Handwritten Digit Recognition using ML

Khadke Prajakta Santosh[1], Abadane Rutuja Mahavir[2], Mankar Sarita Sanjay[3], Mhetar Krantikumar R[4]

[1,2,3,4]*Department of Information Technology, Sharad Institute of Technology Polytechnic, Yadrav, Kolhapur, Maharashtra, India.*

Abstract: Handwritten digit recognition (HDR) is the detection of digit from images, documents, car number plates and other sources and changes them in machine-readable shape for further processing. The accurate recognition of intricate-shaped compound handwritten digit is still a great challenge. Recent advances in convolution neural network (CNN) have made great progress in HDR (Handwritten Digit Recognition) by learning discriminatory characteristics from large amounts of raw data. In this paper, CNN is implemented to recognize the digits from a tested dataset. The main focus of this work is to investigate CNN capability to recognize the digit from the image, documented dataset and the accuracy of recognition with training and testing. CNN recognizes the digits by considering the forms and contrasting the features that differentiate among digits. Our CNN implementation is experimented with the dataset MNIST to obtain the accuracy of handwritten digits. Test result provides that an accuracy of 93.90% accuracy is obtained on 250 images with a training set of 1000 images from MNIST. The aim of this work is to review existing methods for the handwritten digit recognition problem using machine learning algorithms and implement one of them for a user-friendly web application. The main tasks the application provides a solution for are handwriting recognition based on touch input, handwriting recognition from live camera frames or a picture file, learning new characters, and learning interactively based on user's feedback on written format. The recognition model we have chosen is a multilayer perceptron's, a feed forward artificial neural network (ANN), especially because of its high performance on nonlinearly separable problems. It has also proved powerful in OCR and ICR systems that could be seen as a further extension of this work. We had evaluated the perceptron's performance and configured its parameters in the Python programming language, after which we implemented the Web application using the same perception architecture, learning parameters and optimization algorithms. The application was then tested on a training set consisting of digits.

Key Word: pattern recognition, handwritten recognition, digit recognition, machine learning, machine learning algorithm, neural network, classification algorithm, CNN, MNIST dataset.

I. INTRODUCTION

Handwritten digit recognition is the ability of computers to recognize human handwritten digits. It is a tough task for the machine because handwritten digits are not perfect. Handwritten digit recognition is the solution to this problem that uses the image of a digit and recognizes the digit present in the image. In handwritten digit recognition model using MNIST-5 dataset, we used a special type of deep neural network. A human learns to perform a task by practicing and repeating it again and again so that it memorizes how to perform the tasks. Then the neurons present in the human brain gets automatically triggered and they can quickly perform the task they have learned. Deep learning is also very similar to this. The MNIST-5 dataset contains handwritten digits which have a training set of 60,000 images and a test set of 10,000 images. The MNIST-5 dataset for researches who want to try learning techniques and pattern recognition methods on real-world data while spending minimal on preprocessing and formatting. Scientists believe that the most intelligent device is the human brain but the computers have not beaten the level of human brain efficiency. This inefficiencies of the computers as lead to CNN. As a benchmark for testing classification algorithms, The MNIST-5 dataset has been widely used to design novel handwritten digit recognition systems. The convolutional Neural Networks can almost mimic the human brain and are a key ingredient in image processing field. CNN is playing an important role in sectors like image processing. Each image has fixed size. The images are of size 28*28 pixels.

II. LITERATURE SURVEY:

D. C. Ciresan, U. Meier, J. Masci, L. M. Gambardella, and J. Schmidhuber, "Flexible high performance convolution neural networks for image classification" in Twenty-Second International Joint Conference on Artificial Intelligence,2011. It is pretty challenging to get a good performance as more parameters are needed for the large-scale neural network. Many researches are trying to increase the accuracy with less error in CNN. In another research, they have shown that deep nets perform better when they are trained by simple back-propagation. Their architecture results in the lowest error rate MNIST-5 compare to NORB and CIFAR10.

Y. Yin, J. Win, and H. Zheng, "Ncfm: Accurate handwritten digit recognition using convolution neural networks," in 2016 International Joint Conference on Neural Networks (IJCNN),2016,PP.525-531:IEEE. It is being used in recovering sentences in an

image .Some researches are trying to come up with new techniques to avoid drawbacks of traditional convolution layers. Ncfm(No combination of feature maps) is a technique which can be applied for better performance using MNIST-5 datasets.

