A New Features Extracted for Recognizing a Hand Geometry Using BPNN

Dr. Firas M. Al-Fiky, Zainab Salih Ageed

Abstract— The biometrics plays a vital role in person recognition, in this method a 66 features has been calculated and determined for the right hand, the method has two main phases, the first contain the data collection and preproecessing, while the second contain the training and testing of an artificial neural network. The proposed method suggested the BPNN for training with one input layer, one hidden layer, and one output layer. The recognition rate RR for the neural network after testing and using proposed features was clearly shows an enhancement in results through the comparison between the previous works and the proposed method.

Keywords— Identification, Recognition, Hand Geometry, Neuron, BPNN

1 INTRODUCTION

The human identification system using image preprocessing has been used in many application and fields of security. Finger print, face and iris recognition systems are developed and implemented in the banking access, military, customs monitoring system, police recording system for criminal and security system of special objects[1]. As a method of biometric recognition, hand-shape recognition has always been recognized as an effective means of personal identification. At present, the international biometric product based on hand-shape shares 25% of the total sale of biometric recognition product, which is only less than fingerprint recognition. As the hand shape images are easily acquired, meanwhile, comparing with other biometric feature's collection, the means of which is easily accepted. It has a greater potential and prospect for developing and researching [2].

A human body posses several physiological characteristics that can serve as biometric features. Also a human being develops several unique behavioral traits which can also serve as biometric features. The various physiological characteristics that are generally used are face, iris, fingerprints, palm-prints, hand geometry and voice. Face is the biometric primarily used by human beings to recognize each other. This makes it an obvious choice for biometric. The difficulty however is in the fact that the biometric system has to rival the complexity of the human brain. Fingerprints have also been used for quite some time now and have established its value as a biometric. The challenge now is to develop more advanced systems which can process partial prints and speed up the matching process. The behavioral characteristics include signature, handwriting analysis, voice, keystroke pattern and gait. Signatures and handwriting have been used extensively as biometrics. However; they have been used only as an offline biometrics, i.e. no data is collected during the process of signing or writing. Automated biometric systems vastly improve the accuracy of the operation by including data obtained during these processes [3].

2 REALATED WORKS

In 2005, Marcos F. and Guillermo M. [4] built a database of 22 people using a conventional document scanner. There system consist of a study about the discrimination capability of different extracted features, and the identification rate using different classification based on neural network. Some features removed and based only on 9 features per image taken. In 2007, Varchol P., and Levický D. [5], proposed a method to show the possibilities of using hand geometry as the biometric characteristics by using Hamming distance, Euclidian distance, and Gaussian Mixture Model (GMM). The system was tested on 408 hand templates, depending on FAR and FRR values. While in the same year, Saraf Ashish [6] proposed a verification system which is utilizes the geometric features of the hand like length and width of the fingers, diameter of the palm and the perimeter for user authentication. The system accepts a gray-scale handprint from which it extracts the finger lengths, finger widths and perimeter. In 2008, Osslan O. And others [7], present the identification system using Discrete Wavelet Transform. An input image of a hand was obtained using a scanner; the image is pre-processed and transformed to the wavelet domain. In the wavelet domain, 31 hand geometry features were obtained, after that, the input image is tested against 120 images of hands stored on a database. The stage of classification is performed using a simple nearest neighbour algorithm with Euclidean distances, finally a total recognition rate of 70.2 % was obtained after experimental evaluation. In 2009, Wei Chang W. And others [8], use the same value FAR and FRR as the measurements of the system but based on morphology, the experimental results show that 0.0035 % and 5.7692% for FAR and FRR respectively. In 2010, Lingming S. And others [9], presented hand geometry recognition method based on Gaussian mixture model (GMM) which used 1-D centroid distance series to describe 2-D hand geometry. Each departed finger obtained one centroid distance series, which was used to build a Gaussian mixture model and applied to hand geometry recognition. In 2011, another research done by Zena N.[10], proposed a system developed to identify and verify persons and adopted to identify groups in the principle of closed systems and to identify groups in the principle of open systems. It is also show the difference between the two principles.

