High Biometric Recognition Based on Histogram and Semi-discrete Matrix Decomposition via Neural Network

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ABSTRACT
Iris recognition is regarded as the most reliable and accurate biometric identification system available highly protected and stable. Iris situating is the main focus in the procedure of iris recognition and verifies the precision of identification. In this work, a new algorithm for iris localization is suggested based on the median filter and the histogram to determine an automated global threshold and the pupil centre. An algebraic based on semi-discrete matrix decomposition SDD is used to extract iris feature from iris image that decrease the difficulty in input layered neural network, the sizes of input patterns are enhanced. The iris recognition is developed by a neural network with differential adaptive learning rate to identify the iris features. This method is simple, effective and high speed recognition. The system is implemented by using Matlab. Experimental outcomes indicate that the suggested algorithm gives the accuracy of 100 % with time equal 1.4 sec is best than other methods for Daugman and Wildes.
Keywords: iris recognition, biometric identification, pattern recognition, median filter, histogram, Semi Discrete Decomposition (SDD) , Gradient Descent Algorithm(GDA),NN, Singular Value Decomposition (SVD) ,Self-Organizing Map(SOM)

INTRODUCTION
Biometrics indicates the identification and realization of person identity relied on certain physiological traits of a person. The normally utilize biometric features consist of fingerprint, handwriting, gait, speech, face, hand geometry etc. The mush and speech techniques have been used for over 25 years, whilst iris technique is a recently distinctness method .It is the only internal organ of the body which is commonly externally observable. These visible samples are only one of its kind to all singular and it obtain that the probability of finding two singular with matching iris samples is nearly zero. Also, compared with other biometrics such as fingerprint, hand geometry etc. [1], iris classification doesn't contain physical contact during scanning the input pattern [2], [3]. Iris region is indicated in Figure (1). The average diameter of the iris is 12 mm, and the pupil size can vary from 10% to 80% of the iris diameter [4], [5].

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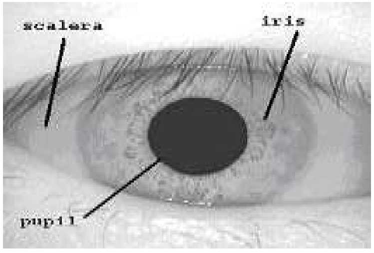


Figure (1): A typical eye structure

Daugman is the inventor of the most successful commercial iris recognition system now and published his wonderful results in 1993 [4]. These algorithms employ methods of pattern recognition and some mathematical calculations for iris recognition. In [1], [2], [3] and [6] the system are used for iris recognition and depends on segmentation scheme that is utilized the Hough transform, and is capable to localize the round iris and pupil area, closing eyelids , eyelashes, and echoes. The obtained iris location was then regularized into a rectangular section with fixed sizes to calculate for imaging irregularities. lastly, the phase data from 1-Dimension Gabor filters was separated and quantized to four stages to encode the only one of its kind sample pattern of the iris into a bit-wise biometric pattern. The Hamming distance was utilized for sorting of iris models, and two models were set to correspond. Most feature extraction methods have been implemented for analysis, e.g. applying zero-crossing representation of 1D wavelet transform at various resolution levels of a virtual circle [7]. In [8], 2D wavelet decomposition is used. In [9] and [10], they used frequency domain to find the feature extraction as 1D Discrete Cosine Transform (1D-DCT) , 1D-long and short Gabor filters. Recently, the numerical linear algebra is also playing a role towards image feature extraction. There are similar to the SVD and the SDD. In [11] and [12] iris feature is extracted by using SVD. In [13] the semi-discrete decomposition (SDD) is applied and provided mostly smaller list of feature terms and has been displayed to be efficient in summarizing data.

Histogram manipulation can be used effectively for image processing applications, such as image segmentation. The authors in [14] processed iris segmentation through simple filtering and histogram operations. In latest years, artificial neural network based iris recognition systems were chosen rather commonly. [15] Trained SOM-NN to distinguish iris vectors. The iris of doughnut figure are transformed into a rectangular shape and nourished to the NN. [16] utilized Multi-layer Perceptron (MLP) for recognizing the iris images. H. Erding K. [17] were classified iris images by using neural network methods including Multi-Layered Perceptron and Modular Neural Networks .(MNN) .

