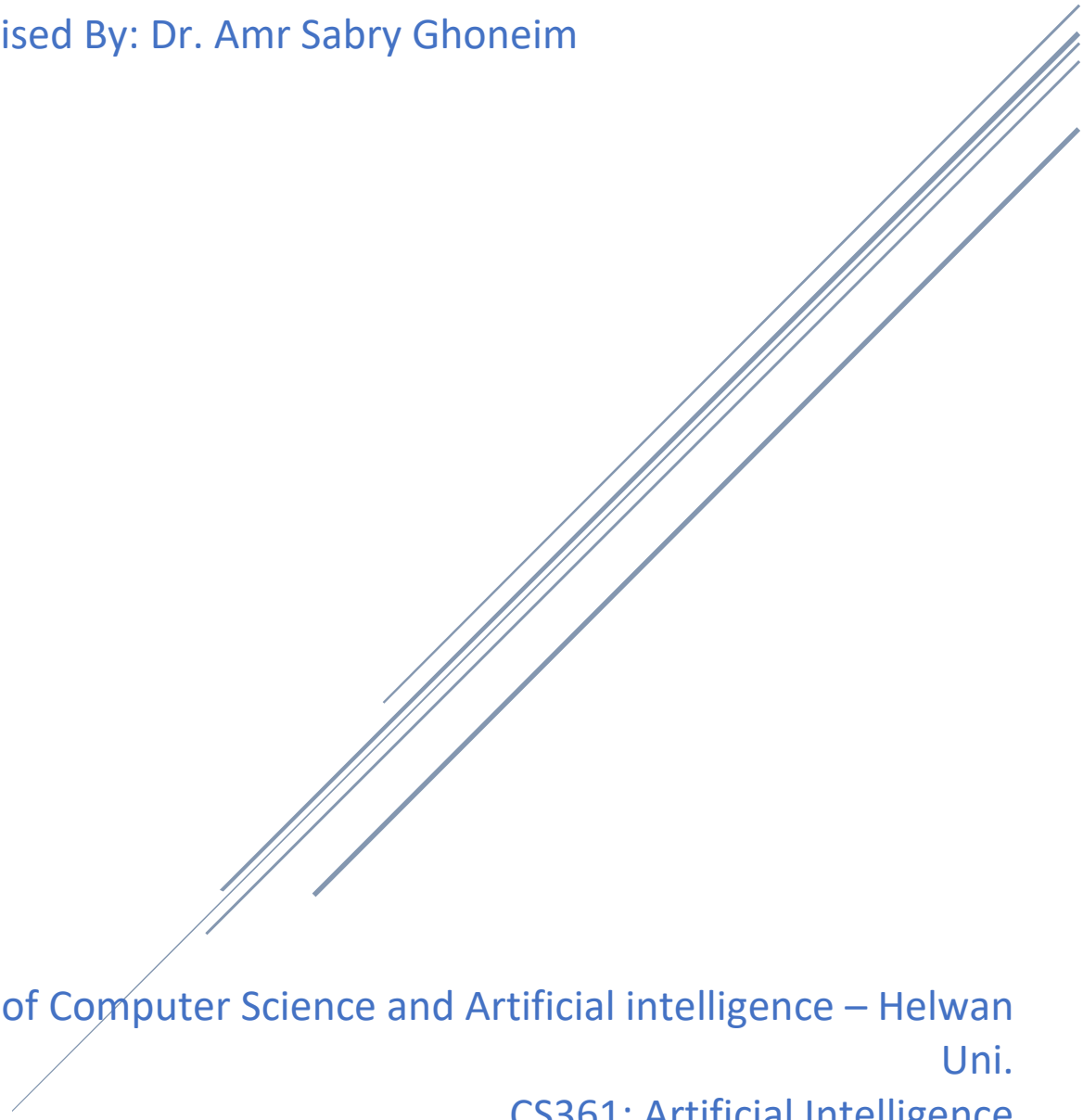
OPTICAL HANDWRITTEN RECOGNITION FOR ENGLISH LETTER LANGUAGE USING ANN (ARTIFICIAL NEURAL NETWORKS)

Supervised By: Dr. Amr Sabry Ghoneim



Faculty of Computer Science and Artificial intelligence – Helwan Uni.

