Text Recognition using Multilayer Perceptron Neural Network

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Abstract: *This work focuses on development of an Offline Hand Written English Character Recognition algorithm based on Artificial Neural Network (ANN). The ANN implemented in this work has single output neuron which shows whether the tested character belongs to a particular cluster or not. The implementation is carried out completely in 'Java' language. Offline handwritten English character recognition is difficult due to variation in shape, slope and size of individual characters. Such variations in handwriting can be handled by better pre-processing and feature extraction techniques. Handwritten character recognition is more difficult process as compared to typed or printed characters. In this paper, we present a handwritten character recognition system in which first of all original image is converted into greyscale image. After that pre-processing steps are applied on that greyscale image. Then individual characters split from word using segmentation. Features are extracted for those characters and multilayer perceptron classifier is used for classification. At last handwritten character is recognized and converted into machine printable form, which will be easier to store and use in future. However, the result showed that the algorithm recognized English alphabet patterns with maximum accuracy of more than 80.00%.*

Keywords: Offline; Hand Written; English Character; Artificial Neural Network

1. Introduction

In this machine learning world, English Hand Written Character Recognition has been a challenging and interesting research area in the field of Artificial Intelligence and Soft computing [1,2]. It contributes majorly to the Human and Computer interaction and improves the interface between the two [3]. For character recognition system one can use neural network, principal component analysis, support vector machine, hidden markov model [4]. The numbers of applications are License Plate Recognition System which can be used in parking areas and for highly security premises, Handwriting Recognition System, Identifying Engine Number and Chassis Number, Text Recognition, Form Processing, Bank Check Processing. Every language has different shape and curve of different characters and digits [5].

Generally, character recognition can be broadly characterized into two types (i) Offline and (ii) Online. In offline method, the pattern is captured as an image and taken for testing purpose. But in case of online approach, each point of the pattern is a function of pressure, time , slant, strokes and other physical parameters. Both the methods are best based on their application in the field of machine learning. Yielding best accuracy with minimal cost of time is a crucial precondition for pattern recognition system. Therefore, hand written character recognition is continuously being a broad area of research.

2. Literature Survey

Available literatures convey that various approaches have been made in order to accomplish the task of character recognition. And in about all the soft computing approaches Neural Network (NN) has been a backend of character classification. This is due to its faster computation.

A. Use of MLP

[6], proposed offline English character recognition model based on artificial neural network, database of 2600 samples are collected from 100 writers for each character, flowchart of system is explained and training is performed using Feed Forward Neural Network Algorithm.

[7] proposed NN based English character recognition system. In this work, MLP with one hidden layer was used. About 500 testing were carried out to test the performance of the design. The best case accuracy obtained in this work was 94%.

B. Statistical and NN

[8] used horizontal and vertical strokes and end points as feature for handwritten numerals. This method reported an accuracy rate of 90.5% in best case.

[9] worked on English alphabet recognition using NN. In this work, binary pixels of the alphabets were used train the NN. The accuracy achieved was found to be 82.5.

[10] paper presents off-line handwritten digit recognition based on structural features, KNN as classified used for classification, it also uses four different types of structural features namely, number of holes, water reservoirs in four directions, maximum profile distances in four directions and fill-hole density for the recognition of digits.

A detailed analysis of some methods is given in Table-1 below which shows the References, approach and its corresponding accuracy.

Table 1: Some Approaches with their Performance

Approach	Reference	Rate of Recognition (%)
Multilayer Perceptron (M LP)	[8]	75.05%
MLP with NN	[9]	94%
Stroke Method	[10]	90.5%
Neural Network with Statistical Approach	[11]	82.5%

3. Recognition System

Steps involved in handwritten character recognition process -

- Acquiring input character by scanning
- Skeletonization and normalization operation
- Feature extraction by boundary detection
- Neural network classification
- Recognition of character
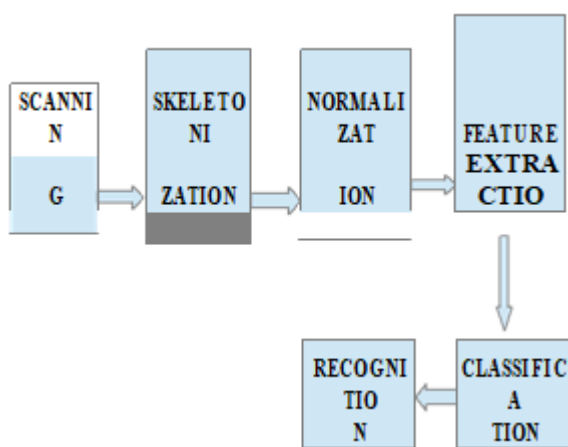
Figure 1: Block diagram of Character Recognition System

4. Methodology

The steps followed in this work of English character recognition are given in the algorithm below.