In this paper, iris segmentation rate is improved with simple algorithm from median filter and histogram analys to find the threshold value automatically for any iris and will be detailed . Also, focus of this job is to demonstrate the use fullness of the SDD to shape a compress set of optimal important features to be extracted for classification using a neural network with the differential adaptive learning rate for back propagation algorithm(BPA).

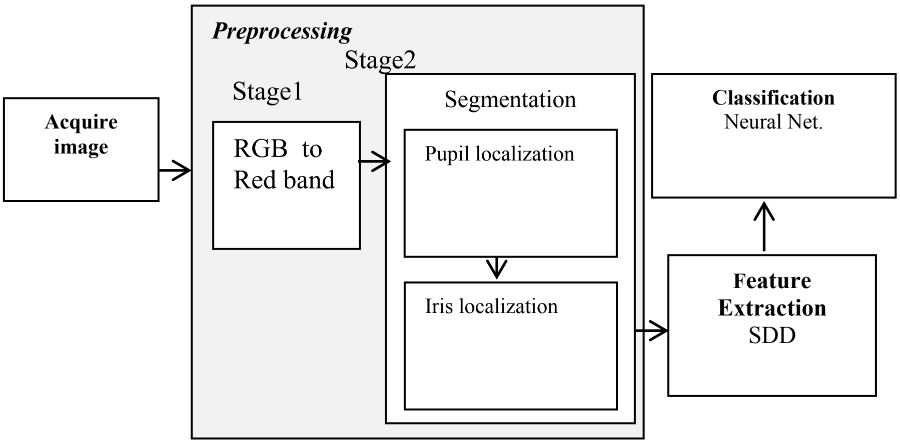
Methodology

Iris recognition requires four main steps as shown in Figure2.

- Acquire image.
- Preprocessing, it includes segmentation that is the iris detecting from the image.
- Feature extraction and generation of template is done using SDD.
- Classification of these templates has used Neural Network.

Acquire Image:

The first step is to collect the iris images. This is done firstly with a 320x280 pixel photograph of the eye taken from 4 centimeters away using a near infrared camera. The near infrared spectrum emphasizes the texture patterns of the iris making the measurements taken during iris recognition more precise.



Figure(2):Block Diagram of the proposal for the iris recognition

Preprocessing

Processing in the proposed method consists of two stages as shown in Fig. 2. These stages are image converter from RGB into a red band only, image segmentation .The detail of these stages is described in the following:-

Stage 1: RGB to Red band

In the pre-processing stage, the red colour space is separated from RGB colour space of the iris images. The reason is that the recognition based on the red component appears to be more reliable than recognition based on green (G) or blue (B) components or gray scale images. It is in accord with the study of Daugman [18].

Stage 2: Segmentation stage

The iris segmentation procedure segments is the annular iris region from the entire eye image. First, it finds the circular inner and outer boundaries (the iris-pupil and iris-sclera boundaries) based on the following step**s** and the flowchart of the suggested iris segmentation is shown in Figure (3).

Input image f(R,C) , [R C]=size(f), x=1,2,…R and y=1,2,…C.

Output image Is(M,M) , M=40.

Step1.

Convolve the iris image with a median filter [10 X 10] to reduce effect of the eyelashes and eyelid in image.

Step2.

Analyze the histogram of the eye image that output from the filter and choose the maximum valve for the histogram at range (1 to 85) gray level as threshold value(t).

Step3.

Convert the original iris image to the binary image using the threshold as in (1).

$$g(x,y) = \begin{cases} 1 & f(x,y) = t \\ 0 & f(x,y) <> t \end{cases} \quad \ldots(1)$$

Step 4.

Calculate horizontal and vertical vectors number of pixels as in the (2) and (3);

$$h(x) = \sum_y^C g(x,y) \quad \ldots(2)$$

$$v(y) = \sum_x^R g(x,y) \quad \ldots(3)$$

Step 5.

Find maximum value for step4 each these values are represented x and y axis for center of the pupil as the follow

$xp = \max(h(x))$ …(4)

$yp = \max(v(y))$ …(5)

Step 6.

Calculate the radius for the pupil as in (6).