CS361: Artificial Intelligence

Table of Contents

INTRODUCTION & OVERVIEW

Abstract & Motivation

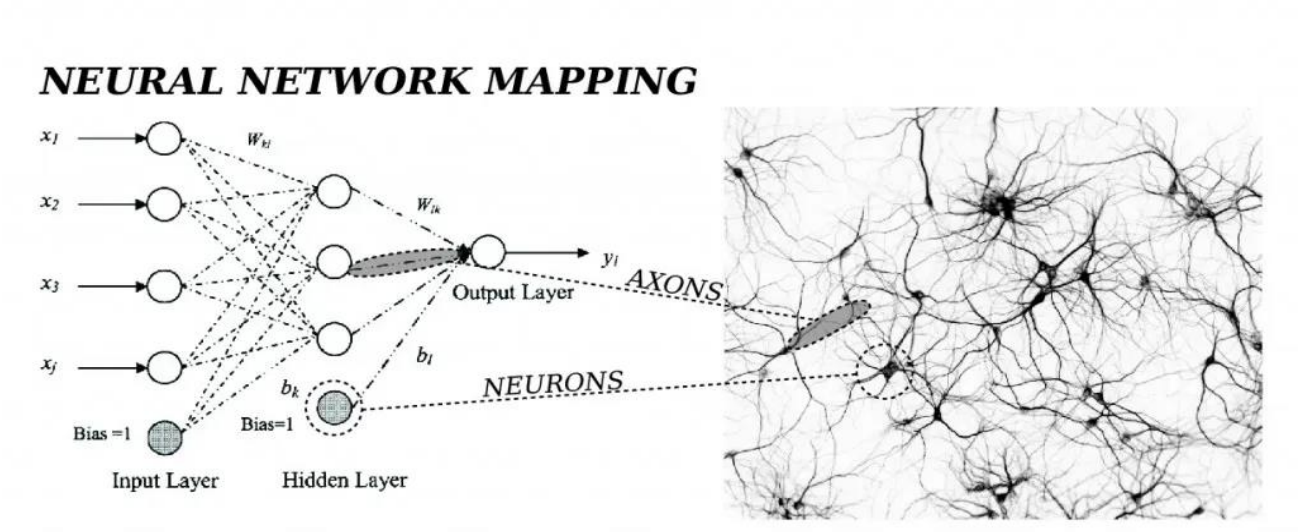
At the beginning of the new era of AI the human beings ambitions directed them to go beyond the normal computer programs and show the real power of computer rather than accepting the normal way of high-computational power that computers have to calculate and execute given instructions; in my POV I guess it could start with *"why this electronic machine CAN not do it on its own"* and everything started at this point, but for a moment the process of making MACHINES thinks is not a clear one actually from the terminology – **Artificial Intelligence** – We can say *"we gave the computer the capability to imitate the Human intelligence"* not only the humans intelligence but their capabilities like ***"vision"*** we can see that in a subfield in AI called *"Computer Vision"*, the capability of ***"talking"*** this is applied in *"Natural language processing"* for the current project that we will discuss the usage of *"NEURAL NETWORKS"* in OCR – Optical Character Recognition - for English alphabet letters using (ANN) "Artificial Neural Networks" the main process is giving a prepared image to the computer system and tries to ***PREDICT*** the given letter.

"A year spent in artificial intelligence is enough to make one believe in God." —Alan Perlis

---

INTRODUCTION

In this project we are trying to teach the computer or giving it the capability to visualize a given picture uploaded to the computer or recognized by the camera In this report we will discuss the process of building the OCR model at first we will mention the purpose of building – **alphabet handwritten recognition** – and the used approach; there are so many approaches related to the OCR but the approach we are following in this report is – Artificial Neural Networks (ANN) – in a brief (ANN) is an approach relies on imitating the humans neural networks the approach raised due to the high computational power of human neural network and the scientists decided to adopt the approach, we will discuss letter why did we decided to use ANN rather the different approaches like SVM for example.



(Fig.1)

in (Fig.1) we are proving the taken approach and how the neural network in humans got propagated on Artificial intelligence.

- Definition : **Artificial neural networks** (**ANNs**), usually simply called **neural networks** (**NNs**) or **neural nets**,[1] are computing systems inspired by the biological neural networks that constitute animal brains
- An ANN is based on a collection of connected units or nodes called artificial neurons, which loosely model the neurons in a biological brain. Each connection, like the synapses in a biological brain, can transmit a signal to other neurons. An artificial neuron receives signals then processes them and can signal neurons connected to it. The "signal" at a connection is a real number, and the output of each neuron is computed by some non-linear function of the sum of its inputs. The connections are called *edges*. Neurons and edges typically have a *weight* that adjusts as learning proceeds. The weight increases or decreases the strength of the signal at a connection. Neurons may have a threshold such that a signal is sent only if the aggregate signal crosses that threshold.

