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# Handwritten character recognition using tensor flow

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**Abstract**
In this paper we present an inventive strategy for disconnected manually written character discovery utilizing profound neural systems. In this day and age, it has gotten simpler to prepare profound neural systems in light of accessibility of enormous measure of information and different Algorithmic developments which are occurring. Presently a-days the measure of computational force expected to prepare a neural system has expanded because of the accessibility of GPU's and other cloud-based administrations like Google Cloud stage and Amazon Web Services which give assets to prepare a Neural system on the cloud. We have planned a picture division based Handwritten character acknowledgment framework. In our framework we have utilized OpenCV for performing Image handling and have utilized Tensor flow for preparing a neural Network. We have built up this framework utilizing python programming language.

**Keywords:** Tensor flow, convolutional neural network, neural network, open CV

## 1. Introduction
As we all know, in today's world AI (Artificial Intelligence) is the new Electricity. Advancements are taking place in the field of artificial intelligence and deep-learning every day. There are many are many fields in which deep-learning is being used [1, 4]. Handwriting Recognition is one of the active areas of research where deep neural networks are being utilized. Recognizing handwriting is an easy task for humans but a daunting task for computers. Handwriting recognition systems are of two types: Online and Offline. In online handwriting recognition system the handwriting of the user is recognized as the user is writing. The information like the order in which the user has made the strokes is also available. But in offline handwriting recognition system, the handwriting of user is available as an image. Handwriting recognition is a challenging task because of many reasons. The primary reason is that different people have different styles of writing. The secondary reason is there are lot of characters like Capital letters, Small letters, Digits and Special symbols [3]. Thus a large dataset is required to train a near-accurate neural network model. To develop a good system accuracy of at least 98% is required. However even the most modern and commercially available systems have not been able to achieve such a high accuracy. Our system comprises of two parts: 1) An Android application: This is the frontend of our system. The android application helps the user to click a picture of text which is to be recognized, using their smartphone camera [4]. This picture is passed on to a python script running on a server which further processes this image to extract the relevant information 2) A server: This is the backend of our system. This server is a computer which is capable of executing a python script. It is needed because an android smart phone does not have the computation power required for running neural networks and performing image processing operations. Also the use of server for performing computationally intensive tasks enables users of older smart phones to make use of our system. We used the Convolutional Neural Network Model in our system. We used the publicly available NIST Dataset which contains samples of handwritten characters from thousands of writers. The neural network model which we have used is Convolutional Neural Network [1, 4]. CNN's are State-of-Art neural networks which have huge applications is field of Computer Vision. The neural network model was trained using Tensor flow which is an open source library used for Machine learning applications. Open CV was used to perform various image processing operations like segmentation, thresholding and Morphological Operations. Open CV is an open source library which is used for Image processing [3, 6].

## 2. Related Works

### 2.1 A snapshot of image Pre-Processing for convolutional neural networks: Case study of MNIST [1].

Deep learning techniques, and particularly convolutional neural systems (CNNs), have shown superb precision in many model characterization issues. Most progressive models apply information enlargement techniques during the preparation stage. This paper gives a concise instructional exercise on information pre-preparing and its favourable circumstances by utilizing the serious MNIST manually written digit characterization issue. We appear and dissect the effect of various pre-handling techniques on the exhibition of the three CNNs, along with their groups, Lenet, Network 3 and Drop Connect. Dissected advances incorporate centralization, flexible twisting, interpretation, pivot, and various mixes of them. Our examination exhibits information pre-preparing techniques, for example, mixes of versatile distortion and revolution consolidated to additionally improve the accuracy of MNIST grouping.

### 2.2 Devnagari Document Segmentation Using Histogram Approach [2].

Record division is one of the basic strides in machine acknowledgment of any language. Legitimate detachment of individual images decides the precision of character acknowledgment innovation. It is utilized to disintegrate the picture of a progression of letters into sub-pictures of individual images by partitioning lines and words. Devnagari is the most well-known content in India. It is utilized to compose Hindi, Marathi, and Sanskrit and Nepali dialects. In addition, Hindi is the third most famous language on the planet. Devnagari reports contain vowels, consonants, and different modifiers. Hence the best possible division of the word Devnagari is testing. A general histogram-based way to deal with portion Devnagari papers is proposed in this paper. Different difficulties have likewise been examined in the Devnagari content.

## 3. Proposed system

The proposed system research is going on in the field of handwritten character recognition. Many people have developed systems for handwritten character recognition. To studied some of the systems: A character recognition system has been designed using fuzzy logic. Their character recognition system is immune to distortion and variations in shift. They have made use of Hamming neural network in their system. The projects developed by them can be used for recognition the handwritten characters are not properly segmented. One of the Authors has presented a unique method for authenticating a person based on their handwriting. The author has used the Multi-layer feed forward neural network in their system. Novel method for handwritten character recognition has been designed which does not use feature extraction. This system uses Self Organizing Map for feature extraction. They have used a recurrent neural network for learning using to recognize the handwriting.