$r = \sum_{n=1}^{xp} g(x_n, yp)$ …(6)

Step 7.

Take regions of the iris from original image at the right and leftward of the pupil are expressed by the mask (40x20) left and (40 x 20) right for up and down to this regions as: $Irl\ up, Irl\ down,\ Irr\ up,\ Irrdown$ respectively and the output image is Is(40 x 40) as the following :-

$Irl\ up(h, h) = f(xp - (0{:}h), yp - 2r{:}yp - (2r - h))$ …(7)

$Irldown(h, h) = f(xp + (1{:}h + 1), yp - 2r{:}yp - (2r - h))$ … (8)

$Irrup(h, h) = f(xp - (0{:}h), yp + 2r{:}yp + (2r + h))$ … (9)

$Irrdown(h, h) = f(xp + (1{:}h + 1), yp + 2r{:}yp + (2r + h))$ .. .(10)

$Is(M, M) = [Irlup\ Irrup\ ; Irldown\ \ Irrdown]$ …(11)

Semi Discrete Matrix Decomposition (SDD).

With a view to generate a feature vector from 2D iris image to the semi discrete decomposition vector, these are applied as an input to the BP neural network. The semi discrete decomposition (SDD) for equal data set and incidence matrix, the SDD does as well as the SVD and uses less than one-tenth the storage space. Let us have k (0 < k < R) and semi discrete decomposition of *Is* was defined as:

$Is \approx Is_k = X_k D_k Y_k^T$ …(12)

Where

R : is the rank of the original matrix *Is* (iris image)

k: is reduced singular decomposition of *Is*.

Each coordinate of X_k and Y_k is constrained to have entries from the set are equal {−1, 0, 1}, and the matrix D_k: is a diagonal matrix with positive coordinates [12].

An SDD estimation can be formed iteratively through a greedy algorithm. Let A_k denotes the k-term estimation ($A_0 \equiv 0$). Let R_k be the remaing at the k^{th} stage, that is $R_k = A - A_{k-1}$. Then the best select of the following (d_k, x_k , y_k) is equal:-

$\min F_k(d, x, y) = \|R_k - dxy^T\|_F^2 \quad s, t, x, y \in \{-1,0,1\}. d > 0$ …(13)

The details of this algorithm is shown in [19] .SDD aids in feature extraction and image decreasing in the size of the input sample from a matrix M x M to M features. In this work take only the main diagonal with reduction by rank k which can be expressed by $D_k=[d_1\ d_2 \ldots\ldots d_k]$ as feature extraction for *Is* matrix .

Neural Network

The NN was employed for classification of iris templates of the network employs the three layers construction: Input, Hidden and Output layer. The numbers of neurons in input layer is equal to the sample vector out of the algebraic technique (SDD).In the hidden layer the number of neurons is nearly twice as outcomes that of input for good classification and in the output layer agree to the number of sorts to be documented. Actual algorithm for a 3-layer network (only one hidden layer) and detail this algorithm in [20].

The adaptive learning proportion is used to increase assurance Convergence and learning speed. The learning of NN coefficients is begun with a little value of learning proportion. Through training, the learning proportion is raised if the value of vary of error □E=E(t)-E(t+1) is positive, and it is reduced if the vary in the error □E=E(t)-E(t+1) is negative.

Experimental Outcomes

Experiments are supported out to test the suggested method. For this determination the suggested method is executed in MATLAB. The iris databases utilized in this experiment were occupied from CASIA. The digital image is acquired RGB of dimensions 320x280 pixels. Lone the red (R) component of the iris image, as displayed in Figure (4), for four iris images. effect of the median blur is to decrease the noise and pixel gray level complication of the image without perturbing the edge fidelity of the original image with 10 x 10 window size. The median blurred images is shown in Figure (5) . Histogram generated in the application following a median blur of an iris images. Note the distinct, left-most (darkest pixel values) peak as a typical pupil's pixel signature on the image shows the histogram of iris images in Figure(6).

