Optical Character Recognition using Modified Back Propagation Algorithm

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Abstract---In this Paper, we present a new neural network based method for optical character recognition as well as handwritten character recognition. Experimental results show that our proposed method achieves 98 percent accuracy in optical character recognition. In this thesis, we present an overview of existing handwritten character recognition techniques. All these algorithms are described more or less on their own. Handwritten character recognition is a very popular and computationally expensive task. We also explain the fundamentals of handwritten character recognition . We describe today's approaches for handwritten character recognition. From the broad variety of efficient techniques that have been developed we will compare the most important ones. We will systematize the techniques and analyze their performance based on both their run time performance and theoretical considerations. Their strengths and weaknesses are also investigated. It turns out that the behavior of the algorithms is much more similar as to be expected.

I. INTRODUCTION

Character recognition is an art of detecting segmenting and identifying characters from image. More precisely Character recognition is process of detecting and recognizing characters from input image and converts it into ASCII or other equivalent machine editable form[1], [2], [3]. It contributes immensely to the advancement of automation process and improving the interface between man and machine in many applications [4]. Character recognition is one of the most interesting and fascinating areas of pattern recognition and artificial intelligence [5], [6].Character recognition is getting more and more attention since last decade due to its wide range of application. Conversion of handwritten characters is important for making several important documents related to our history, such as manuscripts, into machine editable form so that it can be easily accessed and pres independent work is going on in Optical Character Recognition that is processing of printed/computer generated document and handwritten and manually created document processing The objective of OCR software is to recognize the text and then convert it to editable form. Thus, developing computer algorithms to identify the characters in the text is the principal task of OCR. A document is first scanned by an optical scanner, which produces an image form of it that is not editable. Optical character recognition involves translation of this text image into editable character codes such as ASCII. Any OCR implementation consists of a number of preprocessing steps followed by the actual recognition, as shown in Figure 3.

Fig.1 : OCR components

The number and types of preprocessing algorithms employed on the scanned image depend on many factors such as age of the document, paper quality, resolution of the scanned image, amount of skew in the image, format and layout of the images and text, kind of the script used and also on the type of characters: printed or handwritten [Anbumani & Subramanian, 2000]. After preprocessing, the recognition stage identifies individual characters, and converts them into editable text. Figure 4 depicts these steps and they are described in the following section.

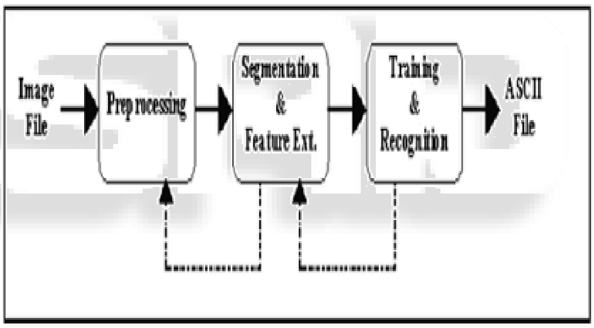

Fig. 2: OCR processing

A. *The various phases of OCR technique are:*

a) Digitization b) Pre-processing c) Segmentation d) Feature Extraction & Classification e) Post processing

B. *Structure of Proposed System:*

OCR is the acronym for Optical Character Recognition. This technology allows a machine to automatically recognize characters through an optical mechanism. Human beings recognize many objects in this manner our eyes are the "optical mechanism." But while the brain "sees" the input, the ability to comprehend these signals varies in each person according to many factors. By reviewing these variables, we can understand the challenges faced by the technologist developing an OCR system. The ultimate objective of any OCR system is to simulate the human reading capabilities so the computer can read, understand, edit and do similar activities it does with the text.

