NEURAL NETWORK – AN EFFICIENT TOOL FOR CHARACTER RECOGNITION

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ABSTRACT

Nowadays it has been a topic based on the simulation processes with a healthy existence in the field of Soft Computing and Artificial Intelligence. When the number of hidden layers are multiple the errors can be obtained which can be eliminated as well as reduced. The technique that has been thought to be applicable is able to detect the number of possible errors. Once we have the errors we put them into dataset again as the input set that would go under certain processing to give some results which we can say the feedback of multilayer neural network. It is always preferred to go for a multilayer neural network.

***Keywords*:** *Single Layered Feed-forward neural networks, Multilayered Feed-forward neural networks, Recurrent Feed-forward neural networks, Supervised Learning, Unsupervised Learning.*

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1. INTRODUCTION

Character recognition has served as one of the principal proving grounds for neural network methods and has emerged as one of the most successful applications of this technology. In this paper, a new network is designed to recognize a set of handwritten characters. This new network consists of two stages. The first is to recognize the main shape of the character, and the second stage is for dots recognition. Also, the characteristics, structure, and the training algorithm for the network are presented. The recognition of characters from scanned images of documents has been problem that has received much attention in the fields of image processing, pattern recognition and artificial intelligence. Classical method in pattern recognition do not suffice for the recognition of visual characters due to the following reasons-

1. The 'same' characters differ in sizes, shapes and styles from person to person and even from time to time with the same person. Like any image, visual characters are subject to spoilage due to noise.

2. There are no hard-and-fast rules that define the appearance of a visual character. Hence rules need to be heuristically deduced from samples.

Neural Networks are being used for character recognition from last many years but most of the works were reported to English character recognition. Character recognition is one of the applications of pattern recognition, which has enormous scientific and practical interest. Many scientific efforts have been dedicated to pattern recognition problems and much attention has been paid to develop recognition system that must be able to recognize a character. The main driving force behind neural network research is the desire to create a machine that works similar to the manner our own brain. There are two types of recognition techniques possible, offline and online. In offline recognition technique, the final character is available that we have to identify. We have no idea as to how this character was formed. On the other hand, in online character recognition, the character formation is known. The character is formed while the algorithm runs. Hence, we may sample the input in spans of time to get an idea as to how the character was formed.

2. BASIC CONCEPTS

Artificial neuron: It is simply an electronically modeled biological neuron.

Single Layered Feed-forward neural networks: Here the data flow from input to output units is strictly feedforward. The data processing is on two layers that is input layer and output layer .

Multilayered Feed-forward neural networks: Here the data flow from input to output units is strictly feedforward. The data processing can extend over multiple (layers of) units, but no feedback connections are present, that is, connections extending from outputs of units to inputs of units in the same layer or previous layers.

Recurrent neural networks: It contain feedback connections. Contrary to feed-forward networks, the dynamical properties of the network are important. In some cases, the activation values of the units undergo a relaxation process such that the neural network will evolve to a stable state in which these activations do not change anymore. In other applications, the change of the activation values of the output neurons are significant, such that the dynamical behaviour constitutes the output of the neural network

Supervised learning: It is also known as Associative learning in which the network is trained by providing it with input and matching output patterns. These input-output pairs can be provided by an external teacher, or by the system which contains the neural network (self-supervised).

Unsupervised learning: It is also known as Self-organisation in which an (output) unit is trained to respond to clusters of pattern within the input. In this paradigm the system is supposed to discover statistically salient features of the input population. Unlike the supervised learning paradigm, there is no a priori set of categories into which the patterns are to be classified; rather the system must develop its own representation of the input stimuli.

Fuzzy Logic: An expert system based on fuzzy logic for optical character Recognition of old printed documents. The fuzzy recognizer presents a very high character Recognition success rate, which confirms the advantage of using expert systems in image based decision systems

Template Matching: Another approach used for recognition is Template matching, or matrix matching. In template matching, individual image pixels are used as features. Classification is performed by comparing an input character image with a set of templates (or prototypes) from each character class. Each comparison results in a similarity measure between the input character and the template. It is a trainable process because template characters may be changed.

Image Scaling: It is the process of resizing a digital image. Scaling is a non-trivial process that involves a trade-off between efficiency, smoothness and sharpness. As the size of an image is increased, so the pixels which comprise the image become increasingly visible, making the image appears soft. Conversely, reducing an image will tend to enhance its smoothness and apparent sharpness. Image need to be rescaled since input to neural network must me of fixed size, irrespective of size of handwritten character.

