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Handwritten-Digit Recognition Using CNN

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Abstract: Handwritten Characters and digit recognition are one of the most active areas of research in computer science and it is inherently difficult because of the high variability of writing styles. Character recognition and isolated word recognition have both been successful in achieving high recognition rates. Until recently, conventional systems of handwriting recognition depended on manual feature extraction and significant prior knowledge. In recent years, research efforts in the field of handwriting recognition have shifted towards the use of deep learning techniques, which have shown significant advancements in performance. However, due to the exponential growth in the amount of handwritten data and the increased availability of processing power, there is a need for improved accuracy in recognition, which warrants further investigation. The most successful method for resolving handwriting recognition issues is to use convolutional neural networks (CNNs), which are exceptionally good at understanding the structure of handwritten characters and words in ways that support the automatic extraction of distinctive features. Creating a CNN-based model to translate handwritten characters into digit recognition is the goal of the proposed effort.

Keywords: Deep Learning, CNN, Image Processing.

1. Introduction

The method of digitizing human handwritten digit images is known as handwritten digit recognition. Because handwritten digits are imperfect and can be generated with a variety of flavours, it is challenging work for the machine. In the field of deep learning, this has been the subject of countless studies.

Low-accuracy models are unsuitable for use in practical situations. Automated bank check processing systems that are designed to read critical information such as the amount and date on the check, require a high level of precision to function accurately. It is not ideal for the system to wrongly identify a digit because this could result in serious harm. That's why a highly accurate algorithm is required in these real-world applications.

Convolutional Neural Networks (CNN) have recently emerged as one of the most alluring methods, and they have played a crucial role in many recent successful and difficult machine learning applications, such as ImageNet object detection, image segmentation, and face recognition. Hence, for our difficult picture classification tasks, we select CNN. It can be used for high-level academic and commercial transactions such as the recognition of handwriting digits.

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To increase the intelligence of computers, developers are adopting a variety of machine learning and deep learning techniques. Convolutional Neural Networking (CNN) is utilized in many areas of deep learning, including object detection, face recognition, spam detection, and image categorization. The characteristics of convolutional neural networks, such as their capacity to extract features from multiple inputs, make them a particularly intriguing choice for addressing issues in the field of computer vision. In fact, computer vision is becoming a testing ground for new CNN developments and approaches. Not only does handwritten digit recognition have professional and commercial uses, but it also has everyday uses that can be quite helpful to people who are blind. Additionally, it facilitates the simple resolution of challenging issues, making our lives easier.

Several algorithms have been created to recognize handwritten digits. But there are so many different writing styles, so they are still not up to par. Misclassification in the handwritten numeral recognition system is also caused by poor contrast, image text ambiguity, interrupted text stroke, undesired objects, distortion, disoriented patterns, as well as interclass and intraclass similarity. An example of HDR The ability of a machine to detect human-written digits is known as handwritten digit recognition (HDR). Because handwritten digits are not always accurate, it is a difficult task for a machine. Our approach, which uses an image of a digit to identify the digit contained in the image, provides a solution to this issue. We used the CNN algorithm to train on a unique dataset.

2. Literature Survey:

Method	Accuracy	Purpose
Optimization of feature selection for recognition of Arabic characters.[1]	88% for numbers and 70% for letters.	To apply a method of selecting the features in an optimized way.
OCR for cursive handwriting. [2]	88.8% for lexicon size 40,000.	To implement segmentation and recognition algorithms for cursive handwriting.
Diagonal-based features extraction for handwritten alphabets recognition system using neural network.[3]	97%	Converting handwritten documents into structural text form and recognizing handwritten names.
A Comparison of Feature and Pixel-Based Methods for Recognizing Handwritten Bangla Digits.[4]	95.1%	Feature extraction techniques can outperform pixel-based methods for handwritten character recognition.
Gujarati handwritten numeral optical character reorganization through a neural network.[5]	82%	Character recognition by using feed forward back propagation neural network.