In 2013, Nidhi Saxena, Vipul Saxena, and others [11]; demonstrates a study about personal verification and identification using hand geometry consists of the lengths and widths of fingers and the width of a palm. Users can place their hands

freely without the n eed for p egs to fix the hand placement with six different distance functions were tested and compared on 96 samples.

3 PROPOSED METHOD

The main ideas behind this system is to get a high recognition rate depending on hand geometry. The samples passed five main stages start from data collection till the decision.

3.1 Data Collection

The data gathered from my friends and mate course. Only the shape of the right hand by using a scanner covered by a box since the light will effect on the features that wil be extracted.

3.2 Preprocessing

3.2.1 Gray-Scale Image

Since the original image is colored it is necessary first colored hand image convert in to gray scale image by using *rgb2gray* function. In gray scale image, value of each pixel is single sample. This sample is contain intensity of information. It is called black and white. Black has weakest intensity. White has strongest intensity. After convert the color image to gray scale, it is converted to *Binary Image* by determining a *Threshold*, This operation called *Binarization*. The image thresholding operation is to binarize the g rayscale image from color image to obtain the binary hand shape images by applying a threshold as follow:

Input image (i,j) ≥ Threshold , Output Image (i,j) = 1 ……(1)
Input image (i,j) < Threshold , Output Image (i,j) = 0 ……(2)

The hand image is converted to gray scale image with noise because there is some noise present in the input colored image due to dust and atmospheric conditions. The noise removal is therefore essential for the system. Figure 1 show the first step of the pre-processing.

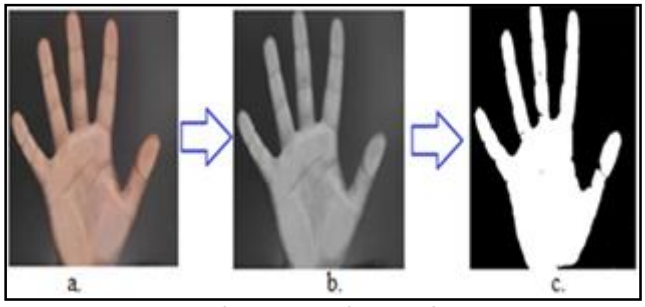


Fig. 1. Steps of conversions

3.2.2 Noise Removal

The next step in image pre-processing is noise removal. It is necessary to remove the noise from the image because it may reduce the differ ence between the actua l hand and th e captured image. This causes the variation in data base feature and measured feature and also affected the ac curacy of the system. Edge detection is difficult in noisy images. Basically the noise produced in the image is due to device using for capturing image, atmosphere condition or surrounding.

3.2.3 Edge Detection

Image contain only edges to extract geometric features of the hand. An edge is a collection of connected high frequency points in an image. Visually, an edge is a region in an image where there is a sharp change in intensity of the image. The *Canny* is used for edge detection. It is the most one that use to detect edge since the edge have its effect on the image while the features extracted.

4 FEATURES EXTRACTION

The proposed method contain 66 features extrcated from the right hand, these features depending on the distances between two points. This method extracted the metrics from two landmarks, named valley5, valley6 respectively. From valley5 and valley6 many segments determined to calculate the area, perimeter and angles on it.

4.1 Basic Points

The basic points contains the tip set and the valley set named TPCenter, VLCenter respectively. Figure 2 show tha basic points of hand shape.

