A STUDY ON DIGITAL RECOGNITION USING NEURAL NETWORK

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ABSTRACT

Handwriting number recognition is a challenging problem researchers had been research into this area for so long especially in the recent years. In our study there are many fields concern with numbers, for example, checks in banks or recognizing numbers in car plates, the subject of digit recognition appears. A system for recognizing isolated digits may be as an approach for dealing with such application. In other words, to let the computer understand the numbers that is written manually by users and views them according to the computer process. Scientists and engineers with interests in image processing and pattern recognition have developed various approaches to deal with handwriting number recognition problems such as, minimum distance,decision tree and statistics.

Key words: Neural network, ANN, segmentation, digital recognition, feed forward back propagation algorithm

INTRODUCTION

Recently, a lot of works was done by depending on the computer; In order to let the processing time to be reduced and to provide more results that are accurate ,for example, depending on different types of data, such as characters and digits and the numbers are used frequently in normal life operation. In order to automatesystems that deal with numbers such as postal code, banking account numbers and numbers on car plates. And an automatic recognition number system is proposed in this study. Digit recognition has been extremely found and studied. Various approaches in image processing andpattern recognition have been developed by scientistsand engineers to solve this problem[1,16]. That is becauseit has an importance in several fields and it mayprobably be used in checks in banks or for recognizingnumbers in cars plates, or many other application.In this study, system for recognized of digits isbuilt, which may benefit various fields, the systemconcerning on isolated digits, the input is considered to be an image of specific size and format, the image isprocessed and then recognized to result of an editeddigits.The proposed system recognizes isolated Arabicdigits as the system acquire an image consisting digits,then, the image will be processed into several phasessuch as image enhancement, thinning, skeletonaizationand segmentation before recognizing the digit. Amultilayer neural network will be used for therecognition phase; a feed forward back propagationalgorithm will be applied for training the network andfinally change them into numeral text[2].

Related work

Pattern recognition is an area of studythat is well-established and known through years ofresearch, especially in the field of digit recognitionwhich is considered one of the obvious challenges andone of the significant contributors to digit recognition.However, Arabic digits recognition is considered therecent major areas that attract researcher's attention. Digits recognition attracts researchers intomainly two areas; first, a ierarchical division of theinput letter space to easily solve the problem. Second, aheuristically defined rule for classification or featureselection, which is depend on both the writer and thewritten material (data).

Experiments were done by Jurgen Frank for thepolynomial classifier approach. There are threeclassifiers; the first one is simple and linear. It wasefficiently built and successfully tested for the purposeof obtaining a reference point for different data set.Accordingly, the performance is improved by dependingon several sophisticated polynomial structures. Thesecond classifier comprises the effects of extracting thefeature which are demonstrated with the Karhunce-loevetransformation and some results iterative learning werementioned to be provided. The third classifier comprises the fixed classifier approach for various structure kindsof the classifier system on the same data set. As a result, the performance effects were demonstrated, the effortsand supporting of these different systems in the training and testing stage are shown in[3].Alceu de Britto *et al*.[4] proposed an approach for recognizing the handwritten numeral strings that relieson the two-stage HMM-based method. The possible loss of recognition performance is returned by the method that is caused by the necessary trade-off between recognition and segmentation in an implicitsegmentation-based strategy. In the first phase of these gmentation process, implicit segmentation processconcerns contextual information in the sense of providing multiple segmentation-recognition hypotheses for a mentioned preprocessed string Is taken. In the second phase, these hypotheses are reranked and verified in a by performing an isolation forthe digit classifier. An experiment on 12,802handwritten numeral strings of different lengths has been conducted to proof that the dependence of thetwo-stage recognition strategy is a promising approach .An average improvement of 9.9% was for theverification stage on the string recognition rate.

A recognition rate of 89.6% on touching digit pairs was obtained by this method.Genetic programming techniques for hand writtendigits recognition was applied by[15] on the USPS dataset. Some variations appears on the selection andevolution methods which normally used accompanied bygenetic programming systems such as aged members, directed crossover, inter-output crossover and nodemutation. This genetic approach shows a promisingresult where the accuracy rate reaches 84.3% using interoutputcrossover using 19 features.An approach to recognize a bank cheque amountthat is manually typed on a bank cheque was proposedby[5]. Several splitting algorithms that achieve a bettersegmentation for the individual digits where obtained.As a result, a designation for the system was done in order to have the most likely one first; if it fails, it usesdifferent techniques. By using the neural networkarchitecture which employs a group of four neuralnetworks of various types that are applicable in parallelto reduce the chances of incorrect readings, the digitsclassified. The data used for training the neural networkconsists of 3103 real cheques and 1444 segments foraccuracy. The overall accuracy using MLP neuralnetwork was about 85%.

