**A Novel Method for Handwritten Digit**

**Recognition System**

**NALAIYA THIRAN PROJECT BASED**

**LEARNING**

**on**

**PROFESSIONAL READINESS FOR**

**INNOVATION,EMPLOYABILITY AND**

**ENTREPRENEURSHIP**

**A PROJECT**

**REPORT**

RABISHA.R**-9**60219106104

RABISHA.T-960219106105

THANISHA.T-960219106141

THANUSIYA.M-960219106142

**BACHELOR OF**

**ENGINEERING**

**IN**

ELECTRONICS AND COMMUNICATION ENGINEERING

Arunchala College of Engineering for Women.

Team id :PNT2022TMID34173

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**CHAPTER 1**

**INTRODUCTION**

Artificial intelligence and computer technology both heavily rely on machine learning and deep learning. Human effort in identifying, learning, making predictions, and many other

areas can be decreased with the application of deep learning and machine learning. The

ability of computer systems to recognise handwritten digits from various sources, such as

photographs, papers, and so on, is known as handwritten digit recognition. The goal of this

project is to enable users to utilise machine learning to eliminate manual digit recognition

jobs. Digit recognition systems are able to identify numbers from a variety of sources,

including emails, bank checks, papers, images, etc. They can also be used in a variety of

real-world situations, such as online handwriting recognition on computer tablets or systems,

identifying vehicle licence plates, processing bank cheque amounts, and reading numbers

from forms that have been filled out by hand.

**CHAPTER 2**

**OBJECTIVE**

The objective of this project is to classify the handwritten digits which is written in the paper and displays which digit is written using the python language.

**CHAPTER 3**

**PROJECT DESIGN AND PLANNING**

**3.1 IDEATION PHASE**

**3.1.1 Literature Survey**

**Improved Handwritten Digit Recognition Using Convolutional Neural Networks (CNN) (2020)**

**Ahlawat, Savita and Choudhary, Amit and Nayyar, Anand and Singh, Saurabh and Yoon, Byungun**

This paper's primary goal was to enhance handwritten digit recognition ability. To avoid difficult pre-processing, expensive feature extraction, and a complex ensemble (classifier combination) method of a standard recognition system, they examined different convolutional neural network variations. Their current work makes suggestions on the function of several hyper-parameters through thorough evaluation utilizing an MNIST dataset. They also confirmed that optimizing hyper-parameters is crucial for enhancing CNN architecture performance. With the Adam optimizer for the MNIST database, they were able to surpass many previously published results with a recognition rate of 99.89%. Through the trials, it is made abundantly evident how the performance of handwritten digit recognition is affected by the number of convolutional layers in CNN architecture. According to the paper, evolutionary algorithms can be explored for optimizing convolutional filter kernel sizes, CNN learning parameters, and the quantity of layers and learning rates.

**An Ancient And Improved Scheme For Handwritten Digit Recognition Based On ConvolutionalNeuralNetwork (2019)**

**Ali, Saqib and Shaukat, Zeeshan and Azeem, Muhammad and Sakhawat, Zareen and Mahmood, Tariq and others**

This study uses rectified linear units (ReLU) activation and a convolutional neural network (CNN) that incorporates the Deeplearning4j (DL4J) architecture to recognize handwritten digits. The proposed CNN framework has all the necessary parameters for a high level of MNIST digit classification accuracy. The system's training takes into account the time factor as well. The system is also tested by altering the number of CNN layers for additional accuracy verification. It is important to note that the CNN architecture consists of two convolutional layers, the first with 32 filters and a 5x5 window size and the second with 64 filters and a 7x7 window size. In comparison to earlier proposed systems, the experimental findings show that the proposed CNN architecture for the MNIST dataset demonstrates great performance in terms of time and accuracy. As a result, handwritten numbers are detected with a recognition rate of 99.89% and high precision (99.21%) in a short amount of time.

