Iris Recognition based on Translation of Iris Templates, AHE, HE and Gabor Wavelet Filter

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Abstract - An iris is reliable biometric trait to authenticate a person. In this paper we propose Iris Recognition based on Transformation of Iris Template, AHE, HE and Gabor Wavelet Filter. The iris is extracted and created as iris template using localization and segmentation. The numbers of iris templates are converted into one iris template per person using averaging technique. The Adaptive Histogram Equalization (AHE) is applied on converted iris templates. The Histogram Equalization (HE) is applied on AHE templates and features are extracted using Gabor wavelet filters. The database iris template features are compared with test iris template features using Euclidian Distance (ED) to compute performance parameters. It is observed that the performance of proposed algorithm is better compared to existing algorithms.

Keywords – *Biometrics, Gabor filter, Iris Template, AHE, HE.*

1. Introduction

Biometric Recognition systems based on physiological and behavioral characteristics of a person are more reliable, accurate and efficient for authentication of an individual in a data access control and security applications due to their inherent stable and unique features. The Biometric traits considered for recognition are (i) physiological traits like face, fingerprint, and iris (ii) behavioral traits such as signature, gait and keystroke must be robust with intra and inter class variations of training and testing data sets. The Iris physiological trait provides more distinguishable and stable unique features which meets the demands of biometric system in terms of robustness and accuracy with large data set comparison due to its rich complex epigenetic texture feature which are distinct stable, flexible, reliable and non invasive in nature. Iris is a circular structure surrounded by pupil at its inner boundary and sclera at its outer boundary containing rich texture information like arching ligaments, furrows, ridges, crypts, rings, corona, freckles and a zigzag collarette for extracting robust features for recognition.

The Iris Recognition system proposed by Daugmam[1] based on Integro differential operator and gabor filter forms the basis of iris recognition model which uses quantized phase information of iris texture features for recognition wildes [2] described iris localization using circular Hough transform and iris spatial feature representation with multi scale decomposition using Laplacian Pyramids. Boles and Boashash [3] proposed a iris recognition based on zero crossings of dyadic wavelet transform on iris to extract features . Magnitude and position of zero crossing is used to match similarity between iris images. L.Ma, et al., [4] presented multi-channel Gabor filter for local and global feature extraction from an iris textures. These existing iris recognition methods provides better recognition at the cost of complex mathematical computation and more time consuming in localization, segmentation and normalization of iris .In the proposed work histogram based iris recognition is proposed which uses Gabor filters and Fast Fourier Transform to extract features from iris template. The morphological operations and connected component analysis of binary images with region properties are used to detect pupil and to extract normalized iris template resulting in less mathematical computation and time compared to conventional and existing iris recognition methods.

Motivation: The Personal identification methods of an individual based on Biometric systems have become a prominent authentication tool in modern word data access and control applications. The goal of achieving better recognition rate demands a selection of an efficient biometric trait which provides better feature representation and robustness against variations in datasets used for feature selection. The iris physiological biometric trait with its unique and stable feature meets these demands of a biometric system with a good accuracy in terms of recognition.

Contribution: In this paper Iris Recognition based on Transformation of Iris Template, AHE, HE and Gabor Wavelet Filter. The iris template is created using localization and segmentation. The number of templates of a single person is converted into one template. The AHE and HE are used to enhance contrast of template. The Gabor wavelet filter is used to extract features.
Organization: The paper is organized into the following sections. Biometric introduction is given in Section 1. Related work is presented in section2. Proposed model is described in section 3. Algorithm of proposed model is given in Section 4. Section 5 discusses the performance analysis of the proposed model and conclusion is given in section 6.

2. Related Work

Vineet Kumar et al., [5] proposed Iris localization of unconstrained Infrared Iris images using Integro-differential operator and morphological operations. The iris images captured with Daugman reflections, low contrast illumination and occlusions due to eyelids and eyelashes are pre-processed before localizing iris part with morphological operations. This method gives good accuracy compared to other iris localization methods.

Volnei Klehm et al.,[6] described a biometric recognition system based on human iris which uses a signal processing algorithms with correlation filters having minimum energy and principal component analysis. The correlation filter with minimum energy features gives more robustness to any variations of iris images. The method results in better recognition rate. Arezou Banitalebi et al., [7] proposed adaptive fuzzy filtering method for noise free iris recognition by reducing noise component in iris part occurring due to eyelids, eyelashes and light illumination in iris images. The noise pixel density is eliminated with the help of filling filter of adaptive window size and fuzzification of noise pixels in iris pattern. Kiran et al., [8] described iris recognition method to overcome the problems of low texture details of iris pattern of eye images captured under visible spectrum using white light emitting diode which extracts high quality iris patterns with more texture details to recognize correct iris test pattern against any illumination variations in iris images. Nalla et al., [9] proposed iris classification method using iris fiber structure radiating from pupil. Iris structure is divided into different classes based on the density of iris fiber The features from these iris fiber structure are derived from log-gabor filter .Sparse representation which gives weighted sum of each class of iris structure is subjected to on-line dictionary algorithm The final classification of iris achieved using adjudication process wherein iris data is divided into groups based on dissimilarity measurement.

