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A Novel Method For Handwritten Digit Recognition System Solution Architecture:

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┌─────────────────────────────────────────────┐
│           INPUT IMAGE FROM USER               │
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┌─────────────────────────────────────────────┐
│           PRE PROCESSING OF IMAGE             │
└─────────────────────────────────────────────┘
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┌─────────────────────────────────────────────┐
│         CLASSIFIER AND DL ALGORITHM           │
└─────────────────────────────────────────────┘
                      │
┌─────────────────────────────────────────────┐
│   SEGMENTATION AND RECOGNITION USING FEATURE  │
│                 EXTRACTION                     │
└─────────────────────────────────────────────┘
                      │
┌─────────────────────────────────────────────┐
│        IDENTIFIED DIGIT SHOWN AS OUTPUT       │
└─────────────────────────────────────────────┘
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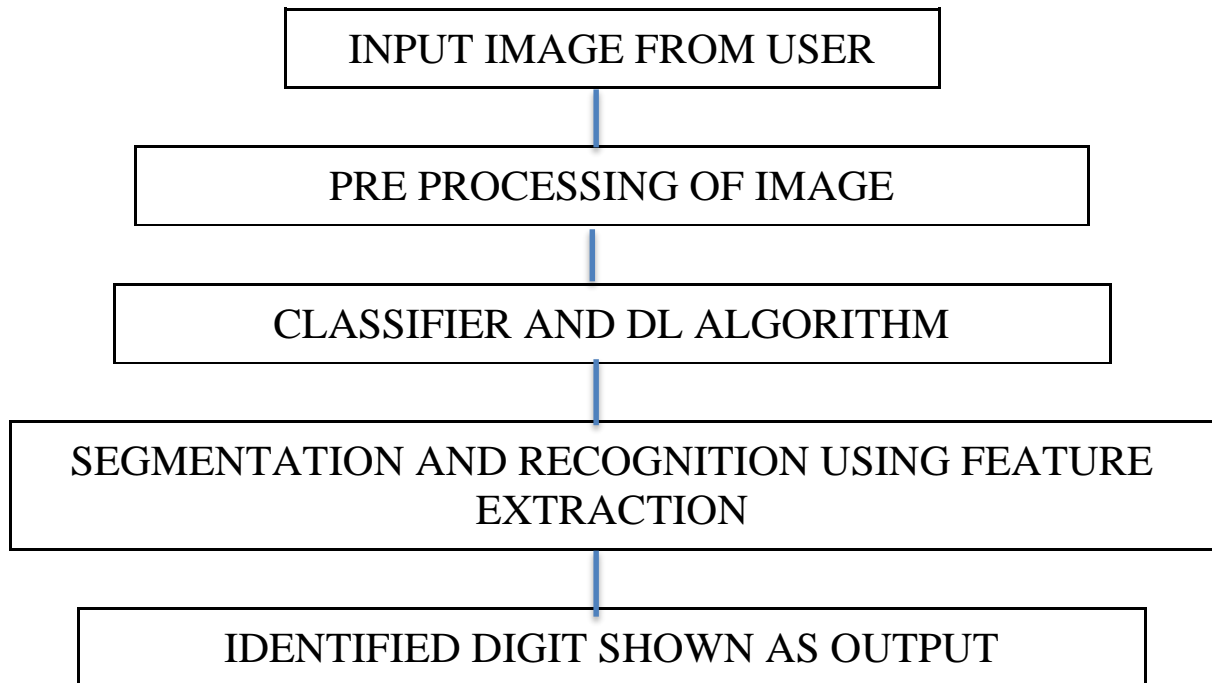
PROJECT DESCRIPTION:

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 digitised 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 utilised 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 utilised 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 utilising a three-layered neural network.

The input layer: The input layer transfers the information from our example systems to the following layer so that the latter can compute its activations.