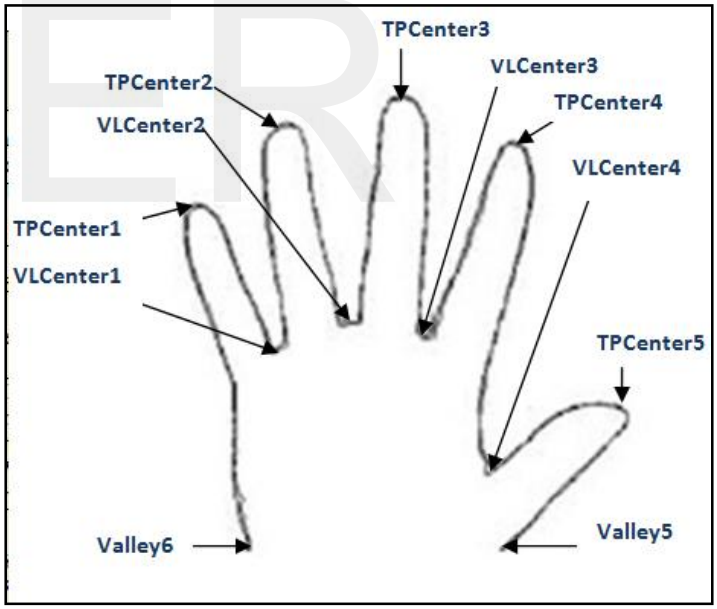


Fig. 2. The basic points

4.2 The Distances

The distances consists of 11 basics distances between two points as shown in figure 3. From D1-to-D5 fingers lengths, D6-to-D10 fingers widths, and D11 as palm width.

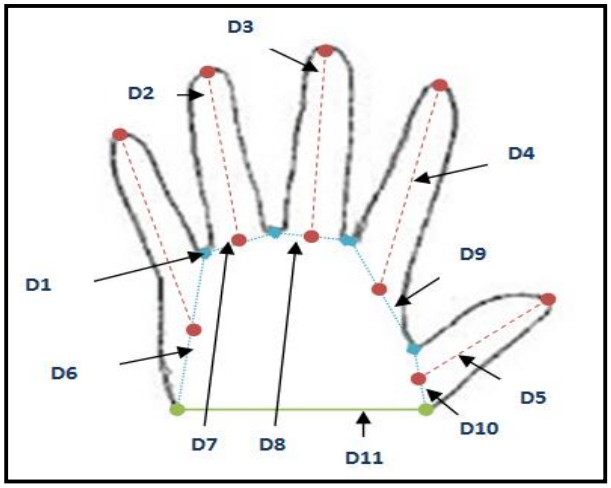


Fig. 3. The distances from D1-to-D11

There many other distances calculated as shown in figure 4 and figure 5.

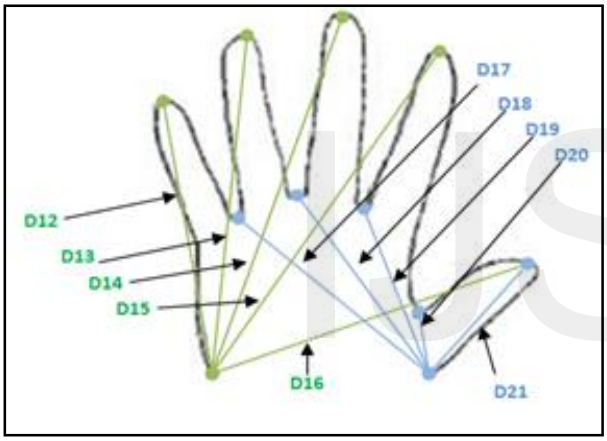
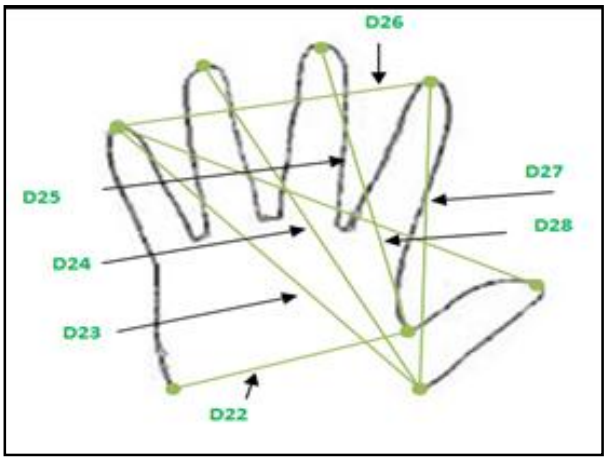


