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

MNIST Kannada Digit Recognition

P. G. Shwetha[1*], Prajna Gatty[2], Shubhashini[3], B. Shraddha[4], K. Janardhana Bhat[5]
[1,2,3,4]*Student, Department of Information Science and Engineering, Srinivas Institute of Technology, Mangalore, India*
[5]*Assistant Professor, Department of Information Science and Engineering, Srinivas Institute of Technology, Mangalore, India*

***Abstract*: Handwritten digit recognition, an active research field of computer vision and pattern recognition. This paper proposes an efficient handwritten Kannada digit recognition approach based on comparing the prediction accuracy of the Convolutional Neural Network (CNN) model and various machine learning algorithms such as Support Vector Machine (SVM), K-Nearest Neighbor (KNN) and Random Forest Classifier (RFC) by training on Kannada-MNIST and testing on the Dig MNIST dataset. The Kannada language has complex digits, identifying such digits is a challenge in pattern recognition. In the end, a comparative study of the above-mentioned algorithms is performed based on recognition accuracy.**

***Keywords*: Computer Vision, Convolutional Neural Network (CNN), Dig MNSIT, Handwritten digit recognition, K-Nearest Neighbor (KNN), Kannada-MNIST, Pattern Recognition, Random Forest Classifier (RFC), Support Vector Machine (SVM).**

1. Introduction

Handwritten digit recognition is one of the major research topics in the field of Artificial Intelligence and Machine Learning. Digit recognition has a broad-spectrum of real-world applications, such as recognizing digits in vehicle license plates, PIN code identification in postal mail sorting, identification and verification of data entered in the form, identification of digits written in bank cheques, identifying digits in ancient scripts, digital libraries, etc. [1]. It is easy for a human to identify digits but the task is to make machines recognize these digits. Digit recognition has always been a difficult task because handwriting styles differ from human to human [2].

Machine learning techniques are always in the limelight because of their use in a large range of applications [2]. In the 21st-century handwritten digit recognition has an important role to play in our daily life and a means of data is shared between individuals. A considerable attempt of research work is made in machine learning to achieve an efficient approach to predict digits with greater accuracy [3]. Pattern recognition is a field in machine learning that recognizes patterns from a set of data [4].

As we know, Kannada is the prominent language of Karnataka. Kannada is a language that is spoken by millions of people around the world. The language is written using official Kannada script [5]. Kannada language has complex digits, identifying such digits is a challenge in pattern recognition [7]. The author in [6], has proposed two datasets called Kannada MNIST and Dig-MNIST. The dig-MNIST has proved more challenging to achieve greater accuracy when tested on pre-trained CNN model, SVM, KNN and RFC machine learning algorithms.

The ingenuity of this paper comes from the fact that we have compared the techniques for predicting digits for Kannada language. Although we can find that great work has been done in many Indian languages [1], [2], Kannada language is not yet considered by many researchers (excluding a few recent publications [5], [6]).

In this paper, we compare the accuracy of CNN model and various machine learning algorithms such as SVM, KNN and RFC by training on the Kannada-MNIST and testing on the Dig-MNIST dataset.

2. Architecture

Techniques used to recognize digits for the Convolutional neural network and Machine learning algorithms are the same. Handwritten digits are pre-processed to perform various tasks on the input image. Pre-processed digit images are segmented into a sub image of individual digits. A Set of features are extracted and these features are trained using CNN model or the classification algorithms. The features of the handwritten digits, which need to be recognised, are extracted and sent to the prediction. At last, the prediction results are outputted and the recognition accuracy is calculated. The below figure 1 is the block diagram that explains whole process of Kannada digit recognition.

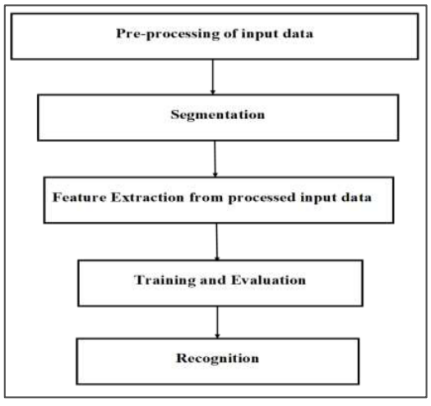

Fig. 1. Block diagram of MNIST Kannada digit recognition

*Corresponding author: pgshwetha01@gmail.com

3. Methodology

A. Dataset

Our goal is to compare the accuracy between CNN, SVM, KNN, and RFC. To do this we used two datasets Kannada-MNIST and Dig-MNSIT. The Kannada-MNIST dataset contains 60000 28×28 gray scale sample images of training data and 10000 uniformly distributed across 10 classes of testing data. The Dig-MNIST dataset consists of 10000 28×28 gray scale images that can be distributed as an out-of-domain test dataset. The Dig-MNIST dataset was contributed by a group of volunteers who had different handwriting styles.

