, θ) where 'r' lies between the interval [0, 1] and 'θ' lies between the interval [0, 2π], so that any rotational shift or tilt in the Cartesian co-ordinate is transformed into translational shift or tilt in the horizontal direction.

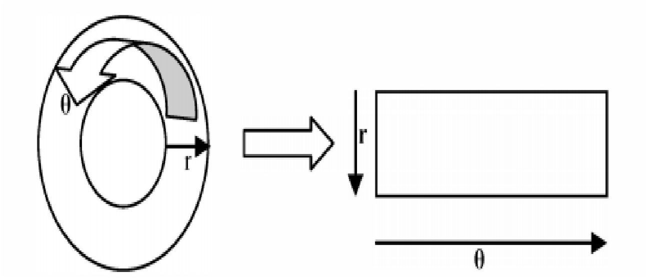
The disk shaped iris region which is in Cartesian coordinates form is remapped to the normalized non-concentric polar form and modelled

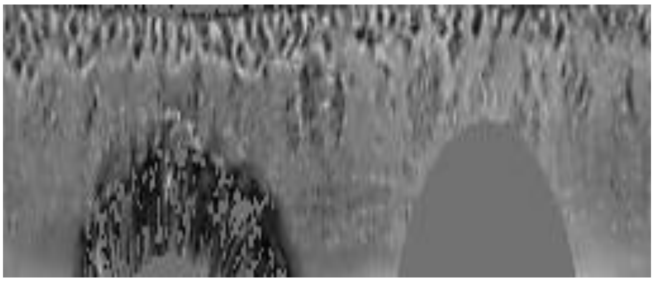
$$r' = \sqrt{\alpha\beta} \pm \sqrt{\alpha\beta^2 - \alpha - r_1^2} \qquad (2)$$

With, $\alpha = o_x^2 + o_y^2$

$$\beta = \cos\left(\pi - \arctan\left(\frac{o_y}{o_x}\right) - \theta\right)$$

where displacement of the centre of the pupil relative to the centre of the iris is given by $o_x$, $o_y$,and r, the distance between the edge of the pupil and edge of the iris at an angle, θ around the region, and $r_1$ is the radius of the iris. The remapping formula first gives the radius of the iris region 'doughnut' as a function of the angle θ.



## VI. FEATURE EXTRACTION

To provide for an accurate method of recognition of individuals, the features which are most distinctive in an iris pattern must be extracted. Only these significant parts must be extracted so that they can be encoded into biometric templates which can be used for comparisons. Iris recognition systems usually use band-pass method to decompose an iris image into a biometric template. The biometric templates generated in this process can be compared together using an appropriate matching algorithm.

Wavelets are usually used to decompose the data in an iris image into different components. A number of wavelet filters are applied on the normalized iris region, one for each of the two resolutions with each wavelet being a scaled version of some mathematical operation. The output of convolving the wavelets is encoded into a biometric template which can be used for comparison.

$$G(f) = \exp\left(\frac{-(\log(f/f_0))^2}{2(\log(\sigma/f_0))^2}\right) \qquad (3.14)$$

Where $f_0$ represents the centre frequency, and σ gives the bandwidth of the filter.

Feature encoding was 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 rows of the 2D normalized pattern are taken as the 1D signal; each row corresponds to a circular ring on the iris region. The angular direction is taken rather than the radial one, which corresponds to columns of the normalized pattern, since maximum independence occurs in the angular direction.

The intensity values at known noise areas in the normalized pattern are set to the average intensity of surrounding pixels to prevent influence of noise in the output of the filtering. The output of filtering is then phase quantized to four levels using the Daugman method [1], with each filter producing two bits of data for each phasor. The output of phase quantization is chosen to be a grey code, so that when going from one quadrant to another, only 1 bit changes. This will minimize the number of bits disagreeing, if say two intra-class patterns are slightly misaligned and thus will provide more accurate recognition.

## VII. MATCHING ALGORITHM

For matching, the Hamming distance was chosen as a metric for recognition, since bit-wise comparisons were 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. The Hamming distance will be calculated using only the bits generated from the true iris region, and this modified Hamming distance formula is given as

$$HD = \frac{1}{2N}\left[\left(\sum_{i=1}^{N} A_h(i) \oplus B_h(i)\right) + \left(\sum_{i=1}^{N} A_v(i) \oplus B_v(i)\right)\right]$$

Only when $A_h(i) \neq 0 \wedge B_h(i) \neq 0, A_v(i) \neq 0 \wedge B_v(i) \neq 0$.

