USING NEURAL NETWORK FOR RECOGNITION HANDWRITTEN INDIAN NUMBERS

Murtadha Ali Majeed[*], Mohsin Najm Srayyih[**]

*Al-Imam Al-Kadhum College for Islamic science **muam1987_computer@yahoo.com**

**University of Misan College of administration and economics muhsen.edu@gmail.com

ABSTRACT

Although not trivial progress has been made in image recognition but it is considered is one of the most critical field of machine learning because of some limitations of what kind of algorithms or methods used for processing. In this work, a powerful algorithm is proposed for image classification. Many robust and efficient models are proposed to increase classification performance and diminish drawbacks inherited from other models. This paper proposes a technique for recognizing Indian numbers using Neural Networks (NN). The main objective for our study was to recognize Indian numbers which have been used in wide applications such as recognizing numbers in car plates or checks in banks.

Our models are test and evaluated using not easy and challenging datasets which we created according for some procedures explained in next our sections. Datasets used in this evaluation consists of Indian digit numbers which consist of around 30 thousand samples. In addition to using advanced technique and challenging dataset, a contemporary and efficient methods widely and formerly used are incorporated in our work to expand model efficiency. To the best of our knowledge, comparing with prior work, our models outperform all other former

models although all the proposed models are evaluated using challenging dataset created and pre-processed for the first time in this work.

Keywords Digital recognition, neural network, and classification.

I. INTRODUCTION

Digit recognition play an essential role in wide real world applications. However, there are still many obstacles diminishing applications performance faced researches. There is huge effort has been depicted for manipulating image recognition. Handwriting recognition includes both digit and letters recognition. In recent years, the handwriting recognition has been become of the subjects are very important and are used in many scientific research concerned distinguishing numbers by hand to easy access to many applications in several areas such as applications used in the electronic archiving and banks. Numerous approaches have been proposed for character recognition and considerable success has been reported [1]. Numeral recognition refers to the process of translating images of handwritten, typewritten, or printed digits into a format understood by the user for the purpose of editing, indexing, searching and reduction in storage size [2]. Number recognition can be online or offline. In online number recognition, data are captured during the writing process with the help of special pen and an electronic interface. Offline documents are scanned images of prewritten text, generally on sheet or paper [3].

In this paper, we work with offline numerals. In this paper, Back propagation neural network is used for recognition Indian numbers (٩ ٨ ٧ ٦ ٥ ٤ ٣ ٢ ١ ٠). We used a dataset consisting of 30000 samples collected from middle and high school students. Datasets divided into two parts training and testing. Training part has 25000 images and the others are used for testing.

II. STEPS OF IMAGE CLASSIFICATION

Image recognition plays an essential role in machine learning because of its wide applications in variety of real world scopes. Researchers have depicted several techniques to accomplish these tasks. The methods presented in this scope are very wide and complicated. However, Neural Network (NN) is considered is one an efficient method used widely in machine learning applications for many reasons such as easy to implement and robustness. Nevertheless, it has some limitations that can influence model efficiency such as computation time and inability to handle challenging datasets because of overfitting. In this work, a neural network was used to train and test hand-written numbers. Using NN for image classification contains many steps as shown in fig. 1 and it can be explained below:

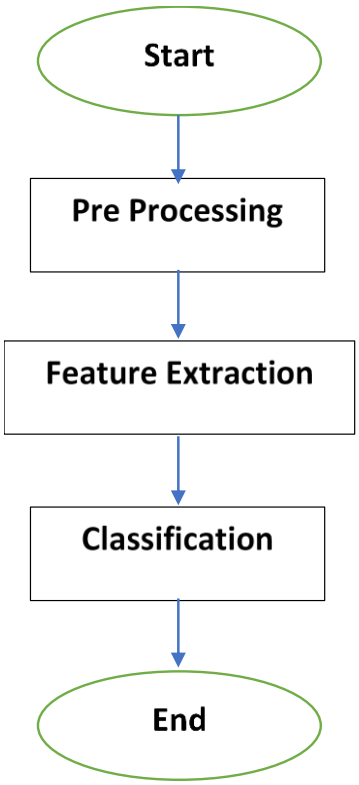

Fig. 1. Steps of Image Classification

1- Preprocessing: - it is the first phase of image recognition and it considered a primary step of image classification or recognition and it is normally known as crucial phase of recognition system [4]. In this phase, the images are re-sized to

be 28 * 28 because our models are designed to receive a fixed image size of 28x28 pixels. Then all images are converted to grayscale instead of color images.

