HINDI CHARECTER RECOGNITION USING KOHONEN NETWORK

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Abstract

Character Recognition (CR) is the electronic conversion of scanned images or camera captured images of hand written text into machine encoded text. In this project various image pre-processing, neural networks and classification algorithms have been discussed, to design high performance character reorganisation software for Indian Language Hindi based on Devanagari script. In this paper it is discussed that how to generate data for input of neural network, how it will work.

Keywords— Hindi character recognition (CR), kohonen neural network (NN), self organising map (SOM), Data set, training of NN, Reorganisation.

1. INTRODUCTION

Machine simulation of human functions has been a challenging research field since the advent of digital computers. In some areas, which require certain amount of intelligence, such as card playing or chess playing, tremendous improvements have been achieved. On the other hand, humans still outperform even the most powerful computers in the relatively routine functions such as vision. Machine simulation of human reading is one of these areas, which has been the subject of intensive research for the last three decades, yet it has not achieved full accuracy. This survey investigates the various steps involved in recognition of handwritten characters. Handwritten text recognition can be classified based upon two major criteria: the data acquisition process (on-line or off-line) and the text type (machine-printed or hand-written). For recognition of handwritten Hindi Characters there are five major stages.

1. Pre-processing, 2. Segmentation. 3. Feature Extraction, 4.Recognition, 5. Post processing. Devnagari script is used in the Indian subcontinent for several major languages such as Hindi, Sanskrit, Marathi and Nepali languages. Research work is going on for forming the software which converts the imaged text into editable Devnagari text. This work comes under category of offline recognition. In one of the earliest works, an attempt was made to describe Devnagari characters in terms of certain number of primitives. Generation of description & also used certain features specific to Devnagari characters. like vertical bars, curves of arbitrary shapes between vertex and junction points. The classifier used is of supervised type. The authors in their work to segment out the touching characters in Devnagari proposed an algorithm which extensively uses structural properties of script. The recognition rate of 85% has been achieved on the segmented touching characters. With regular expressions, global shape features are calculated. Characters can be in arbitrary location, scale and orientation. Most of the work done is of supervised learning type.

In 1965 it began planning an entire banking system, National Giro, using OCR technology, a process that revolutionized bill payment systems in the UK. Canada Post has been using OCR systems since 1971. OCR systems read the name and address of the addresses at the first mechanized sorting centre, and print a routing bar code on the envelope based on the Postal Code. After that the letters need only be sorted at later centres by less expensive sorters which need only read the code. During these days Handwriting recognition, including recognition of hand printing, cursive handwriting, is still the subject of active research, as is recognition of printed text in other scripts. Recognition of cursive text is an active area of research, with recognition rates even lower than that of hand-printed text. Reading the Amount line of a cheque (which is always a written-out number) is an example where using a smaller dictionary can increase recognition rates greatly. Knowledge of the grammar of the language being scanned can also help determine if a word is likely to be a verb or a noun, for example, allowing greater accuracy. The shapes of individual cursive characters themselves simply do not contain enough information to recognize all handwritten cursive script. On the other hand recognition of hindi character is also difficult task, because in hand written character there is variety of format, size as per the users. For this unsupervised learning method with the help of self organizing mapping by using Kohonen network is used. Self Organizing Maps (SOM) network is a type of neural network (NN) with only two layers 1st is input layer,and 2nd is output layer and no hidden layer. As its name suggest, in self organizing maps the weights of the weight matrix are adapted in unsupervised fashion by the iterations of the net itself. To carry out this work a classifier is designed with unsupervised learning using the down sampled data with the help of SOM Network.

2. LITERATURE SURVEY

As computers became more advanced in the 1950's, it was finally possible to simulate a hypothetical neural network. The first step towards this was made by Nathanial Rochester from the IBM research laboratories. Unfortunately for him, the first attempt to do so failed. In 1959, Bernard Widrow and Marcian Hoff of Stanford developed models called "ADALINE" and "MADALINE." In 1962, Widrow & Hoff developed a learning procedure that examines the value before the weight adjusts it (i.e. 0 or 1) according to the rule: Weight Change = (Pre-Weight line value) * (Error / (Number of Inputs)). In 1972, Kohonen and Anderson developed a similar network independently of one another, which we will discuss more about later. They both used matrix mathematics to describe their ideas but did not realize that what they were doing was creating an array of analog ADALINE circuits. In 1986, with multiple layered neural networks in the news, the problem was how to extend the Widrow-Hoff rule to multiple layers. Three independent groups of researchers, one of which included David Rumelhart, a former member of Stanford's psychology department, came up with similar ideas which are now called back propagation networks because it

