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Devnagiri Character Recognition Using Neural Networks

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Abstract:- A neural network approach is proposed to build an automatic offline character recognition system. Devnagari is an Indo-Aryan language spoken by about 71 million people mainly in the Indian state of Maharashtra and neighboring states. One may find so much work for Indian languages like Hindi, kanada, Tamil, Bangala, Malayalam etc but devnagari is a language for which hardly any work is traceable especially for character recognition. In this paper, work has been performed to recognize Devnagari characters using multilayer perceptron with hidden layer. Various patterns of characters are created in the matrix (n*n) with the use of binary form and stored in the file. We have used the back propagation neural network for efficient recognition and rectified neuron values were transmitted by feed forword method in the neural network.

Keywords: **Neural Network, Devnagari Character Recognition, Backpropagation Network, Recognition P.**

I. INTRODUCTION

Devnagari first appeared in writing during the 11 th century in the form of inscriptions on stones and copper plates. In the Marathi is written in the Devnagari script, an alphasyllabary consisting of 16 vowels and 36 consonants making a total of 52 letters. It is written from left to right. Devnagari used to write Marathi is slightly different than that of Hindi or other languages. Earlier, another script called 'Modi' was in use till the time of the Peshwas (18th century). Neural network are recently being used in various kind of pattern recognition. In this paper, we propose a recognition system for Devnagari characters. The usage of neural network made the process of recognition more efficient and reliable. The properties of Artificial Neural Network (ANN) of abstracting essential characteristics from inputs containing irrelevant data. Learning from experience and generalizing from previous examples to new ones came in very handy for pattern recognition and therefore for OCR. Of the various models, the feedforword model of multi layered perceptron (MLP) has been reported to yield encouraging results by many researches. The back propagation Algorithm is used in MLP.

II. LITERATURE SURVEY

1. Work has been performed to recognize Handwritten English [1] character using multiple layer perceptron with hidden layer. Analysis was carried out to determine the number of hidden layers nodes to achieve high performance in the recognition of English [1] character.

2. A neural network approach is proposed to build an automatic off-line handwritten Tamil [2] character recognition system. The input image of handwritten Tamil [2] character is given as input to BPN and character most closely resembling the block of pixels is given as output.

3. Optical Character Recognition (OCR) system have been under research for few decades. Optical character recognition of Oriya [3] characters is a challenging field. Briefly discussion and how automatic tools have helped build new OCR's for the purpose of recognizing Oriya [3] scripts.

4. Recognition of handwritten characters using neural network has been popular research areas since 1870. The researches have done work on some of them like English, Chinese, Latin, Arabic [4] ,Japanese [5], Thai [6], and Devnagari [7]. At present OCR are commercially available for some of the printed Indian scripts many research has been carried out for Bangala [8].

5. There are many scripts and language in India and one of them work has been done for recognition of handwritten Marathi [9] character. Work is based on invariant moments for recognition of handwritten Marathi [9] characters.

III. PROPOSED WORK

Various patterns of characters are created in the matrix (n*n) form and are stored in the file. A new pattern of a character is given input to the system. The system matches this pattern with the patterns which are already stored in the file. Neural networks are used for matching the patterns. Algorithms like feed forward, back propagation are used. This application can be used in various fields in the today's life. This application can be used in various colleges, universities, bank, and census documents, to maintain the old records of government offices. In future we will try to implement this application in such a way that suppose if the user inputs an unknown pattern to this application than according to previous recognized pattern it will predict this newly pattern Handwritten recognition, which of course is also based on the simplicity of character recognition. The new idea for computers, such as Microsoft's new tablet pc is pen-based computing, which employs lazy recognition that runs the character recognition system silently in background instead of in real time. One field that has been developed from character recognition is optical character recognition (OCR). OCR is used widely today in post offices, banks, airport and businesses. OCR

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software is also used in scanners and faxes that allow the user to turn graphic images of text into editable documents .Never application have even expanded outside the limitations of just characters. Eye, face, fingerprint scans used in high- security areas employs a kind of recognition

IV. CHARACTER PATTERNS

Patterns are in the matrix form, they are written as.

