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Research Article

Design and Simulation of Handwritten Text Recognition System

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Abstract

In this paper, the proposed approach for handwriting recognition system preprocessing, segmentation and feature extraction with neural network for character recognition. Input is digitized image containing any text, which is preprocessed to segment it into normalized individual words. Further feature extraction is used for extracting the features of handwritten alphabets. A neural network is trained onto the dataset containing some samples for each of the alphabets for recognition. A new approach for character recognition is implemented in this paper which segments character recognition from the text, which improves the accuracy significantly. A neural network is being used for character classification which also helps in deciding the threshold value for the character separation from the running text word. The software tool used is Labview. The proposed recognition system performs excellently for printed text and separate character written documents with 99.9% accuracy and for cursive handwriting with 70-80% accuracy. And successfully recognized for single, double word and so on and also recognized for a complete sentence.

Keywords: *Handwriting text recognition, Digitization, Preprocessing, Segmentation, feature extraction, neural networks and Labview*

1. Introduction

Many documents used every day are handwritten documents, as for example, postal addresses, bank cheques, medical prescriptions, a big quantity of historical documents, an important part of the information gathered by forms, etc. In many cases it would be interesting to have these documents in digital form rather than paper based, in order to provide new ways to indexing, consulting and working with these documents. Handwriting recognition is the ability of a computer to receive and interpret intelligible handwritten input from sources such as paper documents, photographs, touch-screens and other devices. The image of the written text may be sensed off line from a piece of paper by optical scanning (optical character recognition) or intelligent word recognition. Handwriting recognition has been one of the most fascinating and challenging research areas in field of image processing and pattern recognition in the recent years. In general, handwriting recognition is classified into two types as off-line and on-line handwriting recognition methods. In online handwriting recognition, data are captured during the writing process with the help of a special pen and an electronic surface. Offline documents are scanned images of prewritten text, generally on a sheet of paper . The remainder of the paper contains 4 sections. Section 2 briefly describes the technology, section 3 methodology, Section 4 deals with the experimental results and the same are presented, finally a conclusion is drawn in Section 5.

2. Technology

The history of handwriting recognition systems is not complete without mentioning the Optical Character Recognition (OCR) systems which preceded them. Modern OCR was said to have begun in 1951 due to an invention by M. Sheppard called GISMO, a robot reader-writer. In 1954, a prototype machine developed by J. Rainbow was used to read uppercase typewritten letters at very slow speeds. By 1967, companies such as IBM finally marketed OCR systems. However in the late 60's, these systems were still very expensive, and therefore could only be used by large companies and government agencies. Today, OCR systems are less expensive and can recognize more fonts than ever before. Optical character recognition, usually abbreviated to OCR, is the mechanical or electronic conversion of scanned images of handwritten, typewritten or printed text into machine-encoded text. It is widely used as a form of data entry from some sort of original paper data source, whether documents, sales receipts, mail, or any number of printed records. It is a common method of digitizing printed texts so that the text can be electronically searched and stored easily with more compactly.

3. Methodology

The proposed methodology of the recognition system

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consists of five phases, namely, digitization, preprocessing, segmentation, feature extraction and recognition. The methodology is explained as shown in Figure 1.

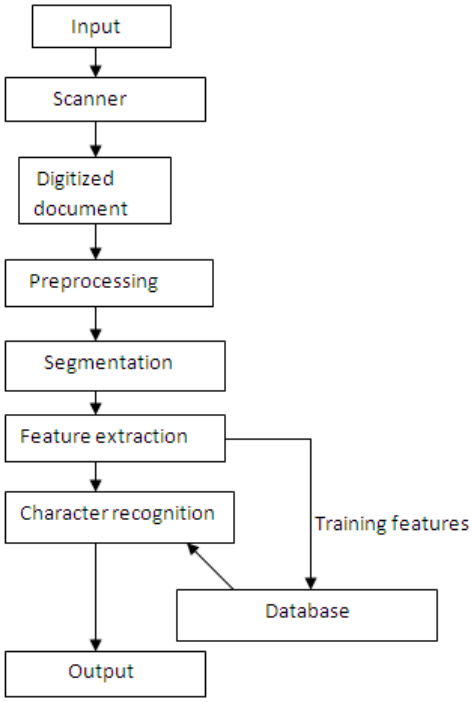

Fig. 1 Block diagram of recognition system

A. Digitization

Digitization is the process of converting the paper based handwritten document into electronic form. The electronic conversion is accomplished using a process whereby a document is scanned and an electronic representation of the original document, in the form of a bitmap image, is produced. Digitization produces the digital image, which is fed to the pre-processing phase.

