GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

HANDWRITTEN DIGIT RECOGNITION USING MULTILAYER SYSTEM AND KNN CLASSIFIER

A Report for the Evaluation 3 of Project 2

Submitted by

ANIKET RANAN

(1613101130/16SCSE101754)

in partial fulfillment for the award of the degree of

Bachelor of Technology

IN

Computer Science and Engineering

SCHOOL OF COMPUTING SCIENCE AND ENGINEERING

Under the Supervision of

Dr. ASHOK KUMAR YADAV

APRIL / MAY- 2020

GALGOTIAS UNIVERSITY

SCHOOL OF COMPUTING AND SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

Certified that this project report "**HANDWRITTEN DIGIT RECOGNITION USING MULTILAYER FORWARD SYSTEM AND KNN CLASSIFIER"** is the bonafide work of "**ANIKET RANJAN (1613101130)"** who carried out the project work under my supervision.

SIGNATURE OF HEAD

Dr. MUNISH SHABARWAL,
PhD (Management), PhD (CS)
Professor & Dean,
School of Computing Science & Engineering

SIGNATURE OF SUPERVISOR

Dr. ASHOK KUMAR YADAV,
M.Tech, PhD
Associate Professor,
School of Computing Science & Engineering

ABSTRACT

Every individual has their style of writing and recognizing them is a very difficult task for the computer. In this research paper, We are going to solve this problem by using different techniques like Multilayer Forward System and KNN classifier. We are taking MNIST dataset for recognizing digits from 0 to 9. The dataset contains a total of 60000 images with their labels for training and 10000 images with their labels for testing. Every digit is represented in a 28X28 grayscale pixel. The digits passed to the 1st layer of Multilayer Forward System i.e input layer then they are forwarded to the next layer i.e hidden layer which contains two sets of layers activation layer and pooling layer. finally it gets mapped with a fully connected layer and classifies the digits using the KNN classifier.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Overall Description

In our mind, there are several neurons connected. We have used this idea in this project. We will use the digits to train a multilayered network. The network should be able to classify it as the right digit between 0-9. Various decision-making models are formed by taking different weights and the threshold value. The 1st layer of the network makes very simple decisions by multiplying the weights with the inputs. In this way, the 2nd layer makes more complex decisions than the first layer. We should continuously change the weight and check the differences. In the first step we will download the database of images from the MNIST website and store it on our local disk. If the file is already present on our local disk then it will not be downloaded. The data is in the form of a 1-D array so we have to convert it into images. Each image has 28*28 pixels. The data are also in the form of bytes so we will convert it to float. The labels are in the form of binary files. In the next step we will create a network with 2 hidden layers of 800 nodes each. The output layer will have 10 nodes – the nodes are numbered 0-9 and the output at each node will be a value between 0-1. The node with the highest value will be the predicted output. The input layer has the dropout of edges to avoid over fitting. Initially the hidden layers are dense/fully connected. Then we will

initialize some weights to this layer so that the training will be done faster. Now we will add a 50% dropout to the hidden layer1. Add another layer and continue the same process. At the last add the final output layer. The output layer has 10 units or nodes and the output at each node will be a value between 0-1 and the max of those will be the final prediction. Training of data to the network comprises 3 steps i.e, compute the error, find the current weight and update the weights. In the next step, we will check the output for 1 image and then feed a test data set of 10000 images to the trained network and check its accuracy. We will use library function lasagne written in python and capable of running by using backend as either Tensor Flow or Theano.

1.2 Purpose

It is very hard task for the machine to recognize the handwritten digits because they are not perfect. The handwritten digit recognition is the solution for this problem which uses the images of the digit to recognize that particular digit with high accuracy.

1.3 Motivation And Scope

Before the computers existed all the important information were stored in written form, this is very inefficient form of storage as the paper information cannot be stored for very long time or can get lost or be destroyed. On the contrary information on computer is stored safely for long time and multiple copies of same information can be made easily.

Thus after the invention of computers, lots of money was wasted in manual labour for converting this paper information into digital information. Instead machine learning can be used to identify and convert this paper information into digital information without human intervention or manual labour. Now, this technology is used in different sectors like banking sector, postal etc.

2. PROPOSED SYSTEM

Many researchers focus on designing handwritten digit recognition using Machine Learning, Artificial Neural Network or any other techniques. To increase the accuracy we have implemented it by using Multilayer Forward System and KNN Classifier. In this, the dataset will be first passed onto the input layer. The input layer is not fully connected because of over-fitting. The output of the input layer will be act as an input for the hidden layer. Then the dataset will be passed further to the hidden layers. The hidden layers are dense/fully connected. The output of hidden layers will act as input for the output layer. The output layer has only 10 nodes and the output at each node will be valued between 0-1 and the maximum of those will be the final prediction. After the prediction from the output layer, the training of data to the network will be performed. The training of data comprises basically three steps i.e error computation, current weight and update the weights. Then check the output for 1 image and then perform a test dataset of 10000 images to the trained network and check its accuracy.

