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## A Literature Review On “Handwritten Text Recognition”

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### ABSTRACT :

With the considerable increase in the application of Handwritten text/character recognition in various domains like pattern recognition , image processing , processing application forms , digitizing ancient articles, processing address, bank check processing and many other handwritten hand processing fields are increasing in popularity. Several methods have been suggested since the last three decades. Handwritten text recognition has drawn the attention of researchers , the well known techniques are CNNs and RNNs (Convolutional Neural Network and Recurrent Neural Networks) . Overall , image processing along with Deep Learning techniques have the potential to improve the accuracy and make handwritten text more efficient.

### I. INTRODUCTION :

Information from handwritten documents must increasingly be saved for later use. Taking pictures of handwritten documents and saving them in image format is a simple way to store information. OCR is based on the process of identifying the text or letters that are visible in the image. Recent research has found that it is difficult to extract text from images because of writing styles, stroke variations, and cursive handwriting. Character recognition is something that we do all the time in our daily lives. Brain performs Handwritten text/character/digit recognition all the time and compares it all the time with the previous experience and responds while reading signs, notes or any book. And as a result , Handwritten text gets recognized. Various sources exist where handwriting can be formed like images, docs , bank cheques , books and many more. There are basically two main recognition of texts, the first

one is handwritten that is normally in scanned format or in image form, and the other one is online capture that has information available according to boundaries. Today we have many Handwritten text recognition methods that are more accurate and efficient with such a wide variety of hand text/characters.

## II. LITERATURE SURVEY :

There have been many research papers published that use deep learning techniques for handwritten text recognition. A few of them are mentioned below.

- This paper is about OCR. A pipeline development needed to extract text from identity cards or to read the number plate of the vehicle. Some important pipelines are text recognition and detection. The preprocessing is needed for making the images more useful and decreasing the noise. Recently for Chinese identity card detection some more development for the pipeline of OCR has been done like statistical image processing and convolutional neural network. Clean background is needed for the algorithm to work therefore a very clean dataset with less distraction is used. In this paper the focus is on comparing the models such as statistical models and neural models. Two works are highlighted in this paper. 1. Recognition and verification of the user faster. 2. A set of pipelines has been developed by practicing various approaches. The dataset is vast as it contains high contrast pictures to some pictures which have missing data and some pictures which have more black noise as compared. Methods which are followed in developing this model are: 1. Datasets have images of train, validation and test data set. More time is spent on Training instead of validation. 2. For making end to end pipeline structure the experiment has been carried out on pre trained models. Detectron 2 is used which is developed by Facebook and it is used for card detection. The architecture is basically object detection architecture. Blur detection is added so that images of the low

resolution which are received from the users can be identified properly. The image whose threshold is below 50 will not be used for letter detection. For deciding the threshold a lot of trials has been done. Two methods are used for text detection. Blur contour is based on two things i.e. faster RCNN and Detection. Contour based detection is particularly used for detecting the text and it is very helpful. If the proper thresholding and pre-processing of the image will be done then the image can also be detected. In the text detection phase RCNN is generally used. This approach has better time for detecting the text. An end to end pipeline is developed by combining several models for optical character recognition. This model uses a neural based approach and gives more accuracy than the model which uses image processing techniques. The disadvantage is that it is unable to detect fraud cases.

Automatic handwriting text recognition is referred as the ability that identifies handwriting. Text can be of two type: offline or online. Offline means textual documents. Online documents are captured while writing using sensors. The offline image is obtained by scanning the image. There are many complexities related to the recognition of text such as width, ink, size of text, style of writing etc. Convolution neural networks are a very widely used technique. CNN is a neural network that extracts very important features from a set of multi dimensional input data sets. These important features are very important for fields such as image processing and computer vision. It works very well in recognising the structure of handwritten text recognition thus works very good for handwritten recognition system. The steps which are followed in handwritten recognition system are: 1. Image Acquisition: The image should be in specific format and can be done by scanning the image. 2. Pre processing: pre processing tends to remove non discriminatory features from handwritten text recognition. The text readability is enhanced by this. Some important pre processing steps for directly

scanned images such as binarization, noise removal, baseline detection, cleaning techniques, filtering image. Pre processing main aim is to improve the recognition of the process. 3. Segmentation: The breaking down of paragraphs into sentences and sentences into words and words into characters so that every segment is readable. Fundamental recognition errors can be known using segmentation and thus accuracy can be increased. 4. Feature Extraction: Here the pattern plays an important role. For removing mis classification and improving the classification relevant patterns has to be recognised. This step saves time in training. There are three categories of feature extraction. (a) structural features related to geometrical characteristics of image. (b) statistical features related to pixels. (c) For converting into more compact form, global transformation is there for converting the pixel. 5. Classification and Recognition: By using classification object is classified into one of given set of classes. Features extracted from previous step helps in decision making phase.

Some of techniques for handwriting classification can be of different types for example deep neural network, k nearest neighbor and support vector machine CNN are very useful today for text recognition and CNN has been used for many languages detection such as Latin, Arabic, Bangla, English. Different architectures for different language recognition system because of difference in writing styles. Pre processing and data augmentation are important for better accuracy. There is challenge when we try to accomplish greater accuracy with less complexity. CNN with SVM will increase the accuracy rate for classification. This paper shows various feature extraction and classification techniques. The importance of pre processing is talked about more in this paper.

