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Creation of Convolutional Neural Network using Max Pooling, Flattening & Full Connection

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ABSTRACT: Detection of if tree is present or not present in the grayscale image. Deep Learning algorithms are designed in such a way that they mimic the function of the human cerebral cortex. These algorithms are representations of deep neural networks i.e., neural networks with many hidden layers. Convolutional neural networks are deep learning algorithms that can train large datasets with millions of parameters, in form of 2D images as input and convolve it with filters to produce the desired outputs. The authors have built an AI/ML model which identifies in a picture, if there exists a tree or not. They have used Python Flask, HTML, CSS and JS. The ad hoc dataset taken includes 1000 images for training and 400 unseen images for testing. The CNN Model offered a high accuracy of 94.25. To make it user friendly they have built a website whose interface gives an option of clicking as well as uploading picture from device media. After uploading the image, the model runs and we get an output in the form of Tree or No Tree. The website was connected to the Model using Flask.

KEYWORDS: CNN,ReLU,Max Pooling, Flattening.

INTRODUCTION

Object detection in an image is salient in computer vision systems. It holds many applications like video surveillance, medical imaging, and robot navigation. Many algorithms can be used for this task like background subtraction, temporal differencing, optical flow, Kalman filtering, support vector machine, and contour matching. Besides the above written algorithms, the latest medium handy in object detection is called convolutional neural networks (CNN). Breakthroughs in image classification started when Alex won the 2012 ImageNet competition using deep convolutional neural networks. They worked upon and trained a deep CNN to categorize 1.2 million high resolution images in the ImageNet contest that has 1000 categories. They backed more accurate prediction than the previous state of the art models. Learning from this huge success, a lot many researchers became interested in finding an unconventional way to develop an deep convolutional neural approaches for network. There are some recent efficient object detection, in paper, the authors developed a denigrated transfer detector using a flexible deep architecture and a regularized transfer learning framework to address object detection using few training data. The idea behind the trained model stays to classify if in a grayscale image if there exists a tree. We use convolutional neural networks for visual target tracking of if there exist tree in an image or not. The authors have created an ad-hoc dataset with positive and negative examples of images with trees and no trees. The CNN classification is a part of deep learning neural network. This is a class of algorithms that searches for the most informative samples to include in a training dataset that is effective in image classification. Lastly, in used artificial neural networks to detect objects by shape and color pattern recognition. This paper is organized as follows; Section II is a brief introduction about convolutional neural networks. Section III is Data Preparation. Section IV. Section V. Section VI is the results conclusion.

Section II
Convolutional Neural Network

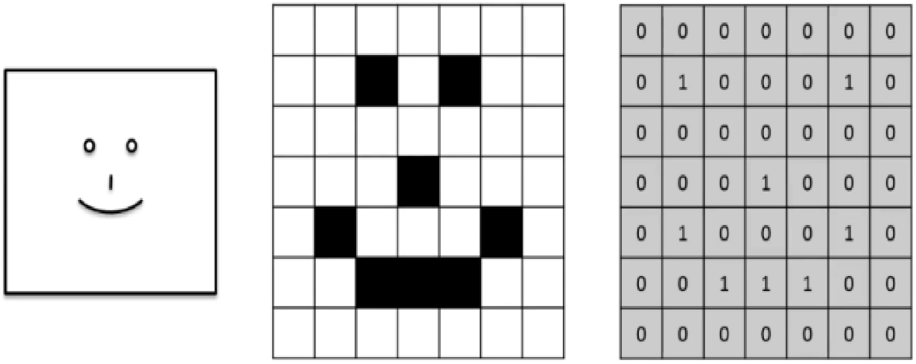
A tremendous interest in deep learning has emerged in recent years. The most established algorithm among various deep learning models is convolutional neural network (CNN), a class ofartificial neural networks that has been a dominant method in computer vision tasks since the astonishing results were shared on the object recognition competition known as the ImageNet Large Scale Visual Recognition Competition (ILSVRC) in 2012. Medical research is no exception, as CNN has achieved expert-level performances in various fields. Needless to say, there has been a surge of interest in the potential of CNN among radiology researchers, and several studies have already been published in areas such as lesion detection, classification, segmentation, image reconstruction, and natural language processing. Convolutional Neural Networks are deep learning algorithms that take input images and convolves it with filters or kernels to extract features. A NxN image is convolved with a fxf filter and this convolution operation learns with the same feature on the entire image. Convolution Neural Networks are good for pattern recognition and feature detection which is especially useful in image classification. Improve the performance of Convolution Neural Networks through hyper-parameter tuning, adding more convolution layers, adding more fully connected layers, or providing more correctly labeled data to the algorithm. Create a Convolution Neural Network (CNN) with the following steps:

1. Convolution
2. Max Pooling
3. Flattening
4. Full Connection

1 A convolution is an integral that expresses the amount of overlap of one function as it is shifted over another function. It therefore "blends" one function with

$$(f * g)(t) \overset{\text{def}}{=} \int_{-\infty}^{\infty} f(\tau)\, g(t-\tau)\, d\tau$$

another. For image recognition, we convolve the input image with Feature Detectors (also known as Kernel or Filter) to generate a Feature Map (also known as Convolved Map or Activation Map). This divulges and conserves patterns in the image, and also compresses the image for easier processing. Feature Maps are generated by element-wise multiplication and addition of corresponding images with Filters consisting of multiple Feature Detectors. This allows the creation of multiple Feature Maps.



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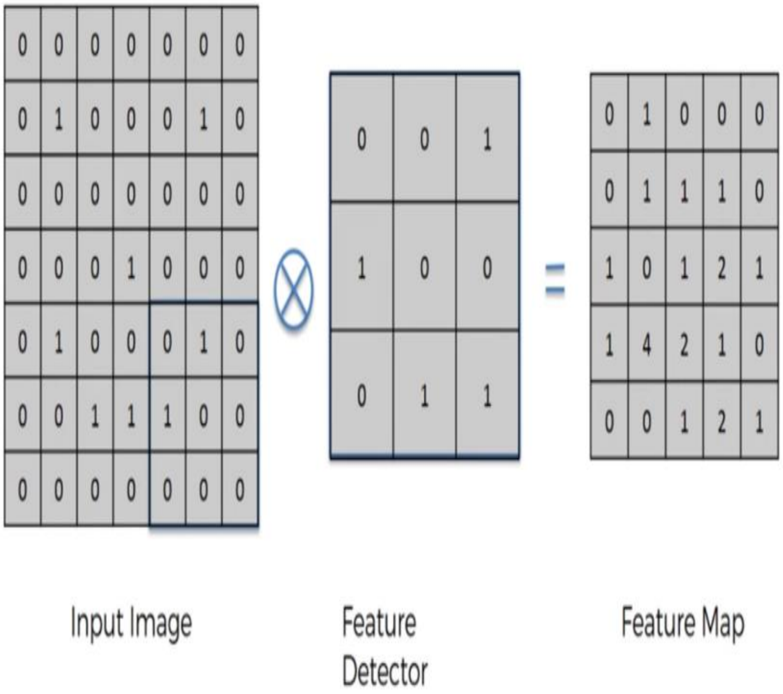