B. Preprocessing

In this second phase the preprocessing of scanned image is been made. The scanned image is pre processed for noise removal. The resultant image is checked for skewing. There are possibilities of image getting skewed with either left or right orientation. Here the image is first brightened and binarized. The processes which get involved in pre-processing are illustrated below:

1. Binarization
2. Noise reduction
3. Normalization
4. Skew correction, thinning

1) *Binarization*

Binarization is a method of transforming a gray scale image into a black and white image through thresholding.

2) *Noise Removal*

Digital images are prone to many types of noises. Noise in a document image is due to poorly photocopied pages.

3) *Normalization*

Normalization is the process of converting a random sized image into a standard size .

4). *Skew correction, thinning*

Thinning is a pre-process which results in single pixel width image to recognize the handwritten character easily. It is applied repeatedly leaving only pixel-wide linear representations of the image characters

C. Segmentation

After pre-processing, the noise free image is passed to the segmentation phase. Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images.

D. Feature extraction

In this phase the feature extraction learns bit by bit with neighbouring letters and stores in the memory and it acts as the original database. In feature extraction, where individual image is considered and extracted for features. Each character is defined by the following attributes: (i) Height of the character. (ii) Width of the character. (iii) Numbers of horizontal lines present—short and long. (iv) Numbers of vertical lines present—short and long. (v) Numbers of circles present. (vi) Numbers of horizontally oriented arcs. (vii) Numbers of vertically oriented arcs. (viii) Centroid of the image. (ix) Position of the various features. (x) Pixels in the various regions .

E. Recognition

Neural network is used for classification and recognition. 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 perception (MLP) of the feed forward networks and the Kohonen's Self Organizing Map (SOM) of the feedback networks .

4. Results and Discussions

A. Result showing single word recognition

Complete single word recognition, indicates that the training is properly carried out

B. Result showing Double word recognition

Same as above result here the change is that double words are recognized at the same time.

C. Result showing the recognition for a sentence

The complete sentence is recognized as shown in figure 4.

