

Handwritten Digit Recognition Using ML (Deep Learning Approach)

Literature Survey:

Prepare below table after reading and analysing IEEE Papers:

Sr. No	Title of Paper	Name of Authors	Published Year	Remarks
1	A Machine Learning and Deep Learning Approach for Recognizing Handwritten Digits	Ayushi Sharma , Harshit Bhardwaj , Arpit Bhardwaj , Aditi Sakalle, Divya Acharya ,and Wubshet Ibrahim	2022	<p>The MNIST database is the central database used to train separators. A training set with 60,000 labels and a test set of 10,000 are included in the database. Each image was subject to a primary orientation method where the value of each pixel was divided by the maximum pixel value of the sample.</p> <p>Support Vector Machine, Decision Tree, Random Forest, K-Nearest Neighbour, Gaussian Naive Bayes, Genetic Programming, Convolutional Neural Network (CNN) are used. CNN has the highest accuracy of 100% at digit 0 and the least at digit 5. SVM stands out to be the second-largest accurate classifier with the highest accuracy (100%) at digit 0 and the least (95%) at digit 5. GP classifier has the highest classification accuracy of 100% for 0 digit and least of 96% for digit 5. The decision tree has the highest accuracy (93%) at digit 2 but is the least accurate classifier among all the other classifiers. the random forest has the highest accuracy (91%) at digit 4 and the least (55%) at digit 3. KNN is the second-highest accurate classifier among all, with the highest accuracy (100%) at digit 4 and least (89%) at digit 3. Similarly, Gaussian Naive Bayes has the highest accuracy (100%) at digit 4 and least (80%) at digit 6. In this paper, they applied machine learning and deep-learning techniques to predict the handwritten digits. they are using keras as the backend and tensorflow as the software library. The CNN classifier outperforms the other classifier with a classification accuracy of 98.83%.</p>
2	HANDWRITTEN DIGIT RECOGNITION SYSTEM USING	Apaar Chadha, Gaurav Yadav, Keshav Ahlawat	2022	<p>A model that may be used to identify and recognise digits written by a user on an editable canvas widget within a graphical user interface (GUI) for text-editing software is the handwritten digit identification system based</p>

	MACHINE LEARNING			on machine learning suggested in this research article. The task is to identify the full number entered by the user and to recognise user-defined handwritten digits. The user-inputted number is then transformed to a binary, octal, or hexadecimal format. For the same, a canvas widget will be used to present the user in a graphical user interface (GUI). Machine learning algorithms put forth a lot of effort to identify patterns in various writing styles. Handwritten digits can be recognised using a variety of techniques. Reduced training time is achieved with Compute Unified Device Architecture (CUDA) on a GPU.
3	Handwritten Digit Recognition Using CNN	Mayank Jain, Gagandeep Kaur, Muhammad Parvez Quamar, Harshit Gupta	2021	<p>The issue of transcribed digit acknowledgment has for some time been an open issue in the field of example order. The fundamental target of this paper is to give effective and solid procedures to acknowledgment of transcribed numerical by looking at different existing arrangement models.</p> <p>Results demonstrate that CNN classifier beat over Neural Network with critical improved computational effectiveness without relinquishing execution.</p> <p>Handwritten digit recognition can be performed using the Convolutional neural network from Machine Learning.</p> <p>MNIST data contains about 70,000 images of handwritten digits from 0-9.</p> <p>CNN consists of 4 hidden layers which help in extraction of the features from the images and is able to predict the result. The layers of CNN are (a) Convolutional Layer (b) ReLu Layer (c) Pooling Layer (d) Fully Connected Layer.</p> <p>CNN is because the fundamental favourable position of CNN contrasted with its archetypes is that it consequently recognizes the significant highlights with no human management.</p> <p>A greater recognition accuracy of 99.16% was delivered by the CNN design with three layers while using the Adam streamlining agent.</p>
4	Hand Written Digit Recognition using Machine Learning	Rohan Sethi , Ila Kaushik	2020	One of the most challenging and fascinating areas of pattern-recognition and image processing has been the recognition of handwritten characters and numbers. This paper's primary goal is to illustrate and

				<p>represent research on hand-written digit recognition. Convex hull technique is used for feature extraction, whereas SVM is used for recognition and classification.</p> <p>Optimal Character Recognition (OCR), Barcode Recognition, Number Plate Recognition.</p> <p>supervised machine learning system, diverse classification algorithms in machine learning. The KNN Classification Algorithm to support the implementation of this project work, “Hand-written digit classification”.</p> <p>Applications: This supervised machine learning approach is most commonly used in data compression, genetic analysis, and other fields.</p> <p>The most important justification for using this method is when there is sufficient data for its flawless use to carry out the necessary classification. Furthermore, only in the presence of non-linear decision boundaries is the direct solution realised. When the value of K varies, this algorithm categorically explains the majority votes of the K closest neighbours. Euclidean distance, Manhattan distance, Minkowski function, Hamming function, and Mahalanobis function are among the distance functions that can be used with the KNN method. The paper uses the effective KNN supervised machine learning technique to classify handwritten digits. For the purpose of training a supervised classification machine learning model, a training dataset containing labelled data is fed to the classifier as input. After successful training, the model is then able to classify handwritten digits based on any testing point fed to the classifier, thanks to the use of Euclidean distance, which identifies the closest labelled datapoint in relation to the testing data point. KNN supervised machine learning technique was employed for classification. Python Notebook, a web application that utilises a local server and is a part of the Anaconda software programme suite. Both training and testing MNIST datasets were used. Future development of this work could lead to quick calculation, which would cut down on time, boost productivity, and aim for better outcomes.</p>
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5	Handwritten Digit Recognition Based on Convolutional Neural Network	Chao Zhang, Zhiyao Zhou, Lan Lin	2020	<p>In the finance industry and large-scale data statistics, handwritten digit recognition is crucial. This study suggests a novel convolutional neural network-based handwritten digit recognition method. In order for the network to automatically learn the spatial properties of handwritten digits, a vast number of images were used to train it .Deep learning-based handwritten digit recognition systems are more accurate than conventional ones due to advancements in artificial intelligence technology. Traditional feature extraction techniques including Scale Invariant Feature Transform (SIFT), Histogram of Oriented Gradient (HOG), and Speeded-Up Solid Qualities Handwritten digit recognition is essential in large-scale data statistics and the banking sector. This paper presents a brand-new handwritten digit recognition technique based on convolutional neural networks. A large number of photos were used to train the network so that it could automatically learn the spatial characteristics of handwritten numerals. Traditional feature extraction techniques including Scale Invariant Feature Transform (SIFT), Histogram of Oriented Gradient (HOG), Speeded-Up Robust Features (SURF), and 13-point feature extraction approach, among others, can be used to achieve character recognition. Traditional feature extraction techniques are dependent on manual labour. The loss function serves as a training process indication. In this system, the loss function between the predicted category and the target category is calculated using cross entropy, and training always seeks to lower the loss function. TensorFlow will automatically distinguish between each variable's loss function before determining the best gradient descent path to update the weight. There are numerous built-in optimization algorithms in TensorFlow.This approach has a very high recognition accuracy for different people's handwritten digits. such as bright and dim lighting, as well as cloudy and sunny days. Comparing this approach to established traditional methods like the histogram of oriented gradient reveals the advantages clearly (HOG).</p>
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