International Journal of Research in Engineering, Science and Management
Volume 4, Issue 7, July 2021
https://www.ijresm.com | ISSN (Online): 2581-5792

Recognition of Handwritten Digits and English Texts using MNIST and EMNIST Datasets

Asha B. Shetty[1], Navya N. Ail[2], M. Sahana[3], Sushmitha[4], Varsha P. Bhat[5*]
[1]*Assistant Professor, Department of Information Science & Engineering, Sahyadri College of Engineering & Management, Mangaluru, India*
[2,3,4,5]*Student, Department of Information Science & Engineering, Sahyadri College of Engineering & Management, Mangaluru, India*

***Abstract*: Our project is meant to implement recognition to text and digit of any input image. We separate our project into two parts ie, recognition of digit and character by using both CNN and LSTM algorithms. Our approach builds upon yan Lecun datasets in digit recognition, and applies the techniques to characters' recognition. Yan lecun datasets include MNIST which is for recognition of digits and EMNIST for recognition of alphabets. Handwritten digit recognition is the ability of a computing system to acknowledge the written inputs like characters etc from a large sort of sources like emails, papers, images, letters etc. This has been a subject of analysis for many years. A number of the analysis areas embrace bank check processing, postal address interpretation from envelopes etc. Handwritten digit recognition plays a significant role in many user authentication applications in the modern world. Character Recognition has been an active area of research in the past and due to its diverse applications it continues to be a challenging topic. The idea is to provide efficient algorithms which takes input as character and predict the output in digital format. After that it processes the image for better comparison. Then after the processed image is compared with already available set of font images. The last step gives a prediction of the character in percentage accuracy.**

***Keywords*: handwritten digit recognition system, deep learning, convolutional neural network, LSTM, MNIST, EMNIST.**

1. Introduction

Machine Learning and deep learning algorithms can be applied to predict the handwritten digit and text. Handwritten Digit Recognition (HDR) is a snippet of OCR that detects digits. Handwritten Text Recognition (HTR) detects texts. The proposed model can predict handwritten digits and English texts. The field of automated reading of printed or handwritten documents by the electronic devices is known as Optical Character Recognition (OCR) system, which is broadly defined as the process of recognizing either printed or handwritten text from document images and converting it into electronic form. Handwritten digit and character recognition is the method of recognizing and classifying handwritten digits from 0 to 9 and alphabets from A-Z without human interaction. Handwritten digit and character recognition is a complex problem due to the fact that variation exists in writing style of different writer. Due to this reason, building a generic recognizer that is capable of recognizing handwritten digits written by diverse writers is not always feasible. However, the extraction of the most informative features with highly discriminatory ability to improve the classification accuracy with reduced complexity remains one of the most important problems for this task. r. Optical Character Recognition uses the image processing technique to identify any character from computer as input or hand written. A lot of work has been done in this field. But a continuous improvisation of OCR techniques is being done based on the fact that algorithm must have higher accuracy of recognition, higher persistency in number of times of correct prediction and increased execution time.

2. Literature Survey

In [1] two- Step CNN Framework for Text Line Recognition in Camera-Captured Images was proposed. The system is designed for mobile or embedded system. It recognizes low quality images of identity documents with complex background and different languages and fonts. In this paper MNIST dataset is used to train and test the images. The input data images are converted to 28 by 28 pixels while initializing the classifier. In [2] they have proposed Deep Convolutional Self-Organizing Map Network for Robust Handwritten Digit Recognition. This paper consists of a set of experiments using MNIST handwritten digit database and all its variants are conducted to evaluate digit recognition. The [3] paper focuses on executing the task of HDR, robust CNN architecture is used for feature extraction and classification. The [4], [5], [7] conference papers proposes a methodology of evaluation algorithm based on CNN. This project uses 7 layered CNN architecture and LSTM as classifier. The [6] paper proposed Analyzing Time Complexity of KNN and CNN in Recognizing Handwritten Digits This paper analyzes the study of time complexity in two different algorithms KNN and CNN. And it concludes that CNN produces high accuracy than KNN. The [8]-[10] proposed online and offline Hadwritten Text Recognition using Long Short-Term Memory(LSTM) deep learning algorithm. The [11] proposed Offline Handwritten Malayalam character

*Corresponding author: varshapbhat16@gmail.com

Recognition using stacked LSTM. The [12] summarizes Handwritten Bangla Numeral Recognition Using Deep Long Short Term Memory(LSTM).