3. SYSTEM DEVELOPMENT

The field of Document Analysis and Recognition is vast and it contains many applications. Character recognition is one of the branches of DAR. As shown in Figure 1, the problem of character recognition can be divided into printed and handwritten character recognition. Handwritten character recognition has been further divided into off-line and online handwritten character recognition. Off-line handwriting recognition refers to the process of recognizing words that have been scanned from a surface (such as a sheet of paper) and are stored digitally in grey scale format. After being stored, it is conventional to perform further processing to allow superior recognition. In the on-line case, the handwriting is captured and stored in digital form via different means. It is generally accepted that the on-line method of recognizing handwritten text has achieved better results than its off-line counterpart. This may be attributed to the fact that more information may be captured in the on-line case such as the direction, speed and the order of strokes of the handwriting because we are using special pen on electrical suface. On the other side machine-printed character recognition can be on good quality documents or degraded printed documents. Devanagri script is used to write many Indian languages such as Hindi, Marathi, Rajasthani, Sanskrit and Nepali.

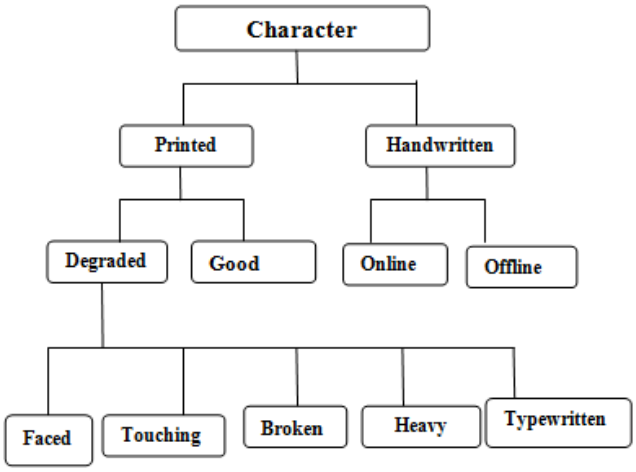

Fig.1 classification of characters

3.1 Artificial neural networks

Character classification problem is related to heuristic logic as human beings can recognize characters and documents by their learning and experience. Hence neural networks which are more or less heuristic in nature are etremely suitable for this kind of problem. Various types of neural networks are used for OCR classification. A neural network is a computing architecture that consists of massively parallel interconnection of adaptive 'neural' processors. Because of its parallel nature, it can perform computations at a higher rate compared to the classical techniques. Because of its adaptive nature, it can adapt to changes in the data and learn the characteristics of input signal. Output from one node is fed to another one in the network and the final decision depends on the complex interaction of all nodes. Several approaches exist for training of neural networks viz. error correction, Boltzman, Hebbian and competitive learning. They cover binary and continuous valued input, as well as supervised and unsupervised learning. Neural network architectures can be classified as, feed-forward and feedback (recurrent) networks. The most common neural networks used in the OCR systems are the multilayer perceptron (MLP) of the feed forward networks and the Kohonen's Self Organizing Map (SOM) of the feedback networks. Self-organizing feature maps (SOFM) learn to classify input vectors according to how they are grouped in the input space. They differ from competitive layers in that neighboring neurons in the self-organizing map learn to recognize neighboring sections of the input space. Thus, self-organizing maps learn both the distribution (as do competitive layers) and topology of the input vectors they are trained on.

3.2 SELF ORGANIZING MAPS NN

3.2.1 The Structure of SOM NN

The SOM NN shown in Fig. 2 contains only an input and output layer of neurons. There is no hidden layer. The input to a SOM NN is given using the input neurons. These input neurons are each given the floating point numbers that make up the input pattern to the network. A SOM NN requires that these inputs be normalized to the range between -1 and 1. Presenting an input pattern to the network will cause a reaction from the output neurons. In a SOM NN only one of the output neurons actually produces a value. Additionally, this single value is either true or false. When the pattern is presented to the SOM NN, one single output neuron is chosen as the output neuron. Therefore, the output from the SOM NN is usually the index of the neuron that fired.

The SOM NN requires that its input be normalized. Input should be between the values -1 and 1. In addition, each of the inputs should fully use the range. Calculate each neuron's output and normalize it & map to a bipolar number. In bipolar system the binary 0 maps to -1 and the binary one remains a 1. From this determine a winning output neuron. Self-organizing in networks is one of the most fascinating topics in the neural network field. Such networks can learn to detect regularities and correlations in their input and adapt their future responses to that input accordingly. The neurons of competitive networks learn to recognize groups of similar input vectors. Self-organizing maps learn to recognize groups of similar input vectors in such a way that neurons physically near each other in the neuron layer respond to similar input vectors.

