**A Novel Method For Handwritten Digit Recognition System**

**LITERATURE SURVEY**

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| **YEAR** | **TITLE** | **AUTHOR** | **PROBLEM STATEMENT** | **TECHNIQUE** | **ADVANTAGES** | **DISADVANTAGES** |
| 2018 | Offline Handwritten Digits Recognition Using Machine learning | Shengfeng Chen,  Rabia Almamlook,  Yuwen Gu, Dr. Lee wells. | This paper compares the performance of five machine learning classifier models namely Neural Network, K-Nearest Neighbor (KNN), Random Forest, Decision Tree and Bagging with gradient boost. | classification- K-Nearest Neighbor, MNIST dataset | This study discusses in detail all advances in the area of handwritten character recognition. The result of this paper shows that K-NN has equally high accuracy of 96.7% compared to Neural Network of 96.8%, but K-NN achieves a processing speed with almost 10 times faster | However, there is no single classifier that works best on all given problems. The larger testing data may give poor accuracy. |
| 2018 | Hand written Digit Recognition using Machine Learning Algorithm. | M Shamim, Mohamma d Badrul AlamMiah, Angona Sarker, Masud Rana | The ability to develop an efficient algorithm that can recognise Hand Written Digit and to ensure effective and reliable approaches for recognition of hand written digits. | Machine learning algorithms, NN, classification algorithm, off-line Hand Written | Get a accuracy level of 90.37% in off-line method. | Lack of accuracy due to absence of convolutional networks. |
| 2018 | Spiking Neural Networks for Handwritten Digit Recognition – Supervised Learning and Network Optimization | Shruti R. Kulkarnia, Bipin Rajendrana. | We demonstrate supervised learning in Spiking Neural Networks (SNNs) for the problem of handwritten digit recognition using the spike triggered Normalized Approximate Descent (NormAD) algorithm. | Neural networks, spiking neurons, supervised learning, pattern recognition, approximate computing, neuromorphic computing. | Efficient 3-layer spiking neural network for identifying handwritten digits, that achieved an accuracy of 98.17% on the MNIST data set using the NormAD learning algorithm. Our studies show that using the precise time of spike issue for classification gives slightly better accuracy compared to the simpler rate coding method. | Even though there will be some error in the precise time of spike issue, a larger time step can 405 be used when the network is used for inference. |
| 2018 | An adaptive deep Q-learning strategy for handwritten digit recognition. | Junfei Qiao, Gongming Wang, Wenjing Li, Min Chen. | An adaptive deep Q-learning strategy is proposed to improve accuracy and shorten running time for handwritten digit recognition. The adaptive deep Q-learning strategy combines the feature-extracting capability of deep learning and the decisionmaking of reinforcement learning to form an adaptive Q-learning deep belief network (Q-ADBN). | Handwritten digits recognition Deep learning Reinforcement learning Adaptive Q-learning deep belief network Adaptive deep auto-encoder. | Results show that the recognition accuracy and running time from Q-ADBN are better than those from the other similar methods. This is the first time to combine deep learning and reinforcement learning (DRL) to recognize the handwritten digits, which brings significant breakthroughs in those fields requiring both features-extracting and decisions-making. | It requires more training data to train the model. |
| 2018 | Assessing Four Neural Networks on Handwritten Digit Recognition Dataset (MNIST) | Neural Network, CNN, CapsNet, DenseNet, ResNet, MNIST. | We compare four neural networks on MNIST dataset with different division. Among of them, three are Convolutional Neural Networks (CNN), Deep Residual Network (ResNet) and Dense Convolutional Network (DenseNet) respectively, and the other is our improvement on CNN baseline through introducing Capsule Network (CapsNet) to image recognition area. We show that the previous models despite do a quite good job in this area, our retrofitting can be applied to get a better performance. | Neural Network, CNN, CapsNet, DenseNet, ResNet, MNIST. | We observe surprisingly that CapsNet requires only a small amount of data to achieve excellent performance. This method come up with the accuracy of 99.75%. | Much complex networks with high computation time. |