It is worth mentioning that there are several methods have been using for preprocessing giving not trivial results. One of these methods use different strategies of preprocessing result in different results. Thus, one of the well-used methods is what is demonstrated in [5].

2- Feature Extraction: - The second essential phase of the classification is feature extraction. Wide methods have been used for this purpose for instance HoG is used for wide and for different applications as demonstrated in [6] Also, it is used in several other applications as obtained in [7]. However, using HoG suffering limitations as showed in [7]. SIFT is also anther method widely used in various application as demonstrated in [8]. SIFT is considered one of the most widely used methods because of its simplicity and its robustness.

   All above mentioned methods are considered handcrafted methods and they have less accuracy and comparing with other methods that not require feature extraction manually such as neural network. Thus, NN is used in this work to extract features.

3- Classification: - The final step of image classification is to find highest probability of final output layer of NN to determine the right handwritten numbers. The most traditional classifier used in neural network is using *soft-max* classifier [9] [10] Used in this work.

III. PROPOSED MODEL ARCHITECTURE

Artificial Neural Network (ANN) is information processing models which are inspired by the biological nervous systems, such as human brain. It is composed of several number of highly interconnected processing elements called neurons working in coordination to solve specific problems [11]. In our experiments, we

use different architectures of neural network trained using back propagation algorithm. One of the best designed architecture is the one consisting of 4 layers as depicted fig. 2(one input layer, two hidden layers and one output layer (soft-max layer)). The input layer consists of 784 nodes fed by input patterns from the training and testing dataset. The next two hidden layers consist of 700 and 100 respectively. Finally, the output layer has 10-output and each output represent one of the ten digits. Every node of hidden and output layers is connected and fed by all nodes of the former layers.

