A Dimensionality Reduced Iris Recognition System with Aid of AI Techniques

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Abstract

Technologies that exploit biometrics have the potential for the identification and verification of individuals designed for controlling access to secured areas or materials. One of the biometrics used for the identification is iris. Many techniques have been developed for iris recognition so far. Here we propose a new iris recognition system utilizing unbalanced wavelet packets and FFBNN-ABC. In our proposed system, the eye images obtained from the iris database are preprocessed using the adaptive median filter to remove the noise. After removing the noise, iris part is localized by using contrast adjustment and active contour technique. Then unbalanced wavelet packets coefficients and Modified Multi Text on Histogram (MMTH) features are extracted from the localized iris image. Then MMTH features extracted are clustered by using the MFCM technique. After clustering, the dimensionality of the features is reduced by using PCA. Then the dimensionality reduced features unbalanced wavelet packet coefficients are given to FFBNN to complete the training process. During the training, the parameters of the FFBNN are optimized using ABC Algorithm. The performance of our proposed iris recognition system is validated by using CASIA database and compared with the existing systems. Our proposed iris recognition system is implemented in the working platform of MATLAB.Keywords: feed forward back propagation neural network (FFBNN), adaptive median filter, unbalanced haar wavelet, modified multi text on histogram (MMTH), iris recognition, artificial bee colony algorithm (ABC), principle component analysis (PCA), modified fuzzy c-means (MFCM).

Index terms— feed forward back propagation neural network (FFBNN), adaptive median filter, unbalanced haar wavelet, modified multi text on histogram (MMTH), iris r

1 A Dimensionality Reduced Iris Recognition

System with Aid of AI Techniques N. Murali Krishna ? & P. Chandra Sekhar Reddy ? Abstract-Technologies that exploit biometrics have the potential for the identification and verification of individuals designed for controlling access to secured areas or materials. One of the biometrics used for the identification is iris. Many techniques have been developed for iris recognition so far.

Here we propose a new iris recognition system utilizing unbalanced wavelet packets and FFBNN-ABC. In our proposed system, the eye images obtained from the iris database are preprocessed using the adaptive median filter to remove the noise. After removing the noise, iris part is localized by using contrast adjustment and active contour technique. Then unbalanced wavelet packets coefficients and Modified Multi Text on Histogram (MMTH) features are extracted from the localized iris image. Then MMTH features extracted are clustered by using the MFCM technique. After clustering, the dimensionality of the features is reduced by using PCA. Then the dimensionality reduced features & unbalanced wavelet packet coefficients are given to FFBNN to complete the training process. During the training, the parameters of the FFBNN are optimized using ABC Algorithm. The performance of our proposed iris recognition system is validated by using CASIA database and compared with the existing systems. Our proposed iris recognition system is implemented in the working platform of MATLAB.

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traditional biometrics such as finger prints and facial features [13]. Also, the probability of finding two people with identical iris pattern is almost zero [7]. That's why iris recognition technology is becoming an important biometric solution for people identification in access control [14]. More technically, the iris is part of the unveil, or middle, coat of the eye. It is a thin diaphragm stretching across the interior portion of the eye and supported by the lens [4]. Iris recognition is a method of biometric authentication that uses pattern-recognition techniques based on high-resolution images of the irises of an individual's eyes [2]. There are four main techniques in Iris Recognition System Namely: Segmentation, Normalization, Feature Extraction And Matching [12]. Iris recognition begins with finding an iris in an image, demarcating its inner and outer boundaries at the pupil and sclera, detecting the upper and lower eyelid boundaries if they occlude and detecting and excluding any superimposed eyelashes or reflections from the cornea or eyeglasses. These processes may collectively be called segmentation [1]. Iris normalization mainly involves two basic operations, one is to detect eye lids and the other is boundary detection. The first step involves extraction of circular shaped iris rim by removing the noisy regions. The second step is to detect the inner and outer boundaries of iris. [5]. The matching module generates a match score by comparing the feature sets of two iris images [11].

The great advantage of the authentication using iris recognition is the irreplaceable nature. It has various applications to high-security facilities, but it is now being widespread developed in information systems such as network, e-commerce, and retail applications [3]. Although, a number of iris recognition methods have been proposed, it has been found that several accurate iris recognition algorithms use multiscale techniques, which provide well-suited representation for iris recognition [10]. The main difficulty of human iris recognition is that it is hard to find the apparent feature points in the image and to keep their represent ability high in an efficient way [17]. The data are unique to the individual and remain so throughout one's life [8]. The performance of iris recognition systems highly depends on the Introduction oday, many countries are considering or even announced procurement of bio-metrically enabled national identity (ID) card schemes, one of whose purposes will be to detect and prevent multiple IDs [1]. Applications such as passenger control in airports, access control in restricted areas, border control, database access and financial services are some of the examples where the biometric technology has been applied for more reliable identification and verification [6]. Biometric is unique to each individual and is reliable [16]. Iris recognition is the most reliable biometric system available because of iris uniqueness [19], stability, permanency and easily taking [3]. Iris based recognition has been gaining popularity in recent years, and it has several advantages compared to other II.

2 Related Works

Fernando et al. [21] have used a modular neural network architectures as systems for recognizing persons based on the iris biometric measurement of humans. In that system, the human iris database was enhanced with image processing methods, and the coordinates of the center and radius of the iris were obtained to make a cut of the area of interest by removing the noise around the iris. The input to the modular neural networks was the processed iris images and the output was the number of the person identified. The integration of the modules was done with a gating network method results demonstrate that the use of the human iris biometric measurement worked with modular artificial neural networks and favorable results of person identification were obtained. Kodituwakku et al. [22] have attempted to develop an algorithm for iris recognition based on Fuzzy logic incorporated with the visible properties of the human iris function. They were considered the visible features of the human iris such as pigment related features, features controlling the size of the pupil, visible rare anomalies and pigment frill. First they extracted the important and essential feature of a human iris image. Secondly, as an AI technique, Fuzzy logic was applied for iris recognition and person identification. The final system was a very successful at a rate of 98.6% accuracy in recognition with small mistakes.

Hariprasath et al. [23] have presented an iris recognition system based on Wavelet Packet Analysis. With an adaptive threshold, WPT sub images coefficients were quantized into 1, 0 as iris signature. Those signatures presented the local information of different irises. By using wavelet packets, the size of the iris signature of code attained was 1280 bits. The signature of the iris pattern was compared against the stored pattern after computing the signature of iris pattern Identification was performed by computing the hamming distance. The accuracy of the proposed system varied when different feature vector was chosen. Pushpalatha et al. [25] have proposed an iris recognition system with iris localization to segment and recognize cooler iris with highest speed and accuracy. Frequency domain magnitude and phase features were used for image feature representation. For classification process, support vector machines with ”winner takes it all” configuration were used. Tests have shown 97% accuracy with average time of 31 milliseconds seconds for classifying each test image. They developed the iris recognition system using C#.Net (.Net 3.5).

3 III. Proposed Iris Recognition System using ai Techniques

In the proposed methodology, the given input image is preprocessed using adaptive median filter for removing salt and pepper noise at the first stage. Following that, by adjusting the contrast and applying active contour technique on the preprocessed eye image, iris is localized. Then Unbalanced Wavelet Packet coefficients and MMTH features are extracted from the localized iris image and the extracted features are clustered using MFCM. Following that the dimension of the features are condensed using PCA. The Unbalanced Wavelet Packet coefficients and the dimension reduced MMTH features are given to train FFBNN. While training the parameters of the FFBNN are optimized using ABC. During the testing process the same procedure is done here till the feature extraction process. Then the output obtained from the feature extraction process is given to well-trained FFBNN-ABC to validate whether the given input iris image is recognized or not. The architecture diagram of the proposed Iris Recognition System is shown in Fig. 1.

proposed method. Section 3 discusses about the proposed technique. Section 4 shows the experimental result of the proposed technique and section 5 concludes the paper. Naresh Babu et al. [24] have proposed an efficient Fuzzy based Iris Recognition Scheme (FIRS). That scheme has four stages namely Segmentation, Normalization, Feature extraction and classification using fuzzy logic. Hough transforms used for detection of Region of Interest (ROI), and combination of Discrete Wavelet Transform (DWT) and Independent Component Analysis (ICA) was used for feature extraction. Using mean and standard deviation as parameters a fuzzy classifier was used to classify the IRIS images. The results were quite convincing and encouraging. The input eye image is initially changed into grey level format. After that using Adaptive median filter, the grey level eye image is preprocessed to take away salt and pepper noise. The input image may have noises which destroy the good pixels in the image. The noise must be eradicated from the input image in order to attain good precision. We are applying adaptive median filter to salt and pepper noise in our suggested work. It identifies the impulse by calculating the difference between the standard deviation of the pixels inside the filter window and the concerned current pixel.