Sheetal Chaudhary et al., [10] Proposed iris recognition based on template security using steganography techniques in which iris code bits are embedded in the last three least significant bits of a cover image pixel to provide more security. The performance of the proposed method gives better results in terms of recognition rate. Yang Hu et al., [11] described iris recognition in less constrained environment subjected to noisy images. The noise component is removed from iris images using sparse error low rank approximation method which uses signal level fusion of iris codes for better recognition rates compared to other existing state of art methods. Mohammed et al., [12] developed iris segmentation for non ideal iris images using a fusion of an expanding and a shrinking active contour model for pupil and iris boundary detection which clearly isolates iris boundary from eyelids and eyelashes. The non circular iris normalization is used to create iris template from iris images. The proposed segmentation method is robust in providing better performance and recognition results. Yong Zhang and Yan W [13] presented an iris recognition based on texture features. The phase information of texture features are extracted using two dimensional Gabor filter and one dimensional log Gabor filters.The Hamming distance is used to classify the test iris images from the database iris images. Bashirul Azam Biswas et al., [14] proposed iris recognition using iris codes generated from log gabor filter and discrete cosine transform features. Iris code bit positions having discriminatory power are calculated from statistical inter and intra class consistency using effective masking process. The proposed method gives better recognition rate in non-cooperative acquision of iris images. Khalid et al. ,[15] described iris recognition using small feature vector size obtained from mean-by-median thresholding and sliding window used along row and columns of iris template. Hamming distance classifier is used for matching. The proposed system consumes less time resulting in increasing speed and accuracy of iris biometric system.

Tanvir Zaman Khan et al., [16] proposed iris localization method using morphological and geometrical operations .The iris part from pupil and sclera boundary is localized from the binary eye image generated with suitable threshold value based on median filter, image compliment and contact labeling methods. The proposed localization method performance better in terms of good recognition rate compared to other existing methods.

3. Proposed Model

In this section the proposed biometric system based on iris using translation of iris templates of a person, AHE, HE and Gabor wavelet filter is discussed with block diagram shown in Figure 1.

3.1 Iris database

Iris is a stable and uniqe internal organ of eye with rich texture features present between pupil and sclera boundary. The eye images captured under Near Infrared light source provide better iris patterns with good contrast and illuminations. The Chinese Academy of Science Institute and Automation (CASIA) V.1 Iris database [17] created with NIR light source consists of 108 persons having each person’s seven different images forming total 756 eye images are considered for training and testing of iris samples. The iris template of first six eye images of each person are considered for computing False Rejection Rate (FRR) and the iris template of seventh eye image of each person is considered for computing False Acceptance Rate (FAR) of proposed algorithm. The sample images of CASIA V.1 database are shown in Figure 2.

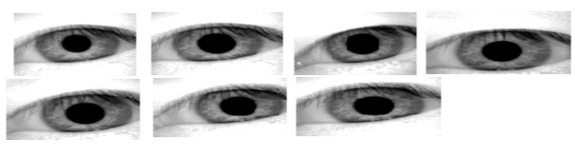


Fig. 2 Seven Samples of single person (CASIA V.1 database)

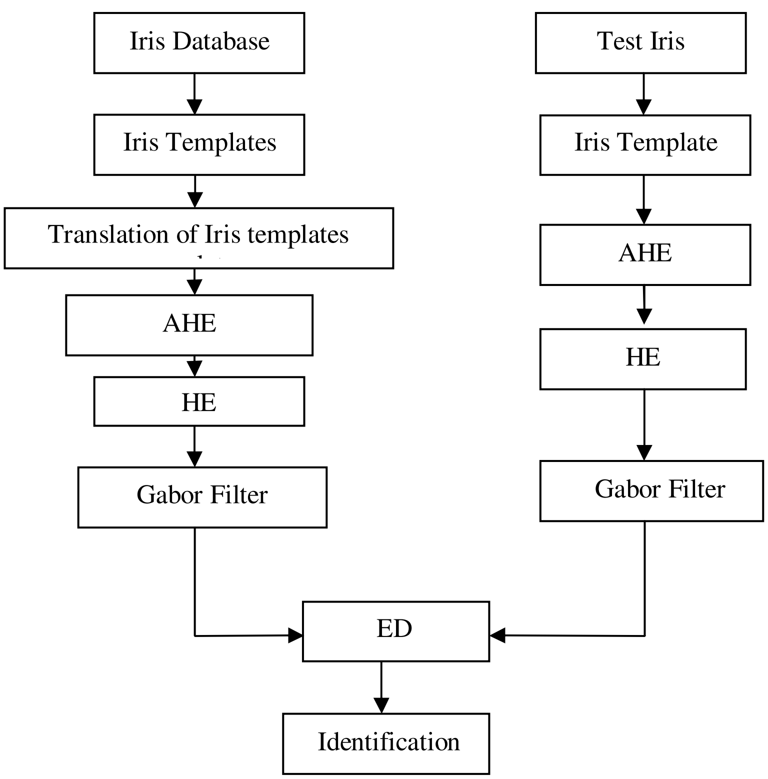


Fig. 1 Block Diagram of Proposed Model

3.2 Iris Templates

Iris is a circular diaphragm layer surrounded by inner pupil and outer sclera boundary in an eye image. The accurate iris part extraction needs localization and segmentation of an iris part as upper and lower part of iris is occluded with eyelids and eyelashes.

