Wavelength Rectangular Coder (WRC) Algorithm Used for Feature Extraction for Iris Person Identification

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Abstract- *Iris person identification is used every where so it is important to make the identification process efficient and fast so reduced error rates are achieved such as FAR, FRR and EER. To achieve this we are proposing a novel approach of identification using Wavelength Rectangular Coder (WRC) for feature extraction..*

Keywords- Iris Biometric, Authentication, identification, False Acceptance Rate, False Rejection Rate

I. INTRODUCTION

Security means securing the things such as information or data from malicious users who can misuse our data. Security plays an important and vital role in our everyday life. There are different ways of performing security such as in user access control, system protection using PIN, password or physically being as authentication proof such concept is done using biometric system, which is more secure and reliable concept for any system. The Electronic systems which are highly prone for attacks by an attacker or hackers such system are banking, airline reservation, health care, Military, immigration, credit card, ATM, cellular phone. Iris as in Figure1 is like a diaphragm between the pupil and the sclera and its function is to control the amount of light entering through the pupil. Iris is composed of elastic connective tissue such as trabecular meshwork. The agglomeration of pigment is formed during the first year of life and pigmentation of the stroma occurs in the first few years[21,22]. The structure of iris is as shown in figure 2 where iris id surrounded by the pupil, and pupil need to be removed or separated from iris because it is not as region of Interest.

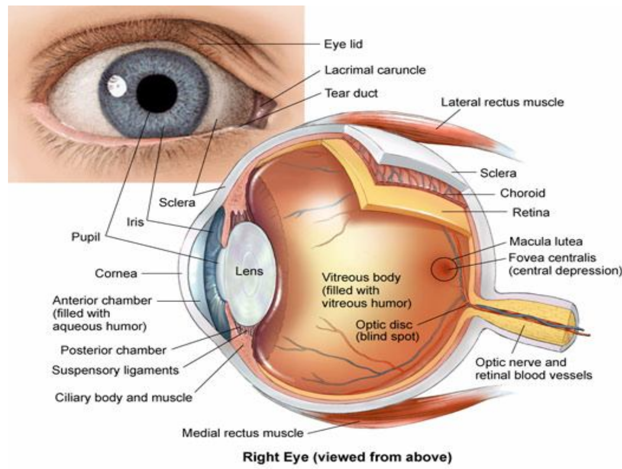


Figure1: Anatomy of Eye

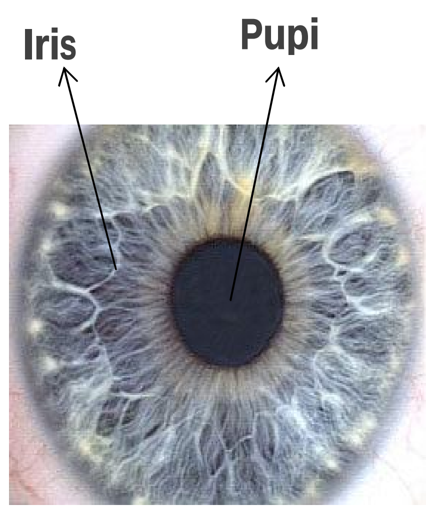


Figure2:Structure of Iris

II. LITERATURE REVIEW

Over the last few years, research in the area of iris recognition has been obtaining significant attention and a number of methods and algorithms have been suggested. In 1987, Flom and Safir initially suggested the idea of automated iris recognition. Since then, several researchers have worked on iris representation and matching and have attained huge progress [21]. Boles and Boashash [3] worked out a zero-crossing representation of one-dimensional (1D) wavelet transform at different resolution levels of a concentric circle on an iris image to distinguish the consistency of the iris. Shufuxie et al. [8] made use of local Gabor XOR designs (LGXP) for recognition of face and iris modalities. Moreover, Roberto Valenti et al. [9] planned to find the core of the eye inside the region of the pupil on low-determination images engaged from a webcam or a comparative gadget. Similarly, J. Raja Sekar et al. [20] have explained the Iris recognition based on the hybrid statistical and co-occurrence multi-resolutional features. In the same way Radman et al [10] provided a rapid iris segmentation strategy. To control the access to limited places, Modern security sciences use these differences which are one of the basic problems in security field. These conventional techniques can be forgotten, stolen, or cracked. For these weaknesses, the current science is concerned in automatic systems of recognition which are based on biometrics technology.

