HANDWRIITEN ENGLISH CHARACTER RECOGNITION USING NEURAL NETWORKS

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ABSTRACT

Neural Networks are being used for character recognition from last many years. This paper presents creating the Character Recognition System, in which Creating a Character Matrix and a corresponding Suitable Network Structure is key. The Feed Forward Algorithm gives insight into the enter workings of a neural network; followed by the Back Propagation Algorithm which compromises Training, Calculating Error, and Modifying Weights. We have made an attempt to recognize handwritten English characters by using a multilayer perceptron with one hidden layer. In addition, an analysis has been carried out to determine the number of hidden nodes to achieve high performance of back propagation network in the recognition of handwritten English characters. The results showed that the MLP networks trained by the error back propagation algorithm are superior in recognition accuracy and memory usage. The result indicates that the back propagation network provides good recognition accuracy of more than 70% of Handwritten English characters.

Keyword: - Hand Written Character Recognition, Feature Extraction, Neural Network, Back Propagation, Multi-layer Perceptron Network

1. INTRODUCTION

One of the most classical applications of the Artificial Neural Network is the Character Recognition System. This system is the base for many different types of applications in various fields, many of which we use in our daily lives. Cost effective and less time consuming, businesses, post offices, banks, security systems, and even the field of robotics employ this system as the base of their Operations. Handwritten character recognition is a difficult problem due to the great variations of writing styles, different size (length and height) and orientation angle of the characters. Handwritten Character recognition is an area of pattern recognition that has become the subject of research during the last some decades. Neural network is playing an important role in handwritten character recognition. Many reports of character recognition in English have been published but still high recognition accuracy and minimum training time of handwritten English characters using neural network is an open problem. Therefore, it is a great important to develop an automatic handwritten character recognition system for English language. In this paper, efforts have been made to develop automatic handwritten character recognition system for English language with high recognition accuracy and minimum training and classification time.

1.1 OCR SYSTEM DESIGN

The architecture of character recognition system is as shown in fig 1.

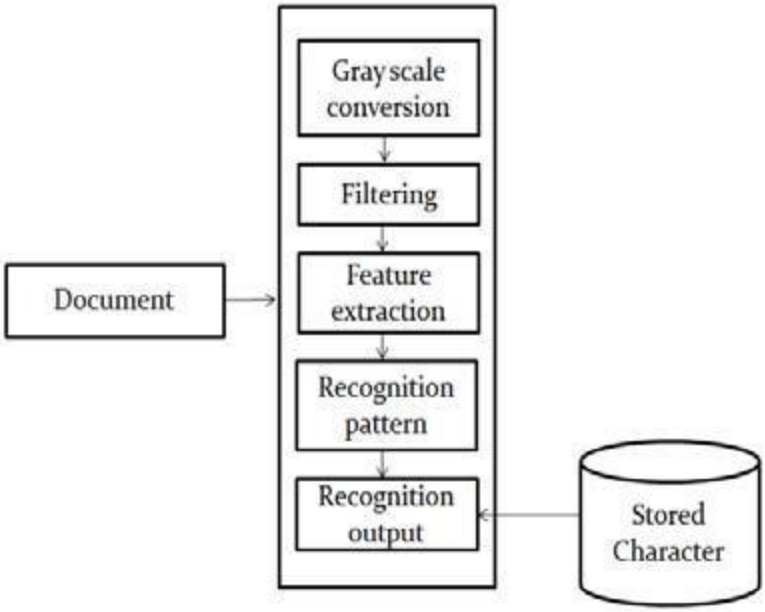

Fig 1 Character Recognition system block diagram

The main functional modules in our OCR systems are: image acquisition module, pre-processing module, and feature extraction module and pattern generation. The main task of image acquisition module is to obtain text image From a scanner or a pre-stored image file. It is called 'image' because scanner inherently scans pixel of the text and not characters when patterns are scanned and digitized, the data may carry some unwanted noise. For example, a scanner with low resolution may produce touching line segments and smeared images. A pre-processor [3, 4] is used to smooth the digitized characters. Moreover, the system must be able to handle touching characters, proportional spacing, variable line spacing and change of font style in the scanned text, in addition to the problems of multi-fonts.