Ankit Sharma, Yogiraj Barole,Kaustubh Kerhalkar,Neural Network Based Handwritten Digit Recognition for Managing Examination Score in paper Based Test,IEEE,vol.5, no.3,march 2016. The author designed using the Principal Component Analysis (PCA),a method of extraction of characteristics based on the digit forms, combined with K-nearest Neighbor to recognize the numeral digits, this approach is tested on the MNIST-5 handwritten isolated digit database. This proposed method shows an excellent performance with higher accuracy, Achieved approximately 86.5 percentage. The intersection feature between PCA and dividing an image into five characteristics zones: West zone, East zone, North zone, South zone and Central zone proposed for the extraction of features and K-Nearest Neighbor classification of the standard database MNIST-5 isolated digit.

III. PROCEDURE METHODOLOGY

Each research work needs some estimation, to measure the accuracy and performance of handwritten digits, MNIST-5 dataset is being used for such reasons. MNIST-5 is the mostbroadly utilized standard for handwritten digit recognition. MNIST-5 is a huge and a standard database of handwritten digits. MNIST-5 dataset has been commonly used as a standard for testing classification algorithms in handwritten digit recognition frameworks.

The comparison of the algorithms (Support vector machines, Multi-layered perceptron and Convolution neural network) is based on the characteristic chart of each algorithm on common grounds like dataset, the number of epochs, complexity of the algorithm, accuracy of each algorithm, specification of the device (Ubuntu 20.04 LTS, i5 7th gen processor) used to execute the program and runtime of the algorithm, under ideal condition.
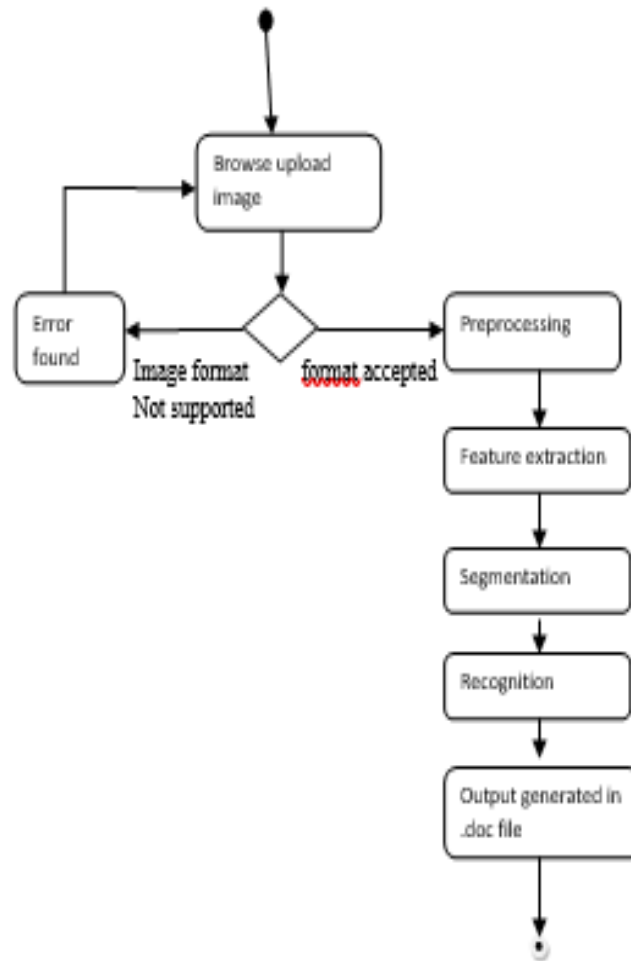
UML Diagram:
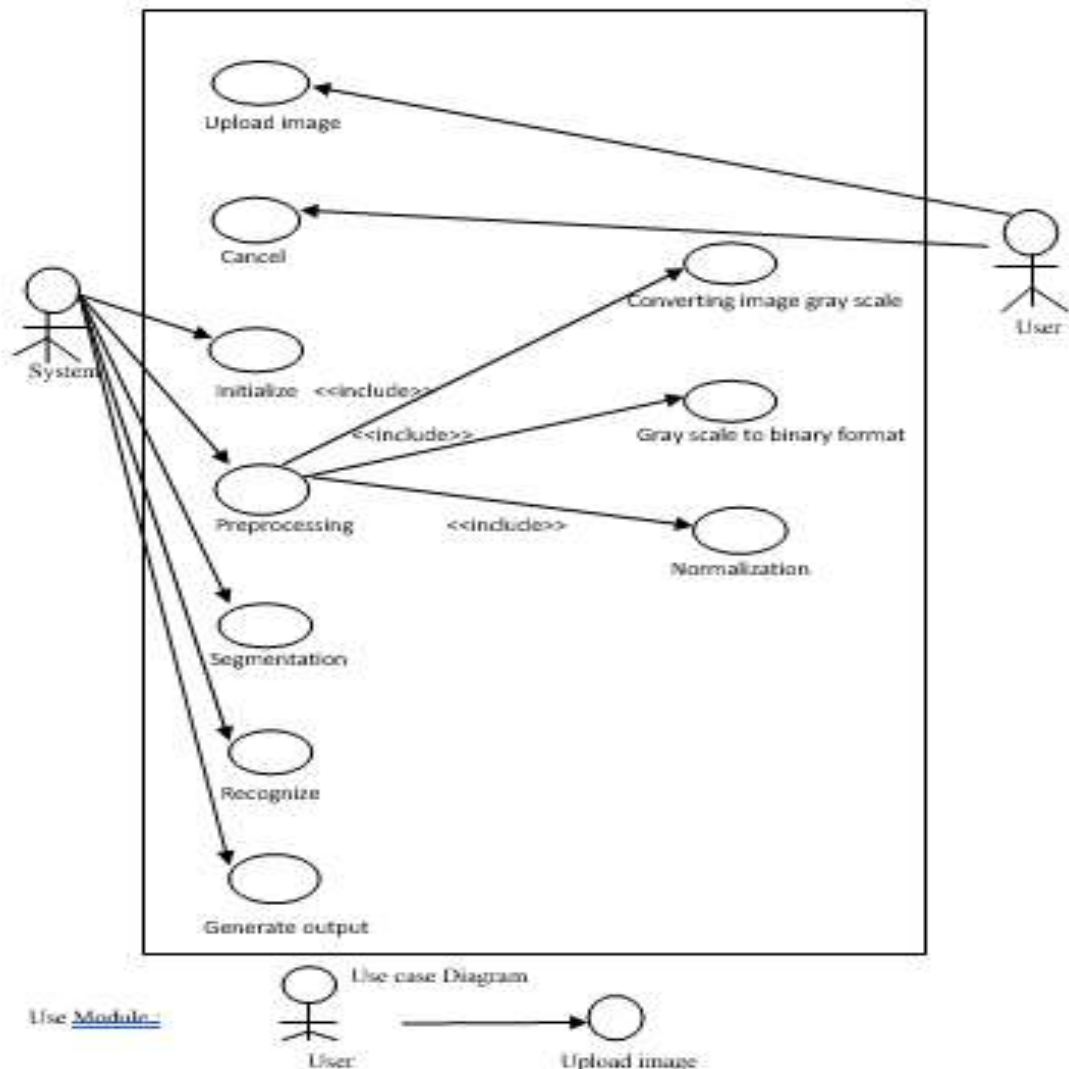
Fig: Activity Diagram