III. IRIS RECOGNITION SYSTEM

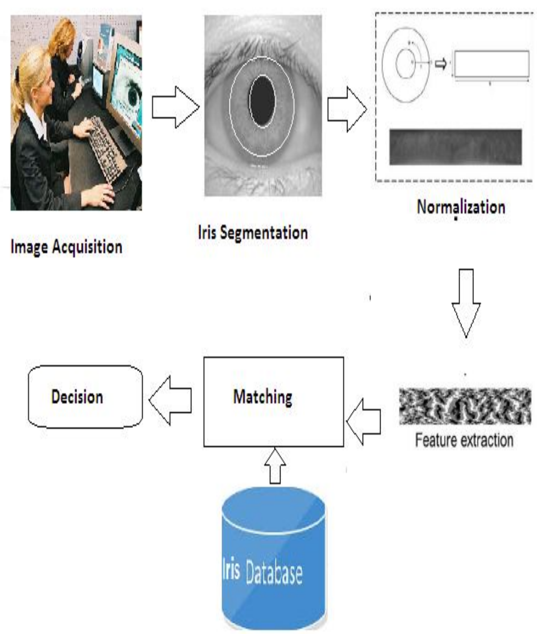


Figure3: Processing steps of the system

1. Image Acquisition: Acquiring images of sufficient resolution and sharpness using good resolution device Charge Coupled Device(CCD) camera in infrared light are used, Good contrast in the interior iris pattern without resorting to a level of illumination that annoys the operator. The images should be well framed (i.e. centered) in acquiring images with less noises in the acquired images should be eliminated as much as possible. Our proposed method uses CASIA , MMU and UBIRIS Iris database.

2. Segmentation of Iris and Pupil using Enhanced Isocentric Segmentation (EISOS): The iris and pupil are very famous circular characteristics which are distinguished by an approximately steady intensity along the limbus (the junction between the sclera and the iris), and the iris and the pupil. In order to localize pupil boundaries the module of the pupil segmentation is planned. More specifically, the module is responsible for performing the following four processing steps, namely: (i) image smoothing, (ii) binary image generation (binarization), (iii) Isophotes curvature estimation and (iv) pupil center and boundary localization using canny operator. As isophotes are slices of the intensity landscape, there is a straight relation among the value of the curvedness and the density of isophotes. As a result, denser isophotes are possible to belong to the similar feature (i.e. edge) and hence locally agree on the similar center. By summing the votes by means of equation (5), we attain high responses around the center of isocentric Isophotes patterns. We name these high responses “isocenters”, or ICs. The maximum isocenter (MIC) in the centermap will be employed as the most possible estimate for the sought after position of the center of the eye.

3. Normalization: After pupil separated from iris we get two concentric circles, next step is to get normalization using Daugman’s rubber sheet model as shown in figure4. Then we get rectangular sheet of 256X128 as in figure 5.

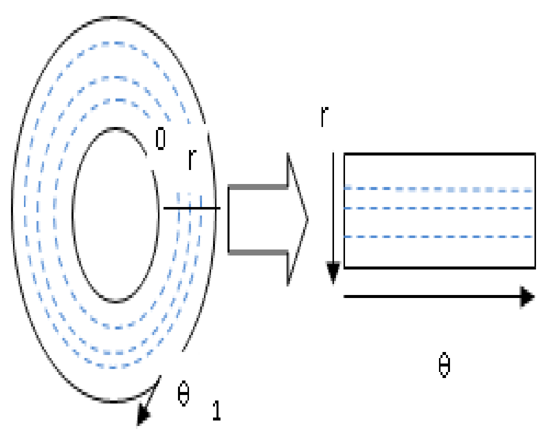


Figure4: Cartesian to polar coordinate

$$I(x(r,\Theta), y(r,\Theta)) \qquad I(r,\Theta) \;\ldots\ldots\; (1)$$

Where r radius lies in the unit interval (0, 1) and Θ is the angle between (0, 2π)

$x(r, \Theta)=(1-r)*x_p(\Theta)+ r*x_i(\Theta)$ …… (2)
$y(r, \Theta)=(1- r)*y_p(\Theta)+r*y_i(\Theta)$ ……. (3)

where $(x_p(\Theta)),y_p(\Theta))$ and $(x_i(\Theta), y_i(\Theta))$ are the coordinates of pupil and iris boundary points respectively.