3. IMAGE DIGITIZATION

When a document is put to visual recognition, it is expected to be consisting of printed (or handwritten) characters pertaining to one or more scripts or fonts. This document however, may contain information besides optical characters alone. The process of digitization is important for the neural network used in the system. In this process, the input image is sampled into a binary window which forms the input to the recognition system. It becomes important for us to encode this information in a form meaningful to a computer. For this, we assign a value *+1* to each black pixel and *0* to each white pixel and create the binary image matrix *I* which is shown in the Fig. below. An Artificial Neural Network usually consists of one input layer, more than one output layers, except the last output layer all other intermediate layers are called hidden layer. Outcome of input layer is fed as input to the hidden layers and outcome of hidden layers are fed as input to the final output layer.

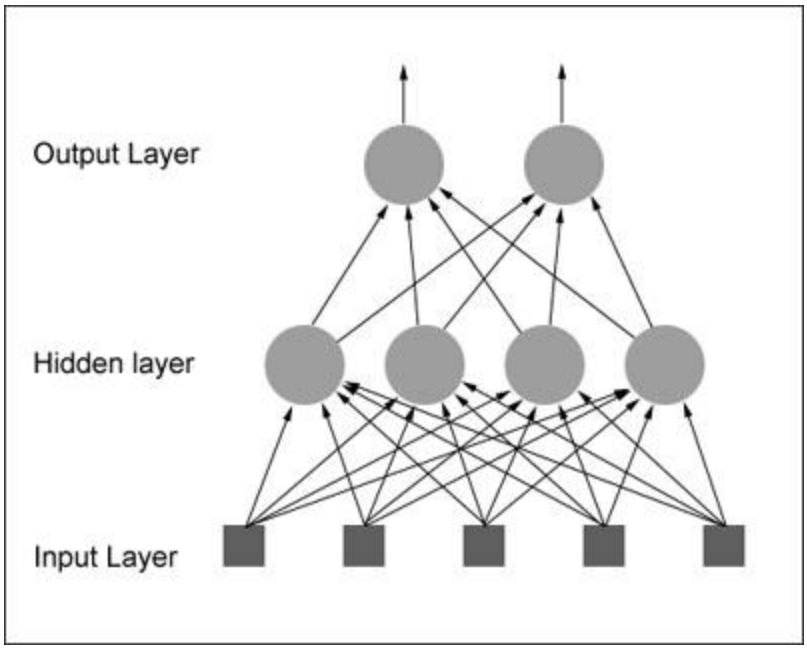


Fig.1 Layers of Neural Network

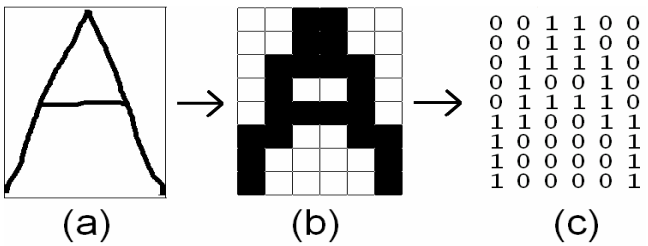


Fig 2. Pattern representation of a Character

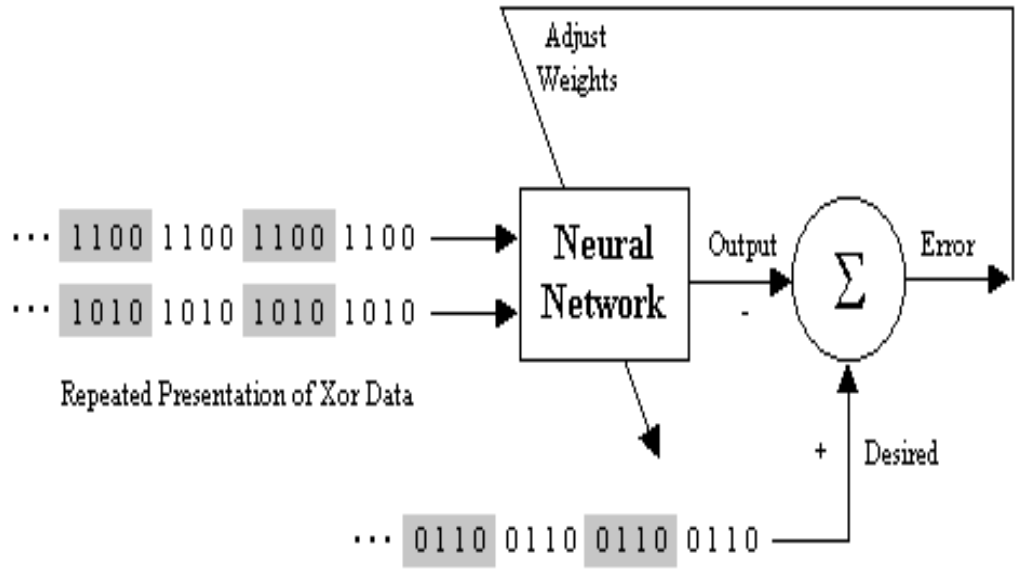


Fig.3 Demonstration of neural network:

Neural network learning to model the exclusive-or (Xor) data. The Xor data is repeatedly presented to the neural network. With each presentation, the error between the network output and the desired output is computed and fed back to the neural network. The neural network uses this error to adjust its weights such that the error will be decreased. This sequence of events is usually repeated until an acceptable error has been reached or until the network no longer appears to be learning.