3.2.1 Iris Localization

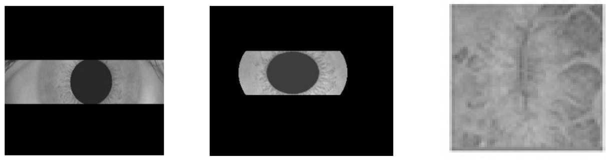
The Localization of iris is performed by first finding centre and radius of pupil [18]. The pupil with low intensity values are approximated with suitable threshold value and masking higher intensity values above threshold value as not a number resulting in a binary image .The binary image obtained by thresholding is subjected to connected component analysis which scans the image and label the binary image based on pixel connectivity into different regions and find out the region with highest diameter value using equidiameter region properties of connected component analysis of binary image which forms a pupil detection as shown in Figure 3

(a) Pupil with eyelashes (b) Extracted Pupil

Fig. 3 Extraction of pupil from an eye image

3.2.2 Iris segmentation

The localized pupil from an eye image is used to segment and extract iris part from an eye image. The region properties like centroid and bounding box are used to find out centre and radius of localized pupil. The pupil centre value x co ordinate is subtracted and added from radius to fix lower row radius and upper row radius along horizontal direction that is above and below the pupil part respectively to remove eyelids and eyelashes which are occluded with upper and lower part of iris by setting all the pixels above these lower and upper radius as a not a number(NAN), similarly the pupil centre y co ordinate value is subtracted and added from radius of a pupil to fix lower column and upper column along vertical direction. The required iris part is segmented and extracted by taking 45 pixels based on Springer CASIA V1 database analysis [19] from on either side of pupil boundary to form an iris template as shown in Figure 4.



(a) Localized iris par(b) segmented iris (c) Iris Template

Fig. 4 Iris Template formation using Extracted pupil

3.3 Translation of Iris Templates

The number of iris templates of a person is converted into single iris template per person using averaging technique. The translation of six iris template images of single person into one iris template increases the speed of computation and requires less memory while creating iris template database. The converting six iris templates of single person into one iris template is as shown in Figure 5

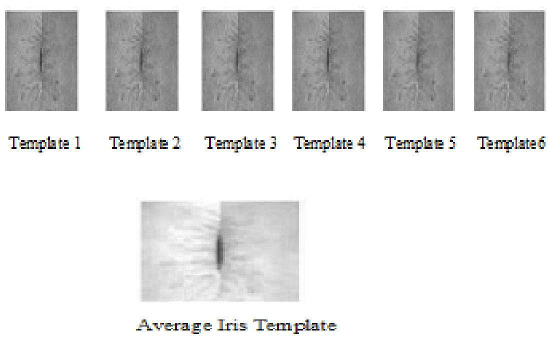
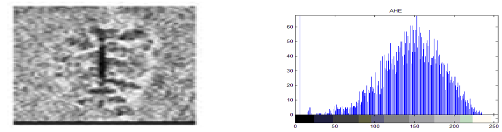


Fig. 5 Translation of six templates into single template using Averaging

3.4 Adaptive Histogram Equalization

The iris extracted from an eye image after localization and segmentation results in low contrast iris image with non uniform distribution of pixel intensity values. Iris image contrast is enhanced using Adaptive Histogram equalization [20] which adaptively increases the overall contrast of iris by dividing iris image into smaller regions called contextual region. The AHE equally enhance the noise component of homogeneous regions which is overcome using Contrast Limited Adaptive Histogram Equalization by clipping the histogram at some predefined level based on contrast limit value calculated with the help of cumulative distribution function. The each pixel intensity in contextual region is transformed based on the mapping of pixel with its four neighbouring corner pixel values. The cumulative distribution function which is measure of probability of occurrence of pixel intensity values of different contextual regions is added using interpolation mapping function derived by finding the slope of cumulative distribution function to increase the contrast of iris image over entire range of intensity values. The contrast enhanced iris and its histogram is as shown in Figure 6 (a) and (b).