Here in this accuracy achieved is 99.9% for separated characters

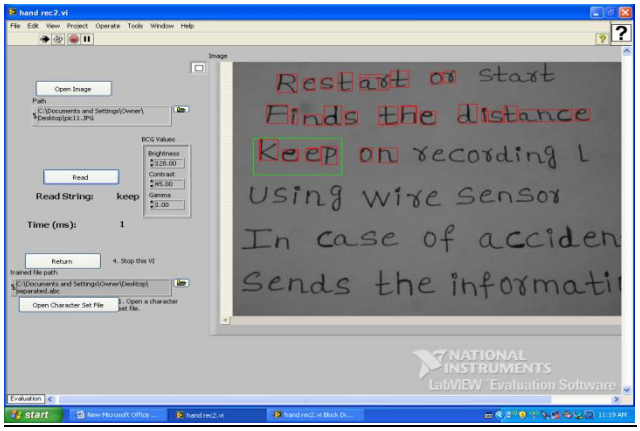

Fig.2. Example for single word recognition

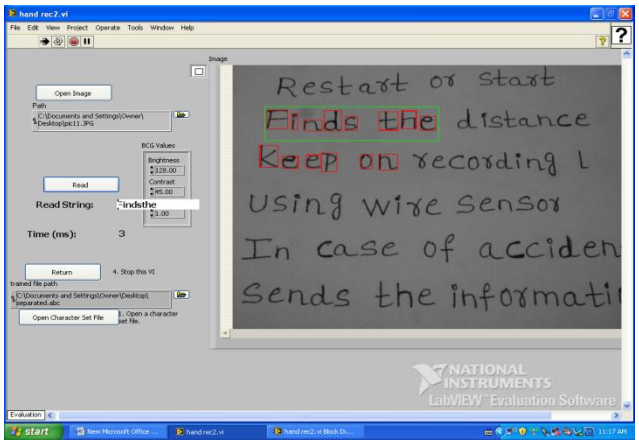

Fig.3. Double word recognition

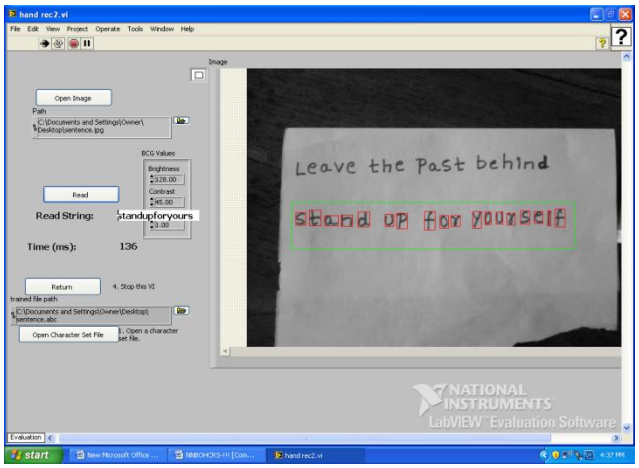

Fig.4. Recognized sentence

D. Result showing an example for cursive text

Here the accuracy achieved is 70-80% for cursive handwriting.

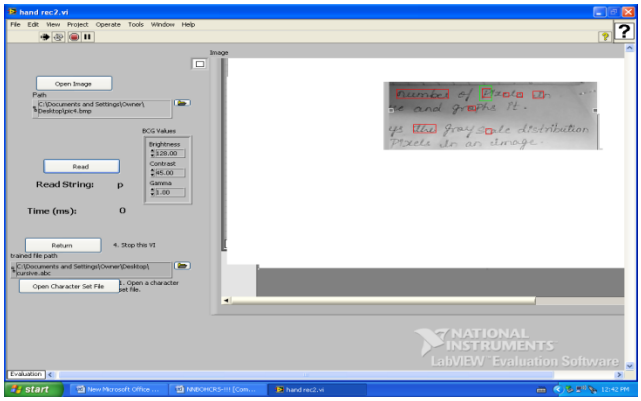

Fig.5. Example for cursive text

E. Result showing an example of not properly trained letters

Here, if the letter is not trained properly, then the output doesn't get recognized properly, it will show Question (?) mark.

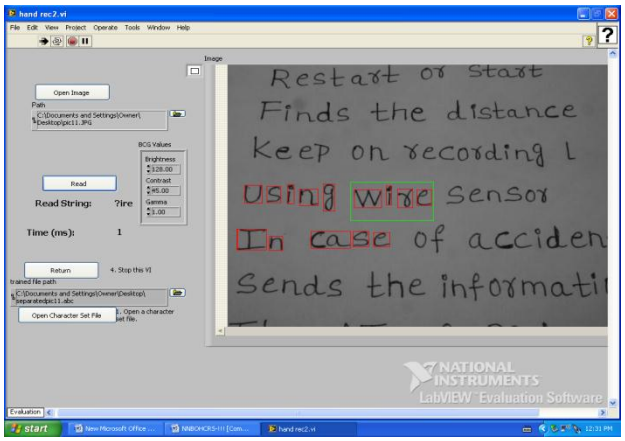

Fig.6. Example of a not properly trained letters

F. Result showing the recognition of special characters
The special characters are recognized easily as any other characters

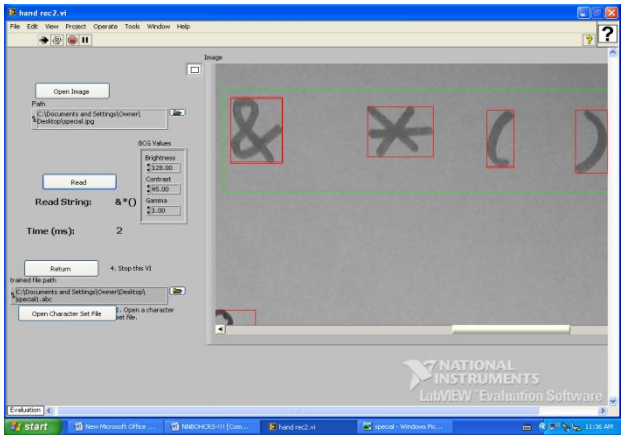

Fig.7. Recognized special characters

G. Result showing recognition of numbers

Similar to the special character the numericals are recognized.

