

Handwritten Text Recognition System Using Neural Network

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Abstract - Now-a-days Text Recognition has become very popular and challenging research area in the field of image processing. In this paper we discuss implementation of Handwritten Text Recognition (HTR) system using Neural Network. The proposed system recognizes handwritten English texts and Numbers. HTR system takes image file of handwritten text as input through user interface. The given input processes through functional modules like pre-processing, segmentation, feature extraction, classification and recognition. CNN technique is used for extracting features. IAM dataset is fed for training model. The GUI is built using Django. The whole system is implemented using python language and tools like Anaconda, TensorFlow. The system was efficient and accuracy rate is 90% to 100%.

Key Words: HTR, Neural Network, CNN, IAM dataset, Django, Python.

1. INTRODUCTION

With the growth of advances in technology, digitization and handwritten text recognition system has got popularity nowadays. The new technologies in mobile phones and computers which have great hardware ability and quick processing are efficient to develop a software application that can run on a mobile phone as well as computers for recognizing and digitizing handwritten texts. 'Handwritten Text Recognition' is a software application that reads an image, taken from camera or scanned image file of handwritten text as input and convert that handwritten text into digital form by recognizing characters of handwritten text. A lot of researches and works are going on for implementing a better system. Accuracy, flexibility, and speed are the main features that characterize a good Handwritten Text Recognition system. The accuracy rate of recognition of these algorithms depends upon choosing features. The performance of the systems has been constrained by the dependence on font, size, and orientation. In our system, we use Neural Network approach for implementation. It consists of Convolution Neural Network layers and Recurrent Neural Network layers. Handwritten text using the Neural Network approach can effectively and efficiently recognize handwritten characters with high accuracy. A Neural network is a Machine learning algorithm which is a family of statistical learning models inspired by a biological neural network. This system involves phases like image pre-processing, segmentation, feature extraction, classification, and recognition. Image pre-processing involves

avoiding noises present in the input image by several methods for easy recognition. The segmentation phase takes pre-processed images and texts are segmented into characters. The feature extraction phase involves the segmentation of characters into multiple features and is arranged as a feature vector. The classification phase uses the NN algorithm for classification. Recognition is the final phase that recognizes characters based on the accuracy of prediction and gives a final digital form of handwritten text. The application of Handwritten Text Recognition is extensive. This system makes work easy and saves precious time in our busy life. It can be used in schools, government offices, organizations, by which they can convert their handwritten documents into digital form. This system is also used in banks, hospitals, universities, etc. By using Pattern matching algorithms this system can be further implemented to give additional features like searching of required word or sentence in the digitalized text.

2. LITERATURE SURVEY

2.1 Optical Character Recognition using Artificial Neural Network

Optical Character Recognition (OCR) is a system which converts printed or handwritten characters into machine usable text using Artificial Neural Network. The objective of this work is to convert handwritten text or printed text recorded using scanner or camera into digital format. In this research work Artificial Neural Network (ANN) algorithm has been used to accomplish recognition task. Their architecture contains modules like: Document accessing module, Pre-processing module, Feature improvement module, Feature Extraction module, Neural Network module and finally User Input module. OCR system performs well against all the inputs.[1]

2.2 Text Recognition from image using Artificial Neural Network and Genetic Algorithm

Handwritten Text or Character Image Recognition from is difficult. The decoding of handwritten texts has important applications in many areas. This research paper proposes Text Recognition system using ANN and Genetic Algorithm to solve text recognition and classification problems. In this work, Neural Network is proposed to train the system for deciphering texts from .jpg or .pdf images which are not readable and Genetic algorithm is proposed to performs crossover on sections and parts of text data from image file to train the system.[2]

2.3 A Programming based Handwritten Text Identification

This work proposes a handwritten text categorization technique using supervised and unsupervised learning. For alpha numeral identification learning system based on neural network is used. The identified characters are converted into printed form. A word matching algorithm with a programmed glossary is used to find out the most appropriate words. In this work, the printed text is identified by matching the keywords of the text with the programmed glossary of different subjects. After text identification, the inappropriate words are corrected to match the respective subject of the text, which further improves the meaning of the identified handwritten text.[3]