(a) AHE Enhanced Iris (b) AHE Histogram

Fig. 6 Enhanced Iris Template using AHE

3.5 Histogram Eqalization

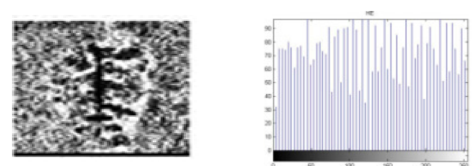
Equalization is a image contrast enhancement method based on pixel intensity values [21]. It increases the contrast of image through equally distributing all pixels of an image equally over the entire intensity range using probability density function of pixel intensity values. The probability density function gives the probability of occurrence of number of pixels with particular intensity in an image. The histogram enhanced iris and its histogram is shown in Figure 7 (a) and (b). The each pixel intensity r_k is transformed to a new intensity value s_k by adding all previous probability density function $p(r_j)$ values from j=0 to k as shown in equation (1)

$$S_k = T(r_k) = \sum_{j=0}^{k} p(r_j) \quad k = 0,1 \ldots L-1 \quad ..(1)$$

Where

S_k represents transformed kth intensity value

$p(r_j)$ represents probability of occurrence o r_j th intensity value



(a) HE Enhanced Iris (b) HE histogram

Fig. 7 Enhanced Iris Template using HE

3.6 Feature Extraction

The segmented iris is characterized with high texture patterns which can be used to better representation of iris texture features. The Gabor wavelet filters provides local information with different frequency and orientation to discriminate texture features present in iris images.

3.6.1 Gabor Wavelet Filters

Gabor wavelet filter functions are localized sinusoids in both time and frequency capturing texture features with different scale and orientations [22]. A 2-D Gabor filter is a spatial sinusoid modulated by a Gaussian kernel as given in equation (2).

$$\psi_{\Pi}(f,\theta,\gamma,\eta)=\frac{f^2}{\pi\gamma\eta}e^{-\left(\frac{f^2}{\gamma^2}x'^2+\frac{f^2}{\eta^2}y'^2\right)}e^{j2\pi x'} \quad (2)$$

$$x' = x\cos\theta + y\sin\theta \qquad y' = -x\sin\theta + y\cos\theta$$

Where, f is central frequency of sinusoid, θ gives orientation of Gaussian kernel and localized sinusoidal plane. γ and η measures the spatial width along major and minor axis of Gaussian kernel with parallel and perpendicular to the direction of sinusoidal wave . The Gabor filters with different scales and orientation are designed as per the parameters given in equation (3)

$$\left.\begin{aligned} \psi_{u,v}(x,y) &= \psi_{\Pi}(f,\theta,\gamma,\eta) \\ f_u &= \frac{f_{max}}{\left(\sqrt{2}\right)^u} \\ \theta_v &= \frac{v}{8}\pi \end{aligned}\right\} \quad (3)$$

Where $\psi_{u,v}(x,y)$ gives the Gabor filter with scale u and orientation v at pixel coordinate x and y of an Iris image. $f_{\max}$ is the maximum frequency of spatial sinusoidal plane with a value=0.25. The value of γ and η is taken as √2 The values of u ranges from 0 to 4 and v ranges from 0 to 7 for five scales and eight orientations. The gabor filters with five scale along row direction and eight orientations along columns are as shown in Figure 8

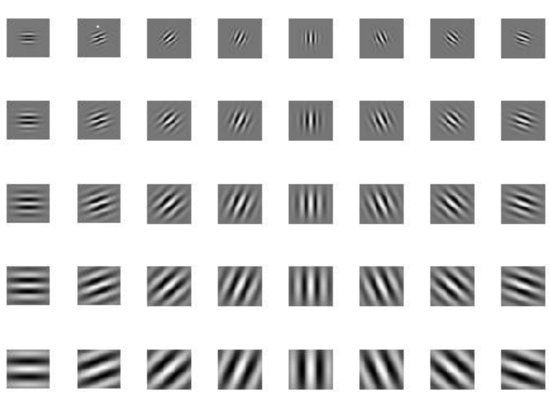


Fig .8 Gabor Filters with Five scale and Eight Orientations

3.6.2 Gabor Wavelet Features

The Gabor filter bank [23] with an cell array of 5x8 which represents five scale and eight orientations consists of 40 gabor filters. The translated iris template with size 80x60 is convolved with these Gabor filters to extract texture features as shown in Figure 9 with five scale and eight orientations to derive 1x12000 Gabor wavelet coefficients as given in equation (4) and equation (5).

$$O_{u,v}(x,y) = I(x,y) * \psi_{u,v}(x,y) \quad (4)$$

$$F = \left(O_{0,0}{}^T\, O_{0,1}{}^T\, O_{0,1}{}^T \ldots\ldots\ldots O_{0,7}{}^T\right)^T \quad (5)$$

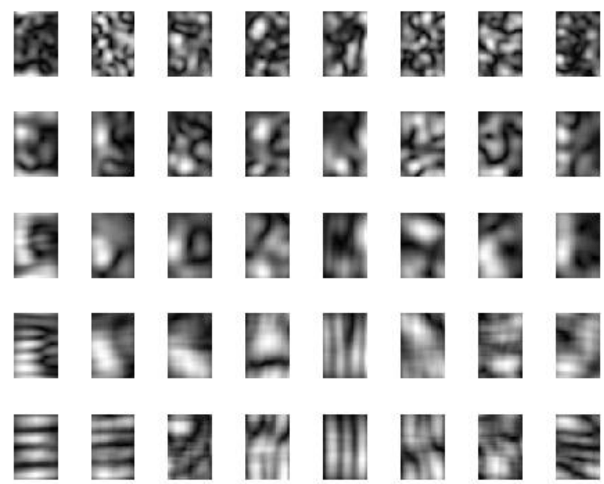


Fig. 9: Iris Texture Features with Gabor Filter

4. Algorithm

In this section, the proposed Iris recognition using translation of iris template, AHE, HE and Gabor wavelet filters is discussed and is given in Table 1.