3. Methods

The Recognition of Handwritten Digits and English Texts using MNIST and EMNIST datasets, aims at designing and develop a suitable model that is efficient for predicting handwritten digits and English texts using CNN and LSTM on MNIST and EMNIST dataset.

1) Preprocessing

Preprocessing refers to all the transformations on the raw data before it is fed to the machine learning or deep learning algorithm. Image is taken as an input, and then image preprocessing is applied on that image. Preprocessing is the common name used in the image processing for the operations with the images at the lowest level of abstraction. The main objective of preprocessing is not only to improve or enhance the image but also to deduce the unused portion from the image. Image preprocessing uses the considerable severance in images. There are various reasons for the requirement of image preprocessing phase such as noise reduction, image quality improvement, contrast enhancement, reduction or elimination of not required images, correction of missing or wrong pixel values.

2) Feature Extraction

Features are the representatives of images. When the input data to an algorithm is too large, then it is converted into the reduced representative image. Transforming the data into features is called feature extraction. If features which need to

be extracted are accordingly chosen, then that set will give related information to it. The dataset is passed through this phase to select the features for the predictive model.

3) Classification

Classification refers to a process in computer vision that can classify according to its visual content. After extracting features, the role of classification is to classify the type of classifier used. Classification is done using CNN and LSTM algorithm. It is done based on the set of training data and testing data. For classification the extracted features are used as inputs. Then similarities for trained features and tested features are compared and accurate output is shown.

A. Algorithms

1) Convolution Neural Network

A CNN works by extracting features from images. This eliminates the need for manual feature extraction. They're learned while the network trains on a set of images. The following algorithm depicts the working of CNN.

Input: Preprocessed image(.png)

Output: Recognized text and .txt output file

- Step 1: Initializing all the variables, which includes accuracy, data, input image and corpus.
- Step 2: Training CNN with MNIST and EMNIST dataset, where train function is given with model and loader as input parameters.
- Step 3: The validation of trained model is done. In this phase the recognized features in trained model will be compared with actual features.
- Step 4: Testing the input image with pre-trained model. The input image will be passed to CNN model to extract the feature and these feature vectors will be compared with pre-trained model to recognize it.

2) Long Short-Term Memory

A LSTM works by extracting features from images. This eliminates the need for manual feature extraction. They're learned while the network trains on a set of images. The following algorithm depicts the working of LSTM.

Input: Preprocessed image(.png)

Output: Recognized text and .txt output file

- Step 1: Initializing all the variables, which includes accuracy, data, input image and corpus.
- Step 2: Training LSTM with MNIST and EMNIST dataset, where train function is given with model and loader as input parameters.
- Step 3: The validation of trained model is done. In this phase the recognized features in trained model will be compared with actual features.
- Step 4: Testing the input image with pre-trained model. The input image will be passed to LSTM model to extract the feature and these feature vectors will be compared with pre-trained model to recognize it.
- Step 4: Testing the input image with pre-trained model. The input image will be passed to CNN model to extract the feature and these feature vectors will be compared with pre-trained model to recognize it.

The below table contains the accuracy of SVM and CNN algorithms using MNIST and EMNIST datasets.

Table 1
Accuracy table

Datasets	CNN	LSTM
MNIST	98.23 %	98.35 %
EMNIST	85.17 %	85.71 %

Figure 1 represents a plan or drawing that shows the function along with working of a system.

