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Hand Written Digit Recognition System

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Abstract: ***This research paper provides a comprehensive analysis of the application of Artificial Neural Networks (ANNs) and Convolutional Neural Networks (CNNs) for the task of handwritten digit recognition, focusing on the extensively studied MNIST dataset. The study delves into the strengths and weaknesses of both approaches, considering various aspects such as accuracy, computational efficiency, and robustness. Through an in-depth exploration of the literature and empirical evidence, this paper aims to offer valuable insights into the advancements, challenges, and future directions in the field of handwritten digit recognition.***

Keywords: Handwritten Digit Recognition, Artificial Neural Network, Convolutional Neural Network, MNIST Dataset.

I. INTRODUCTION

The introduction provides a clear overview of the significance of handwritten digit recognition and the pivotal role played by the MNIST dataset in benchmarking various algorithms. It sets the stage for the reader by outlining the objectives and scope of the review.

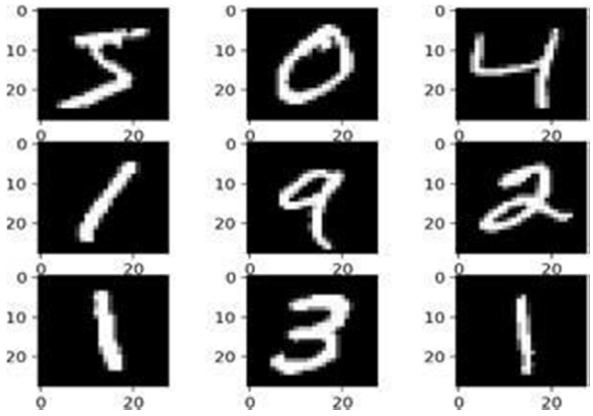


Fig 1: MINT Data Set

An HDR photograph was taken by a human hand in its natural handwriting. Offline handwritten recognition and online handwriting recognition are two types of handwritten recognition. If the writing is scanned before being printed Offline handwriting recognition occurs when a computer recognises a person's handwriting without the use of a computer., When handwriting is identified while being typed on a touchpad using a stylus pen, this is referred to as online handwritten recognition.
In terms of classifiers, there are two types of digit recognition systems: segmentation-free (global) and segmentation-based (local) (analytic).

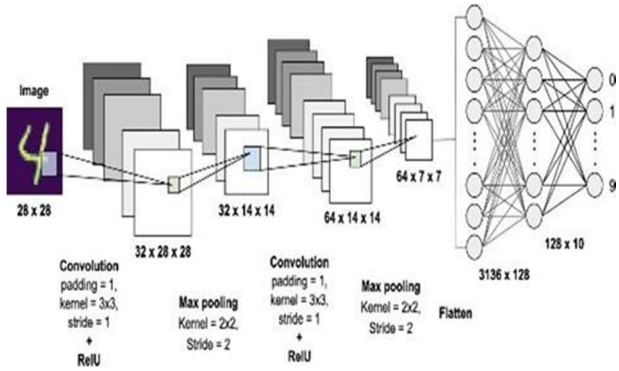


Fig 2: Convolutional Neural Network

The divided part is also known as a holistic approach for recognizing the digit without dividing it into subgroups or digits. Each word appears as a set of global features, e.g. ascender, loops, etc. Whereas the segmentation based on the approach of each of the word is divided into other subgroups either they are uniform or non-uniform or then subunits are considered independent. The Handwritten Digit processing system is domain and application specific so it's not possible to design a generic system in which we can process all of the types of handwritten scripts and languages. There is a lot of work has been done on the European languages and Arabic (Urdu) language. Whereas the domestic languages which are Hindi, Punjabi, Bangla, Tamil, Gujarati, etc. are very less or looked into them due to their limited usage. In this paper, section II has described the basic principle of HDR which is generally followed by a detailed.

II. RELATED WORK

Handwriting recognition has been the main subject of research for almost the last forty years. This research work analyzes the behavior of classification techniques (CNN) in a large handwriting dataset (MNIST) to predict a digit. Machine-learning techniques, particularly when applied to Neural Networks like CNN or ANN, have played an increasingly important role in the design of these recognition systems. Several methods have been developed in handwritten digit recognition and these methods have been classified into categories: knowledge-based methods, feature-based methods, template-based methods, and appearance-based methods. Errors in Digit recognition cause severe problems like digits written on a bank cheque if recognized erroneously could result in unfortunate consequences.

The goal of our work is to create a model that will be able to recognize and classify the handwritten digits from images by using concepts of Convolution Neural Network. Though the goal of our research is to create a model for digit recognition and classification, it can also be extended to letters and an individual's handwriting. The major goal of the proposed system is understanding Convolutional Neural Network, and applying it to the handwritten digit recognition system by working on the MNIST dataset.

There have already been significant advancements in this area of research previously. We have tried to form a model around the Conventional Neural Network with MNIST as our dataset so that the model has high accuracy and has been trained and tested on a large dataset. We shall also consider developing a robust test harness for estimating the performance of the model and then exploring improvements to the model. With high accuracy rates, the model can solve a lot of real- life problems.

Here, the HOG feature extraction method is used for both SVM and ANN to derive accuracy and performance. The deep learning method is used for CNN to derive accuracy and performance. The results obtained from the above methods are compared and method with high accuracy and high performance is considered as the best method for handwritten digits.

There is a huge number of studies conducted in the field of handwritten digits.