An Optical Character Recognition (OCR)framework was developed by[6]. It depends on the handprintednumeric recognition field. From the VISA creditcard application forms, the numeric fields were takenfrom binary images. Individual identity telephonenumbers and other numbers were contained in theimage. The proposed OCR framework is considered tobe as a cascaded neural network. It contains threestages; the first stage is the self-organizing feature mapalgorithm. The second stage maps distance values to thevalues of allograph membership by using a gradientdescent learning algorithm. The third stage is a networkof multi-layer feed-forward. Experiments wereefficiently performed on a test data set from theCCL/ITRI database which contains above 90,390handwritten numeric digits. A test recognition rate of98.85% was achieved by this experiment.Ernst Kussul and Tatiana Baidyk[7] have efficientlydeveloped a novel neural classifier Limited ReceptiveArea (LIRA). The classifier LIRA is contained of threeneuron layers:

output, sensor and associative layers.The classifier was tested over two image databases. Thefirst database is the MNIST database which contained60,000 handwritten digit images for the classifiertraining and 10,000 handwritten digit images for theclassifier testing. The second database has 441 images
of the assembly micro device. For dividing the databasea random procedure was used to test and train subsets.
The classifier LIRA provides error rate of 0.61% as amean value of three trials.

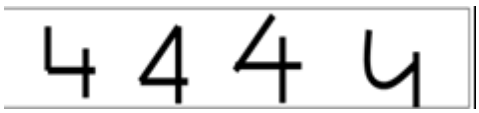

Fig. 1: Examples of different shapes in number 4

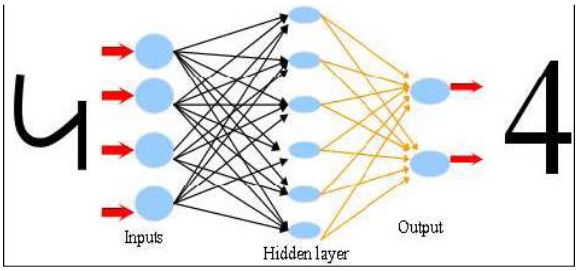

Fig. 2: Scenario of number recognition with artificialneural network

A finally approach was presented by WESTALL inorder to use the neural networks in the system of the decision logic for the handwritten numeralssegmentation. This approach has been successfullyimplemented in a commercial system that isinternationally used in the recognition of hand writtenamounts on personal bank checks; computer-basedrecognition of unconstrained hand written fields withinscanned images of financial documents has three steps.The first step is the field identification that supplies thelocation within the image of the typically rectangularregion of interest that consists of the target field. Thesecond step, an identification must be performed by thesegmentation of the group of pixels compressing eachnumeral of the field. The third step is to classify thenumerals that are extracted by segmentation.

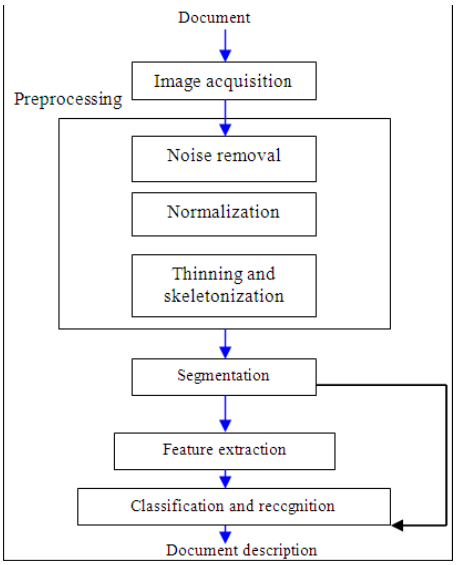

Fig. 3: A general diagram for Arabic digit recognition system.

MATERIALS AND METHODS

There are four steps to build the isolated digits recognition system. These steps are presented on Fig. 3 and below are the descriptions of them:

Image acquisition:

We will acquire an image to our system as an input .this image should have a specific format, for example, bmp format and with a determined size such as 30□20 pixels. This image can be acquired through the scanner or, digital camera or other digita linput devices[9].

