

Analysis of Learning Rate Using CPN Algorithm for Hand Written Character Recognition Application

W. H. Bangyal, J. Ahmad, and Q. Abbas

Abstract—This paper presents the analysis of the learning rate using the Counter Propagation network (CPN) algorithm for the hand written characters recognition application. The recognition process uses the forward only CPN algorithm to recognize the hand written characters. The experimental results obtained with different learning rate values shows that learning rate has large effect on the recognition process. Upper-case English alphabets for a number of different styles gathered from different peoples are used in the analysis for the performance of the CPN algorithm. The obtained recognition rates were 60% to 98% using the CPN for different learning rate value. The experimental results are very encouraging and satisfactory.

Index Terms—Handwritten character recognition, counter propagation networks, learning rate, performance.

I. INTRODUCTION

ANN can be more impressive as computational processors for different tasks like data compression, classification, combinatorial optimization problem solving, pattern recognition etc.

ANN has many advantages over the other classical methods. While having the computational complexity, ANN offered many advantages in pattern recognition adapting a very little context of human intelligence [11].

Communication is an integral component of human society that has been greatly enhanced by the evolution of the technological age. Verbal communication has been revolutionized by the advent of television, telephone and radio technology, and written communication has likewise been transformed by the development of word processors and electronic data. Handwriting is a natural means of communication which nearly everyone learns at an early age. Thus it provides a means of data entry for computers in which the user needs virtually no training. Handwriting recognition can be approached from both perspectives, and the current focus of the market today is on-line handwriting recognition. This is due to the popularity of personal management devices which involve the use of digital pen architecture

In the future, handwriting may only thrive more because of the technological developments under way that intend to establish handwriting as a new mode for humans to communicate with computers [9]. Handwriting has long been

studied by different fields for various different aspects and purposes, and it includes neuroscience, engineering, computer science, anthropology, education, etc [1]-[3].

Hand writing recognition has become very popular field in the last few years Handwriting recognition can be divided into two categories: on-line recognition and off-line recognition. In on line recognition, the writing person is physically connected to a computer through a mouse, an electronic pen, and the style of handwriting is recorded as a time dependent process. While in off line systems the data is collected on static image as the writing process is finished

Pattern recognition is the research area that is used to study and design of the system for the recognition of the different pattern either it is in the form of text, image or numeric [8].

In the last few decades, many applications have been developed to solve the different problems like as such as face recognition [4] and character recognition [5]. From the last few decades, a lot of research is carrying on in the field of handwriting recognition [6].

The paper presents the analysis of handwritten character recognition using the forward only CPN algorithm. Twenty six upper case English alphabets are considered in this paper for the experiments. No restriction is applied on the style of writing. This learning rate parameter of the neural network has a great affect on the accuracy of the network results.

In this paper forward only counter propagation network is used, and it is combination of unsupervised and supervised learning together proposed by Robert Hecht- Nielson[7], consisting of input layer, competitive layer and output layer. From input layer to competitive layer form the Kohonen network, while from competitive layer to and output layer form the Gross berg network. Using the Winner- Take-All strategy in the competitive learning, one neuron can be winner in the competitive layer and set its status to 1 while other to 0.

The rest of the paper is organized as follows. In Section 2, background and related work are introduced. The Section 3 gives an overview of the proposed system. Section 4 describes the feature extraction steps from the handwritten character. In Section 5 the experimental results are provided with some analyses and discussions. Lastly Section 6 presents the concluding remarks and future work.

II. LITERATURE SURVEY

This paper present an analysis of the learning rate of forward only CPN for the hand written character recognition application. In an effort to determine the applicability of the forward only CPN for the problem of the hand written character recognition application, an analysis is conducted using the learning rate value.

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As learning rate is used in ANN more frequently but still not as much analyzed for any application specially pattern recognition applications. Learning rate plays an effective important rule in any application.

In [8] the author used Kohonen Neural Network for the license plate number identification character recognition application and its performance for the license plate number identification and the result shows that it gives the better performance with 78.57% of accuracy in recognizing the particular plate number.

