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Handwritten Digit Prediction Using CNN

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***Abstract:** For many years, numerous methods have been used in extensive research on handwriting recognition. The capacity to create an effective algorithm that can recognise handwritten digits given by users via scanner, tablet, and other digital devices is at the core of the issue. The automatic processing of bank checks, postal addresses, and other sorts of data already makes substantial use of handwritten digit recognition. Computational intelligence methods like artificial neural networks used by several current systems. CNN and the MNIST data set will be used to complete this. Handwriting Recognition, Deep Learning, CNN, and Computational Intelligence are key terms.*

I. INTRODUCTION

Handwriting Recognition is a machine's ability to recognise and predict human handwritten digits. It is a difficult task for machines because handwritten digits are not perfect and can be made in a variety of flavours. As a result, this paper presents a solution for accurately recognising and predicting handwritten digits. The number recognition framework is simply a task that the machine must complete in order to prepare and interpret numbers. Handwritten digit recognition interprets manually written numbers from a variety of sources such as messages, bank checks, documents, photos, and so on, as well as in a variety of situations for web-based handwriting recognition on PC Tablets and in vehicles. There are numerous techniques that can be used to gain recognition. Convolutional Neural Network (CNN), Semi Incremental Method,Line and Word Segmentation, and other techniques are used. Convolutional Neural Networks are one of the most effective and well-known methods of handwriting recognition (CNN). It's a component of deep learning. Artificial neurons make up Convolutional Neural Networks (CNN). The number recognition model recognises numbers from various sources using large datasets.

II. LITERATURE REVIEW

Handwriting recognition is a vast area of study. Many researchers are working on this topic to achieve the best possible results. Various techniques were used by different researchers for image recognition and digit recognition. Now the paper proposes a framework for annotating large scale handwritten word images with ease and speed by Kartik Dutta, Praveen Krishnan, Minesh Mathew, and C.V. Jawahar [1]. This paper uses state-of-the-art deep neural architectures to benchmark major Indian scripts such as Devanagri and Bangla for the tasks of word spotting and handwritten recognition. It employs Word Spotting via a CNN-RNN hybrid network. Nikita Singh [2], This paper proposes a method for recognising handwritten Devanagari characters. The proposed method is based on individual character classification using ANN (Artificial Neural Network). The proposed method could be helpful for blind people to read handwritten contents. Roshan Fernandes and Anisha P Rodrigues [3], propose two techniques for recognising handwritten Kannada script with high accuracy. Techniques : 1. Teseeracttool, 2. Convolution neural Network (CNN). We achieved 86% accuracy with the tesseract tool and 87% accuracy with the convolution Neural Network. One of the authors proposed using decision tree learning to classify various writing styles of identical digits. To implement the classification, several direction features were used. That is, if the stroke direction of some digits is similar, Decision tree learning can correctly classify them. However, as more features are added, it becomes more difficult to manage sets of possibilities.

III. FEASIBILITY ANALYSIS

There are numerous aspects of feasibility. Let it be discussed individually.

A. Technical Feasibility

The software used in this project is completely open source, and anyone can connect to it whenever they want. Aside from that, the entire software running environment Google Colab is fully open source and easily accessible in the presence of an internet connection. The user can also be a non-programmer and set the digit in the webcam screen and see the output by clicking the Run button.

B. Seasonal Feasibility

This project is feasible in terms of time, which means that it was started on a specific date and completed in the allotted time. It was an efficient effort that resulted in the project being completed on time.

C. Economic Feasibility

Because all open source software was used, this project is economically free; therefore, no money was charged or given. Only the study materials on the developer or designer side are not available for free. The software or programme is completely free.

IV. METHODOLOGY

A. Dataset

The first step in recognising handwritten forms was to collect a large amount of data for training. The hand printed forms and digits database NMIST Dataset is used. The dataset we used contains 60,000 of handwritten images in size 28*28, with each number in the image centre fitted to a 20*20 pixel box. Every image will be in Grey Scale.