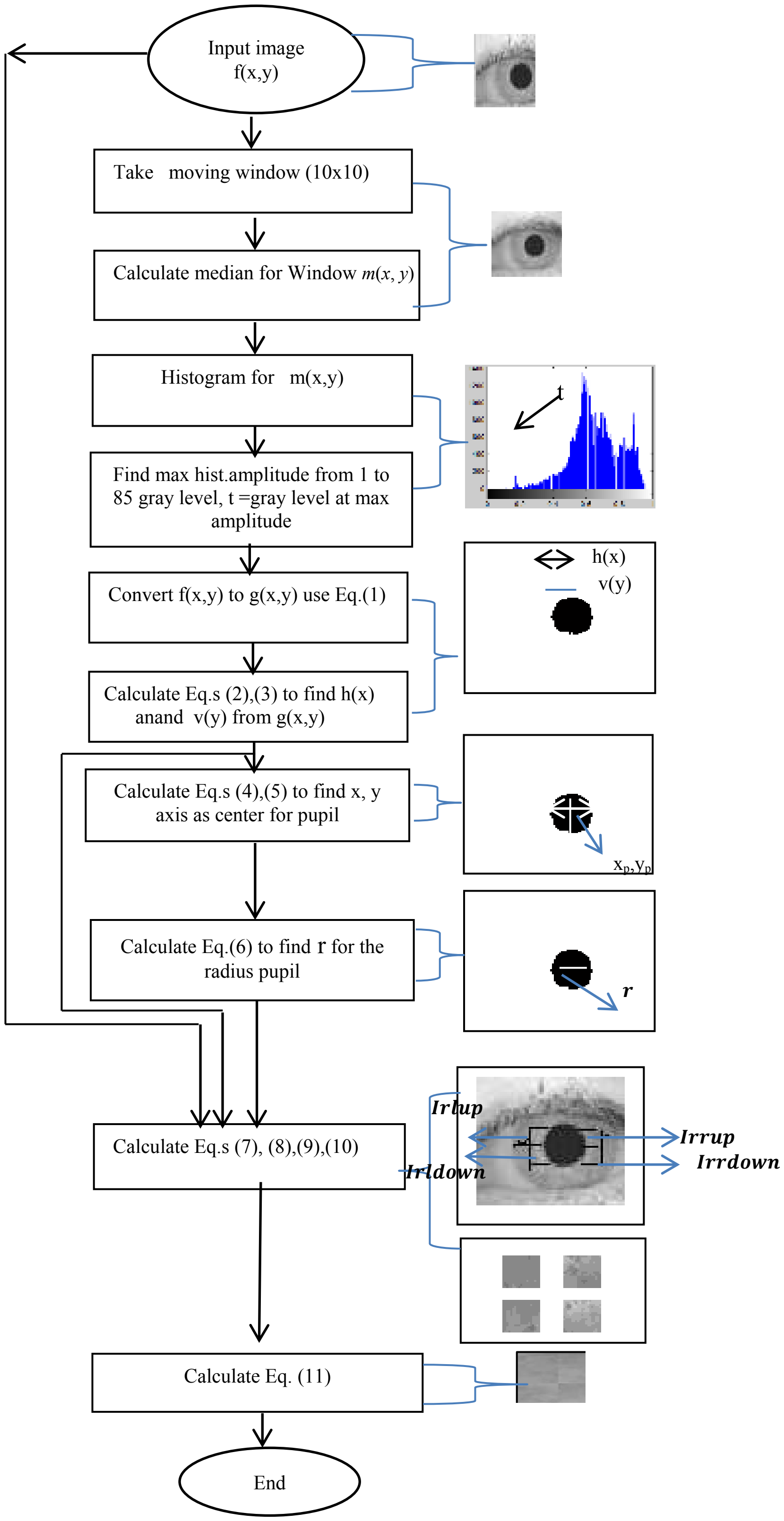
To get the pupil area, select a sensible threshold value as a maximum value in the histogram from zero to 85 grey axis. The pupil's areas intensity value are lesser than another areas in the total eye image, therefor the analysis of the histogram of the special eye image and selected the threshold value are achieved. Afterwards, the original iris image is changed to the binary image by utilizing these thresholds, the pupil is separated and the centroid (xp, yp) of the pupil is extracted. Also horizontal and vertical vectors are plotted. Figure.(7) displays the level in which the eyelashes must remove by automatically select threshold is proposed.

