A NOVEL METHOD FOR HANDWRITTEN DIGIT RECOGNITION SYSTEM

Literature Survey

S.NO	TITLE	AUTHORS	ABSTRACT	DRAWBACKS
1	A Novel Handwritten Digit Classification System Based on Convolutional Neural Network Approach	Ali Abdullah Yahya, Jieqing Tan, Min Hu	An enormous number of CNN classification algorithms have been proposed in the literature. Nevertheless, in these algorithms, appropriate filter size selection, data preparation, limitations in datasets, and noise have not been taken into consideration. As a consequence, most of the algorithms have failed to make a noticeable improvement in classification accuracy. To address the shortcomings of these algorithms, our paper presents the following contributions: Firstly, after taking the domain knowledge into consideration, the size of the effective receptive field (ERF) is calculated. Calculating the size of the ERF helps us to select a typical filter size which leads to enhancing the classification accuracy of our CNN. Secondly, unnecessary data leads to misleading results and this, in turn, negatively affects classification accuracy. To guarantee the dataset is free from any redundant or irrelevant variables to the target variable, data preparation is applied before implementing the data classification mission. Thirdly, to decrease the errors of training and validation, and avoid the limitation of datasets, data augmentation has been proposed. Fourthly, to simulate the real-world natural influences that can affect image quality, we propose to add an additive white Gaussian noise with $\sigma = 0.5$ to the MNIST dataset. As a result, our 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.	As the noise increases, it results in the steady decrease in the accuracy of the handwritten digit recognition.
2	Hybrid CNNSVM Classifier for Handwritten Digit Recognition	Ahlawat Savita, Amit Choudhary	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. The MNIST dataset consists of handwritten digits images which are diverse and highly distorted. The receptive field of CNN helps in automatically extracting the most distinguishable features from these handwritten digits. The experimental results demonstrate the effectiveness of the proposed framework by achieving a recognition accuracy of 99.28% over MNIST handwritten digits dataset.	Essentially our testing dataset is too controlled. An ideal dataset should consist of practical examples that we will meet out on the field, meaning that we want a dataset that consists of a variety of lighting, different hands and rescaled images.

3	Deep Convolutional Self organizing Map Network for Robust Handwritten Digit Recognition	Saleh Aly, Sultan Almotairi	Deep Convolutional Neural Networks (DCNN) are currently the predominant technique commonly used to learn visual features from images. However, the complex structure of most recent DCNNs impose two major requirements namely, huge, labelled dataset and high computational resources. In this paper, we develop a new efficient deep unsupervised network to learn invariant image representation from unlabelled 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. However, this work employs high dimensional map size to create a new deep network. The N-Dimensional SOM (NDSOM) grid is trained to extract abstract visual features using its classical competitive learning algorithm. The topological order of the features learned from ND-SOM helps to absorb local transformation and deformation variations exhibited in the visual data. The input image is divided into an overlapped local patch where each local patch is represented by the N-coordinates of the winner neuron in the ND-SOM grid. Each dimension of the NDSOM can be considered as a non-linear principal component and hence it can be exploited to represent the input image using N Feature Index Image (FII) bank. Multiple convolutional SOM layers can be cascaded to create a deep network structure A set of experiments using MNIST handwritten digit database and all its variants are conducted to evaluate the robust representation of the proposed DCSOM network. Experimental results reveal that the performance of DCSOM outperforms state-of-the-art methods for noisy digits and achieve a comparable performance with other complex deep learning architecture for other image variations	The input image is overlapped, so it may lead to confusions in digit recognition

- **Salvador España-Boquera et al,** in this paper hybrid Hidden Markov Model (HMM) model is proposed for recognizing unconstrained offline handwritten texts. In this, the structural part of the optical model has been modelled with Markov chains, and a Multilayer Perceptron is used to estimate the emission probabilities. In this paper, different techniques are applied to remove slope and slant from handwritten text and to normalize the size of text images with supervised learning methods. The key features of this recognition system were to develop a system having high accuracy in pre-processing and recognition, which are both based on ANNs.

- **R. Bajaj, L. Dey, S. Chaudhari et al,** employed three different kinds of features, namely, the density features, moment features and descriptive component features for classification of Devanagari Numerals. They proposed multi classifier connectionist architecture for increasing the recognition reliability and they obtained 89.6% accuracy for handwritten Devanagari numerals