2.4 Application of Artificial Neural Network Model for Optical, Character Recognition

In this paper, for OCR system a neural network method, which effectively reduce the image processing time while maintaining efficiency and versatility has been discussed. Factors involved in this implementation are: an optimal selection of features and low image processing time. This system contains functional modules like image acquisition module, image Pre-processing module, feature extraction module and neural network module. Enhancement to their OCR system is inbuilt training pattern editor and a user interface. This system has been implemented using C++ and Turbo vision.[4]

2.5 Handwritten Character Recognition Using Deep-Learning

An innovative method for offline handwritten character detection using deep neural networks has been presented in this research work. In this system they used OpenCV for performing Image processing and have used TensorFlow for training the neural Network. For processing of input image, the methods involved are: Pre-processing, Conversion to Gray-Scale, Thresholding and Image Segmentation. The CNN model has been used in this system. CNN model is good at image recognition. NIST database which contains thousands of images of handwritten characters have been used for training. The tools used for implementation are Python, Android, OpenCV and TensorFlow.[5]

3. PROPOSED SYSTEM

Neural Network is one of the popular algorithms in machine learning. It has proven that the Neural Network performs very well in accuracy and speed over other algorithms. In proposed system we used neural network algorithms. We used following methodology, design, tools to build HTR system.

3.1 Methodology

Step 1: Image Acquisition: Getting input i.e. handwritten text image of .jpg,.png,.jpeg format from camera through GUI.

Step 2: Image Preprocessing: The image is preprocessed using different image processing algorithms. In this module data augmentation, changing image contrast, changing image width takes place.

Step 3: Segmentation: After preprocessing of the image segmentation is done. This is done with the help of following steps:

1. Remove the borders
2. Divide the text into rows
3. Divide the rows (lines) into words
4. Divide the word into letters

Step 4: Feature Extraction: Once the character is segmented, features are extracted using CNN. And features are fed into training model.

Step 5: Classification and recognition: In this phase, we are going to train the model using Neural Network, calculate CTC loss, Backpropagate through the network to reduce loss, finally save the trained model and use the model for classification and recognition.

Step 6: User interface for displaying output: Getting final output of above steps i.e. input handwritten text in digital form.

3.2 System Architecture

The proposed system takes input from the user through the user interface which is implemented using Django in python language. After getting input, the system will process an image then the output of image process module will give as input for segmentation process, after segmentation the system will do feature extraction process using CNN, the output of feature extraction process is fed as input for classification and recognition module where the model is trained by IAM dataset using Neural Network and finally recognized text will be given as output in the editable form through UI for the user.

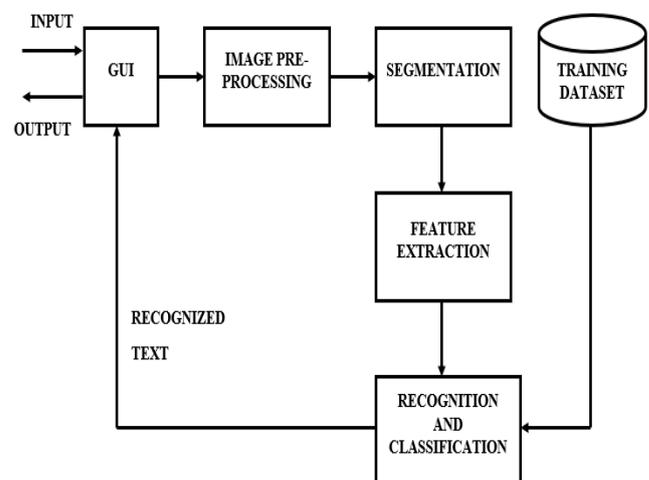


Fig 1: Handwritten Text Recognition System Design

3.3 Neural network algorithm

A neural network algorithm is defining as a biologically inspired model that consists of network architecture composed of artificial neurons. This algorithm contains set of parameters, which can be adjusted to perform specific task.

