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Digit Recognition Using MNIST Dataset

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Abstract: ***In this paper, we have performed handwritten digit recognition using MNIST datasets using Support Vector Machines (SVM), Multi-Layer Perceptron (MLP) and Convolution Neural Network (CNN) models. Our main goal is to compare the accuracy of the above models along with their execution time to obtain the best possible model for digit recognition. Reliability of humans over machines has never been so high that from classifying objects in photographs to adding sound to silent movies can all be done using deep learning and machine learning algorithms. Similarly, handwriting recognition is one of the important areas research and development with a range of possibilities that could be achieved. Handwriting recognition (HWR), also known as handwritten text recognition (HTR), is a capability computers to receive and interpret comprehensible handwritten input from sources such as paper documents, photos, touch screen.***

Keywords: Deep Learning, Machine Learning, Handwritten Digit Recognition, MNIST datasets, Support Vector Machines (SVM), Multi-Layered Perceptron (MLP), and Convolution Neural Network (CNN).

I. INTRODUCTION

Handwritten digit recognition is the ability of a computer to recognize human handwriting digits from various sources such as pictures, papers, touch screens, etc. and classify them into 10 predefined classes (0-9). This has been the subject of endless research in the field of deep learning. Digit recognition has many applications such as license plate recognition, mail sorting, banking control processing, etc. [2]. Handwritten digit recognition faces many challenges due to different writing styles different nations because it is not optical character recognition. This research provides a comprehensive comparison between different machine learning and deep learning algorithms for the purpose of recognizing handwritten digits. For this we used Support Vector Machine, Multilayer Perceptron and Convolutional Neural Network.

II. PROPOSED STRUCTURE

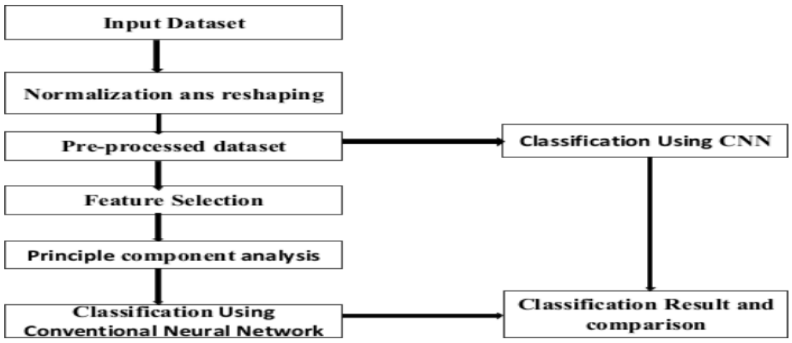


Figure1- System Architecture

The analysis of the architectural design in the system is the analysis of the system architecture. This the system helps in detecting the correct digit. This system is effective and helps to detect a classify the digit at a time and place that is convenient for the user.

1) *Load Image:* The input to the system is a handwritten digit. This input is obtained from user end. The digit used as input must be stored with an extension.
2) *Segmentation:* Digit can be RGB so it can be easier after flattening segmentation.
3) *Feature Extraction:* Based on digit detection using features digit it can extract from the data set.
4) *Machine Learning:* Machine learning is used to classify digits and their functions into several classes. This training process will create 3 outputs that correspond to the stated goals determined in the training process.
5) *Classification:* Classification is done by entering testing data into the classification system which was introduced in the previous training system. Classification results include a similar label to the numeral.

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A. Analysis Model: SDLC Model to be Applied Waterfall Model

The methodology used in this system for software development is the Waterfall Model. Waterfall is where all business processes must be planned and planned in advance done and then done. A linear series life cycle model. This model is great easy to understand and use. Communication to the waterfall method, Planning, Modeling, Construction and Placement.

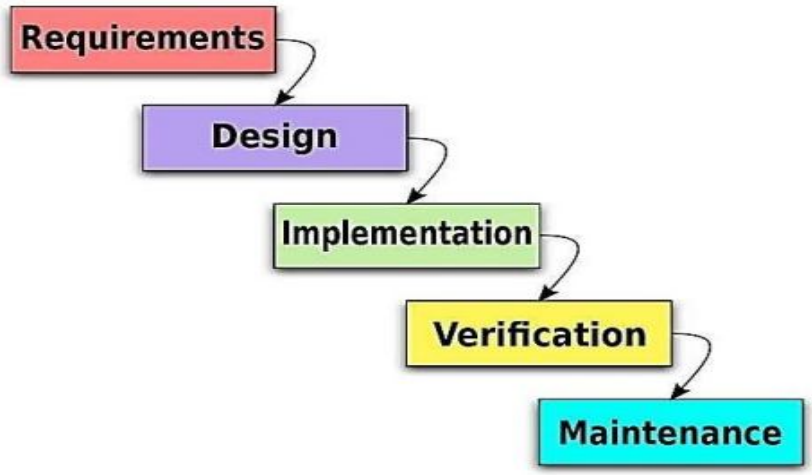


Figure2-SDLC Waterfall Model

The stages of the waterfall model are:

1) *Gathering Phase Requirements:* All system requirements developed at this stage is integrated and then documented as needed specification document.
2) *Design Phase:* Study according to the requirements of the previous phase At this stage, the system design is prepared. The design of this system helps us in determining the hardware and system requirements and preparing the entire system architecture.
3) *Implementation Phase:* After the design phase comes the implementation phase. This is it Each design module is then coded in the appropriate language.
4) *Testing Phase:* In the testing phase the entire system must be checked for errors or failure.
5) *Installation Phase:* After we check the system, the "Program" is deployed release for customers or market use.
6) *Maintenance Phase:* Maintaining the system after the system is ready and deployed be an important part of developing the system and improving it.

B. UML Diagrams

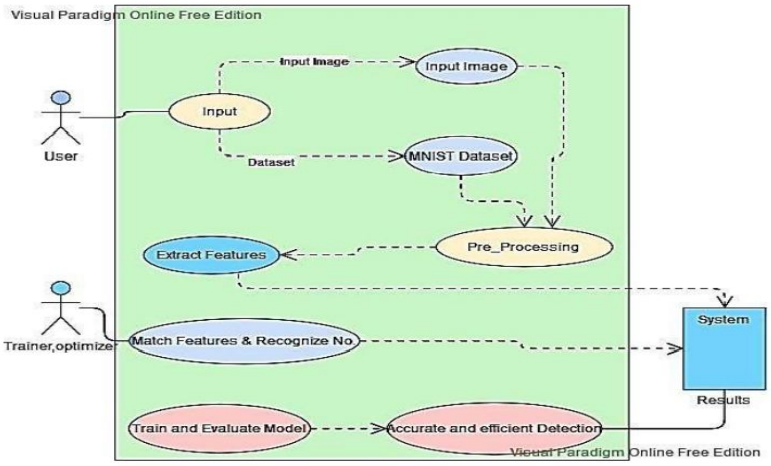


Figure3-Use Case diagram

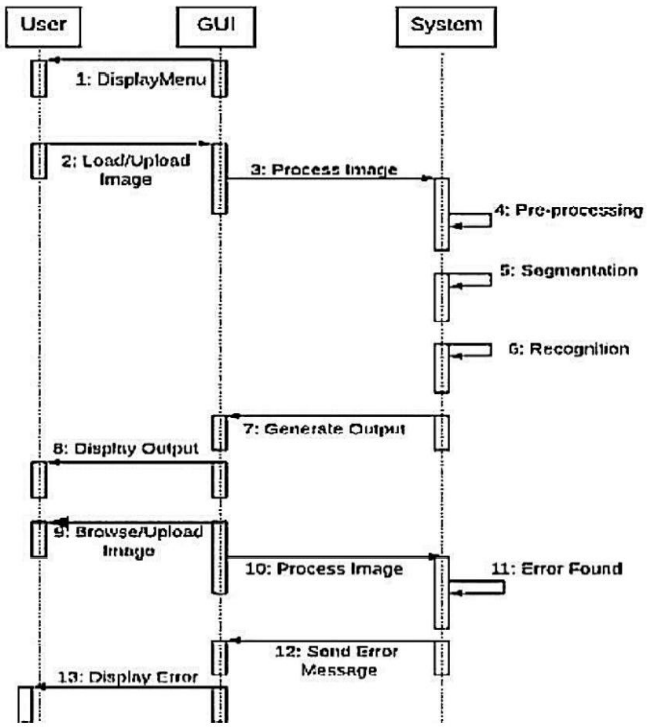


Figure4- Sequence diagram

III. CONCLUSIONS

In this research, we implemented three handwritten digit recognition models MNIST datasets based on deep and machine learning algorithms. We compared them based on their characteristics so that the most accurate model can be evaluated from them. Support vector machines are one of the basic classifiers, therefore it is faster than most algorithms and in this case, it provides the maximum degree of training accuracy, but due to its simplicity it cannot be classified complex and ambiguous images as accurately as achieved using MLP and CNN algorithms. We found that CNN provided the most accurate results for handwritten digit recognition. This leads us to conclude that CNN is best suited for any type of prediction problem including image data as input. Furthermore, by comparing the execution time of the algorithms we concluded that increasing the number of epochs without changing the configuration the algorithm is useless due to the limitation of a certain model and we noticed that after a certain number of epochs the model starts to overfit the data set and gives us a bias forecast.