Problem Definition: The iris is used to authenticate a person efficiently by converting number of iris templates of a single person into one iris template and Gabor wavelet filters are used to extract features.

Objectives: The Recognition of a person based on iris is very effective and the objectives are:

(i) To increase TSR
(ii) To decrease FRR, FAR and TSR

The proposed iris recognition model is as shown in Table1. The Iris template of size 80x60 is obtained from an eye image with pre-processing using morphological operations and region properties of connected component analysis. The contrast of iris is enhanced by applying Adaptive histogram Equalization and Histogram Equalization for better feature extraction. The Gabor wavelet function is applied on iris template to extract texture features with different scale and orientation.

Table 1: Proposed Algorithm

Input: Test Eye image
Output: Recognition of a person
Step 1: Read an eye image.
Step 2: Iris template is created using Localization and Segmentation.
Step 3: Translation of number of iris templates of a single person into one iris template to reduce number of templates in database.
Step 4: Adaptive Histogram Equalization is applied on iris template to increase contrast
Step 5: Histogram equalization is applied on AHE.
Step 6: The Gabor wavelet filters with five scale and eight orientations are used to extract 1x1200 gabor coefficient texture features.
Step 7: Database and Test iris images are matched using Euclidian distance classifier
Step 8: Result of Matching and Non Matching for different threshold are obtained with Euclidian Distance.

5. Performance Analysis

In this section , the definitions of performance parameters such as FRR, FAR, TSR, EER and Optimum TSR with their variations against threshold for different combination of PID: POD are discussed.

5.1 Definitions of Performance Parameters

5.1.1 False Rejection Rate (FRR): It gives the measure of falsely rejected persons and can be determined by taking the ratio of number of persons rejected falsely to the total no of persons present inside the database.

$$FRR = \frac{Number\ of\ Persons\ rejected\ falsely}{Total\ number\ of\ Persons\ present\ inside\ the\ database} \quad (6)$$

5.1.2 False Acceptance Rate (FAR): It gives the measure of falsely accepted persons and can be determined by taking the ratio of number of persons accepted falsely to the total no of samples present outside the database

$$FAR = \frac{Number\ of\ Persons\ accepted\ falsely}{Total\ number\ of\ Persons\ present\ outside\ the\ database} \quad (7)$$

5.1.3 Total Success Rate (TSR): It gives the measure of the correct matching between training and test persons and can be determined by taking the ratio number of true matches to the total no of samples inside the database.

$$TSR = \frac{Number\ of\ Persons\ matched\ correctly}{Total\ number\ of\ Persons\ present\ inside\ the\ database} \quad (8)$$

5.1.4 Equal Error Rate: It gives error rate with equal values of False Acceptance rate and False Rejection Rate.

5.1.5 Optimum TSR: It measures the Recognition Rate corresponding to the EER Value.

5.2 Performance Parameters variations for different Combinations of PID: POD.

5.2.1 Combination of PID and POD of 10:90

The performance parameters FRR, FAR and TSR variations with threshold for different combination of PID: POD are discussed in the following section. The Percentage variations of FRR, FAR and TSR values with threshold for PID: POD of 10:90 are shown in Table 2 and Figure 10. It is observed that the values of FAR increases from zero to maximum value of 100 and FRR values decreases from maximum value of 100 to minimum value of zero as threshold increases towards higher value.

Table 2: The Performance parameters with threshold for PID: POD of 10:90

PID : POD 10: 90			
THRESHOLD	FAR	FRR	TSR
0.56	0	100	0
0.60	0	90	10
0.64	0	50	50
0.68	0	50	50
0.72	0	30	70
0.76	10	10	90
0.80	29	0	100
0.84	50	0	100
0.88	83	0	100
0.92	94	0	100
0.96	100	0	100

The maximum success rate TSR of 100 and Optimum TSR value of 90 are obtained with an EER value of 10 at threshold value of 0.76.

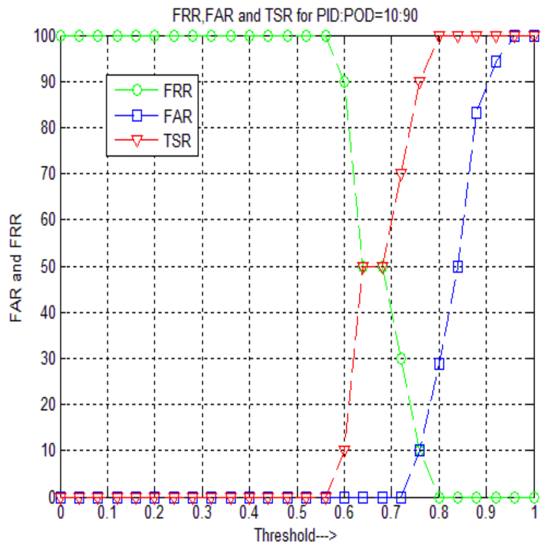


Fig. 10: FRR, FAR and TSR for PID: POD=10:90

5.2.2 Combination of PID and POD of 20:80

The Percentage variations of FRR, FAR and TSR values with threshold for PID: POD of 20:80 are shown in Table 3 and Figure 11.