A

0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,

0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,
0,0,0,0,0,1,1,0,0,0,0,1,1,0,0,
0,0,0,1,1,0,0,1,1,0,0,1,1,0,0,
0,0,1,1,0,0,0,0,1,1,0,1,1,0,0,
0,1,1,0,0,0,0,1,1,0,0,1,1,0,0,
0,0,0,0,0,0,1,1,0,0,0,1,1,0,0,
0,0,0,0,0,1,1,0,0,0,0,1,1,0,0,
0,0,0,0,1,1,1,1,1,1,1,1,1,0,0,
0,0,0,0,1,1,1,1,1,1,1,1,1,0,0,
1,1,0,0,0,1,1,0,0,0,0,1,1,0,0,
0,1,1,0,0,0,1,1,0,0,0,1,1,0,0,
0,0,1,1,0,0,0,1,1,0,0,1,1,0,0,
0,0,0,1,1,0,1,1,0,0,0,1,1,0,0,
0,0,0,0,0,1,1,0,0,0,0,1,1,0,0,

In this way many patterns for an every character are stored in the file in the matrix form. A character can be written in many ways, thus there can be many patterns of a single character.

V. BACK PROPAGATION NETWORK

Back propagation is a common method of training artificial neural networks so as to minimize the objective function. It is a supervised learning method, and is a generalization of the delta. It requires a dataset of the desired output for many inputs, making up the training set. This learning algorithm is applied to multilayer feed-forward networks consisting of processing element with continuous differentiable activation function (networks that have no feedback or simply, that have no connections that loop). The term is an abbreviation for "backward propagation of errors". The aim of neural network is to train the net to achieve balance between the net's ability to respond & its ability to give reasonable responses to the input that is similar but not identical to the one that is used in training. The back propagation algorithm is different from the networks in respect to the process by which the weights are calculated during the learning period of the network. The training of BPN is done in 3 stages:-feed-forward of the input training pattern, the calculation and back propagation of the error & updating of weights. The testing of the BPN involves the computations of feed-forward only. there can be more than one hidden layer but only one hidden layer is sufficient layer. The training process is very slow but once the network is trained it can produce its output very rapidly.

VI. ARTIFICIAL NEURAL NETWORK

An Artificial Neural Network (ANN), usually called "neural network" (NN), is a mathematical model or computational model that tries to simulate the structure and/or functional aspects of biological neural networks. It consists of an interconnected group of artificial neurons and processes information using a connectionist approach to computation. In most cases an ANN is an adaptive system that changes its structure based on external or internal information that flows through the network during the learning phase. 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.

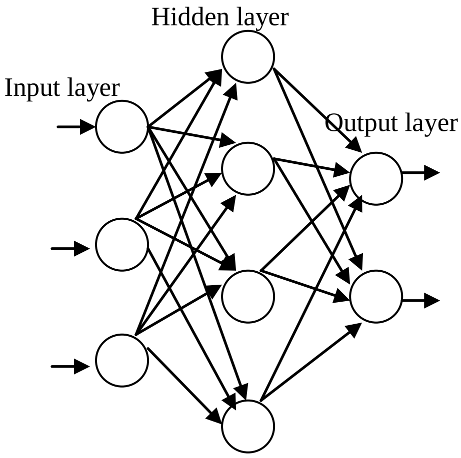

Fig. Multilayered Artificial Neural Network

Feed Forward Neural Network approach is used to combine all the unique features, which are taken as inputs, **one** hidden layer is used to integrate and collaborate similar features and if required adjust the inputs by adding or subtracting weight values, finally **one** output layer is used to find the overall matching score of the network. If the score is within the predefined range then the character is recognized else the system is trained again.

