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HANDWRITTEN TEXT RECOGNITION SYSTEM

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Abstract: Handwriting detection is a computer system or capability that receives and interprets meaningful handwriting input from a variety of sources, including paper documents, touch displays, photo graphs, and so on. One type of area pattern recognition is handwritten text recognition. Pattern recognition is a technique for grouping or categorizing data or objects into one of several categories.. We represent a novel deep neural network-based approach for offline handwritten text recognition in this study. It has gotten easier to train neural networks as a result of the vast amount of data available today and the multiple algorithmic improvements that are occurring. This handwritten character recognition system based on image segmentation.

Index Terms **– Handwritten text recognition, Convolutional neural network, and recurrent neural network.**

I. INTRODUCTION

One of the most important ways of daily communication is handwriting. Despite the availability of modern writing tools, many individuals prefer to take notes in the old-fashioned way with pen and paper. However, there are certain disadvantages to writing text by hand. It is difficult to store and retrieve the physical paper and to give it to the one who needs it. It's hard to store, access, and process physical data on a regular basis. It is necessary to update the data manually, and work is required to keep the data organized properly. We have been experiencing serious data loss for a long time due to the old manner of data storage. As a result, a lot of critical information is lost or never analyzed since papers are never converted to digital format. We chose to address this issue in our project because we believe that the considerably greater ease of handling digital text compared to written text will allow people to access, search, share, and analyze their records more efficiently while still allowing them to write in their preferred style. Handwriting recognition systems are available in two types that is offline and online. Offline systems use handwritten input in the form of an image, which is known as optical character recognition (OCR). Online systems use a recorded list of pen tip motions to represent the handwritten character.

The aim of this project is to further explore the task of classifying handwritten text and to convert handwritten text into the digital format. Handwritten text is a broad concept, so we wanted to reduce the scope of the project by defining what handwritten text means for our purposes. In this project, we took on the challenge of classifying the image of handwritten text. The purpose of this project is to go deeper into the problem of identifying handwritten text and converting it to a digital representation. Handwritten text is a broad word, and we intended to restrict the scope of the project by defining handwritten writing specifically for our needs. We took on the task of identifying the picture of handwritten text in this research.

II. LITERATURE SURVEY

[1] Andrew Smith have introduced Offline handwritten text recognition is the process of extracting text from a photograph and translating it to a digital image. The past approaches were dependent on lexical segmentation, complex feature extractions along with some knowledge related to the language. The proposed approach combines a convolutional recurrent neural network with connectionist temporal classification, which is a sort of neural network output and will be connected with a score function, to recognize offline handwritten texts. The applied methods are character independent which makes the model globally trainable and can be applied for various languages. Optical character recognition is the process of converting printed texts, whether they are printed or handwritten, into digital, machine-readable language. To recognize texts, a convolutional recurrent neural network with three neural network blocks was used: a convolutional block for image feature extraction, a recurrent block for sequence learning, and a final block for labelling with connectionist temporal classification linked to the scoring function.

[2]Thomas Deselaers developed the handwritten text Recognition (HTR) system is implemented in Optical Character Recognition (OCR) model. Three techniques that were used to build a scalable handwritten text recognition were HTR system, OCR model and a Dual head which is the integration of HTR into OCR. When compared to handwritten text recognition systems and optical character recognition models, the dual head model was able to categorize both printed and handwritten text, yielding the highest accuracy. Firstly there is a need of a good amount of training data with good quality and then a line recognition model based on the neural network and without any recurrent connections.

[3] Anshul Gupta have introduced the method of identifying offline handwritten recognition of English words in which individual characters are recognized first, followed by the complete word. The primary approaches to handwritten text recognition are divided into two categories: holistic and segmentation. For the recognition of limited size vocabulary holistic based approach is used where from the entire word image the global features that are extracted are considered. When the vocabulary grows larger, the complexity of this holistic approach grows as well, resulting in a decrease in the rate of character recognition. The other is segmentation-based, which uses a bottom-up approach that starts at the character level and works its way up to generating a meaningful word. After the segmentation is done the problem will be reduced from recognizing an entire word into recognizing a single character and thereby increasing the size of the vocabulary. To identify the individual characters neural networks will be used

[4] Peng Ren Using deep learning techniques, they have developed a handwritten text recognition programme. The proposed method is based on a detection algorithm for objects. Here the recognition of offline handwritten texts takes place in two steps that is first by preprocessing then by the recognition of the characters. Preprocessing is done first with a quicker R-CNN, and then the character is recognized with a convolutional neural network. The problem of the segmentation of characters have been reduced as the detection of objects. There will be a preliminary processing where the segmentation of sentence into words takes place and then in the meticulous processing there involves segmentation of words into characters and later the characters will be recognized.