2. ARTIFICIAL NEURAL NETWORK

The main driving force behind neural network research is the desire to create a machine that works similar to the manner our own brain works. Neural networks have been used in a variety of different areas to solve a wide range of problems. Unlike human brains that can identify and memorize the characters like letters or digits; computers treat them as binary graphics. Therefore, algorithms are necessary to identify and recognize each character.

A neural network is a processing device, either an algorithm or an actual hardware, whose design was inspired by the design and functioning of animal brains and components thereof. The neural networks have the ability to learn from example, which makes them very flexible and powerful. These networks are also well suited for real-time systems because of their fast response and computational times, which are because of their parallel architecture.

A neural network is a set of connected input/output units in which each connection has a weight associated with it. During the learning phase, the network learns by adjusting the weights so as to be able to predict the correct class label of the input values. Neural Network learning is also known as connectionist learning due to the connection between units. Fig.2.2 shows the mathematical representation of the ANN.

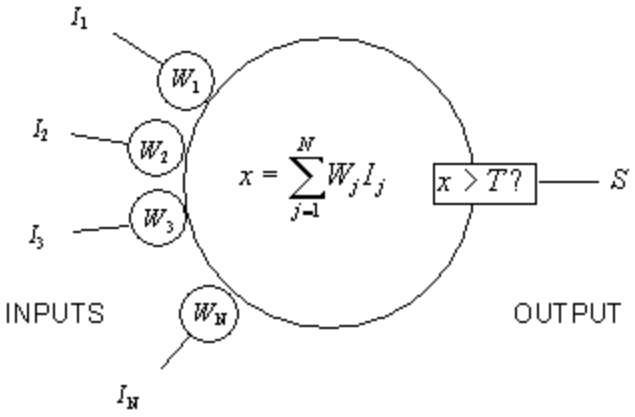

Fig 2 Mathematical Representation of ANN

3. NEURAL NETWORK DESIGN

Neural network mainly consist of three things

- Network Topology
- Network Transfer Function
- Network Learning Algorithm

3.1 NETWORK TOPOLOGY

The neural network topologies are classified based upon interconnection are arranged with in the layer, there two well-known neural network topologies are.

- Feed Forward Topology
- Recurrent Topology
- BackPropogation Topology

3.1.1 FEED FORWARD TOPOLOGY

In feed forward topology network, the nodes are hierarchically arranged in layers starting with the input layers and ending with output layers. In between the input layer and output layer the number of hidden layers provide most of the network computational power. The nodes in each layers connect to next layer through uni-direction paths starting from one layer (source) and ending at the subsequently layer (sink). The output of a given layers feed the nodes of the following layers in a forward directions and does not allow feedback flow of information in the structure. Application multilayer layer perception network and radial basic function network. [5]

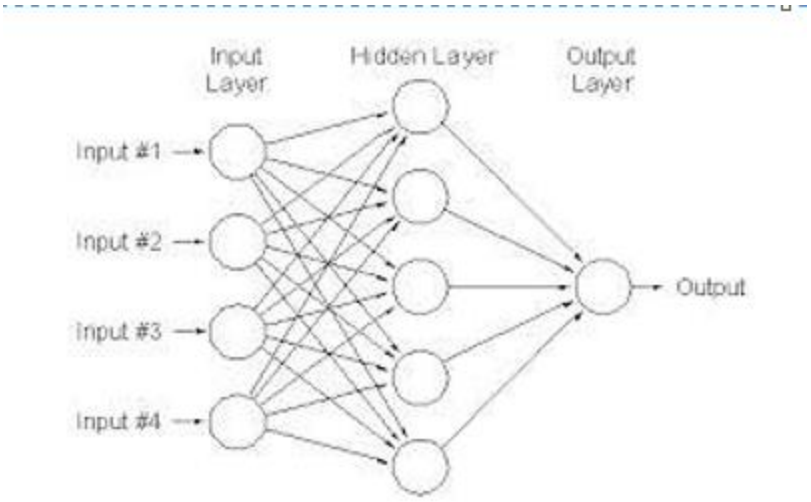

Fig 3 Feed Forward Topology

3.1.2 BACK PROPOGATION TOPOLOGY

A Back propagation (BP) network consists of at least three layers of units, an input layer, at least one intermediate hidden layer, and an output layer. When a Back propagation network is cycled, an input pattern is propagated forward to the output units through the intervening input-to-hidden and hidden-to-output weights. Fig. 4 shows the working of BP algorithm. Back propagation learns by iteratively processing a data set of training values, comparing the network's prediction for each set with the actual known target values [3]. For each training dataset, the weights are modified so as to minimize the mean squared error between the network's prediction and the actual target value. These modifications are made in the "backwards" direction, i.e. from the output layer, through each hidden layer. Although it is not guaranteed, in general the weights will eventually converge, and the learning process stops.