B. Convolutional Neural Network

Convolutional neural network (CNN, or ConvNet) is a domain that comes under deep neural networks. They are commonly applied to evaluate visual imagery. CNN were Influenced by biological processes where the connection pattern between the neurons is similar to the structure of the animal visual cortex. Compared to other image classification algorithms CNNs have a lesser pre-processing duration. Input layer, Hidden layers and Output layer are the three layers of CNN. The activation function and final convolution hides the inputs and outputs of the middle layers hence they are called hidden layers. Tensorflow and keras provide libraries for creating neural networks. The dimensions of data are decreased by pooling layers by combining the output of one layer into a single neuron in the next layer. The neuron in every layer is combined to every neuron in another layer by fully connected layers. The output value is calculated by each neuron by applying a specific function to the input value collected from the previous layer. This is called weights which act as filters and represent particular features. CNN for image classification resulted with highest accuracy compared to other algorithms.

C. Support Vector Machine

A Support vector machine abbreviated as SVM is a supervised machine learning algorithm. It is used to solve classification problems. A SVM builds a hyperplane or a set of hyperplanes in a high or infinite dimension space, which can be used for classification. Classification of the data points are done by the help of decision boundaries of Hyperplanes. Data points on both sides of the hyperplane can be different classes. Dimension of the hyperplane depends upon the number of features. If the input feature is 2, then the hyperplane is just a line. If the input feature is 3, then the hyperplane becomes 2D. It is difficult to imagine when the number exceeds 3. The decision boundary created helps to classify the classes. If you have a figure, simply paste it in the template and adjust the size of the figure as per the requirement.

D. K-Nearest Neighbor

The k-nearest neighbors abbreviated KNN is a supervised machine learning algorithm that is used to solve both classification and regression problems. Here KNN mainly deals with classification purposes. It firstly understands the similarity between the new data and the existing data and then puts the new data to the category that it belongs to.

E. Random Forest Classifier

The random forest classifier abbreviated as RFC is a supervised machine learning algorithm. This method consists of many learning models that help in getting better result. In a simpler way RFC builds up numerous decision trees and merges them together to get more stable and accurate predictions. It also adds up some additional randomness to the model while trees are growing.

4. Result

The efficiency of the machine's learning capacity can be acknowledged through its results. The explained system in this paper undergoes training and testing process using the MNIST dataset. The below table 1 manifests the accuracy of machine learning algorithms that are considered in the process.

Table 1
Simulated accuracy for the algorithms

Algorithm	Accuracy
Convolutional Neural Network	99.51%
Support Vector Machine	98.79%
K-Nearest Neighbor	98.39%
Random Forest Classifier	97.66%

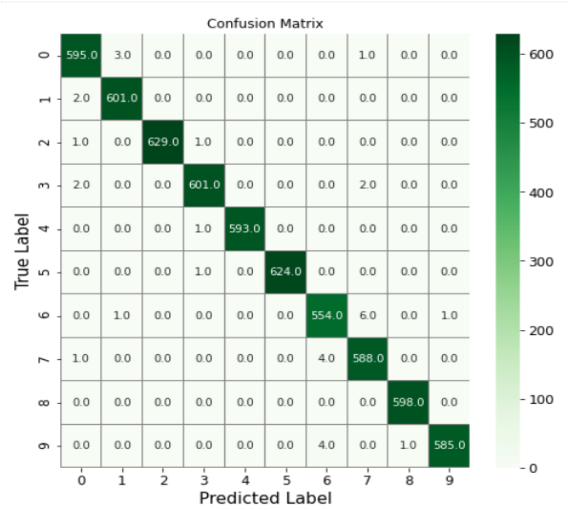

Fig. 2. Confusion Matrix of CNN

The above figure 2 is the confusion matrix of CNN. It is an N x N matrix that is used for evaluating the performance of a classification model; here N is represented as the number of target classes. The matrix here compares the actual target values with other values, which are predicted by the machine learning model.

