Project Requirement and Specification

on

Hand written digit recognition using Deep learning

(B.Tech VI Semester Mini project )

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1.1 About Project

### What is Handwritten Digit Recognition?

The handwritten digit recognition is the ability of computers to recognize human handwritten digits. It is a hard task for the machine because handwritten digits are not perfect and can be made with many different flavors. The handwritten digit recognition is the solution to this problem which uses the image of a digit and recognizes the digit present in the image.

In this project, I am going to implement a handwritten digit recognition web app using the self created dataset. We will be using a special type of deep neural network that is Convulational Neural Network.It would be better to train the model using google colab.

What is Convulational Neural Network?

A Convolutional Neural Network, also known as CNN or ConvNet, is a class of neural networks that specializes in processing data that has a grid-like topology, such as an image. A digital image is a binary representation of visual data. It contains a series of pixels arranged in a grid-like fashion that contains pixel values to denote how bright and what color each pixel should be.

Chart, background pattern

Description automatically generated

Figure 1: Representation of image as a grid of pixels

The human brain processes a huge amount of information the second we see an image. Each neuron works in its own receptive field and is connected to other neurons in a way that they cover the entire visual field. Just as each neuron responds to stimuli only in the restricted region of the visual field called the receptive field in the biological vision system, each neuron in a CNN processes data only in its receptive field as well. The layers are arranged in such a way so that they detect simpler patterns first (lines, curves, etc.) and more complex patterns (faces, objects, etc.) further along. By using a CNN, one can enable sight to the computers.

Why Convulational Neural Network?

Convolutional neural networks (CNN) are one of the most popular models used today. This neural network computational model uses a variation of multilayer perceptrons and contains one or more convolutional layers that can be either entirely connected or pooled. These convolutional layers create feature maps that record a region of image which is ultimately broken into rectangles and sent out for nonlinear processing.

Advantages:

* Very High accuracy in image recognition problems.
* Automatically detects the important features without any human supervision.
* Weight sharing.

Disadvantages:

* CNN do not encode the position and orientation of object.
* Lack of ability to be spatially invariant to the input data.
* Lots of training data is required.

# Convolutional Neural Network Architecture

A CNN typically has three layers: a convolutional layer, a pooling layer, and a fully connected layer.

Diagram, engineering drawing

Description automatically generated

* Convolutional layer: Convolutional layers are made up of a set of filters (also called kernels) that are applied to an input image. The output of the convolutional layer is a feature map, which is a representation of the input image with the filters applied. Convolutional layers can be stacked to create more complex models, which can learn more intricate features from images.
* Pooling layer: Pooling layers are a type of convolutional layer used in deep learning. Pooling layers reduce the spatial size of the input, making it easier to process and requiring less memory. Pooling also helps to reduce the number of parameters and makes training faster. There are two main types of pooling: max pooling and average pooling. Max pooling takes the maximum value from each feature map, while average pooling takes the average value. Pooling layers are typically used after convolutional layers in order to reduce the size of the input before it is fed into a fully connected layer.
* Fully connected layer: Fully-connected layers are one of the most basic types of layers in a convolutional neural network (CNN). As the name suggests, each neuron in a fully-connected layer is Fully connected- to every other neuron in the previous layer. Fully connected layers are typically used towards the end of a CNN- when the goal is to take the features learned by the previous layers and use them to make predictions. For example, if we were using a CNN to classify images of animals, the final Fully connected layer might take the features learned by the previous layers and use them to classify an image as containing a dog, cat, bird, etc.

1.2 Requirement of Project

1.2.1 Hardware Requirement:

* PROCESSOR: INTEL® PENTIUM® CPU @ 2.0 GHZ
* RAM: 4 GB(MINIMUM)
* STORAGE: 5 MB(MAXIMUM)
* OS: WINDOWS 8

1.2.2 Software Requirement:

* Python 3.6 (one of the most compatible python version)
* Pycharm (for creating and training the model)
* Vscode (for creating the front end of the project)

1.3 Modules of Project:

1.3.1 Tensorflow():

TensorFlow is an open-source software library. TensorFlow is an end-to-end open source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries and community resources that lets researchers push the state-of-the-art in ML and developers easily build and deploy ML powered applications.

Advantages of Tensorflow

* It builds and train ML models easily using intuitive high-level APIs like Keras with eager execution, which makes for immediate model iteration and easy debugging.
* It easily train and deploy models in the cloud, on-prem, in the browser, or on-device no matter what language you use.
* It is a simple and flexible architecture to take new ideas from concept to code, to state-of-the-art models, and to publication faster.

TensorFlow requires a recent version of pip, so upgrade your pip installation to be sure you're running the latest version.

pip install --upgrade pip

It can be installed by typing the following pip command ,

pip install tensorflow

1.3.2 Keras:

Keras is a high-level, deep learning API developed by Google for implementing neural networks. It is written in Python and is used to make the implementation of neural networks easy. It also supports multiple backend neural network computation.

Keras is relatively easy to learn and work with because it provides a python frontend with a high level of abstraction while having the option of multiple back-ends for computation purposes. This makes Keras slower than other deep learning frameworks, but extremely beginner-friendly.

**Keras and TensorFlow are open source Python libraries for working with neural networks, creating machine learning models and performing deep learning. Because Keras is a high level API for TensorFlow, they are installed together.** **When you install TensorFlow 2.0+, Keras will be automatically installed, as well.**

Keras can also be installed by using the following commands in terminal:

Pip install Keras

1.3.3 Numpy:

NumPy is a Python library used for working with arrays. It also has functions for working in domain of linear algebra, fourier transform, and matrices. NumPy was created in 2005 by Travis Oliphant. It is an open source project and you can use it freely.

1.3.4 Pillow():

What is Python pillow used for?

Pillow is a Python Imaging Library (PIL), which adds support for opening, manipulating, and saving images. The current version identifies and reads a large number of formats. Write support is intentionally restricted to the most commonly used interchange and presentation formats.

Installation

To install the pillow module, first of all, you have to open the terminal and write “pip install pillow”

1.3.5 Flask

Flask is a small and lightweight Python web framework that provides useful tools and features that make creating web applications in Python easier. It gives developers flexibility and is a more accessible framework for new developers since you can build a web application quickly using only a single Python file.

For installing it ,refer to its documentation at https://phoenixnap.com/kb/install-flask

ANY OTHER RELEVANT INFORMATION SUCH AS

A picture containing graphical user interface

Description automatically generated

# 1.5 REFERENCE

1. GEEKS FOR GEEKS.
2. STACK OVERFLOW.
3. BOOKS : Python Crash Course
4. Tensorflow documentation