IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 9, Issue 2, Ver. VII (Mar - Apr. 2014), PP 65-68
www.iosrjournals.org

Recognition of Devnagri Numeral: A Review

Mahendra Choudhary, Hasnine Mirja
Department of Electronics & Communication, OIST-Bhopal

Abstract: *Character recognition is the study of how machines can observe the environment, learn to distinguish characters of interest from their background, and make sound and reasonable decisions about the categories of the character. Handwritten numeral recognition belongs to the field of pattern recognition, which is a hot field for a large number of researchers. This paper review an algorithm for recognition of handwritten devnagri numerals using various schemes.*
Keywords: *Devnagri, Numerals, Neural Network, RBFN*

I. Introduction

1.1 Character Recognition

Character recognition is becoming more and more important now-a-days. Every zone of our life is under the HCI influence. The ability to identify characters in an automated/ semi-automated manner has obvious applications in numerous fields. The advancement in pattern recognition has accelerated recently, due to the number of emerging applications which are not only challenging, but also computationally more demanding. The field of character recognition is a multidisciplinary field, which forms the foundation of other fields, as for instance, Image Processing, Artificial Intelligence and Machine Vision.

There are different challenges faced while attempting to solve this problem. The handwritten digits vary in size, thickness, orientation and position relative to the margins. Handwritten numeral recognition belongs to the field of pattern recognition, which is a hot field for a large number of researchers. It is widely used in education, public security, transportation, finance, taxation and other industries in the practical activities.

[1] "Character recognition is the study of how machines can observe the environment, learn to distinguish characters of interest from their background, and make sound and reasonable decisions about the categories of the character." A very relevant present-day field of natural interface research is hand writing recognition technology. The domain of handwriting recognition belongs to the field of 2D pattern recognition, challenged by high intra and interclass's variability.

Extraction of features is very important while developing a handwriting recognition system. Features are properties of the characters to be recognized, that highlights their differences and suppress their commonality.

India is a multilingual-country over more than 1.2 billion population with 18 constitutional languages with 10 different scripts. Devnagri is used by a number of Indian Languages. It was developed to write Sanskrit but later adapted to write many other languages, such as Marathi, Hindi, Konkani and Nepali [2].

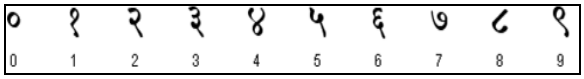

Fig.1 Devnagri Numerals

In recent years, OCR (Optical Character Recognition) technology has been applied throughout the entire spectrum of industries, revolutionizing the document management process. Input to an OCR system consists of text printed on paper. The output is a coded file with some character code representation of choice, as well as special symbols for unrecognized/ doubtfully recognized patterns.

1.2. Neural Networks

Neural networks [3] can be viewed as massively parallel computing systems consisting of an extremely large number of simple processors with many interconnections. They have input connections which are summed together to determine the strength of their output, which is the result of the sum being fed into an activation function. The resultant of this function is then passed as the input to other neurons through more connections, each of which are weighted. These weights determine the behaviour of the network.

When we create Artificial neural networks, the neurons are usually ordered in layers. The fist layer contains the input neurons and the last layer contains the output neurons, representing the input and output

variables that we want to approximate. Between the input and output layer, a number of hidden layers exist and the connections to and from these hidden layers determine the performance of the ANN. The main characteristics of neural networks are that they have the ability to learn, use sequential training procedures, and adapt themselves to the data.

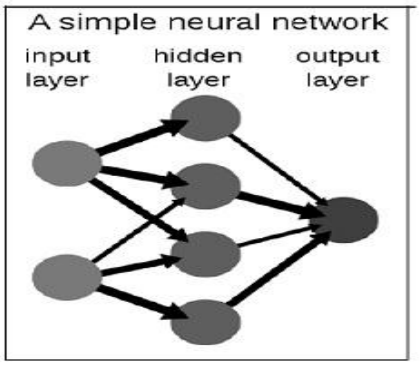

Fig. 2 Artificial neural network

A neural network has to be configured such that the application of a set of inputs produces the desired set of outputs. All inputs are summed altogether and modified by the weights. This activity is referred as a linear combination. Finally, an activation function controls the amplitude of the output. Mathematically, this process is described in the figure below.