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3. Methodology

3.1. Data set

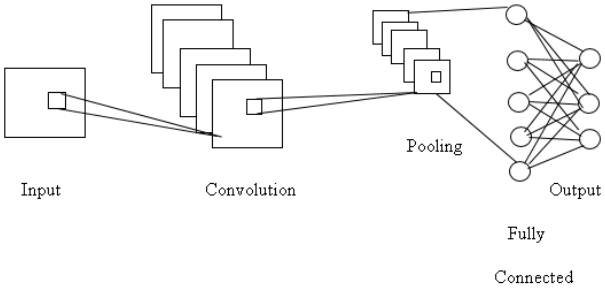
We collected handwritten digits from our college students and OMR sheets. The data set contains digits in the range of 0 to 9, with different styles and sizes. Our data set contains 500 images for each digit, size 28 ×28 ×1.

3.1.1 Pre-processing: The data will be normalized before being sent to the network. The input data should be normalized to speed up the training.

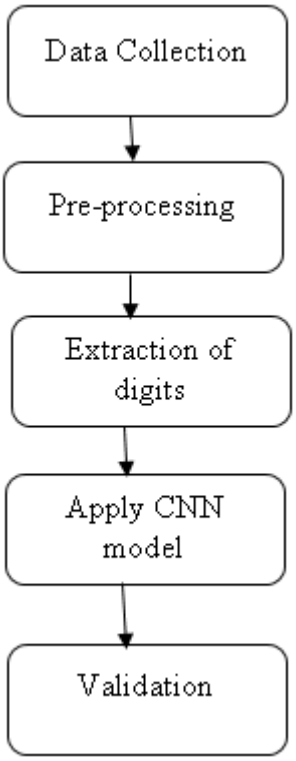
The pixel values range from 0 to 255. Since the scale is generally understood and well-behaved, scaling input values is advantageous when employing neural network models. We can simply normalize pixel data to the range of 0 and 1 by dividing each value by the maximum intensity of 255.

3.2. Algorithm:

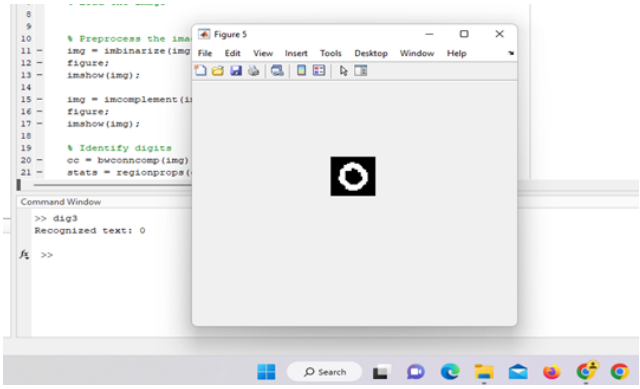
In this work, we applied Convolutional Neutral Network for the recognition of digits. We created a CNN model with 5 layers. Convolutional Neural Networking (CNN) is utilized in deep learning in a variety of applications, including spam detection, object detection, face recognition, and image categorization. Convolutional neural networks are a particularly intriguing alternative for problem-solving because of their characteristics, such as their capacity to extract features from multidimensional inputs. So, Convolutional Neutral Network is the best approach for digit recognition.



Work Flow of Hand written digit recognition:



