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Intelligent Handwriting Recognition System Using Two Neural Network

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A B S T R A C T

*The identification of manually typed numbers is one of the most important problems in computer, which has made many researchers to research on this topic and create intelligent systems to identify them. The main problem that faces the researchers is the dig data for the input image, thus, they tried to reduce the size of the image without making effect in its quality, so in our experiment in this paper we will use pattern averaging technique to reduce the size of the image as small as possible. In this paper we will create an intelligent system that recognizes the digits from 1 to 9 written manually, this paper is separated into two principle parts. In the first part, image processing techniques were used to determine the geometric shape of digit's image which was written by hand, the image was filtered using median filtering technique, thereafter the image adjusted, after that by using canny edge detection, the image number edges detected, finally the image resized by using pattern averaging technique which will be ready for next stage. In the second part, two back propagation neural networks were used to recognize the numbers, the first network was trained by digit image has dimension of 8*8 matrix, whilst the second network was trained by digit image has dimension of 10*10 matrix , in training stage 4 samples were used for each digit as training input, however in testing stage the two networks were tested by one sample for each digit. The result shows that the second network recognition rate was 88.88% for training phase and 90% for testing phase, , while the first network recognition rate was 94.4% for training phase and 100% for testing phase, this leads to that the first network has more efficiency than the first network in both training and testing phases.*

Keywords: *, Intelligent systems, recognition geometric shapes, pattern averaging, back propagation neural network.*

1. Introduction

Computer has a high speed and ability to process millions of data in parts of a second but it cannot do many things that a person does. For example, if a small child at 10 years old showed him a group of pictures, the child will simply know the picture like a cat the image of the tree and others. Scientists have studied the cells of human neural networks, and tried to simulate them by computer, so that we can build a network that works in the same principle, so we can get that smart computer capable of distinguishing, and from here began the idea of artificial neural networks. Neural networks are more complex in the use of parallel computing methods and processing, this is one of the reasons why the human brain is able to process the data with the most simultaneous array of neurons at the same time in parallel. Today's computers simulate this process in what is called computerization Parallel, despite the high speed resulting from this technique. Handwriting recognition is a capacity and strategy of the framework which get the contribution from touch screen, electronic ,pen, scanner, pictures and paper archives. Disconnected Handwriting recognition framework is a specialty of distinguishing the word from pictures. As we probably am aware each individual has their distinctive written work style, so it is extremely hard to perceive the

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revise written by hand characters and digits. There are numerous viable issues where Handwriting recognition framework is exceptionally helpful like documentation investigation, mailing address translation, bank check preparing, signature confirmation, postal locations.

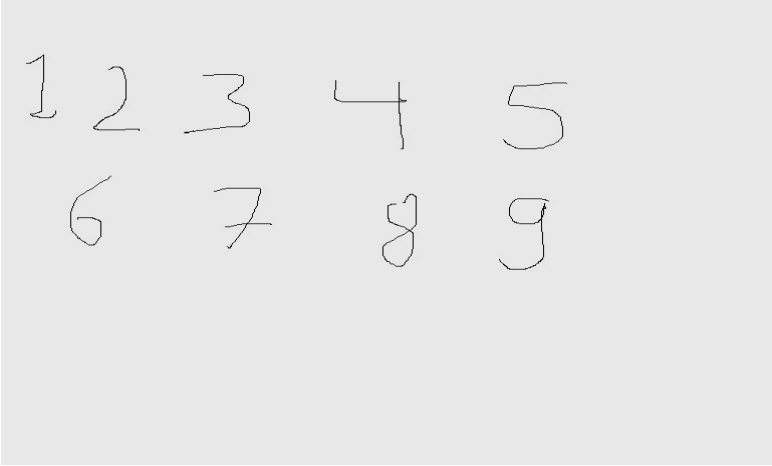

Fig1.Handwriting digits

In the proposed paper an intelligent recognition is developed for handwriting digits, Volunteer students wrote numbers from 1 to 9 in deferent shapes, these digit samples were scanned and fed to the computer, first we use image processing technique to calculate the images shapes, the digit image converted into gray scale, thereafter the grayscale digit image adjusted and then the edges of digit image digit detected by using canny edge detection at the end the digit image resized by using pattern averaging technique, in this part firstly the digit image resized by 8*8 which will be input for the first network the it resized by 10*10 to be input for second network, in the recognition phrase, in this paper we use two back propagation neural networks to recognize the digits every network has deferent input number from the other, the experiment shows that the second network gives more efficiency in the than the first network.