Figure (8) and Figure (9) are completed by clipping the iris region over the upper edge of the pupil and the area lower the underneath border of the pupil. The purpose of this works is to find the iris mask that is practically needed to reduce the needless parts to get the right recognition.

Figure (10) shows a plot of SDD pattern vectors for k=15 (rank) and Table (1) shows difference values between SDD pattern vectors for different images. Table (2) expresses the comparative outcomes of two type techniques utilized for iris localization. The mean time for the finding of internal and external circles of the irises was 1. 4s.The precision proportion was 100% .The outcomes display that the suggested iris localization region algorithm has best presentation. Figure (11) displays the convergence behavior of NN utilizing GDA for a normal situation. It is viewed the MSE was achieved in 411 times for 10 classes. The recognition level of NN system was 100%. The achieved recognition outcome is compared with the recognition outcomes of Babasaheb [13] as in the Table (3) to display the classification precision with difference number of SDD , SVD sizes and number of classes. As indicated in the table, the classification result acquired utilizing the NN approach shows the success of its effective utility in iris identification.

Conclusions

In this work, a new iris recognition scheme was proposed. The new algorithm of finding left and right iris region contains the more important information that is suitable for data extraction and most important factors driving recognition performance .Also method employed iris feature extraction that uses an algebraic technique based on semi-discrete matrix decomposition analysis. In order to extract iris features, SDD parameters were the more important coefficients of the feature pattern lengthways with the features concerned to properties, guides and consistency of iris . The operation of BPA neural network was effective and fast compared with Hamming matching that always used in matching and compared with Babasaheb work that used SVD-BP neural Network .And the experimental result shows that the proposed approach has a good recognition Performa.



Figure(3): Flow chart of the iris segmentation

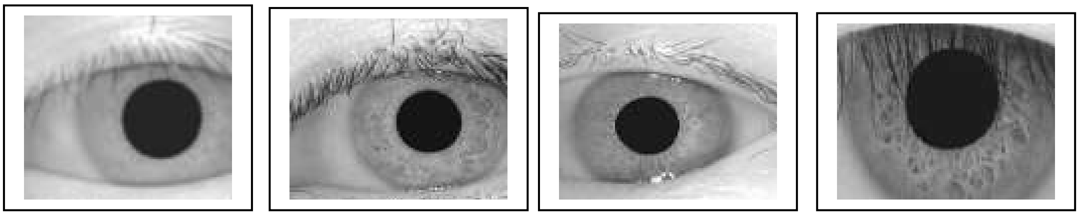


Figure (4) :Red band images

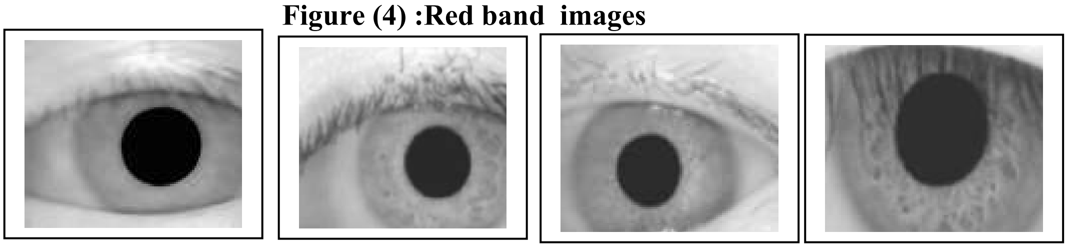


Figure (5) : Median filter for iris images

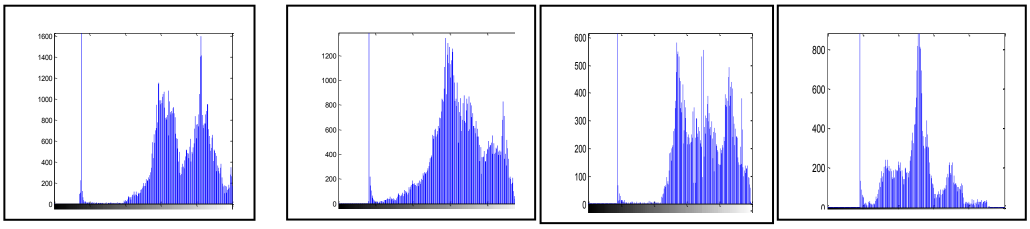


Figure (6) : Histogram results for images median filter.

