Handwritten Character Recognition and Text Formation for Digital Notepad

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Abstract— An handwritten alphabetical character recognition system using multilayer feed forward neural network is described in the paper. A new method, called, diagonal based feature extraction is introduced for extracting the features of the handwritten alphabets. Fifty data sets, each containing 26 alphabets written by various people, are used for training the neural network and 570 different handwritten alphabetical characters are used for testing. The proposed recognition system performs quite well yielding higher levels of recognition accuracy compared to the systems employing the conventional horizontal and vertical methods of feature extraction. This system will be suitable for converting handwritten documents into structural text form and recognizing handwritten names.

Key words: Handwritten Character Recognition, Image Processing, Feature Extraction, Feed Forward

I. INTRODUCTION

The development of a system that is robust enough to recognize numerical handwritings with the lowest error. The first test was done with a neural network trained with only the Character Vector Module as its feature extraction method. A result that is far below the set point of the recognition accuracy was achieved, a mere average of 64.67% accuracy. However, the testing were later enhanced with another feature extraction module, which consists of the combination of Character Vector Module, Kirsch Edge Detection Module, Alphabet Profile Feature Extraction Module, Modified Character Module and Image Compression Module. The modules have its distinct characteristics which is trained using the Back-Propagation algorithm to cluster the pattern recognition capabilities among different samples of handwriting. Several untrained samples of numerical handwritten data were obtained at random from various people to be tested with the program. The second tests shows far greater results compared to the first test, have yielded an average of 84.52% accuracy. OCR stands for optical character recognition i.e. it is a method to help computers recognize different textures or characters OCR are sometimes used in signature recognition which is used in bank And other high security buildings In addition, texture recognition could be used in fingerprint recognition OCR's are known to be used in radar systems for reading speeders license plates and lot other things. Throughout the years, various efficient techniques have been deployed by researchers to recognize various numeric handwritten characters, but still remains a sturdy hurdle with thousands of different shaped handwriting trends.

II. LITERATURE SURVEY

Wong Yoong Xiang, Patrick Sebastian, "Handwriting Recognition Using Webcam for Data Entry" 2015 IEEE 11th International Colloquium on Signal Processing & its Applications (CSPA2015), The main contribution of this paper is algorithm is robust enough to recognize handwriting samples and produce high recognition rate. Neural network has self-learning, self-adapt and self-process capabilities which make it robust for handwritten recognition systems. There are three layers in the typical neural network. W. L. Goh, D. P. Mital, and H. A. Babri, "An artificial neural-network approach to handwriting recognition," in Knowledge Based Intelligent Electronic Systems, 1997. KES '97. Proceedings.1997 First International Conference on, 1997, pp. 132-136 vol.1.he neural network is sometimes referred as multilayer perceptron (MLP). One advantage of using neural network is that it can be trained to perform the error-correction learning rule. K. Pyeoung Kee, "Improving handwritten numeral recognition using fuzzy logic," in TENCON '97. IEEE Region 10 Annual Conference. Speech and Image Technologies for Computing and Tele-communications., Proceedings of IEEE, 1997, pp. 539-542 vol.2. Most of the research that is based on neural network have achieved ultimately high recognition accuracy of more than 65%. Even with this high accuracy, the correct learning rate () has to be chosen to ensure the recognition results.

M. Y. Chen, A. Kundu, and J. Zhou, "Off-line handwritten word recognition (HWR) using a single contextual hidden Markov model," in Computer Vision and Pattern Recognition, 1992. Proceedings CVPR '92., 1992 IEEE Computer Society Conference on, 1992, pp. 669-672.The learning rate is the rate of which the number of training sample sets used to train the neural network. If a low value of is chosen, the result obtained will be slow and inaccurate. J. Wan, Y. Huang, G. Zhang, and C. Wan, "Offline Handwritten Numeral Recognition Based on Principal Component Analysis," in Electronic Measurement and Instruments, 2007. ICEMI '07. 8th International Conference on, 2007, pp. 1-298-1-302. In this paper we presented the concept of "Handwriting Recognition for Data Entry (HandRec)" which in this project, the goal is to achieve a more robust output.