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0	0	1
1	0	0
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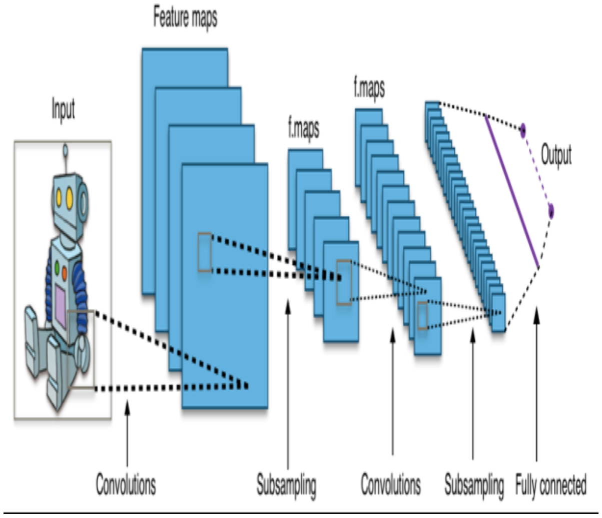
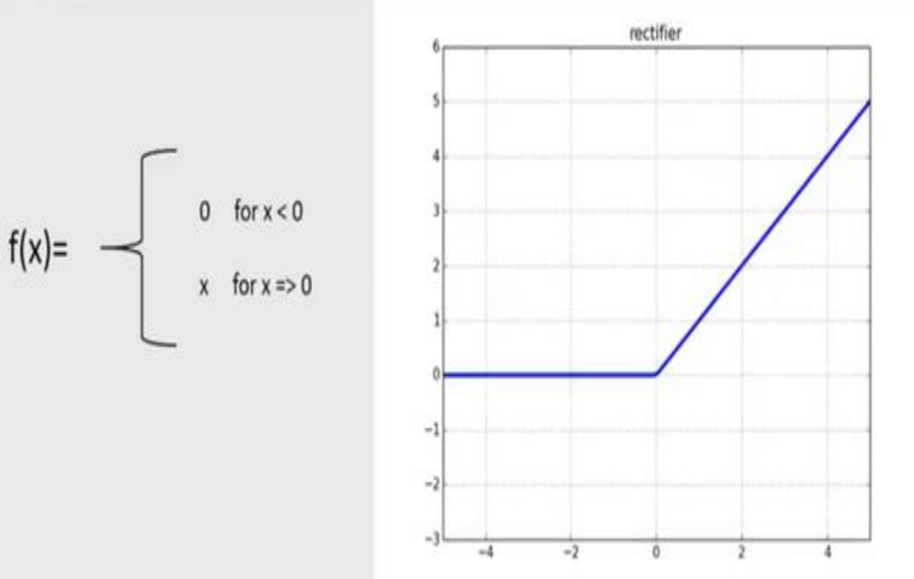
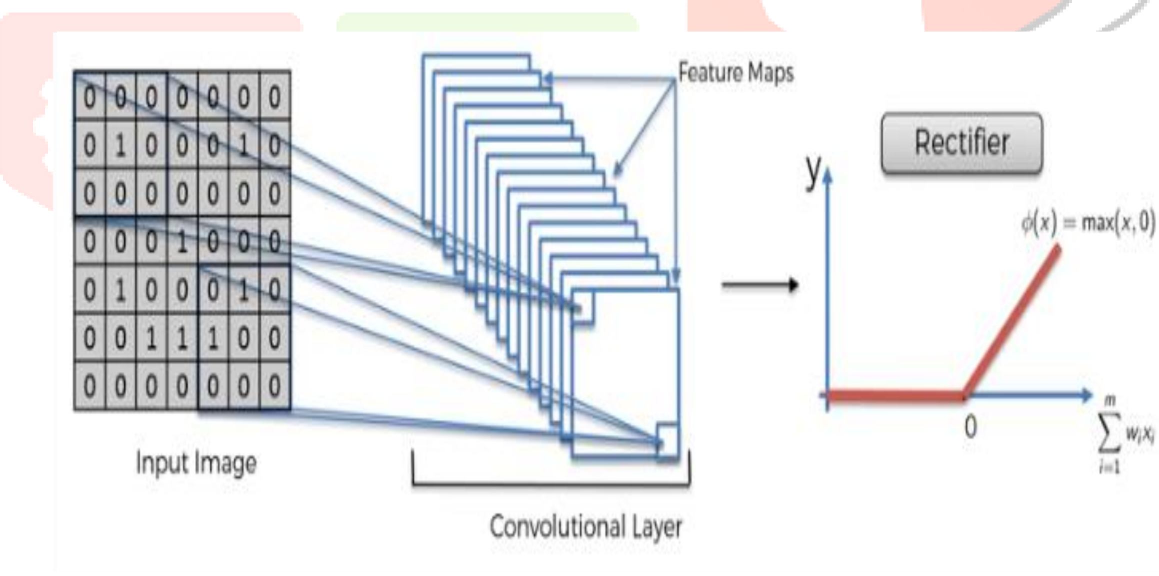


Rectified Linear Unit (ReLU) Function

One of the most popular AFs in DL models, the rectified linear unit (ReLU) function, is a fast-learning AF that promises to deliver state-of-the-art performance with stellar results. Compared to other AFs like the sigmoid and tanh functions, the ReLU function offers much better performance and generalization in deep learning. The function is a nearly linear function that retains the properties of linear models, which makes them easy to optimize with gradient-descent methods. The ReLU function performs a threshold operation on each input element where all values less than zero are set to zero. Thus, the ReLU is represented as:





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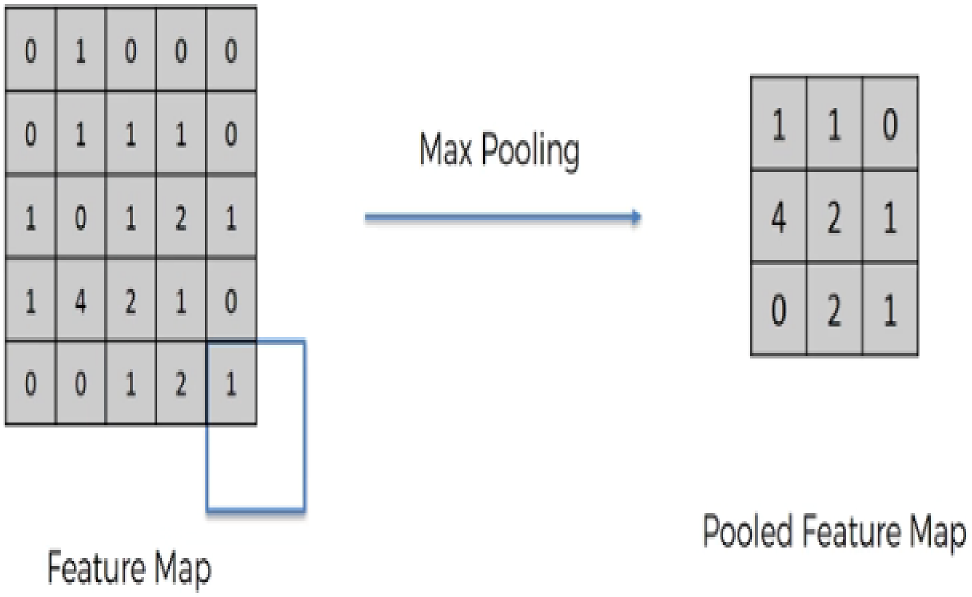
0	0	1	1	1	0	0
0	0	0	0	0	0	0

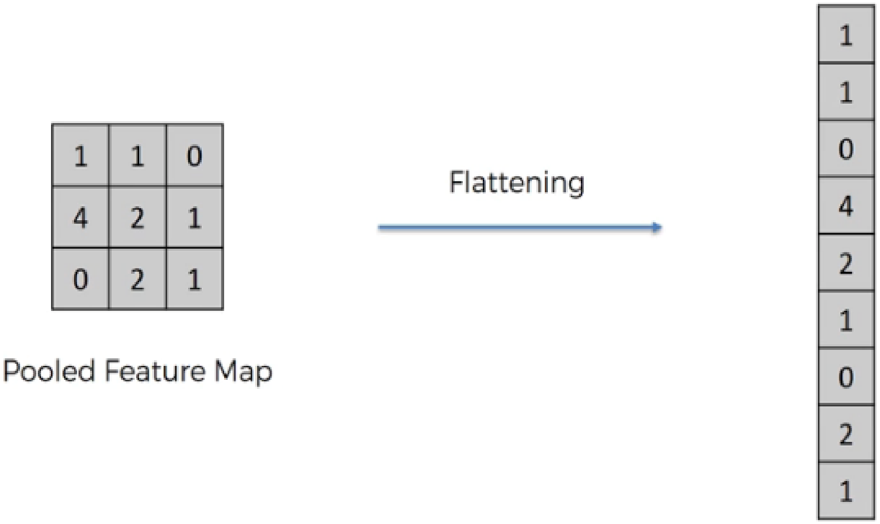
2. MAX POOLING

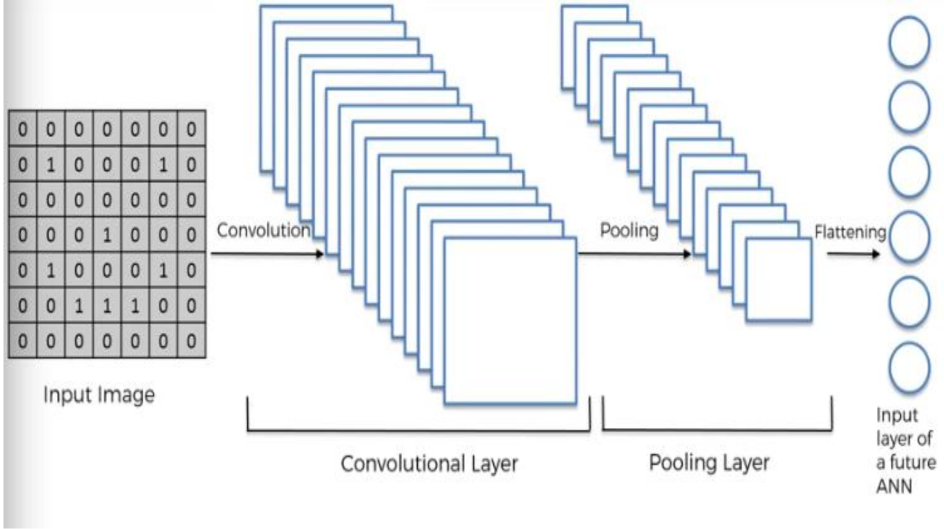
Max pooling is a pooling operation that selects the maximum element from the region of the feature map covered by the filter. Thus, the output after max-pooling layer would be a feature map containing the most prominent features of the previous feature map. It adds a small amount of translation invariance - meaning translating the image by a small amount does not significantly affect the values of most pooled outputs.