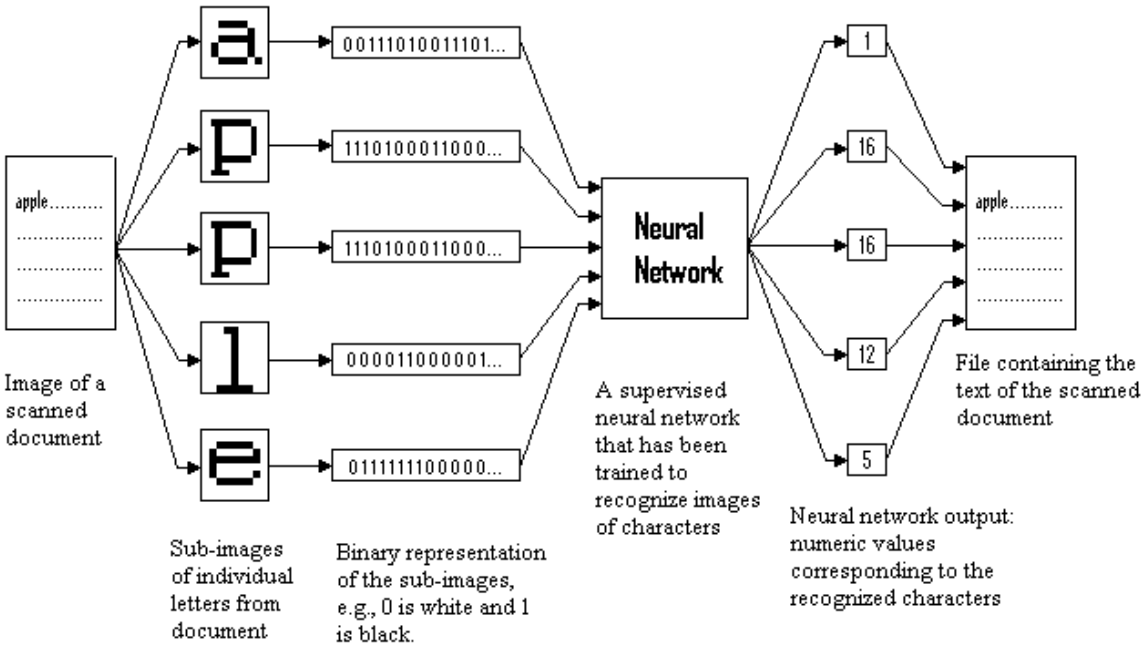


Fig.4 Demonstration of neural network using characters

The above figures given in Fig.3 and Fig.4 are the demonstrations given for neural network used within an optical character recognition (OCR) application. The original document is

scanned into the computer and saved as an image. The OCR software breaks the image into sub-images, each containing a single character. The sub-images are then translated from an image format into a binary format, where each 0 and 1 represents an individual pixel of the sub-image. The binary data is then fed into a neural network that has been trained to make the association between the character image data and a numeric value that corresponds to the character. The output from the neural network is then translated into ASCII text and saved as a file.