Let the iris database ( ) I contains many eye images and let j i

x , be one of the grey level images taken from the database. The lower and upper bounds x are ( ) ? ? + ? = + ? = = k i k i m k j k i n n m s j i su , ,**(2)**

4 ( ) ( ) ( )

j i WS j i su j i , , , = µ (4) Global Journal of Researches in Engineering ( ) Volume XIV Issue IV Version I ( ) ( ) ( ) ( ) j i WS j i j i k i k i m k i k i n j i s , , , , ? ? ? ? ? ? ? ? = ? ? + ? = + ? = µ ? (5)

Next by means of these local mean, standard deviation and as well a user defined multiplier upper and lower bounds are computed. j i m j i s , , 1 min ? µ × ? = (6) ( ) ( ) j i m j i s , , 1 max ? µ × + = (7)

The noise candidates only substituted by the median s ws med j i , , in the above adaptive median filter algorithm, while staying behind are unaltered. By means of the above adaptive median filter algorithm the salt and pepper noise is eliminated from the specified input eye image and the preprocessed eye image is indicated as ’

x . This preprocessed eye image ( )’

x is subsequently subjected to iris localization process.

5 b) Iris Segmentation and Normalization

Iris segmentation is the main part in the process of iris recognition. In order to segment the iris from the eye image, here enhanced iris segmentation technique by considering the adaptive thresholding is utilized. The proposed iris segmentation technique has four phases namely,? Removing Holes ? Pupil Detection ? Iris Detection ? Adaptive Normalization the preprocessed image ( ) ’

x is binarized. The process of removing the hole from the pupil is detailed in the below steps:

Step 1: Set the threshold value (?) as 0.1.

Step 2: Obtain the binary image (’ Bx).

Step 3: Take the complement image (’Cx) of the binarized image (’ Bx).

Step 4: Take the binary image (’ Bx) with all zeros and consider it as hole. 0 , ’ = q where Hx q

Step 5: Catch a point (po) inside the hole.

Step 6: Check whether Bx Bx then go to step 7

Step 7:’) ’ (1 Cx Bx B q q ? Î?” ? = ? where Î?” is the structuring element defined as ? ? ? ? ? ? ? ? ? ? 0 1 0 1 1 1 0 1 0 Step 8: If 1 ’ ’ ? = q q Bx Bx ,then discover the hole filled image (’ Hx) where ’ ’ ’ Bx Bx Hx k ? =

Step 9: Find the number of connected components (?) from the hole filled image (’ Hx) .

Step 10: Increment the threshold value (?) as

6 i. Hole Filling

The eye image has holes in the pupil region which is the darkest region in the eye with nearly circular shape. In order to remove the holes from the pupil, binarized image is obtained by applying adaptive thresholding technique. The range of the threshold value (?) is between 0.1to 0.5. The binary images are obtained by adaptive thresholding technique. The maximum pixel value in the preprocessed image ( )’

x is multiplied with the threshold value (?). Then by considering the value obtained after the multiplication, () (c L md

) by 2. By using the obtained center (CPpl) and the radius (RPpl), pupil (Ppl) is detected.

iii. Iris detection For iris identification, the preprocessed iris image is upgraded to have sharp variety at the image limits utilizing histogram evening out. This difference upgraded image is utilized for discovering the external iris range by drawing concentric loops of diverse radii from the understudy focus and the intensities lying over the border of the loop are summed up. Among the applicant iris loops, the loop having most extreme Here, scale based normalization approach [29] is utilized to normalize the iris image) (I in order to preserve the texture property of the features in the iris region) (I . In the normalization process, the obtained iris part) (I is converted into Cartesian space to nonuniform polar space. After that, the points lying on the perimeter of the iris

)) ((I P and pupil circle)) ((ppl P are obtained. Subsequently, the range of radius between the pupil and iris boundaries is obtained and it is mapped to a rectangle by considering the distance between the pupil and iris boundaries [29]. Finally, the obtained normalized iris image ( ) , ,..., 1 / , n i n i f X i i = + = ? (8) Where s i ' ? are random variables with ( ) . 0 = i E ?

We first give a description of the construction of the UH vectors. Suppose that our domain is indexed by , ,..., 1 n i = as is the case in ( ), n b i ? + = The breakpoint n b < 1 , 0

is to be chosen by the analyst. The positive change in power as for the long ago drawn round is the iris external limit. The sweep of the iris location steps is itemized in the accompanying steps.

Input: radius of the pupil (RPpl), center of the pupil (CPpl), preprocessed image ( )' x

Output: Radius of the iris (IR)

Step 1: Obtain the preprocessed image ( )' x .

Step 2: Find the histogram equalized image ( )' x HE

Step 3: Compute the size of the preprocessed image ( )C R x × ? '

Step 4: Calculate the radius of the iris as5 . 1 × = Rppl IR Step 5: Check whether, 2 R IR ?

, then go to step 6.

Otherwise go to step 10

Step Step 7: Find the coordinates (j i,) of the image) cos( ) (? × + = IR l Rpp i i) sin(? × + = IR Rppl j j) ' ( ) (x HE IR Sum = +

Step 8: Increment the angle ( ) ? by 10

Step 9: If 360 ? ? go to step 7 otherwise go to step 5

Step 10: Change the intensity over circumference

Step 11: For i=1 to IR , do the following,1 + ? = i i i

7 S S differnce

Step 12: Find the maximum change in the intensity

Step 13: Obtain the radius of the iris ( ) IR way that ( ) The recursion then continues in the same manner for as long as feasible, with each vector k j, ? having at most two "children" vectors **??**).a the elements of1 1 1 1 1 1 1 1 2 1 2 1 e l b s e b e b l s s e s b < ? + ? ? ? ? ? ? ? + ? ? ? ? < ? ? ? ? ? ? ? ? ? + ? ? + ? = (9)

The inner product between X and n b , , 1 + + + ? < = l j s l j e b X b l **jmax arg , 1 , 1 , 1 >**

where k k l 2 , 1 2 ? = again

Where( ) k j k j f DUHT d , , =**with**( ) { } n i n i f f 1 = = and ( ) K J k j DUHT , , ? ? = with { } . 1 n i i = = ? ? The s d k j '

, are the true UH coefficients of f which are known and need to be estimated.

8 ?

Estimate each k j d , by means of a suitable "universal" shrinkage rule( ) , , , , ? k j k j Y h d = . , , , k j k j k j d Y ? + = A Dimensionality Reduced Iris Recognition System with Aid of AI Techniques © 2014 Global Journals Inc. (US) ( ) ( ). , , , i X DUHT X K J K J k j i ? ? = (**12**)

where the function h has the property that ( )

9) (2 V H

) To remove the attributes from the images, MTH (Liu, et al., 2010) [26] is a dominant device which extorts the feature from the iris image by combining the benefits of co-occurrence matrix and histogram. Besides with these benefits, mean and variance measures are applied to develop the feature extraction process.