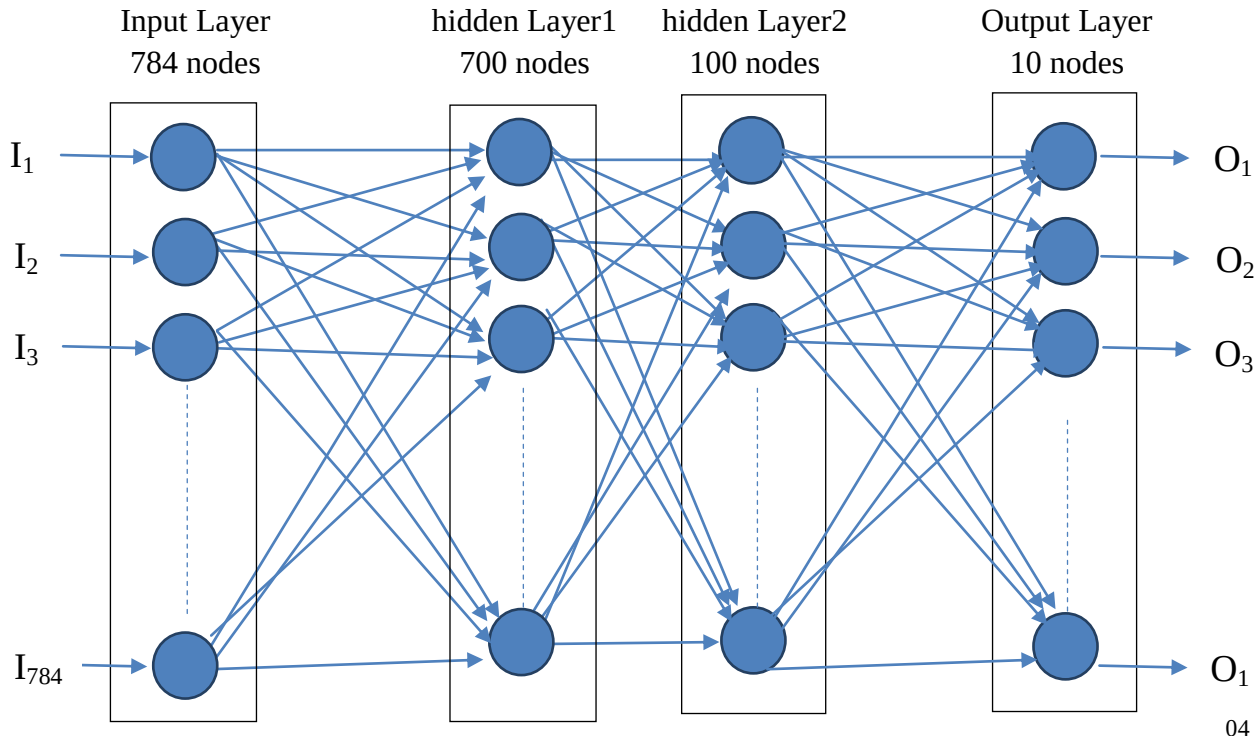

Fig. 2. Proposed Model Architecture

IV. Dataset

In this study, a challenging dataset is collected from different resources of various levels of schools. Specifically, samples are collected from Elementary, middle, and high school students. Since all the collected samples are gathered from different resources and manipulated manually, they have not equal sizes. Thus, the patterns are pre-processed by resizing to have same size because they will be fed to

same NN models. Also, the patterns are cropped from the center and whitening is added as well. Furthermore, samples are converted to be gray-scale image of size (28×28) pixels. Fig. 3 shows some sample images. As the common rule, a random 25000 samples of the input dataset were used for training and the remaining 5000 samples were used for validation of the overall accuracy of the system.

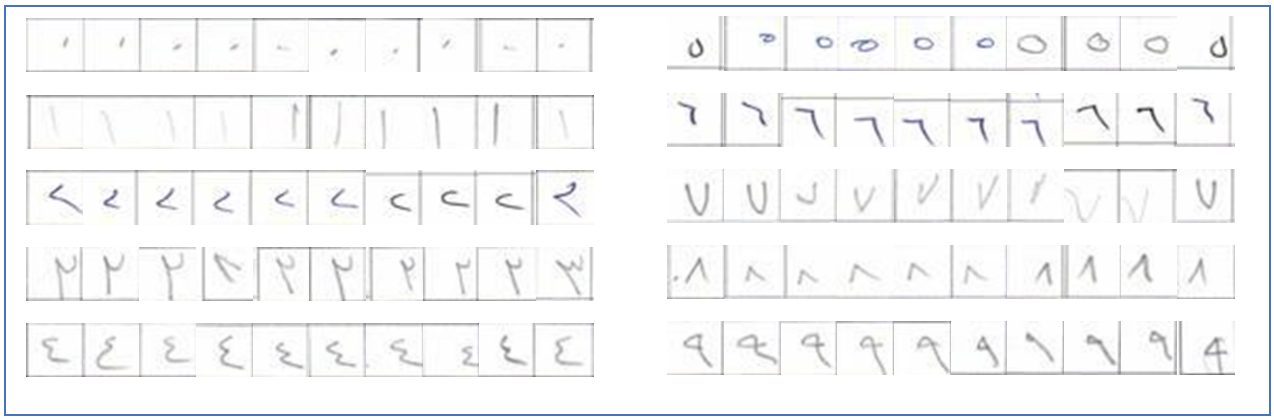

Fig. 3 Sample handwriting digits from dataset.

