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Hand Written Digit Recognition using CNN

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Abstract: Digit Recognition is an interesting and significant topic. Because the manually written digits are not all the same size, thickness, position, and direction, and to determine the issue of handwritten digit recognition, different obstacles must be considered. The variety and distinctiveness of different people's composition styles also influence the appearance and presence of the digits. It is a method of perceiving and organizing transcribed digits. It offers a wide range of uses, such as programmed bank checks, postal locations, and tax paperwork, among others.
The goal of this project is to create a classification algorithm that can recognize handwritten digits. The outcomes of some of the most widely used Machine Learning Algorithms, such as SVM, KNN, and RFC, as well as Deep Learning calculations, such as multilayer CNN, using Keras, Theano, and TensorFlow. Using these, an accuracy of 98.70% was reached using CNN (Keras) when compared to 97.91% using SVM, 96.67% using KNN, and 96.89% using RFC.

I. INTRODUCTION

Recognition is the process of identifying or distinguishing an object or an individual based on previous experiences or learning. Similarly, Digit Recognition is the process of recognizing or identifying numbers in a document. Digit recognition framework is essentially how a machine works to prepare or interpret digits. Handwritten Digit Recognition is a computer's ability to interpret manually written digits from various sources such as messages, bank cheques, papers, pictures, and so on and in various situations such as web-based handwriting recognition on PC tablets, identifying number plates of vehicles, handling bank cheques, digits entered in any forms, and so on.

Machine Learning provides a variety of approaches for reducing human effort in recognizing manually written digits. Deep Learning is a machine learning technology that trains computers to do what people do naturally: learning through examples. Human efforts in seeing, learning, recognizing, and many other areas can be reduced by using deep learning technologies.

The computer learns to do classification tasks from images or the text of any document using deep learning. Deep Learning models can achieve state-of-the-art accuracy, outperforming humans. To recognize digits from diverse sources, the digit recognition model makes use of vast datasets. Character handwriting recognition has been around since the 1980s. Handwritten digit recognition with a classifier has a wide range of applications, including online digit recognition on PC tablets, recognizing zip codes on mail, processing bank check amounts, numeric sections in structures filled out by hand (for example, tax forms), and so on. There are numerous difficulties encountered while attempting to address this problem. The digits are not necessarily the same size, thickness, orientation, or position relative to the margins. The primary goal was to implement a pattern categorization approach for seeing the handwritten digits in the MINIST data set containing images of handwritten digits (0-9 and characters from one-nine).

II. LITERATURE SURVEY

He achieved a 98.72% accuracy by using a convolutional Neural Network using Keras and Theano as the backend. Furthermore, CNN execution using TensorFlow yields a remarkably better result of 99.70%. Despite the fact that the technique and coding appear to be more complicated when compared to standard Machine Learning algorithms, the accuracy he obtained is becoming increasingly visible. Saeed AL-Mansoori presented a paper in which he used a Multilayer Perceptron (MLP) Neural Network to recognize and predict handwritten numerals from 0 to9. The suggested neural system was trained and tested using MNIST datasets.

A. Existing System

Nowadays, a rising number of people use images to exchange data. It is also common practice to isolate critical data from images. Image Recognition is a critical study area because of its widely utilized applications. In general, one of the challenging tasks in the realm of pattern recognition is the precise computerized recognition of human handwriting. Without a doubt, this is a difficult subject due to the wide variation in handwriting from one individual to the next.

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Despite the fact that this distinction is insignificant to most people, it is becoming increasingly difficult to educate computers to comprehend typical handwriting. In the case of image recognition, such as handwritten classification, it is critical to understand how information is represented on to images.

Handwritten Recognition from the MNIST dataset is well known among scientists as by utilizing different classifiers for various parameters, the error rate has been decreased, for example, from linear classifier (1-layer NN) with 12% to 0.23% by a board of 35 convolution neural systems. The scope of this is to implement a Handwritten Digit Recognition framework and think about the diverse classifiers and different techniques by concentrating on how to accomplish close to human performance. For an undertaking of composing diverse digits (0-9) for various people the general issue confronted would be of digit order issue and the closeness between the digits like 1 and 7, 5 and 6, 3 and 8, 9 and 8 and so forth.

III. ARCHITECTURE

The purpose of this document is to investigate the design possibilities of the proposed system, such as architecture design, block diagram, sequence diagram, data flow diagram, and user interface design, in order to define the steps such as pre-processing, feature extraction, segmentation, classification, and digit recognition.