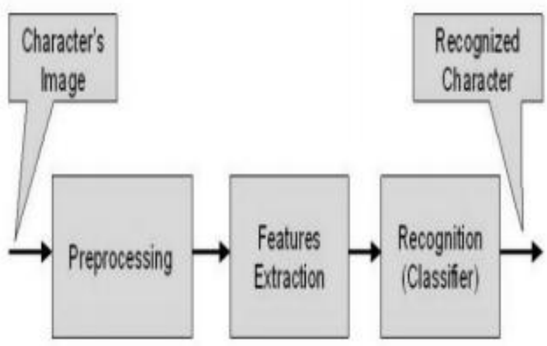

Fig. 2: structure of the proposed system

Block diagram of the typical OCR system. Each stage has its own problems and effects on the overall system's efficiency. Thus, to tackle the problems, either by solving each particular problem.OCR system by integrating all stages to one main stage, and this is what our research proposes. This thesis presents new structure of OCR system which relies on the powerful proprieties. The algorithm is designed and tested in the related sections.

II. ARTIFICIAL NEURAL NETWORK

A neural network is a powerful data modeling tool that is able to capture and represent complex input/output relationships. The motivation for the development of neural network technology stemmed from the desire to develop an artificial system that could perform "intelligent" tasks similar to those performed by the human brain.

Neural networks resemble the human brain in the following two ways:

1) A neural network acquires knowledge through learning.
2) A neural network's knowledge is stored within inter-neuron connection strengths known as synaptic weights.

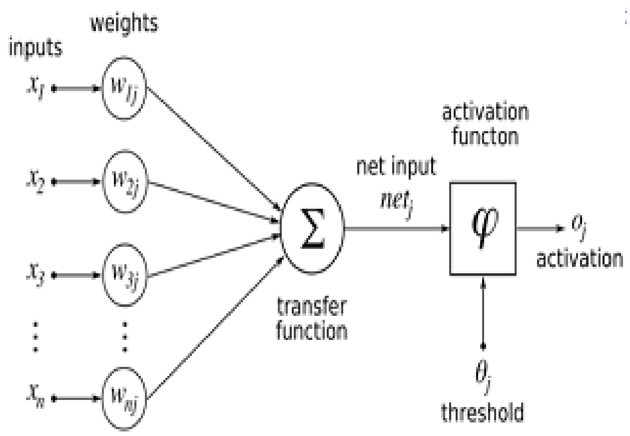

Fig. 3: Structure of ANN

The most common neural network model is the multilayer Perception (MLP). This type of neural network is known as a supervised network because it requires a desired output in order to learn. The goal of this type of network is to create a model that correctly maps the input to the output using historical data so that the model can then be used to produce the output when the desired output is unknown. A graphical representation of an MLP is shown below.

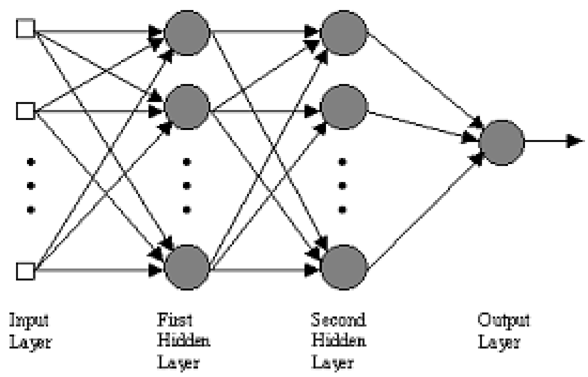

Fig. 4: Block diagram of MLP

Block diagram of a two hidden layer multiplayer perceptron (MLP). The inputs are fed into the input layer and get multiplied by interconnection weights as they are passed from the input layer to the first hidden layer. Within the first hidden layer, they get summed then processed by a nonlinear function (usually the hyperbolic tangent). As the processed data leaves the first hidden layer, again it gets multiplied by interconnection weights, then summed and processed by the second hidden layer. Finally the data is multiplied by interconnection weights then processed one last time within the output layer to produce the neural network output.