III. PROPOSED SYSTEM

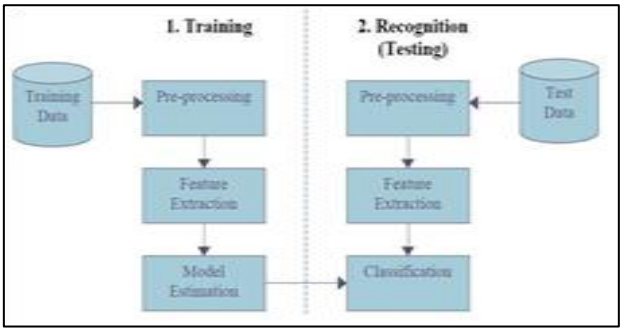

Fig. 1: System Flow

The goal of Optical Character Recognition (OCR) is to classify optical patterns (often contained A digital image) corresponding to alphanumeric or other characters. The process of OCR Involves several steps including

segmentation, feature extraction, and classification. Each of These steps is a field unto itself, and is described briefly here Implementation of OCR.

A. The Classification Process

There are two steps in building a classifier: Training and testing. These steps can be broken down further into sub-steps.

1) Training

- Pre-processing – Processes the data so it is in a suitable form for…
- Feature extraction – Reduce the amount of data by extracting relevant Information—usually results in a vector of scalar values. (We also need to NORMALIZE the features for distance measurements!)
- Model Estimation – from the finite set of feature vectors, need to estimate a model Testing
- Classification – Compare feature vectors to the various models and find the closest match. One can use a distance measure

IV. RESEARCH METHODOLOGY

The proposed work is planned to be carried out in the following manner

- Binarization – Usually presented with a grayscale image, Binarization is simply a matter of choosing a threshold value.
- Morphological Operators – Remove isolated specks and holes in characters, can use the majority operator.
- Segmentation – Check connectivity of shapes, label, and isolate.

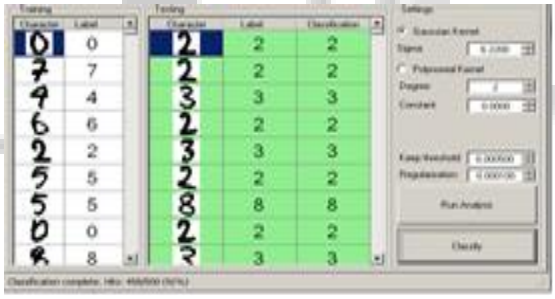

Fig. 2: Preprocessing

Once the network has been initialized and the training input space prepared the network is ready to be trained. Some issues that need to be addressed upon training the network are:

- How chaotic is the input space? A chaotic input varies randomly and in extreme range without any predictable flow among its members.
- How complex are the patterns for which we train the network? Complex patterns are usually characterized by feature overlap and high data size.
- What should be used for the values of:
  - Learning rate
  - Sigmoid slope
  - Weight bias
- How many Iterations (Epochs) are needed to train the network for a given number of input sets?
- What error threshold value must be used to compare against in order to prematurely stop iterations if the need arises.

Alphabetic optical symbols are one of the most chaotic input sets in pattern recognitions studies. This is due to the unpredictable nature of their pictorial representation seen from the sequence of their order. For instance the Latin alphabetic consecutive character 'A' and 'B' have little similarity in feature when represented in their pictorial symbolic form. The figure below demonstrates the point of chaotic and non-chaotic sequence with the Latin and some factious character set. The complexity of the individual pattern data is also another issue in character recognition. Each symbol has a large number of distinct features that need to be accounted for in order to correctly recognize it. Elimination of some features might result in pattern overlap and the minimum amount of data required makes it one of the most complex classes of input space in pattern recognition.

V. ANALYSIS OF RESULTS

Pattern detection or character candidate detection is one of the most importance problems. To recognize characters in a document picture. There are some researches that have proposed very good algorithms for object, but they are too complicated for a free-time project like my own. A small algorithm when teaching my daughter drawing solved my problem. Of course, it still has limitations, but it exceeded my expectations in the first test. In the normal, character candidate detection is divided to row detection, word detection and character detection with separate and different algorithms. My approach is little bit different. Detections used same algorithm with functions:

VI. CONCLUSIONS

A simple off-line handwritten English alphabet characters recognition system using a new type of feature extraction, namely, diagonal feature extraction is proposed. Two approaches using 54 features and 69 features are chosen to build the Neural Network recognition system. To compare the recognition efficiency of the proposed diagonal method of feature extraction, the neural network recognition system is trained using the horizontal and vertical feature extraction methods. Six different recognition networks are built. Experimental results reveals that 69 features gives better recognition accuracy than 54 features for all the types of feature extraction. From the test results it is identified that the diagonal method of feature extraction yields the highest recognition accuracy of 97.8 % for 54 features and 98.5% for 69 features. The diagonal method of feature extraction is verified using a number of test images. The proposed off-line hand written character recognition system with better-quality recognition rates will be eminently suitable for serval applications including postal/parcel address recognition, bank processing, document reading and conversion of any handwritten document into structural text form.

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