Fig. 4. The distances from D12-to-D21



Fiig. 5. The distances from D22-to D28

4.3 Calculation Area, Peirmeter, and Angles Values

To calculate the area, perimeter, and find the values of angles, 12 segments determined for this purpose as shown in figure 6. After features's extraction stage, the values saved in a database for next stage.

5 ANN

5.1Training ANN

In this stage an artificial neural network be trained .the back propagation NN is suggested for this purpose (BPNN):

i. One input layer: 66 nodes represent 66 features.
ii. One hidden layer: 35 neuron.
iii. One output layer: 10 nodes represent one output.

Figure 7 show the topology of BPNN.

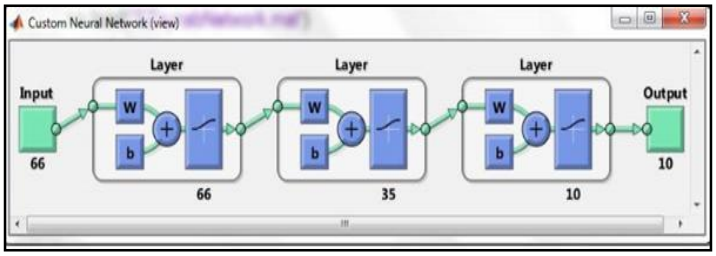


Fig. 7. The topology of BPNN

5.2 Testing ANN

Test NN will be the next step, in this step there are three picture for each person to test the NN on it. If any error occurred during testing, it will be simply taken another sample.

