Recognizing Devanagari Numeral Using Deep Neural Networks.

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Abstract— Handwritten Devanagari numeral using neural network is presented in this paper. Handwritten character recognition is one of the most fascinating and challenging research areas in the field of image processing. It is the ability of the computer to receive and interpret handwritten input from various sources and convert it into editable text format. Feature extraction plays an important role in handwritten character recognition because of its effect on the capability of classifiers. Recognition and classification of numerals are then done by the use of Neural Networks. The recognition rate of the proposed system has been found to be quite high. In this project, we consider the problem of recognizing handwritten numerals using Machine Learning techniques. The first step is building the database using various image processing techniques etc. We found a dataset of 20,000 Devanagari numerals which is used to train and test our classifiers. Following neural network algorithms were used - back-propagation algorithm, perceptron algorithm. For each of the classier, after training the networks, their accuracy of classification was calculated and compared on the test set.

Index Terms— Handwritten character recognition, Devanagari numeral, Neural networks, CNN (Convolutional neural network), TensorFlow, Deep learning, backpropagation algorithm.

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1 INTRODUCTION

Hindi and English are the official language of our country and majority of people knows hindi so hindi recognition is very important task. So, we consider the problem of recognizing handwritten numerals using Machine Learning and deep learning techniques. In general, handwriting recognition can be categorized into two types: on -line and off-line handwriting recognition methods. But, we only focus on off-line recognition; handwriting is usually captured by optically scanning the input from a surface such as sheet of paper and is stored digitally. Handwriting recognition is easier in case of on-line recognition methods as compared to off-line recognition

Methods due to the temporal information available with the former.

Handwriting is the way by which people communicate with each other from the long time. Basically we use deep learning techniques, which use neural network to simulate human like behavior. By using deep learning we can train our own dataset and test accordingly. Deep learning is a subset of machine learning and it works like human brain. Pattern recognition is formally defined as the process whereby received patterns are assigned to one of a prescribed number of classes (categories). The goal of pattern-recognition is to build machines, called classifiers that will automatically assign measurements to classes.

1.1 Applications:
Handwritten numerals recognition have numerous
Applications including those in postal addresses recognition, bank cheque processing, document verification, job application form sorting, automatic sorting of tests containing multiple choice questions and data entries.

1.2 Overview:
Understanding neural network implementation and adapting tensor flow of the same, so that it can easily understand Devanagari numerals.
The aim of our project is to develop a System which will easily recognize Devanagari numerals, by using neural networks. For developing a system we will use convolutional neural networks. The only input to the system is image of devanagari numerals which will recognize and gives us the output.

2. GENERAL SYSTEM DESCRIPTION

Basically we use deep learning techniques, which use neural network to simulate human like behavior. By using deep learning we can train our own dataset and test accordingly. Deep learning is a subset of machine learning and it works like human brain. For this we require a neural network which has weight and activation function to recognize devanagari numerals.

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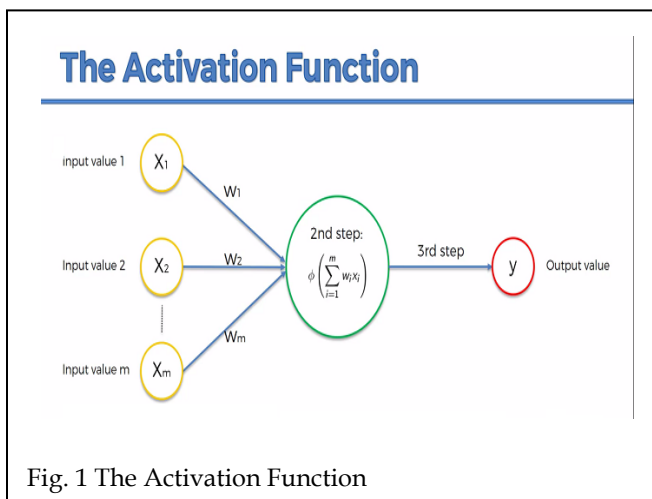
Fig. 1 The Activation Function