IV. ACKNOWLEDGMENT

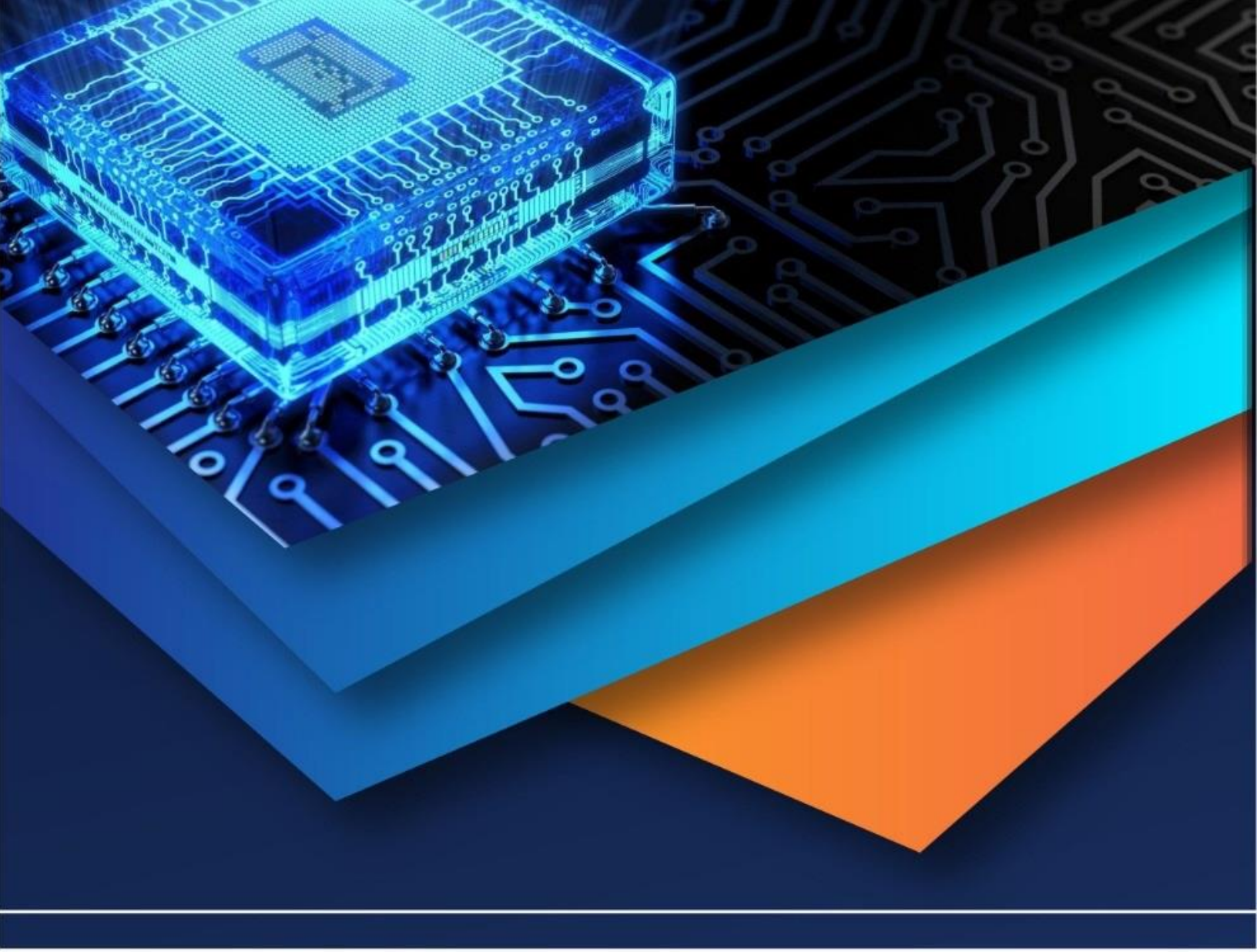
On this great occasion of completing our project “Handwritten Digit Recognition Using MNIST Dataset” It is our great pleasure to present our report. The project acts as a bridge between theoretical and practical learning and with this mindset we worked on the project. We I would like to express our deep gratitude to our guide, prof. Ajita Mahapadi, for her preciousness suggestions and encouragement. We are also grateful to our Department of Computer Engineering, DYPSOE (SPPU-PUNE), for giving us all the help and support we needed. Our special thanks go to Dr. To Pankaj Agarkar, Head of Department of Computer Engineering, DYPSOE (SPPU-PUNE), Pune for providing all the help and support and Dr. Farrok Sayyad, Director, Dr. D Y Patil School of Engineering (DYPSOE) (SPPU PUNE) who motivated us and provided us with all the facilities. A special mention to all the staff for clearing our doubts and providing thorough support.

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