IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 6, June 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 6, June 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1106010 |

An Efficient Approach for Handwritten Digit Recognition Using Machine Learning

D.Saikeerthana, Dr. Sreedhar Bhukya

Dept. of Computer Science and Engineering, Sreenidhi Institute of Science and Technology,

Yamnampet, Hyderabad(TS), India.

ABSTRACT: The task of recognizing handwritten digits is a highly challenging work. It is difficult to extract features from and segment handwritten numerical script because the numbers in this identification challenge are not precisely written or scripted since they vary in size or shape. In the suggested work, segmentation is accomplished by the use of vertical and horizontal projections. The process of categorising optical patterns included in a digital image is called as optical character recognition. Segmentation, feature extraction, and classification are used to recognise characters. Designing a system of classification that can distinguish handwritten numerals is the goal of this project.

KEYWORDS: support vector machine, machine learning

I. INTRODUCTION

The term "Optimal Character Recognition" (OCR) refers to a technique that can recognise and identify text by converting typed images, handwritten text, or printed text into machine-encoded text. The text that has been machine-encoded is in ASCII or Unicode format. After conversion from an equivalent character or digit representation, a letter's pixel representation is obtained. The procedure is a simulation of human reading by the machine. The study of how machines can differentiate the digit of interest from other digits in their environment and make correct predictions about decisions involving digits and letters is known as "digit recognition."

The MNIST dataset has been extensively utilised in the development of revolutionary handwritten digit recognition systems as a benchmark for evaluating classification techniques. Numerous studies using the MNIST dataset have been published in the literature, offering numerous approach suggestions. The effectiveness of previously proposed classifiers, such as linear and polynomial classifiers, Nearest Neighbour classifiers, and other neural networks, is compared in-depth by LeCun et al. Combining different neural network classifiers results in a best test error rate of roughly 0.7%.

People don't always write the same digit exactly the same way when they write it, which makes the within class variance one of the biggest obstacles to the recognition of handwritten digits. To improve the ability to discriminate, numerous feature extraction methods have been put forth in an effort to characterise the shape invariance within a class. Experiments have demonstrated that the accuracy and effectiveness of many classifiers could be greatly increased by extracting direction features, local structure features, or curvature features. The MNIST database is used in this study to conduct pattern analysis and train and test a set of classifiers for the handwritten digit recognition problem. Extraction of direction characteristics is a component of dimension reduction. performance in terms of swiftness and precision is compared using KNN, Random Forest, and Support vector machines. The use of classifier combinations as well as rejecting choices is suggested and considered as potential improvements.

II. LITERATURE SURVEY

Yes, here is a synopsis of the literature on machine learning for handwritten digit recognition:

Y. LeCun, L. Bottou, Y. Bengio, & P. Haffner (1998). Application of gradient-based learning to document recognition. IEEE Proceedings, 86(11), 2278–2324.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 6, June 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1106010 |

The CNN architecture for handwriting recognition was first presented in this seminal publication. On the MNIST dataset, the authors obtained cutting-edge results and demonstrated that CNNs can outperform conventional machine learning algorithms.

Steinkraus, D.and Platt& J. C., and Simard, P. Y. in the year2003. Visual document analysis using convolutional neural network best practises. 958–962: An International Symposium on Content Analysis and Recognition Proceedings.

This study suggests various recommended practises, including as data normalisation and augmentation methods, for training CNNs to analyse documents. The authors also demonstrated that deepening cnn performance.Performance can be improved by the CNN department.

T. M. Breuel (2013). LSTM networks are used for outstanding performance OCR for Fraktur and written English. 16(2), 239–250, The Global Journal of Document Identification and Analysis.The Long Short-Term Memory network for handwriting recognition is introduced in this research. On some datasets, the authors demonstrated that LSTMs can perform better than CNNs, particularly when dealing with handwriting in cursive.