We will use convolutional neural network which is a little bit different than artificial neural network. In CNN the neuron is connected to a small region of networks
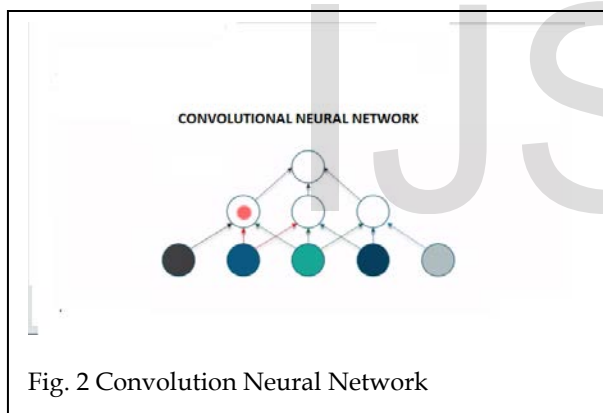

Fig. 2 Convolution Neural Network

3 DATA COLLECTION AND METHODOLOGY

Data collection is one of the most important factors of our project. In this project we require a large number of dataset. In our project we have a dataset of 20000 images of Devanagari numerals from 0-9.In which 17000 images are for training and 3000 images are for testing and statistic is given below, which is very small as compared to mist dataset.

TABLE 1

Digit	No of samples
0	2000
1	2000
2	2000
3	2000
4	2000
5	2000
6	2000
7	2000
8	2000
9	2000

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4 TOOLS AND TECHNOLOGY USED

Some of the technology used for recognizing Devanagari numeral and they are:
(1) TENSORFLOW: It is basically a library which is used to implement deep learning model.
TensorFlow consist of tensors which is a multidimensional array, an extension of 2-dimensional table to data with higher dimensions
Tensors of [6, 4]

1	68	4	4
25	9	6	6
6	4	5	9
8	5	97	7
0	5	53	56
6	9	4	3

TensorFlow core program consist of 2 discrete section

1: Building a computational graph
 2: Running a computational graph
Computational graph: It is a network of node and each node is operation.

(2)Python Jupiter notebook: In this we will write a python programming which is required for tensor flow.

CNN: In CNN, the neuron in a layer will only connected to small region of layer instead of all neuron

CNN has following layer:

Convolutional layer

Relu layer

Pooling layer

Fully connected layer

5 FLOW OF WORKING

The first step is to create or find a dataset of Devanagari numerals and then train our dataset using a large number of samples, and finally check the output. This all work is done by using CNN and it has following advantage:

1. It Saves time

2. Improves efficiency

It has four layers and all this layers have different functions.

1: Convolutional layer: In this layer we move our feature to every possible position.

It has 3 steps:

A: Line up the feature and image

B: multiply each image pixel by corresponding feature pixel.

C: Find the average of all value

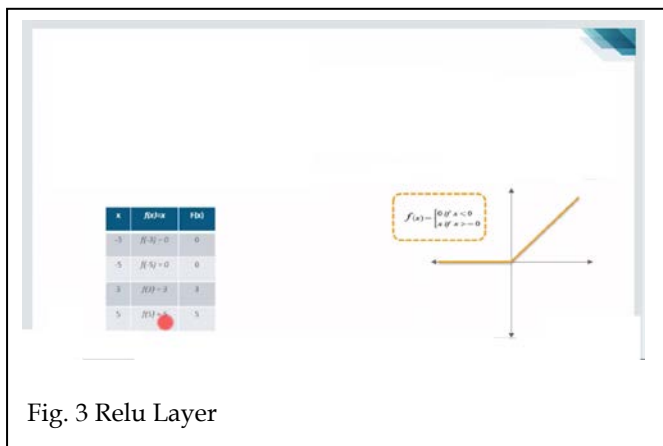**2: Relu layer:** In this layer we remove every negative value from filtered image and replace it with 0.

Fig. 3 Relu Layer

It activates node only when the value is above certain quantity while the input is below zero than output will be zero.