This paper is about optical character recognition. The documents have both uniqueness of handwriting and ambiguity. This paper compares different classification and extraction techniques. Online

system for this type of classification and recognition are complex. The weak areas of OCR are also highlighted. It also helps in identifying the area which are not yet discovered. Classification is training the model on known dataset and also categorizing the alphabets and digits to predefined classes. The artificial neural network which consists of neurons that together work for data input for classification. There are weights associated with neurons and these weights across the neurons are manipulated to get more accurate results. RNN and CNN have replaced multi layer perceptron network and recurrent neural network. There are many kernel learning models component like kernel principal component analysis can be used for categorisation. Kernel fisher discriminant analysis is also prevalent for offline handwritten text recognition. There are statistical models like parameter classifiers and non parameter classifiers. Parametric classifiers have a fixed number of parameters and use less time as compared to non parameter classifiers. Its complexity does not vary with the size of the dataset and it can also work with small training dataset. If we need more flexibility then a non parametric classifier works well. KNN is one statistical model. Template matching technique is a new method for classification. It uses a sliding window technique. It has a predefined template and the template is matched with some part of the image. The template image acts as sliders on a small part of the image on which classification has to be obtained. Another technique is structural pattern recognition. Chain code histogram is one type. But the condition is that the image should be in binary format and it should have well defined boundaries. This can be further categorized in two methods like grammar and graphical based methods. Datasets are very important for training models. Some of the important datasets are CENPARMI, UCOM, CEDAR, HCC2000 etc. The IAM dataset consists of full English sentences. There are six languages on which OCR is practiced i.e. English, French, Chinese, Persian, Indian, Chinese. Each individual has different handwritings and it makes difficult for recognition. CNN is

generally used today. It is also concluded in this paper that some techniques work great with some languages whereas with other languages it does not. The absence of dataset in other languages is another hindrance.

The paper deals with offline handwritten Japanese kanji characters of online trajectory recovery of multiple strokes . The three main challenges for perfect recovering on different online strings with many strokes are first , finding two end points and reinitializing the writing direction and managing the strokes. These difficulties are brought on by a variety of writing techniques and touch points from multiple strokes. When there are numerous writers and character categories, the GMM tries to inherit to different patterns . To show the effectiveness, experiments are conducted on roughly 120,000 characters of grater then 1,300 JK letter categories.



Fig.4 Japanese characters involving multiple strokes .

Multiple-stroke Japanese kanji characters have numerous relationships in both the horizontal as well as vertical axes that must be recorded when reviving online trajectories.

So, instead of using an LSTM network in our encoder, we use an attention mechanism in our decoder.

We consider the output of our network to be a series of GMM parameters.

The quality of reinitialized trajectories can be improved by using the ED network(Encoder Decoder) by adding an attention layer.Using the reinitialized trajectories the scanned rate of on paper written characters increased . These offline images creates a challenge for reconstructed online

trajectories to make equal contribution to it , because they are inadequate and still need to be improved. However, online recognition of reinitialized trajectories influences offline character recognition.

The paper from 2020 Int. Conference on automation , Computation and Knowledge (ICCA KM) Amity University compares techniques that were used in handwritten text recognition and gives an overview of traditional and modern methods used. It also highlights the pros and cons of the existing approaches in order to provide a clear vision for further application . Offline handwriting recognition (OHR) is the process of automatically converting a picture's text into letters that can be read by computers and texting software. Traditional techniques include character extraction and recognition . Modern methods focus on recognizing all the different characters in a structured row rather than the traditional methods that focus on segmenting for recognition.To recognize visual characters they mainly implemented or used ML . Handwritten Recognition using KNN, SVM and other is neural network and Handwritten Test Image Other then this it explained about Handwritten testing of Image authentication that uses Back Propogation . The data set for this method is located and read using Python, openCV, and sklearn. Results from the MNIST are used for training and classification assessment . When using SVM, the component is represented graphically as a dot in an N-size space and each characteristic value is represented by a coordinate value. In truth, there is no learning from the KNN classification. The fundamental unit of this algorithm is the distance between functional vectors. Unidentified data points are classified by the KNN algorithm. Because the image cannot be used as the output of the neural network directly, back propagation converts it into a matrix . Red, green, and blue (RGB) values of the image are converted, and these values are then using normalization method these values are normalized .

The paper “Handwritten Text Recognition from an Image with Android Application” provides an in depth insight for two different models for text recognition that were BiLSTM and proposed CNN . The mentioned model consists of feature extraction using CNN, sequence labeling and transcription/decoding. The IAM dataset is used to interpret the model. Researchers have tested the model and deployed it on Firebase server so that the different android application can use it. Users of the application can choose different images/photos from the files/gallery or take a photo of it. The deployed model receives the chosen image as input. The model will take the uploaded image's text and retrieve it, returning the text in string format. The detected text is visible to users on the screen. The text data can be saved by the user for later use.

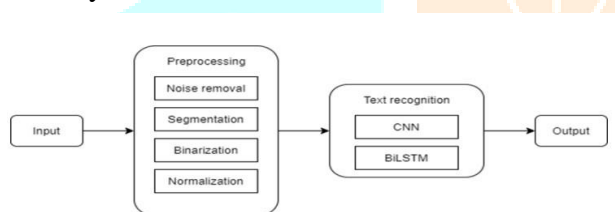


Fig.4 process flow

The image is pre-processed to remove noise .Segmentation is performed to separate words followed by binarization that divides the pixels . Carrying forward, normalization is done to transform characters into a required size. Recognition again involves feature extraction using CNN, sequence labeling and transcription/decoding. For character Recognition a perfect and effective method which is referred to as the BNN(Bidirectional Neural Network) . CNN receives the segmented image as input. In order to extract the features from the image, a convolution network is used. 512 features, each measuring 100x1, are extracted by CNN. The bidirectional LSTM network, that consists of two different layers —one is the forward layer and other

is the backward layer— that uses the output as input of CNN . Then the model is deployed. Therefore a new image is formed from the same image what is given to for training so that it can handel of various types , which improved picture accuracy. This handwriting identification challenge uses random noise, blur filter ,reduced line thickness, and random stretch as data augmentation techniques

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