V. Results

To evaluate our proposed models, a challenging dataset is used for evaluation as demonstrated previously. A powerful hand Arabic digit is collected and designed in this work to be our targeted task. To best our knowledge, the dataset used in this work is biggest dataset comparing with prior works. All former works used small dataset having very few patterns as explored in [12]. Hence, our results are not compared to previous works because it is first time used in this work with NN. However, it was used with Convolutional Neural Network (CNN) as demonstrated in [13]. The accuracy gotten in this work is 0.90. in addition to accuracy obtained in this work, simple applications using MATLAB is designed to show the results as shown in figures below. It is obvious that our model achieves good results even with challenging samples as shown in figures below.

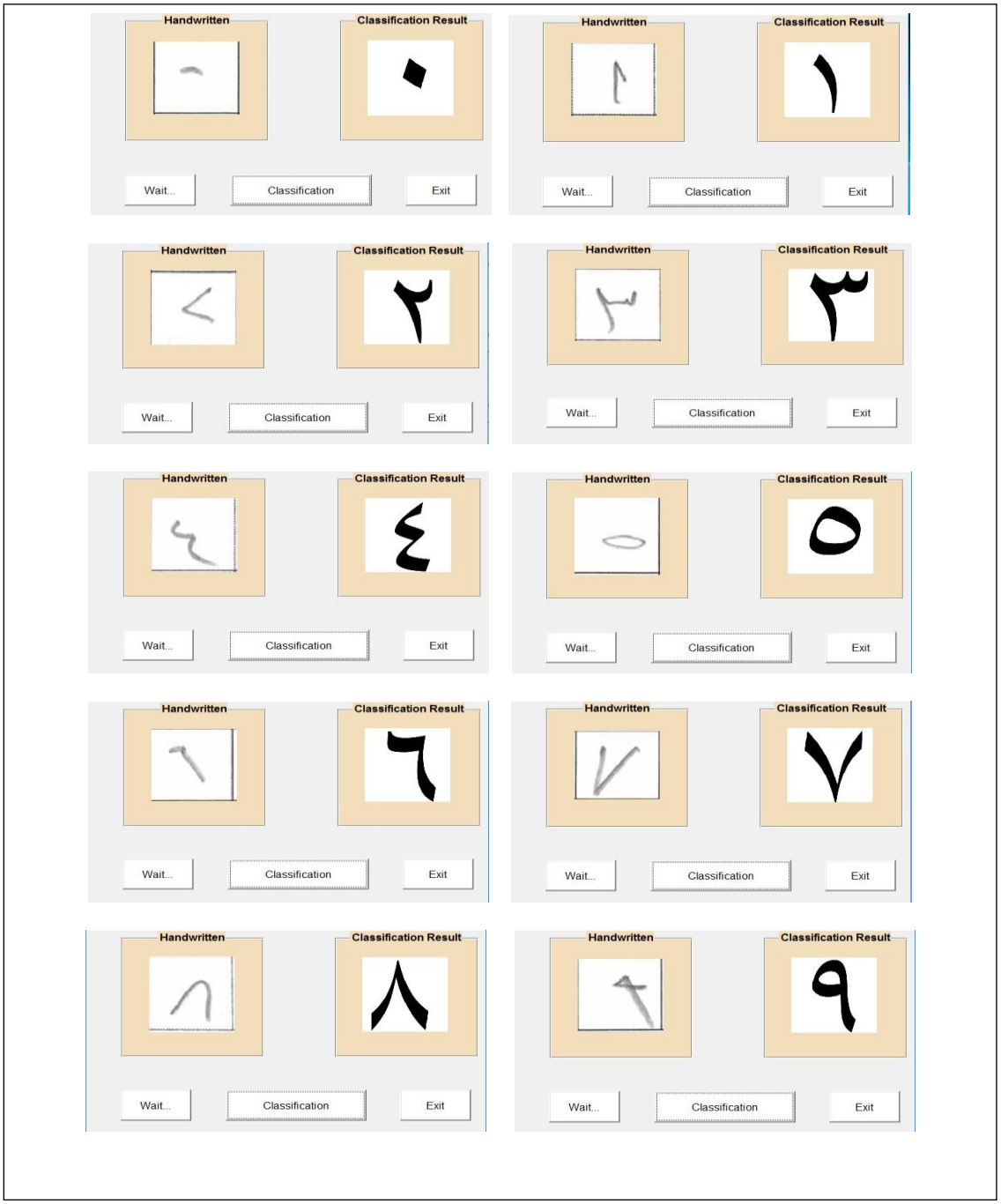

Fig 4.a Samples Image Classification

However, it is still that there are some errors occurring during classification because of limitations inherited by NN as shown in fig. 4.b.