VII. RECOGNITION

Recognition of handwritten characters is a very complex problem. The characters could be written in different orientation, thickness, format and dimension. This will give infinite variations. The capability of neural network to generalize and insensitive to the missing data would be very beneficial in recognizing handwritten characters. In this paper, for Devnagari character recognition in neural Feed Forward Multi-Layer Perceptron network (MLPN) with one hidden layer has been used. For training, back-propagation algorithm has been implemented

VIII. IMPLIMENT XOR FUNCTION

The truth table for XOR function

X1	x2	y
0	0	0
0	1	1
1	0	1
1	1	0

In this case the output is "ON" for only odd number of 1's. for the rest it is "OFF". XOR function can not be represented by simple and single logic function; it is represented as

$y = x1\overline{x2} + \overline{x1}x2$

$y = z1 + z2$

Where

$z1 = x1\overline{x2}$ (function 1)

$z2 = \overline{x1}x2$ (function 2)

$y = z1\ (OR)\ z2$ (function 3)

A single layer net is not sufficient to represent the function. An intermediate layer is necessary.

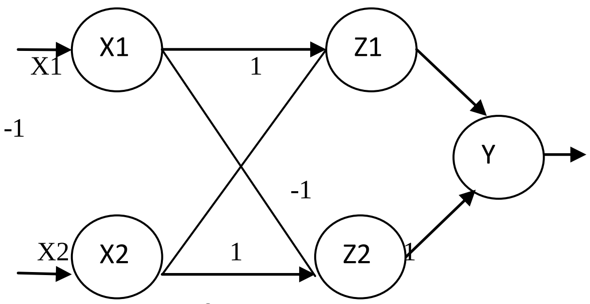

Fig 1: Neural Net for XOR Function (The Weights Shown are Obtained After Analysis).

First function (z1 = x1x2): The truth table for function z1 is shown

x1	x2	z1
0	0	0
0	1	0
1	0	1
1	1	0

The net representation is given as

Case 1: Assume both weights as excitatory, i.e. ,

w11 = w21 = 1

Calculate the net inputs. For inputs,

(0, 0), z1in = 0 * 1 + 0 * 1 = 0

(0, 1), z1in = 0 * 1 + 1 * 1 = 1

(1, 0), z1in = 1 * 1 + 0 * 1 = 1

(1, 1), z1in = 1 * 1 + 1 * 1 = 2

Hence, it is not possible to obtain function z1 using these weights.

Case 2: Assume one weight as excitatory and the other is inhibitory i.e.,

w11 = 1; w21 = -1

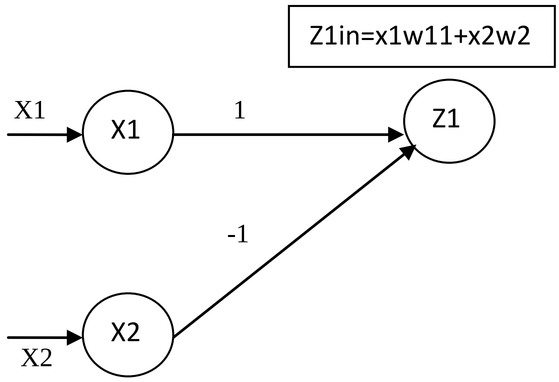

Fig 2 : Neural net for Z1.

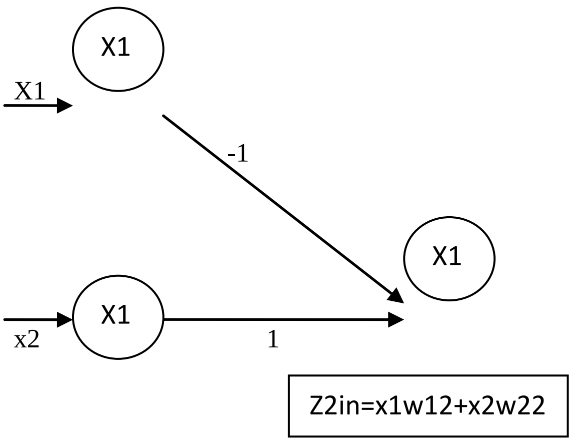

Fig 3 : Neural net for Z2.