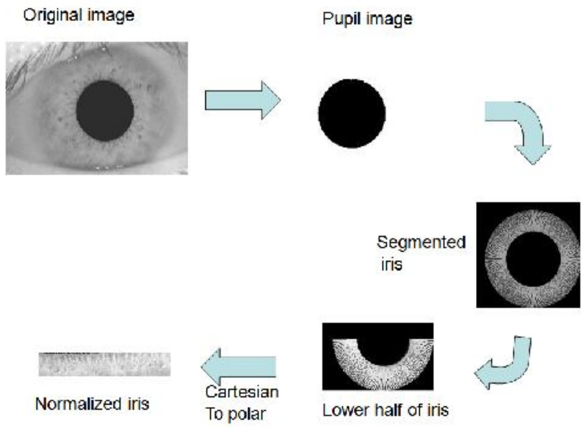


Figure5: process of system till normalization

4. Feature extraction using Wavelength Rectangular Coder(WRC)

Feature extraction is used to reduce the input iris image and convert it into feature vector.

The wavelet based feature extraction is fast and it well suitable for texture classification.

the normalized rectangular block with fixed size 256× 128 this is given to the input of the WRC.

After applying the WRC for each image we obtain the feature vector size of 1×107.

WRC Algorithm:

1. **Define:**

- $A(x , y)$ = Original image (rectangular array)
- $A_{LL}(x, y) = LL$ band transformation image
- $A_{HL}(x, y) = HL$ band transformation image
- $A_{LH}(x, y) = LH$ band transformation image
- $A_{HH}(x, y)= HH$ band transformation image
- BC_{LL} = Binary code of $A_{LL}(x, y)$
- BC_{HL} = Binary code of $A_{HL}(x, y)$
- BC_{LH} = Binary code of $A_{LH}(x, y)$
- BC_{HH} = Binary code of $A_{HH}(x, y)$
- B_S = Obtained Single 8-bit binary code
- D_B = Corresponding decimal value
- $A_{out}(x, y)$ = Final output of the rectangular array image

2. **Apply:** DWT to decompose into Fourier Subbands like LL, LH, HL, HH, each of Subbands are divided into set of blocks of 3X3 with center pixel, X_c.

3. **Code generation**: from 3X3 blocks to replace center pixel in original image. Apply the condition on each center block X_c based on each neighborhood to generate 8-bit binary code.

$$P_i = \begin{cases} 0 \text{ } for \text{ } Xi :> Xc \\ 1 \text{ } for \text{ } otherwise \end{cases}$$

Where

P_i ⟶ i^{th} *pixel*
X_c ⟶ Center block of 3x3 block
X_i ⟶ i^{th} block

4. **Binary code generation**: After apply the above condition and represented as

$BC_{LL} \leftarrow [A_{LL}(x,y)]_{3X3}$
$BC_{HL} \leftarrow [A_{HL}(x,y)]_{3x3}$
$BC_{LH} \leftarrow [A_{LH}(x,y)]_{3x3}$
$BC_{HH} \leftarrow [A_{HH}(x,y)]_{3x3}$

5. **OR operation**: performed to obtain single 8-bit binary code'

$B_S = OR[BC_{LL} , BC_{HL} , BC_{LH} , BC_{HH}]$

6. **Conversion**: from single 8-bit binary code B_S to equivalent decimal value D_B with central pixel X_c and the above process is repeated for whole image to obtain $A_{out}(x, y)$.

7.

8. **Finally**, column-wise mean value is taken for obtained M×N image, and it is deducted to size of 1×N and it gives to recognition phase.

The working model of the WRC algorithm is as shown in Figure 5. The Image is decomposed into four bands such as Low Low(LL), Low High(LH), High High(HH) and High Low, then each of these band are followed step by step as depicted in the algorithm and hence results the feature vector of size 1x107.

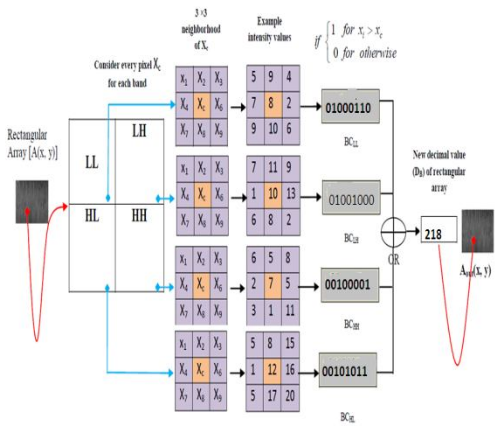


Figure 6: WRC algorithm working model

After normalization we results with the rectangular array of 256 X 128 and converted to the feature vector of size 1x107. To achieve this proposed method used id Wavelet Rectangular coder (WRC) which shows better results in terms of time in milliseconds (MS) for extracting feature per image as compared with benchmark methods of Daugman and Wildes. Our results show better performance when compared with existing methods such as with Boles and Li Ma. Summary of the comparison is as shown in Table 1 and Graph is as shown in Figure7.