Figure 8 shows the flowchart of ANN training and testing

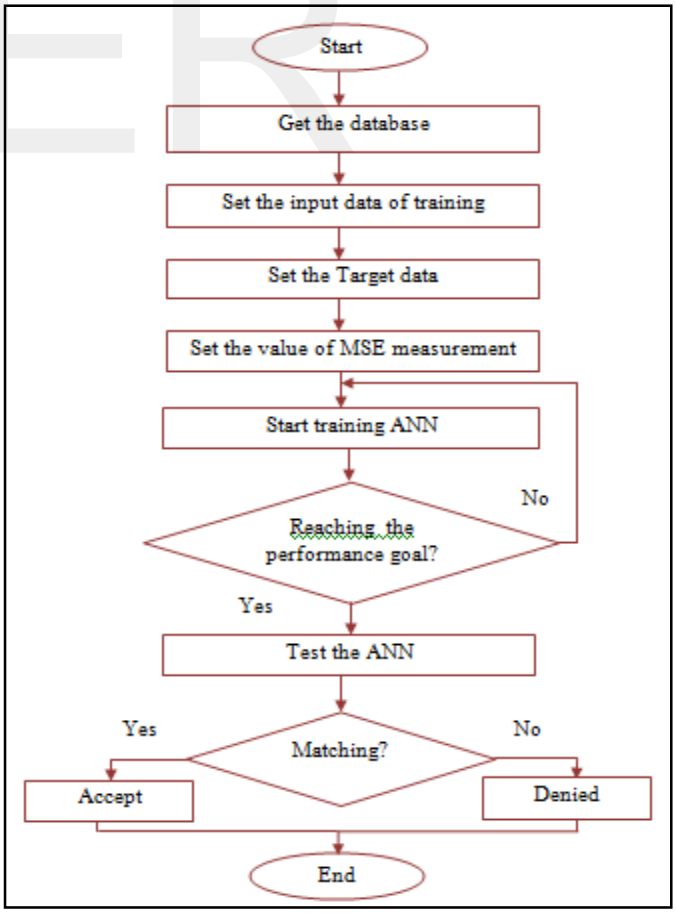


Fig. 8. The flowchart of ANN training and testing operations

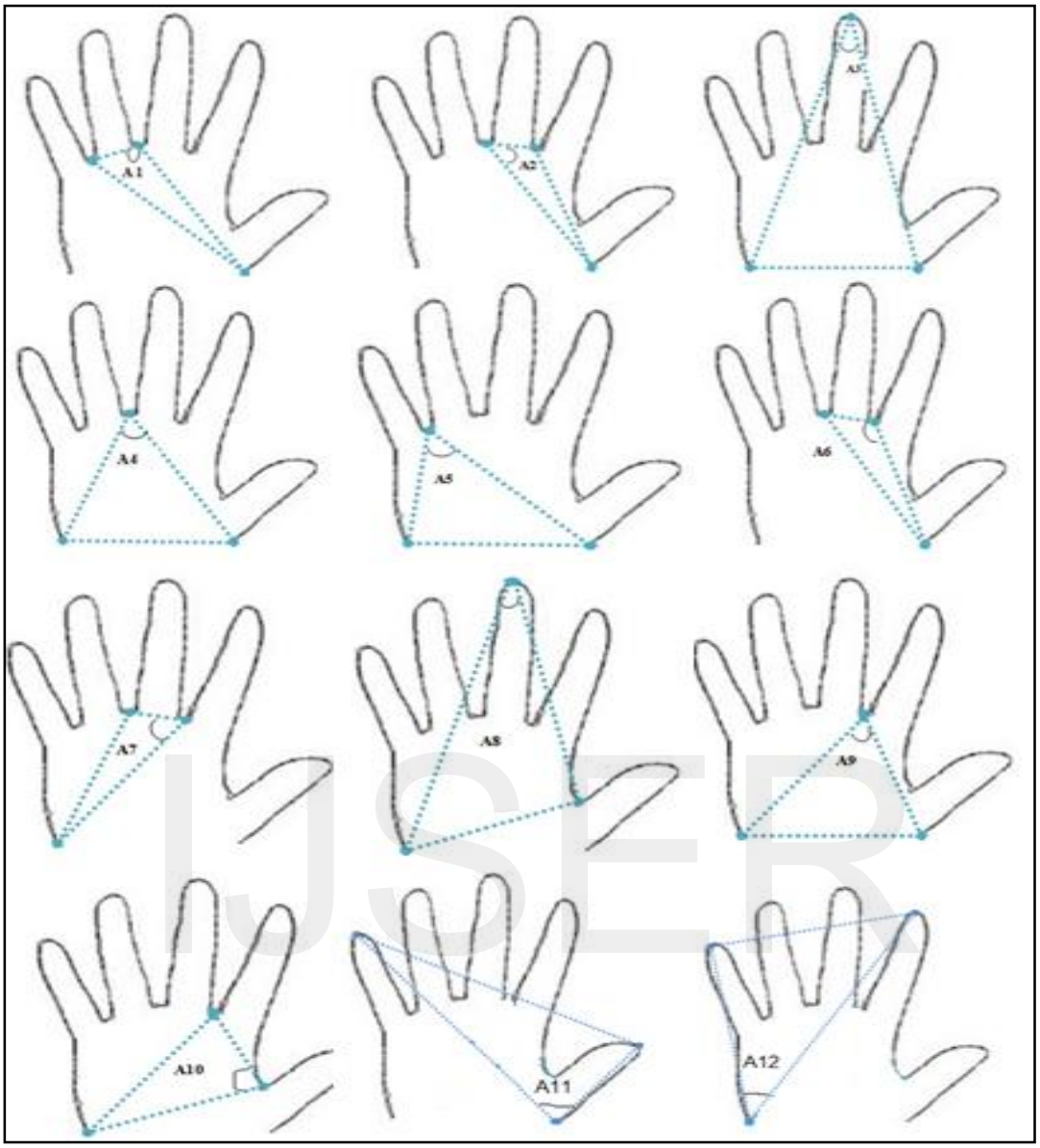


Fig. 6. The segments from A1-to-A12

6 Experimental Results

The system has been tested on 100 images. These samples contain some images at different interval times. Methodology used the three layers [input=66, hidden=35 neuron, output=10], and used BPNN with threshold equal to 0.8 and trainlm algorithm. After test the NN th at been t rained. The recognition equal to 9 3% and the mean squared error = 0.000001 as shown in Figure 9. Figure 10 shows the training state of BPNN when the goal of network met, and Table 1 show the comparison between the previous works and the proposed method .

