

Artificial Intelligence

Synopsis : Handwritten Digit Recognition

Name :	Nikita Tipule	Harshal Chavan
MIS:	111903051	111903036
Email:	tipulens19.comp@coep.ac.in	chavanhv19.comp@coep.ac.in
Batch:	T3	
Proposed Topic:	Handwritten Digit Recognition	

Introduction

Machine learning and deep learning plays an important role in computer technology and artificial intelligence. With the use of deep learning and machine learning, human effort can be reduced in recognizing, learning, predictions and many more areas. This project presents recognizing the handwritten digits (0 to 9) from the famous MNIST dataset, comparing classifiers like convolution neural network on basis of performance with using different parameters with the classifiers.

- **What is deep learning ?**

Deep learning is a subset of **machine learning**, which is essentially a neural network with three or more layers. These neural networks attempt to simulate the behavior of the human brain—albeit far from matching its ability—allowing it to “learn” from large amounts of data. While a neural network with a single layer can still make approximate predictions, additional hidden layers can help to optimize and refine for accuracy.

- **What is Handwritten Digit Recognition ?**

Handwritten digit recognition is the ability of a computer to recognize the human handwritten digits from different sources like images, papers, touch screens, etc, and classify them into 10 predefined classes (0-9).

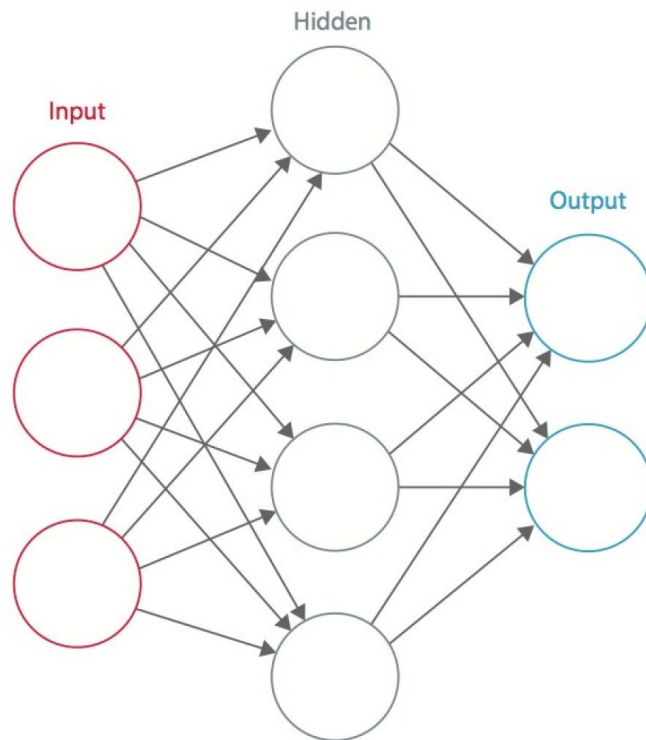
- **How Handwritten Digit Recognition is part of deep learning ?**

In Handwritten digit recognition, we face many challenges because handwritten digits are not always of the same size, thickness, or orientation and position relative to the margins. Also problem arises due to similarity of between the digits like 1 and 7, 5 and 6, 3 and 8, 9 and 8 etc. Also people write the same digit in many different ways.

Deep learning methods can achieve state-of-the-art results on challenging computer vision problems such as image recognition, object detection, and face recognition. That's why handwritten digit recognition is part of deep learning.

- **What is Convolutional Neural Network ?**

A Convolutional Neural Network (ConvNet/CNN) is a **Deep Learning algorithm** which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics.



- **What is MNIST dataset ?**

The MNIST dataset is an acronym that stands for the Modified National Institute of Standards and Technology dataset.

It is a dataset of 60,000 small square 28×28 pixel grayscale images of handwritten single digits between 0 and 9.



Feasibility Study

- **Need of project :**

A lot of information is available on paper, and processing of digital files is cheaper than processing traditional paper files. Hence handwriting recognition system is needed to convert handwritten characters into machine readable format.

Digit recognition system is required to to recognizing the digits from different sources like emails, bank cheque, papers, images, etc. and in different real-world scenarios for online handwriting recognition on computer tablets or system, recognize number plates of vehicles, processing bank cheque amounts, numeric entries in forms filled up by hand (say tax forms) and so on.

