

A Novel Method for Handwritten Digit Recognition System

Abstract

Handwritten digit recognition has recently been of very interest among researchers because of the evolution of various Machine Learning, Deep Learning, and Computer Vision algorithms. In this report, We compare the results of some of the most widely used Machine Learning Algorithms like CNN- convolutional neural networks and with Deep Learning algorithm multilayered Neural Networks (MNN) using Keras with Theano and TensorFlow. MNIST is a dataset that is widely used for handwritten digit recognition. The dataset consists of 60,000 training images and 10,000 test images. Artificial neural networks can all most mimic the human brain and are a key ingredient in the image-processing field. For example Convolution Neural networks with backpropagation for image processing. The applications where these handwritten digit recognition can be used are the Banking sector where it can be used to maintain the security pin numbers, it can also be used for blind people by using sound output.

Literature Survey:

Paper 1: A novel method for Handwritten Digit Recognition with Neural Networks (2011)

Authors: Malothu Nagu, N.Vijay Shankar, K.Annapurna

Character recognition plays an important role in the modern world. It can solve more complex problems and makes humans' job easier. An example is handwritten character recognition. This is a system widely used in the world to recognize zip codes or postal codes for mail sorting. There are different techniques that can be used to recognize handwritten characters. Two techniques researched in this paper are Pattern Recognition and Artificial Neural Networks (ANN). Both techniques are defined and different methods for each technique are also discussed. Bayesian Decision Theory, Nearest Neighbor rule, and Linear Classification or Discrimination are types of methods for Pattern Recognition. Shape recognition, Chinese Character, and Handwritten Digit recognition uses Neural Network to recognize them. Neural Network is used to train and identify written digits. After training and testing, the accuracy rate reached 99%. This accuracy rate is very high.

Paper 2: A novel method for Handwritten Digit Recognition using Deep Learning (2019)

Author: Rohini. M and Dr.D.Surendran

Deep Learning has emerged as a central tool for self-perception problems like understanding images, and voices from humans, and robots exploring the world. The project aims to implement the concept of Convolution Neural Networks which is one of the important architectures of deep learning. Understanding CNN and applying it to the handwritten recognition system is the major target of the proposed system. There is a reason behind using CNN for handwritten digit recognition. Let us consider a multi-layer feed-forward neural network to be applied to the MNIST dataset, which contains images of 28×28 pixels (roughly 784 pixels). So if a hidden layer has about 100 units, then the first layer weights come up to about 78k parameters, which is large but manageable. However, in the natural world, the size of the image is much larger. If we consider the size of the typical image which is around 256×256 pixels (roughly about 56,000 pixels), then the first layer weights will have about 560k parameters! So that becomes too many parameters and hence makes it unscalable for real images. Hence, it will be so large that it will become very difficult to generalize the new data fed into the network. Convolution Neural Network extracts the feature maps from the 2D images by applying filters and hence making the task of feature extraction from the images easier. Basically, a convolution neural network considers the mapping of image pixels with the neighborhood space rather than having a fully connected layer of neurons. Convolution Neural Networks have been proven to be a very important and powerful tool in signal and image processing. Even in the fields of computer vision such as handwriting recognition, natural object classification, and segmentation, CNN has been a much better tool compared to all other previously implemented tools.

Paper 3: A novel Handwritten Digit Classification System Based on Convolutional Neural Network Approach (2020)

Author: Ali Abdullah Yahya, Jieqing Tan and Min Hu

An enormous number of CNN classification algorithms have been proposed in the literature. Nevertheless, in these algorithms, appropriate filter size selection, data preparation, limitations in datasets, and noise have not been taken into consideration. As a consequence, most of the algorithms have failed to make a noticeable improvement in classification accuracy. To address the shortcomings of these algorithms, our paper presents the following contributions: Firstly, after taking the

domain knowledge into consideration, the size of the effective receptive field (ERF) is calculated. Calculating the size of the ERF helps us to select a typical filter size which leads to enhancing the classification accuracy of our CNN. Secondly, unnecessary data leads to misleading results and this, in turn, negatively affects classification accuracy. To guarantee the dataset is free from any redundant or irrelevant variables to the target variable, data preparation is applied before implementing the data classification mission. Thirdly, to decrease the errors of training and validation, and avoid the limitation of datasets, data augmentation has been proposed. Fourthly, to simulate the real-world natural influences that can affect image quality, we propose to add an additive white Gaussian noise with $\sigma = 0.5$ to the MNIST dataset. As a result, our CNN algorithm achieves state-of-the-art results in handwritten digit recognition, with a recognition accuracy of 99.98%, and 99.40% with 50% noise.

Paper 4: A Novel Approach for Handwritten Character Recognition Using K-NN Classifier (2020)

Author: Abhay Mishra, Krishan Kumar, Parveen Kumar, and Prakhar Mittal

In this digital era, it is crucial to identify the authenticity of the words where the writer's identification becomes a big challenge. This paper highlights an efficient approach to recognizing the character from the handwritten document using a k-nearest neighbor algorithm. Then, a supervised-learning algorithm is employed to identify the character. From the experimental results, it is observed with our proposed model, we achieved about 92% accuracy for the digits and about 94.15% accuracy for the English alphabet. To see the merits of the proposed model, the comparison is made against the state-of-the-art models.