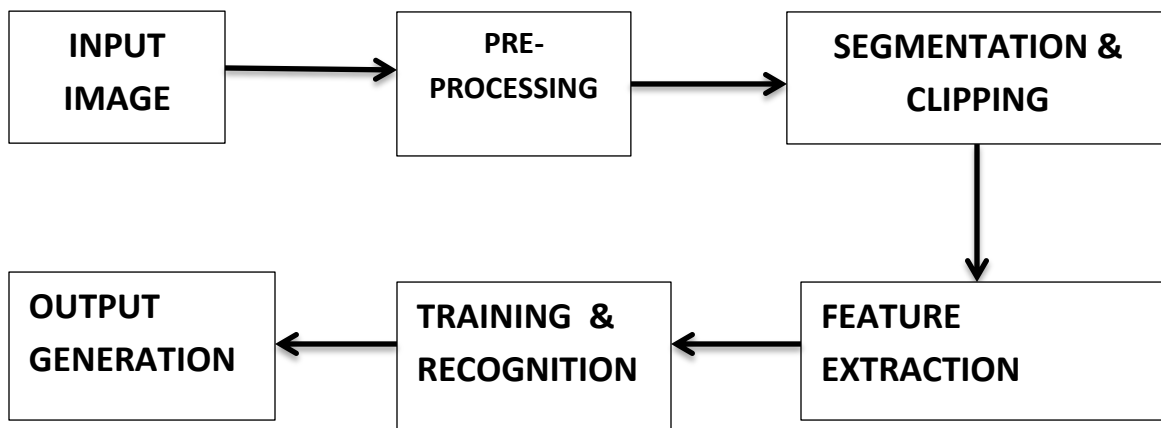


**TEAM ID : PNT2022TMID35898**

## **A NOVEL METHOD FOR HANDWRITTEN DIGIT RECOGNITION SYSTEM**

### **SOLUTION ARCHITECTURE:**



### **PROJECET DESCRIPTION:**

Handwritten digit recognition has recently been of very interest among the researchers because of the evolution of various Machine Learning, Deep Learning and Computer Vision algorithms. In this report, We compare the results of some of the most widely used Machine Learning Algorithms like CNN- convolution neural networks and with Deep Learning algorithm like multilayer CNN using Keras with Theano and Tensorflow. MNIST is a dataset which is widely used for handwritten digit recognition. The dataset consist of 60,000 training images and 10,000 test images. The artificial neural networks can all most mimic the human brain and are a key ingredient in image processing field. For example Convolution Neural networks with back propagation for image processing. The applications

where these handwritten digit recognition can be used are Banking sector where it can be used to maintain the security pin numbers, it can be also used for blind peoples by using sound output.

## **SOLUTION ARCHITECTURE:**

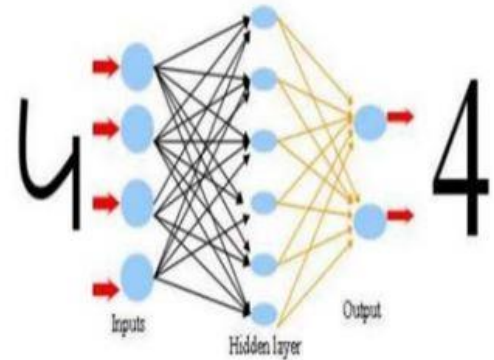
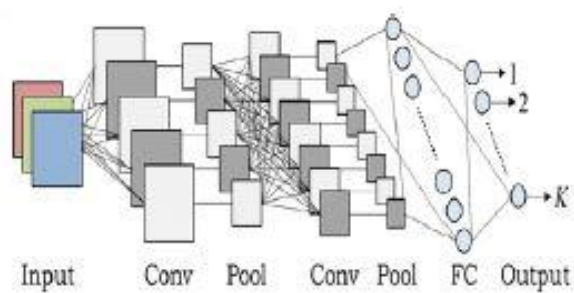
### **DATASET:**

The dataset used is the MNIST database of handwritten digits. It consists of a training set of 60,000 examples, and a test set of 10,000 examples. The digits have been size-normalized and centered in a fixed-size image. The images are of size 28\*28 pixels. It is a good database for people who want to try learning techniques and pattern recognition methods on real-world data while spending minimal efforts on preprocessing and formatting.



### **METHODOLOGY:**

There is a reason behind using CNN for handwritten digit recognition. Let us consider a multi-layer feedforward neural network to be applied on MNIST dataset which contains images of size 28x28 pixels (roughly 784 pixels). So if a hidden layer has about 100 units, then the first layer weights comes up to about 78k parameters, which is large but manageable. However, in the natural world the size of the image is much larger. If we consider the size of the typical image which is around 256x256 pixels (roughly about 66,000 pixels), then the first layer weights will have about 660k parameters! So that becomes too many parameters and hence make it unscalable for real images. Hence, it will be so large that it will become very difficult to generalize the new data fed into the network.



## WORKING:

Neural Networks receive an input, and transform it through a series of hidden layers. Each hidden layer is made up of a set of neurons, where each neuron is fully connected to all neurons in the previous layer. Neurons in a single layer function completely independently. The last fully-connected layer is called the "output layer".

## CONVOLUTION LAYER:

The Convolutional layer is the core building block of a CNN. The layer's parameters consist of a set of learnable filters (or kernels), which have a small receptive field, but extend through the full depth of the input volume. During the forward pass, each filter is convolved across the width and height of the input volume, computing the dot product between the entries of the filter and the input and producing a 2- dimensional activation map of that filter. As a result, the network learns filters that activate when they see some specific type of feature at some spatial position in the input.

## **FEATURE EXTRACTION:**

All neurons in a feature share the same weights .In this way all neurons detect the same feature at different positions in the input image. Reduce the number of free parameters.

## **TENSORFLOW:**

TensorFlow is an open-source machine learning library for research and production. TensorFlow offers APIs for beginners and experts to develop for desktop, mobile, web, and cloud. See the sections below to get started. By scanning the numerical digit and convert into png format using python3 command in terminal we can get text output and sound output.