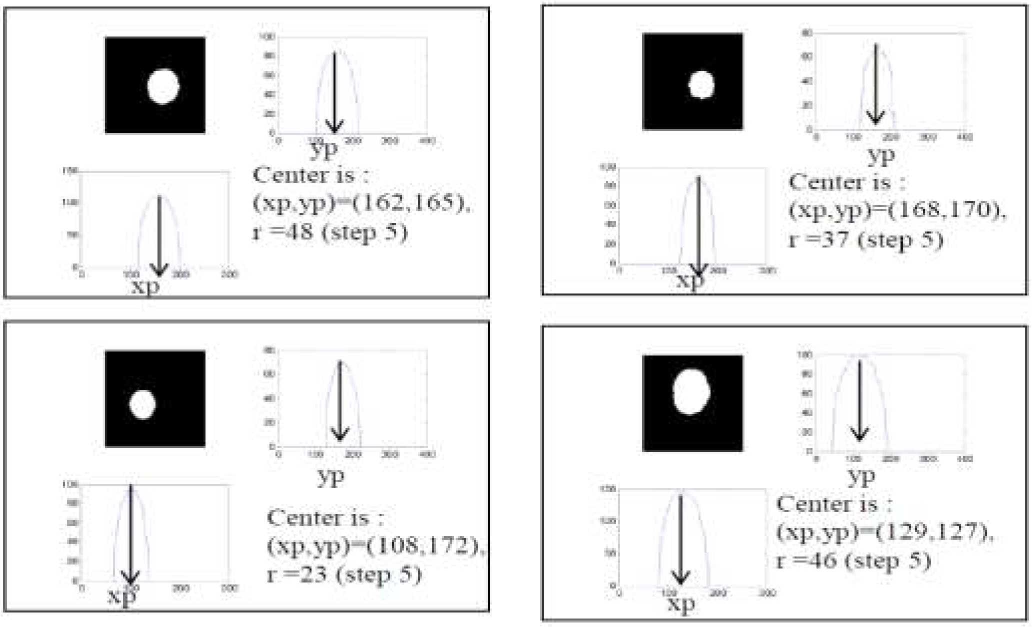


Figure (7) : Binary images with results for step

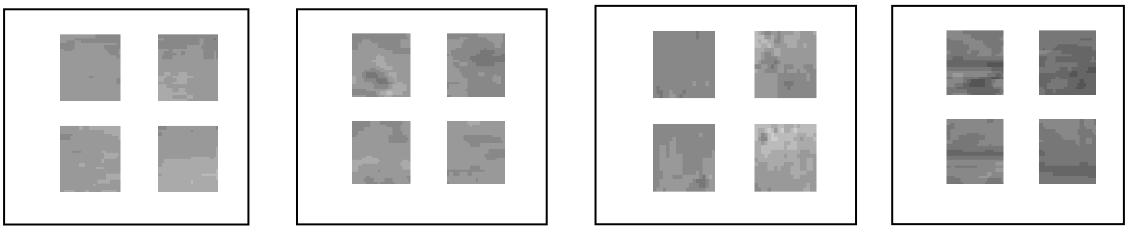
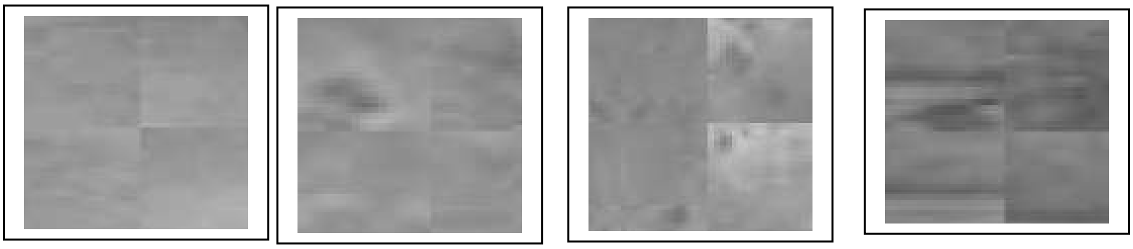
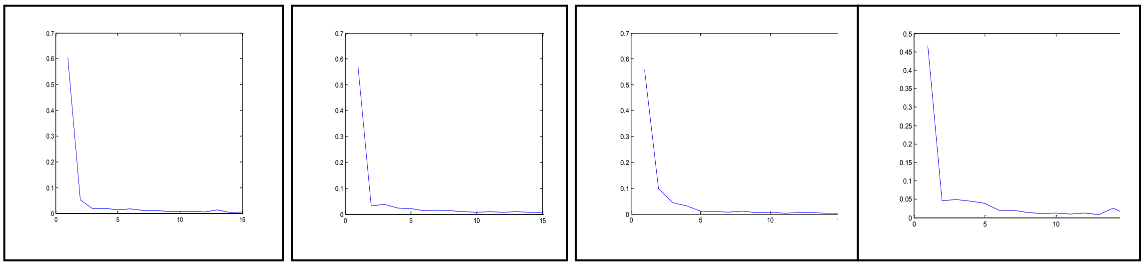