(2009). Graves, A., Liwicki, M., Fernández, S., Bertolami, R., Bunke, H., & Schmidhuber, J. a brand-new connectionist handwriting recognition system. 31(5), 855-868, IEEE Transactions on Pattern Analysis and Machine Intelligence.

In this study, a bidirectional LSTM and a Conditional Random Field (CRF) model are used in tandem to suggest a unique method for handwriting recognition. On numerous datasets, the authors produced cutting-edge results, having IAM datset.

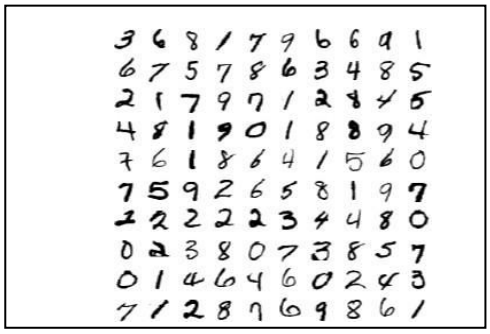
Phung, D., Venkatesh, S., Pham, T., Tran, T., & Khanna, N. (2020). Convolutional Neural Networks for Handwritten Digit Recognition: A Comprehensive Review. IEEE Access, 8(20624–20647).

This article offers a thorough analysis of current work on CNN-based handwritten digit recognition. The authors talk about network designs, optimisation algorithms, and numerous techniques for data augmentation. Additionally, they contrast how various approaches perform when applied to various benchmark datasets. These are only a few instances from the extensive body of work on machine learning-based handwritten digit recognition. These papers might serve as the foundation for your own study and literature review.

Data Description: In order to train the digit recognition system, Modified National Institute of Standards and Technology database(mnist) database comprises 40,000 digits in the range of 0 to 9, and an additional 10,100 digits are used as test data. Each digit is normalised and centred in a grayscale image with features that are 48* 48, or 1024 pixels overall.

Examples from MNIST dataset

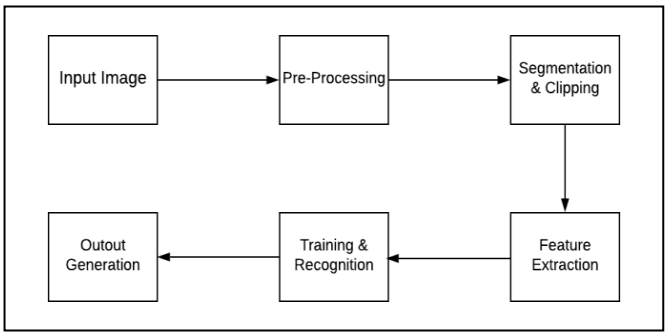
Proposed System: for the purpose of defining processes like digit recognition, segmentation, feature extraction, and classification.



| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 6, June 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1106010 |



The above diagram shows the Architecture of proposed system

Four stages are included in the recommended approach for identifying and categorising the numbers:

I. Pre processing
II. Segmentation
III. Feature Extraction
IV. Recognition & Classification

I. PRE PROCESSING: Here are some actions on the input image that will be explained in the pre-processing step. It essentially enriches the image by making it categorization-ready. Pre-processing's primary goal is to remove an intriguing example from its backdrop. The main tasks at this level are noise filtering, smoothing, and standardisation. A more condensed representation of the example is also characterised by the pre-processing. A grayscale image is converted into a binary image using binarization.

II. SEGMENTATION: After the input images have undergone the required pre-processing, the series of pictures is then used to produce sub-images of individual digits. A sub-image of separate digits with a unique number is created from pre-processed digit pictures. Each digit's size is translated into pixels. In this stage, the images from the dataset are segmented using an edge detection algorithm.

III.FEATURE-EXTRACTION: After the aforementioned steps are complete, the pre-processed images are shown as a matrix made up of extremely big image pixels. The representation of the digits in the images that have the relevant data will be useful in this way. Feature extraction is the process in question. Redundancy from the data is eliminated during the feature extraction stage.

