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# A Survey on Handwritten Digit Recognition System

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**ABSTRACT:** The reliance of humans over machines has never been so high such that from object classification in photographs to adding sound to silent movies everything can be performed with the help of deep learning and machine learning algorithms. Likewise, Handwritten text recognition is one of the significant areas of research and development with a streaming number of possibilities that could be attained. Handwriting recognition (HWR), also known as Handwritten Text Recognition (HTR), is the ability of a computer to receive and interpret intelligible handwritten input from sources such as paper documents, photographs, touch-screens and other devices [1]. Apparently, in this paper, we have performed handwritten digit recognition with the help of MNIST datasets using Support Vector Machines (SVM), Multi-Layer Perceptron (MLP) and Convolution Neural Network (CNN) models. Our main objective is to compare the accuracy of the models stated above along with their execution time to get the best possible model for digit recognition. Keywords: Deep Learning, Machine Learning, Handwritten Digit Recognition, MNIST datasets, Support Vector Machines (SVM), Multi-Layered Perceptron (MLP), and Convolution Neural Network (CNN). Keywords: Product recommendation systems, Hybrid recommendation, Content-based filtering, Collaborative filtering, Deep learning, Evaluation metrics, Applications.

## I. INTRODUCTION

Humans can very easily see, read & write any handwritten digits, when written in proper format. Even if the digits are not written in proper format we can use our logic and predict what digit it could be. But It is a hard task for the machine to recognize handwritten digits as these are not perfect and can be made with many different flavors. Thus handwritten digit recognition is the solution to this problem which uses the image of a digit and recognizes the digit present in the image. The handwritten digit recognition is the ability of computers to recognize human handwritten digits. Since the 1980s handwriting recognition of digits has been around. Research in this area has been a standard area because of its usage in technologies such as postal mail sorting, bank check processing, form data entry, etc. Even though any digital image is a matrix of 0's and 1's, the computer comes to know whether the input image is a digit by recognizing some specific formats. Thus a handwritten digit recognition model helps in recognizing such patterns which in turn recognizes the digits. Our goal is to build a model that can efficiently and reliably recognize the digits and output the proper result. Amongst all the other neural networks, working and implementing a model using Convolution Neural Network gives out the most precise results. It is most popularly used for analyzing images as well as for other data analysis or classification problems. CNN has hidden layers called convolutional layers. These layers work the same way as other layers do but here we need to specify the no of filters each layer should have. These filters are actually what detects the pattern. Patterns could be edges, corners, circles or any complex other objects like eyes, ears or even deeper full dogs, cats, etc. Thus, the specialization of CNN as compared to other NN of being able to detect patterns is what makes it so useful for recognizing handwritten digits.

## II. LITERATURE SURVEY

A. In the paper, "Handwritten Digit Recognition Using Deep Learning" the authors, "Anuj Dutt, Aashi Dutt" have compared the results of some of the most widely used Machine Learning Algorithms like KNN & RFC and with Deep Learning algorithm like multilayer CNN using Keras with Theano and Tensorflow. Using these, they were able to get the accuracy of 98.70% using CNN (Keras+Theano) as compared to 97.91% using SVM, 96.67% using KNN, 96.89% using RFC [1]. The authors of the paper, "Handwritten Digit Recognition: Applications of Neural Network Chips and