| 2019 | Handwritten Digit Recognition System Based on LRM and SVM Algorithm | Hafiz Ahamed,  Ishraq Alam, Md. Manirul Islam | It recognize handwritten digit using Logistic Regression Model (LRM) and Support Vector Machine (SVM). | SVM, LRM, Modified NIST (MNIST) database is used. | The model is used for many purpose like license plate recognition, in banks for reading checks, street number recognition, in post offices for sorting the mail. The LRM achieve 92.80% and SVM achieve 97.83%. | Less accuracy when compared to neural network algorithms. |
| 2019 | Hand written digit recognition using Convolutional Neural Networks | Vijayalaxmi R, Bhavanishankar K | To implement a classification algorithm to recognise the handwritten digits. | CNN,SVM,RFC,KNN | Execution of CNN utilizing Tensor Flow gives a stunningly better consequences of 99.70%. The high amount of accuracy can be obtained. | Large training data needed, don’t encode the position and orientation of object. |
| 2019 | Hand written digit recognition using Convolutional Neural Networks | Anwar Hossain and Md. Mohan Ali | To create a model that will be able to identify and determine the handwritten digits from its image with better accuracy. | MNIST Dataset, CNN. | It can completely abolish the need for typing. It gives more accuracy. | Large training data is need to training and testing the model. |
| 2019 | An efficient and improved scheme for handwritten digit recognition based on convolutional neural network. | Saqib Ali, Zeeshan Shaukat, Muhammad Azeem, Zareen Sakhawat, Tariq Mahmood, Khalil ur Rehman. | The aim of the proposed endeavor was to make the path toward digitalization clearer by providing high accuracy and faster computational for recognizing the handwritten digits. The present research employed convolutional neural network as classifier, MNIST as dataset with suitable parameters for training and testing and DL4J framework for hand written digit recognition. | Handwritten digit recognition (HDR) · Convolutional neural networks (CNNs) · Feature extraction and classification · MNIST dataset · Deep learning · DL4J. | The mentioned system successfully imparts accuracy up to 99.21% which is higher than formerly proposed schemes. In addition, the proposed system reduces computational time significantly for training and testing due to which algorithm becomes efficient. | Architectures like CNN are computationally expensive and lead to wastage of resources when used with less complex research problems. |
| 2020 | Improved Handwritten Digit Recognition Using Convolutional Neural Networks (CNN) | Anand Nayyar, Saurabh Singh and Byungun Yoon. | Training on optical character system is a challenging task. Handwriting recognition is focused on deep learning techniques has achieved good performance. | CNN,SGD optimization algorithm, MNIST dataset | Using this techniques 99.87% accuracy is achieved. | More training data is required. |
| 2020 | Effective Hand Written Digit Recognition using Convolutional Neural Networks | Yella pragrada, SS Bharadwaj, Rajaram P, Sriram V.P.Sudhakar | CNN are implemented with an MNIST Data Set, this method achieved 98.51% accuracy for real world hand written prediction with less than 0.1% loss. | CNN, MNIST Data Set, OCR, Tensor flow, segmentation, cross validation. | This method obtained 98% accuracy and bit is able to identify real world images as well as. Loss percentage in both training and evaluation is led than 0.1%. | Runtime is slow when compared to other algorithms. |
| 2020 | Hybrid CNN-SVM Classifier for Handwritten Digit Recognition | Savita Ahlawata, Amit Choudharyb. | The aim of this paper is to develop a hybrid model of a powerful Convolutional Neural Networks (CNN) and Support Vector Machine (SVM) for recognition of handwritten digit from MNIST dataset. The proposed hybrid model combines the key properties of both the classifiers. In the proposed hybrid model, CNN works as an automatic feature extractor and SVM works as a binary classifier. The MNIST dataset of handwritten digits is used for training and testing the algorithm adopted in the proposed model | Hybrid model, Convolutional Neural Network, Support Vector Machine. | The experimental results demonstrate the effectiveness of the proposed framework by achieving a recognition accuracy of 99.28% over MNIST handwritten digits dataset. | MLP models never considers detailed topology information of input and are not suitable for complex problems. |