IV.RECOGNITION & CLASSIFICATION: In the classification & recognition stage, each of the following classifiers receives the recovered feature vectors as an individual input. Extracted characteristics are integrated and specified using the following three classifiers to demonstrate the functioning system model:

i) KNN

ii)RFC

iii)SVM

Algorithms used:

I)K-Nearest Neighbor algorithm: KNN algorithm is a Case-based learning technique. The efficiency of the KNN technique when working with extremely massive amounts in information and its tolerance to noisy training data are two of its main advantages. For this strategy to work well, a collection of training datasets with correctly labelled data points is required. KNN is yet another non-parametric classifier. When new data points are entered, the algorithm accepts them as input and categorises them by figuring out the separation between them and the data points that have already been categorised. This distance is calculated using the Euclidean or Hamming distance formulas.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 6, June 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1106010 |

II)Random Forest Classifier: A method for supervised learning is RFC. It means that the amount of trees worldwide present and outcome reached are directly related, the more trees present, will get more accurate the output will be. This classifier can be used for both classification and regression. The RFC method prevents the classifier from overfitting the model, which, provided there are enough trees, prevents overfitting issues. This classifier can handle the missing quantities. Predictions are obtained from the average and each individual tree after training.

III)Support Vector Machine: This is another method for supervised learning. Additionally, svm is utilised to resolve problems that require regression and categorisation. This type of algorithm's data pieces can be thought of as points in a space that has n dimensions.