By using the sobel operator on the iris image along both the horizontal and the vertical directions, the gradient images ( ) The MMTH feature extraction process consists of following three steps:y gx x gx ' , '? Computing Original Image Feature ( ) (1 V H) ? Computing Orientation Image Feature ( ) (2 V H) ? Modified Histogram Features ( ) (V H) a. Computing Original Image Feature ( ) (1 V H)

Initially, the unique iris image is fragmented in to a number of grids where the grid may have the size of 3x3, 5x5 and so on. Subsequently for every grid, mean (m) and variance (v) are computed and by means of those calculated mean (mean) and variance (var), threshold value (v t) is calculated.v t = { var var, ? + mean mean } (**16**)

Then for each grid, the center pixel value is compared with the threshold value (t v).? ? ? ? ? ? + = = otherwise Unchanged i i mean t i i mean t mean i C v v p ,)} var( ) (( )) var( ) ({(,) ((**17**)

But the center pixel value lies in between the threshold value (v t), it is substituted with the mean value of the grid or else not as shown in equiv. (11). The grids are partly covered and this process is used for all the grids. The histogram vector (

10) (1 V H

) is attained after completing the interchanging process, by finding the frequency of grids (not pixels) based on every grey levels only from the recognized areas. b. Computing Orientation Image Feature ( ) c After obtaining the orientation image i.e. the gradient image as mentioned above using equiv. (**??**) & (9), the same process done for the original image as explained in section 3.2.1. is repeated for the orientation image. Finally, the histogram vector is obtained, denoted as) (2 V H

only from the identified regions.

[ ]?? = = ? ? = N r c j j i ij m c x O 1 1 2) ( ) 1 (µ ? (18)

Where, m is any real number greater than 1, u ij is the degree of membership of x i in the cluster j, x i is the ith of d-dimensional measured data, c j is the d- To attain the cluster, the resultant MMTH features are subsequently passed to the MFCM. Fuzzy c-means (FCM) is a technique of clustering which permits one piece of data to belong to two or more clusters. This technique is often applied in pattern recognition. To develop the clustering result adapted FCM is applied based on minimization of the objective function specified in equiv. (12): In our suggested method, the texture attributes computed are clustered in to 2 clusters by means of MFCM.? = ? ? ? ? ? ? ? ? ? ? ? ? = c k m k i j i ij c x c x 1 1 2 || || || || 1 µ (19) ? ? = = = N i m ij N i j m ij j x c 1 1 µ µ (20) This iteration will end when { } ? µ µ < ? + k ij k ij ij 1 max

, where ? a termination criterion between 0 and 1, whilek isthe iteration step. This process unites to a local minimum or a saddle point of O. The collected attributes are subsequently passed to the next process that is dimensionality reduction.

11) (V H)

The determined vectors achieved such as () (1 V H) and ( ) (2 V H

) are concatenated to acquire the MMTH feature (

12) (V H

). The attained MMTH features are subsequently focused to clustering process. assesses a novel set of variables, called principal components. Each principal component is a linear mixture of the real values. The entire principal components are orthogonal to each other, so there is no unnecessary information. The principal components as a total form an orthogonal basis for the space of the information. Principal component analysis is a changeable reduction process. It is constructive when you have attained data on a number of variables and consider that there is some idleness in those variables. In this case, redundancy represents that some of the variables are linked with one another, probably because they are measuring the similar construct. As of this redundancy, you consider that it should be probable to decrease the observed variables into a smaller number of principal components that will report for most of the variance in the examined variables. For analyzing information, PCA is a dominant device. This will obtain you through the steps you required to execute a Principle Components Analysis on a set of data. At this point, attributes in each cluster are decreased and as a result the reduced cluster features are employed for additional process.

Thus the dimension reduced features are then passed in to FFBNN to continue the recognition process. The obtained feature vector has the length of 6.

13 f) Recognition

Feed Forward neural Network (FFBNN) is applied to identify the iris. In the training phase, uneven wavelet coefficients and the dimension reduced features are specified as the input to the FFBNN. Using these texture features, the neural network is well educated in order to identify the iris. The neural network contains n number of input units, h hidden units and one output unit. The structure of the FFBNN is specified as below:

( ) ( )? = + + + + + = H n tn tn t tn tn tn tn tn tn tn f w f w ep w bp w sp w t x 1 1 ..., ?(**21**)

( )( ) t x e a x ? + = 1 1 (22)

Er is the FFBNN network output, n n A and D are the preferred and actual outputs and h is the total number of neurons in the unseen layer.

14 In bias function

tn sp , tn bp , tn ep , 1 t f , 2 t f ... tn f are the uneven coefficients such as starting point, break point, ending point and features attained after dimension reduction correspondingly. The activation function for the output layer is specified in Eq. (16).

? Get the learning error. ii. Optimization of FFBNN parameters by ABC Now we are applying the ABC algorithm for optimizing the parameters of FFBNN while training to acquire competent iris recognition result. ABC algorithm is a swarm based meta-heuristic algorithm which was motivated by the sharp foraging behavior of the honey bees. It contains three components namely, employed bees, onlooker bees and scout bees. The employed bees are combined with the food sources in the region of the hive and they shift the data to the onlookers about the nectar quality of the food sources they are utilizing. Onlooker bees are looking the dance of the employed bees within the hive to pick one food source to use according to the data offered by the employed bees. The employed bees whose food source is discarded turn into Scout and look for novel food source randomly. The number of food sources indicates the location of probable solutions of optimization problem and the nectar amount of a food source represents the quality of the solution. The FFBNN parameters ( ) . This generation process is called as initialization process. The fitness value of the produced food sources is computed by equation (**??**5) to assess the best food source.

15 b. Employed Bee Phase

Using the beneath equation, novel population parameters are produced in the employed bee phase, ( )j k j i ij j i j i x x x V , , , , ? + = ?**(27)**

? Compute BP mistake for every node and revise the weights as follows:) ( ) ( ) (tn tn tn w w w ? + = (24)) (tn w ? is attained as, ( ) B t x w n tn . .) (? = ? (25)

Where ? is the learning rate, which usually ranges from 0.2 to 0.5, and Be is the Back Propagation fault.

? Next do again the steps (2)

Using ABC, the FFBNN parameters ( ) for the onlooker bees from the solutions (j i x ,) based on the probability value (j P). After that the fitness function is computed for the novel solution. In order to choose the best parameter, use the greedy selection process later.

16 d. Scout Bee Phase

Find out the abandoned parameters for the scout bees. If any abandoned parameter is present, after that substitute that with the novel parameters found out by scouts by means of the equation (**??**8) and assesses the fitness value. After that memorize the best parameters accomplished so far. Afterward the iteration is increased and the process is prolonged till the stopping criterion is arrived.

17 IV.

18 Experimental Results

Our proposed iris recognition system with FFBNN-ABC is implemented in the working platform of MATLAB (version 7.13).Our proposed iris recognition

19 J

Where, k and j is an arbitrary chosen index, ? is randomly produced number in the range [-1, 1] and j i V , is the novel value of the th j position. Next the fitness value is calculated for every novel generated population parameters of food sources. From the calculated fitness value of the population, best population parameter is chosen i.e. the population parameter, which has the highest fitness value by using greedy selection process. Probability of the chosen parameter is calculated by the equation (**??**2) after choosing the best population parameter.

system is the combination of FFBNN and ABC. In order to reduce the computation complexity and get higher performance, the dimensionality of features is reduced with the help of the well-known optimization algorithm PCA. Then the dimensionality reduced features are given to the FFBNN to achieve the training process. So as to get more accuracy in the process of recognition, the FFBNN parameters are optimized using ABC algorithm. In the testing process, more data are given to the well trained FFBNN-ABC to validate the performance of the proposed technique. The performance of the proposed iris recognition system is evaluated using CASIA database and the proposed technique's performance is compared with the existing iris recognition systems given in [21], [23] and [24]. a) Performance Analysis By applying the statistical measures which is specified in [27], the concert of our suggested iris recognition system is examined. We employ CASIA iris thousand -NG database which has 788 number of iris images to complete the performance analysis process. For one dataset, our proposed technique takes 0.3225 seconds for training and 0.0054 seconds for testing. Totally our database consists of 51 dataset. The performance of the proposed technique is compared with other classifiers such as FFBN, FFBN_GA, Fuzzy, ANFIS&KNN and the corresponding statistical measures are given in Table 1(i). Then the performance of the proposed technique is analyzed by using Unbalanced Haar Wavelet and it is compared with other wavelets such as Haar, Coif let, Symlet & Bi-orthogonal wavelet and the corresponding statistical measures are given in Table 1(ii). Also our suggested iris recognition system performance is assessed and compared with the conventional iris recognition system given in [21], [23] & [24] and the corresponding statistical measures are given in Table