2. Methodology

2.1 Image processing

Image processing technique is concerned about the use of mechanisms and algorithms for The images treatment types are : improve the image, crop the important parts of the image, extract characteristic features before starting the subsequent operations, such as recognizing objects in the image or measuring sizes. The main part of this paper is image processing, which the digit image is treated, filtered, segmented and reshaped. Processing digital images. The objectives of image processing technique are varying widely. Image processing is one of the cornerstones of computer vision.

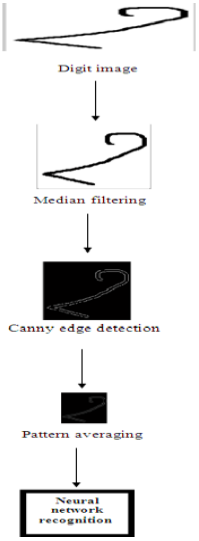

Fig2. Flowchart of the proposed identification system

2.2 Grayscale

The first image processing technique is converting colored digit image into grayscale image. Grayscale is a scope of shades of dark without clear shading. The darkest conceivable shade is dark, which is the aggregate nonattendance of transmitted or reflected light. The lightest conceivable shade is white, the aggregate transmission or impression of light at all noticeable

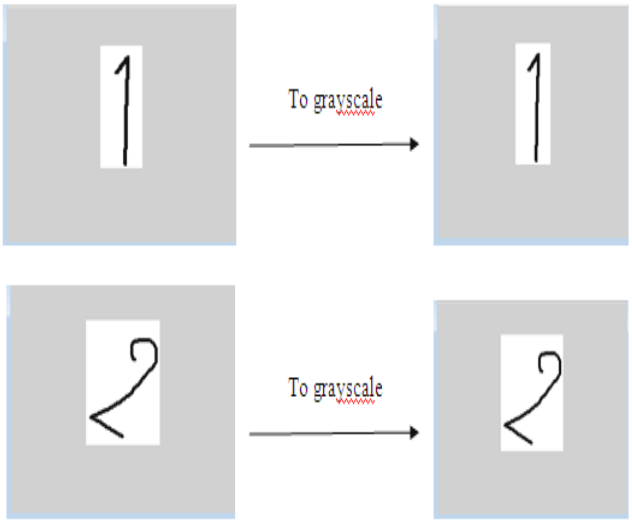

Fig3.Digit image to grayscale

1.2 Filtering

For filtering, median filtering method is used. *Median filtering* is known as a nonlinear technique that used to expel noise from pictures. It is generally utilized as it is extremely successful at expelling clamor while safeguarding edges.

1.4 Edge detection

The edge is a fine thread that passes between the unconnected areas of the heterogeneous image that appear suddenly. The detection of edges is important in the field of image processing as used in the process of distinguishing patterns. In this paper canny edge detection is used to detect the digit edges, This detector moves towards a mathematical solution and it is considered to be the most ideal type, because the method of searching for the curved confluence depends on the x-axis (Points Crossing Zero) This detector is characterized by noise processing White.