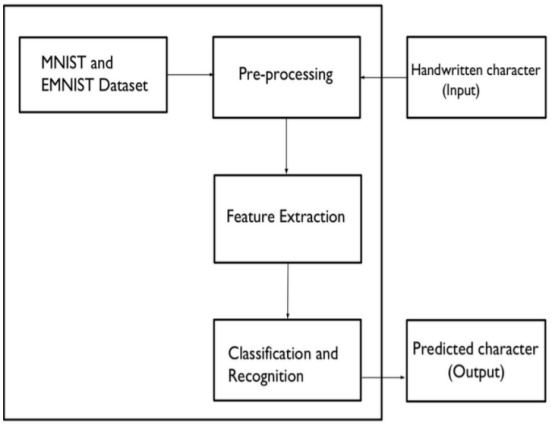

Fig. 1. Architecture of the model

Figure 2 shows the sample of MNIST Dataset.

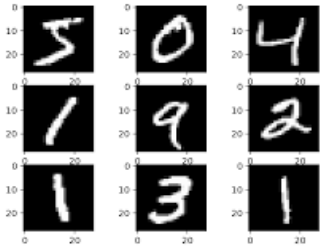

Fig. 2. MNIST dataset

Figure 3 shows sample of EMNIST Dataset.

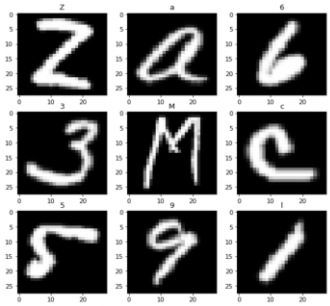

Fig. 3. EMNIST dataset

Figure 4 illustrates the recognized digit and accuracy of the image using CNN.

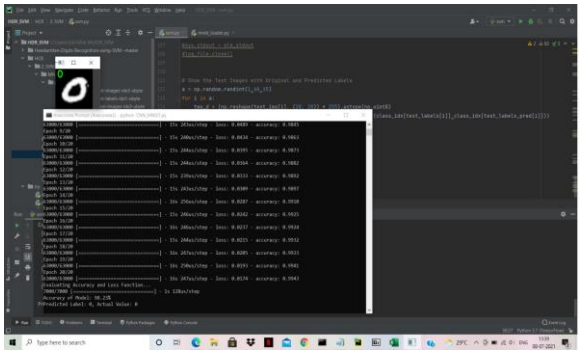

Fig. 4. Output snapshot

Figure 5 illustrates the recognized text and accuracy of the image using CNN.

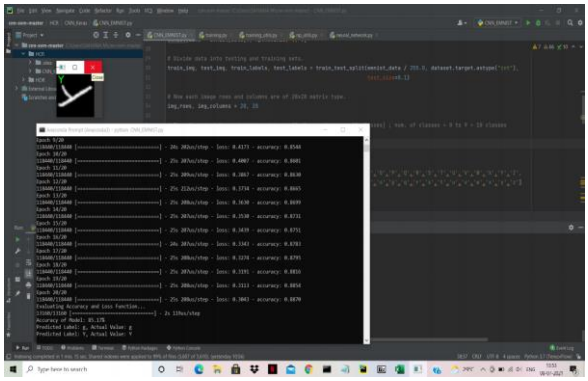

Fig. 5. Output snapshot

Figure 6 illustrates the recognized digit and accuracy of the image using LSTM.

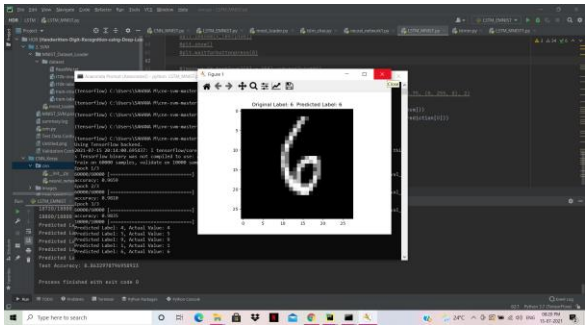

Fig. 6. Output snapshot

Figure 7 illustrates the recognized text and accuracy of the image using LSTM.