LITERATURE REVIEW

Handwritten characters were a difficult task because characters are written in various ways, so they could be of different sizes, orientation, thickness and dimension. An offline HCR(English) system using neural network is presented in this report. Neural networks were good at recognizing handwritten characters as

these networks are insensitive to the missing data. A Backpropagation neural network is used for classification. Experimental result of this system shows that results 93%. In this paper A neural network approach is proposed for automatic offline character recognition system. In this paper, work has been performed to recognize Devanagari characters using multilayer perceptron. Various patterns of characters were created in the matrix with the use of binary form and stored in the file. This system used the back propagation neural network for efficient recognition and neuron values were transmitted by naive bay's method in the neural network. This paper provides review of existing works in HCR based on soft computing technique during the past decade. proposed system deals with development of grid-based method which is combination of image centroid zone and zone centroid zone of individual character or numerical image. Use of feed forward neural network for recognition. Complete process of Devanagari character recognition works in stages as document preprocessing, segmentation, feature extraction, classification using grid-based approach followed by recognition using naive bay's. Fifty data sets, each containing 26 alphabets written by various people, are used for training the neural network and 570 different handwritten alphabetical characters are used for testing. This system performs quite well yielding higher levels of recognition accuracy compared to the systems employing the conventional horizontal and vertical methods of feature extraction. Suitable for converting handwritten documents into structural text form and recognizing handwritten names.

2.HANDWRITTEN RECOGNITION SYSTEM (METHODOLOGY)

3. INTEGRATED APPROACH TO FEATURE EXTRACTION AND CLASSIFICATION

During the last few decades, the field of character recognition has received a major attention from research workers in diverse disciplines such as conversion of handwritten document to an editable soft format, recognition of postal addresses for automated postal system, data and word processing, data acquisition in bank checks and processing of archived institutional records. Some methods integrate the feature extraction and classification tasks. Such methods are simpler and

easier to implement. In this paper such methods are studied, and the accuracy achieved is reported.

3.1 Template Matching

Template matching is a simple and commonly used classification technique for character recognition. The unknown input character image is compared pixel-by-pixel with the templates of the recognizable characters. The character, whose template has the closest resemblance to the input image in terms of maximum pixel matching, is declared as the input character. In this paper, each test data was resized into an image of size 30x20 pixels. The printed character template (Times New Roman style) is saved in the database. No training is required. The test data was given as input and the recognition accuracy obtained is 54.27%. This method is simple, but recognition is poor as handwriting styles vary considerably among different people and some English characters have similar structures. Hence this method cannot be used in applications, which require high recognition rates [17].

3.2. Neural Network based classifier Neural Network (NN)

techniques offer a promising solution as classifiers in the handwritten character recognition system. The image after resizing is taken as an input. The classification capability of the network depends on the architecture and learning rule. The architectures considered in this paper are feed forward architecture [18-19], nearest neighborhood [20] and radial basis function architecture [21]. To evaluate the performance of the proposed method the handwritten uppercase English alphabets were collected from different individual writers. Of the 7800 samples collected, 5200 samples were used for training purpose and remaining 2600 samples were used for testing. The proposed recognition system has been implemented using Python 3.3. The recognition systems were designed using different methods but, in this report, we are only focusing on the NN classifier, and the justification will be represented using table.1

3.2.1 Feed Forward Back Propagation Neural Network Classifier

The scanned image is taken as dataset/ input and feed forward architecture is used. As each image is resized into 28X28 pixels, the input layer has 600 neurons equal to the total number of pixels. The number of output neurons is based on the number of alphabets. As all the English alphabets are used, the output layer

has 26 neurons. All the neurons use log sigmoid transfer functions. The back propagation algorithm with momentum and adaptive learning rate is used to obtain the parameters of the network. Two Hundred different handwritten data sets were used for training the neural network. The number of hidden layers and the number of neurons in each layer are to be obtained through trial and error. Through numerous simulations it was identified that a maximum of two hidden layers and a maximum of 100 neurons in each hidden layer would be sufficient for character recognition. Further increase in the number of neurons did not considerably improve the accuracy. This feed 103 J. Pradeep et al/ IJE TRANSACTIONS B: Applications Vol. 25, No. 2, (May 2012) 99-106 forward neural network architecture was trained for a target MSE of 10e-8. After the network is satisfactorily trained, the parameters of the trained network are fixed to enable testing. The architecture of the three-layer neural network for the handwritten recognition system is shown in Fig.5 and the network training parameters are shown in Table 1. The results obtained are shown in Table. 2.