Table 3: The Performance parameters with threshold for PID: POD of 20:80

PID : POD 20: 80			
THRESHOLD	FAR	FRR	TSR
0.52	0	100	0
0.56	0	95	5
0.60	0	85	15
0.64	0	55	45
0.68	0	40	60
0.72	5	25	75
0.76	15	15	85
0.80	39	10	90
0.84	66	5	95
0.88	91	0	100
0.92	98	0	100
0.96	100	0	100

The maximum Total Success Rate of 100 and Optimum TSR value of 86 are obtained with an EER value of 14 at threshold value of 0.72.

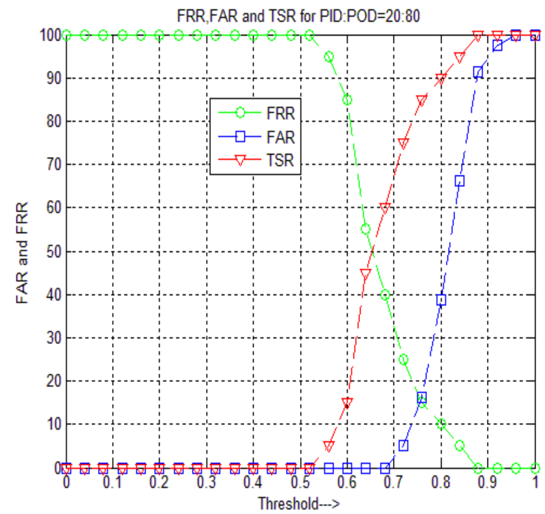


Fig. 11: FRR, FAR and TSR for PID: POD=20:80

5.2.3 Combination of PID and POD of 30:70

The Percentage variations of FRR, FAR and TSR values with threshold for PID: POD of 30:70 are shown in Table 4 and Figure 12.

Table 4: The Performance parameters with threshold for PID: POD of 30:70

PID : POD 30: 70			
THRESHOLD	FAR	FRR	TSR
0.52	0	100	0
0.56	0	97	3
0.60	0	90	10
0.64	0	70	30
0.68	0	50	50
0.72	6	30	70
0.76	19	13	87
0.80	40	7	93
0.84	69	3	97
0.88	91	0	100
0.92	97	0	100
0.96	100	0	100

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The maximum Total Success Rate of 100 and Optimum TSR value of 85 are obtained with an EER value of 15 at threshold value of 0.75.

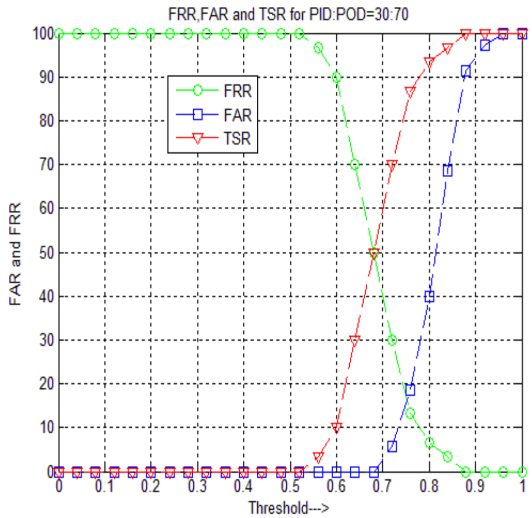

Fig. 12: FRR, FAR and TSR for PID: POD=30:70

5.2.4 Combination of PID and POD of 40:60

The Percentage variations of FRR, FAR and TSR values with threshold for PID: POD of 40:60 are shown in Table 5 and Figure 13.

Table 5: The Performance parameters with threshold for PID: POD of 40:60

PID : POD 40: 60			
THRESHOLD	FAR	FRR	TSR
0.44	0	100	0
0.48	0	97	3
0.52	0	95	5
0.56	0	92	8
0.60	0	85	15
0.64	0	57	43
0.68	0	40	60
0.72	10	20	80
0.76	22	10	90
0.80	43	5	95
0.84	77	3	98
0.88	90	0	100
0.92	98	0	100
0.96	100	0	100

The maximum Total Success Rate of 90 and Optimum TSR value of 84 are obtained with an EER value of 16 at threshold value of 0.73.