1(iii). Figure ??, 4 and 5illustrate the sample of iris images, preprocessed images and iris segmented images correspondingly. In Table ??1(i) and Figure 6.(i), the performance of the proposed technique is compared with various classifiers such as FFBNN, FFBNN-GA, Fuzzy, ANFIS and KNN. By seeing both table and graph, we can say that the proposed technique yields higher rate of accuracy than the proposed technique. From the measurement of the accuracy, we can say that our proposed technique recognize the iris images effectively. In addition to that, the sensitivity and specificity are the two measurements which can provide the additional details about the performance of a technique. On looking at the sensitivity and specificity measures, our proposed technique has given better rate than the other classifiers. In specificity measure, our proposed technique is yielded 100% specificity. Also, when looking at the other measurements such as FPR and FDR, the proposed technique obtained 0% FPR and In Table ??1 (ii) and Figure (ii), the performance of the proposed technique is compared by changing wavelets such as Haar, Coif let, Symlet and Bi-Orthogonal. In our proposed technique, Unbalanced Haar Wavelet is utilized. On looking at both table and graph, we can say that the proposed technique yields higher rate of accuracy, sensitivity and specificity when compared to the other wavelet techniques. All the performance measures are showed that our proposed technique recognize the iris images efficiently. Similarly, the performance of the proposed technique is compared with the existing techniques such as [21], [23] and [24] and it is given in Table1.(iii) and figure 6 system in iris recognition process presents an incredible rate of accuracy (98.8317757), sensitivity, (98.69451697), specificity (100), FAR (0) and FRR (1.305483029). The high value of these measures illustrates that our suggested technique more precisely identifies the iris images from the specified test images. Based on FFBNN-ABC, the comparison result illustrates that our suggested iris recognition system has specified high accuracy than existing methods. Hence our suggested iris recognition system competently identifies the iris imaged by applying the FFBNN and ABC techniques.

Discussion: Comparison of the performance of the proposed technique with the other techniques in terms of FAR and FRR.

In Figure ??7, the performance of the proposed technique is compared with other techniques in terms of FAR and FRR. Our proposed technique has less FRR rate when compared to the other techniques. While seeing the value of FAR, our proposed technique offers 0% of FAR. It adds additional strength to our proposed technique in its performance. Thus our proposed technique proved its efficiency in the recognition of iris.

V.

20 Conclusion

We have suggested an iris recognition system based on FFBNN and ABC at this point. The suggested system was executed and CASIA iris thousand -NG database is employed to examine the results of the suggested iris recognition system. The presentation study confirmed that the suggested iris recognition J e XIV Issue IV Version I [1] [2] [3]

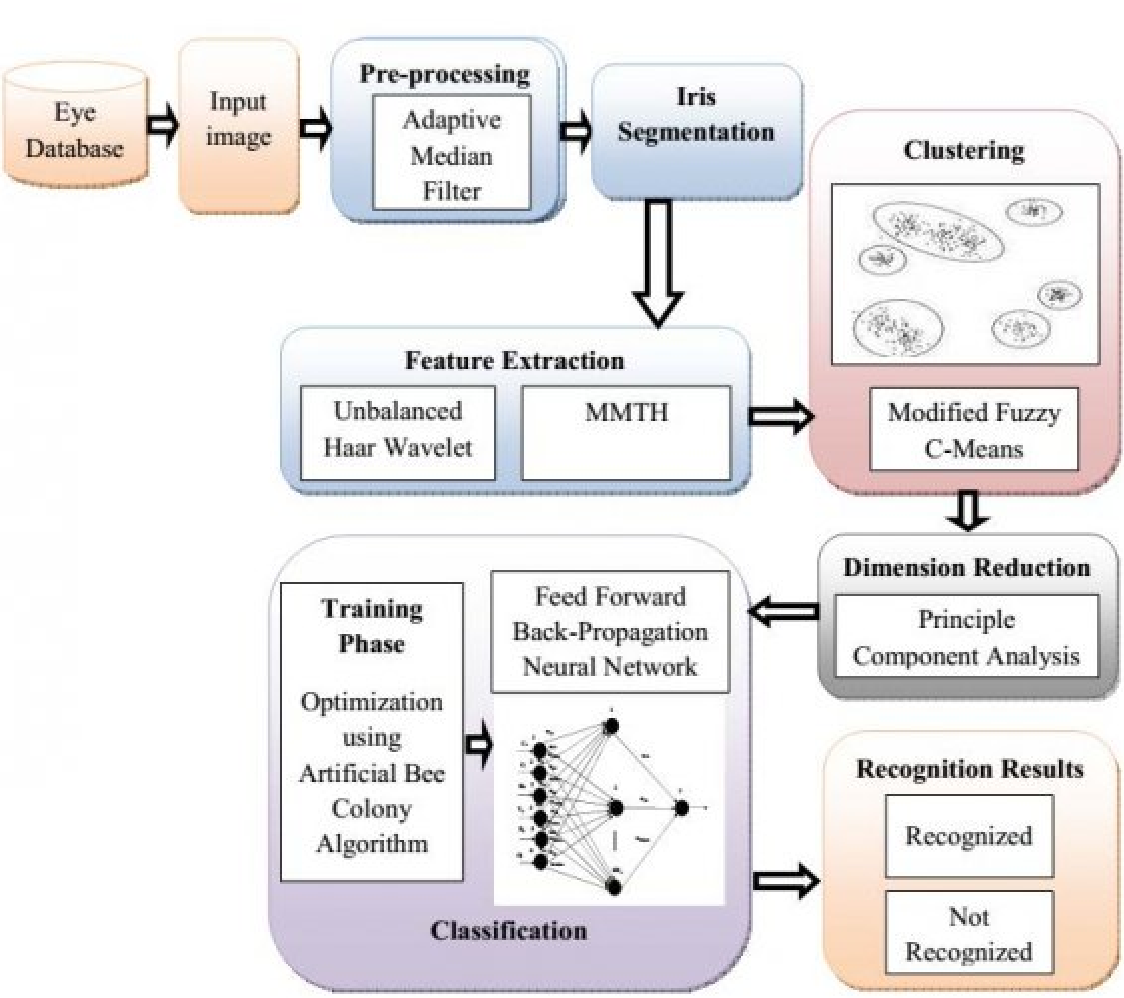
1

Figure 1: Figure 1 :

[1] Year 2014 J

[2] © 2014 Global Journals Inc. (US) (MMTH). After that, gradient map ( )

[3] © 2014 Global Journals Inc. (US)


Eye
Database
Input
image
Pre-processing
Adaptive
Median
Filter
Iris
Segmentation
Clustering
Feature Extraction
Unbalanced
Haar Wavelet
MMTH
Modified Fuzzy
C-Means
Dimension Reduction
Principle
Component Analysis
Training
Phase
Optimization
using
Artificial Bee
Colony
Algorithm
Feed Forward
Back-Propagation
Neural Network
Classification
Recognition Results
Recognized
Not
Recognized

5

Figure 2: 5 .