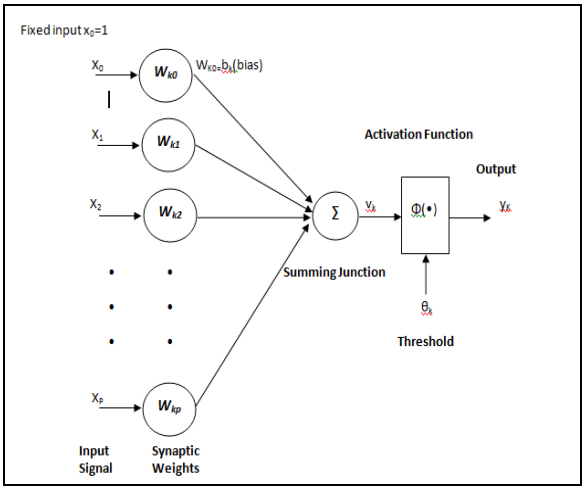

Fig 3. Mathematical model of artificial neural network

The interval activity of the neuron can be shown as:

$$v_k = \sum_{j=0}^{p} W_{kj} X_j \qquad \text{(Eq.1)}$$

The output of the neuron, y_k, would therefore be the outcome of some activation function on the value of v_k.

$$y_k = \Phi(v_k) \qquad \text{(Eq. 2)}$$

An artificial neural network is developed with a systematic step-by-step procedure that optimizes a criterion, the learning rule. Learning [4] is a process by which the free parameters of a neural network are adapted through a process of stimulation by the environment in which the network is embedded.

Pattern recognition [5] is formally defined as the process whereby a received pattern/signal is assigned to one of the prescribed number of classes. Pattern recognition can be defined narrowly as dealing with feature extraction and classification. A neural network performs pattern recognition, by first undergoing a training session during which the network is repeatedly presented a set of patterns along with the category to which each pattern belongs. Later, a new pattern is presented to the network that has not been seen before, but belongs to the same population of pattern used to train the network. This network is able to identify the class of that particular pattern by the information it has extracted from the training data.

1.3 Radial basis function

Radial Basis Functions [6, 7] emerged as a variant of artificial neural network in late 80's. The Radial Basis Function (RBF) network is a three-layer feed-forward network that uses a linear transfer function for the output units and a nonlinear transfer function (normally the Gaussian) for the hidden layer neurons. In case of Radial Basis Function Network we need to specify the hidden unit activation function, the number of processing units, a modelling criterion and a training algorithm for finding the parameters of the network. After training RBF network can be used with data whose underlying statistics is similar to that of the training set.

1.3.1 RBF Training

RBFs are commonly trained following a hybrid procedure that operates in two stages or time scales

a) Unsupervised selection of RBF centres

RBF centres are selected so as to match the distribution of training input. This critical step is normally performed in a slow iterative manner. Fortunately, a number of strategies can be used to solve this problem.

b) Supervised computation of output vectors

Hidden-to-output weight vectors are determined so as to minimize the sum-squared error between RBF outputs and desired targets. Because the outputs are linear, the optimal weights can be computed using fast, linear matrix inversion.

II. Related Work

[4] C. Vasantha Lakshmi, Ritu Jain, and C. Patvardhan presented a fast and robust method for achieving better recognition rates for handwritten Devnagri numerals with some pre-processing and post-processing logic. An effort is done using hierarchical clustering to reduce the database size not in terms of features but in terms of number of samples keeping in mind the true representation of all samples in database. This reduces the time consumed in recognition drastically. With the incorporation of structural features, recognition accuracies are further increased to 99.1% on a database of 9000 samples.

[8]Raghuraj Singh, C. S. Yadav, Prabhat Verma, Vibhash Yadav proposed a technique for OCR System for different five fonts and sizes of printed Devnagri script. It is concluded that the input matrix of size 48X57 gives better results than other choices. The recognition rate of OCR system with the image document of Devnagri Script is quite high. The test set used in this experiment is of 77 characters of five different types of fonts.

[5] G.G.Rajput and S.M.Mali propose an effective method for recognition of isolated Marathi handwritten numerals written in Devnagri script. Fourier Descriptors that describe the shape of Marathi handwritten numerals are used as feature. 64 dimensional Fourier Descriptors represents the shape of numerals, invariant to rotation, scale and translation. Three different classifiers, namely, nearest neighbourhood (NN), K-nearest neighbourhood (KNN) and Support Vector Machine (SVM) are used independently in order to recognize test numeral. These classifiers are trained with 64 dimensional Fourier Descriptors (FD) of training samples. The proposed system is experimented with a database of 13000 samples of Marathi handwritten numerals using fivefold cross validation method for result computation. An overall recognition rate of 97.05%, 97.04% and 97.85% are obtained for NN, KNN and SVM respectively.

[9] U. Bhattacharya, S. K. Parui, B. Shaw and K. Bhattacharya presented a two-stage classification system for recognition of handwritten Devnagri numerals. A shape feature vector computed from certain directional-view-based strokes of an input character image, has been used by both the HMM and ANN classifiers of the present recognition system. The two sets of posterior probabilities obtained from the outputs of the above two classifiers are combined by using another ANN classifier. Finally, the numeral image is classified according to the maximum score provided by the ANN of the second stage. In the proposed scheme, they achieved 92.83%

recognition accuracy on the test set of a recently developed large image database of handwritten isolated numerals of Devnagri.