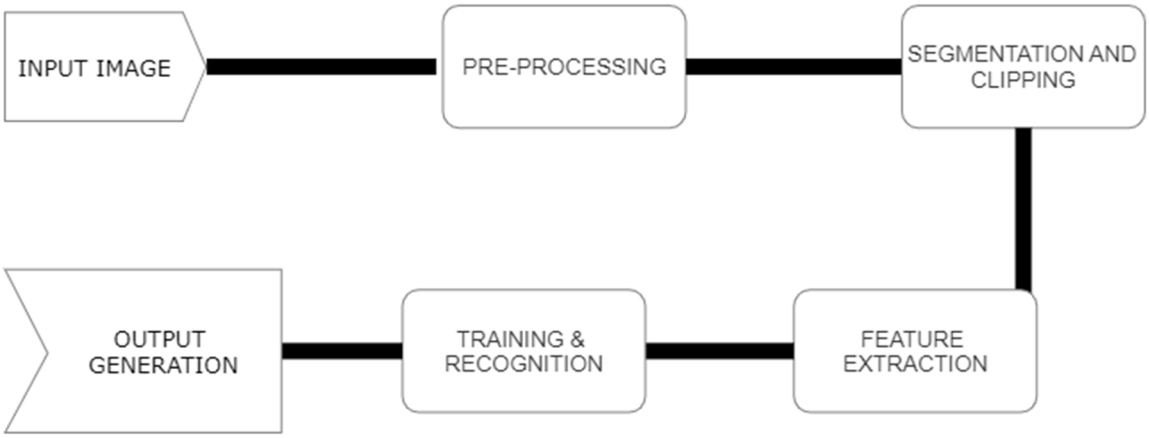


Fig 1:- Architecture of the Proposed System

Figure 1 depicts the architecture diagram of the proposed system. The suggested approach has four stages for classifying and detecting digits:

A. Pre-processing

The role of the pre-processing step is it performs various tasks on the input image. It basically upgrades the image by making it reasonable for segmentation. The fundamental motivation behind pre-processing is to take off a fascinating example from the background. For the most part, noise filtering, smoothing and standardization are to be done in this stage. The pre-processing additionally characterizes a smaller portrayal of the example. Binarization changes over a gray scale image into a binary image.

The first method to the training set photos that will be processed to decrease data by thresholding them into a binary image. Figure 2 depicts a selection of photos from the MNIST database.



Fig 2: - Sample images taken from MNIST database

B. Segmentation

After the input photos have been pre-processed, the sequence of images is used to create sub-images of individual digits. Digit pictures that have been pre-processed are split into a sub-image of individual digits, which are assigned a number to each digit. Each unique digit is converted to pixels. In this stage, an edge detection algorithm is utilized to segment dataset pictures.

C. Feature Extraction

Following the completion of the pre-processing and segmentation stages, the pre-processed pictures are represented in the form of a matrix containing very big image pixels. It will be advantageous to portray the digits in the photos that carry the relevant information in this manner. This is known as feature extraction. Redundancy in the data is eliminated during the feature extraction step.

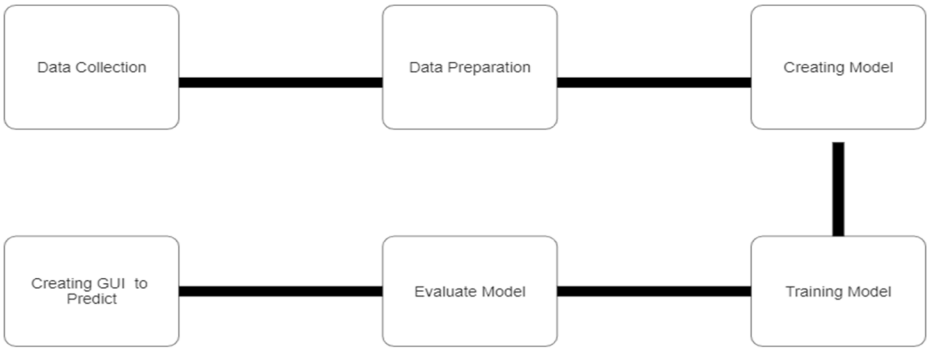
D. Classification and Recognition

In the classification and recognition step the extracted feature vectors are taken as an individual input to each of the following classifiers. Inorder to showcase the working system model extracted features are combined and defined using following classifier.