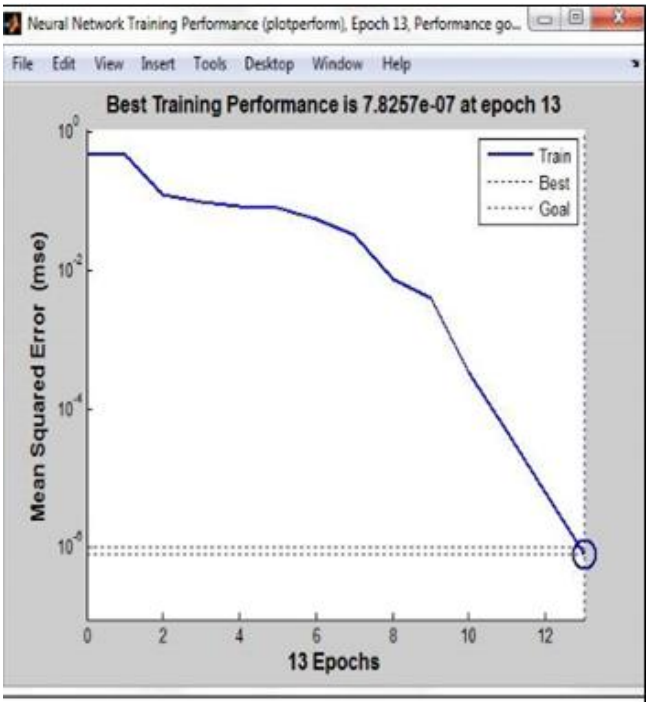


Fig. 9. The MSE curve

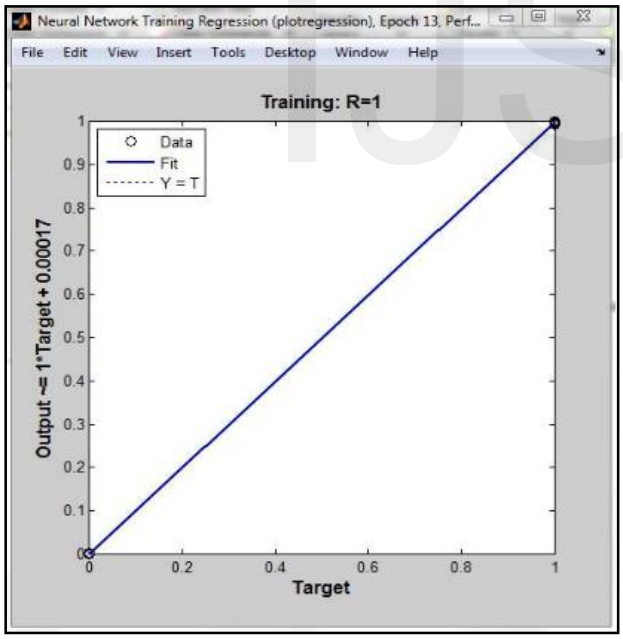


Fig. 10. The training state of BPNN

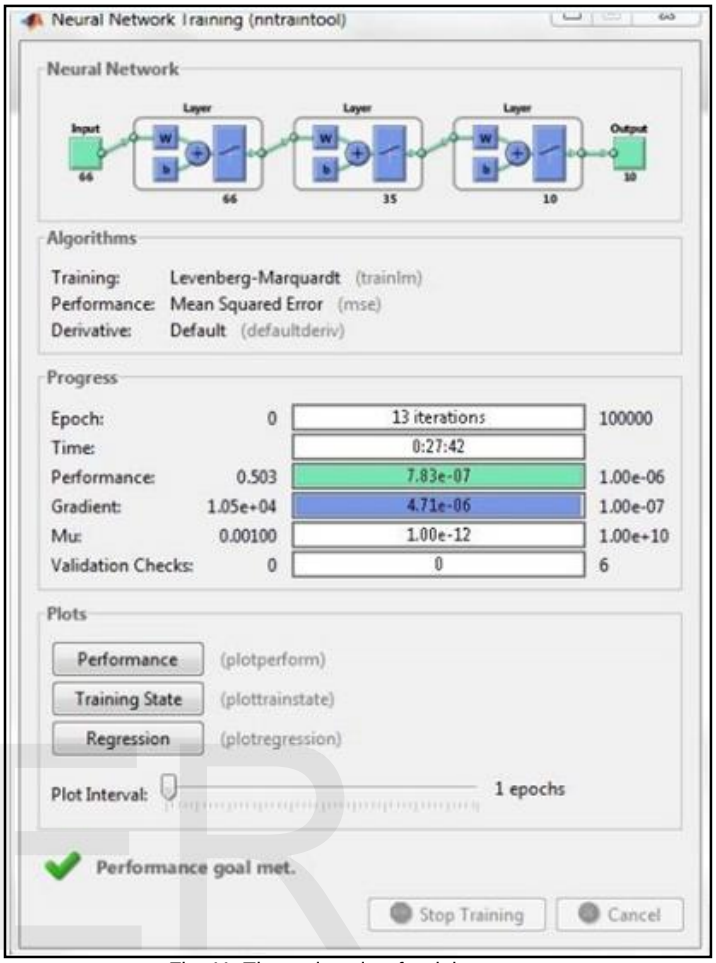


Fig. 11. The main veiw of training

TABLE 1
COMPARISONS WITH PREVIOUS WORK

Name of Paper	Techniques Applied for Recognition	Size of Database	Features	RR %
Biometric Identification by Means of Hand Geometry and a Neural Net Classifier [4]	more than one tech: Nearest Neighbour MSE,	220	reduced to 9 features	73.64%
	Radial Basic Function			90%
Using of Hand Geometry in Biometric Security Systems [5]	GMM	408	21	80.18%
	FAR and FRR value			14.58%
Biometric Human Identification of Hand Geometry Features Using Discrete Wavelet Transform [7]	Discrete Wavelet Transform	120	31	70.2 %
Making Hand Geometry Verification System More Accurate Using Time Series Representation with R-K and Learning[12]	Dynamic Time Warping distance measure with centroid based technique and three value FAR, FRR, and TSR	118	50	23.67%
				23.43%
				76.33%
Proposed method	BPNN with MSE value	100	66	93%
				$1*10^{-6}$

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Dr. Firas M. Al-Fiky, received his BSc degree from University of Mosul-Iraq, College o f Engineering, Electric department, at 1997, and MSc, and PhD degrees from University of Mosul-Iraq, College of Engineering, computers engineering department, at 2000 and 2007 respectively. He is lecturer since 2007, and he started teaching and supervising post graduate courses since 2009 and until now. He is a director of IT and Networks center in Duhok Polytechnic University (DPU).

Zainab Salih Ageed, received her BSc at 2009 in computer science and mathematics Dept. at Mosul University. She is working now to get MSc degree in computer science in Zakho University. This paper is one of her research part productions working together with her supervisor Dr. Firas M. Al-Fiky.