In [9] the author used CPN Neural Network for the implementation of the remembering the user of the telephone number from a given list, even if the user only remembers part of a number or if the given number list having a series of exchanged digits. The input consists of from 0 to 9 digits and processing is performed on input number and it returns the selected number among all the learned number. It gives a simple learning methodology by assigning a number to the weights and in that way answer is obtained in a quick way.

In [10] the author used CPN Neural Network for the improvement of the accuracy of the grade of bank note recognition. The results show that CPN can solved the bank note recognition problem and speed of CPN is much better than the BP

In [10] the author used CPN Neural Network for on line hand written recognition application and the results the recognition rates were 60% to 94% using the CPN for different sets of character samples.

In [14] the author have used Neural Network classifier as a statistical methodology for feature extraction of hand written digits and obtained the accuracy up to 98% in the results of the experiments.

In [11] the author have used CPN Neural Network for the on line character recognition classifier and described the feature extraction methodology in detail and the results of the accuracy were from 60% to 90% in the application

III. THE PROPOSED NETWORK ARCHITECTURE

I have proposed forward only counter propagation network for the analysis of the hand written character recognition application. The forward only CPN network has three layers. First layer is called the input layer. The second layer is known as kohonen (competitive layer) and third layer is called as Gross berg layer.

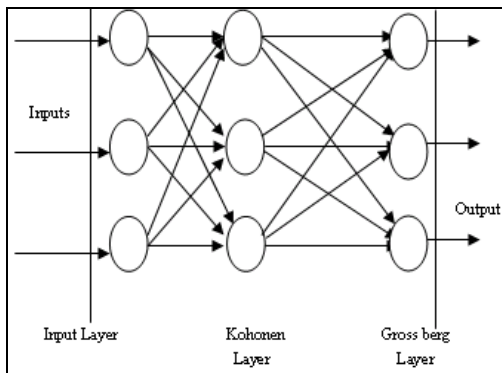


Fig. 1. FOCPN Architecture

The characters that are being used here are English

alphabets written in the form of a matrix of 10×10 . The parameters can affect the forward only counter propagation network k algorithm in term of the accuracy of result. Several experiments have been performed to look into the effect of using different learning rate. The analysis for the recognition of the hand written character is now done on the basis of different learning rate value that shall be discussed next.

IV. LEARNING/TRAINING

In case study, 26 English Upper case alphabets characters have been used. Each writer was asked to write on writing area. No restriction was imposed on the content or style of writing. The writers consisted of university students, professors, and employees in the university.

The character is digitized into $10 \times 10 = 100$ digital cells, each having a single color, either black or white. It is important to encode this information into a useful meaningful form to a computer. For this, assign a value +1 to each black pixel and 0 to each white pixel and create the binary image matrix. The size of the matrix is defined by trial and error method in order to find the best matrix size of 10×10 .

A 10×10 grid results in 100 inputs vectors and the boxes found with character pixels are considered "as on" and the remaining considered as "off" then it will presented to the neural network input for training and recognition purposes. The pre-processing of these hands written English alphabets characters is to convert them in to two dimensional matrixes of binary 0 and 1. The binary 1 show the existence of the character in the cell and binary 0 shows that that there is no character in the cell. A file is maintained of these 1000 hand written upper case English alphabets characters and then used in simulation to get the results. Now this matrix containing binary 0 and 1, to be used as Input for training and testing of the ANN.

And for training I have collected data of about 10000 characters 40 sample of each of the twenty six characters is used to get the results. For effective training of the designed network (to avoid over-fitting), the testing sets of 250 characters are used randomly .A set of examples used only to assess the performance or generalization of a fully-specified classifier [12] [13].

V. EXPERIMENTAL RESULTS

As it is described earlier that testing is performed on the basis of the samples taken from individuals who did not participate in the initial process of setting up the training data sets. The accuracy of results for hand written characters shown in the Fig. 2.

