iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** III **Month of publication:** March 2019

DOI: http://doi.org/10.22214/ijraset.2019.3485

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue III, Mar 2019- Available at www.ijraset.com

Devanagari Character Recognition using Machine Learning

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Abstract: ***In recent years, deep learning has been widely used in supervised learning as well as unsupervised learning problems. Among all the deep learning models available, CNN has exceeded all others for pattern recognition problems. Although CNN achieves outstanding accuracy, still a huge number of iterations and chances of getting stuck in local optima (loops) makes it computationally expensive to train the model. So apart from CNN we have also used other algorithms like SVM to test the accuracy of our model. At the end, we have taken the Devanagari handwritten numeral dataset. This study concludes that the CNN technique is more efficient than other deep learning algorithms and also gives better accuracy.***
Index Terms: Handwritten Character, Convolution Neural Network, Support Vector Machines, Decision Trees, Back propagation, Multilayer perceptron.

I. INTRODUCTION

The purpose of this project is to take handwritten Devanagari characters as input, process the character and train the neural network algorithm. Secondly, to recognize the pattern and modify the character to an understandable version of the input. This project will be helpful in developing software which will be recognizing characters of Devanagari language. This project is allowed to Devanagari characters only. It can be further modified to recognize the characters of different languages. It covers the concept of neural network. One of the primary means by which computers are not compared with human abilities is through the use of a neural network.

Neural networks are fundamentally useful for solving problems that cannot be expressed as a series of steps, such as recognizing patterns, categorizing them into groups, series prediction and data mining and text mining. We know that pattern recognition is perhaps the most common use of neural networks.

The neural network is presented with a target vector and also a vector which contains the pattern information such as pixel values, this could be an image and hand written data. The neural network then tries to determine if the input data matches a pattern that the neural network has been trained on. A neural network trained for classification is designed to take input samples and classify them according to the required output. These groups may be vague, without clearly defined boundaries. This project concerns detecting free handwritten Devanagari characters.

II. BACKGROUND STUDY

A. Support Vector Machines

A Support Vector Machine (SVM) is a supervised machine learning classifier formally defined by using hyperplanes. In other words, if labeled training data (supervised learning) is provided, this algorithm gives an optimal hyperplane that will categorizes new data according to the trained data. In 2-D space this hyperplane is nothing but a line that divides a plane in two parts where each part contributes to each class.

Support Vector Machine (SVM) is a supervised discriminative classifier that can be used for both classification and regression challenges. Majorly, it is used in classification problems. In this algorithm, we plot each instance of data item as a point in N-dimensional space (where N is the no of features) with the value of each attribute being the value of a particular data point. Then, we perform classification by finding the optimal hyperplane that will be differentiating the two classes very well.

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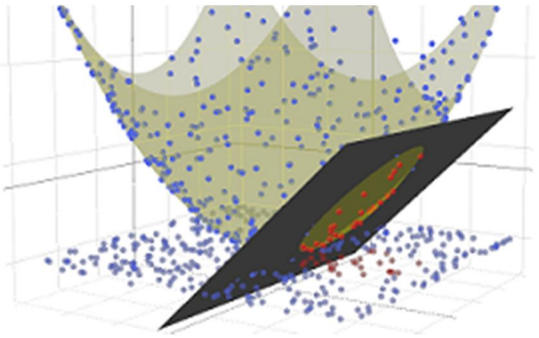

Fig 1: Support Vector Machine Architecture

B. Decision Trees

Decision trees are supervised machine learning algorithms used for both classification and regression problems. Decision tress often copies the human level thinking so it is so simple to understand the data and make some good interpretations. Decision trees actually make you see the logic for the data to interpret. A decision tree takes as input an object or situation described by a set of properties, create a tree like structure and outputs a yes/no decision according to the training dataset. Decision tree induction is known to be one of the simplest and yet the most desirables forms of machine learning. Each node tests the value of an input attribute and Leaf nodes provides the output to be returned if that leaf is reached.

