

## Handwritten Digit Recognition using Machine Learning Algorithms

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### Abstract :-

In the modern world, handwriting recognition technology is crucial. since everything in this digital age, including documents and notes, is stored digitally. It is necessary to transform these digital documents into processed information in the digital world. Through various machine learning models, handwritten digit recognition is a method or technology for automatically identifying and recognising handwritten digital data. The technique of digitising handwritten digit pictures is known as handwritten digit recognition (HDR). The cost of translating paper-based information into digital format is enormously wasteful. HDR can be used to fix this issue. In this work, it is addressed how HDR can be classified using classifiers like KNN, SVM, and CNN. These classifiers are used to convert any digitally scanned document into a computer document format after being trained on a preset dataset. This project's primary goal is to create a GUI-based application that enables users to anticipate the numbers drawn on the interface using machine learning and displays the results in percentages of how likely the prediction is to be accurate. Python will be used to build the project, and the application will be trained using data from MNIST and the linear regression algorithm.

**Keywords :-** Handwritten Digit Recognition, Image Processing, Pattern recognition,

### INTRODUCTION :-

To increase the intelligence of computers, developers are adopting a variety of machine learning and deep learning techniques. Convolutional neural networks (CNN) are utilised in numerous deep learning applications, including object detection, face recognition, spam detection, and pattern recognition. This is a summary of the most recent methods for handwriting recognition that have been published. Handwritten digit recognition has become highly well-liked in the field of pattern recognition because it can be used in so many different fields. Convolutional neural networks (CNNs) are a very common deep learning algorithm that may be used to interpret images. By giving biases and weights to different aspects of the image, it achieves this and is fairly good at telling one image from another of its kind.

In the area of automatic processing of postal addresses, bank checks, and other types of data, handwritten digit recognition is frequently utilised. Some of the modern systems also make use of computational intelligence techniques like artificial neural networks, but other ones might merely be large lookup tables.

Neural networks, a branch of machine learning, are designed after the human brain. Each neuron acts as a weight carrier, and the layers are represented by mathematical functions in its layered architecture. Layers exist between the input and the output. Layers that are hidden can be changed based on the task. Neocognitron is a machine learning and pattern recognition system that was created by K. Fukushima and was made public in 1980. Hubel and Wiesel's research served as the inspiration for it, which served as the forerunner to the artificial intelligence we have today. Through the neocognitron, downsampling and convolution layers were added to CNNs. A technique known as handwritten digit recognition converts the ordered trajectory created when writing on handwriting implements into the internal code of digits. In reality, it entails converting the coordinates of a handwritten route to the internal digital code. It is one of the simplest and most practical methods for anyone to communicate with computers.

### **Methodology :-**

The MNIST dataset was used in this work as the primary training set for the model.

### **MNIST Dataset (Modified National Institute of Standards and Technology Dataset ) :-**

- It is a collection of 700,000 tiny images of handwritten numbers created by US Census Bureau staff and students.
- The number that each image refers to serves as its identification.
- Each of the 700,000 images has 784 characteristics.
- In each 28 x 28 pixel image, each feature only denotes one pixel intensity, ranging from 0 (white) to 255 (black).

Below is a handwritten digit in the MNIST data set.



After importing the dataset, these steps are followed in the handwritten digit recognition system :-

- **Data Preprocessing :-**

Since the model is unable to directly receive image data, we must first process the data and perform some simple operations before putting it in front of our neural network. In HDR, pre-processing is included. It will be much simpler to recognise the boundaries if there are some rules, such as a box for each digit.

- **Creating and training the model :-**

The model is first built using CNN. This will create many convolutional and pooling layers. More models will be trained using Python tools including TensorFlow, Pillow, OpenCV, Tkinter, and Numpy.

- **Evaluating the model :-**

To evaluate the accuracy of our model, The testing dataset is a specific section of the entire MNIST dataset, and it serves as the foundation for computing the suggested model's accuracy.

- **Creating a GUI for the user to draw digits and predication :-**

After the above-mentioned model is evaluated, we create Graphical User Interface (GUI) for the User. In this GUI, the user can draw a digit for the prediction of our model.

### Results and discussions :-

Results and discussions for A Recognition System for Handwritten Digits Using CNN are presented in this section. Since our model is intended to be used with real-world data, real-world images are incomparably different from MNIST raster images. The GUI code will be executed to allow users to input the number (draw) after the model has been run and trained.



The result reveals that it correctly predicts the number 1 , 99% accuracy.



The result reveals that it correctly predicts the number 6 , 77% accuracy.

This survey paper's goal is to comprehend the many models employed in handwritten digit recognition. After all, the work model is able to predict the number.

If a user has bad handwriting, then accuracy may vary from user to user. The max pooling and convolution procedures are carried out by these neural network layers.

Further, the result will transfer to the created GUI, and it will show with digits and accuracy.

### **Conclusion :-**

In this paper, many users can draw and predict with different handwriting styles. In this, we use CNN as a machine learning algorithm. The seven-layer convolutional network known as CNN has one input layer, five hidden layers, and one output layer. In this, we see that we predict 1 with an accuracy of 99% and 6 with an accuracy of 77%. This technology can also be implemented on the GPU in addition to the CPU to increase efficiency by speeding up calculations.

### **Future work :-**

In future work, we will use CNN as a more accurate and extended form. It is possible to extend this research to distinguish handwritten characters. We also plan to use other machine learning techniques, except CNN.

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