

Literature Review

Handwritten digit classification using Neural Networks has been a topic of research for a long time. It has seen a lot of progress in the recent years due to availability of resources for the computation.

In [1], the author discusses the various algorithms that could be used for Character Recognition such as logistic regression, Support Vector Machines, etc although these may provide analytical and computational properties but that their practical applicability is limited by the curse of dimensionality. In order to apply such models to large scale problems, it is necessary to adapt the basis functions to the data. The approach is to fix the number of basis functions in advance but allow them to be adaptive, in other words to use parametric forms for the basis functions in which the parameter values are adapted during training. The most successful model of this type in the context of pattern recognition is the feed-forward neural network, also known as the multilayer perceptron.

David Rumelhart, Geoffrey Hinton, and Ronald Williams in [3] suggested that neural networks with backpropagation could be used for character recognition. This paper introduced the backpropagation algorithm, which is a method for training neural networks to minimize error on a supervised learning task, such as character recognition. Prior to this paper, neural networks had been used for character recognition, but the backpropagation algorithm made it possible to train large and deep networks more effectively, which led to significant improvements in performance.

The implementation of Neural Networks in Character Recognition can be found as early as 1998 by LeCun et al. [2] with an error rate as low as 12% using a single perceptron model. Further use of deeper Neural Networks have been done and results with error less than 1%.

Handwritten Nepali Digit Classification has been a topic of research for the recognition of the Nepali digits. This has been a difficult task because of the complexity and variations in the handwritten Nepali Devanagari digits.

In [4] by Yadav, Cuadrado and Morato, in 2013 used ANN's for Devanagari OCR and achieved an accuracy of 90% in character recognition. However, the given accuracy is for only 5 fonts. In this paper, they propose an OCR for printed Hindi text in

Devanagari script, using Artificial Neural Network (ANN), which improves its efficiency. One of the major reasons for the poor recognition rate is error in character segmentation. In this work, three feature extraction techniques-: histogram of projection based on mean distance, histogram of projection based on pixel value, and vertical zero crossing, have been used to improve the rate of recognition. These feature extraction techniques are powerful enough to extract features of even distorted characters/symbols. For development of the neural classifier, a back-propagation neural network with two hidden layers is used. The classifier is trained and tested for printed Hindi texts. A performance of approximately 90% correct recognition rate is achieved. [4]

In another study by Nirajan Pant and Balkrishna Bal, in [5], proposed a hybrid OCR system for printed Nepali text using the Random Forest (RF) Machine Learning technique. It incorporates two different approaches of OCR – the Holistic and the Character level recognition. The system first tries to recognize a word as a whole; if it is not confident about the word being recognized, then the character level recognition is performed. The recognition rates of approximately 78.87% and 94.80% were achieved for character level recognition method and the Hybrid method respectively. They attempted to minimize the segmentation errors by reducing the segmentation tasks. [5]

Similarly in [7] , Sharma and Bhattarai in 2017 has shown a high character recognition accuracy using Convolutional Neural Networks. However, upon analysis of their confusion matrix, we found that they represented the character ‘ङ’ (nga) as ‘ड’ (Da) (a combination of two characters ‘ड’ and ‘.’), which resulted in a high rate of error for that character, especially since 70% of their dataset was generated artificially. This study uses Tesseract and ANN with some modifications, wherever necessary, for Nepali script.

Likewise, in a study by Owais Mujtaba Khandey and Dr. Samad Dadvandipour, [6] covers the work done in handwritten digit recognition and the various classifiers that have been developed. Methods like MLP, SVM, Bayesian networks, and Random forests were discussed with their accuracy and are empirically evaluated. Boosted LeNet 4, an ensemble of various classifiers, has shown maximum efficiency among these methods. The boosted LeNet 4 method performs the best with the accuracy of

99.3% and is the best among the methods that have been studied in this paper. The only tradeoff is the training time, which is very large and is about five weeks. The operational/actual recognition time is 0.05 ms.

Moreover, in the study by Nikita Singh, in 2018, the image partitioning technique is used for piecewise Histogram of Oriented Gradients (HOG) features extraction. To train the neural network, a feature vector composed of HOG features of all partitions is used. The proposed approach achieves the maximum of 99.27% classification accuracy in training and is able to recognize the different handwritten Devanagari characters with an average accuracy of 97.06%. The proposed approach may be useful in the application for blind people to read the handwritten contents.[8]

References

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