Convolution Neural Network: Convolutional Neural Networks (CNN) is one among the variants of neural networks used heavily within the field of Computer Vision. It derives its name from the sort of hidden layers it consists of. The hidden layers of a CNN typically contain convolutional layers, pooling layers, fully connected layers, and normalization layers. Here it simply means rather than using the traditional activation functions defined above, convolution and pooling functions are used as activation functions. In HTR system input image is fed into CNN layers. These layers are trained to extract features from the image. Initially, the convolution operation, which applies a filter kernel of size 5×5 in the first two layers and 3×3 in the last three layers to the input. Then, the non-linear RELU function operation is done. Finally, a pooling layer summarizes image regions and outputs a downsized version of the input.

Recurrent Neural Networks or RNN, are a really important type of neural networks heavily utilized in Natural Language Processing. In a neural network, an input is processed through layers and an output is produced, with an assumption that two successive inputs are independent of every other. The RNN propagates relevant information through the feature sequence obtained from CNN operation. The popular Long Short-Term Memory (LSTM) implementation of RNNs is used, as it will propagate information through longer distances

3.4 Tools Used

To develop this offline Handwritten Text Recognition system, we used Python language and tools like Anaconda, TensorFlow, Django.

4. RESULTS AND DISCUSSION

The results show that the system has performed well against inputs given. For some inputs we got 100% accuracy. HTR system works for handwritten English words, lines, multiple lines, numbers, and also for input images containing printed texts. Fig-2 shows the user interface of HTR system where user chooses input image which contains handwritten text that should be recognized. Fig-3a and 3b shows the input text file fed as input and the output of HTR system respectively. Fig-4a and 4b shows input and output of cursive handwritten recognition

The following figures show the result of the HTR system. It consists result of the registration form, login form, index page, output of the given input image.