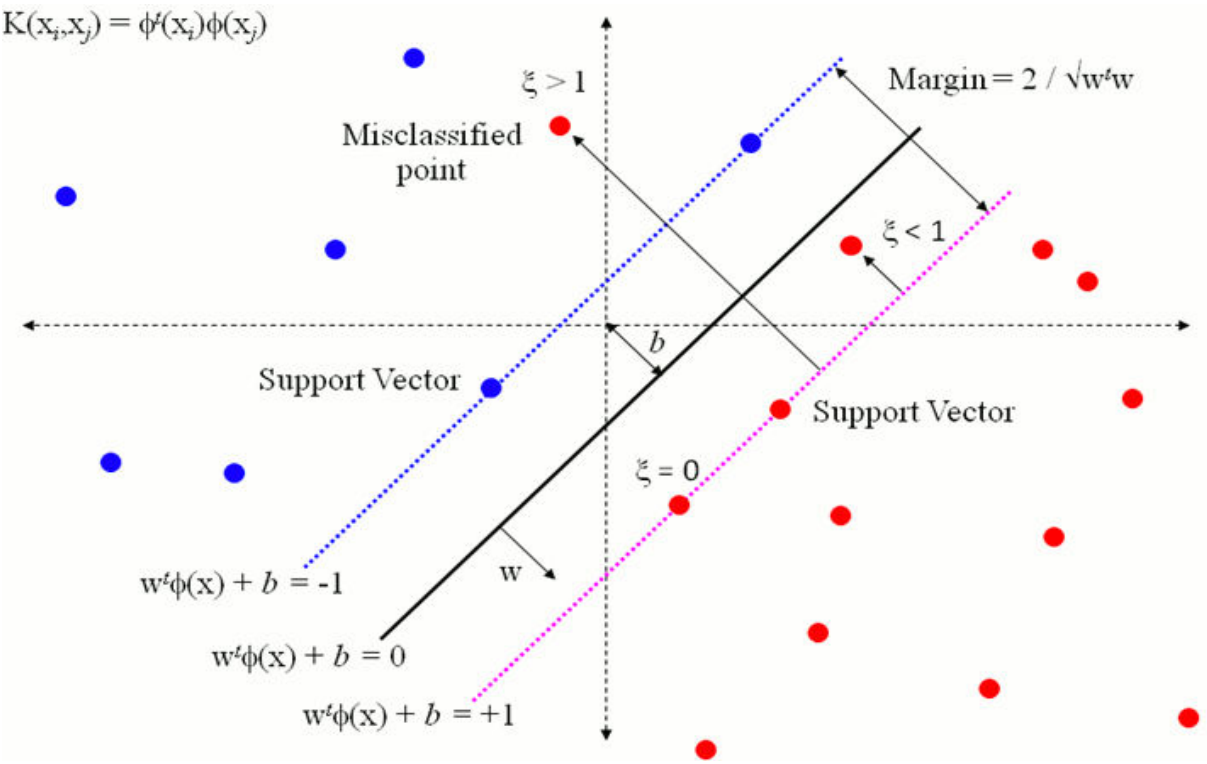


Diagram for SVM for red and blue and two classes classification

Implementation

Literally, the word "implementation" implies to carry out or put into action. The software's system implementation phase is concerned with turning the design specifications into source code. The implementation's overarching purpose is to create easily verifiable source code and internal documentation. Debugging, testing, and modification should be made easier by writing the code and documentation in this way.

PANDAS

Pandas is an open source, BSD-licensed library for the Python programming language that provides high-performance, sociable data structures and tools for data analysis. The Python module pandas, which provides rapid, flexible, and expressive data structures, can make working with "relational" or "labelled" data simple and natural. It aims to be the fundamental, high-level building block for employing Python for real, practical data analysis. The main goal of the project is to become the most powerful and flexible open-source data analysis and manipulation tool available in any language. It is already moving in this direction very quickly.The The two primary data structures of pandas, Series (1-dimensional) and Data Frame (2-dimensional), can handle the majority of frequent use cases in finance, statistics, social science, and many other subjects.

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 6, June 2023 ||

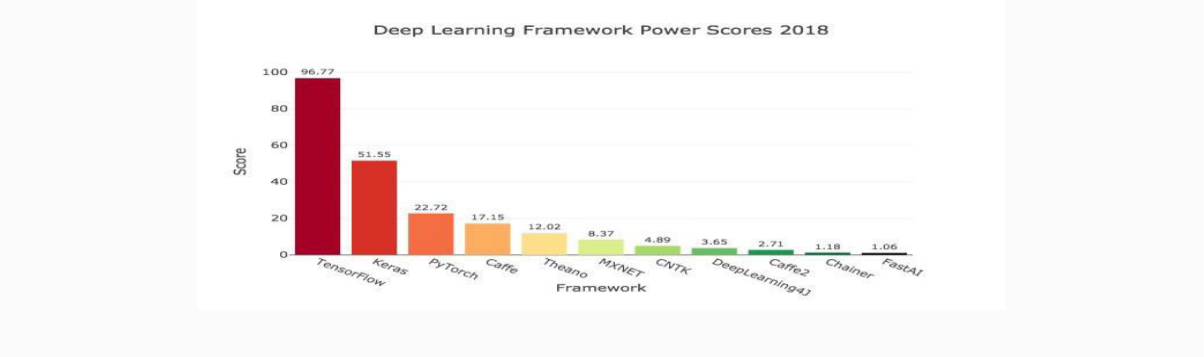
| DOI: 10.15680/IJIRCCE.2023.1106010 |

Let's start with a quick, imperfect study of pandas' basic data structures to get you going. Regarding data types, indexing, and axis labeling/alignment, all of the objects display the same fundamental behaviours. You can start by importing NumPy and loading pandas into your namespace.

```
>>> s = pd.Series(data, index=index)
```