[5] Francisco Zamora-Martinez introduced a new technique for removing slants from handwritten text has been developed, and the size of the text images has been balanced using artificial neural networks. Normalization of the handwritten text from the scanned image includes image cleaning, page skew correction and line detection. Skew-corrected lines database have been used so pages skew correction and line detection are skipped. There are various preprocessing steps to reduce the variations in handwritings. The line that has been scanned from the image is first cleaned before preprocessing. The next step is the slope removal and then the slant removal. When the entire image is free from slopes and the slants normalization is done for the size of the text line so as to minimize the changes in size and the position. The ANN system have been used for recognizing the offline handwritten text lines.

[6] Martin Rajnoha introduced the method for recognition for handwritten text which is of comenia font. The proposed method has preprocessing of data, normalization of data and based on the Support Vector Machine there is an optical character recognition. The comenia script is simple and modern and is same as block letters. The proposed model made use of more than one classification model for the purpose of character recognition which showed an increase in the accuracy when compared with the single model approach. The entire method of recognizing handwritten texts involves feature extraction and it uses support vector machine for the classification.

[7] Batuhan Balsi developed method to classify the individual handwritten word so that it can be translated to a digital form. To approaches have been used in this method first is to classify the words directly then then the segmentation of the characters. To train a model for word classification, a convolutional neural network with several topologies was utilized. To construct the bounding boxes for a single character long short term memory networks with convolution is used. The segmented characters are then transferred to a convolutional neural network for classification, and each word is then reconstructed based on the findings of character classification and segmentation. To improve the results of direct classification for a word made an alternate move by segmenting the characters and then the word is reconstructed by classifying each character individually.

8] Rohan Vaidya introduced the method for the detection of offline handwritten characters using deep neural networks. The handwritten character recognition system based on image segmentation have been designed in this proposed method for the development of this system python programming language have been used. Various tools like android opencv and tensor flow have been used to design the offline handwritten character recognition system. The built Android application must allow the user to take a photo of handwritten text that must be identified using the Android phone's camera. In order to serve the predictions there is a use of pretrained neural network model then the image processing operation is performed. The neural network model is trained using tensor flow. The processing of image involves preprocessing where the noise from the image will be removed. After the preprocessing there will be conversion of image into grayscale. After the image has been converted to grayscale, thresholding will be used to separate the image's darker and lighter regions.

[9] Vu Pham introduces a recurrent neural network to recognize the handwritten texts where the image which is taken as an image is divided into blocks and is then sent to the long short term memory layers which will scan the input and the output of this long short term memory layer will be sent to a convolutional layer. The output of the convolutional layer will be added from vertically and then will be given for softmaxing where in the softmax layer and then the output of the softmax layer is processed by connectionist temporal classification. Here dropout involves removal of some hidden units from the training randomly and then using it for the purpose of testing. Another method which is same as that of dropout is Drop connect where instead of dropping the hidden units' values here the connection is dropped. Both convolution and recurrent layers are compatible with the dropout. First the dropout will be applied for the top layer of the long short term memory. If the size of the model is large and if there is an over fitting found then the dropout is helpful.

III. DATASET

A huge set of vision dataset which is used training and testing is IAM

figure 1.Example image from IAM dataset

The IAM Handwriting Database contains handwritten English text in a variety of forms that can be used to train and test text recognizers, as well as undertake writer identification and verification studies. In 2002, the IAM Handwriting English Sentence Database was released. Forms of unconstrained handwritten text were scanned at 300dpi and recorded in the database as PNG images with 256 grey levels.

IV. METHODOLOGY

Convolution Neural networks for Text Recognition

In pattern recognition and image processing problems neural network are often used. CNN is the most promising method for doing so. It is a deep learning technique which is inspired by the neuron connectivity pattern in animal visual cortex. CNN is mainly used in image recognition, object recognition etc. The CNN model for recognizing the digits is constructed using the KERAS library of python and Tensor Flow as a backend. Sequential Model is used as classifier which consists of linear stack of layers. The weights and biases of the neurons in CNN can be learned. Compared to others CNN requires minimum pre- processing. The input is always a vector in neural network but in CNN the input will be a multi channeled image. The CNN comprises of an input layer, hidden layers and an output layer. The hidden layer constitutes the convolutional layer, Rectified layer unit (ReLU) i.e. activation function, pooling layers, normalized layers and fully connected layers.