### 3.1 Algorithms

#### 3.1.1 Convolutional Neural Network

The convolutional neural system (CONNET/CNN) is a deep learning calculation that takes in the information picture, allots significance (learnable loads and inclinations) to various components/objects in the picture, and recognizes it from each other. The pre-handling in ConvNet is negligible contrasted with other arrangement calculations. Despite the fact that channels are hand-built in crude manners, with satisfactory preparing, ConNets is fit for learning these channels/highlights.

The structure of the raised system is like the neuronal availability design in the human cerebrum and is motivated by the association of the visual cortex. Singular neurons react to upgrades just in a limited locale of the visual field called the open field. The assortment of such fields covers to cover the whole visual territory.

### 3.2 Neural Network

Neural networks are a lot of calculations that are free after the human cerebrum, intended to identify designs. They decipher tactile information through a sort of machine mindfulness, naming or bunching crude information. The models they distinguish are numerical, vectors in which all true information, regardless of whether it be pictures, sound, text or time arrangement, must be interpreted. Neural systems have three layers: Input Layer, Hidden Layers, and Output Layer.

**3.2.1 Input Layer:** Input variables, sometimes called the visible layer.

**3.2.2 Hidden Layers:** Layers of nodes between the input and output layers. There may be one or more of these layers.

**3.2.3 Output Layer:** A layer of nodes that produce the output variables.

## 4. Results and Discussions

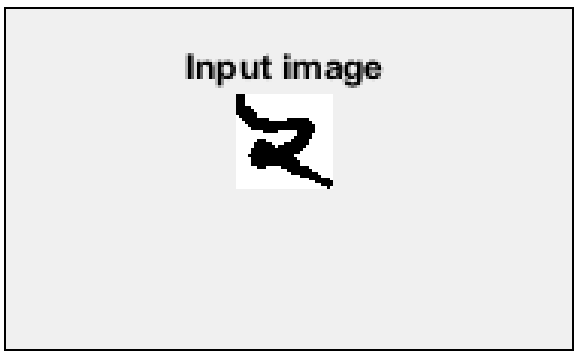


**Fig 5:** Input Image

In the above mentioned Fig 1 we are giving input as this image for training and testing purpose. And applying the Convolution neural network (CNN) we are testing the inage.

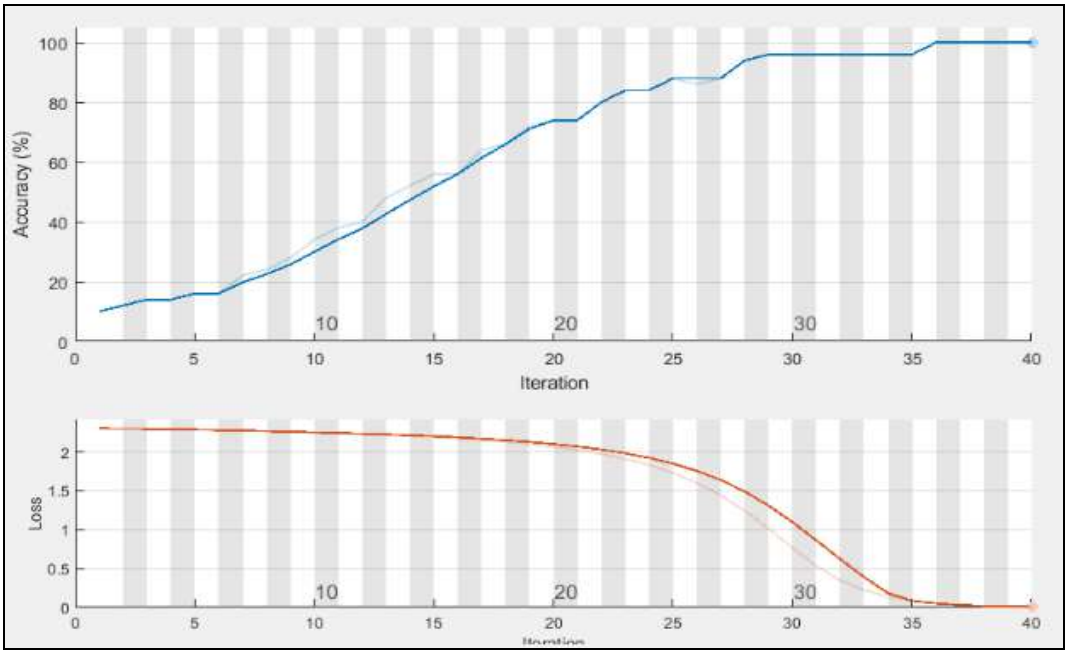


**Fig 6:** Training Process

In the above Fig 2 displaying graph describes the training process of the input image to the model.

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**Fig 7:** Output Text

Here in Fig 3 we are showing the outcome of the input image through the applied algorithm CNN.

## 5. Conclusion

There are many developments possible in this system in the future. As of now the system can't recognize cursive handwritten text. But in future we can add support for recognition of cursive text. Currently our system can only recognize text in English languages. We can add support for more languages in the future. Presently the system can only recognize letters and digits.

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