A. DataSets

MNIST Database (Modified NIST) is a large database of handwritten letters which contains 60,000 training images and 10,000 testing images. Database named Letter Recognition Data Set is available on UCI Machine Learning Repository

B. Scanning

Handwritten English characters are scanned. They are resized into 1024 (32x32) binary pixels.

C. Image Pre-processing

Pre-processing is performed to increase quality of handwritten/ printed data and applied before the feature extraction. Pre-processing is sequence of operations performed on acquired image so, that subsequent tasks become easier.

D. Skeletonization

The skeletonization process will be used to binary pixel image and the extra pixels which are not belonging to the backbone of the character has been deleted and the broad strokes has been reduced to thin lines [2].
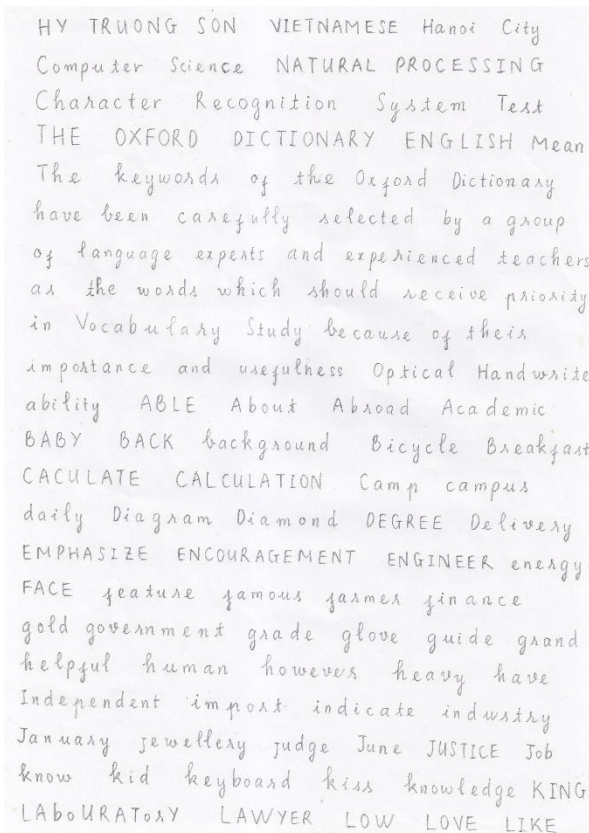

Figure 2: Input Handwritten English Characters

E. Normalization

Normalization is process to equate size of all character bitmap into standard size. To standardize character, extra rows and columns containing 0 are removed from all sides of character.

F. Segmentation

The goal of segmentation is to simplify and change the image representation so that it can be meaningful and easier to analyse further. Segmentation involves line, word and character segmentation.
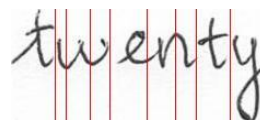
Figure 3: Segmentation

G. Feature Extraction

For achieving a good performance of handwritten character recognition system one of the essential steps is feature extraction. Feature Extraction is the process of extraction of certain types of information from the given character image. The features which are important for classification are

extracted at this stage. It is the strongest part of any character recognition system to get high performance. The character is represented by a features vector, which becomes its identity.

H. Classification

Classification is the decision making phase of Character Recognition system. This phase uses the features extracted in the previous stage for deciding the class membership and to recognize the input characters. The performance of the classifier relies on the quality of the features to be extracted. Multilayer Perceptron Neural Network as classifies is used for classification.

I. Recognition

Efficient recognition system helps in accuracy. So, after the training set is ready and network is trained the next step is to use learning set to recognize particular character given as input. Here the character is recognized if it resides in dataset otherwise character cannot be recognized.

a) Multilayer Perceptron Network

The multilayer perceptron neural networks have been applied successfully to solve some difficult and diverse problems by training them in supervised manner with a highly popular algorithm known as error back-propagation algorithm. The error back-propagation algorithm is based on error-correction learning rule. In this paper, two-layer perceptron network is used. In two-layer perceptron there are one hidden layer and one output layer presents. Fig.2. shows multi-layer perceptron network.
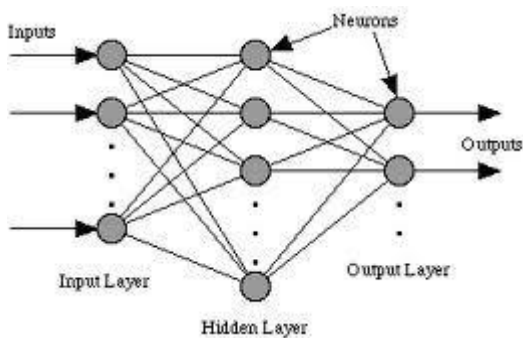

Figure 4: Multi-Layer Perceptron Network (MLPN)

Error back-propagation learning consists of two passes through the different layers of the network and they are: a forward pass and a backward pass. In forward pass, an activity pattern (input vector) is applied to the sensory nodes of the network, and its effect propagates through the network layer by layer. Finally, a set of outputs is produced as the actual response of the network. During the forward pass, the synaptic weights are fixed. During the backward pass, the synaptic weights are adjusted in accordance with an error-correction rule. The actual response of the network is subtracted from the desired (target) response to produce an error signal. This error signal is then propagated backward through the network against the direction of synaptic connections.

