Forest Fire Detection from Satellite Imagery

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Project Guide

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Contents

Project Introduction

- Forest fire is a major concern as it causes huge damage to environment. Forest fire detection and coming up with optimal solution is a challenge.
- The satellite imagery from Planet.com will help in monitoring the surface bed of earth.
- Imagery of the entire land surface of earth at 3-5 meter resolution are available and a coarse-resolution imagery from Landsat(30 meter pixels) or MODIS (250 meter pixels).

Literature Survey on Project

Literature Survey on Project

Summary of Literature Survey

1. Satellite imagery finds many applications but all of them evolve around object detection and removing noise from the images.
2. Algorithms that were proved to be the best were Resnet-50 ,Alexnet ,GoogleNet and Mask R-CNN for masking the objects found in the image.

Objectives

1. Forest Fires are not a sudden incidents they occur in steps and the focus is to detect it in latest possible stage.
2. Detecting patches in field where heat-maps give high temperature readings.
3. Detecting nearby local areas to find the sensitivity of incident.
4. Providing an optimal solution recover the fire.

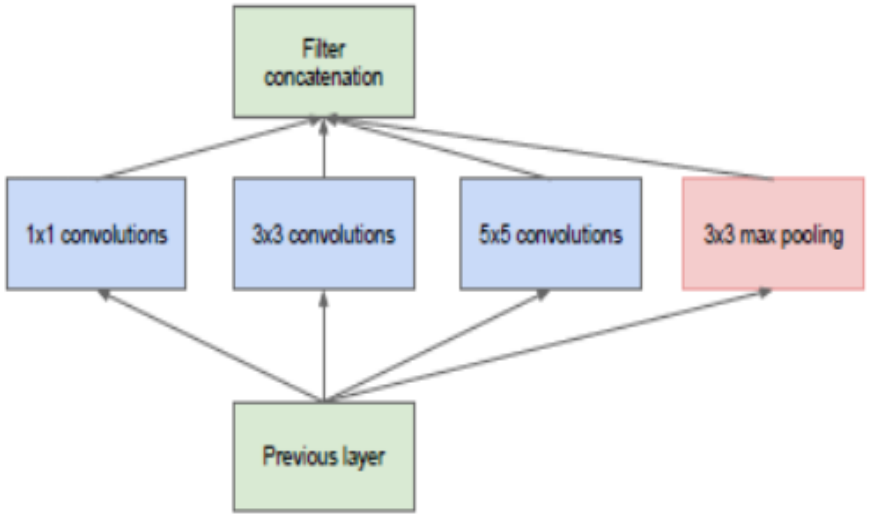
Seminar Topics

1. Pawan Phalak - GoogleNet(Smoke Detection with Noise Filteration)
2. Durgendra - Mask R-CNN(Masking over detected patches)
3. Vighnesh - Resnet-50(Train an eye in sky)
4. Veer Abhimanyu - CNN(Patches Detection Pseudo Color Image Processing for infrared forest fire detection)

GoogLeNet I

Application of the network in network architecture in the form of the inception modules is a key feature of the GoogleNet architecture

GoogLeNet II



(a) Inception module, naïve version

[6]

Mask RCNN

- A convolutional neural network (CNN) is mainly for image classification. While an R-CNN, with the R standing for region, is for object detection.
- Mask RCNN is a deep neural network aimed to solve instance segmentation problem in machine learning or computer vision. In other words, it can separate different objects in a image or a video. You give it a image, it gives you the object bounding boxes, classes and masks.

Mask RCNN

Facebook AI Research [7]

Pseudo Color Image Processing for infrared forest fire detection

- Histogram statistical analysis is carried out, and based on the gray value distribution, we divide it into different local histograms.
- We analyze the rates of local histogram of the gray changing and its corresponding gray-scale, do partial equilibrium to the histogram the gray value of which is at around 128, because the gray value around 128 is the division of the area covered by smoke and background; the transformation function is:

$$s = T(r) = \int_0^r \Pr(w)\,dw \tag{1}$$

Where w is the integral of the dummy variables.
For the discrete gray-level, we have adopted ways of summation, and the equalization is transformed into

$$s_k = T(r_k) = \sum_{j=1}^{k} p_r(r_j) = \sum_{j=1}^{k} n_j / n \tag{2}$$

Where k = 1,2, ..., L, and s_k is the brightness value of output (processed) image, which corresponds to the brightness value of the input image r_k .