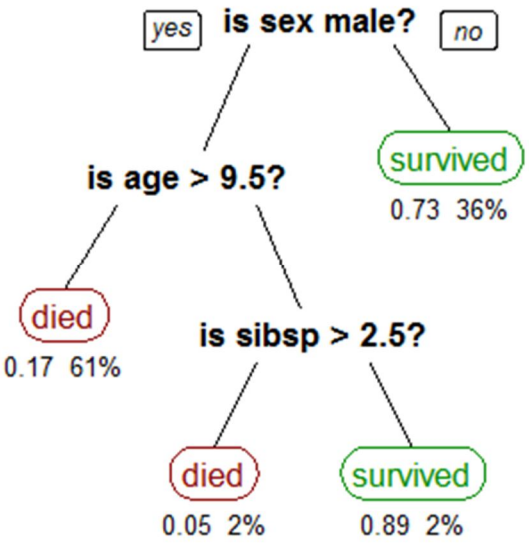

Fig 2: Decision Tree Architecture

C. Convolutional Neural Networks

Convolutional neural networks are deep artificial feed forward neural networks that are used primarily to classify images, cluster them by their similarity (photo search), and perform object recognition within scenes. These are algorithms that can be used to identify faces, individuals, tumors, street signs, diseases and many other aspects of visual data. Convolutional networks does optical character recognition to digitize text and make natural language processing (NLP) possible on analog and handwritten data (docs), where the images are symbols to be transcribed. This algorithm can also be applied to sound where it is represented visually as a spectrogram. More recently, CNNs have been applied directly to text analytics as well as graph data with graph ConvNets. The efficiency of convolutional nets in image recognition is one of the main reasons why the world has woken up to the efficacy of deep learning. They are enabling major developments in computer vision (CV) that has applications such as self-driving robotics, cars, security, drones, medical diagnoses, and treatments for the visually impaired.

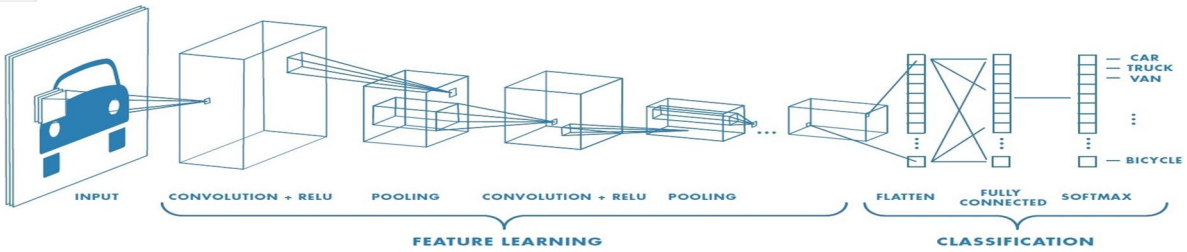

Fig 3: CNN Architecture

III. DATASET, METHODOLOGY AND EVALUATION

A. *Dataset*

The dataset used is being collected from Kaggle platform which is publicly available. But due to the limited Devanagari datasets the characters that we were able to get are 35 consonants and 10 digits. For each character of dataset there are 2000 images of 32 by 32 and thereby contributing 1024 pixels that will be used for classifying purpose.

B. *Methodology*

1) *Input:* Devanagari character dataset.
2) *Output:* Give the accuracy of the model with recognized character.
3) *Steps*
a) Convert range of pixel values between 0 and 1 by using the basic standard scalar normalization function.
b) If image is in RGB then conversion to Grayscale is performed.
c) Preparation of CNN Architecture for training of model.
d) Input pixel data is provided to the model and training and validation is performed.
e) Trained model is saved for further use in application.
f) Words consisting of Devanagari characters are taken into account and segmentation is performed.
g) Start a while loop processing each character.
h) Bounding box of each character is defined.
i) These bounded segmented Characters are passed to the model that was earlier saved.
j) Output is provided thereby recognizing characters.
k) Stop

C. *Evaluation*

There are a variety of measures for various algorithms and these measures have been developed to evaluate very different things. False Positive (FP), False Negative (FN), True Positive (TP), and True Negative (TN) and the relation between them are quantities which are usually adopted to compare the accuracy of different approaches. The aim of all algorithms and techniques is to minimize FP and FN rate and maximize TP and TN rate and with a good detection rate at the same time.

IV. RESULT

In this paper we got the accuracy of 97 percent by using the convolutional neural network.

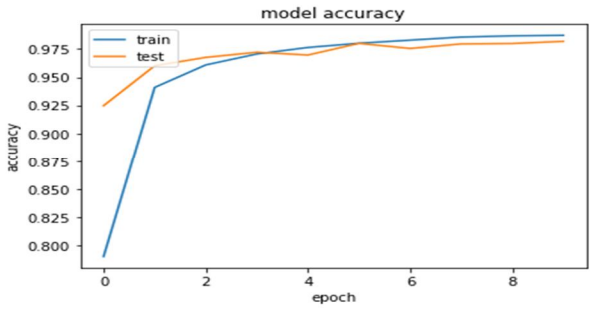

Fig 4: Accuracy Graph

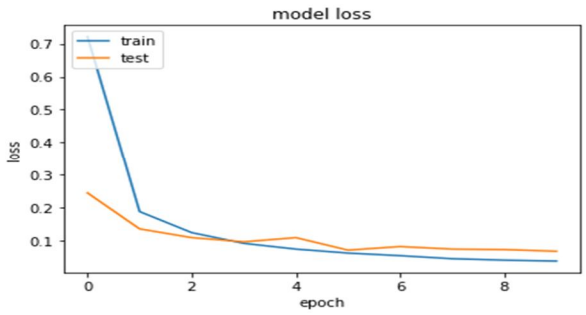

Fig 5: Loss Graph

V. CONCLUSION

Many regional languages throughout the world have their own unique and different writing styles which can be recognized with HCR systems using proper strategies and algorithms. We have built learning for recognition of Devanagari characters. It has been found that recognition of these handwritten character becomes difficult due to presence of odd characters or similarity in shapes for multiple characters that happens in case of Devanagari too. Scanned image is pre-processed to get a cleaned image and the characters are segmented into individual characters. Preprocessing work is done which includes normalization, filtration is performed using processing steps which produce noise free and clean output. Managing our evolution algorithm with proper training and evaluation of other step wise process will lead to successful output of system with better results. Use of some statistical features and geometric features through convolutional neural network will provide better recognition result of Devanagari characters. This work will be very beneficial to the researchers for the work towards other script as well.