TABLE I: ACCURACY OF RESULTS AGAINST DIFFERENT LEARNING RATE VALUE

Learning Rate	Recognition Rate %				
	NO Noise	5% Noise	10% Noise	15% Noise	20% Noise
0.9	98	96	94	75	57
0.8	92	90	88	60	40
0.7	88	86	82	52	35
0.6	86	80	78	50	31
0.5	80	75	70	48	23

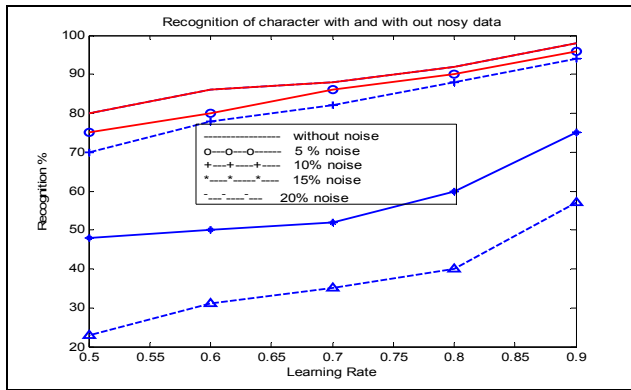


Fig. 2. Simulation result for the accuracy of results against learning rate

A. Analysis

From Table I, have the following observations and it shows that learning rate and recognition rate can be analyzed with and without noisy data as follows

- The value of accuracy increases as the learning rate increases as shown in corresponding table and graph. The value of accuracy decreases as the noise is increased in the data sets. Recognition rate is up to 98% So the learning rate and noise affects the performance of the proposed CPN.
- As noise increases in the data sets, value of accuracy decreases with the decrease in the learning rate.

B. Analysis

From Table II, have the following observations and it shows that learning rate, training samples and recognition rate can be analyzed as follows

- The value of accuracy increases as shown the training samples increases as in corresponding table and graph. Recognition rate is up to 98%

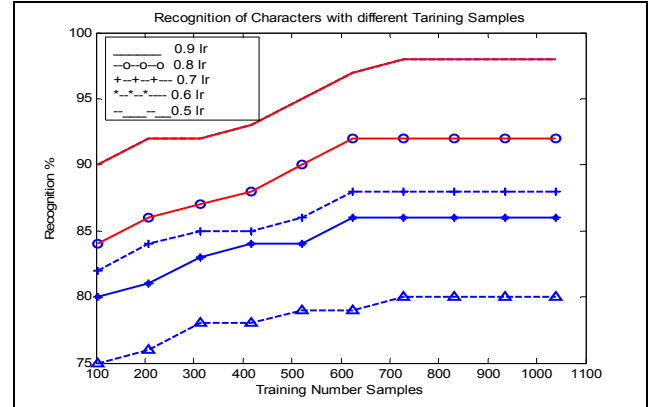


Fig. 3. Simulation result for the accuracy of results against learning rate with different training samples

TABLE II: TRAINING TIME OF RESULTS AGAINST DIFFERENT LEARNING RATE VALUE WITH DIFFERENT TRAINING SAMPLES

Lr 0.9		Lr 0.8		Lr 0.7		Lr 0.6		Lr 0.5	
Samples	Accuracy	Samples	Accuracy	Samples	Accuracy	Samples	Accuracy	Samples	Accuracy
104	90	104	84	104	82	104	80	104	75
208	92	208	86	208	84	208	81	208	76
312	92	312	87	312	85	312	83	312	78
416	93	416	88	416	85	416	84	416	78
520	95	520	90	520	86	520	84	520	79
624	97	624	92	624	88	624	86	624	79
728	98	728	92	728	88	728	86	728	80
832	98	832	92	832	88	832	86	832	80
936	98	936	92	936	88	936	86	936	80
1040	98	1040	92	1040	88	1040	86	1040	80

VI. CONCLUSION

The paper concludes that the proposed algorithm has very good capability of the hand written character recognition. And from the performance analysis it can be concluded that the learning rate affects the accuracy of the recognition of the hand written character recognition. And also it is observed that as the training samples increases accuracy also increases. So, the selection of learning rate plays a vital role in the recognition of hand written characters application and effect the accuracy of the results.

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