**Improved Handwritten Digit Recognition Using Quantum K-Nearest Neighbor Algorithm (2019)**

Wang, Yuxiang and Wang, Ruijin and Li, Dongfen and Adu-Gyamfi, Daniel and Tian, Kaibin and Zhu, Yixin

The KNN classical machine learning technique is used in this research to enable quantum parallel computing and superposition. They used the KNN algorithm with quantum acceleration to enhance handwritten digit recognition. When dealing with more complicated and sizable handwritten digital data sets, their suggested method considerably lowered the computational time complexity of the traditional KNN algorithm. The paper offered a theoretical investigation of how quantum concepts can be applied to machine learning. Finally, they established a fundamental operational concept and procedure for machine learning with quantum acceleration. The KNN algorithm, however, is a method for handling handwritten digit recognition. The challenges mentioned in this study can be solved more effectively using the deep learning neural network approach.

**Handwritten Digit Recognition Using Machine And Deep Learning Algorithms (2021)**

Pashine, Samay and Dixit, Ritik and Kushwah, Rishika

In this study, they developed three deep and machine learning-based models for handwritten digit recognition using MNIST datasets. To determine which model was the most accurate, they compared them based on their individual properties. Support vector machines are among the simplest classifiers, making them faster than other algorithms and providing the highest training accuracy rate in this situation. However, due to their simplicity, SVMs cannot categorize complicated and ambiguous images as accurately as MLP and CNN algorithms can. In their research, they discovered that CNN produced the most precise outcomes for handwritten digit recognition. This led them to the conclusion that CNN is the most effective solution for all types of prediction issues, including those using picture data. Next, by comparing the execution times of the algorithms, they determined that increasing the number of epochs without changing the configuration of the algorithm is pointless due to the limitation of a certain model, and they discovered that beyond a certain number of epochs, the model begins overfitting the dataset and provides biased predictions.

**3.1.2 Problem Statement**

● The problem statement is to classify handwritten digits. The goal is to take an image of a handwritten digit and determine what that digit and character is.

● It is easy for the human to perform a task accurately by practicing it repeatedly and memorizing it for the next time. Human brain can process and analyse images easily. Also, recognize the different elements present in the images.

● The goal is to correctly identify digits from a dataset of tens of thousands of handwritten images and experiment with different algorithms to learn first-hand what works well and how techniques compare .

● The handwritten digit recognition is the capability of computer applications to recognize the human handwritten digits. It is a hard task for the machine because handwritten digits are not perfect and can be made with many different shapes and sizes.

● The handwritten digit recognition system is a way to tackle this problem which uses the image of a digit and recognizes the digit present in the image. Convolutional Neural Network model created using Python library over the MNIST dataset to recognize handwritten digits .

● Handwriting number recognition is a challenging problem researchers had been research into this area for so long especially in the recent years.

| **QUESTION** | **DESCRIPTION** |
| --- | --- |
| What does the problem affect? | Handwriting recognition tends to have problems when it comes to accuracy. People can struggle to read others’ handwriting. How, then, is a computer going to do it? The issue is that there’s a wide range of handwriting – good and bad. This makes it tricky for programmers to provide enough examples of how every character might look. |
| What are the boundaries of the problem? | As the manually written digits aren't of a comparable size, thickness, position and direction, numerous difficulties need to be taken into consideration to decide the problem of handwritten digit recognition and it also involves the difficulty of visual pattern recognition. |
| What is the issue? | The handwritten digits are not always of the same size, width, orientation and justified to margins as they differ from writing of person to person, so the general problem would be while classifying the digits due to the similarity between digits such as 1 and 7, 5 and 6, 3 and 8, 2 and 5, 2 and 7, etc. |
| When does the issue occur? | Perhaps the most obvious problem when processing handwritten forms during the data capture process is poor quality or illegible handwriting. We all know the old stereotype about doctors’ handwriting, so trying to perform accurate data capture and validation on this type of form-filling may result in little meaningful data being extracted. |
| Where is the issue occurring? | During the data capture validation stages of any forms processing activity,all required text fields are processed which involves recognition and extracting the written characters. |
| Why is it important that we fix the problem? | The high variance in handwriting styles across people and poor quality of the handwritten text compared to printed text pose significant hurdles in converting it to machine readable text. Nevertheless it's a crucial problem to solve for multiple industries like healthcare, insurance and banking. |

**CUSTOMER JOURNEY MAP:**

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**IDEATION:**

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