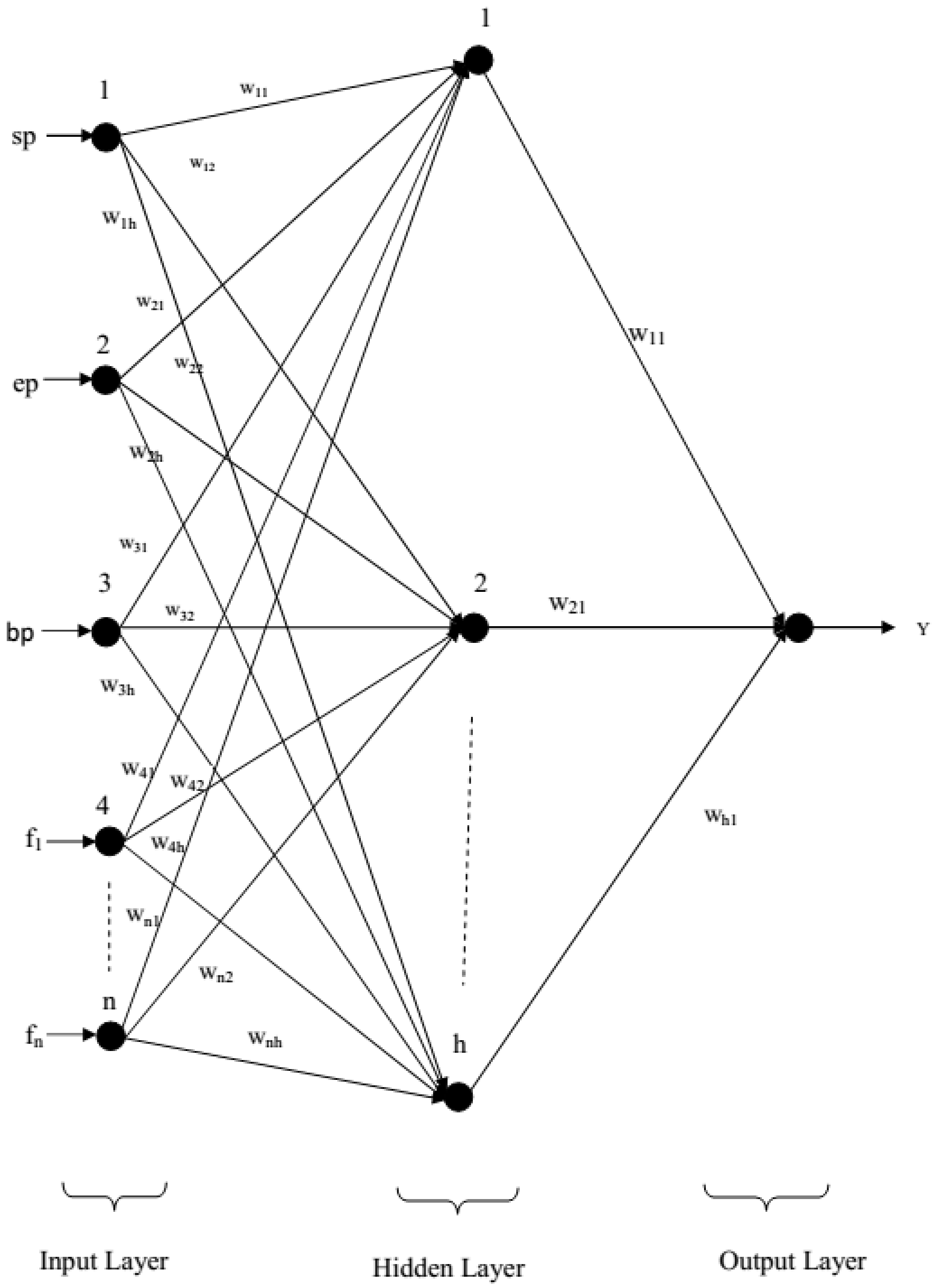


Figure 3: A

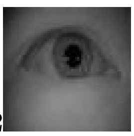
12

Figure 4: 12 :

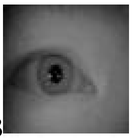
13 

Figure 5: Step 13 :

Figure 6:

Figure 7: A

6 

Figure 8: 6 :

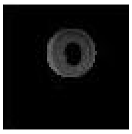


Figure 9: ?

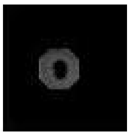


Figure 10:

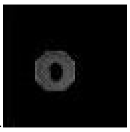
31 

Figure 11: the range of b is such that assumption 3 1 n

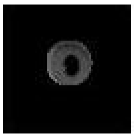


Figure 12:

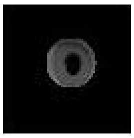


Figure 13:

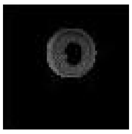


Figure 14:

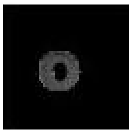


Figure 15:

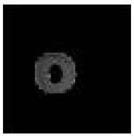


Figure 16:

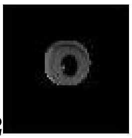
2 

Figure 17: Figure 2 :

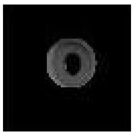


Figure 18:

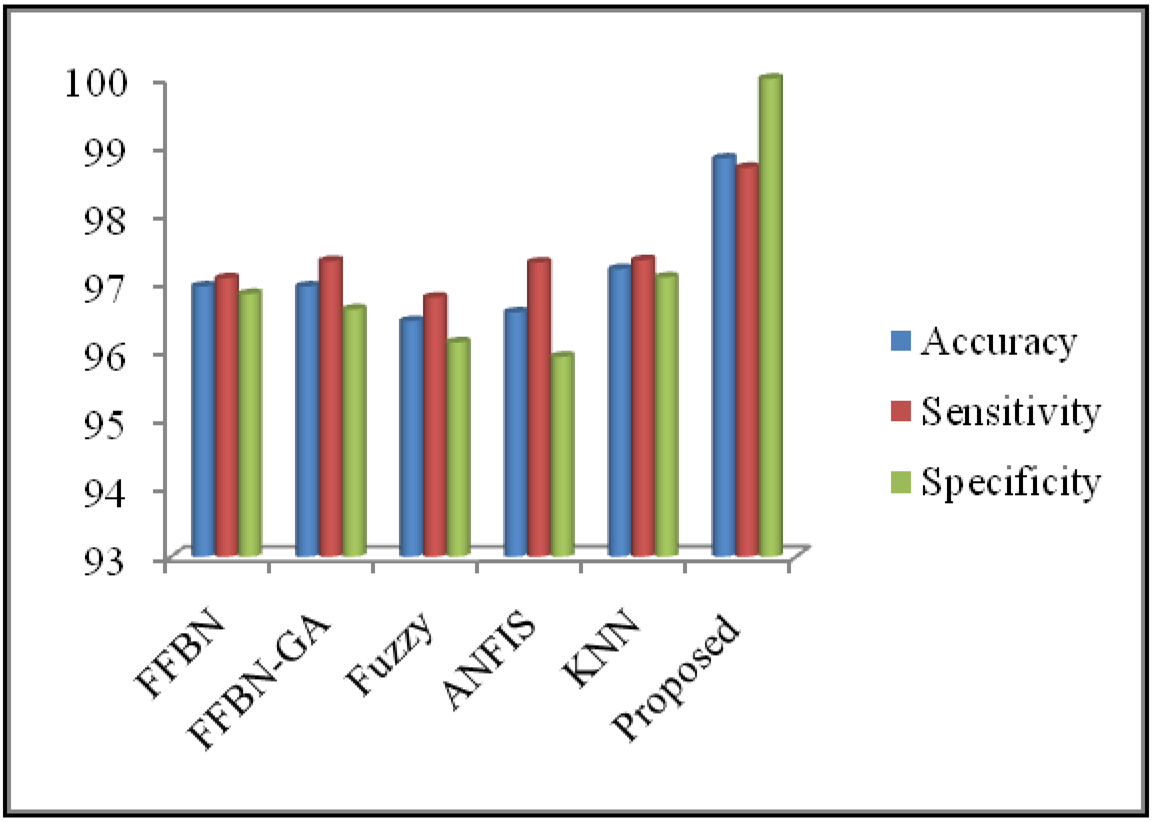


Figure 19:

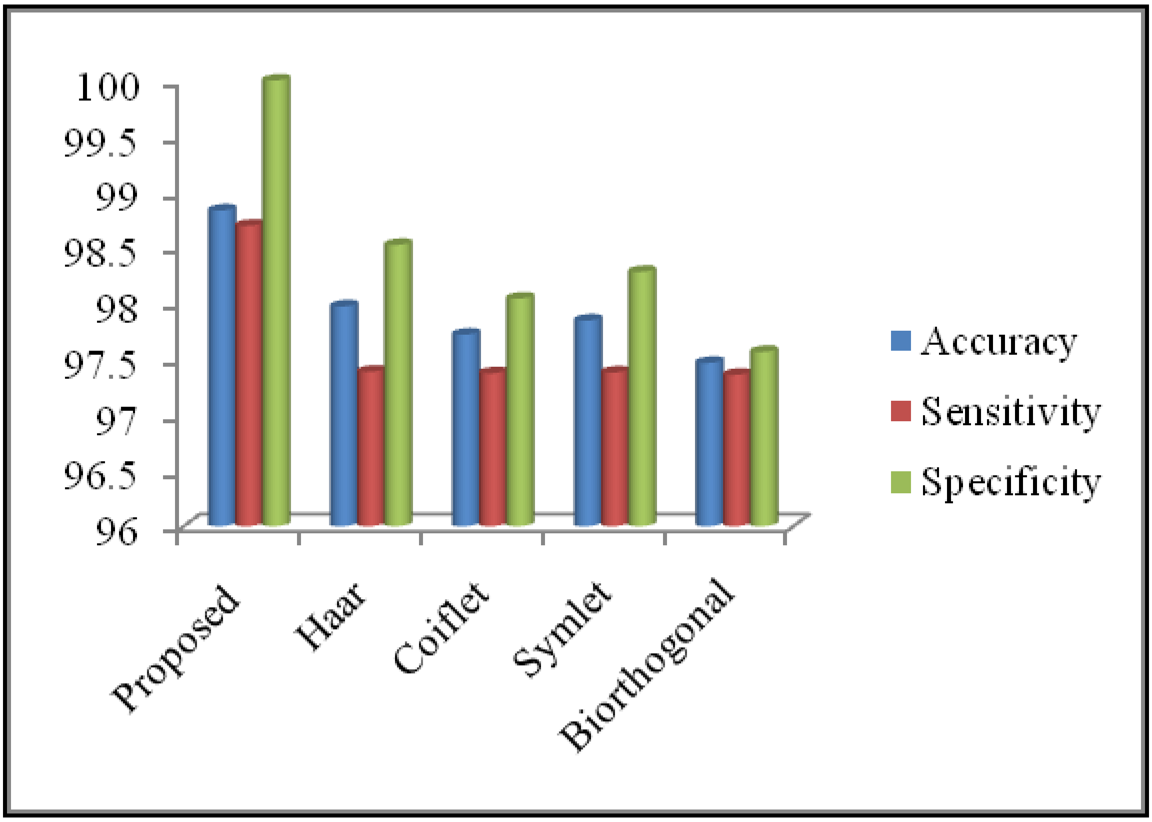


Figure 20: P

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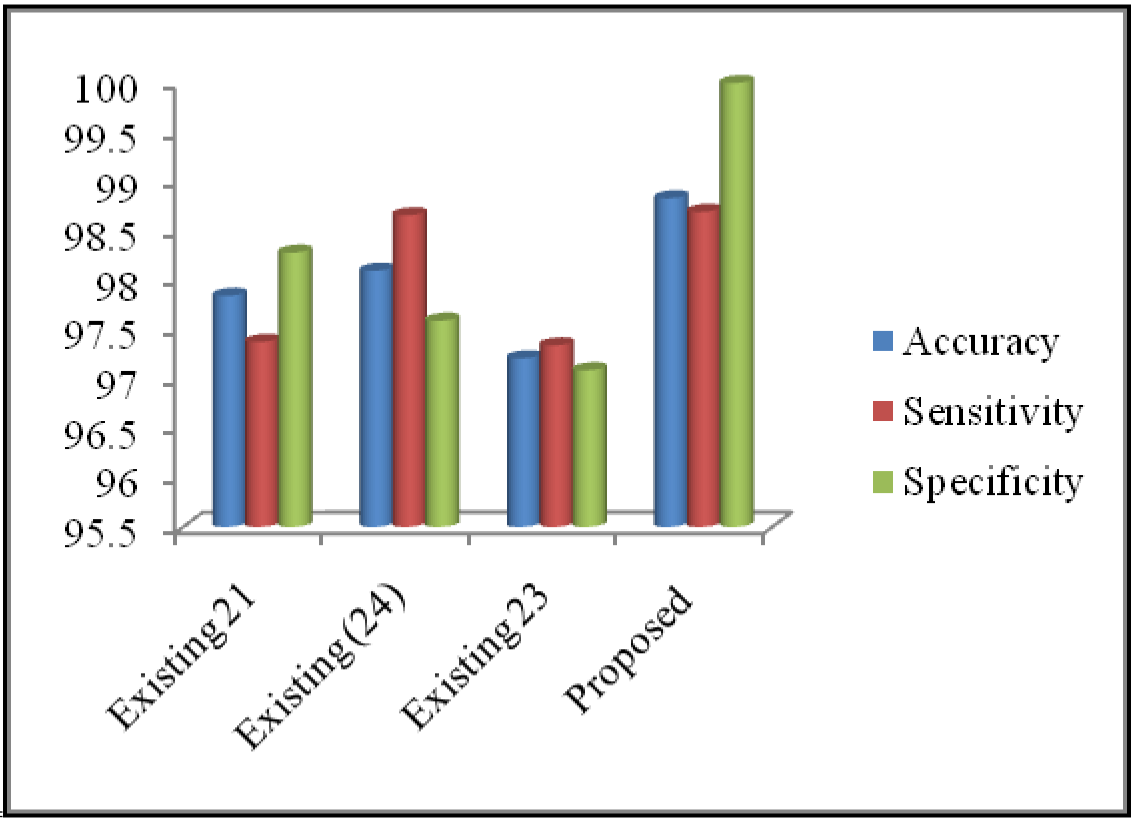

Figure 21: Figure 3 :Figure 4 :