Automatic Learning”, had applied neural network methods to a large, real-world task. Our results appear to be the state of the art in digit recognition. We demonstrated that a general-purpose neural network chip can be incorporated as an accelerator in a large network. They found that real problems with regularity scale well. They also showed that a network can be trained on a low-level representation of data that has minimal preprocessing [2]. In the paper, “Unconstrained Handwritten Numeral Recognition Using Majority Voting Classifier” the authors, “Rajiv Kumar, Pervez Ahmed, Mayank Kumar Goyal, Amresh Kumar” presented a simple profile, combined local & global features and majority voting scheme classifier for unconstrained handwritten numeral recognition. Linear discriminant analysis and KNN classifiers are used for classifying these features. An A majority voting scheme has been performed with three neural network classifiers and KNN classifiers. The performance is tested on MNIST dataset. The network was trained on 60,000 and tested on 10,000 numeral samples of which 98.05 % test samples are correctly recognized [3][4]. The authors, “Stefan Knerr, LCon Personnaz, and GCrard Dreyfus” of “Handwritten Digit Recognition by Neural Networks with Single-Layer Training” had introduced the STEPNET procedure, which decomposes the handwritten digit recognition problem into simpler subproblems that can be solved by linear separators. They presented results from two different databases: a European database comprising 8700 isolated digits, and a zip code database from the U.S. Postal Service comprising 9000 segmented *digits*

### III. PROBLEM STATEMENT

The goal of this project is to make a model which will be ready to acknowledge and confirm the written digits from its image by exploitation the ideas of Python Programming. Although the goal is to make a model which may acknowledge the digits, it will be extended to letters associated an individual’s handwriting. The most important goal of the planned system is knowing Python Programming and applying it to the written recognition system.

### IV. PROPOSED METHODOLOGY

In this part we are depicting the different advances and acknowledges like general algorithm, strategies, datasets utilized, how the models are made and how the models were prepared are tried.

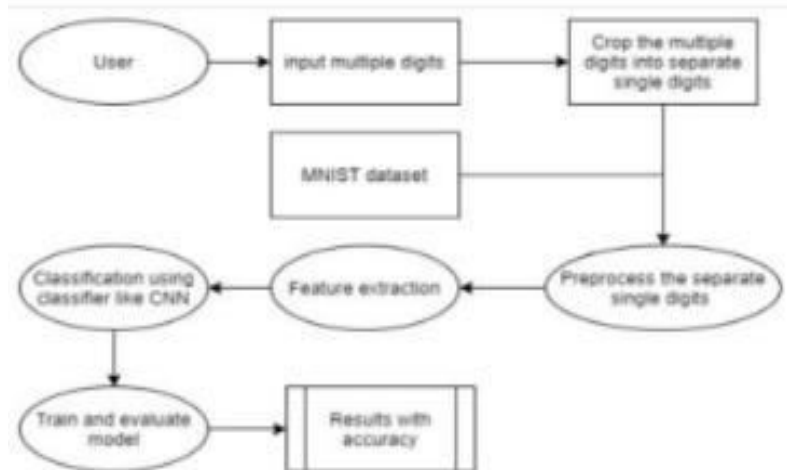


Fig. 1.1 working

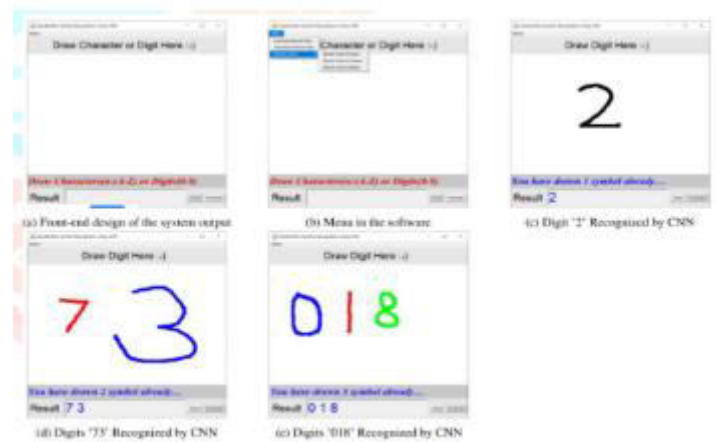


Fig. 4.1 Images of software

## V. PROJECT PURPOSE

Handwritten digit recognition is the process to provide the ability to machines to recognize human handwritten digits. It is not an easy task for the machine because handwritten digits are not perfect, vary from person-to-person, and can be made with many different flavors.

## IV. ACKNOWLEDGMENT

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