- We compare the results of partial equilibrium with the original image histogram, then amend it, and map it to the gray space.

Figure 3. gray-scale image scanned by forest fire detector.

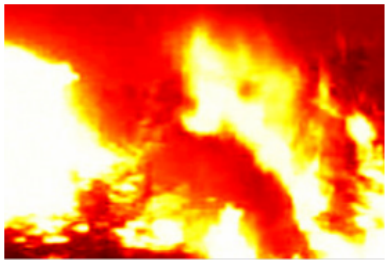


Figure 4. the gray-scale image processed by this algorithm

Figure 5. the gray-scale image processed by complementary color coded.

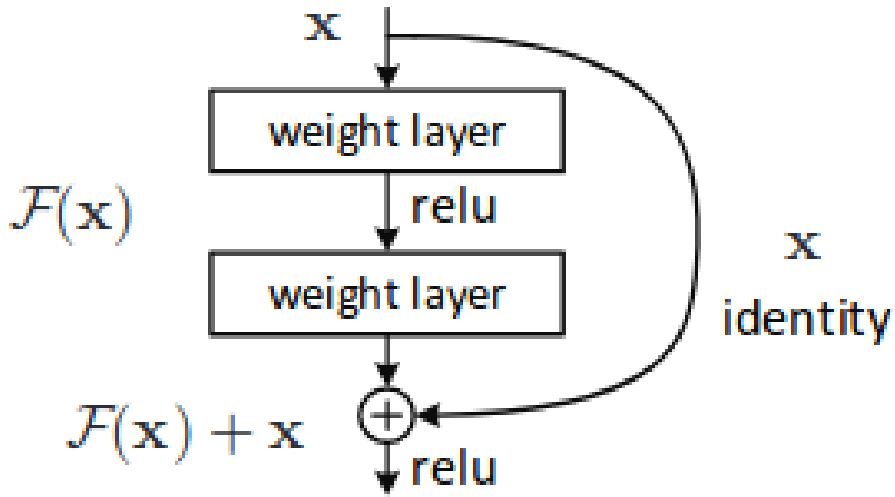
[8]

