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Devanagari Handwritten Character Recognition Using Deep Learning

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***Abstract:** In this paper, we present the implementation of Devanagari handwritten character recognition using deep learning. Hand written character recognition gaining more importance due to its major contribution in automation system. Devanagari script is one of various languages script in India. It consists of 12 vowels and 36 consonants. Here we implemented the deep learning model to recognize the characters. The character recognition mainly five steps: pre-processing, segmentation, feature extraction, prediction, post-processing. The model will use convolutional neural network to train the model and image processing techniques to use the character recognition and predict the accuracy of rcognition.*
***Keywords:** convolutional neural network, character recognition, Devanagari script, deep learning.*

I. INTRODUCTION

Deep convolutional neural network have tested their ability to solve type problems the use of a hierarchical model, thousands and thousands of parameters, and learning with huge databases. Convolutional neural networks (CNN) are a special class of deep neural networks that consist of numerous convolutions, pooling, and fully linked layers; this has established to be a strong technique for picture or video processing, type, and sample reputation. In latest years CNN has attracted interest for reaching advanced results in numerous applications inside the laptop vision area, consisting of medicinal drug, aerospace, natural language processing and robotics. when we design the CNN architecture, we face so many challenges like high computational cost for information processing and finding optimal parameters for CNN architecture. To solve this problem many researchers are implemented the optimal CNN architecture to increase its performance.

II. DEVANAGARI SCRIPT

In India, Devanagari script is most popular script and used for the most spoken languages such as Sanskrit, Marathi ,and Hindi. The Devanagari script contains 12 vowels and 36 consonants.

क	ख	ग	घ	ङ	च	छ	ज	झ	ञ	ट	ठ	ड	ढ	ण
त	थ	द	ध	न	प	फ	ब	भ	म	य	र	ल	व	श
ष	स	ह	ळ	क्ष	ज्ञ									

Table 1: Basic consonants in Devanagari

अ	आ	इ	ई	उ	ऊ	ए	ऐ	ओ	औ	अं	अः	ॲ	ऑ	ऋ

Table 2: Basic vowels in Devanagari.

III. CONVOLUTIONAL NEURAL NETWORK

Convolutional neural networks are deep artificial neural networks that are used primarily to classify images (e.g., name what they see), cluster them by similarity (photo search), and perform object recognition within scenes. They are algorithms that can identify faces, individuals, street signs, tumors, platypuses and many other aspects of visual data. The efficiency of convolutional nets (ConvNets or CNNs) in image recognition is one of the main reasons why the world has woken up to the efficacy of deep learning. They are powering major advances in computer vision (CV), which has obvious applications for self-driving cars, robotics, drones, security, medical diagnoses, and treatments for the visually impaired.
The convolutional neural network have convolutional layer, pooling layer, flatten layer, dense layer, dropout layer. The convolutional operations are done in convolutional layer. The dropout layer is used to avoid the overfitting problems.

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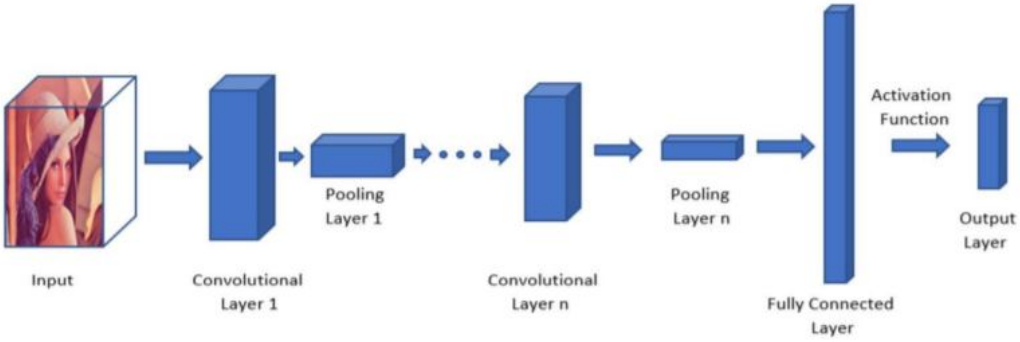


Fig 1: General CNN architecture

IV. CHARACTER RECOGNITION

The character recognition is two types one is optical character recognition and handwritten character recognition**.** Hand written recognition divided into six steps such as image acquisition, pre-processing, segmentation, Feature extracting.

A. Image Acquisition

In this step digital image taken as input. the electronic tablet or digitizer is used for the input. input images of the hand written characters also be taken by the methods such as scanner, or directly write in the computer by using stylus.