III. UPDATED BACK PROPAGATION ALGORITHM:

Here we are presenting an updated back propagation algorithm. It is based on the concept of minimization of sum of squares for error computation. By using this concept the error is computed quickly. Therefore the network learning time is reduced. Also it achieves 100 percent accuracy in OCR

Assume a network with N inputs and M outputs. Let xi be the input to ith neuron in input layer, Bj be the output of the jth neuron before activation, yj be the output after activation,bj be the bias between input and hidden layer, bk be the biasbetween hidden and output layer, wij be the weight betweenthe input and the hidden layers, and wjk be the weight between the hidden and output layers. Let η be the learningrate, d the error. Also, let i, j and k be the indexes of the input, hidden and output layers respectively. The response of each unit is computed as:

$$Bj = Xi * Wij$$
$$Yj = (1/(1 + exp(-Bj)))$$

Weights and bias between input and hidden layer updated as follows: For input to hidden layer, for I = 1 to n,

$$Wij\ (t + 1) = Wij\,(t) + \eta\, \delta j yi + \alpha * (wij\,(t) - wij\,(t - 1)\,)$$
$$(t + 1) = (\,) + \eta\, \delta j + \alpha * ((bj\,(\,) - bj\ (t - 1)\ )$$

δj is the error between input and hidden layers and calculated as follows:

$$\delta j = yj * 1 - yj * \delta k W jk$$

Weights and bias between hidden and output layer updated as follows: For input to hidden layer, for j = 1 to n,

$$(t+1) \; = \; (\,) \; + \eta \; \delta kyj + \alpha * wjk\,(\,) \; - wjk\,(\,t-1)$$

$$(t+1) \; = \; (\,) \; + \eta \; \delta k + \alpha * (\;(t\,) - bk\,(\,t-1)\;)$$

δk is the error between, hidden and output layers and calculated as follows:
δk = yk * 1 - yk * (**δ**k - yk)

IV. Working Procedure

The input pattern is presented to the input layer of the network. These inputs are propagated through the network until they reach the output units. This forward pass produces the actual or predicted output pattern. Because back propagation is a supervised learning algorithm, the desired outputs are given as part of the training vector. The actual network outputs are subtracted from the desired outputs and an error signal is produced. This error signal is then the basis for the back propagation step, whereby the errors are passed back through the neural network by computing the contribution of each hidden processing unit and deriving the corresponding adjustment needed to produce the correct output. The connection weights are then adjusted and the neural network has just "learned" from an experience. Once the network is trained, it will provide the desired output for any of the input patterns.

The network undergoes supervised training, with a finite number of pattern pairs consisting of an input pattern and a desired or target output pattern. An input pattern is presented at the input layer. The neurons here pass the pattern activations to the next layer neurons, which are in a hidden layer. The outputs of the hidden layer neurons are obtained by using perhaps a bias, and also a threshold function with the activations determined by the weights and the inputs. These hidden layer outputs become inputs to the output neurons, which process the inputs using an optional bias and a threshold function. The final output of the network is determined by the activations from the output layer. The computed pattern and the input pattern are compared, a function of this error for each component of the pattern is determined, and adjustment to weights of connections between the hidden layer and the output layer is computed. A similar computation, still based on the error in the output, is made for the connection weights between the input and hidden layers. The procedure is repeated with each pattern pair assigned for training the network. Each pass through all the training patterns is called a cycle or an epoch. The process is then repeated as many cycles as needed until the error is within a prescribed tolerance. The adjustment for the threshold value of a neuron in the output layer is obtained by multiplying the calculated error in the output at the output neuron and the learning rate and momentum parameter used in the adjustment calculation for weights at this layer. After a network has learned the correct classification for a set of inputs from a training set, it can be tested on a second set of inputs to see how well it classifies untrained patterns.

V. Conclusion

In this paper, we surveyed a number of methods of optical character recognition. We analyzed the advantages and drawbacks of various OCR methods. We also proposed a modified back propagation method. It is used in neural network. The proposed method computes error rate efficiently. It results in increasing the accuracy of neural network. Our proposed neural network based method is providing 100 percent accuracy in OCR.

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