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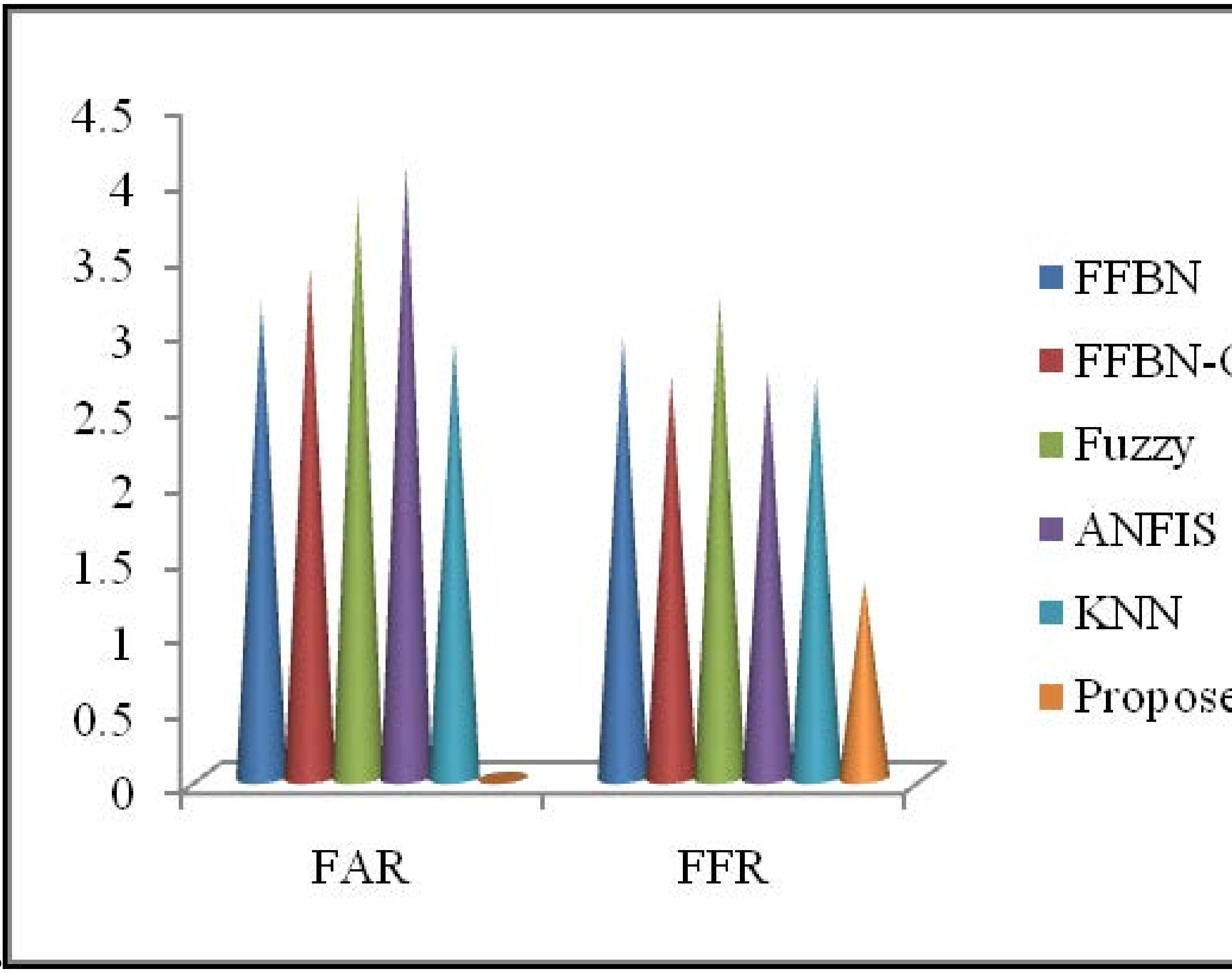
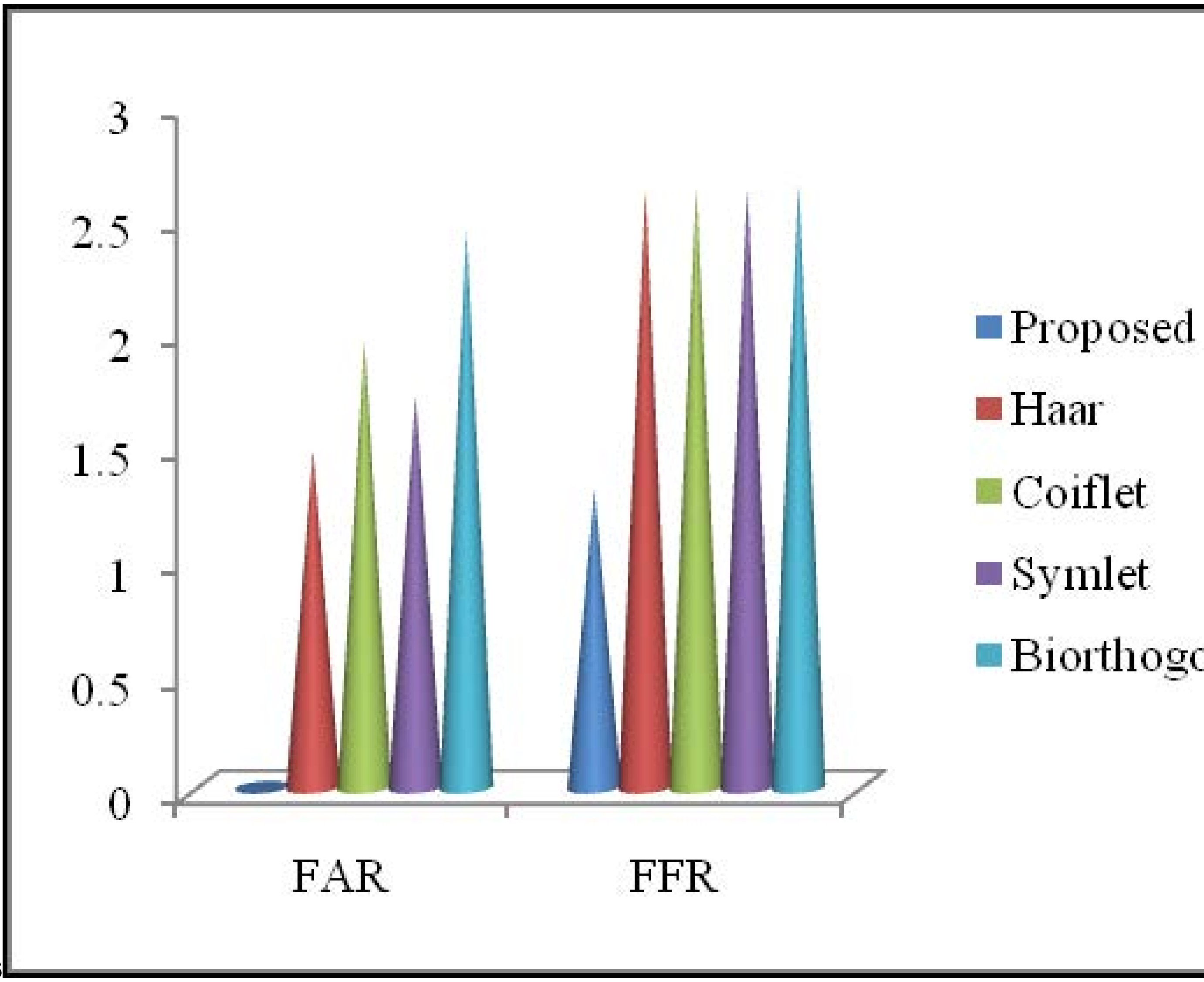


Figure 22: Figure 5 :



6

Figure 23: Figure 6 :