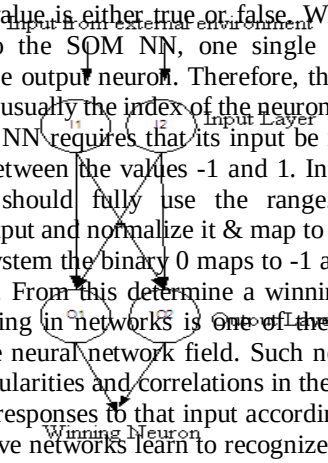

Fig.2 Self Organizing Map NN

3.2.2.) Training a SOM NN

Overall process for training a SOM NN involves stepping through several epochs until the error is below acceptable level. The training process is competitive. For each training set one neuron will "win". This winning neuron will have its weight adjusted so that it will react even more strongly to the input the next time. As different neurons win for different patterns, their ability to recognize that particular pattern will be increased. These individual steps to training the SOM network are summarized in Fig. 2.

The equations used in the SOM network are

Wt+1 = Wt+_x / ||Wt+_x|| Additive Method (1)

Wt+1 = Wt+_e Subtractive Method (2)

Where

Wt = the weight of the winning Neuron

Wt+1 = new weight of the winning Neuron

X = training vector

_ = learning rate

The purpose of the SOM NN is to classify the input into several sets. The error, therefore, must be able to measure how well the network is classifying these items. The error is a percent number that gives an idea of how well the SOM network is classifying the input into the output groups. The error is the difference between the input neurons and the weight vector for that neuron. The error itself is not used to modify the weights.

4. DATA COLLECTION

SOM network is a self organizing feature map network. It does not require any kind of features for designing the classifier. The classifier is designed with the help of the preprocessed input data. After entering the input character, it is read as an image. The part which contains information is being cropped out. The cropped image is then down sampled to a 5x7 matrix. Then it is converted to a binary vector containing 35 vectors. These neurons are then converted to bipolar form and given as an input to the SOM network which then process this input to produce the recognition result. In broad sense the trained network is shown in the Fig. 3. Here the block represents the trained SOM network. For the system how the SOM network works is explained in terms of logical steps given below as: data collection, training and recognition.

4.1) Data collection

The data for 20 Devnagari characters is collected with the help of the Image object. This data is then converted into pixels. Fig.3 shows the Filtered image From this the part of the image which contains character is cropped out. The character image is then down sampled to get a 5 x 7 matrix. Fig.4 shows the binary form of image. This 5 x 7 matrix is then converted to a input vector of length 1 x 35. This is a binary vector and represents a stream of 0s and 1s. Thus for a 20 characters a training set of 20 input vectors is formed.

Fig.3 Filtered image

1	1	1	1	1
1	1	1	1	1
1	1	0	1	1
1	1	0	1	0
1	1	0	1	1
0	0	1	1	0
1	1	1	1	1

Fig.4 Binary form of down sampled image

4.2) Training

For the SOM network the elements in the input vector will become as input nodes (input neurons) and the number of characters 20 becomes output neuron. Hence the network will contain 35 input neurons and 20 output neurons. The network will accept only real numbers as its input. Therefore the binary vectors (0,1) will be converted to bipolar vectors (-0.5, 0.5). Determine the normalized input neurons by multiplying the input with normalization factor (normalization factor = 1/vector length). Create a random output matrix of size [output neuron][input neuron]. Here it is 20 x 35. Normalize the output matrix. From the normalized training set take the normalized input vector and multiply it with each row of output matrix. For the output neuron which gives maximum value is declared as winning neuron. Now the weights of this output neuron are adapted in a fashion to reach more closely to the input vector. These steps are repeated to get one winner neuron for each character. Once trained, the output matrix contains weights for every output neuron. The training process continues and goes on modifying the weight matrix in every iteration. The process goes on still the weights of all output neurons are adapted. The weights are said to be adapted when they reaches more closer to the values of the input neurons. This condition will reach when all output neurons won for single time.

4.3) Recognition

The recognition of the entered character will be performed as you will Enter the character. The character is pre-processed as similar in data collection stage and a character vector is formed. This character vector will then converted into real and applies to the network. For this given input vector, one of the forty neurons will fire. The winning neuron will give the recognized character. The Self Organizing Maps network does not contain the feature extraction part and the training stage is different in the self organizing maps.

5. CONCLUSION

This neural network is under development but as per my knowledge and previous record kohonen neural network with self organising map will surely give better result than other neural network. There will be increment in percentage of recognition rate compare to other neural network. As we know that the SOM is

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