Ideation Phase
Literature Survey

Date	19 September 2022
Team ID	PNT2022TMID06491
Project Name	A Novel Method for Handwritten Digit Recognition System
Maximum Marks	4 Marks

Paper: Handwritten Digit Recognition Using Convolutional Neural Networks.
Publication year: 22-Feb-2022.
Author Name: Shailesh S Rajput, Yoonsuk choi.

Summary:

- Deep learning has witnessed a significant evolution recently with growth in high-performance devices and research in the neural network. The central aspect of this paper is to discuss the deep learning concept ideas and problems faced during the deep training the model and come with a solution for better accuracy, illustrated by digit recognition and
- prediction using a conventional neural network. The first part of the research focused on the techniques used for training models in neural networks and enlightened the previous study in digit recognition. The second half of the paper detailed the concept of the accuracy by preprocessing samples and ensemble of two or more models with different architectures and preprocessing. Preprocessing of samples and implementation of the model architecture is done using python.

Literature Review:

1) Hybrid CNN-SVM Classifier for Handwritten Digit Recognition by Savita Ahlawat and Amit Chaudhary[1]. Support Vector Machine (SVM) classifier is not good enough to recognize noisy data but is recommended for error generalization. In this approach, the convolution neural network is used for a feature and building neaural network. The SVM classifier is used instead of the final softmax classification layer of Convolution Neural Network (CNN) to give the binary classification. The accuracy result of the hybrid model CNN-SVM is 99.28, while that of just SVM classifiers is 98.35, which is a significant change.

2) Prabhanjan Soukar and Dinesh Ramesh Gowda [2] presented an approach for fusing multiple classifiers by stacking classifier technique for handwritten devanagari numeral recognition. They used Naive Bayes, Instance-based learner, Random Forest, sequential minimal optimization classifiers and combined them to get their proposed classifier stacking. They have mentioned an accuracy result of 99.68 for fused classifier stacking, which was much better than individual classifiers. This is yet another example of a hybrid classifier that supports the idea of combining two or more references for better accuracy.

3) Neural Network based handwritten character recognition system without feature extraction by J. Pradeep, E. Srinivasan, and S. Himavati [3] roposed to digit recognition

architecture that claims the same accuracy without feature extraction. Thus decreasing the complexity of the architecture and getting good accuracy of 90.19%. After segmentation, the preprocessed data is directly sent into a neural network to predict the digits without feature extraction.

Conclusion:

- We have illustrated LeNet-5 architecture and model 2 with its accuracy individually. This paper supports the idea of merging two or more references (Ensemble technique in our case of MNIST digit classification) which can give more accurate results as details lost by one model may result in misprediction can be predicted correctly by the other. Our paper trained and tested two different models individually and combined their predictions to get an accuracy of 99.25%, which can be improved by adding more models to the architecture with different preprocessing steps. Later, Predictions of the two different models are used and summed up together to get the final prediction which gave an efficient result.
- This paper has implemented two models with different accuracy and combined them for improved efficiency. Multiple models are suitable for accuracy but considering the time constraint is not beneficial. We will decrease the layers and implement the final layer with more trainable parameters with less training time for each epoch so that the model can be trained with fewer resources and be more time efficient. Furthermore, this paper and the model presented were tested and trained only on MNIST digit recognition. But, training for handwritten letters with the EMNIST dataset will be more challenging; the model will be implemented and tested on the same proposed ensemble architecture to calculate the accurate result. In this paper, both models had the same preprocessed sample, but different image processing and feature extraction can be done for each model to achieve higher accuracy. Also, Image segmentations are still challenging as it is sometimes difficult to recognize the single letter or digit when they are overlapped.

References:

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[5] Li J, Sun G, Yi L, Cao Q, Liang F, Sun Y. Handwritten Digit Recognition System Based on Convolutional Neural Network. In2020 IEEE International Conference on Advances in Electrical Engineering and Computer Applications (AEECA) 2020 Aug 25 (pp. 739-742). IEEE

Paper 2: An Enhanced Handwritten Digit Recognition Using Convolutional Neural Networks.
Publication year: 21-march-2021
Author Name: Malathy.S, Dr C N Vanitha, Nirdhum Narayan, Dr Rajesh Kumar, Gokul.R

Summary:

- The issue of transcribed digit acknowledgment has for some time been an open issue in the field of example order. A few examined have demonstrated that Neural Network has an incredible execution in information arrangement. 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. This paper thinks about the exhibition of Convolutional Neural Network (CCN). Results demonstrate that CNN classifier beat over Neural Network with critical improved computational effectiveness without relinquishing execution.
- Handwritten digit recognition can be performed using the Convolutional neural network from Machine Learning. Using the MNIST (Modified National Institute of Standards and Technologies database and compiling with the CNN gives the basic structure of my project development. So, basically to perform the model we need some libraries such as NumPy, 'Pandas', TensorFlow, Keras. These are the main structure on which my main project stands. MNIST data contains about 70,000 images of handwritten digits from 0-9. So, it is a class 10 classification model. This dataset is divided into 2 parts i.e. Training and Test dataset. Image representation as 28*28 matrix where each cell contains grayscale pixel value.

Conclusion:

The impact of expanding the quantity of convolutional layers in CNN design on the presentation of transcribed digit acknowledgment is unmistakably introduced through the tests. The oddity of the current work is that it altogether explores all the boundaries of CNN engineering that convey best acknowledgment precision for a MNIST dataset. Companion scientists couldn't coordinate this precision utilizing an unadulterated CNN model. A few analysts utilized gathering CNN network models for the equivalent dataset to improve their acknowledgment precision at the expense of expanded computational expense and high testing multifaceted nature yet with practically identical exactness as accomplished in the present work. In future, various designs of CNN, in particular, cross breed CNN, viz., CNN-RNN and CNN-HMM models, and space explicit acknowledgment frameworks, can be researched. Developmental calculations can be investigated for streamlining CNN learning boundaries, to be specific, the quantity of layers, learning rate and portion sizes of convolutional channels.

References:

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