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Conversion of Handwritten Text into Digital Form using CNN

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Abstract-- **Even though computers and smartphones are more common than ever, many individuals still enjoy the classic writing experience of ink on paper. However, the conventional method of writing text has some drawbacks. The capacity to translate legible handwritten input into digital form from sources like paper documents is known as handwriting recognition. A handwriting recognition system manages formatting, completes accurate character segmentation, and identifies the most likely words. Thus, converting handwritten characters to digital representation is becoming more and more common. It has become crucial to save any handwritten documents in digital format. In this paper, we are creating a HCR model, which will be used to overcome the disadvantages of conventional method. After receiving the handwritten document as input in the form of an image, the programme segments and recognises each character in the image. Additionally, it recognises the letters before going on to find the words in the image. This is accomplished using CNN algorithm with better accuracy as well as machine learning methods. The specified input image will be provided in word document format as the intended output. Large data sets of images, such as those from IAM and MNIST, that display the various writing styles and forms can be used to train the system. This can also be applied to businesses and organisations who only keep critical records in writing form.**

Keywords— **Convolutional Neural Network, Handwritten Character Recognition, Pre-processing, Segmentation, Image gathering.**

I. INTRODUCTION

Machine Learning Is now considered to be one of the biggest innovations in the field of Artificial Intelligence since the microchip. AI is on its way to becoming a crucial part of our daily routine in many people's lives. With the availability of so much data that is processed, it is now possible to build any predictive models that can analyse and study the complex data stored in the dataset to find useful insights and deliver more accurate results. Many companies build various Machine Learning models by using all the data received from people and use this in order to identify profitable opportunities and avoid risks. The science of automatically learning computer algorithms is known as machine learning. It offers the capacity to autonomously learn from experience and get better without explicit programming. The algorithm finds natural patterns in data that generate insight and help you make better diagnosis. Under Machine Learning is a subset called Deep Learning, where artificial neural networks, algorithms are all based on the neurons of the human brain. Massive volumes of data are used to train these deep learning algorithms. Similar to how people learn from past experiences, the deep learning algorithm will repeat the tasks with each iteration, improving the model little by little to produce better results. It is referred to as deep learning because the neural network has various layers that enable the model for learning the various patterns, data, etc. Because the amount of data the users generate every day is increasing at a staggering rate, it's the resource (data) that makes deep learning possible as these models need tremendous amounts of data to learn. This increase in data creation is one of the reasons that deep learning is used due to its capabilities of learning with strong computing power that is available today. This makes it possible for computers to solve complicated issues even when the dataset is large, diversified, and poorly built. The more the model learns, the better they perform and better the capabilities to solve with different datasets. This paper demonstrates how the digit is recognised and displays the model's forecast of how the number will be recognised from the dataset. Handwritten digit recognition is the ability of computers to recognise human handwritten digits. With the help of the dataset, this allows the model to analyze and predict the outcome of the number fed into the model with various flavours of the handwriting available. Since deep learning systems typically have a large number of layers, the term "deep" is employed. With the use of a neural network with numerous hidden layers and a large amount of training data, this learning seeks to learn the relevant feature representation of the input data by creating high level features using the low level pixels. In contrast to traditional machine learning methods, deep learning approaches have made significant advancements and maturation with useful applications in speech recognition, image analysis, information retrieval, computer vision, and natural language processing. Deep learning research has attracted a lot of attention, and intriguing findings have been documented in the literature. Deep learning is a promising and developing approach, however this discipline faces a number of obstacles like expensive hardware costs, high computing costs, and a lack of data.

II. LITERATURE SURVEY

Mansi Shah et al [9] compared OCR and HCR in a handwritten character recognition literature review. They also provide a thorough study of the available handwritten character recognition technologies. It was discovered that neural networks are the best option for training and that it is impossible to build a fully automated network that can recognise all varieties of handwriting.

With the use of a unique function extraction technique termed diagonal feature extraction, J. Pradeep et al. [8] have been presenting their work in which they use a multi-layer feed forward network to recognise alphabetical characters in offline settings. The photos with handwritten data are in the common formats, such as JPG, PNG, etc. A competitive layer serves as the output layer, while the hidden layers are employed to activate the Log sigmoid function. According to the trial results, 69 diagonal methods were recognised with a maximum recognition precision of 97.8 percent and 54 diagonal method features.

Sanjay Kumar et al. [7] proposed research on offline textual character detection, particularly to identify when doctors employ neural networks and to match prescription medications. Throughout the process, the OCR system makes an estimate and stores the character. It was shown that accurate words cannot be detected, but only doctors' handwriting can forecast.

Manoj Sonkusare et al [10]. received a survey of manuscript identification techniques for English alphabets. In their research, they investigated global skew correction methods that correct the text line's alignment during photo scanning. Slant correction, which controls the type's tilt, is also done during the pre-processing stage. They concurred that much more work has to be done by UNHCR to offer a workable solution that is open to all.

Abdulloh Al-Mubarok and Hertog Nugroho [12] worked on a hierarchical character matching in the handwritten identification. Here, handwritten alphabets are transformed into charts based on the skeleton of the letters. The CEDAR dataset includes 9454 zip codes, 4938 state terms, and 5632 city terms for training purposes. Additionally, the writing, implementing, and writing styles in the CEDAR dataset are unrestricted. The proposed method had a 93.40% accuracy rate, and pre-treatment deformation causes, forced identification, and comparable looks were all present.

Suman Avdhesh Yadav et al.'s [11] thorough technique for offline English character identification has produced a collection of 2600 samples from 100 writers for each character. The neural network was used to analyse 1041 samples, while the recognition model was used to evaluate the remaining examples. For feedback, they used the neural network technique. Once the network has been established and the error propagation error over the connection has been identified, routine training procedures are put into place. At 86.74 percent, they are well informed on the aforementioned work.