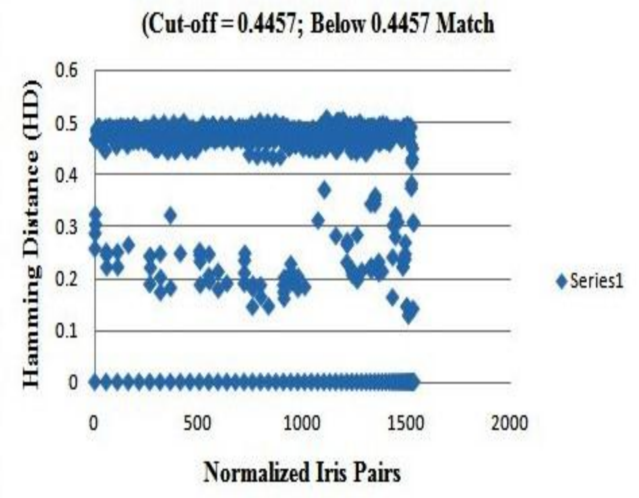
Although, in theory, two iris templates generated from the same iris will have a Hamming distance of 0.0, in practice this will not occur.

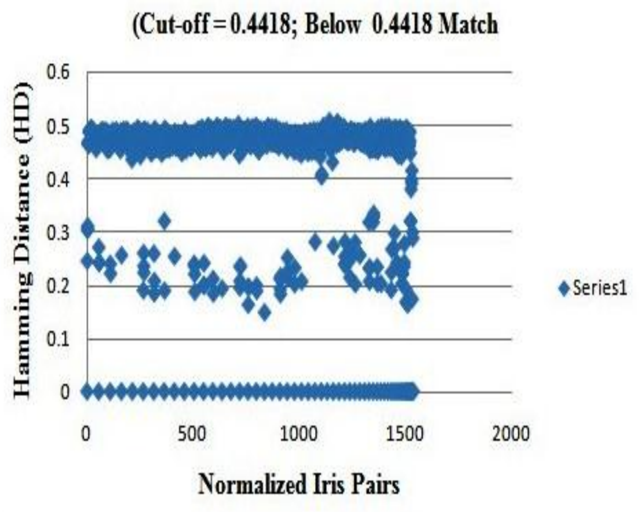
Although, in theory, two iris templates generated from the same iris will have a Hamming distance of 0.0, in practice this will not occur. Normalization is not perfect, and also there will be some noise that goes undetected, so some variation will be present when comparing two intra-class iris templates.

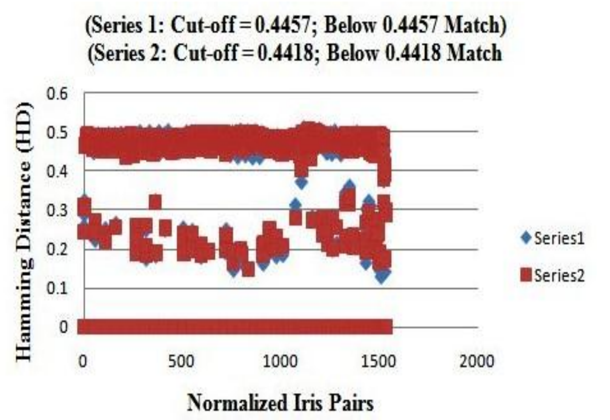
## VIII. RESULT AND DISCUSSION

While biometric authentication can offer a high degree of security among all biometric traits, Iris based system is most accurate and reliable but at the same time there is a risk to privacy. Iris recognition Process is divided in to some basic steps; this paper focus on Image De-noising, Feature Extraction & Encoding and matching process. MATLAB software package is used to implementation the algorithms for above steps. Fig.8. and Fig.9. shows the variation in Hamming Distance (HD) with Iris code pairs for with Noise and without noise cases respectively. 1540 Iris data pairs have been used to calculate the FRR and FAR values [10].

Table I. shows the changes in FRR and FAR values with Isolation of noise.




| Performance Parameter | With Noise | Without Noise (proposed) | Masek's Method [11] |
|---|---|---|---|
| FRR (%) | 0.78 | 0.71 | 10.43 |
| FAR (%) | 0.58 | 0.13 | 3.71 |

## IX. CONCLUSION

Experimental result suggests that the proposed Isolation technique for eyelid and eyelash noise removal is relatively simple and efficient against many existing methods. After the normalized iris image, matching results are very smooth and easily distinguishable between authentic persons and imposters. Table 1 indicates that with masking FRR value improves whereas FAR value degrades slightly. In future we will aim to bring improvement in FAR value by implementing some noise technique that will isolating only those parts of image which are corrupted due to eyelid and eyelash noises and in computational speed of the system using HW/SW co-design.

## ACKNOWLEDGMENT

The preferred spelling of the word "acknowledgment" in American English is without an "e" after the "g." Use the singular heading even if you have many acknowledgments. Avoid expressions such as "One of us (S.B.A.) would like to thank ... ." Instead, write "F. A. Author thanks ... ." **Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page**.

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