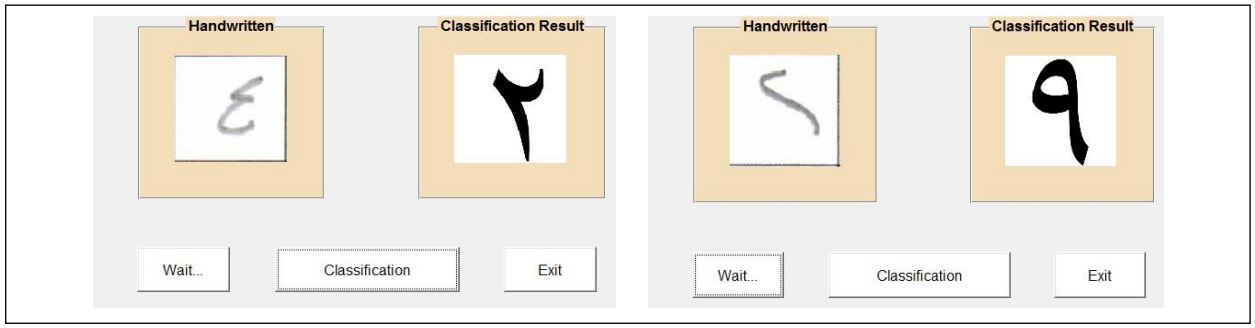

Fig 4.b Samples Image Classification (errors)

To show miss-classification rate, fig.5 hows the results of error and miss-classification rate where x-axis represent number of epochs and y-axis represent error and miss-classification for training and validation. It is noticeable that there is smooth difference between training and validation which refers to there is small overfitting.