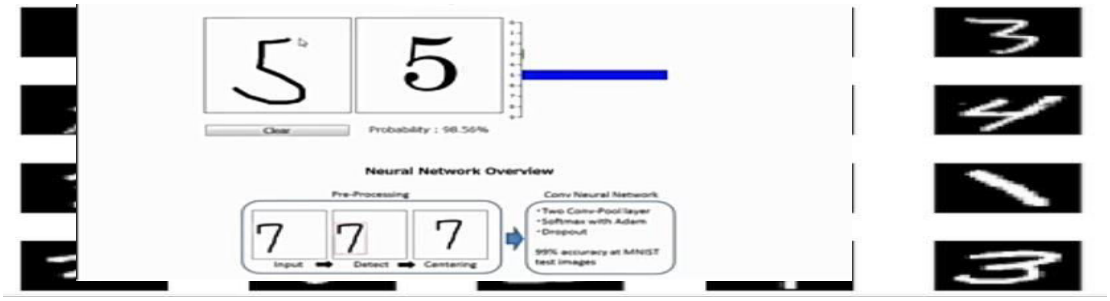
```
In [2]: import pandas as pd
```

III. RESULTS



Based on 11 data sources and 7 categories, Jeff Hale's ranking of deep learning frameworks The Keras API is the official interface of TensorFlow, via the tf.keras module, and has more than 250,000 unique users as of mid-2018, making it the deep learning framework with the strongest adoption in the business and research communities.

OUTPUT SCREENS



The above screens tells that the handwritten digit recognition, which appears on the screen once the user enters the necessary digits using the designated tools.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 6, June 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1106010 |

IV. CONCLUSION AND FUTURE SCOPE

I conclude that this research uses deep learning techniques to recognise handwritten digits.KNN, SVM, RFC, and CNN, four of the most well-liked machine learning techniques, were created and assessed on the same dataset to gauge the effectiveness of the classification algorithms. This strategy focuses on which classifier performs better when compared to other research approaches, boosting classification model performance by greater than 99%. A CNN may produce accuracy of roughly 98.72% when using Keras as a database and Tensorflow as the application code. In this initial trial, CNN delivers accuracy of 98.72%, KNN offers accuracy that is not very outstanding, while RFC and SVM FUTURE SCOPE: Handwritten digit recognition is an important area of research in the field of machine learning. Here are some potential future work ideas for a paper on the topic:

1. Investigate the impact of data augmentation on the performance of handwritten digit recognition models. By applying different changes to the original data, such as growing, rotating, or inverting the images, data augmentation is a technique for creating fresh training data.

2.Investigate transfer learning's application to handwritten digit recognition. Using a pre-trained model on a similar task and fine-tuning it on a new task are both examples of transfer learning. A model that has already been trained on a similar job, such character recognition, might be modified to recognise handwritten numbers in this scenario.

3. Consider using comprehensible AI methods to recognise handwritten digits. The goal of explainable AI techniques is to shed light on the decision-making process behind a model. This can entail displaying the model's decision-making process or determining which elements of the input image are crucial for the forecast.

ACKNOWLEDGEMENT

I want to thank Dr. Sreedhar Bhukya (Prof)of the CSE Department at SNIST in Hyderabad for his helpful feedback and innovative ideas that strengthened our study.

REFERENCES

[1]. M. Wu and Z. Zhang, Handwritten Digit Classification using the MNIST Dataset, 2010.
[2]. A. Dutta and A. Dutta, Handwritten digit recognition using deep learning, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), vol. 6, no. 7, July 2017.
[3]. Al Maadeed, Somaya, and Abdelaali Hassaine, Automatic prediction of age, gender, and nationality in offline handwriting. EURASIP Journal on Image and Video Processing, no. 1 2014.
[4]. Gaurav Jain, Jason Ko, Handwritten DigitsRecognition, Project Report, University of Toronto, 11/21/2008.
[5]. Hamid, Norhidayu Abdul, and NilamNur Amir Sjarif,Handwritten recognition using SVM, KNN and neural network,arXiv preprint arXiv:1702.00723 (2017).
[6]. R.G.Mihalyi, Handwritten digit classification using support vector machines, 2011.
[7]. Z. Dan, C. Xu, The Recognition of Handwritten Digits Based on BP Neural Networks and the Implementation on Android, In: 3rd International Conference on Intelligent System Design and Engineering Applications, pp. 1498-1509, 2013.

INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor: 8.379

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

www.ijircce.com

Scan to save the contact details