B. Pre-processing

The main objective is to normalize stokes and remove variations otherwise it complicate the recognition and reduce the recognition rate. These variation includes irregualation size of text, left or right bend in handwriting etc.

C. Segmentation

It used to separate the individual characters of image.at first level we used row histogram. From each row words are extracted from using column histogram. Finally characters are extracted from words.

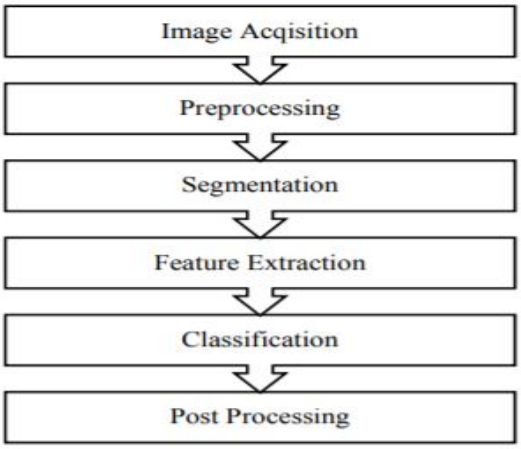


Fig 2: Character Recognition

D. Feature Extraction

The main aim of feature extraction phase is to extract that pattern which is most pertinent for classification. Feature extraction techniques like Principle Component Analysis (PCA), Linear Discriminant Analysis (LDA), Chain Code (CC), Scale Invariant Feature Extraction (SIFT), zoning, Gradient based features, Histogram might be applied to extract the features of individual characters. These features are used to train the system.

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E. Classification

When input image is presented to HCR system, its features are extracted and given as an input to the trained classifier like artificial neural network or support vector machine. Classifiers compare the input feature with stored pattern and find out the best matching class for input.

F. Post Processing

Post-processing refers to the procedure of correcting misclassified results by applying linguistic knowledge. Postprocessing is processing of the output from shape recognition. Language information can increase the accuracy obtained by pure shape recognition. For handwriting input, some shape recognizers yield a single string of characters, while others yield a number of alternatives for each character, often with a measure of confidence for each altern.

V. RESULTS

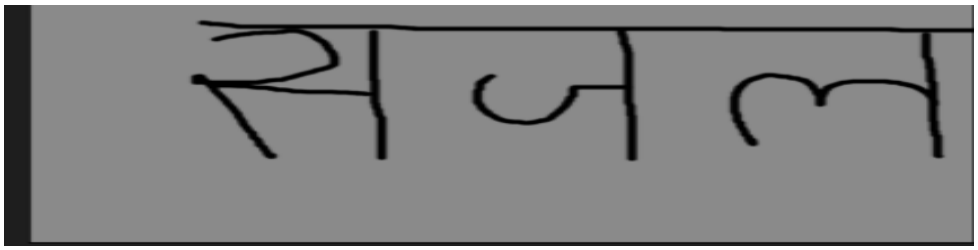


Fig 3: Input image

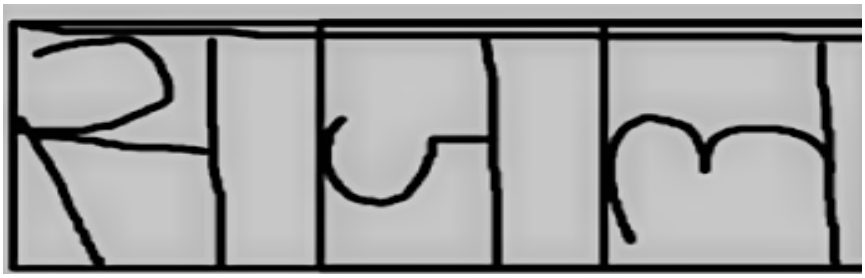


Fig 4: Segmented image.

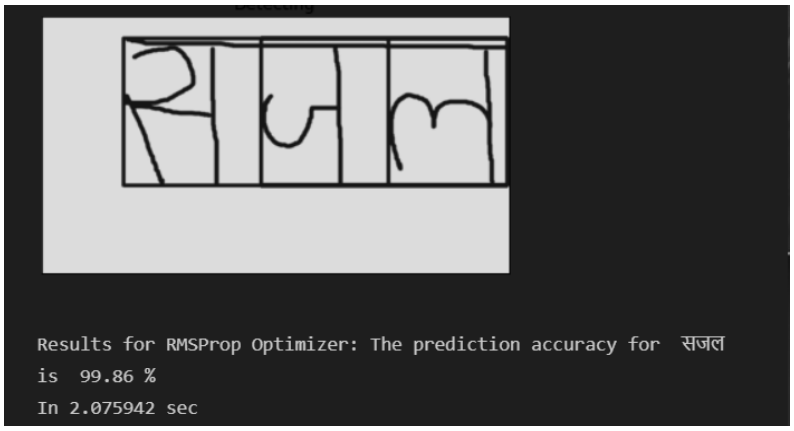


Fig 5: predicted image with accuracy.