4.1 User Interface

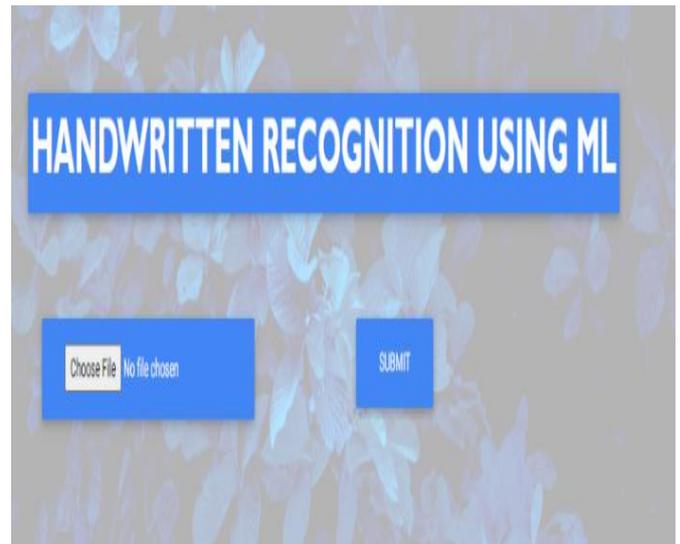


Fig 2: User Interface

4.2 Input Image and Recognized Text

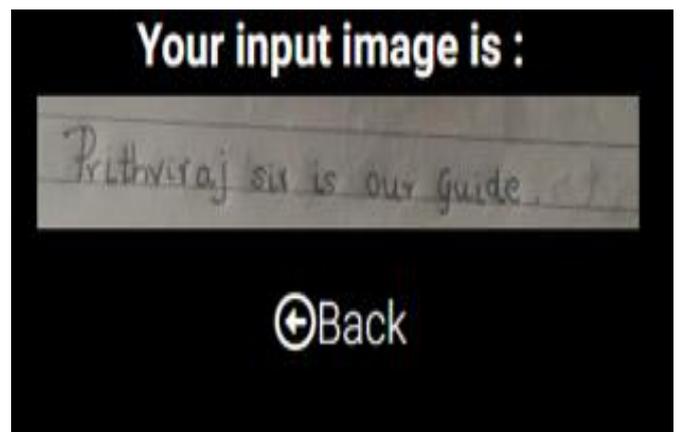


Fig 3: Input Image



Fig 4: Output

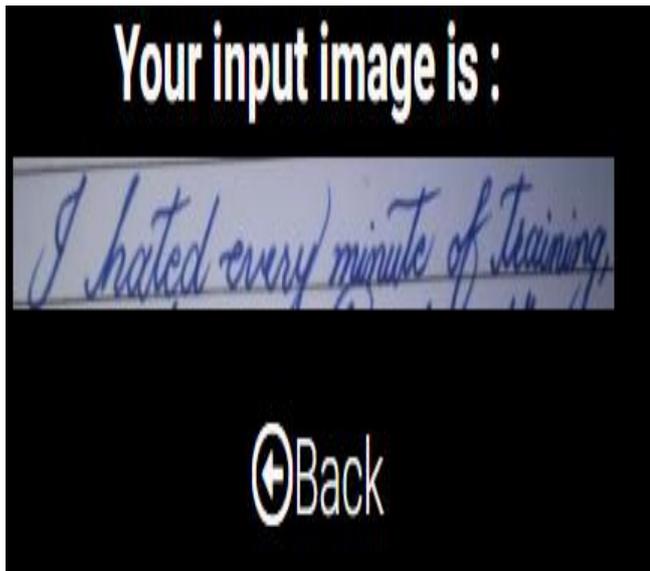
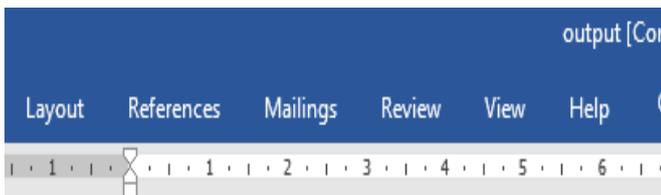


Fig 5: Cursive Handwritten text



I hated every minute of training,

Fig 6: Recognized text in editable form (.docx form)

4.3 Discussion

Below table-1 shows the results analysis for some inputs. The table gives the accuracy percentage for input images which contains handwritten texts. For result analysis we took n number of test cases, for example as shown in table -1 and we got 100% accuracy for some cases and for other cases some of the characters were wrongly recognized. The overall accuracy we got for these test cases is 98%. Hence hypothetical analysis gives accuracy in range between 90% (for incorrect handwriting or image) to 100%. This HTR system addresses limitation of the existing system like: Some existing Handwritten text recognition system do not detect cursive texts. Whereas our HTR system is able to recognize cursive texts. Therefore, this HTR system is accurate and efficient.

Table 1: Result Analysis for given inputs

No of Characters	No of Characters Correctly Recognized	Accuracy
27	27	100%
64	64	100%
127	127	100%
36	35	97%
88	86	97.7%
155	152	98%

5. CONCLUSION

“A real-time Handwritten Text Recognition system” is aimed at recognizing handwritten text from real-world image which is challenging research in the field of image-processing. This project establishes an efficient system that converts the input image of handwritten text into a digital format using NN. The input pattern of this system is to read the input image, pre-process the acquired image, segmentation of the pre-processed image, feature extraction of the segmented image, finally train the model for recognizing text and display the output in the form of editable format. Some external and internal factors affect the accuracy of recognition, such as image degradation and incorrect handwriting. Since the input for this project is an image of handwritten text, 100% accuracy cannot be obtained for some incorrect handwritten characters. Finally, we can conclude that this system gave accuracy in the range of 90% to 98% for incorrect or noisy handwritten texts and 100% accuracy for correct handwritten texts. Future work that can be added to this project is, the Handwritten text recognition can be done for other local languages, also for recognizing handwritten text in pages and more work can be done on each module for higher accuracy.

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