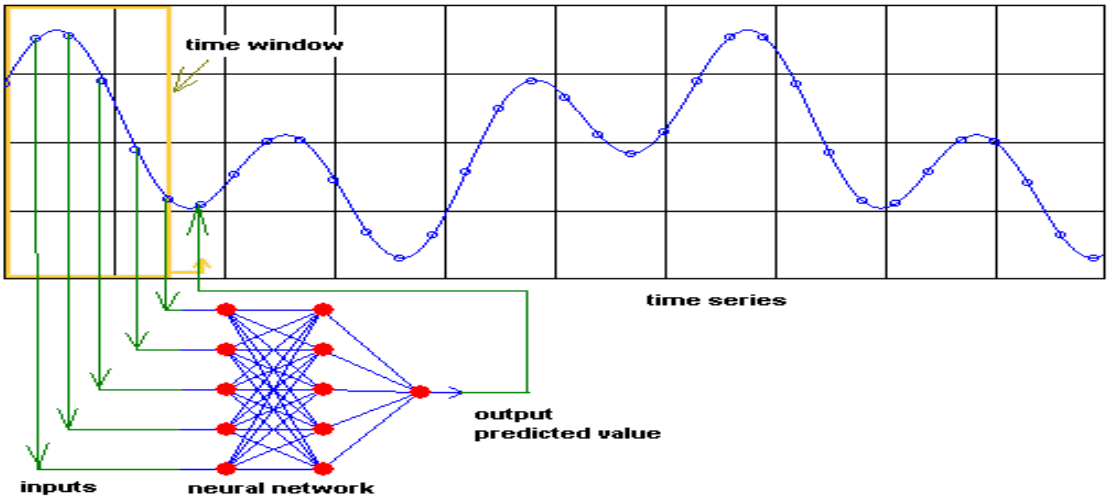


Fig.5 Graphical representation of predicted values of characters using Neural Network

This above figure demonstrates the time series without interventional variables. The points in graph represent time series obtained by sampling of continuous data.

4. PROPOSED ALGORITHM OF FEED FORWARD NEURAL NETWORK:

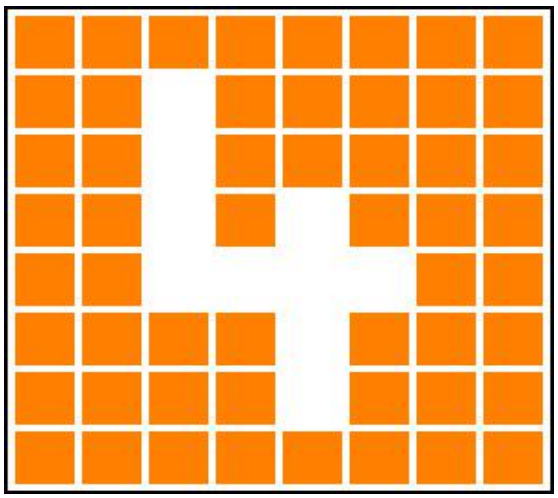
1. Form network according to the specified topology parameters
2. Initialize weights with random values within the specified ± weight bias value.
3. Load trainer set files (both input image and desired output text)
4. Analyze input image and map all detected symbols into linear arrays
5. Read desired output text from file and converts each character to a binary Unicode value to store separately
6. For each character:
    a. Calculate the output of the feed forward network
    b. Compare with the desired output corresponding to the symbol and compute error
    c. Back propagate error across each link to adjust the weights
7. Move to the next character and repeat step 6 until all characters are visited
8. Compute the average error of all characters

9. Repeat steps 6 and 8 until the specified number of epochs:

a. Is error threshold reached? If so abort iteration

b. If not continue iteration

Each input is sent to every neuron in the hidden layer and then each hidden layer's neuron's output is connected to every neuron in the next layer. There can be any number of hidden layers within a feedforward network but one is usually enough to suffice for most problems you will tackle. Also the number of neurons we have chosen for the above diagram was completely arbitrary. There can be any number of neurons in each layer, it all depends on the problem.. We probably know already that a popular use for neural nets is character recognition. So let's design a neural network that will detect the number '4'. Given a panel made up of a grid of lights which can be either on or off, we want our neural net to let us know whenever it thinks it sees the character '4'. The panel is eight cells square and looks like the figure shown below.



We would like to design a neural net that will accept the state of the panel as an input and will output either a 1 or zero. A 1 to indicate that it thinks the character '4' is being displayed and 0 if it thinks it's not being displayed. Therefore the neural net will have 64 inputs, each one representing a particular cell in the panel and a hidden layer consisting of a number of neurons (more on this later) all feeding their output into just one neuron in the output layer. Once the neural network has been created it needs to be trained. One way of doing this is initialize the neural net with random weights and then feed it a series of inputs which represent, in this example, the different panel configurations. For each configuration we check to see what its output is and adjust the weights accordingly so that whenever it sees something looking like a number 4 it outputs a 1 and for everything else it outputs a zero.

This type of training is called supervised learning and the data we feed it is called a training set.

5. CONCLUSION

Neural networks are suitable for predicting time series mainly because of learning only from examples, without any need to add an additional information that can bring more confusion than prediction effect. Neural networks are able to generalize and are resistant to noise. The algorithm uses a hierarchical approach for the problem. The first step is to use a rule-based system. This system takes an input and applies standard rules to the input to get the output class. Once the class is known, we apply the given input to the class specific neural network. On the other hand, it is generally not possible to determine exactly what a neural network has learned and it is also hard to estimate possible prediction errors. However, neural networks were often successfully used for predicting time series. They are ideal especially when we do not have any other description of the observed series. In future research, experiments will be undertaken using non-resized character images along with resized ones. Also, further experiments will be undertaken using thinned character image representations along with character boundaries.

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