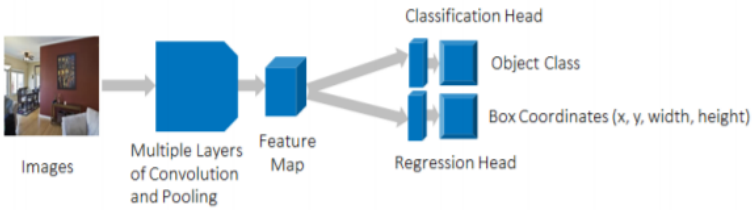

figure 2. Convolutional neural network

The input layer consists of 28 by 28-pixel images which means it contain the network of 784 neurons as input data. The layer next to input layer is convolutional layer which receives the output from the input layer. In the convolutional layer, the input is subjected to a convolution procedure. The operation performed in this layer helps in reducing the number of free parameters. And design each filter such that it slides above the input data to have pixels with the utmost intensity.

The Rectified Linear Unit (ReLU) is an activation function which is a linear function, easy to use and achieves better performance. It doesn't saturate either. The concept of pooling layer is to merge the product of neuron at one layer into single neuron at the next level. The completely linked layer calculates the input digits' score. At the end a SoftMax classifier is applied at the end which returns the probabilities of all output classes. From all these values, the class with the largest value is selected as a final classification. To work on Keras API, it is converted into 4 dimensional NumPy arrays. The normalization is done by dividing RGB code by 255. Adam optimizers is used to update the neuron weights and it require little memory.

Faster R-CNN:

It consists of two modules: a deep convolutional network based on regions and a Fast R-CNN detector that use these areas. This technology generates a uniform network for object detection. This algorithm is incredibly fast because the time spent on each image is decreased to 10ms. This strategy, however, requires a lot of computation, making it unsuitable for applications that must run on CPUs with limited processing capability.

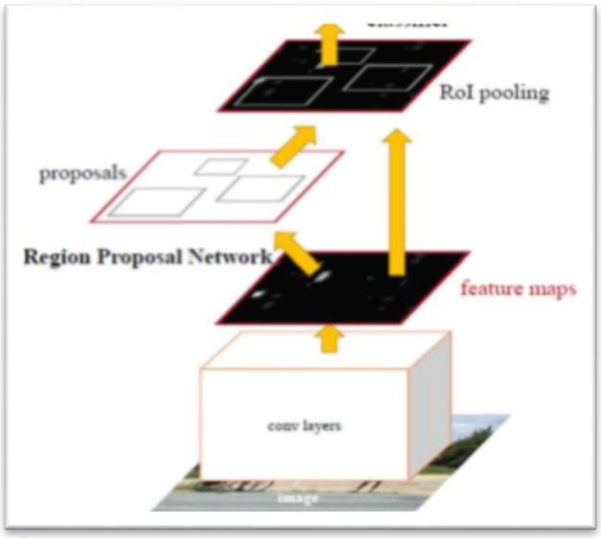

figure 3. faster r-cnn

Admin will load the handwritten image dataset. The size and color channels of images in computer vision tasks, as well as the amount of the dataset, vary. The more dimensions a picture contains and the higher the values of each dimension, the more computationally demanding it is for an algorithm to process. As a result, a CNN's job is to compress images into a format that is easier to calculate while still preserving crucial predictive properties. Document analysis, often known as pre-processing, is the process of extracting text from a document. Background noise reduction, filtering, and original picture restoration are all examples of pre-processing. Read the image files in the data folder. Decode the png file into RGB pixel grids with channels. Convert them to floating-point tensors for neural network input. Between 0 and 255, rescale the pixel values (as training neural networks with this range gets efficient).