- **Significance :**

1. The aim of a handwriting digit recognition system is to convert handwritten digits into machine readable formats.
2. The main objective of this work is to ensure effective and reliable approaches for recognition of handwritten digits and make banking operations easier and error free.
3. Handwriting digit recognition system is very useful in number plate recognition.
4. In the project , We will implement an efficient strategy to train a model, using the latest advances in deep learning, with really short training times.

Literature Survey

Handwritten text recognition is an important application of deep learning and machine learning which is helpful in detecting forgeries and a wide range of research has already been done that encompasses a comprehensive study and implementation of various popular algorithms like works done by S M Shamim , Anuj Dutt , Norhidayu binti and Hongkai Wang to compare the different models of CNN with the fundamental machine learning algorithms on different grounds like performance rate, execution time, complexity and so on to assess each algorithm explicitly.

There are different challenges faced while attempting to solve this problem. The handwritten digits are not always of the same size, thickness, or orientation and position relative to the margins. According to many research papers, problem arises due to similarity of between the digits like 1 and 7, 5 and 6, 3 and 8, 9 and 8 etc. Also people write the same digit in many different ways. The uniqueness and variety in the handwriting of different individuals also influence the formation and appearance of digits.

Research Gap

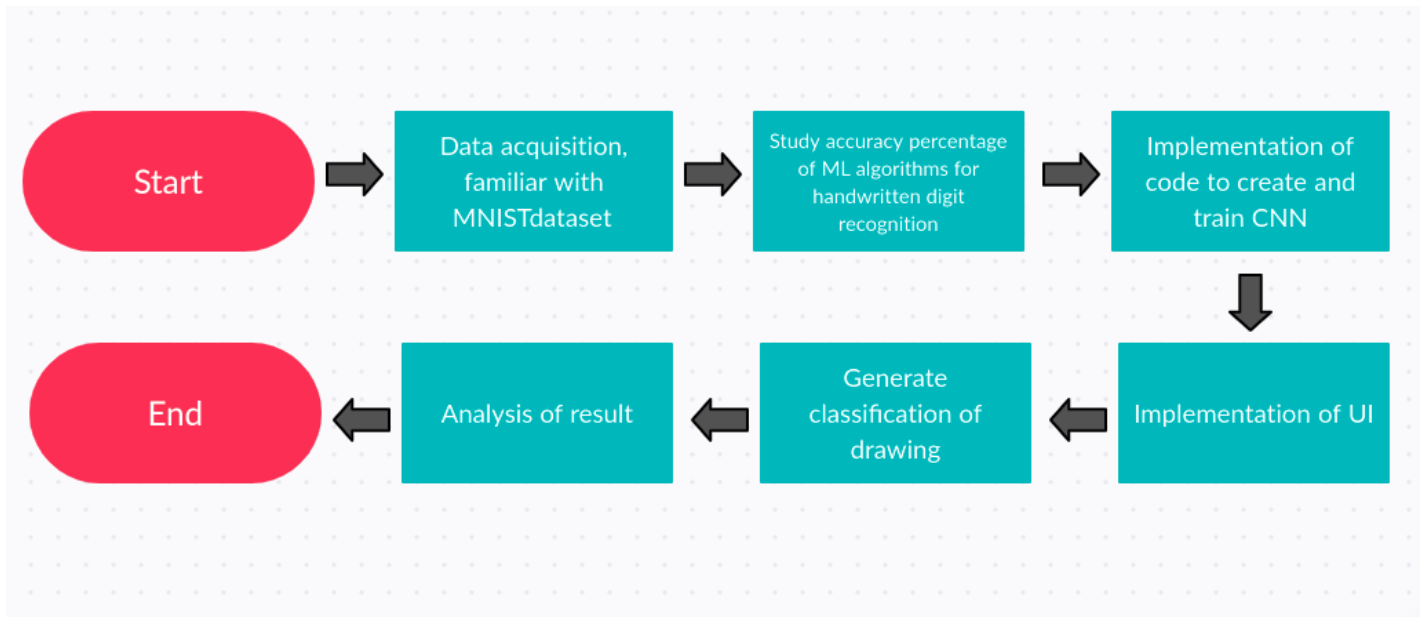
S M Shamim concluded that the Multilayer Perceptron classifier gave the most accurate results with minimum error rate followed by Support Vector Machine, Random Forest Algorithm, Bayes Net, Naïve Bayes, J48, and Random Tree respectively.

