Project Design Phase-I

Proposed Solution

Date	19 September 2022
Team ID	PNT2022TMID01504
Project Name	Project - A Novel Method for Handwritten Digit Recognition System
Maximum Marks	2 Marks

Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Handwriting recognition is one of the compelling research works going on because every individual in this world has their own style of writing. It is the capability of the computer to identify and understand handwritten digits or characters automatically. 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 Artificial neural networks to train these images and build a deep learning model. 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.
2.	Idea / Solution description	HANDWRITTEN digit recognition is the ability of a computer system to recognize the handwritten inputs like digits, characters etc. from a wide variety of sources like emails, papers, images, letters etc.

		Here comes the use of Deep Learning. In the past decade, deep learning has become the hot tool for Image Processing, object detection, handwritten digit and character recognition etc. A lot of machine learning tools have been developed like scikit-learn, scipy-image etc. and pybrains, Keras, Theano, Tensorflow by Google, TFLearn etc. for Deep Learning. These tools make the applications robust and therefore more accurate. The Artificial Neural Networks can almost mimic the human brain and are a key ingredient in image processing field. For example, Convolutional Neural Networks with Back Propagation for Image Processing, Deep Mind by Google for creating Art by learning from existing artist styles etc..
3.	Novelty / Uniqueness	The first layer of the architecture is the User layer. User layer will comprise of the people who interacts with the app and for the required results. The next three layers is the frontend architecture of the application. The application will be developed using Bootstrap which is the open source platform for HTML, CSS and JavaScript. The application is deployed in the localhost which is shown on the browser. Through the app, the user will be able to upload pictures of the handwritten digits and convert it into the digitalized form. The one in between the database and view layer is the business layer which is the logical calculations on the basis of the request from the client side. It also has the service interface. The backend layer consists of two datasets: Training Data and Test Data. The MNIST database has been used for that which is already divided into training set of 60,000 examples and test of 10,000 examples.

4.	Social Impact / Customer Satisfaction	As with any work or project taken up in the field of machine learning and image processing we are not considering our results to be perfect. Machine learning is a constantly evolving field and there is always room for improvement in your methodology; there is always going to be another new approach that gives better results for the same problem. The application has been tested using three models: Multi-Layer Perceptron (MLP), Convolution Neural Network (CNN). With each model we get a different accuracy of the classifier which shows which one is better.
5.	Business Model (Revenue Model)	The results of training the network is stored in .npz format so that whenever a user tries to recognize the digit, the application does not go into the training loop again. For classification, we have used logistic classifier, softmax function, one hot encoding, cross entropy and loss minimization using mini batch gradient descent. These are some of the basics of Neural Network which are required to process the output from the network and display in the form the user can understand.
6.	Scalability of the Solution	An implementation of Handwritten Digit Recognition using Deep Learning has been implemented in this paper. Additionally, some of the most widely used Machine Learning algorithms i.e. CNN using Tensorflowhave been trained and tested on the same data to draw a comparison as to why we require deep learning methods in critical applications like Handwritten Digit Recognition. In this project, we have shown that using Deep Learning techniques, a very high amount of accuracy can

		be achieved. Using the Convolutional Neural Network with Keras and Theano as backend, I am able to get an accuracy of 95.72%. Every tool has its own complexity and accuracy. Although, we see that the complexity of the code and the process is bit more as compared to normal Machine Learning algorithms but looking at the accuracy achieved, it can be said that it is worth it. Also, the current implementation is done only using the CPU .Thus we settled on classifying a given handwritten digit image as the required digit using three different algorithms and consequently testing its accuracy. In future we are planning to further explore the topic to recognize people's handwriting.