ResNet-50

Residual Network working

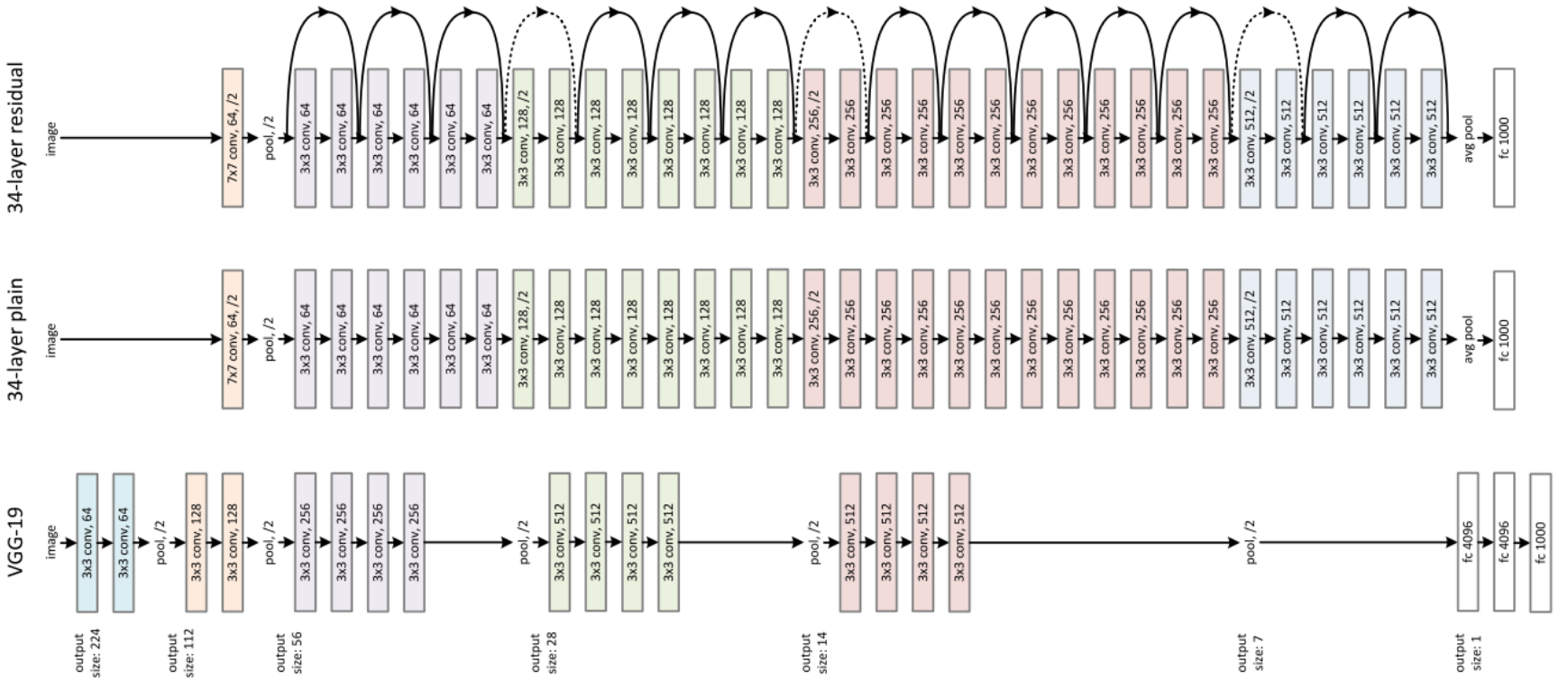
- Instead of learning a direct mapping of x to y with a function H(x) (A few stacked non-linear layers). Let us define the residual function using F(x) = H(x)-x, which can be re-framed into H(x) = F(x)+x, where F(x) and x represents the stacked non-linear layers and the identity function(input=output) respectively.

ResNet-50



2 Layer ResNet Architecture

ResNet-50



ResNet-50 Architecture[5]

Dataset Details

1. Planet: Understanding the Amazon from Space.
2. Size : 34 GB
3. Type : .tif files
4. Provider : Planet and SCCON

Applications of Satellite Imagery

1. There are currently over 4500 satellites orbiting the Earth. Over 600 of them are regularly taking pictures of the Earth's surface. The best available resolution is 25cm per pixel, which means that 1 pixel covers a square of 25cm x 25cm. This translates to a person taking about 3 pixels on an image.
2. Object Detection over earth's surface is an interesting task to keep an eye over activities.
3. Traffic Monitoring, Intrusion Surveillance, Ship Detection on Oceans, Advancing Agriculture is huge field of study which enriches farmers activity.

References I

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[3] Anju Unnikrishnan , Sowmya V, Soman K P, *Deep AlexNet with Reduced Number of of Trainable Parameters for Satellite Image Classification*.

[4] Grant J. Scott,Matthew R. England,William A. Starms, Richard A. Marcum (Member of IEEE), *Training Deep Convolutional Neural Networks for Land–Cover Classification of High-Resolution Imagery*

References II

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[6] Christian Szegedy, Google Inc *Going deeper with convolutions,17 Sep 2014*

[7] Moulay A. Akhloufi, Roger Booto Tokime, Hassan Elassady *Wildland fires detection and segmentation using deep learning,27 April 2018*

[8] Tingting wang,Jianmin Su,Yinglai Huang *Study of pseudo color processing for infrared forest fire detection*

Thank You !