IV.RESULT

We have created and deployed a successful machine learning project of handwritten digit recognition .We build the GUI for easy learning where we draw a digit on the canvas then we classify the digit and show the results.

V. PROBLEM DEFINITION

Handwriting digits recognition is a challenging problem researcher had been research into this area for so long especially in the recent years. In our study there are many fields concern with digits (numbers), for example, messages, bank cheques, papers, pictures or recognizing numbers in car plates, the subject of digit recognition appears. A system for recognizing isolated digits (numbers) may be as an approach for dealing with such application. In other words, to let the computer understand the Arabic numbers that is written manually by users and views them according to the computer process. Handwritten digit recognition is the ability of a computer to recognize the human handwritten digit from different sources like images, papers, touch screens, mobile, tablet, handwritten filled forms and any other sources, and classify them into 10 predefined classes (from 0-9 digit).

Resources required:

Hardware Requirements:

Computer system(RAM -8GB)

Project Requirements

1. Python (3.7.4)
2. IDE (Jupyter)

Required Algorithms are

1. Numpy (version 1.16.5)
2. cv2 (open CV) (version 3.4.2)
3. Keras (version 2.3.1)
4. Tensor flow (Keras uses Tensor Flow in backend and for some image preprocessing) (version 2.0.0)
5. Matplotlib (version 3.1.1)
6. Pandas (version 0.25.1)

Advantages:

This approach has many advantages:

1. The system not only produces a classification of the digit but also a rich description of the instantiation parameters which can yield information such as the writing style.
2. The generative models can perform recognition driven segmentation.

VI.CONCLUSION

In this research, a deep learning technique ML is implemented for handwritten digit recognition. The main focus of this work is to investigate CNN capability to recognize the characters from NIST dataset with a high degree of accuracy. It was found

that the accuracy obtained from 200 training images ICMSE 2020 Journal of Physics: Conference Series 1918 (2021) 042152 IOP Publishing doi:10.1088/1742-6596/1918/4/042152 5 as 65.32% is improved gradually with increasing training images. The accuracy reaches to 93.90% with the 250 training images. Thus, further increment of training images will continue to enhance the accuracy towards to certain limit.

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