Figure (8) : Images results for the step 7



Figure(9) :Images results for the equation (11)



Figure(10) :SDD Pattern Vectors for four iris images

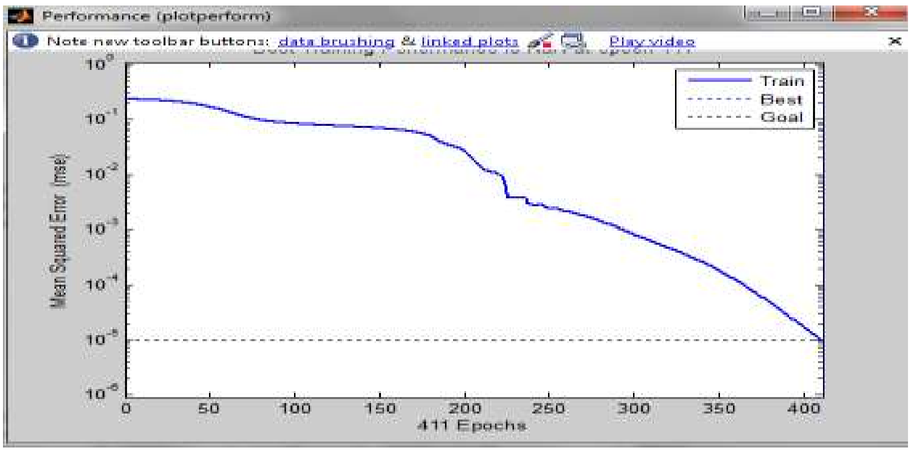


Figure (11) : Training of the BPA -NN

Table (1) : Comparative with four iris images in SDD feature with 9 ranks

Im1sdd	0.6022	0.0523	0.0178	0.0196	0.0123	0.0183	0.0105	0.0109	0.0076
Im2sdd	0.5714	0.0309	0.0374	0.0229	0.0205	0.0135	0.0146	0.0139	0.0093
Im3sdd	0.5779	0.0513	0.0314	0.0415	0.0258	0.0244	0.0142	0.0224	0.0119
Im4sdd	0.4678	0.0456	0.0490	0.0449	0.0390	0.0203	0.0199	0.0133	0.0115

Table (2): Precision rate for the segmentation

Methods	Precision rate(%)	Mean time(s)
Daugman [21]	57.7	90
Wildes [14]	86.49	110
Proposed	100	1.4

Table(3): The recognition performance in comparing with Babasaheb [13]

Categorization Accuracy								
N.O. Classes	N.O. SVD Dim. (Babasaheb[13])				N.O. SDD Dim. (Proposed)			
	3Dim	10Dim	20Dim	40Dim	3Dim	10Dim	20Dim	40Dim
3	50%	100%	100%	100%	100%	100%	100%	100%
4	50%	87.5%	100%	100%	100%	100%	100%	100%
5	50%	80%	100%	100%	100%	100%	100%	100%
6	41.66%	58.33%	91,67%	91.67%	100%	100%	100%	100%
7	57.14%	64.29%	92.86%	78.57%	100%	100%	100%	100%
9	61.11%	55.55%	94.44%	83.33%	100%	100%	100%	100%
10	35%	55%	70%	65%	100%	100%	100%	100%

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