IV. METHODOLOGY:

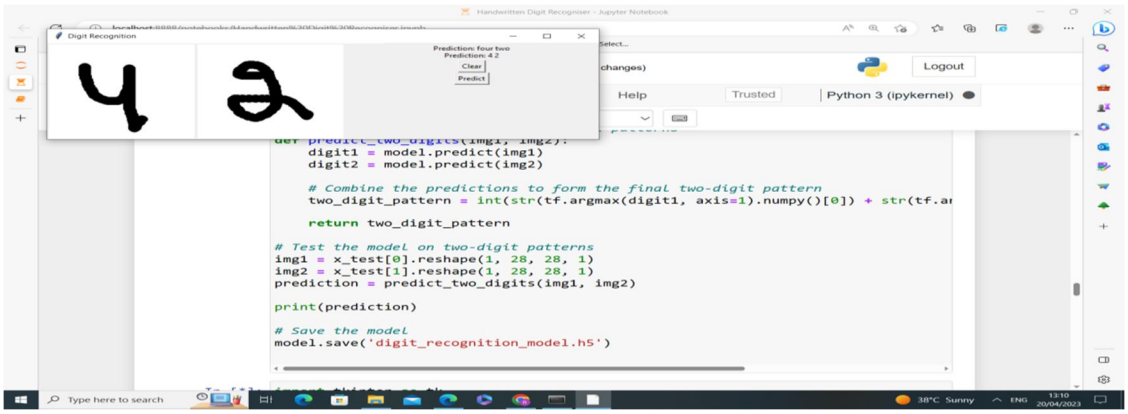
To test the accuracy and performance of handwritten digits, the MNIST dataset is employed. MNIST is the most widely used standard for handwritten digit recognition. MNIST is a massive and widely used database of handwritten digits. The MNIST dataset has been widely utilized as a baseline for evaluating classification methods in handwritten digit recognition frameworks.

The first step is to place the dataset, which is easily accomplished using the Keras programming interface. The images in the MINIST collection are given as a cluster of 28x28 values that make up an image, together with their labels. This is similar if an occurrence of the testing photos is possible. The pixels are specified as 784-d pixels with a range of 0 to 255, where 0 denotes black and 255 denotes white.

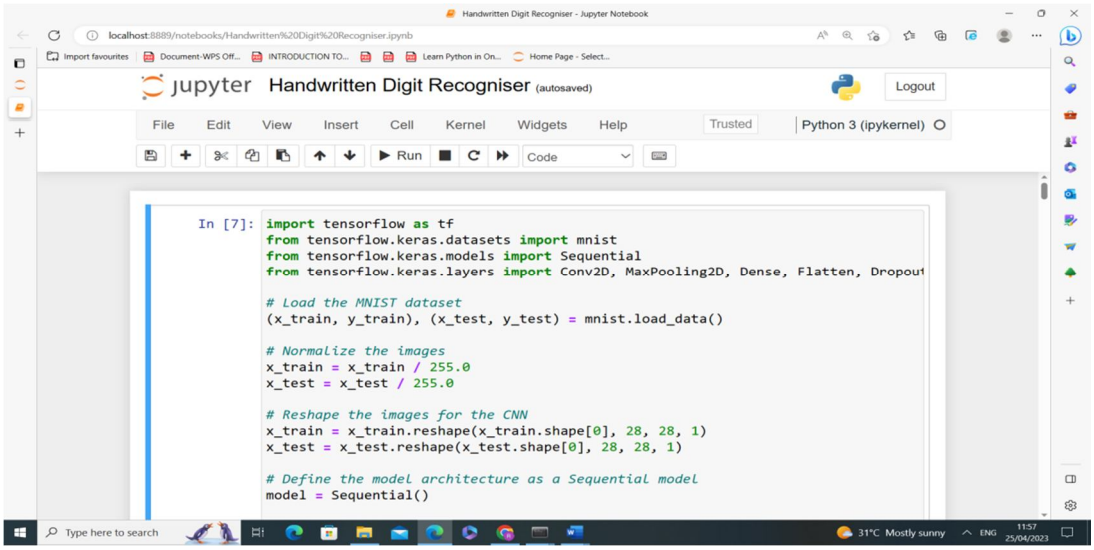


Module 2 Flow Chart

VI.RESULTS



The following figures show the sequence of steps to be carried out to obtain the required output.



In Jupyter Notebook, It is a virtual environment and the following code is trained and in order to achieve the accuracy of the output this software is used.

