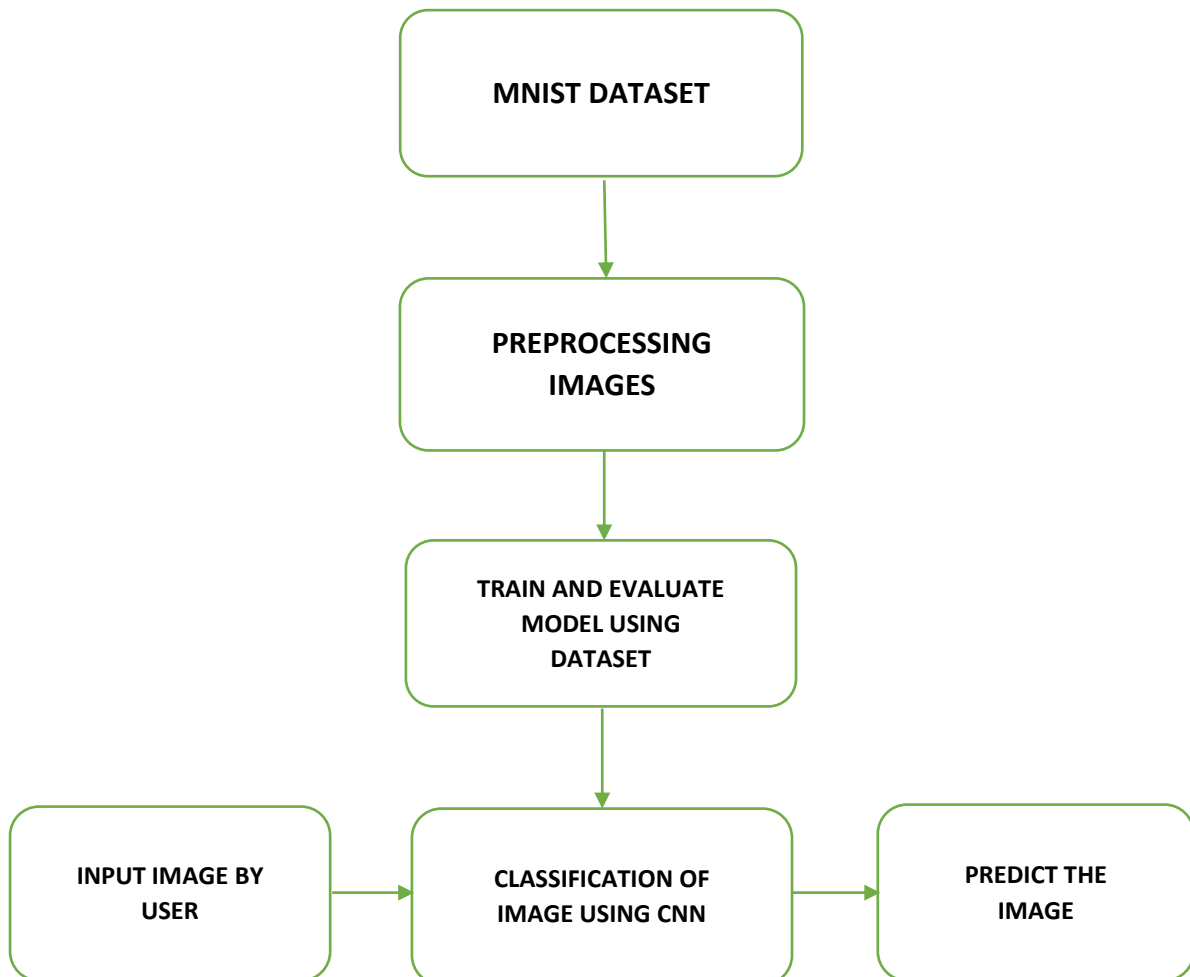


**PROJECT DESIGN PHASE-1**  
**SOLUTION ARCHITECTURE**

<b>Team ID</b>	<b>PNT2022TMID11500</b>
<b>Project Name</b>	<b>A Novel Method for Handwritten Digit Recognition system</b>
<b>Date</b>	<b>25.09.2022</b>
<b>Team Members</b>	<b>1. Hemapriya K B 2. Bhuvaneshwari R S 3. Chandra V S 4. Karthiga mai N L 5. Nandhini R</b>



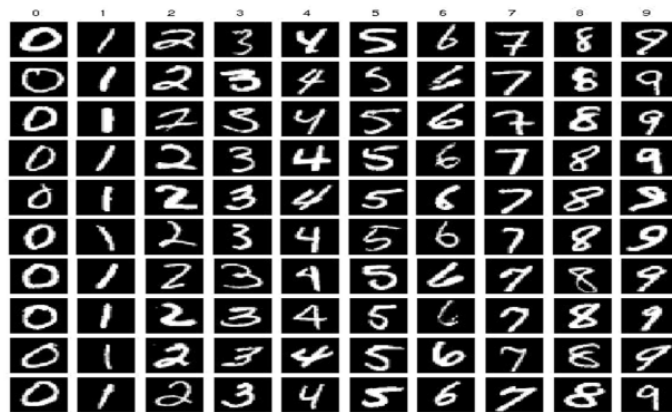
## PROJECT DESCRIPTION:

Everyone in the world has a unique writing style, handwriting identification is one of the fascinating research projects now being conducted. It is the ability of a computer to automatically recognize and comprehend handwritten numbers or letters. Every aspect of life is being digitized to lessen the need for human labour as a result of advancements in science and technology. Thus, handwritten digit recognition is required in many real-time applications. The MNIST data collection, which contains 70000 handwritten digits, is frequently utilized for this recognition method. In order to train these photos and create a deep learning model, we use artificial neural networks. A web application is developed that allows users to upload pictures of handwritten numbers. The model examines this image and the detected result is returned to the User Interface.

