

Smart System Final Project

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Hand Written Digit Recognition by neural network:

The application that I chose is an application of neural network that recognize the handwritten digits using MNIST dataset, it is a major application made with the help of Neural Network. It basically detects the scanned images of handwritten digits.

Goal: predicting digits using Neural Network.

- First, we will import the needed libraries.
- Then, we will download the **mnist** dataset from tensorflow keras → dataset with bunch of handwritten digits in 28×28 pixel formats. Will use that as training data for our NN then we're going to test it and [in the end we're going to provide our own handwritten images](#).
- Load the dataset.
- Split the data into training data and testing data
When we train the model we get the dataset which is the labeled data which is in our project (all the digits).
Training data → use to train the data.
Testing data → use to assess the model so we see how well it perform on data that have never seen before.
- Then we have to normalize it → means scaling down so that every value is between zero and one.
we only normalize the pixels because that makes it easier for neural network to do calculations.
- Create the neural network model
- Add layers to the model as flattened layer it flatten a certain input shape and turns them into one flat layer (not a grid of 28*28)
it turns them into one big line of 784 pixels instead of having this grid.

- Add dense layer which is basic neural network that each neuron is connected to each other neuron of other layers
- Add another dense layer.
- Add another dense layer but with 10 units because it will be the output layer and we want this 10 units to represent the individual digits (0,1,2,3,4,5,6,7,8,9) = 10 neurons, and activation function is softmax → makes sure that all the outputs (10 neurons) add up to one also it gives us the probability for each digit to be the right answer.
- Compile the model.
- Once the model is compiled we need to fit the model by using fit function and pass to it the training data.
- Right now we have a fully working model so better to save it.

Output:

```
Epoch 1/3
1875/1875 [=====] - 7s 3ms/step - loss: 0.2645 - accuracy: 0.9221
Epoch 2/3
1875/1875 [=====] - 6s 3ms/step - loss: 0.1077 - accuracy: 0.9664
Epoch 3/3
1875/1875 [=====] - 6s 3ms/step - loss: 0.0739 - accuracy: 0.9768
```

- Instead of running the previous cells everytime we can load the model.
- Then we need to evaluate them all to see how well this model perform on testing data.

Output:

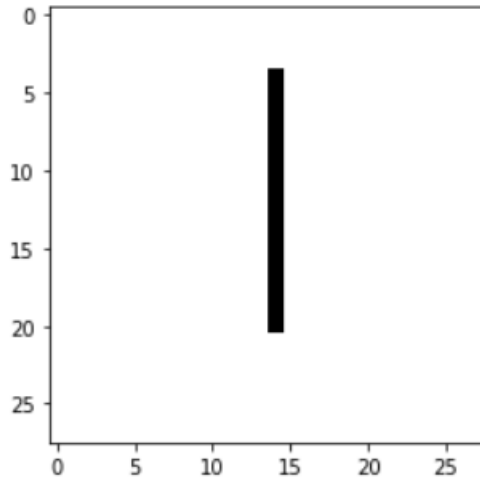
```
0.08582749962806702
0.9757000207901001
```

As we can see we have very low loss and accuracy is about 97% that's pretty good and this means that about 3% only were classified incorrectly.

- Now we're to have some handwritten digits and we will feed them to the model to predict the digits. I uploaded some handwritten digits in a folder called digits and it will be classified using neural network.

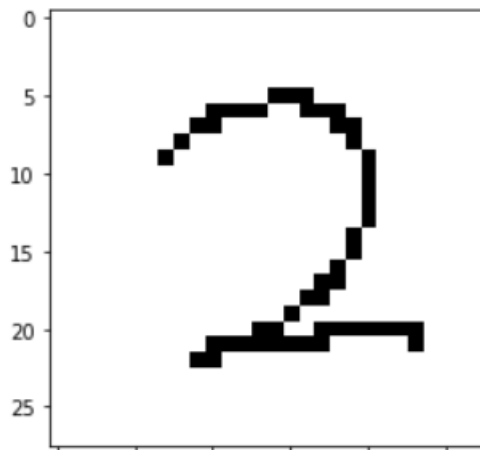
Output:

This digit is probably a 1



1/1 [=====] - 0s 19ms/step

This digit is probably a 2



Reference → [\(175\) Neural Network Python Project - Handwritten Digit Recognition - YouTube](#)