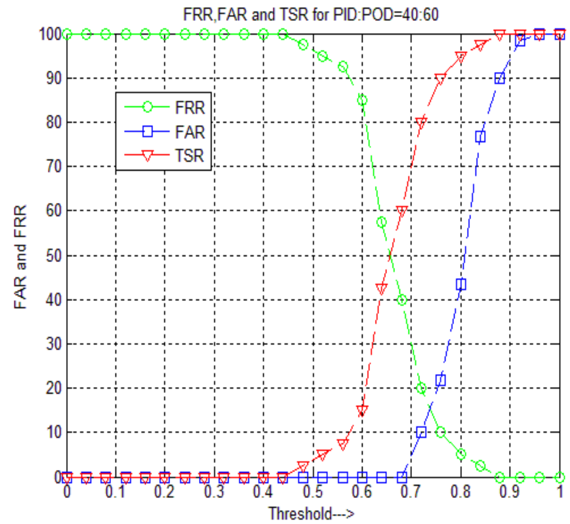

Fig. 13: FRR, FAR and TSR for PID: POD=40:60

5.2.5 Combination of PID and POD of 50:50

The Percentage variations of FRR, FAR and TSR values with threshold for PID: POD of 50:50 are shown in Table 6 and Figure 14.

Table 6: The Performance parameters with threshold for PID: POD of 50:50

PID : POD 50: 50			
THRESHOLD	FAR	FRR	TSR
0.44	0	100	0
0.48	0	96	4
0.52	0	94	6
0.56	0	88	12
0.60	0	76	24
0.64	0	52	48
0.68	0	32	68
0.72	18	18	82
0.76	36	8	92
0.80	50	5	94
0.84	84	3	98
0.88	94	0	100

The maximum Total Success Rate of 100 and Optimum TSR value of 83 are obtained with an EER value of 17 at threshold value of 0.72.

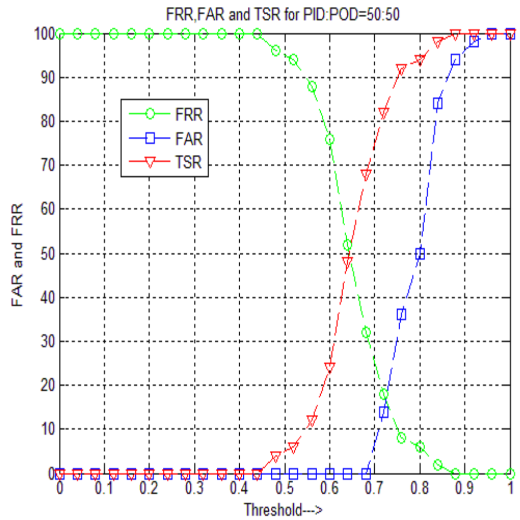

Fig. 14: FRR, FAR and TSR for PID: POD=50:50

5.2.6 Combination of PID and POD of 60:40

The Percentage variations of FRR, FAR and TSR values with threshold for PID: POD of 60:40 are shown in Table 7 and Fig 15.

Table 7: The Performance parameters with threshold for PID: POD of 60:40

PID : POD 60: 40			
THRESHOLD	FAR	FRR	TSR
0.44	0	100	0
0.48	0	96	4
0.52	0	94	6
0.56	0	88	12
0.60	0	76	24
0.64	0	52	48
0.68	0	32	68
0.72	18	18	82
0.76	36	8	92
0.80	50	5	94
0.84	84	3	98
0.88	94	0	100
0.92	98	0	100
0.96	100	0	100

The maximum Total Success Rate of 100 and Optimum TSR value of 82 are obtained with an EER value of 18 at threshold value of 0.72.

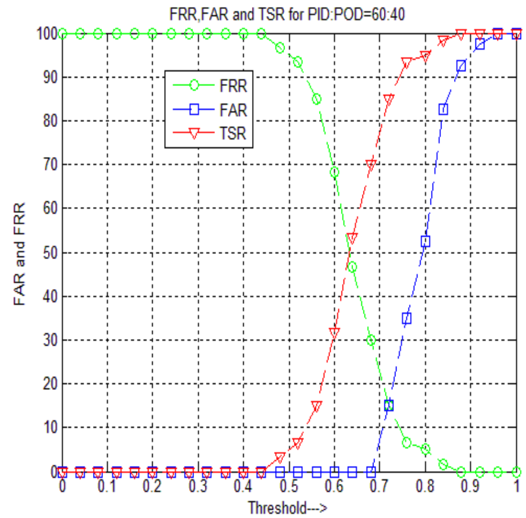

Fig. 15: FRR, FAR and TSR for PID: POD=60:40

5.2.7 Combination of PID and POD of 70:30

The Percentage variations of FRR, FAR and TSR values with threshold for PID: POD of 70:30 are shown in Table 8 and Fig 16.

Table 8: The Performance parameters with threshold for PID: POD of 70:30

PID : POD 70: 30			
THRESHOLD	FAR	FRR	TSR
0.40	0	100	0
0.44	0	100	1
0.48	0	96	7
0.52	0	94	10
0.56	0	88	17
0.60	0	76	33
0.64	0	52	56
0.68	0	32	71
0.72	18	18	81
0.76	36	8	89
0.80	50	5	96
0.84	84	3	97
0.88	94	0	99

The maximum Total Success Rate of 98 and Optimum TSR value of 81 are obtained with an EER value of 19 at threshold value of 0.72.