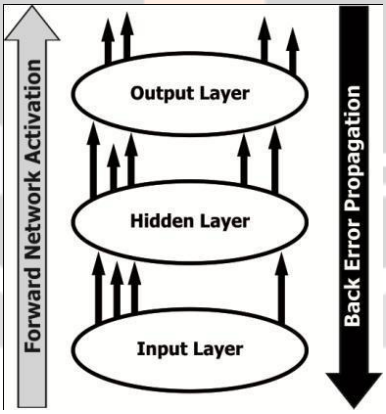

Fig 4 Working of Back propagation Algorithm

3.2 NETWORK TRANSFER FUNCTION

The basic unit of neural network is neuron, these are sorts of simple processors which take the weighted sum of their input from other node and apply to them non-linear mapping function called an activation function before delivering the output to the next to the next neuron.[3]

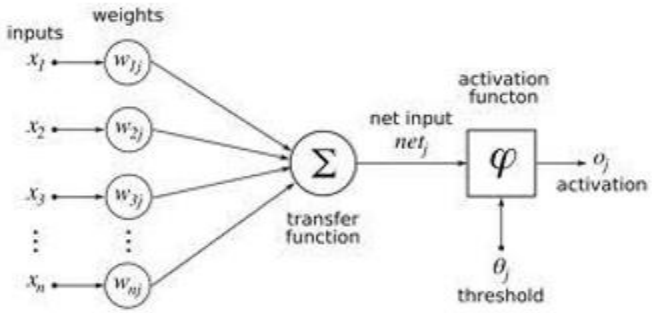

Fig 5 Network Transfer Function

3.3 NEURAL NETWORK WORKING ALGORITHM

3.3.1 SUPERVISED LEARNING ALGORITHM

In supervised learning mechanism, the external source provides the network a set of input stimulus for which the output is a priori known and during the running process the output results are continuously compared with the desire data. After number of iterations, the gradient descent rule uses the error between the actual output and the target data to adjust the connections weights so as to obtain the closest match between the target out and the actual out. Application: feed forward network.

3.3.2 UNSUPERVISED LEARNING ALGORITHM

It is also called as self-organizing learning algorithm because there is no any external source to provide the network and relies instead upon local information and internal control. The training data and input pattern are presented to the system and system organization .the data into clusters or categories. A set of training data is presented to the system at the input layer level; the network connection weights are then adjusted through some sort of competition among the node of the output layer where the successful candidate will be the node with the highest value.

3.3.3 REINFORCEMENT LEARNING ALGORITHM

The reinforcement learning algorithm also called as graded learning it has mimic in a way the adjusting behavior of humans which interacting with a given physical environment .the network connections are modified according to feedback information provided to the network by its environment. This information simply instructs the systems on whether or not a correct response has been obtained. In case of correct response the corresponding connections leading to that output are strengthened otherwise they are weakened.