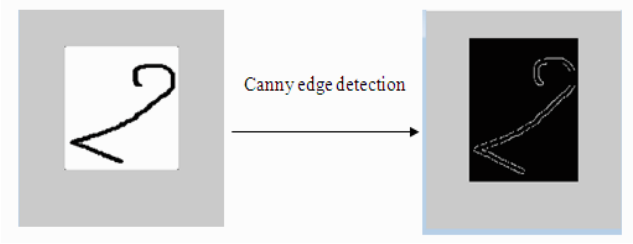

Fig4.Canny edge detection

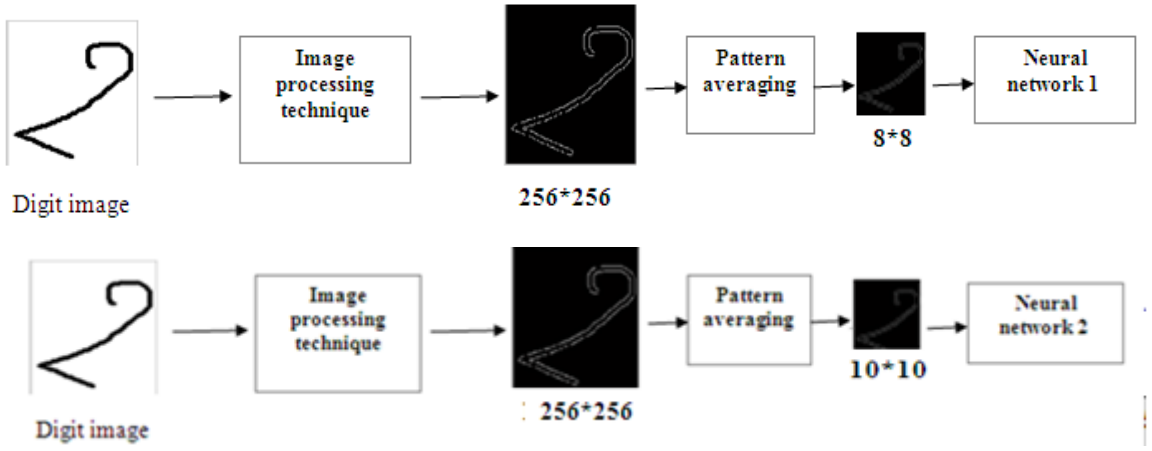

Fig5. The different phases of the proposed system

3. Recognition phase

In this phase digits from 1 to 9 were recognized using a supervised neural network.two back propagation networks used in this paper. We used 45 images in the proposed system, for each digit has 5 image. In the traning stage we used 36 images The input layer of the BPNN1 network consists of 64 neurons since each image is rescaled to 8*8 bitmap using pattern averaging. The hidden layer consists of 35 neurons, while the output layer has 9 neurons since we have only 9 output digits.the second propagation network BPNN2 consists of 100 neurons since each image is rescaled to 10*10 using pattern averaging for the other parameters, hidden layer cosist of 35, while the output layer has 9 neurons since we have only 9 output digits