TABLE 1. Feedforward Neural Network Training Parameters

Feedforward Neural Network Parameters	
Input nodes	600
Hidden layers	2
Hidden layers nodes	100
each Output nodes	26(alphabets)
Training epochs	9
Training algorithm	Gradient descent with momentum training and adaptive learning Performance function Mean Square Error (MSE)
Training goal achieved	10e-8

TABLE 2. Performance Comparison of Different Classifiers

Enrollment in local colleges, 2005

Classifier	Number of Correctly Recognized alphabet	Recognition Rate in %
Template Matching	*1411*	54.27

Feed Forward NN	2448	94.15
Nearest Neighbor NN	2244	86.96
Radial basis function NN	2245	89.42

As observable in the previous table the NN Classifier got the highest recognition capability in contrast with the other algorithms, and for more we will provide extra table and charts to demonstrate the detailed results.

TABLE 3. Summary of the results achieved by the proposed methods

Classifier	No of alphabets with recognition rate greater than 90%	Alphabets with a recognition rate greater than 90%
Template Matching	2	U, L
Feed Forward NN	23	A,B,C,F,G,I,J,K,L,M,N,O, P,Q,R,S,T,U,V,W,X,Y,Z
Nearest neighbour NN	8	C,D,L,O,P,T,U,W
Radial basis function NN	14	A,C,F,G,L,N,P,S,T,U,V,W, Y,Z

4. RESULTS AND DISCUSSION

The experimental results obtained in recognizing the handwritten English characters using four different classifiers are summarized in Table.2. The recognition accuracy obtained for the template matching method and the NN methods are also summarized in Table 2. The results in Table 2 indicate the superior recognition accuracy of Feedforward Neural network as compared to other classifiers. Using a number of handwritten tests data the confusion matrix was obtained for the four different classifiers. This was to investigate the recognition accuracy for each alphabet. This parameter is important as any written text would have a varied number of each alphabet. If the classifier has more than 90% recognition rate for each alphabet, then the overall worst case recognition rate would be almost constant irrespective of the data. Table 3 reports the number of alphabets having recognition rate less than 90% and the

alphabets are also listed. It is seen from Table 3 that template matching has a poor recognition rate for 24 alphabets and hence has very poor recognition accuracy. Among the NN based classifiers the Feed forward neural network recognizes 23 alphabets with over 90% accuracy and is the best classifier. The classification accuracy of the Feedforward NN is shown separately for each alphabet in Fig. 7. The maximum number of misclassifications occurs for the letter D which is misclassified 16 times for every 100 presentations (84% recognition). All the other alphabets have better recognition accuracy.

Figure 7. Performance illustration the correct & error individual alphabets for the Feed forward NN

5.CONCLUSION

An off-line handwritten character recognition system with four different classifiers namely, template matching, Feedforward NN, radial basis function NN and neatest neighbor NN for recognizing handwritten English alphabets has been described in this paper. The feature extraction and classification tasks are performed together as a single process in the proposed system unlike in typical handwritten recognition systems in which these tasks are carried out in two different stages. As a result, the proposed system is found to be less complex and allows faster recognition of characters. All the different classifiers have been trained with 200 sets of data and extensively tested. Experimental results show that the feed forward neural network is distinctly superior to the other classifiers in recognizing the handwritten English alphabets. Further investigation was

carried out to identify the recognition rates for each letter of alphabet. This would help to estimate the recognition rate irrespective of the handwritten content. It was identified that the Feedforward NN outperformed the remaining classifiers. The proposed system will find useful applications in recognizing the handwritten names, reading documents and conversion of any handwritten document into structural text form. Further improvements may be possible with a more complex Feedforward NN architecture, but this would also increase the computation complexity. Therefore, combination of a standard feature extraction technique with Feedforward NN may provide better solutions.

202000436	شريف شعبان محمود عبد الغفار
202000661	كريم اشرف السيد جبريل
202000257	حبيبه عبدالغني سيد
202000005	إبراهيم عصام محمود عبد الرحمن
202000884	مريم محمد سليمان
202000472	ضحى حسانين محمد الصاوي