4. Results



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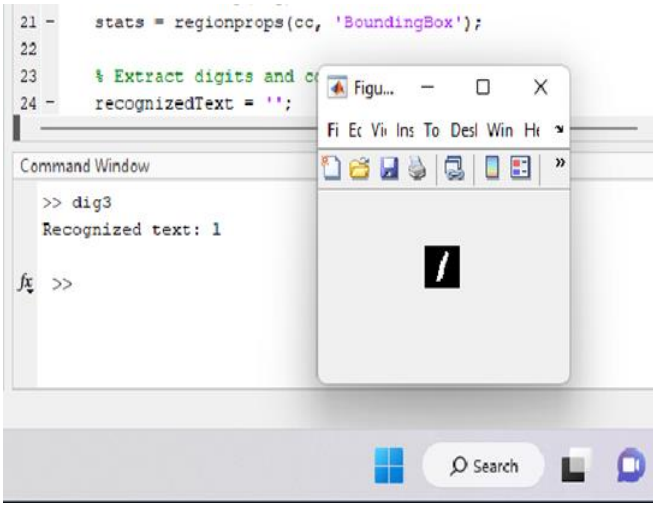

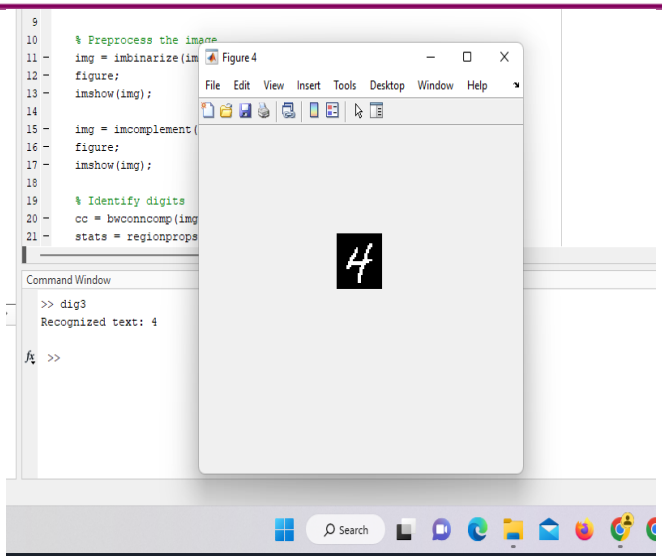

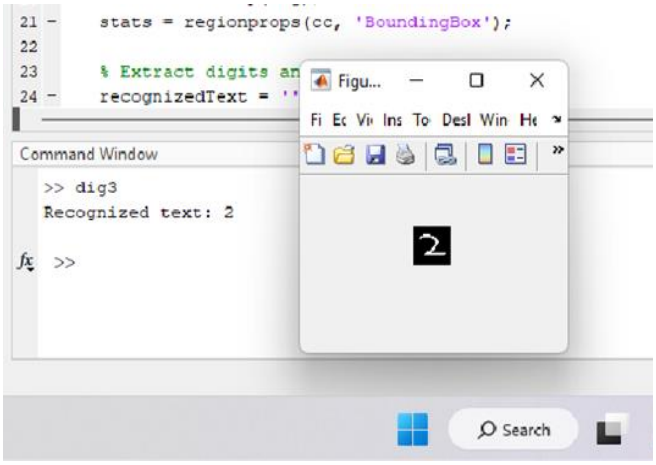