To develop the VNPR system, A. George and V.J. Pillai [14] suggested using their artificial neural network. They created a database with 40 images of different car licence plates. It is used to convert grayscale photos into binary images, which minimises the variation in pixel classes. The probabilistic neural network is a novel concept that was introduced in this paper. You used this method to train 100 characters and obtain 91% accuracy in generating a database. In order to achieve greater results, they were also growing their database.

Nisha Sharma et al. [13] offered numerous approaches for the performance and recognition of hand-written character in their evaluation of the recognition of hand-written English letter. The SVM Classifier is used by the Fourier descriptor, which has a 98 percent efficacy rate. Various extraction techniques have also been explored. They discovered that even though there are a number of approaches, much more research is necessary before a complete software solution can be offered in this area.

III. ARCHITECTURE

Convolutional neural networks (CNN) are among the most well-known and often utilised deep learning architectures. In the field of computer vision, CNN has a wide range of applications, including face identification, object detection, natural language processing, picture classification, character recognition, and speech recognition. The discriminative and robust representation learned using CNN has proven useful for a number of computer vision tasks. The CNN network is fed image pixel values as input, negating the need for human feature extraction. Depending on the input layer of CNN, the raw picture may be binary, grayscale, or RGB. In a CNN, the convolutional layer is always the top layer. Filters with a specific size convolve with the entire input image in the convolutional layer, performing by creating the activation maps, which are then provided as input to the following layer, the convolutional operation. Convolutional or the pooling layer can once more be the next CNN layer. The layers of the neural network perform recognition operations that change the data in the Hand Written Text Prediction with the goal of learning a certain feature from the data. In the CNN architecture, the layers that work behind the process of the Hand Written Text recognizer are as follows:

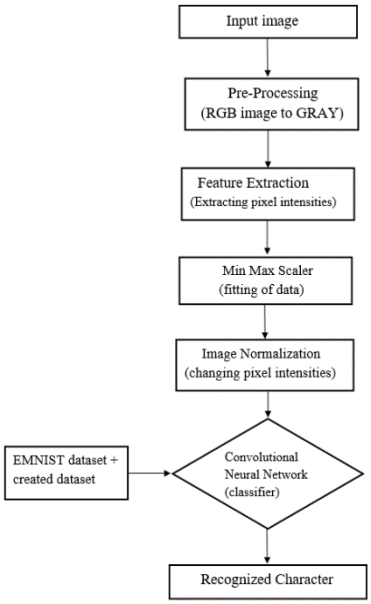

Fig 1. System Architecture of HCR.

A. Image Pre-Processing:

Pre-processing, which includes smoothing, binarization, skew detection, slant correction, thinning or skeletonization, filtering, base line identification, etc., is one of the most important steps in OCR. Pre-processing is a preliminary step that transforms the incoming data into a format that can be processed more easily and effectively. It boosts the effectiveness of recognition systems. Following this step demands precision because it has a direct impact on the effectiveness and dependability of the other phases. It gets the picture ready for further operations like segmentation and feature extraction.

B. Segmentation:

In order to determine what exactly makes up the input image, the pre-processed input data must be divided or segmented into sub-data. This process is known as segmentation. During the segmentation phase, the input material is divided into paragraphs, paragraph text is further divided into lines, lines are divided into words, words are divided into characters, and characters are lastly divided into sub-characters. The sub-parts are designed so that the subsequent processes may process them more quickly and efficiently.

C. CNN:

In this layer, the model puts the input images through a set of convolutional filters, where each of the filters activates certain features from the images. By mapping all the negative values to zero and keeping only the positive values, the ReLU enables faster and more efficient training of the deep learning model. Because only the activated characteristics are carried out and take place in the following layer, this process is known as activation. Pooling layer does non-linear down-sampling to simplify the output by lowering the amount of parameters that the neural network must learn. The network has tens or hundreds of layers, and each layer learns to recognise various properties of the data from the dataset by repeating all the processes carried out by the aforementioned levels.

IV. RESULT

The CNN model used learned information to predict the output as shown in fig. 2 after receiving a picture as input (see figure 2).

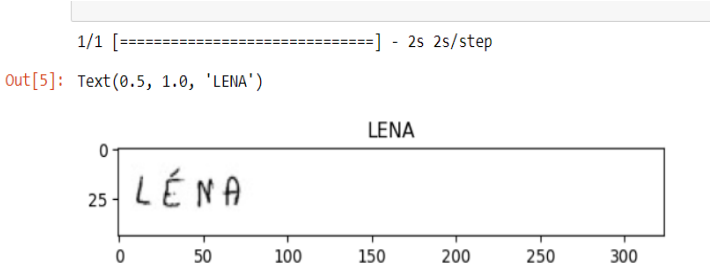

Fig 2. Output

V. CONCLUSION

In conclusion, the paper of "Conversion of Handwritten text into Digital form using CNN" has a great potential to transform various industries and improve efficiency, accuracy, and accessibility in many areas. The ability to automatically convert handwritten text into digital format using ML and CNN can save significant time and resources, and also help preserve important historical documents and records.

Here are various techniques and methodologies available to recognize and convert handwritten text using AI and machine learning, such as convolutional neural networks and recurrent neural networks. However, this paper also has its limitations, such as the accuracy of recognition may depend on the quality of the handwritten input and the availability of training data.

Overall, this model has a wide range of applications across different fields, including education, healthcare, finance, and legal industries, and can bring significant benefits to these industries. The future research in this field can further improve the accuracy and efficiency of handwritten to digital text conversion using AI and machine learning.

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