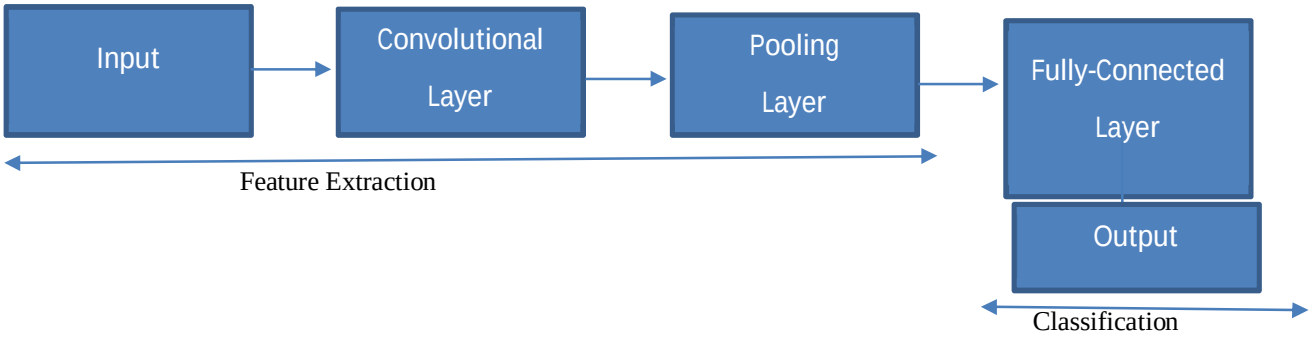
B. Preprocessing

It is a procedure for converting raw data into a usable and efficient format. Pre-processing is a process that consists of various operations that are performed on input images. Images are reshaped during this process. The rearrangement of the data's form without changing the data's contents. Various types of arrangements are made in this process based on the parameters required to continue the process.

C. Dataset Training

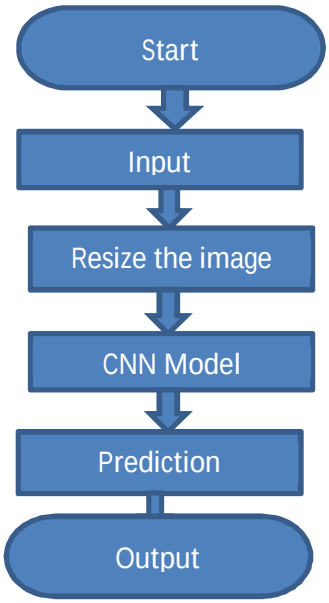
Model accuracy is measured using training and testing. The data is divided into two sets during this process: training and testing. Data is used for training 80% of the time and testing 20% of the time. CNN has been used to train this system. Training accuracy is 0.9885, training loss is 0.04737, and testing accuracy is 0.98607, with a testing loss of 0.06844.

D. CNN Modelling



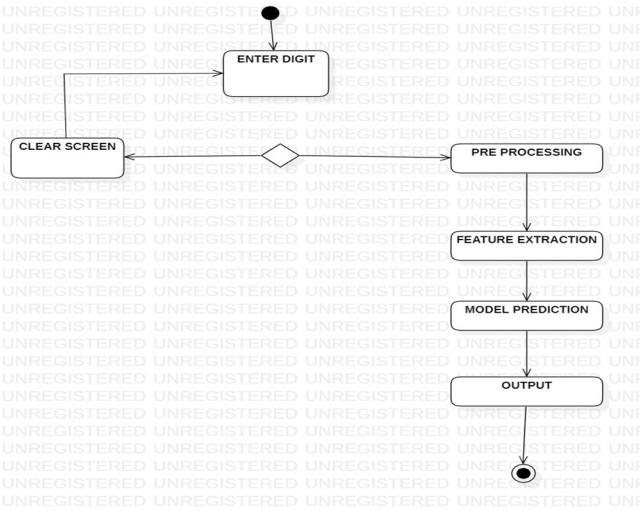
Deep Learning includes Convolutional Neural Networks (CNN). To this day, CNN is a very efficient and effective way to achieve handwritten recognition. Convolutional Neural Networks are used to extract image features using multiple layers of filters.

V. WORKING



In practise, input is provided via a graphical user interface (GUI). We've now created a new file for the GUI in which we've built an interactive window with buttons for drawing digits on the canvas and recognising the digits. The Tkinter library was used to create the GUI. Python. It enables you to quickly and easily create GUI applications. After receiving the input, it goes through the prediction process. The given input is advanced to resize in a specific format in order to obtain the actual prediction. The resized image is then moved down for the Prediction model, which extracts the given input features. It occurs. Following that, based on the estimated significance of the set of input variables, the modelling generates a prediction representing the probability of the target variable. The graphical user interface application displays the expected results. The output will contain the expected digits with position.

VI. UML DIAGRAM



VII. ANALYSIS

Model	Layer	k	s	d	p	i/p	o/p	r	Recognition Accuracy(%) and Total Time Elapsed					
									8-16-32	6-12-24	12-24-32	8-16-24	8-24-32	12-24-28
Case 1	Layer 1	5	2	2	2	28	14	5	93.76% (20 s)	84.76% (42 s)	98.76% (45 s)	94.08% (46 s)	96.12% (42 s)	98.08% (44 s)
	Layer 2	5	2	1	2	14	7	9						
	Layer 3	5	2	1	2	7	4	25						
Case 2	Layer 1	5	2	2	2	28	14	5	96.04% (37 s)	88.91% (27 s)	99% (37 s)	93.08% (37 s)	96.12% (37 s)	98.48% (17 s)
	Layer 2	5	2	1	2	14	7	9						
	Layer 3	5	2	1	2	7	4	17						
Case 3	Layer 1	5	2	2	2	28	14	5	98.96% (27 s)	86.88% (27 s)	99.7% (29 s)	98.72% (39 s)	99.28% (31 s)	99.60% (53 s)
	Layer 2	5	2	1	2	14	7	13						
	Layer 3	5	2	1	2	7	4	29						