Table 1: Computational complexity cost for feature extraction

Methods	**Feature Extraction (in ms)**
Daugman[1]	682.5
Wildes et al.[2]	210.0
Boles et al.[3]	170.3
Li Ma et al.[5]	260.2
Proposed Method	77.0

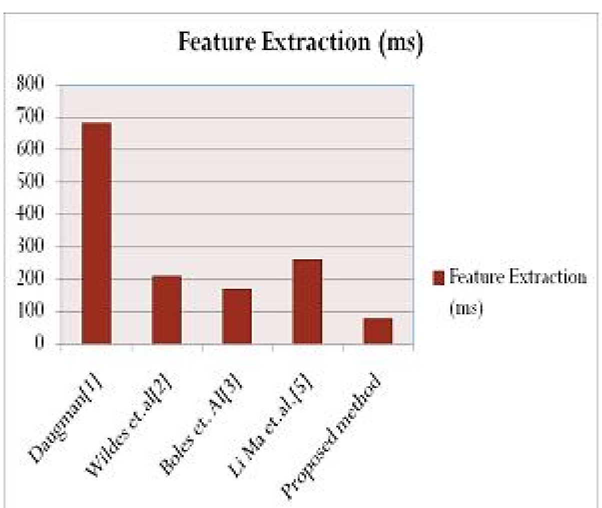


Figure 6: Comparative graph of feature extraction time per image

5. Matching using Fuzzy logic classifier

The recognition of iris sample is carried out using the fuzzy system designed in the previous sub-section. The testing iris image T_S with extracted features which is given to the fuzzy logic system, where the test iris image T_S is converted to the fuzzified value based on the fuzzy membership function. Then, the fuzzified input is matched with the fuzzy rules defined in the rule base. Here, the rule inference procedure is used to obtain the linguistic value that is then converted to the fuzzy score using the average weighted method. From the fuzzy score obtained, the decision is generated whether the test iris image belongs to the recognition or not. The Figure 7 illustrates the Flow diagram of Genfis2based Fuzzy Interference System.

Table 2: Sample rule of the system

Rules	Sample rules
R_1	IF (X_1 is C_1) and (X_2 is C_1) and (X_3 is C_2) and (X_4 is C_1) and . . . . (X_N is C_2) THEN Y_0 =1
R_2	IF (X_1 is C_2) OR (X_2 is C_1) OR (X_3 is C_1) OR (X_4 is C_2) OR . . . . (X_N is C_1) THEN Y_0=0.
⋮	
R_k	IF (X_1 is C_1) OR (X_2 is C_2) OR (X_3 is C_2) OR (X_4 is C_1) OR . . . . (X_N is C_2) THEN Y_0 =0

Where

- R_1, R2 . . . R_k are the fuzzy rules,
- X_1, X2, X3 . . . . X_N are the input attribute of the rectangular array with size 1×N.

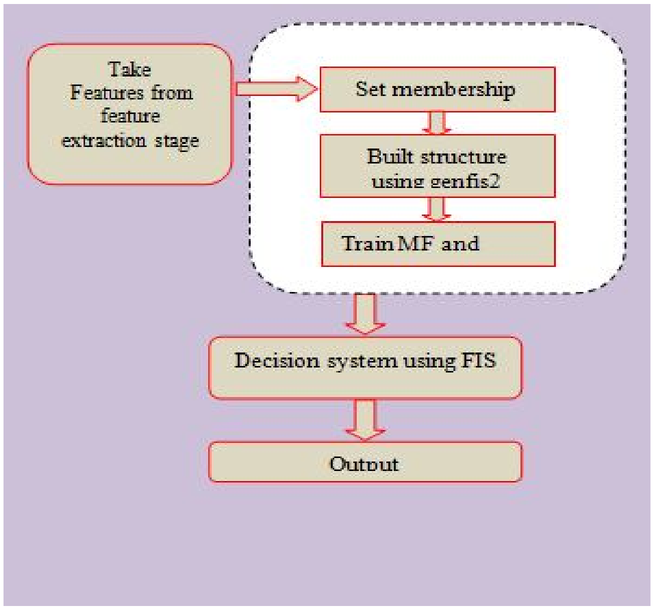
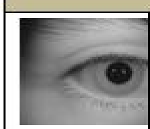
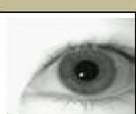
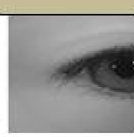
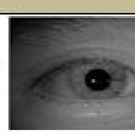
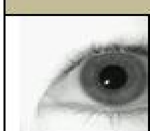
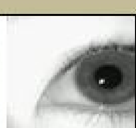
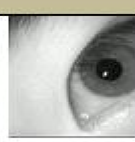
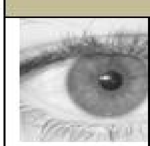
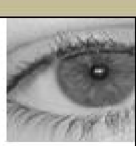
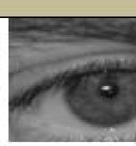
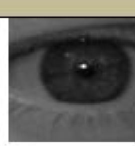