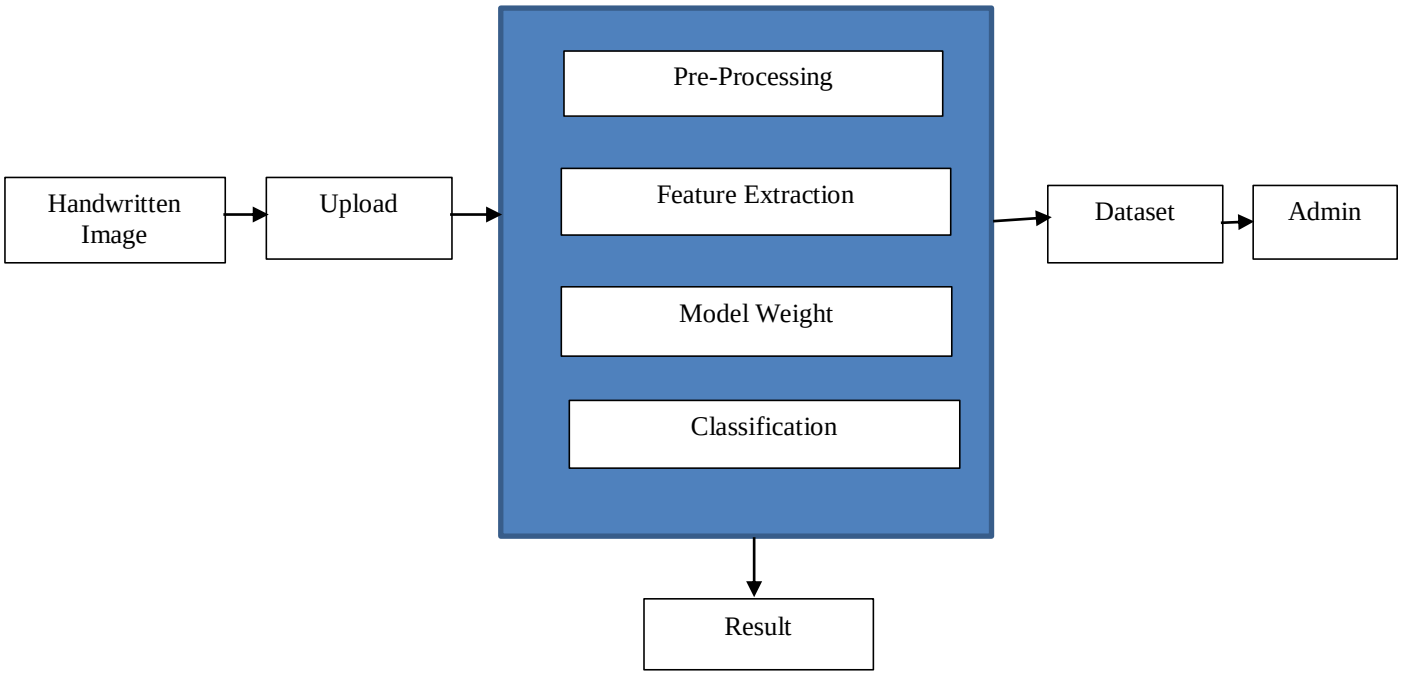

figure 4. proposed system

In the CNN block, there are seven convolutional layers. To minimize internal covariate shift, a max-pooling layer is applied after the first, second, fourth, and sixth layers for down sampling, and a batch normalization layer is applied after the third and fifth levels for batch normalization. By replacing each sub-region with the sub-largest region's value, max-pooling lowers the dimensionality of a matrix. Rectified Linear Unit function activates all convolutional layers.

Feature extraction is a step in the dimensionality reduction process, which divides and reduces a large collection of raw data into smaller groupings during the feature extraction process, each character is represented as a feature vector, which gives it its identity. Feature extraction's main objective is to extract a collection of features that improves recognition rate.

A neural network's Model Weight parameter changes input data inside the network's hidden layers. We need to supply a starting value rather than an empty placeholder for the weight and bias values because these are the parameters that the network will alter during the training phase. These values are used in the activation functions of neurons, and they are essentially where the network learns. The user has to upload the image and the uploaded image is compared with model weight for classification. An input character is classified by comparing it to a collection of templates (prototypes) from each character class. If the input characters match the (prototypes) templates, the identity of the character is changed to the most comparable template. All of the aforementioned stages are utilized in a pipelined way, which means that the success of each step is dependent on the success of the previous phase, and all phases are dependent on the success and accuracy of each other phase since the output of one phase is used as input to the following phase.

V. RESULT

The result that has been generated by the system after submitting the text file in the system.