2. FlATTENING

The flattening step is a refreshingly simple step involved in building a convolutional neural network. Flattening puts values of the pooled Feature Map matrix into a 1-D vector. This makes it easy for the image data to pass through an Artificial Neural Network algorithm.





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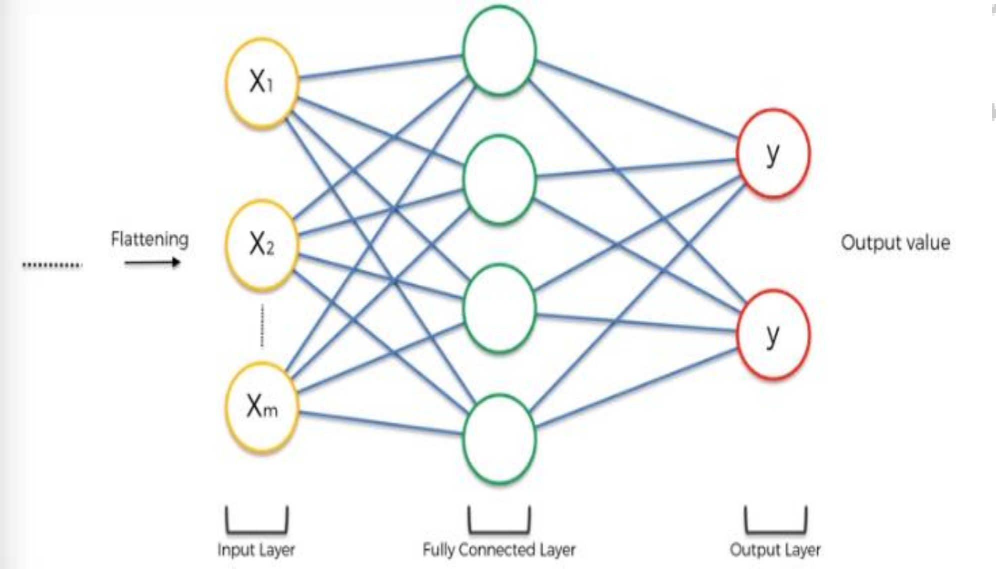
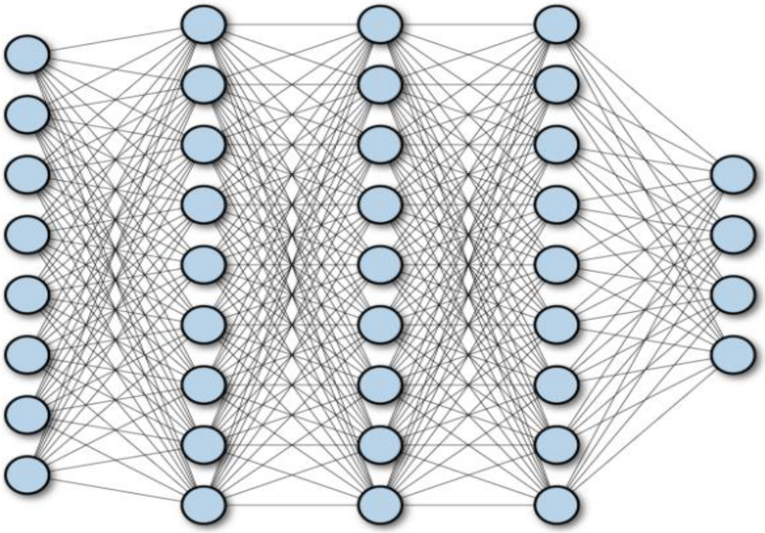
0	0	0	1	0	0	0
0	1	0	0	0	1	0
0	0	1	1	1	0	0
0	0	0	0	0	0	0

4. FULL CONNECTION

A fully connected neural network consists of a series of fully connected layers that connect every neuron in one layer to every neuron in the other layer.The reason this is called the full connection step is because the hidden layer of the artificial neural networks is replaces by a specific type of hidden layer called a fully connected layer. It's important to note that CNNs require fully-connected hidden layers whereas regular ANNs don't necessarily need full connections.

