

A novel method for handwritten digit recognition with neural networks

Abstract:

In today's society, character recognition is becoming increasingly vital. It facilitates human work and aids with the resolution of more difficult issues. One illustration is handwritten character recognition, which is extensively used worldwide. This technique was created to recognize zip codes or postal codes for use in mail sorting. This can aid people in the difficult-to-read postal code mail sorting process. Researchers have been working on handwriting recognition for more than thirty years. The number of firms participating in handwriting recognition research has steadily expanded over the last several years. Handwriting processing has advanced due to a mix of factors such as improved recognition rates and the usage of complicated systems.

Handwritten Digit Recognition has various real-life time uses. It is used in the detection of vehicle number, banks for reading cheque, post offices for arranging letter, and many other tasks.

Literature Survey

Paper 1: Handwritten Digit Recognition System Based on Convolutional Neural Network

J. Li, G. Sun, L. Yi, Q. Cao, F. Liang and Y. Sun, "Handwritten Digit Recognition System Based on Convolutional Neural Network," *2020 IEEE International Conference on Advances in Electrical Engineering and Computer Applications(AEECA)*, 2020, pp. 739-742, doi: 10.1109/AEECA49918.2020.9213619.

Abstract: Image recognition is widely used in the field of computer vision today. As a kind of image recognition, digit recognition is widely used. Today, the online recognition technology in digit recognition is relatively mature while the offline recognition technology is not. This paper mainly introduces an offline recognition system for handwritten digits based on convolutional neural networks. The system uses the MNIST dataset as a training sample and pre-processes the picture with the Opencv toolkit. Then it uses LeNet-5 in the convolutional neural network to extract the handwritten digit image features, repeatedly convolution pooling, and pull the result into a one-dimensional vector. And finally find the highest probability point to determine the result to achieve handwritten digit recognition with the Softmax regression model. The application of this system can greatly reduce labor costs and improve work efficiency, which is of great significance in many fields.

URL: <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9213619&isnumber=9213450>

Paper 2: Handwritten Character Recognition using Neural Network and TensorFlow

Year : 2019

Authors : Megha Agarwal, Shalika, Vinam Tomar, Priyanka Gupta

The offline handwritten character recognition in this study will be carried out using Tensorflow and a convolutional neural network. a process known as using SoftMax Regression, one may assign probabilities to one of the many characters in the handwritten text that offers the range of values from 0 to 1, summed to 1. The objective is to create software that is extremely accurate and that has a minimum level of spatial and temporal complexity It was determined that strategies for feature extraction like diagonal and direction are significantly better at producing highaccuracy. Outcomes in comparison to other conventional vertical and horizontal techniques moreover use the best Neural network tried layers provides the benefit of a higher accurate outcome by having a high noise tolerance. The feed forward model in neural networks is the back-propagation algorithm that was primarily used to classify the characters, recognise them, and receive training continually more. In addition to these, normalizing along with feature extraction, the results were better and more effective. Character recognition is the outcome of accuracy. The paper will describe the best approach to get more than 90% accuracy in the field of Handwritten Character Recognition (HCR).

Paper 3: Improved Handwritten Digit Recognition Using Convolutional Neural Networks (CNN)

Year : 2020

Authors: Savita Ahlawat , Amit Choudhary , Anand Nayyar , Saurabh Singh and Byungun Yoon

Customized features and a vast quantity of past knowledge have been used in traditional handwriting recognition systems. It is difficult to train an optical character recognition (OCR) system based on these conditions. Deep learning approaches have enabled significant performance in the field of handwriting recognition research in recent years. Nonetheless, the increasing increase in the amount of handwritten data, along with the availability of vast computing capacity, necessitates improvements in recognition accuracy and warrants additional exploration. Convolutional neural networks (CNNs) are extremely excellent in perceiving the structure of handwritten characters/words in ways that aid in the automatic extraction of distinguishing features, making CNN the best solution for solving handwriting recognition challenges.

The proposed work aims to investigate several design alternatives for CNN-based handwritten digit recognition, such as the number of layers, stride size, receptive field, kernel size, padding, and dilution. Furthermore, we intend to assess the effectiveness of several SGD optimization techniques in enhancing the performance of handwritten digit recognition. Using ensemble architecture improves the recognition accuracy of a network. In this case, we want to obtain equal accuracy by employing a pure CNN design without ensemble architecture, because ensemble structures increase computational overhead and testing complexity. CNN design is developed in order to obtain higher accuracy than ensemble systems while reducing operational complexity and expense. Furthermore, we demonstrate an appropriate combination of learning parameters in the design of a CNN that leads us to a new absolute record in categorising MNIST handwritten digits. We conducted extensive trials and achieved 99.87% recognition accuracy for an MNIST dataset.

Paper 4: A Novel Handwritten Digit Classification System Based on Convolutional Neural Network Approach

Year: 2021

Authors: Ali Abdullah Yahya, Jieqing Tan, Min Hu

There have been a tonne of CNN classification algorithms put forth in the literature. However, these algorithms do not take into account the proper filter size selection, data preparation, dataset restrictions, or noise. As a result, few algorithms have been able to significantly increase classification accuracy. The paper makes the following contributions to solve these methods' drawbacks: First, the size of the effective receptive field (ERF) is determined after taking domain knowledge into account. They choose a typical filter size with the aid of the ERF calculation, improving the classification accuracy of our CNN. Second, excessive data produces inaccurate results, which has a detrimental impact on classification accuracy. Before carrying out the data classification task, data preparation is conducted to ensure that the dataset is devoid of any redundant or irrelevant variables to the goal variable. Thirdly, data augmentation has been suggested as a way to reduce training and validation errors and prevent dataset limitations. Fourthly, the paper suggests adding an additive white Gaussian noise with a threshold of 0.5 to the MNIST dataset in order to imitate the natural factors that can affect image quality in the real world. With a recognition accuracy of 99.98% and 99.40% with 50% noise, our CNN algorithm achieves state-of-the-art performance in handwritten digit recognition.