VII.CONCLUSION

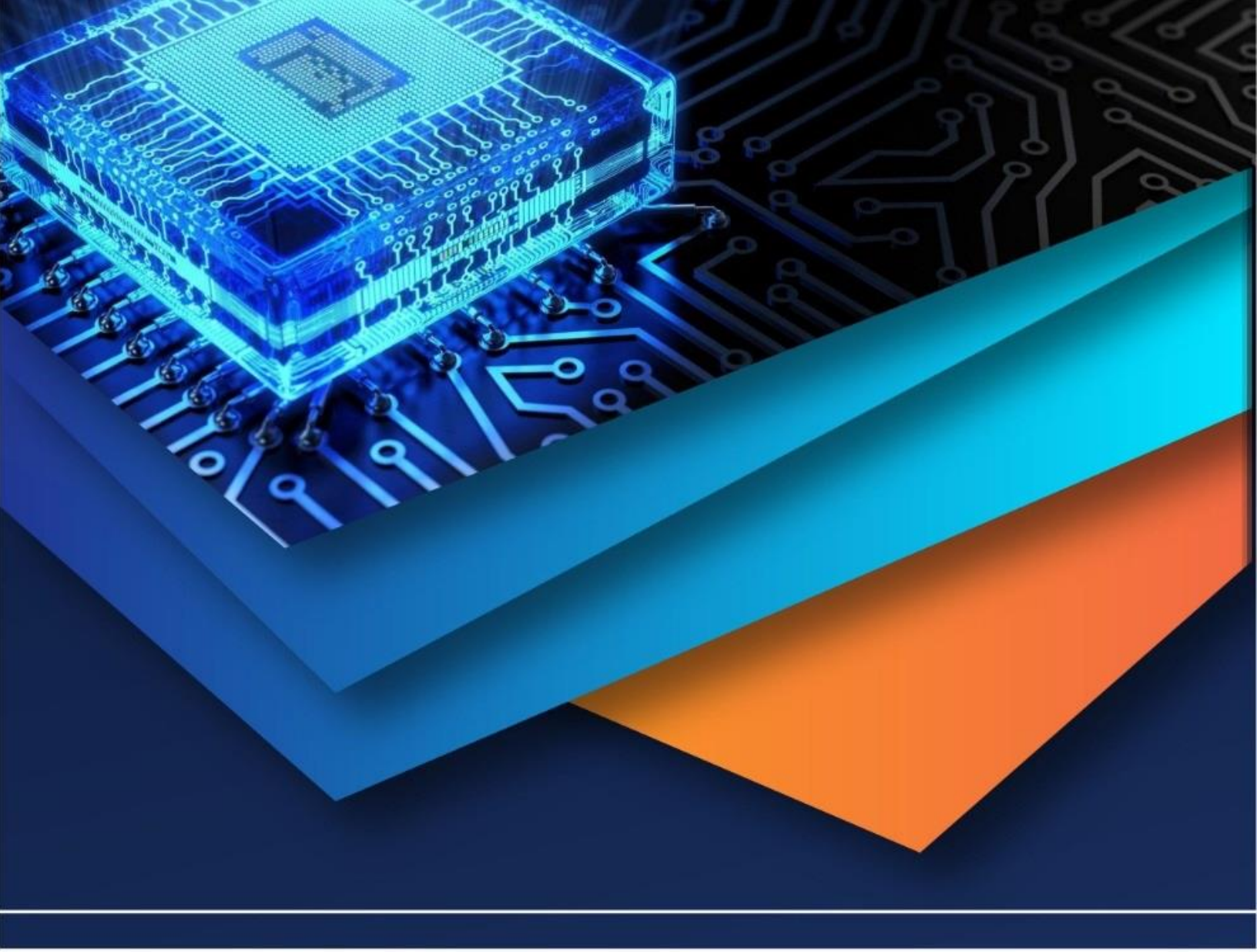
Handwritten Digit Recognition using Deep Learning Methods has been implemented in this research. The most extensively used machine learning algorithms, KNN, SVM, RFC, and CNN, were trained and tested on the same data in order to compare classifiers. A great level of accuracy can be reached with these deep learning approaches. In comparison to previous research approaches, this strategy focuses on which classifier performs best by enhancing classification model accuracy by more than 99%. A CNN model with Keras as the backend and TensorFlow as the software may achieve an accuracy of approximately 98.72%. In this preliminary experiment, CNN achieves an accuracy of 98.72%, KNN achieves an accuracy of 96.67%, whereas RFC and SVM perform poorly.

VIII. AKNOWLEDGEMENT

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