Preprocessing:

After acquiring the image, it will be processed through sequence of preprocessing steps to be ready for the next step.

Noise removal:

reducing noise in an image. For on-line there is no noise to eliminate so no need for the noise removal. In off-line mode, the noise may come from the writing style or from the optical device captures the image[10].

Normalization-scaling:

standardize the font size within the image. This problem appears clearly in hand written text, because the font size is not restricted when using handwriting.

Thinning and skeletonization:

Representing the shapeof the object in a relatively smaller number of pixels[9]. Thinning algorithms can be parallel or sequential.Parallel is applied on all pixels simultaneously. Sequential examine pixels and transform themdepending on the preceding processed results.

Segmentation:

Since the data are isolated, no need forsegmentation. With regards to the isolated digits, to apply vertical segmentation on the image containingmore than digit will isolate each digit alone.

Normalization scaling and translation:

Handwriting produces variability in size of written digits. This leads to the need of scaling the digits size within the image toa standard size, as this may lead to better recognition accuracy. We tried to normalize the size of digit withinthe image and also translate it to a specific position by
the following.

Feature extraction:

Feature extraction is not part ofthis project. Feature types are categorized as follows:

- Structural features: It describes geometrical andtopological characteristics of a pattern byrepresenting its global and local properties
- Statistical features: Statistical features are derivedfrom the statistical distribution of pixels and describe the characteristic measurements of thepattern
- Global transformation: Global transformationtechnique transforms the pixel representation to amore compact form. This reduces thedimensionality of the feature vector and providesfeature invariants to global deformation like translation, dilation and rotation

Classification and recognition:

Neural Network is anetwork of non-linear system that may be characterized according to a particular network topology. Where, thistopology is determined by the characteristics of the neurons and the learning methodology. The mostpopular architecture Of Neural Networks used in Arabic digits recognition takes a network with threelayers. These are: Input layer, hidden layer and output layer. The number of nodes in the input layer differsaccording to the feature vector's dimensionality of the segment image size.

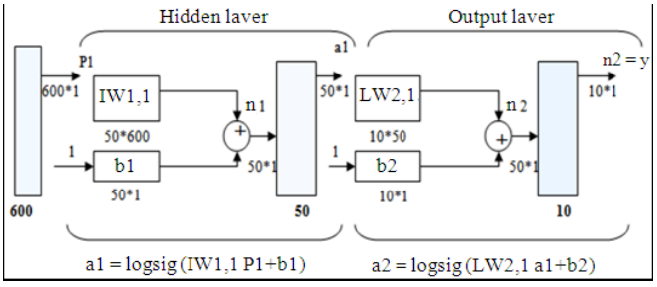

Fig. 4: Two layers network, one hidden and one output,

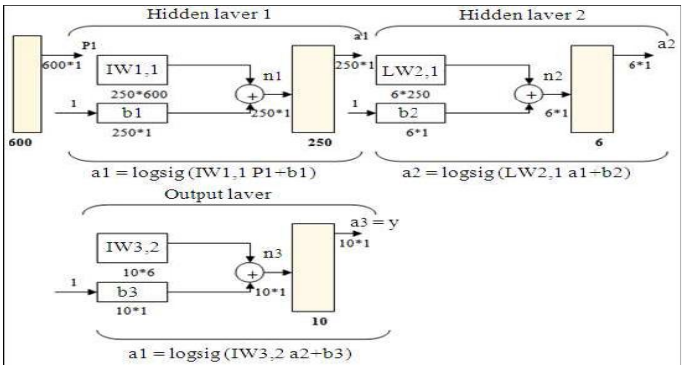

Fig. 5: Three layers network, two hidden and one output,.

DISCUSSION

To analyse the efficiency of proposed method several experiment are yet to be conducted.Scientists and researchers are still interested in thisarea, because it has many challenges until now ,and thesystem involves a verity of process operate sequentiallyto achieve the goal, many issues related to those processhave not been touched, as the needed in the future thoseissues can be studied and tested under the proposedsystem and some of the following can be consider asthe base for the future work, like check robustness innoisy setting and with different random initializationsand skew detection and correction to the digits.

CONCLUSION

Several experiment were conducted that neural network seems to be better than other technique used for recognition.

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