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Calculate the net inputs. For inputs,

(0, 0), z1in = 0 * 1 + 0 * -1 = 0

(0, 1), z1in = 0 * 1 + 1 * -1 = -1

(1, 0), z1in = 1 * 1 + 0 * -1 = 1

(1, 1), z1in = 1 * 1 + 1 * -1 = 0

On the basis of this calculated net input, it is possible to get the required output. Hence,

w11 = 1;   w21 = -1

$\theta \geq 1$ for the Z1 neuron.

Second function ($z1 = x1\overline{x2}$): The truth table for function z2 is shown

x1	x2	z2
0	0	0
0	1	1
1	0	0
1	1	0

The net representation is given as

Case 1: Assume both weights as excitatory, i.e. ,

w12 = w22 = 1

Calculate the net inputs. For inputs,

(0, 0), z2in = 0 * 1 + 0 * 1 = 0

(0, 1), z2in = 0 * 1 + 1 * 1 = 1

(1, 0), z2in = 1 * 1 + 0 * 1 = 1

(1, 1), z2in = 1 * 1 + 1 * 1 = 2

Hence, it is not possible to obtain function z2 using these weights.

Case 2: Assume one weight as excitatory and the other is inhibitory i.e.,

w12 = 1;   w22 = 1

Calculate the net inputs. For inputs,

(0, 0), z2in = 0 * -1 + 0 * 1 = 0

(0, 1), z2in = 0 * -1 + 1 * 1 = 1

(1, 0), z2in = 1 * -1 + 0 * 1 = -1

(1, 1), z2in = 1 * -1 + 1 * 1 = 0

On the basis of this calculated net input, it is possible to get the required output. Hence,

w12 = -1;   w22 = 1

$\theta \geq 1$ for the Z2 neuron.

Third function (y = z1 OR z2): The truth table for function is shown as:

x1	x2	y	z1	z2
0	0	0	0	0
0	1	1	0	0
1	0	1	1	0
1	1	0	0	0

Here the net input is calculated using

yin = z1v1 + z2v2

Case 1: Assume both weights as excitatory, i.e. ,

v1 = v2 = 1

Calculate the net inputs. For inputs,

(0, 0), yin = 0 * 1 + 0 * 1 = 0

(0, 1), yin = 0 * 1 + 1 * 1 = 1

(1, 0), yin = 1 * 1 + 0 * 1 = 1

(1, 1), yin = 1 * 1 + 1 * 1 = 0

(because for x1 = 1 and x2 = 1 ,z1 = 0 and z2 =0)

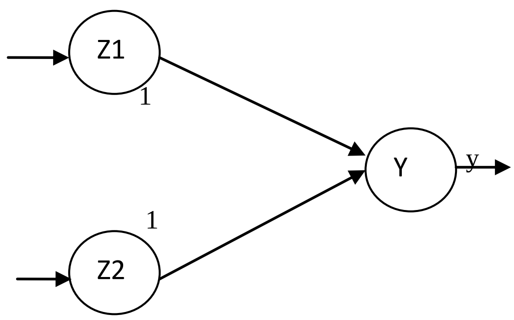

Fig 4 : Neural net for Y (Z1 OR Z2).

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Setting a threshold of $\Theta \geq 1$, v1 = v2 = 1, which implies that the net is recognized. Therefore, the analysis is made for XOR function using M-P neurons. Thus for XOR function, the weights are obtained as

w11 = w22 = 1 (excitatory)

w12 = w21 = -1 (inhibitory)

v1 = v2 = 1 (excitatory)

IX. CONCLUSION

"Devnagari Character Recognition System" is aimed at recognizing the devnagari characters. The input pattern of a character is read preprocessed feature extracted and recognized, recognized character is displayed. The "Devnagari Character Recognition System" is implemented using a java neural network. Devnagari is an ancient abugida. Maintaining and getting the contents from and to the books is very difficult. In a way "Devnagari Character Recognition" can provide paperless environment. If a knowledge base of rich Devnagari contents is created, it can be accessed by people of varying categories with ease and comfort.

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