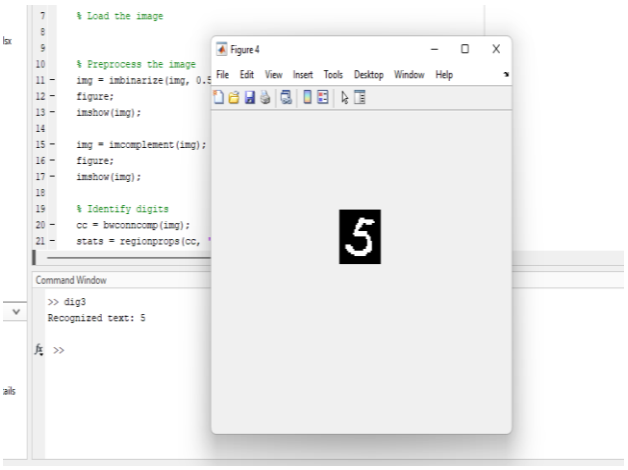

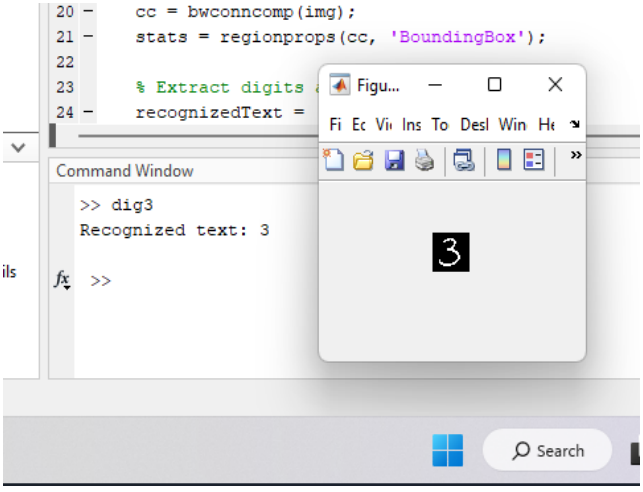

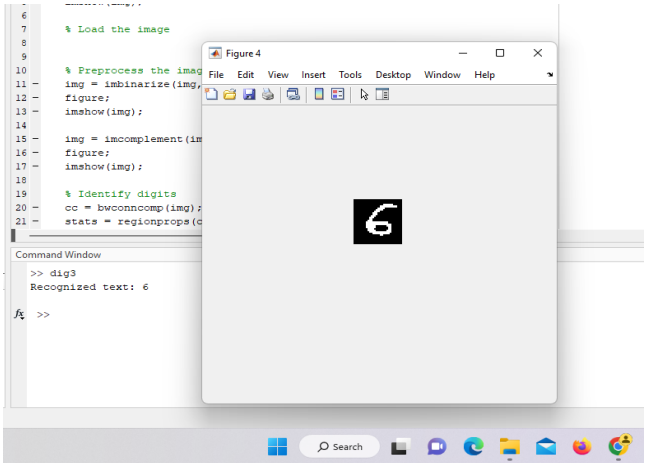

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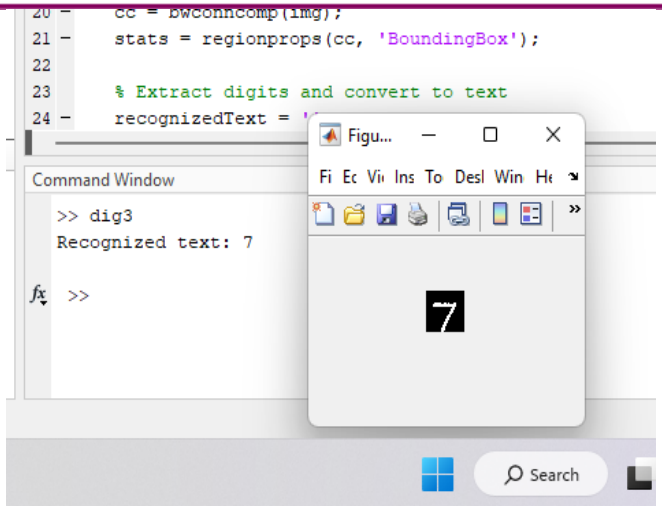