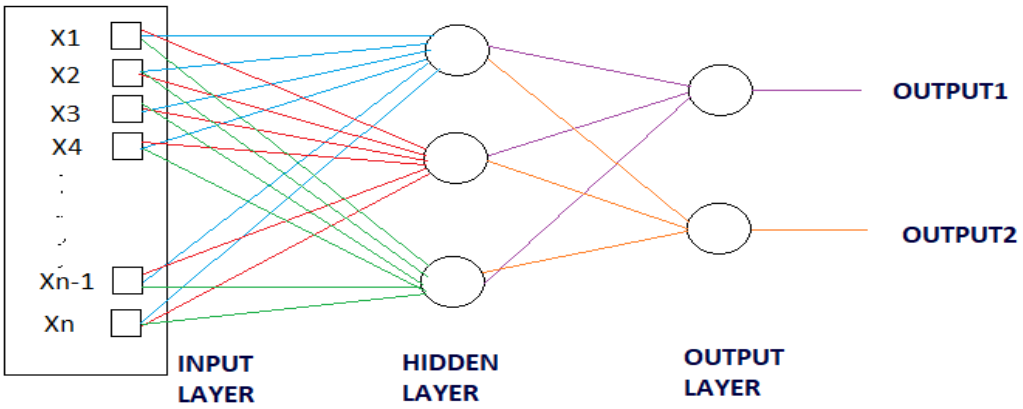
3. EXISTING SYSTEM

Many researchers focus in designing handwritten digit recognition using Machine Learning, Artificial Neural Network or any other techniques. They focus to accelerate the computation of Neural Networks with the help of parallel programming. Pendlebury et al. framed parallel simulation of ANN on NVIDIA CUDA.This simulation was comprised of Intel Qual core i5 2xNvidia GeForce GTX480 and hence there was an improvement of around 80% when done in CUDA instead of CPU. One interesting accuracy was achieved by Ernst Kussul et al Of 99.4% when tested on MNIST dataset by framing a neural classifier Limited Receptive Area to recognize the digits. But one Disadvantage was it consumed huge training time of 55 hrs on Pentium III, 500MHz processor

4. IMPLEMENTATION

4.1 Architecture Diagram

The architecture of Multilayer Neural Network System is shown below-



We have used python programming to implement this because we have library functions for mathematical computation and plotting functions are present in it.

4.2 Library Packages

4.2.1 Theano:- Theano is a mathematical package that allows us to define and perform mathematical computations like NumPy but with high dimensional arrays like Tensors.

4.2.2 Lasagne:-Lasagne is a library that uses Theano heavily and supports the building of neural networks. It comes with functions to set up layers, define error functions, train neural networks, etc.

4.2.3 Matplotlib:-Matplotlib is a library package which is used for creating static, animated and attractive visualizations. Matplotlib consists of several plots like line graph, bar graph, scatter plot etc

4.2.4 OS:- OS package provides a way of using operating system dependent functionality. The functions that OS module provides allows you to interface with the underlying operating system that python s running on – be that Windows, Linux, or Mac.

5. RESULT

There are various factors in which the performance of the network depends like low memory requirements, low run time and better accuracy. In this paper we are only concerned about getting better accuracy in recognizing the handwritten digits. And in the end we are getting better accuracy.

6. FUTURE WORK

The neural networks are applied to many applications like handwritten digit recognition, character recognition etc but they can be useful for many more applications like signature recognition or captcha recognition. The more the training set, the more accuracy will be achieved.

7. REFRENCES

1. LeCun, Y., Cortes, C: THE MNIST DATABASE of handwritten digits, http://yann.lecun.com/exdb/mnist/
2. T SIVA AJAY, “Handwritten Digit Recognition Using Convolutional Neural Networks”, July-2017
3. Shashank Mishra, D. Malathi, K. Senthilkumar, “DIGIT RECOGNITION USING DEEP LEARNING”.
4. Fathma Siddique , Shadman Sakib , Md. Abu Bakr Siddique, “Recognition of Handwritten Digit using Convolutional Neural Network in Python with Tensorflow and Comparison of Performance for Various Hidden Layers”
5. Pendlebury, John, HuanhuanXiong, and Ray Walshe. "Artificial neural network simulation on CUDA." Proceedings of the 2012 IEEE/ACM 16th International Symposium on Distributed Simulation and Real Time Applications. IEEE Computer Society, 2012.
6. Kussul, Ernst, and Tatiana Baidyk. "Improved method of handwritten digit recognition tested on MNIST database." Image and Vision Computing 22.12 (2004): 971-981.
7. Y.LeCun,B.Baser,J.S.Denker,D.Henderson ,R.E.Howard,R.Hubbard,and L.D.Jackel , Handwritten digit recognition with a back- propogation network in D.Tourezky, Advances in Neural Information Processing Systems 2, Morgan Kaufman(1990)

8. Haider A.Alwzwazy, Hayder M. Albehadili, Younes S.Alwan ,Naz E Islam paper on “Handwritten Digit Recognition Using Convolutional Neural Networks” Vol 4 ,Issue 2,February 2016