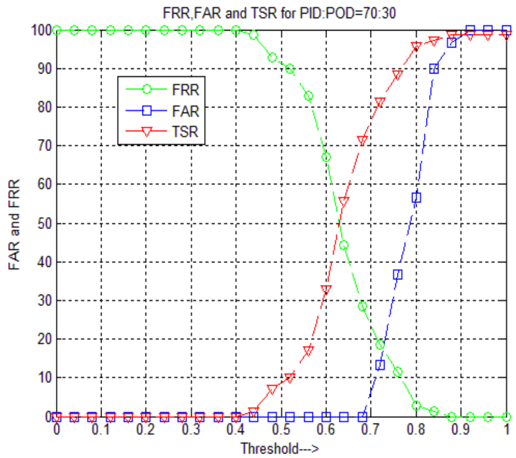

Fig. 16: FRR, FAR and TSR for PID: POD=70:30

5.2.8 Combination of PID and POD of 80:20

The Percentage variations of FRR, FAR and TSR values with threshold for PID: POD of 80:20 are shown in Table 9 and Fig 17.

Table 9: The Performance parameters with threshold for PID: POD of 80:20

PID : POD 80: 20			
THRESHOLD	FAR	FRR	TSR
0.40	0	100	0
0.44	0	98	2
0.48	0	94	6
0.52	0	91	9
0.56	0	79	21
0.60	0	64	36
0.64	0	41	58
0.68	0	24	76
0.72	15	16	84
0.76	30	8	92
0.80	50	3	97
0.84	90	1	99
0.88	100	0	99

The maximum Total Success Rate of 99 and Optimum TSR value of 90 are obtained with an EER value of 10 at threshold value of 0.72

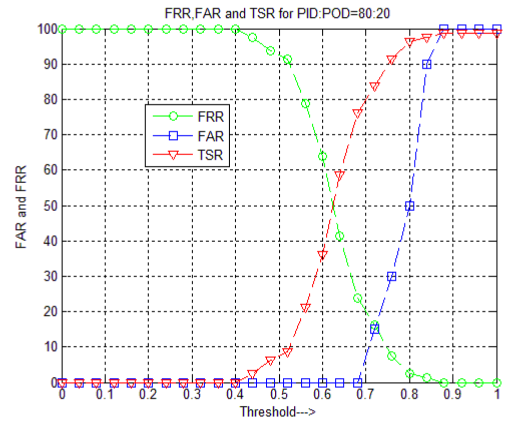

Fig. 17: FRR, FAR and TSR for PID: POD=80:20

5.3Performance Parameters Comparison for different Combinations of PID: POD

The Equal Error rate, maximum TSR and optimum TSR values are compared with different combinations of PID and POD values as given in Table 10.

Table.10: Performance Parameters Comparison for different combinations of PID and POD

PID	POD	EER (%)	Optimum TSR (%)	Maximum TSR (%)
10	90	10	90	100
20	80	14	86	100
30	70	15	85	100
40	60	16	84	100
50	50	17	83	100
60	40	18	82	100
70	30	19	81	99
80	20	19	81	99

The values of optimum TSR and Maximum TSR decreases as PID increases from 10 to 80 . The EER values increases as person inside database increases to maximum number 80. The success rate of recognition ie.,TSR values are high for low PID values. The optimum error ie., EER value is less with low values of PID.

5.4 The Proposed Method Comparison with Existing Methods

The Proposed method performance parameters are compared with existing methods and the results are given in Table 11. The TSR values are better in the case of proposed method compare to existing methods presented by Yanghua et al., [24], Jianxu Chen et al., [25], Sushilkumar S et al., [26], and Nishanth Rao et al., [27] for the following reasons (i) iris templates of single person are translated into single template using averaging,(ii)contrast of translated iris template is enhanced with AHE and HE (iii) The Gabor wavelet filters with five scale and eight orientations are used to extract texture features to recognize iris images with low error values in terms of FRR and FAR.

Table. 11: Comparison of Optimum TSR of Proposed method with existing methods

Sl. No.	Authors	Techniques	TSR (%)
1	Yang hua et al., [24]	Gabor+ optimized	96.46
2	Jianxu Chen et al.,[25]	Iris Crypts +EMD	96
3	Sushilkumar S et al.,[26]	Log-Gabor+ FFT+ANN	95.90
4	Nishanth Rao P R et al.,[27]	Gabor +DCT+DBPSO	95
6	**Proposed Method**	AHE+HE+Gabor	98

6. Conclusion

Iris biometric trait is used in high security areas to identify a person. In this paper Iris Recognition based on Transformation of Iris Template, AHE, HE and Gabor Wavelet Filter is proposed. The iris template is created using localization and segmentation techniques. The many templates of a person in a database are converted into single person using averaging technique to reduce number of templates per person to increase speed of identification. The AHE and HE are used to enhance quality of iris template. The features are extracted using gabor wavelet filters. The ED is used to compare test and database features to test performance of the proposed algorithm. It is observed that the performance of proposed method is better compared to existing methods.

Future Scope

In future, the algorithm can be tested using real time hardware.

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