VIII. CONCLUSION

To recognise the various handwritten digits, the project presented a Convolutional Neural Network approach. This project involves the classification of digits. The project is completed using a traditional neural network. The accuracy we obtained was greater than 90%. The project provides the highest accuracy for text with the least amount of noise. The accuracy is entirely dependent on the dataset; as the data set grows, so will the accuracy. If we try to avoid cursive writing, we will get the best results. We intend to expand this study in the future so that different embedding models can be considered on a wide range of datasets. No one will write on paper or with a pen in the future because everything is based on technology. In that scenario, they wrote on touch pads so that the inbuilt software could automatically detect the text they were writing and convert it to digital text, making searching and understanding much easier.

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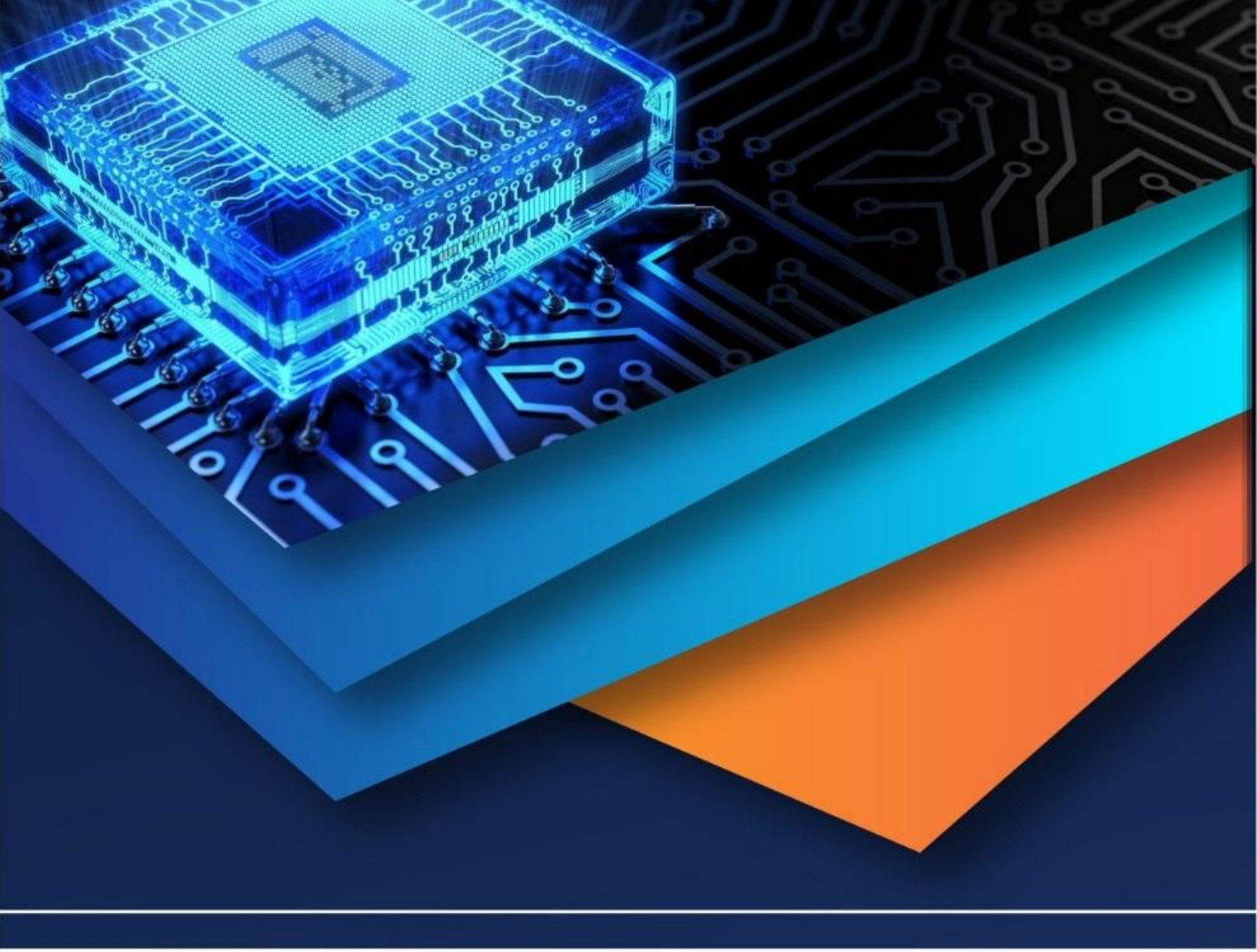

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