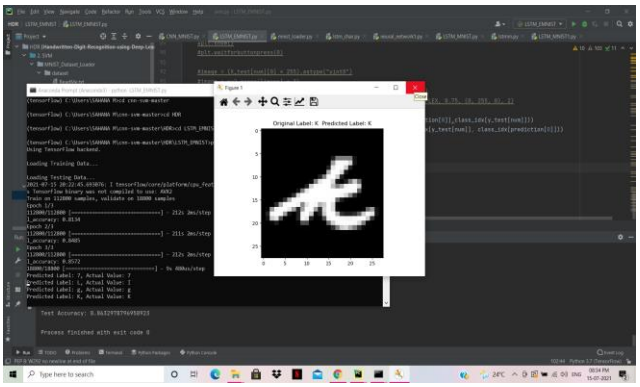

Fig. 7. Output snapshot

4. Conclusion

This paper presented an overview on recognition of handwritten digits and English texts using MNIST and EMNIST datasets.

References

[1] Yulia S. Chernyshova, Alexander V. Sheshkus and Vladimir V. Arlazarov, “Two-Step CNN Framework for Text Line Recognition in Camera-Captured Image”, IEEE Access, January 10, 2020.

[2] Saleh Aly (Associate Member, IEEE) and Sultan Almotairi “Deep Convolutional Self-Organizing Map Network for Robust Handwritten Digit Recognition”, IEEE Access, May 20, 2020.

[3] Taraggy M Ghanim, Mahmoud I Khalil, Hazem M. Abbas (Senior Member, IEEE), “Comparative Study on Deep Convolution Neural Networks DCNN-based Offline Arabic Handwriting Recognition” IEEE,2020.

[4] Alain Biem, “Minimum Classification Error Training for Online Handwriting Recognition” International Journal of Engineering Development and Research, IEEE Access, July 2006.

[5] Jamshed Memon, Maira Sami, Rizwan Ahmed Khan and Mueen Uddin, “Handwritten Optical Character Recognition (OCR): A Comprehensive Systematic Literature Review (SLR)”, IEEE Access, June 24, 2020.

[6] Jinze Li, Gongbo Sun, Leiye Yi, Qain Cao Fusen Liang, Yu Sun, “Handwritten Digit Recognition System Based on Convolution Neural Network”, 2020, IEEE International Conference on Advances in Electrical Engineering and Computer Application(AEECA), Dalian, China, 2020.

[7] Reya Sharma, Baijinath Kaushik, Naveen Gandhi, “Character Recognition using Machine Learning and Deep Learning- A survey”, International Conference on Emerging Smart Computing and Informatics (ESCI), Pune, India.

[8] Gregory Cohen, Saeed Afshar, Jonathan Tapson and André van Schaik, "EMNIST: Extending MNIST to handwritten letters", International Joint Conference on Neural Networks (IJCNN), 2017.

[9] Abhishek Das, Gyana Ranjan Patra and Mihir Narayan Mohanty, "LSTM based Odia Handwritten Numeral Recognition", International Conference on Communication and Signal Processing (ICCSP), 2020.

[10] James Arnold Nogra, Elmer Maravillas, Cherry Lyn Sta Romana, "LSTM Neural Networks for Baybáyin Handwriting Recognition", IEEE 4th International Conference on Computer and Communication Systems (ICCCS), 2019.

[11] Jino P J, Jomy John, Kannan Balakrishnan, "Offline Handwritten Malayalam character Recognition using stacked LSTM", International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT).

[12] Mahtab Ahmed, M.A.H. Akhand, M.M. Hafizur Rahman, "Handwritten Bangla Numeral Recognition Using Deep Long Short Term Memory", 6th International Conference on Information and Communication Technology for The Muslim World (ICT4M), 2016.