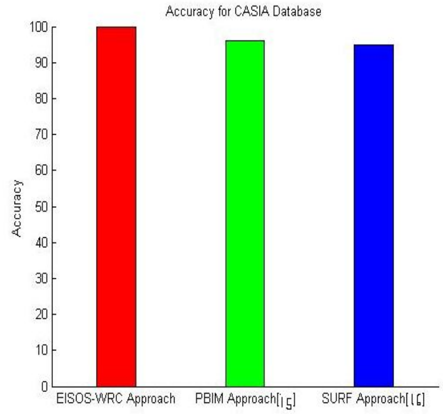
Figure 7: Flow diagram of Genfis2based Fuzzy Interference System

IV. RESULTS AND DISCUSSION

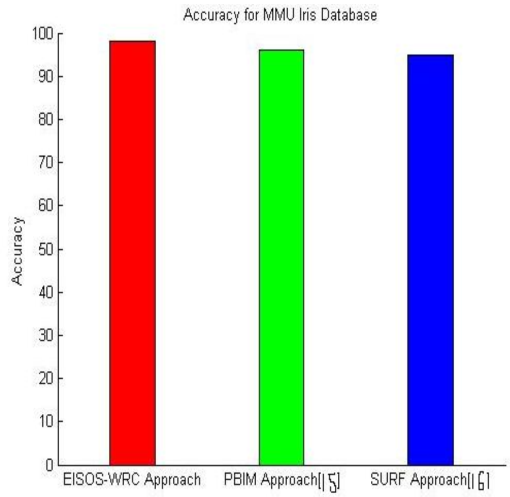
The result obtained from the proposed iris recognition system. For implementing the proposed technique we have used Mat lab version 7.12. This proposed technique is done in windows machine having Intel Core i5 processor with speed 1.6 GHz and 4 GB RAM. In this experimental we utilized the resized database images of size 128×128. For comparing the performance, we using three type of dataset such as CASIA, UBIRIS and MMU iris database as shown in Figure8

Table4: Sample iris images from CASIA[19], MMU[18] and Ubiris[17] database

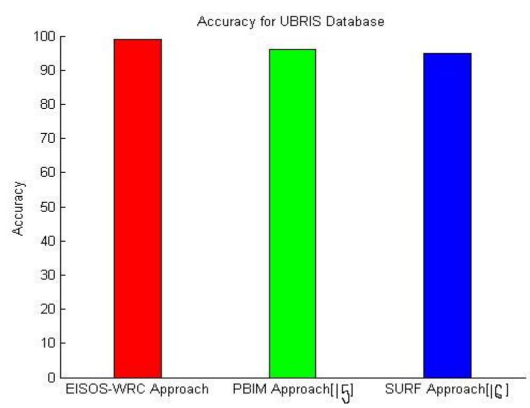
CASIA dataset images			
			
MMU dataset			
			
UBIRIS dataset			
			



(A)



(B)



(C)

Figure 5: Performance of accuracy plot of CASIA database (a), the accuracy plot of MMU database (b), the accuracy plot of the UBIRIS database between proposed against existing approach

V. CONCLUSION

In this paper, we utilized EISOS approach based isophote properties for segmentation part to locate the center of the eye within the area of the pupil. The utilization of isophotes yields low computational cost and robustness to rotation and direct illumination changes. A broad assessment of the proposed segmentation methodology was performed, testing it for accurate eye location in standard low determination images. After that, we developed a new feature extraction algorithm called as WRC which is used to generate the unique features and reduce the partial occlusion present in the images. Finally, we adapted the iris recognition system based on the fuzzy logic classifier. Experimental results indicate that the proposed method of EISOS+WRC for iris segmentation and recognition framework have outperformed by having better accuracy of 99.75%.

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