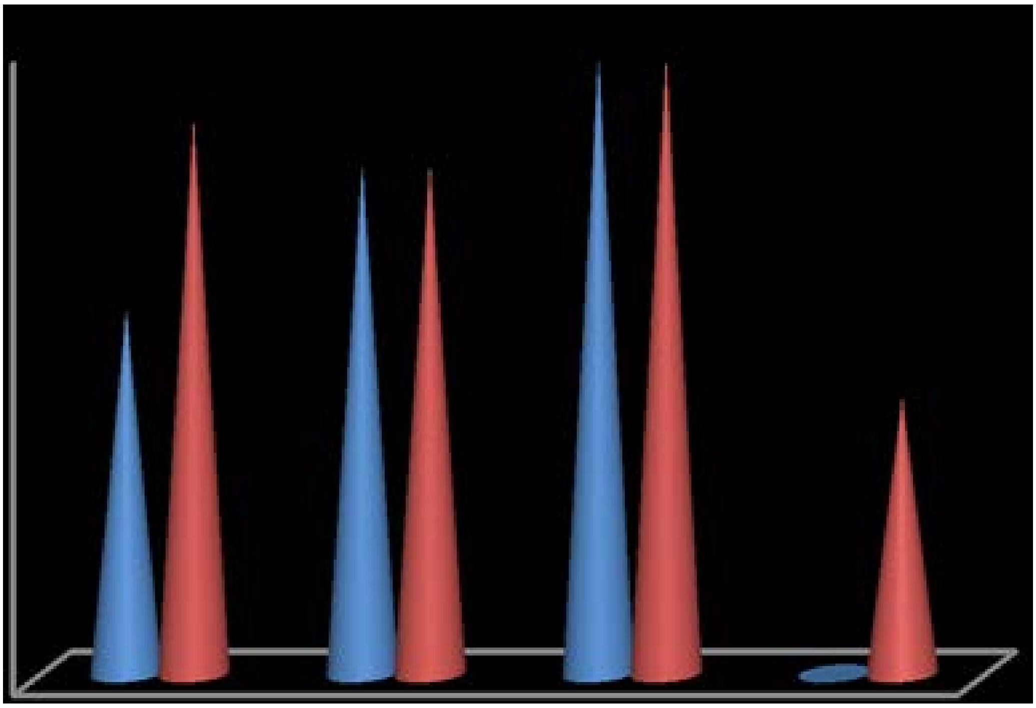


Figure 24: FDR

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Measures	Proposed Technique	FFBNN	FFBNN-GA	FUZZY	ANFIS	KNN
Accuracy	98.8317757	96.95431472	96.95431472	96.44670051	96.57360406	97.20812183
Sensitivity	98.6945169	97.07446809	97.32620321	96.79144385	97.30458221	97.34042553
Specificity	100	96.84466019	96.61835749	96.1352657	95.92326139	97.08737864
FPR	0	3.155339806	3.381642512	3.8647343	4.076738609	2.912621359
PPV	100	96.56084656	96.2962963	95.76719577	95.5026455	96.82539683
NPV	90	97.31707317	97.56097561	97.07317073	97.56097561	97.56097561
FDR	0	3.439153439	3.703703704	4.232804233	4.497354497	3.174603175
MCC	94.2470505	93.89852174	93.90090616	92.88352799	93.14569616	94.40708603
FAR	0	3.155339806	3.381642512	3.8647343	4.076738609	2.912621359
FRR	1.305483029	2.925531915	2.673796791	3.20855615	2.69541779	2.659574468

(i)

[Note: Performance measures of Proposed FFBNN-ABC-PCA technique with other (i) other classifiers (ii) other wavelets (iii) existing techniques (i)]

Figure 25: Table 1 :

[Kadry and Smaili ()] 'A Design and Implementation of A Wireless Iris Recognition Attendance Management System'. Seifedine Kadry , Khaled Smaili . *Information Technology and Control* 2007. 36 (3) p. .

[Boles ()] 'A Human Identification Technique Using images of the Iris and Wavelet Transform'. Boalshash Boles . *IEEE Transactions on Signal Processing* 1998. 46 (4) p. .

[Nithyanandam ()] 'A New Iris Normalization Process for Recognition System with Cryptographic Techniques'. Gayathri Nithyanandam , Priyadarshini . *International Journal of Computer Science Issues* 2011. 8 (1) p. .

[Nithyanandam ()] 'A New Iris Normalization Process for Recognition System with Cryptographic Techniques'. Gayathri Nithyanandam , Priyadarshini . *International Journal of Computer Science* 2011. 8 (4) p. .

[Nabti et al. ()] 'An effective and fast iris recognition system based on a combined multiscale feature extraction technique'. Makram Nabti , Lahouari Ghouti , Ahmed Bouridane . *Pattern Recognition* 2008. 41 (3) p. .

[Kodituwakku ()] 'An Offline Fuzzy Based Approach for Iris Recognition with Enhanced Feature Detection'. Fazeen Kodituwakku . *Advanced Techniques in Computing Sciences and Software Engineering*, 2010. 2 p. .

[Suk Winder Singh and Jatav ()] 'Closure Looks To Iris Recognition System'. Ajay Suk Winder Singh , Jatav . *IOSR Journal of Engineering* 2013. 3 (3) p. .

[Verma et al. ()] 'Daughman's Algorithm Method for Iris Recognition-A Biometric Approach'. Prateek Verma , Maheedhar Dubey , Praveenverma , Somak Basu . *International Journal of Emerging Technology and Advanced Engineering* 2012. 2 (6) p. .

[Suganthy ()] 'Effective Iris Recognition for Security Enhancement'. Ramamoorthy Suganthy , Krishnamoorthy . *International Journal of Engineering Research and Applications* 2012. 2 (2) p. .

[Lim et al. ()] 'Efficient Iris Recognition through Improvement of Feature Vector and Classifier'. Shinyoung Lim , Kwanyong Lee , Okhwan Byeon , Taiyun Kim . *ETRI Journal* 2001. 23 (2) p. .

[Sim Hiew Moi et al. ()] 'Error Correction On Iris Biometric Template Using Reedsolomon Codes'. Puteh Sim Hiew Moi , Nazeema Saad , Rahimsubariah Ibrahim . *Proceedings of the Fourth Asia International Conference on Mathematical/Analytical Modelling And Computer Simulation*, (the Fourth Asia International Conference on Mathematical/Analytical Modelling And Computer SimulationKota Kinabalu, Malaysia) 2010. p. .

[Mehrotra ()] 'Fast segmentation and adaptive SURF descriptor for iris recognition'. Sa Mehrotra , Majhi . *Mathematical and Computer Modelling*, 2013. 58 p. .

[Daugman ()] 'How Iris Recognition Works'. John Daugman . *IEEE Transactions on Circuits And Systems For Video Technology*, 2004. 14 p. .

[Liu et al. ()] 'Image retrieval based on multi-texton histogram'. Guang-Hai Liu , Lei Zhang , Ying-Kun Hou , Zuo-Yong Li , Jing-Yu Yang . *Pattern Recognition* 2010. 43 (7) p. .

[Sun et al. ()] 'Improving Iris Recognition Accuracy via Cascaded Classifiers'. Zhenan Sun , Yunhong Wang , Tieniu Tan , Jiali Cuiieee . *IEEE Transactions On Systems, Man, and Cybernetics-Part C: Applications And Reviews* 2005. 35 (3) p. .

[Jhamb and Kumar ()] 'Iris Based Human Recognition System'. Mansi Jhamb , Vinod Kumar . *International Journal of Biometrics and Bioinformatics* 2011. 5 (1) p. .

[Hariprasath ()] 'Iris Feature Extraction and Recognition Using Wavelet Packet Analysis'. Venkatasubramanian Hariprasath . *proceedings of International Conference on Signal and Image Processing*, (International Conference on Signal and Image ProcessingChina) 2010. p. .

[Murty et al. ()] 'Iris Recognition System Using Fractal Dimensions of Haar Patterns'. Chandra Murty , Srinivasan Reddy , Ramesh Babu . *International Journal of Signal Processing* 2009. 2 (3) p. . (Image Processing and Pattern Recognition)

[Babu and Vaidehi ()] 'Iris Recognition System with Frequency Domain Features optimized with optimized with PCA and SVM Classifier'. Naresh Babu , Vaidehi . *IEEE Proceedings of International Conference on Recent Trends in Information Technology*, (Chennai) 2011. 2012. 9 p. . (Fuzzy Based IRIS Recognition System (FIRS) For Person Identification)

[Wildes ()] 'Iris Recognition: An Emerging biometric Technology'. Richard P Wildes . *In Proceedings of the IEEE* 1997. 85 (9) p. .

[Gaxiola et al. ()] 'Modular Neural Networks for Person Recognition Using the Contour Segmentation of the Human Iris Biometric Measurement'. Fernando Gaxiola , Patricia Melin , Miguel Lopez . *Soft Computing for Recognition Based on Biometrics* 2010. 312 p. .

[Bremananth ()] 'New Methodology for a Person Identification System'. Chitra Bremananth . *sadhana* 2006. 31 (3) p. .

[Daugman ()] 'New Methods in Iris Recognition'. John Daugman . *IEEE Transactions on Systems, Man and Cybernetics Part B: Cybernetics* 2007. 37 (5) p. .

[Omaima Ahmad Al-Allaf et al. ()] Abdelfatah Omaima Ahmad Al-Allaf , Aref Tamimi , Shahlla Abdalkader . *Volum for Iris Recognition System: Comparisons between Different Models Architectures and Algorithms*, 2012. 2 p. .

[Ashok and Neifeld ()] 'Point Spread Function Engineering for Iris Recognition System Design'. Amit Ashok , Mark Neifeld . *Applied Optics* 2010. 49 (10) p. .

[Bava and Mathew ()] 'Securing Web Services by Iris Recognition System'. Elizabeth Bava , Mathew . *International Journal of Computer Applications* 2011. 13 (7) p. .

[Fryzlewicz ()] 'Unbalanced haar Technique for Nonparametric function Estimation'. Piotr Fryzlewicz . *Journal of the American Statistical Association* 2007. 102 (480) p. .