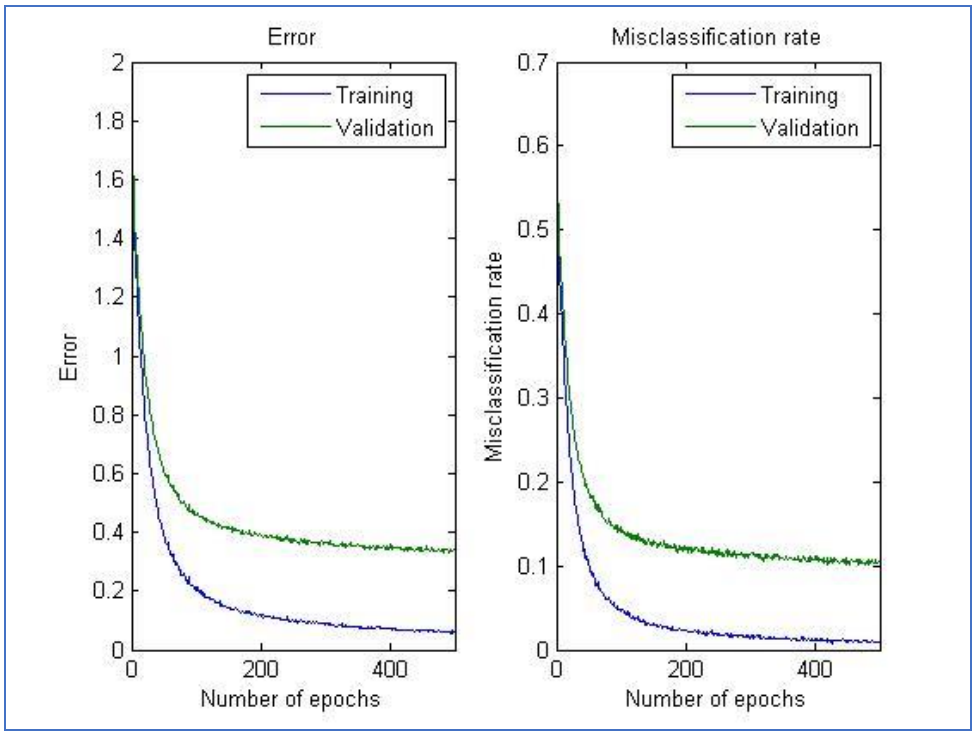

Fig. 5. error and miss-classification

VI. Conclusion

In this paper, we used the Neural Network (NN) for Indian handwritten recognition. We proposed and demonstrated a new training model of NN.

Originally various models were designed and implemented. However, we chose the one that gives best results. In this work, different parameters are explored and investigated to obtain best results comparing with prior works. Furthermore, our models are tested and evaluated using not trivial datasets consisting of 30 thousand samples. All samples of dataset are collected from different levels of study schools. Thus, our NN architecture achieves superior results.

Acknowledgments

We would like to express out deep thanks and appreciation to Allah in everything. We also would like to thank Dr. Hayder Mohammed Obaid who has been very helpful for his collaboration in this research and we ask Allah to grant him success in his life.

VII. References

1- Rejean Plamondon and Sargur N. Srihari ” On-Line and Off-Line Handwriting Recognition: omprehensive Survey 1EEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE. VOL. 22, NO. 1. JANUARY 2000.

2- Amritpal kaur and, Madhavi Arora “ Neural network based Numerical digits Recognization using NNT in Matlab ” International Journal of Computer Science & Engineering Survey (IJCSES) Vol.4, No.5, October 2013.

3- Munish kumar, M.K.Jindal and R.K Sharma,”Classification of characters and grading writers inoffline handwritten gurmukhi script”,2011 International Conference on image information processing.

4- Babita Kubde Vijay Laxmi Sahu. International Journal of Science and Research (IJSR), India, Offline Handwritten Character Recognition Techniques using Neural Network, page 87 -93.

5- Ian J. Goodfellow, David Warde-Farley, Mehdi Mirza, Aaron Courville, Yoshua Bengio “Maxout Networks” ICML 2013

6- N. Dalal and B. Triggs. “Histograms of oriented gradients for human detection”. In CVPR, 2005. 1.

7- Dalal, N. and Triggs, B. (2005). “Histograms of oriented gradients for human detection”. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, pages 886–893.

8- Lowe, D.G. 1999. “Object recognition from local scale-invariant features”. In International Conference on Computer Vision, Corfu, Greece, pp. 1150-1157.

9- Tsung-Han Chan, Kui Jia, Shenghua Gao, Jiwen Lu, Zinan Zeng, and Yi Ma, “PCANet: A Simple Deep Learning Baseline for Image Classification?” arXiv:1404.3606v2 [cs.CV] 28 Aug 2014.

10- Dan C. Cires¸an, Ueli Meier, Jonathan Masci, Luca M. Gambardella, Jurgen Schmidhuber” Flexible, High Performance Convolutional Neural Networks for Image Classification” Proceedings of the Twenty-Second International Joint Conference on Artificial Intelligence.

11- Sakshica and Dr. Kusum Gupta “ Handwritten Digit Recognition using various Neural Network Approaches “ International Journal of Advanced Research in Computer and Communication Engineering Vol. 4, Issue 2, February 2015.

12- Shatha M. Noor, Ihab A. Mohammed and Loay E. George “ Handwritten Arabic (Indian) Numerals Recognition Using Fourier Descriptor and Structure Base Classifier “ Journal of Al-Nahrain University Vol.14 (2), June, 2011, pp.215-224.

13- Haider A. Alwzwazy, Hayder M. Albehadili, Younes S. Alwan and Naz E. Islam “ Handwritten Digit Recognition Using Convolutional Neural Networks” International Journal of Innovative Research in Computer and Communication Engineering (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 2, February 2016.