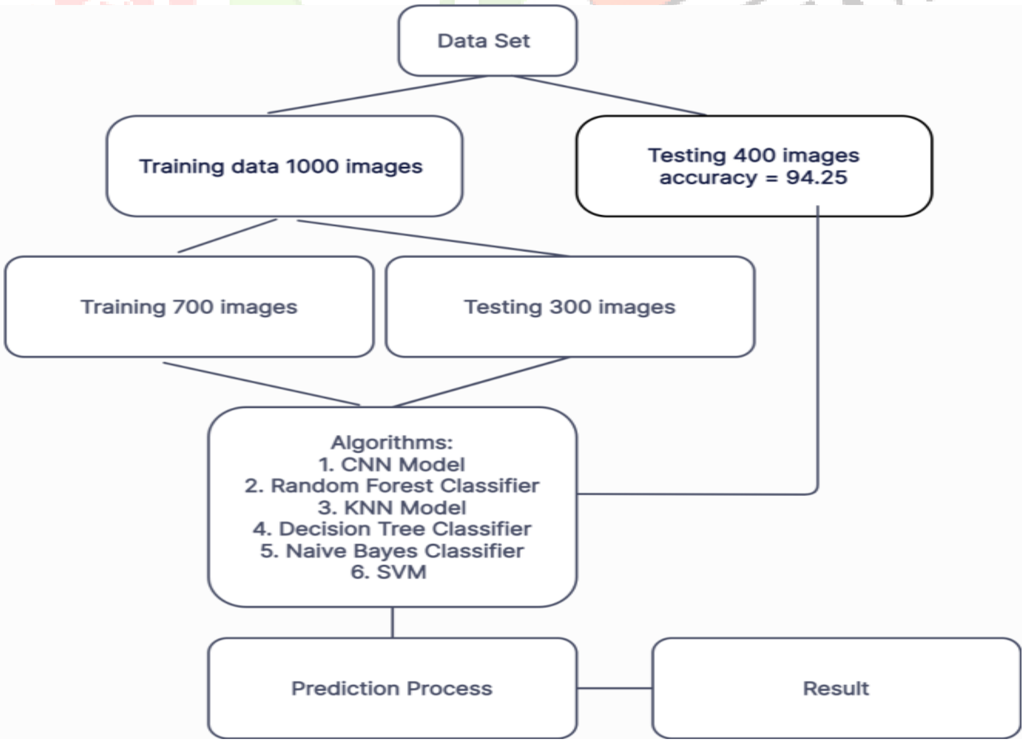




Section III

DATA PREPARATION

Initially, a dataset containing 1000 images [Provided by Yamaha Motor Solutions Limited India] was taken and was segmented into two sections, first containing 700 images for training purpose and the further 300 images for testing. The CNN was over fit therefore, there arose a situation of modifying the dataset. Hence, using data augmentation the authors increased the dataset. After cleaning and selection of dataset, they came up with ad havoc unseen dataset for testing by the model.



Section IV

PREDICTION

Algorithm	Accuracy
CNN	0.9425
Random Forest Classifier	1.0 overfit
KNN	1.0 overfit
Decision Tree Classifier	1.0 overfit
Naïve Bayes Classifier	1.0 overfit
SVM	1.0 overfit

Section – V

REAL-LIFE APPLICATION

Automatic tree detection is the initial phase in many applications. The system is marking the treecenter and assign to it the geographic coordinates. One of the major applications here is stock evaluation. The stock figures here are most accurate due to the high detection performance. In addition to this, in the self-driving cars, tree detection plays an important role since it is paramount to detect the trees for the vehicle to apply push brakes when it approaches near to any tree. It plays a crucial role in the industry since it helps in the prevention of large number of accidents. Last but not the least tree detection plays role in helping the drone water the trees and plants. The drone detects the trees and therefore by the concept of sprinkler irrigation, the trees and plants are watered constructively.

Section VI

CONCLUSION

Lots of research had been done and different algorithms come out to be superior with two conditions like if there exists a tree or not. Various models have been trained. The authors finally came up to a conclusion that CNN algorithm proved to be a superior algorithm than other's for tree detection in a grayscale image.

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