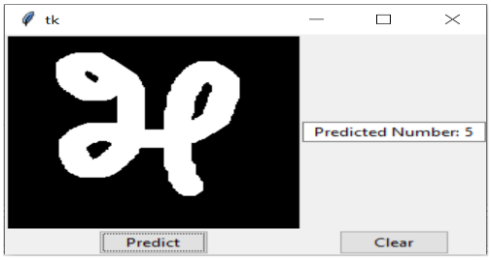

Fig. 3. Predicted digit 5 using CNN

The above figure 3 shows the resulted output for user's input of digit 5. The Tkinter GUI Toolkit above helps to predict exact output for given Kannada digit input for CNN algorithm.

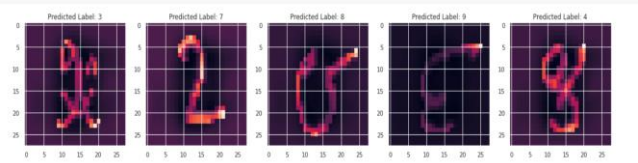

Fig. 4. Predicted digits 3, 7, 8, 9, 4 using SVM

The above figure 4 explains the resulted output for SVM algorithm and predicted Kannada digits are 3,7,8,9,4.

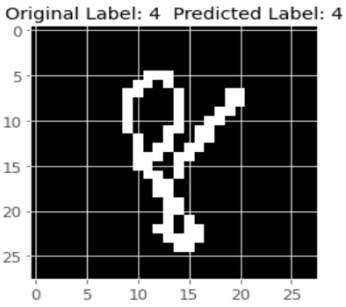

Fig. 5. Predicted digit 4 using KNN

The above figure 5 explains the resulted output for KNN algorithm and predicted Kannada digit is 4.

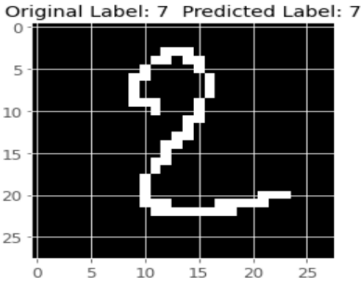

Fig. 6. Predicted digit 7 using RFC

The above figure 6 explains the resulted output for RFC algorithm and predicted Kannada digit is 7.

5. Conclusion

Already existing solutions had put limelight regarding minor faults that arises in the process of recognizing handwritten Kannada digits. The proposed solution in this paper dealt with these faults to produce better results. The system narrated in the paper was made to recognize the handwritten Kannada digits flawlessly and also to produce highest possible accuracy that is 99.51% through CNN algorithm in comparison with other machine learning algorithms. Further enhancement of accuracy can be obtained by implementing supplementary machine learning concepts.

References

[1] Caiyun Ma, Hong Zhang, "Effective handwritten digit recognition based on multi-feature extraction and deep analysis", 2015 12th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD), 2015.

[2] Soufiane HAMIDA, Bouchaib Cherradi, Abdelhadi Raihani, Hassan Ouajji, "Performance Evaluation of Machine Learning Algorithms in Handwritten Digits Recognition", 2019 1st International Conference on Smart Systems and Data Science (ICSSD), 2019.

[3] S. M. Shamim, Mohammad Badrul Alam Miah, Angona Sarker, Masud Rana & Abdullah Al Jobair, "Handwritten Digit Recognition using Machine Learning Algorithms", vol. 18, no. 1, 2018.

[4] Atefeh Dehghanian, Vahid Ghods, "Farsi Handwriting Digit Recognition Based on Convolutional Neural Networks", 2018 6th International Symposium on Computational and Business Intelligence (ISCBI), 2018.

[5] Elvis S. Gati, Benjamin D. Nimo, Elisha K. Asiamah, "Kannada-Mnist Classification Using Skip CNN", 2019 16th International Computer Conference on Wavelet Active Media Technology and Information Processing.

[6] V. U. Prabhu, "Kannada-MNIST: A new handwritten digit's dataset for the Kannada language," Aug. 2019.