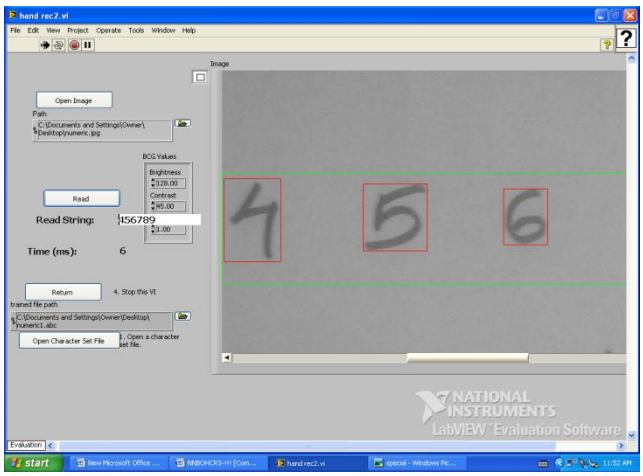

Fig.8. Example for recognized numbers

H. Result showing recognition for online image
Recognized for online image

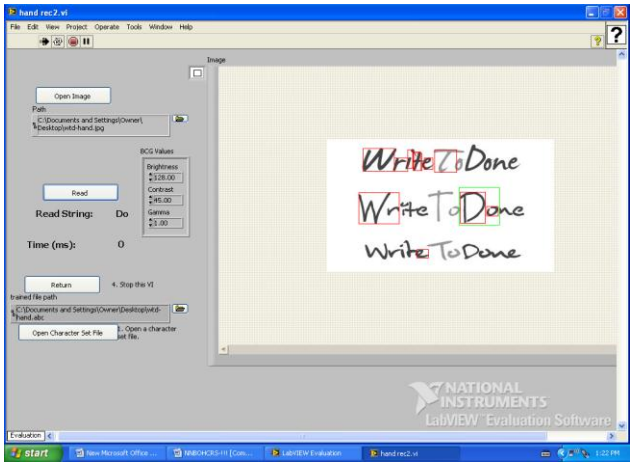

Fig.9. Recognized for online image

I. Result showing another example for recognition is that, here in this image if we select one time or, then the output is total number of or' s are present in the same image are recognized at the same time .recurring words

Conclusion

In this paper the work is carried out using LABVIEW. The tool is chosen because of its very effortless, unproblematic and uncomplicated to use and debugging is also simple. Codes are not necessary to write for the development of module. Algorithm used is pattern matching and method is segmentation based on neural networks for recognition and finally technology used is OCR. Successfully the algorithm recognizes the alphabets, numericals, special characters, double characters, etc,. Results are very promising indicating that a neural networks based recognition can produce recognition rates of up to 99.9% accuracy for handwritten words and for cursive handwriting with 70-80% accuracy**.** And even recognized for a complete sentence. Here results are based on a small database of handwritten words. In future the work can be extended to a larger database and for other scripts and scribbling.

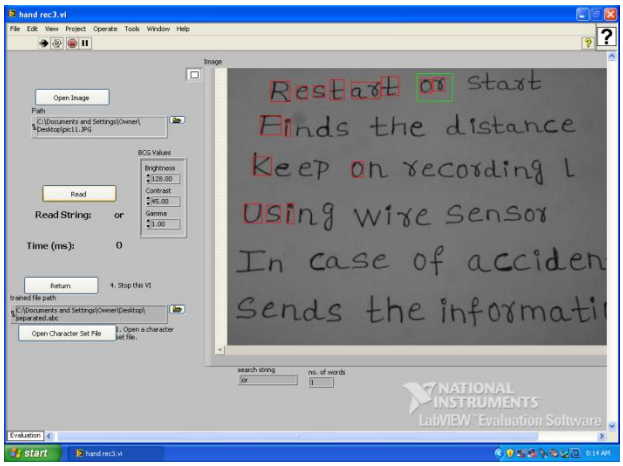

Fig.10. Recognized for recurring words

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