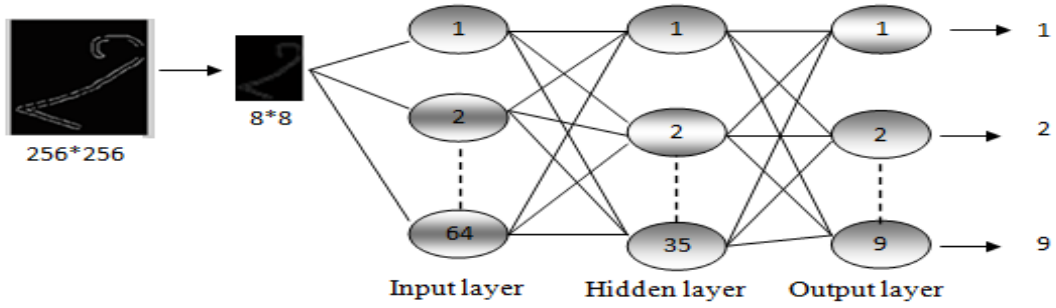

Fig 6. BPNN1

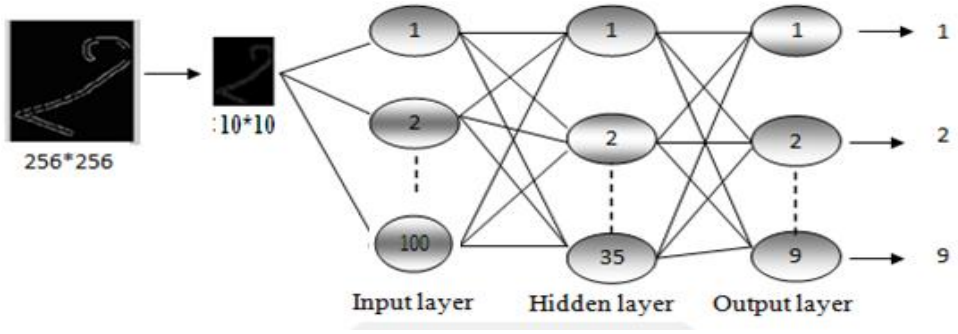

Fig 7. BPNN2

Table 1: NN Parameters

	BPNN1	BPNN2
Parameters	**Value**	**Value**
Number of neurons in input layer	64	100
Number of neurons in output layer	9	9
Number of neurons in hidden layer	35	35
Maximum Iteration number	5000	5000
Learning rate	0.001	0.001
Momentum rate	0.4	0.4
Error	0.001	0.001
Activation Function	Sigmoid	Sigmoid

4. System training

The networks was simulated and trained on Matlab software and tools. We used nine different set of images of nine digits (from 1to 9). The following is the training results of the two sets (learning curve) for both BPNN1 and BPNN 2.

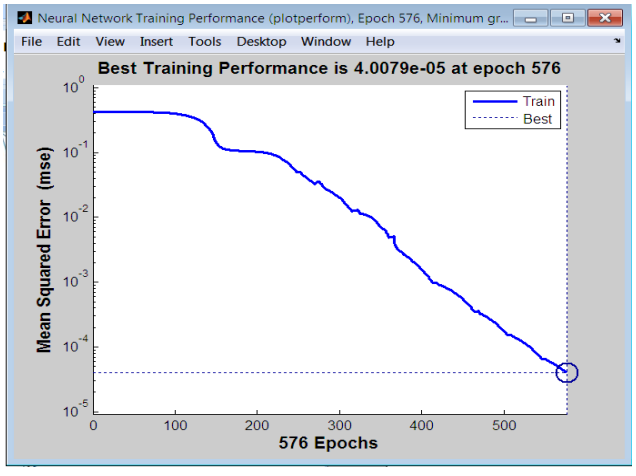

Fig. **8**. Learning curve for BPNN1

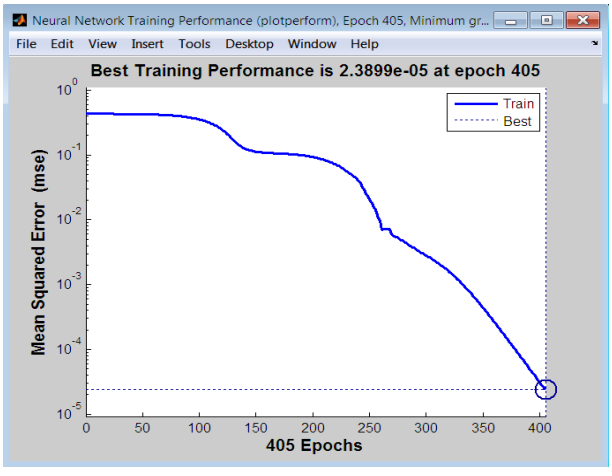

Fig. 9. Learning curve for BPNN2

The fig.8 and fig. 9 shows the learning curve of the two back propagation neural networks used for training the proposed system. It is remarkable that the BPNN1 learned better than the BPNN2 which can be due to the small size of the input data in the second one, where the averaged image size was 64. However, the averaged image's size used in the BPNN2 was 100.

5. Conclusion and result

In this paper an intelligent hand writing digits system is developed, this system based on image processing and neural network. The system is trained by four digit images for every number from 1 to 9 which they written manually by student volunteers in high institute of sciences and technology in Alhraba, Libya. The input training images is divided into sizes, trained by two deferent network, the first type the image is reshaped using pattern averaging technique into dimension of 8*8, which was the training input image for BPNN1, the training recognition rate was 94.4 % , however, testing recognition rate was 100%. The second type of digit image is reshaped using pattern averaging technique into dimension of 10*10, which was the training input image for BPNN2, the training recognition rate was 88.88% , however, testing recognition rate was 90%.

Table **2**: ANN results

	BPNN1	**BPNN2**
Processing time	0.01 minutes	0.04 minutes
Recognition rate during training	94.4%	88.88%
Recognition rate during testing	100%	90 %

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