| 2020 | Deep Convolutional Self-Organizing Map Network for Robust Handwritten Digit Recognition | Saleh Aley, Sultan Almotairi. | We develop a new efficient deep unsupervised network to learn invariant image representation from unlabeled visual data. The proposed Deep Convolutional Self-organizing Maps (DCSOM) network comprises a cascade of convolutional SOM layers trained sequentially to represent multiple levels of features. The 2D SOM grid is commonly used for either data visualization or feature extraction. | Unsupervised feature learning, 2DSOM grid, N –Dimensional SOM grid, MNIST dataset. | The proposed deep architecture is unique and different from other deep networks which are based on SOM. The proposed DCSOM network achieves comparable results with other state-of-the-art methods while it achieves best performance on handwritten digits datasets contaminated with random and image background noise. | However, this work employs high dimensional map size to create a new deep network. |
| 2021 | A Novel Handwritten Digit Classification System Based on Convolutional Neural Network Approach | Ali Abdullah Yahya, Jieqing Tan and Min Hu. | We presented a novel convolutional neural network architecture based on data preparation, receptive field, data augmentation, optimization, normalization, and regularization techniques for handwritten digit recognition. | Data augmentation, Root Mean Square Propagation (RMSprop), batch normalization; MNIST handwritten digit database. | Qur CNN algorithm achieves state-of-the-art results in handwritten digit recognition, with a recognition accuracy of 99.98%, and 99.40% with 50% noise. | To guarantee the dataset does not contain any unnecessary details and that it is fit for applying in our CNN model, data preparation is conducted as an essential first step in our proposed model. Without applying data preparation to the raw data, it is highly possible that unnecessary data leads to misleading results. |
| 2021 | Hand written digit recognition using Deep Learning | Ganganshee.J, S.Padmashli | To make sure effective and reliable approaches for recognition of hand written digits. | CNN, KERAS, Tensor flow. | CNN algorithm win with a recognition accuracy of 99.2%, followed by the KNN with 96.68% and less complexity. | It gives less accuracy when compared to other algorithms. |
| 2021 | Hand written Digit Recognition using Machine Learning and Deep Learning Algorithms. | Rithik Dixit, Rishika Kuswah, Samay Pashine. | To compare the accuracy of the along with their execution time get the best possible model for digit recognition. | Deep learning, MNIST Data Set, CNN. | CNN is the best suitable for any type of predictive problem including images data as an input. | It required more training data to train the model. |
| 2021 | Review on Deep Learning Hand Written Digit Recognition using CNN. | Akhanksha Gupta, Ravindra Pratap, Narwaria Narwaria,Madhav sigh. | In this project the classifiers like KNN, SVM, CNN are used for hand written digit recognition. The CNN is very accurate for hand written recognition but still there is a scope to improve. | CNN, ANN, OCR, MNIST, SVM, KNN, ReLV, NN. | The CNN is providing better performance than others. | Required more training data. |
| 2021 | Hand Written Digit Recognition using open CV and CNN. | K.Swetha, Y.Hithai shi, P.Partha saradhi. | To observe the varients of different algorithm that can classify the hand written digits using different hidden layers various number of epochs and to make a comparison based on the accuracy. | Hand Written Digit Recognition, Epochs, Hidden Layers, MNIST Data Set. | Get more accuracy compare to other neural networks. | Taking huge data set. Compare the model with a greater number of epochs. |
| 2021 | Research On Off-line Handwritten Digit Recognition Algorithm Based On Binary Classification Tree. | He Kai –lin, Luo jia, Ding Xiao – feng. | This paper is proposed a novel off-line handwritten numeric recognition algorithm based on binary classification tree. In this it’s recognized handwritten numeric based on holistic feature (Concave and Convex). | Binary classification algorithm. | The experimental results show that the algorithm in this paper has been improved in the original recognition rate and is more adaptive to the deformation of handwritten numerals. Compared with other popular contour based features and neural network based algorithms, there is an obvious advantage in speed. | This algorithm is only suitable for the sample of the writing specification, in real life, the numbers have a variety of deformations by the randomness of people’s writing, it affects the recognition rate of this algorithm. |
| 2022 | Hand written digit recognition using Convolutional Neural Networks | Sachin s Panchal. | This work is to provide realistic and robust approaches for confirming translated mathematics by examining several current plan models. | CNN, Tensor Flow, Numpy, Pandas. | Varients of a Convolutional brain to avoid difficult preplanning, excessive part extraction, and a perlexing group approach. | More data is required to train and test the model. |