A Novel Method for Handwritten Digit Recognition System

Hemapriya K B, Bhuvaneshwari R S, Chandra V S, Karthiga mai N L, Nandhini R

Department of Electronics and Communication Engineering

K.L.N. College of Engineering

Abstract: Handwriting recognition is one of the compelling research works going on because every individual in this world has their own style of writing. The recognition of handwritten content is the process of converting non-intelligent information such as images into machine edit-able text. Because of the progress in the field of science and technology, everything is being digitalized to reduce human effort. Hence, there comes a need for handwritten digit recognition in many real-time applications. MNIST data set is widely used for this recognition process and it has 70000 handwritten digits. We use Machine Learning algorithms like Convolutional neural networks and Deep Learning algorithms like Artificial neural networks to train these images and identify the digits. Web application is created where the user can upload an image of a handwritten digit. this image is analyzed by the model and the detected result is returned on to UI.

Keywords: Digit Recognition, CNN, ANN, MNIST data set.

I. INTRODUCTION

Digit recognition plays an important role in the modern world. It can solve more complex problems and makes humans job easier. In this way, since the handwritten digits are not of same size, thickness, position, various difficulties are faced in determining the problem of recognizing handwritten digits. This type of system can be widely used in the world to recognize zip code or postal code for mail sorting. In Banking Sector too where more handwritten numbers are involved like account number, figure of cash and checks. Several classification methods using Machine Learning have been developed and used for this purpose, such as K-Nearest Neighbours, SVM Classifier, Random Forest Classifier, etc., but these methods, whilst having the accuracy of 97%, are not adequate for real-world purposes. In current years, the research community has been gaining significant interest in deep learning-based strategies to remedy a range of supervised, unsupervised and reinforced getting to know problems. One of the most regularly occurring and broadly used strategies is Convolution neural networks (CNN's), a kind of neural networks which can extract relevant features robotically from enter information. Here, we will learn about the implementation of well-known MNIST facts set to predict and recognize handwritten digits the use of deep gaining knowledge of techniques and Machine Learning algorithms. This is not a new topic and the MNIST information set is nonetheless very common and essential to take a look at and affirm new algorithms after quite a few decades. The project requires a lot of libraries such as primary ML libraries, deep mastering libraries, EDA (Exploratory Data Analysis) and tensor-flow the place tensor-flow is used as back-end with keras at some stage in the development process. The Artificial Neural Networks can also mimic the human brain and are a key ingredient in image processing field. We may choose to use ANN to build statistical models from massive datasets. These tools make the applications robust and therefore more accurate.

II. LITERATURE REVIEW

As we know there is no computer which can beat the level of the human brain. So due to these inefficiencies in computers we use artificial neural networks to make them somehow efficient like humans. Human brain easily processes and analyzes images. Brain automatically identifies and recognizes the elements and features of images. Image processing is a field which deals with enabling machines to do such tasks that our brain can do with images. Nowadays we see that technology is increasing repeatedly and many options are available to perform Handwritten digit recognition. But CNN plays a very crucial role in many image processing applications. CNN is used for detection of data loss (fault) and accuracy of the application. The use of deep learning with others such as CNN using TensorFlow, Keras, OpenCV. These algorithms are used widely for the theories of machine learning. This technique is used other than machine learning algorithms such as SVM, KNN, and RFC etc., they prefer to use CNN because it gives high accuracy and less error correction in image classification, video analysis etc. The CNN (Convolutional Neural Network) has brought a revolutionary change in the field of machine learning. Particularly in character recognition. In 2003, Simard et al. introduced a general CNN architecture for analysis of visual documents and the

sophisticated training method of neural networks. Mahmoud M. Abu Ghosh compared CNN, DNN, DBN strategies for making understanding which neural network is useful in the computer vision field especially in image processing like OCR. According to their findings, DNN gives accuracy of around 98.85% but fails against CNN approach in team of time. Badri Narayanan et al. performed a convolution neural network for semantic segmentation. An encoder network, a decode network, and a pixel-wise classification layer make up the segmentation. For decoding, the proposed approach used max-pooling indices, and the result was quickly observed as good results. This method was also analyzed with past existing techniques for more deep understanding.

III. METHODOLOGY

A. Understanding the data

ML depends heavily on data, without data, it is impossible for a machine to learn. It is the most crucial aspect that makes algorithm training possible. In Machine Learning projects, we need a training data set. It is the actual data set used to train the model for performing various actions. TensorFlow already has MNIST Data set so there is no need to explicitly download or create Dataset. The MNSIT dataset contains ten classes: Digits from 0-9. Each digit is taken as a class. In this activity, let's load the data and understand the features of the data.

❖ **Importing the libraries**

Importing the required libraries which are required for the model to run. The dataset for this model is imported from the Keras module. The dataset contains ten classes: Digits from 0-9. Each digit is taken as a class. Keras is a high-level neural community API written in Python that can run on top of TensorFlow.

❖ **Loading the data**

The dataset for this model is imported from the Keras module. We split the data into train and test. Using the training dataset, we train the model and the testing dataset is used to predict the results. It lists out the dimensions of the data present in it. In trainset, we have 60000 images, and in the test set we have 10000 images.

❖ **Analyzing the data**

Image analysis involves processing an image into fundamental components to extract meaningful information. It involves tasks such as finding shapes, removing noises etc.

B. Creating the model

Creating the model and adding the input, hidden, and output layers to it. The Sequential model is a linear stack of layers. You can create a Sequential model by passing a list of layer instances to the constructor.

❖ **Training the model**

Preparing the training dataset and understand the model of how the Convolutional Neural Network models work. Evaluate the data and validation of the training results of your system.

❖ **Evaluate the model**

In this step we the printing the predicted output. According to that by using argmax function here we are printing the labels with high prediction values.

❖ **Predicting the result**

After evaluation, we are resizing the input image, converting the image as per the CNN model and we are reshaping it according to the requirement. At last, we are predicting the result.

C. Application building

Here we are creating a web application where the user can upload an image of a handwritten digit. It is the image we have to recognize the digit and shown in the UI.

❖ **Creating the UI**

After recognition of digit, we have to show the predicted results to the users. It is done by creating a UI using Python Flash Frameworks.

IV. CONCLUSION

This survey presented various algorithms and techniques to recognize handwritten digit images. The most widely used Machine learning algorithms CNN has been trained and tested on the MNIST dataset. With extensive testing using the MNIST data, the current function suggests the role of various hyper parameters. We also confirmed that a good adjustment of hyper parameters is important in improving the performance of Convolutional Neural Network. Utilizing this deep learning technique, a high amount of accuracy can be obtained. This model is able to achieve a recognition rate of 98.85% accuracy and is significantly identifying real world images as well. The future model is to achieve accuracy of 99.98% on the MNIST data set using data augmentation with CNN.

V. REFERENCES

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