3: Pooling Layer:

In this layer we shrink the image into smaller size

Steps:

A: Pick a window size (2 or 3)

B: pick a stride

C: Walk your window across a filtered image.

D: from each window take maximum value.

4: Fully connected layer:

This is the final layer where actual classification happens. Here we take our filtered or shrink image in to single list.
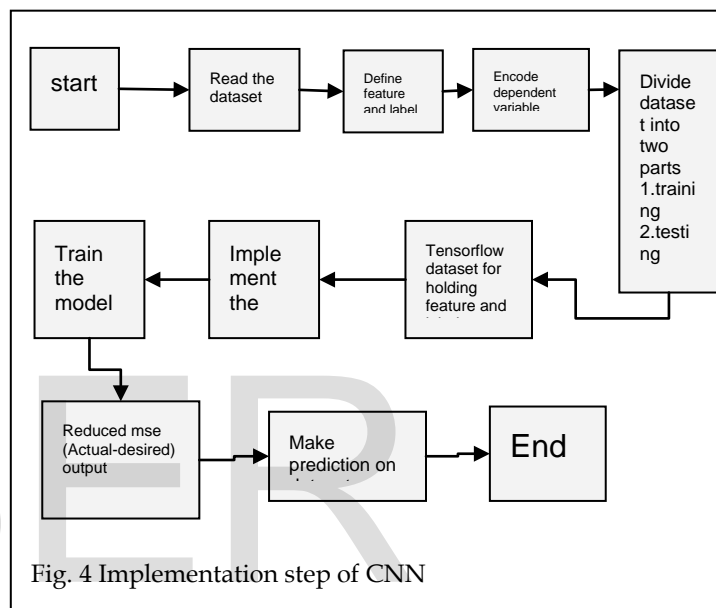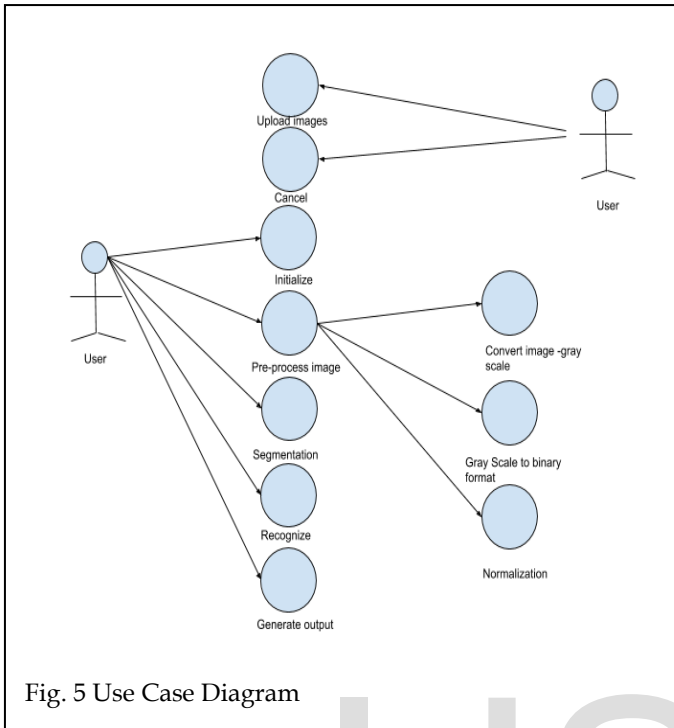
6 IMPLEMENTING THE USE CASE

Implementation steps:

Fig. 4 Implementation step of CNN

6.1   Use Case diagram

Fig. 5 Use Case Diagram

6.2: Data Flow diagram

Fig. 6 Data Flow Diagram

7 7. CONCLUSION

By using neural network we can train our dataset and it is easy as compared to algorithmic approach. By using NN it can learn by its own, by looking the example.

Limitation of System:
Source materials that often cause issue are:
1. Forms
2. Small text
3. Blurry copies
4. Mathematical formula

Future Scope of Project:
1. language converter
2. speech recognition
3. speech to text converter

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