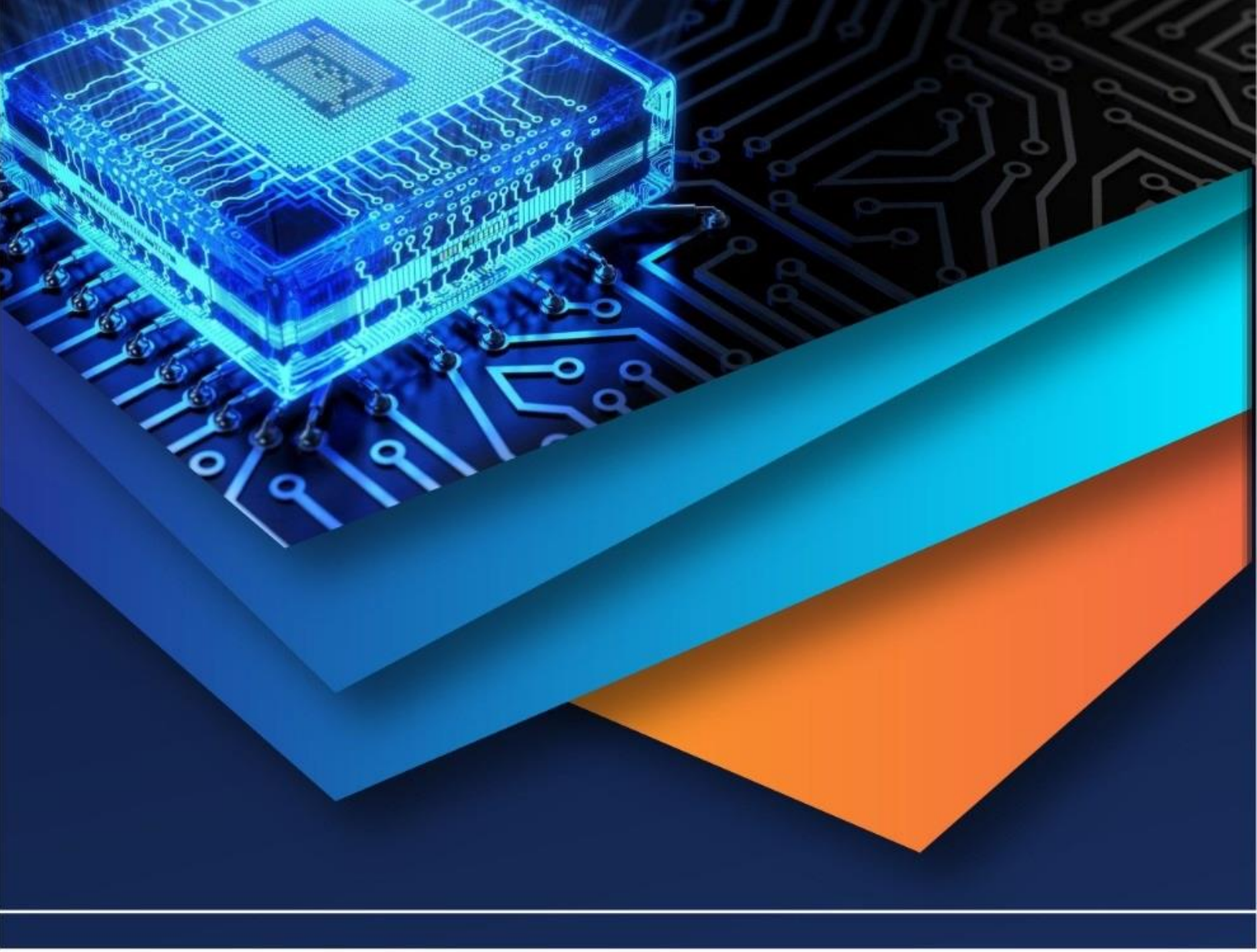
VI. CONCLUSION

In this paper we implemented the system for character recognition. In this system segmentation is done character wise instead of breaking a word into several modifiers. The convolutional network is used to extract the features of character recognition. This system predict the accuracy of the characters.

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