While **Anuj Dutt** presented a comparison between SVM, CNN, KNN, RFC and were able to achieve the highest accuracy of 98.72% using CNN (which took maximum execution time) and lowest accuracy using RFC.

Norhidayu binti did the detailed study-comparison on SVM, KNN and MLP models to classify the handwritten text and concluded that KNN and SVM predict all the classes of dataset correctly with 99.26% accuracy but the thing process goes little complicated with MLP when it was having trouble classifying number 9, for which the authors suggested to use CNN with Keras to improve the classification.

Fathma Siddique, Shadman Sakib, Md. Abu Bakr Siddique has used a convolution neural network for handwritten digit recognition using MNIST datasets. They have used 7 layered CNN model with 5 hidden layers along with gradient descent and back propagation model to find and compare the accuracy on different epochs, thereby getting maximum accuracy of 99.2%

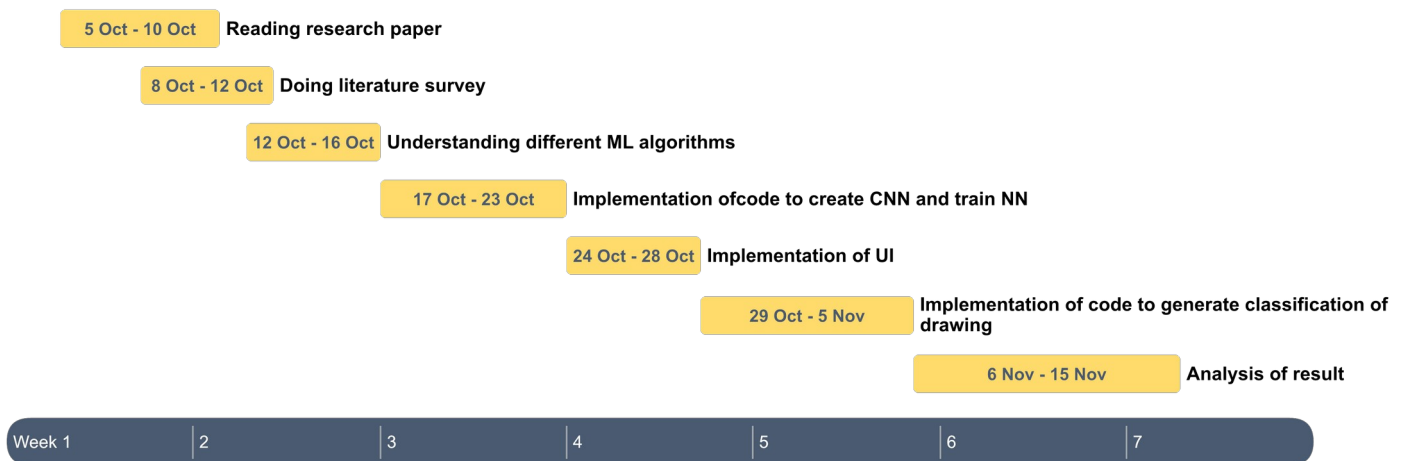
Methodology/ Planning of work



Facilities required for proposed work

1. Python 3.5 +
2. Scikit-Learn (latest version)
3. NumPy (for Windows)
4. Matplotlib
5. Skleran
6. Keras
7. Tensorflow

Timeline



Bibliography

1. ["Handwritten Digit Recognition using Machine Learning Algorithms"](#) , S M Shamim, Mohammad Badrul Alam Miah, Angona Sarker, Masud Rana & Abdullah Al Jobair.
2. ["Handwritten Digit Recognition Using Deep Learning"](#) , Anuj Dutt and Aashi Dutt.
3. ["Recognition of Handwritten Digit using Convolutional Neural Network in Python with Tensorflow and Comparison of Performance for Various Hidden Layers"](#) , Fathma Siddique, Shadman Sakib, Md. Abu Bakr Siddique.
4. ["Advancements in Image Classification using Convolutional Neural Network"](#) , by Farhana Sultana, Abu Sufian & Paramartha Dutta.
5. <http://ijcsit.com/docs/Volume 7/vol7issue1/ijcsit2016070101.pdf>
6. "Handwriting recognition": https://en.wikipedia.org/wiki/Handwriting_recognition
7. <https://medium.com/dataseries/basic-overview-of-convolutional-neural-network-cnn-4fcc7dbb4f17>