III. METHODOLOGY

The methodology section adequately outlines the architecture and training process of both Artificial Neural Networks and Convolutional Neural Networks. However, the paper could benefit from a more detailed discussion of the rationale behind the chosen hyperparameters and the selection of specific layers in the neural network architectures. Additionally, a brief overview of the data preprocessing techniques and their impact on model performance would enhance the clarity of the methodology. Artificial Neural Network: A Detailed explanation of the architecture and training process of the artificial neural network employed in this study. Discussion on hyperparameter tuning and model selection. Convolutional Neural Network: An in-depth exploration of the Convolutional Neural Network Architecture, focusing on its ability to capture spatial hierarchies and translational invariance in image data. Discussion on the use of convolutional layers, pooling layers, and fully connected layers.

IV. CONCLUSION

The conclusion effectively summarizes the key findings and their implications. The recommendations for future research directions add depth to the conclusion, encouraging further exploration in the field. However, providing a concise recapitulation of the main takeaways for readers would enhance the overall impact of the conclusion.

Overall, this review paper makes a substantial contribution to the understanding of handwritten digit recognition using ANNs and CNNs. With a solid literature review and insightful analysis of experimental results, it provides a valuable resource for researchers and practitioners in the field. Addressing the aforementioned suggestions would further enhance the clarity and completeness of the paper.

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A summary of the findings, insights gained, and implications for the field of handwritten digit recognition. Recommendations for future research directions and improvements in model architectures.

We study some Handwriting Digit Recognition and Artificial Neural network-based recognition algorithms to decide on the finest algorithm in terms of many aspects such as accuracy and performance. Different authors proposed many models and they took some criteria such as implementation time has been also taken into consideration. Random and standard datasets of handwritten digits are used to calculate the algorithms. The results show that DNN is the finest algorithm in aspects of accuracy and performance. CNN algorithm and DNN are almost equal in terms of accuracy. DNN algorithm, however, was finer than CNN and DBN in aspects of execution time. By recognizing the correct digits, the margin of errors may take place with similarities between the digits.

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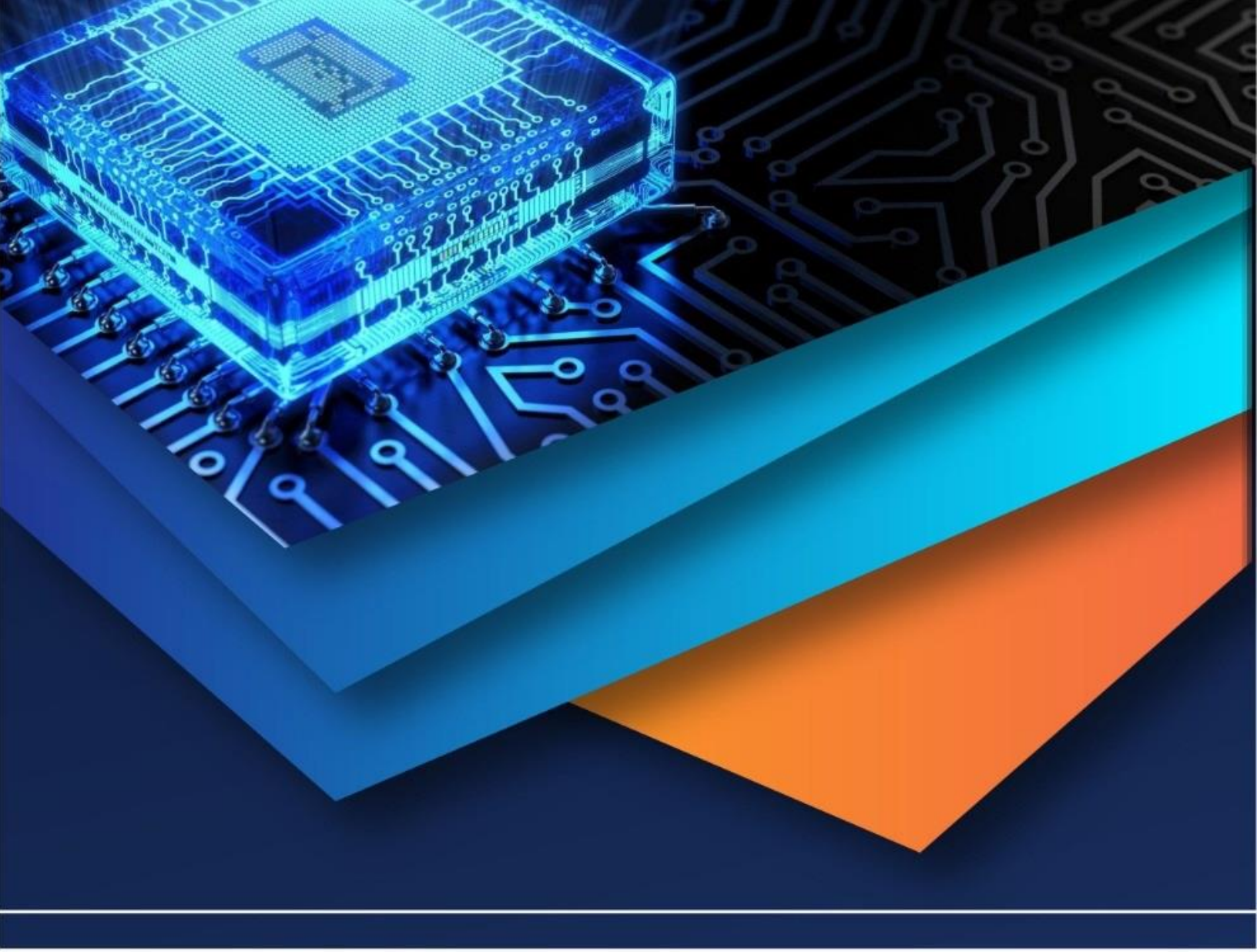
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