[10] Shailendra Kr.Srivastava and Sanjay G.Harde applies Support Vector Machines (SVM) technique for recognizing handwritten numerals of Devnagri Script. Since, standard database does not exist globally; this system is constructed database by implementing Automated Numeral Extraction and Segmentation Program (ANESP). Pre-processing is manifested in the same program which reduces most of the efforts. 2000 samples are collected from 20 different people having variation in writing style. Moment Invariant and Affine Moment Invariant techniques are used as feature extractor. These techniques extract 18 features from each image which is used in Support Vector Machine for recognition purpose. Binary classification techniques of Support Vector Machine is implemented and linear kernel function is used in SVM. This linear SVM produces 99.48% overall recognition rate.

III. Problem Identification

Computers are greatly influencing the lives of human beings and their usage is increasing at a tremendous rate. Every zone of our life is under HCI (Human Computer Interaction) influence. The ease, with which we exchange information between user and computers, is of immense importance today. Handwriting recognition is in research for over four decades, and has attracted many researchers across the world. Handwriting variation is one prominent problem and achieving high degree of accuracy is a tedious task.

From the literature survey, it is evident that handwritten numerals recognition is still a fascinating area of research for designing a robust and efficient Optical Character Recognition (OCR) system. This has motivated us to design a simple and robust algorithm for handwritten numerals recognition system, which is independent of size, slant, ink and writing styles.

IV. Conclusion & Future Work

This paper proposes a technique of applying Radial Basis Function for handwritten Devnagri numeral recognition. Since the database is not globally available, firstly we created the database, and then by the use of Principal Component Analysis we extracted the features of each image. At the hidden layer, centres are determined and the weights between the hidden layer and the output layer of each neuron are determined to calculate the output, where output is the summing value of each neuron.

In our future work we plan to test the system on a larger database including a larger number of writers. This work can be extended to whole Devnagri script.

References:

[1]. A. P. Shivprasad and V. K. Govindan, 1990, “Character Recognition - A Review", Pattern Recognition, vol. 23, no. 7, pp 671-683.
[2]. Adrian G.Bors, 1999,”Introduction of Radial Basis Function”. *IEEE Transactions on Image Processing*, vol. 8, no. 12, pp. 1744-1756.
[3]. Leonardo M. Reyneri, ”Weighted Radial Basis Function for improved Pattern Recognition and signal processing”
[4]. C. Vasantha,Ritu Jain and Patvardhan, December 2008, ”Fast and robust scheme for recognition of handwritten Devnagri Numerals”, *National System Conference,* IIT Roorkee, Roorkee, pp 1-7.
[5]. G.G.Rajput, S.M.Mali, June 2010, “Fourier Descriptor based Isolated Marathi Handwritten Numeral Recognition”, *International Journal of Computer Applications*, vol 3, No.4, pp 1-5.
[6]. Cheng-Lin Liu , 2006, “Handwritten Chinese Character Recognition: Effects of Shape Normalization and Feature Extraction”, *National Laboratory of Pattern Recognition(NLPR), Institute of Automation, Cinese Academy of Sciences(IACAS),* China, pp 1-15.
[7]. Holambe A.N., Thool R.C., Shinde U.B. and Holambe S.N., 2010, “Brief review of research on Devanagari script”, *International Journal of Computational Intelligence Techniques,* ISSN: 0976–0466, Volume 1, Issue 2, pp-06-09.
[8]. Raghuraj Singh, C. S. Yadav, Prabhat Verma, Vibhash Yadav, 2010,” Optical Character Recognition (OCR) for Printed Devnagari Script Using Artificial Neural Network”, *International Journal of Computer Science and communication,* Vol. 1, No. 1, January-June 2010, pp. 91-95.
[9]. U. Bhattacharya, S. K. Parui, B. Shaw and K. Bhattacharya ,“Neural Combination of ANN and HMM for Handwritten Devanagari Numeral Recognition”, IWFHR October 23-26, 2006, pp. 613-618, La Baule, France.
[10]. Shailendra Kr.Srivastava and Sanjay G.Harde,“SVM for handwritten Devanagri Numeral Recognition”, IJCA ,Volume 7– No.11, 2010.
[11]. ”Handwritten Digits Recognition” by Gaurav Jain and Jason Ko.
[12]. “Fast and robust scheme for recognition of handwritten Devanagari Numerals”, Vasantha,Ritu Jain and Patvardhan, NSC 2008. Improving the performance of Radial Basis Function by learning center location”, Dietrich and Thomas.
[13]. Pattern Recognition using K-nearest neighbours”, Seiji,Kiyasu and Miyahara.
[14]. Weighted Radial Basis Function for improved Pattern Recognition and signal processing”, Leonardo M. Reyneri.
[15]. R. M. K. Sinha and H. N. Mahabala, ”Machine recognition of Devanagari script", IEEE Transactions on Systems, Man and Cybernetics.