MLP utilizes a supervised learning technique called backpropagation for training of the network. MLP is a modification of standard linear perceptron and distinguish the data that are not linearly separable. There can be one input layer, one output layer and more than one hidden layers. Each node in one layer connects with certain weight to every node in other layer.

5. Result and Conclusion

A Multilayer Perceptron Neural Network based method is presented here for increasing accuracy of offline handwritten character recognition. We have tested our developed algorithm. The result is in the below output image (about 80.00% of accuracy is defined).
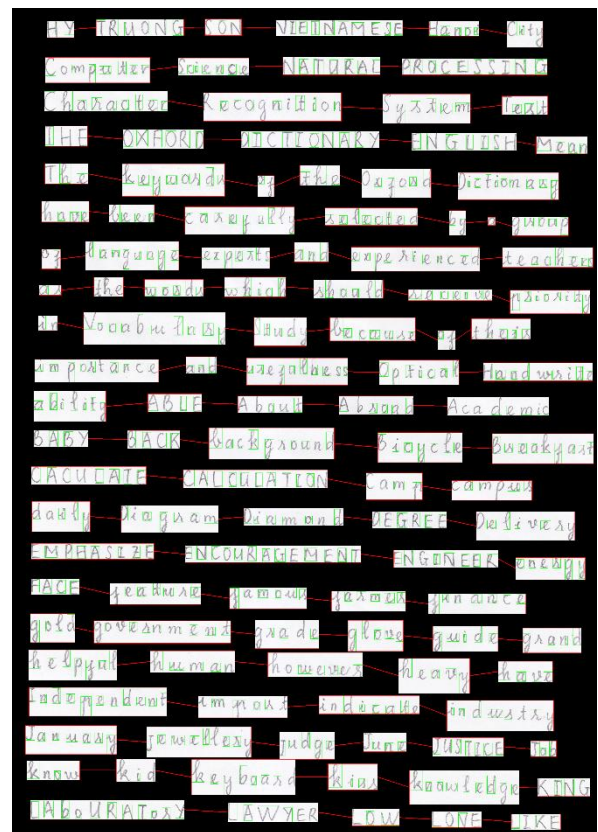

Figure 5: Output Handwritten English Characters

In this paper, we have proposed multilayer perceptron neural network based offline handwritten English character recognition system to recognize English characters. Proposed system reduced training time and cost to identify handwritten characters. Neural Networks are commonly used for character recognition due to high noise tolerance. Feature extraction is one of the most essential steps in character recognition.

References

[1] Impedovo, S. et al. (1991) "Optical character recognition," International Journal of Pattern Recognition and Artificial Intelligence, Vol. 5(1-2), pp. 1-24.
[2] Mori, S. et al. (1992) "Historical review of OCR research and development," Proceedings of IEEE, vol. 80, pp. 1029-1058.

[3] Pradeep J. et al. (2011) "Diagonal based feature extraction for handwritten alphabet recognition system using neural network," International Journal of Computer Science and Information Technology, Vol.3, No.1, pp. 27-38.

[4] Er. N. Bhatia, "Optical Character Recognition Techniques: A Review," International Journal of Advanced Research in Computer Science and Software Engineering, Vol. 4, Issue 5, ISSN: 2277 128X, May 2014.

[5] N. Venkata Rao, Dr. A.S.C.S.Sastry, A.S.N.Chakravarthy and Kalyanchakravarthi P, "Optical Character Recognition Technique Algorithms," Journal of Theoretical and Applied Information Technology, Vol. 83. No. 2, ISSN 1992-8645, 20 January 2016.

[6] S. A. Yadav, S. Sharma and S. R. Kumar, "A robust approach for offline English character recognition," 2015 International Conference on Futuristic Trends on Computational Analysis and Knowledge Management (ABLAZE), Noida, 2015, pp. 121-126.

[7] Pal, A. and Singh, D. (2010) "Handwritten English Character Recognition Using Neural Network," International Journal of Computer Science and Communication, Vol.1, No.2, pp. 141-144.

[8] Dinesh, A. U. et al. (2007) "Isolated handwritten Kannada numeral recognition using structural feature and K-means cluster," IISN, pp. 125-129.

[9] Perwej, Y. and Chaturvedi, A. (2011) "Neural Networks for Handwritten English Alphabet Recognition," International Journal of Computer Applications, Vol. 20, No. 7, pp. 1-5.

[10] U. R. Babu, Y. Venkateswarlu and A. K. Chintha, "Handwritten Digit Recognition Using K-Nearest Neighbour Classifier," 2014 World Congress on Computing and Communication Technologies, Trichirappalli, 2014, pp. 60-65

Author Profile

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