4. IMPLEMENTATION

Step 1: Scan the Input Image

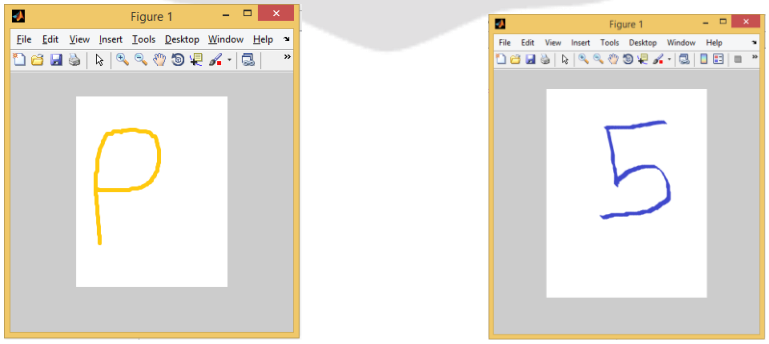

Fig 6: Input Image

Step 2: Pre-Processing

- **RGB to Grayscale Conversion**

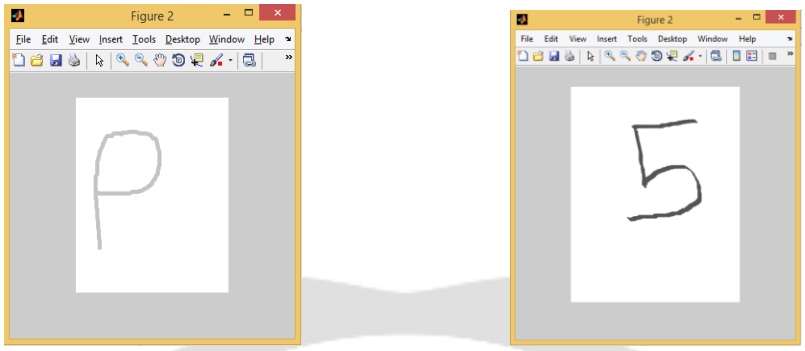

Fig 7: RBG to Grayscale Conversion

- **Gray Threshold (Binarization)**

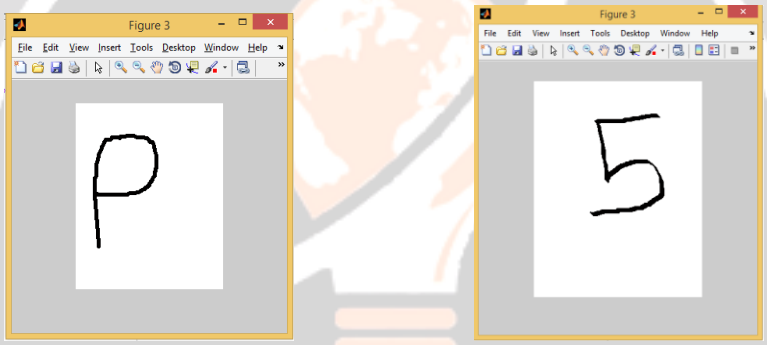

Fig 8: Gray Threshold Image

- **Edge Identification**

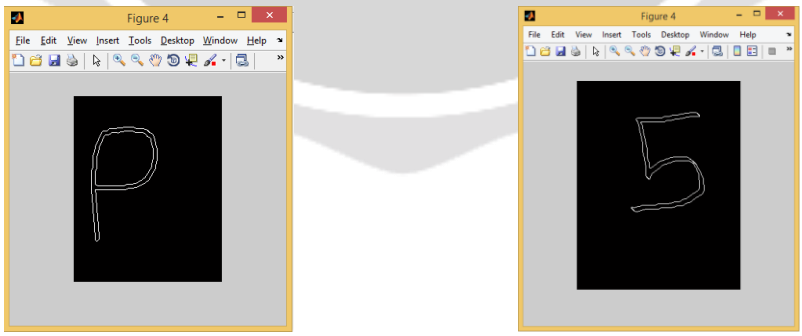

Fig 9: Edge Identification

- **Dilation**

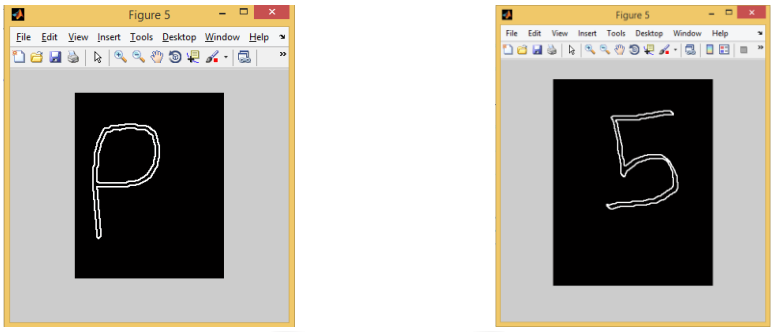

Fig 10: Image Dilation

- **Edge Filling**

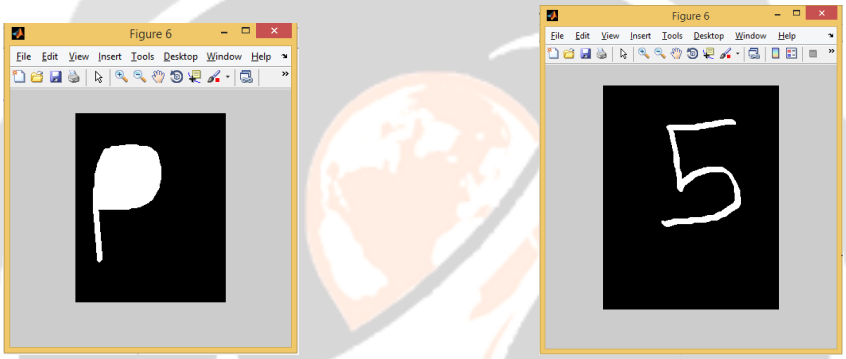

Fig 11: Edge Fill Image

Step 3: Neural Network Training

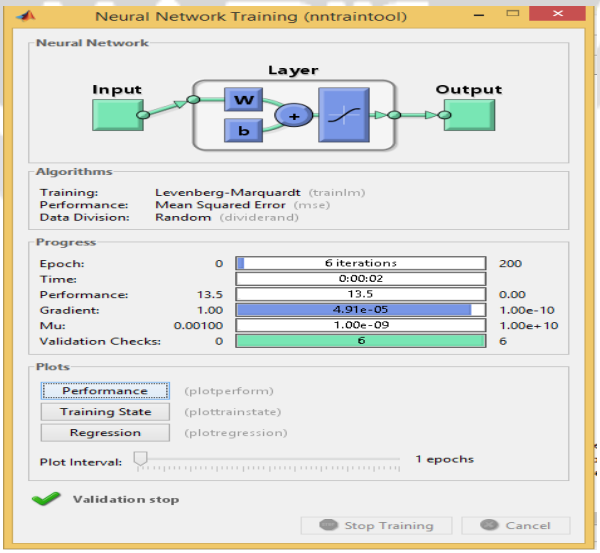

Fig 12: Neural Network Training

Step 4: Recognition of Character:

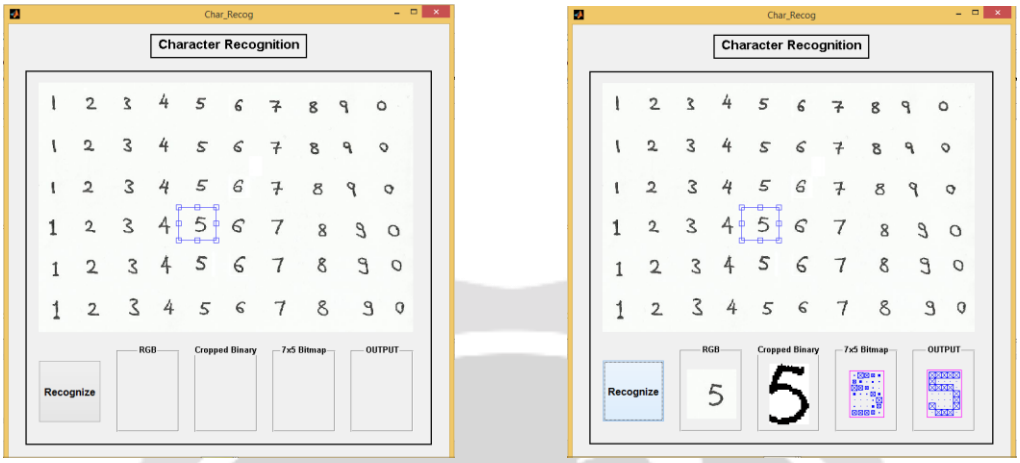

Fig: 13 Character Recognition output

5. RESULTS

CHARACTER	% EFFICIENCY	CHARACTER	% EFFICIENCY
A	97	S	87
B	83	T	92
C	86	U	95
D	88	V	92
E	92	W	87
F	95	X	92
G	88	Y	86
H	86	Z	94
I	94	0	85
J	92	1	85
K	82	2	87
L	89	3	90
M	94	4	89
N	81	5	86
O	81	6	92

P	85	7	87
Q	81	8	89
R	90	9	84

6. CONCLUSION

Artificial neural networks are commonly used to perform character recognition due to high noise tolerance. The systems have the ability to yield good results. The feature extraction step of character recognition is the most important. A poorly chosen set of features will yield poor classification rates by any artificial neural network.

7. REFERENCES

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