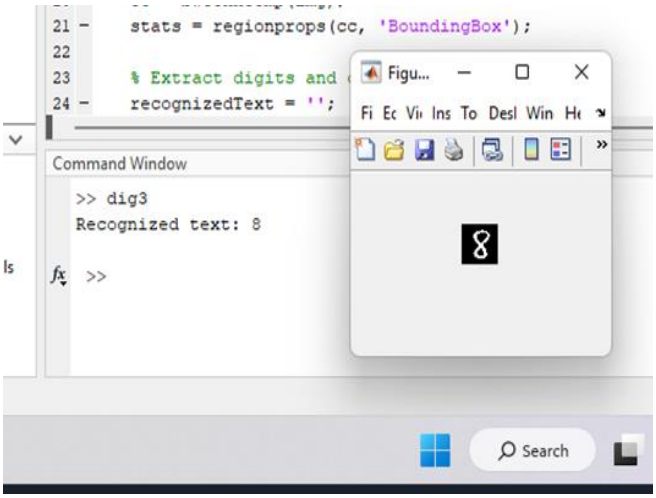

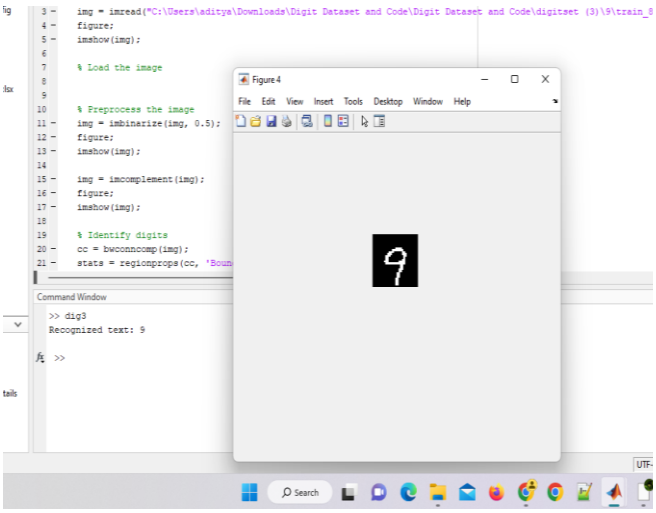

Graphical Representation:

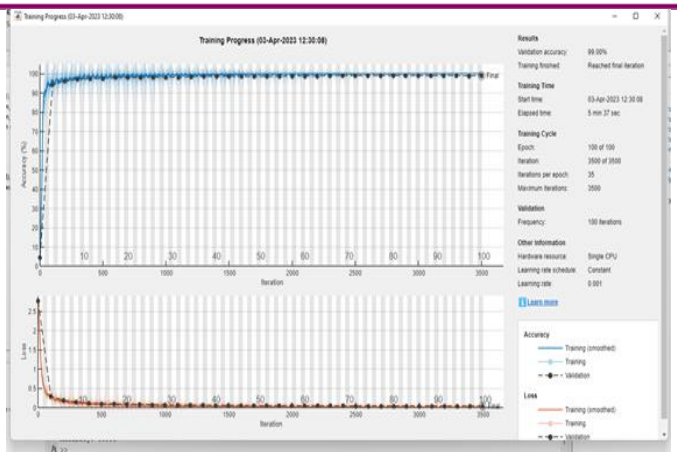

Fig: Training Progress

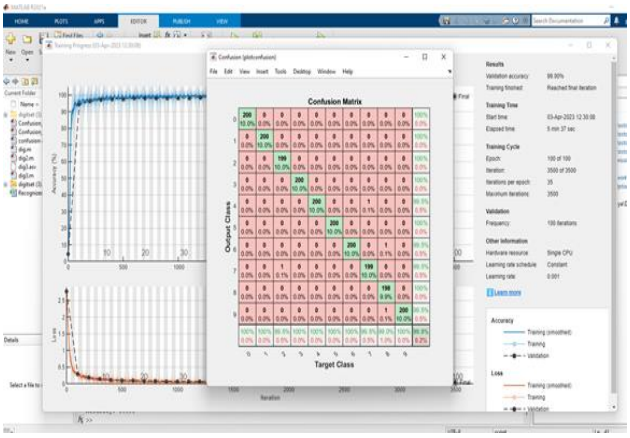

Fig: Confusion Matrix

5. Conclusion

In this work, we developed a model that helps us recognize handwritten digits using deep learning. We have used a convolutional neural network to recognize the handwritten digit. We collected handwritten images from OMR sheets. This CNN model recognizes the handwritten digit image and gives the recognized digit. This process will reduce manpower and save time if we apply it to different applications.

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