The hidden layer: The network's nonlinear ties are provided by hidden units termed activations that make up the hidden layer. Depending on our needs, there can be a variety of concealed layers.

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.
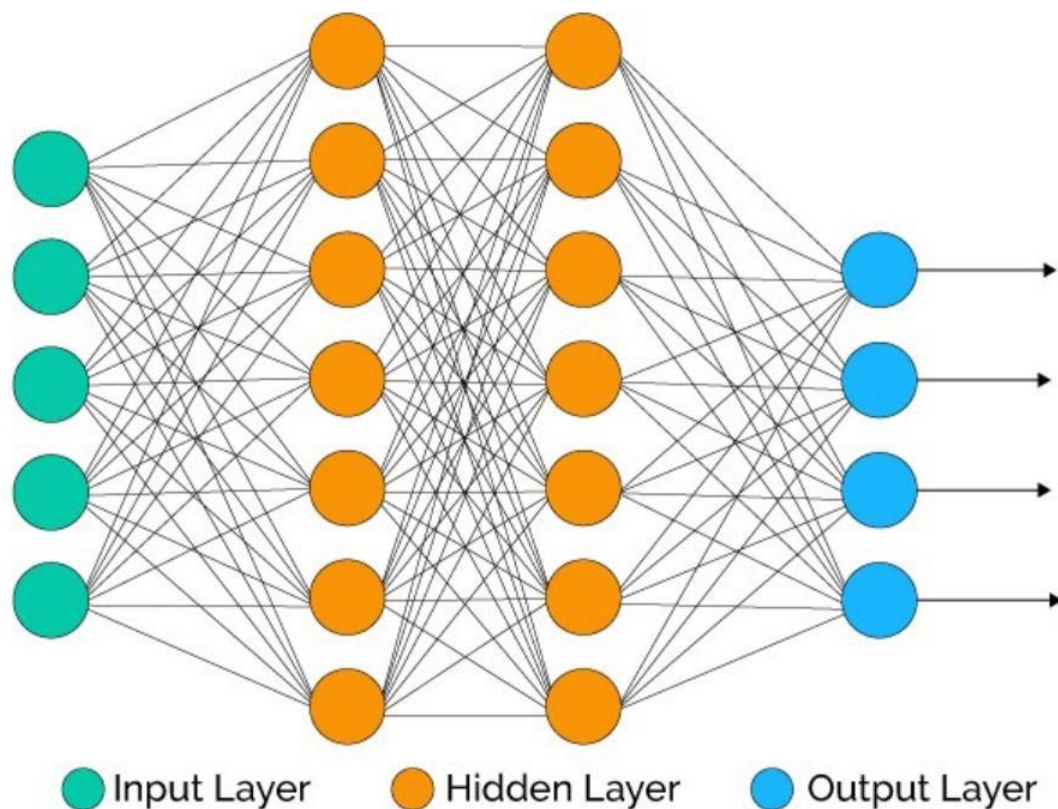
A neural network is a model of the brain's operations. It is made up of numerous layers with a variety of activations; these activations mimic the neurons in our brain. An attempt is made by a neural network to learn a set of parameters from a set of data that might aid in understanding the underlying 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

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 regularisation parameter lambda is set to 0.1. To identify the model that fits the situation the optimizer runs for 70 times.

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 have 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 :

The input image is used by the feature extraction network. The extracted feature signals are utilised by the neural network for classification. The neural network classification then works on the basis of the image features and produces the output. The neural network for feature extraction includes convolution layer piles and sets of pooling layers. As its name implies, the convolution layer transforms the image using the process of the convolution. It can be described as a series of digital filters. The layer of pooling transforms the neighbouring pixels into a single pixel. The pooling layer then decreases the image dimension. As CNN's primary concern is the image, the convolution and pooling layers' procedures are intuitively in a two-dimensional plane. This is one of CNN's distinctions with other neural networks

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. To get started, refer to the sections below. 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.