VI. ACKNOWLEDGEMENT

We would like to express our deepest appreciation to all those who provided us the possibility to complete this project. We would like to thank our college Army Institute of Technology for supporting us and providing us with various resources. We give special gratitude to our HOD, Dr. Sangeeta Jadhav, whose contribution in stimulating suggestions and encouragement, helped us to coordinate our project.

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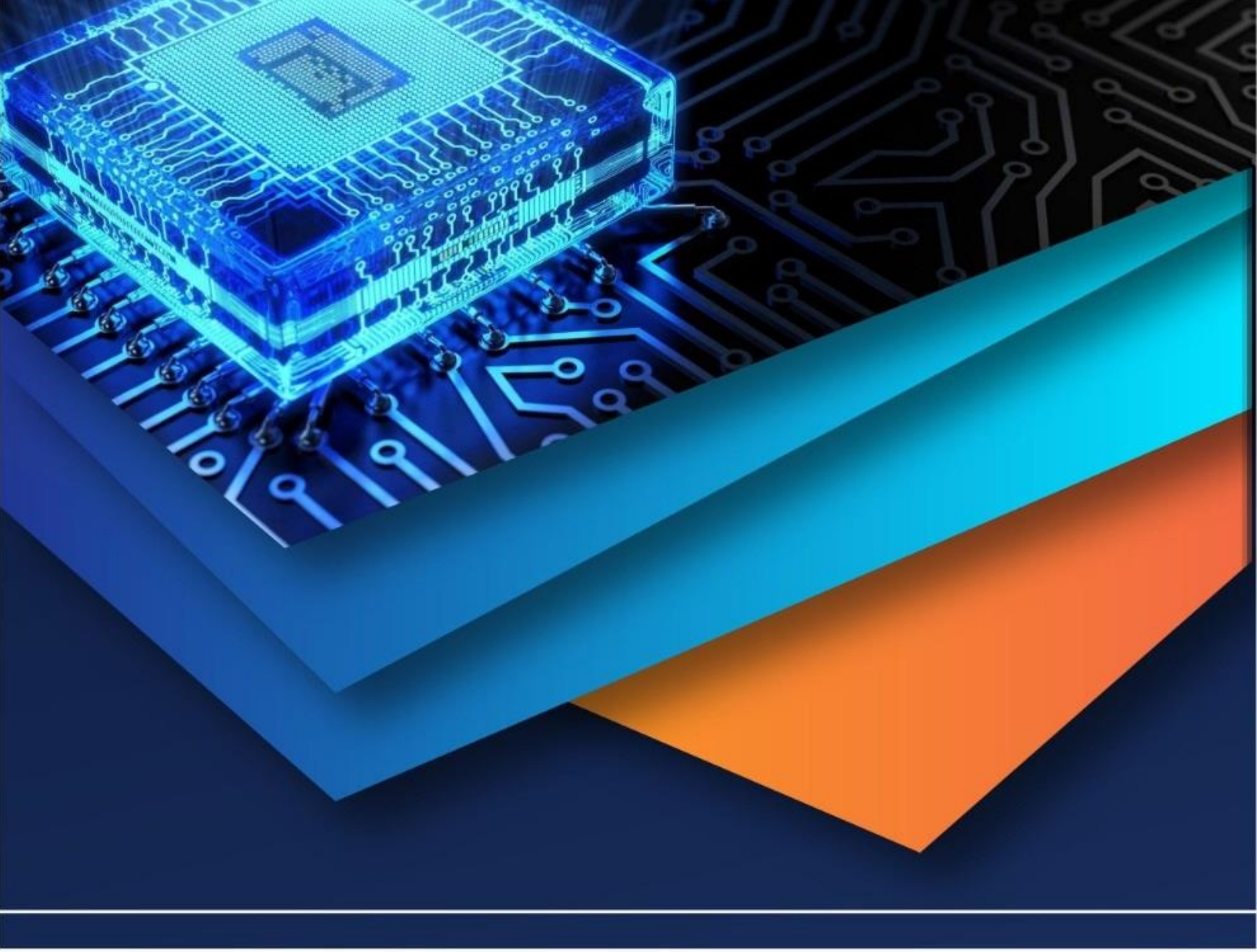

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