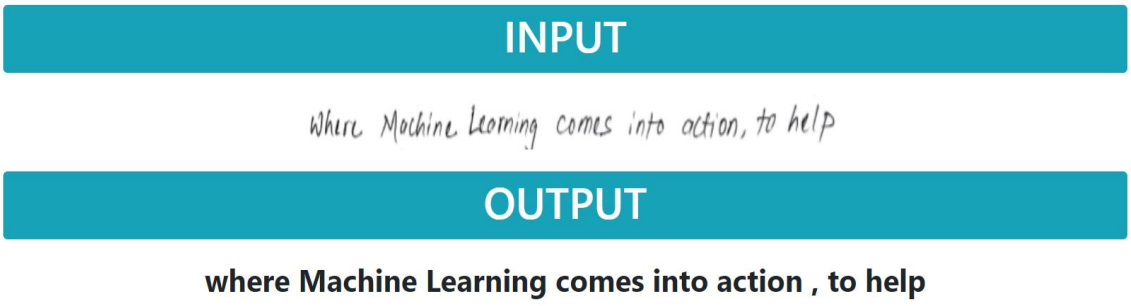

figure 5. recognition of the text

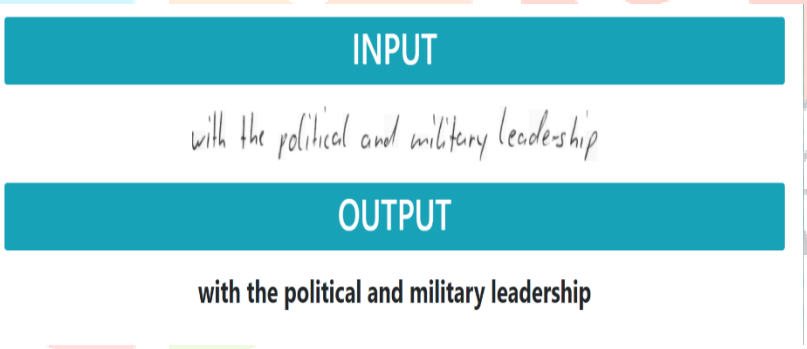

figure 6.recognition of text

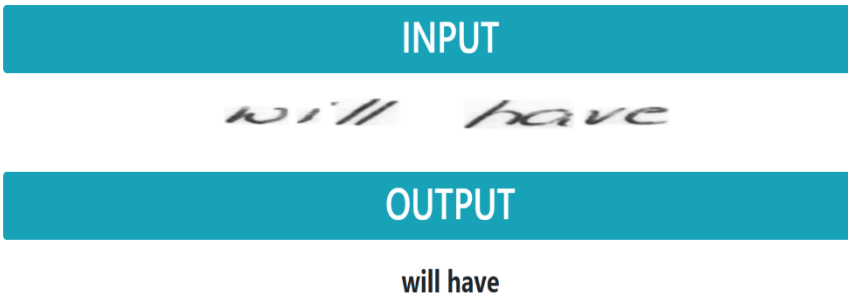

figure 7. recognition of text will have

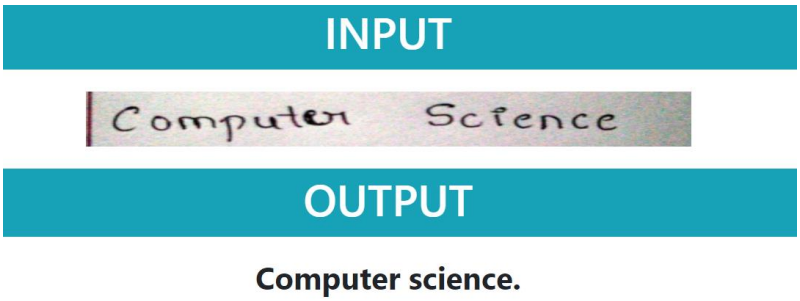

figure 8. Recognition of the text

VI. CONCLUSION AND FUTURE ENHANCEMENT

We devised a workable method for recognizing handwritten letters in a fraction of the time. The difficult of handwriting text recognition is character segmentation, by transforming the problem of character segmentation into the object detection, successful finishing character segmentation with high accuracy, so the method based on Faster-CNN is used to overcome this difficult. Then finishing character recognition based on CNNs for each character. We have used method that finishes handwriting text recognition through opening a new dimension, transforming the problem into many sub-problems by modular designs.
The proposed system can be show the character recognition for the whole page. The system can be highly accurate while also being quick.

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