## SOLUTION ARCHITECTURE:

### DATASET:

The MNIST data collection, which contains 70000 handwritten digits, is frequently utilized for this recognition method. In order to train these photos and create a deep learning model, we use artificial neural networks. A web application is developed that allows users to upload pictures of handwritten numbers. The model examines this picture. The 60,000 training and 10,000 testing labelled handwritten digit images in the MNIST Handwritten Digit Recognition Dataset.



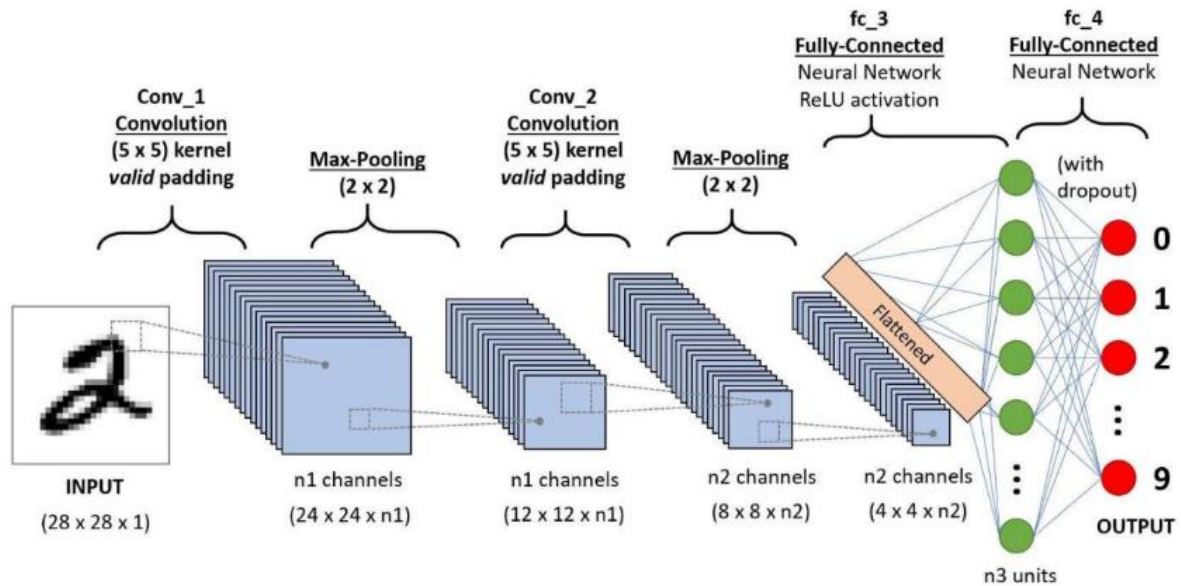
### APPROACH:

This project will be approached utilizing a convolutional neural network. (CNN)

- ✚ The convolutional and max-pool layer: The feature is extracted from the input image and got max pooled to reduce the dimensionality of the image without any changes in the extracted feature.
- ✚ The dense layer: The flattened output from the max-pool layer is fed to a feed-forward neural network and backpropagation applied to every iteration of training.
- ✚ The output layer: The nodes in this stratum are referred to as output units. It gives us access to the neural network's final prediction, which may be used to make final predictions.

### METHODOLOGY:

A neural network with one hidden layer and 100 activation units has been put into practice (excluding bias units). The features (X) and labels (Y) were retrieved after the data was loaded from a mat file. To prevent overflow during computation, features are then scaled into a range of [0,1] by dividing by 255. 10,000 testing cases and 60,000 training examples make up the data. With the training data, feedforward is used to calculate the hypothesis, and backpropagation is then used to lower the error between the layers. To combat overfitting, the regularization parameter lambda is set to 0.1. To identify the model that fits the situation the optimizer runs for 70 times.



A neural network is a model of the brain's operations. It is made up of numerous layers with a variety of activations; these activations mimic the neurons in our brain. An attempt is made by a neural network to learn a set of parameters from a set of data that might aid in understanding the underlying relationships. Since neural networks are capable of adapting to changing input, the network can produce the best outcome without having to change the output criterion

### WORKING:

After receiving an input, neural networks change it using a number of hidden layers. Each group of neurons in a hidden layer is completely linked to every other neuron in the layer above it. One layer of neurons has perfect independence from one another. The "output layer" is the final layer to be fully connected.

### CONVOLUTION LAYER:

The foundational component of a CNN is the convolutional layer. The parameters of the layer are a set of learnable filters (or kernels) that cover the entire depth of the input volume but have a narrow receptive field. Each filter is convolved across the width and height of the input volume during the forward pass, computing the dot product between each filter entry and the input to create a two-dimensional activation map of the filter. As a result, the network picks up filters that turn on when it detects a certain kind of feature at a particular spatial location 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:

An open-source machine learning library for both research and production is called TensorFlow. TensorFlow provides developers of all skill levels with APIs for desktop, mobile, web, and cloud applications. We can achieve text output and sound output by scanning the number digit and converting it to PNG format using the python3 command in the terminal.