Detecting Infected Trees

Signal, image and video

University of trento

Masters in Artificial intelligence systems

Hanusha Sabbavarapu,

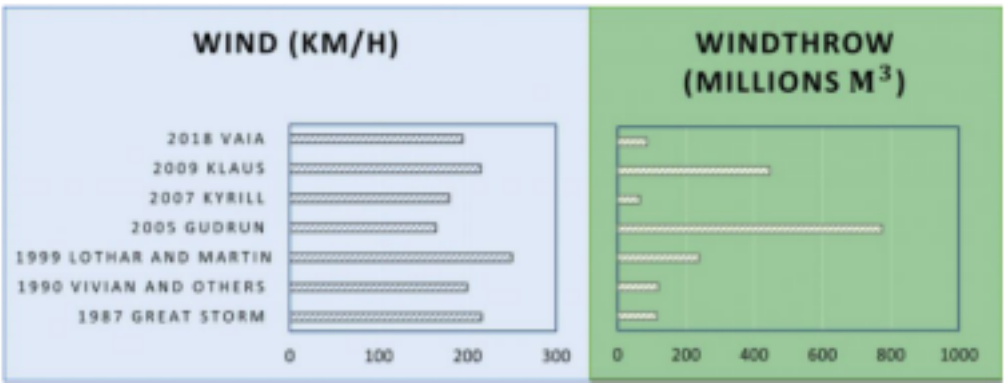
Instructors: Francesco De Natale, Andrea Rosani

Abstract: The "Vaia" storm of a few years ago, which led to the destruction of entire forests in northeast Italy. This has favoured the spread of an insect (Bostrico in Italian) that has affected fallen trees but then spread and is spreading to healthy trees causing destruction of those too. Here we will be detecting the Affected trees using computer vision techniques.

1. **Introduction**:

The effects of climate change and climate variability on forest ecosystems are evident around the world and further impacts are unavoidable. The Storm has caused the trees to infect and disturbed the Natural Habitat in Northeast Italy.

The Insect Infection has been spread over a large area and it needs to be controlled and stopped to protect the Natural Habitat and wildlife in this region. This area alone produces 2/3 of all Italian timber. Here, over 60% of the forests are PEFC certified for their sustainable management.



On the night between the 28th and 29th of October 2018, Italy was hit by the most damaging windstorm that has ever affected the country. Wind gusts hit the Northeast of Italy at speeds higher than 190 km/h, affecting four out of the six regions in the area (from West to East, Lombardy, Trentino & South Tyrol, Veneto and Friuli-Venezia Giulia). More than 41,000 hectares of forest were destroyed and more than 8 million m3 of timber were windthrown. The Vaia windstorm has shattered the Italian forest system, but has also had many severe direct and indirect socioeconomic impacts on mountainous areas

2. Problem Statement:

Here the main problem is to detect the infected Part of Trees. As a Single Tree can be partially infected and partially healthy.

Mostly during the time of Autumn/Winter the trees get their brown shades, which makes

it more difficult to detect the infected region.
As the colours are around the same for infected and non-infected parts, it is becoming more difficult to treat the infected part.

Natural

Natural tree :

Affected

Effected tree:

In the above Image we can see the Natural and affected regions, and it can be imagined how difficult it is to detect the parts separately in such a big region.

3. Goal of the Project:

The main aim is to use the technologies like Computer Vision and Python to detect the Infected regions and segregate them using colour mask. So that the Affected region can be properly identified.
The video of the region will be passed to the code and then we will be able to detect the masked region with the infected trees and regions.

4. Colour Detection:

To do that we have used data that includes colour names and some values to match with those colours in the Images. So that we can differentiate between the level of colours to detect the affected region. Since most of the colours can be defined using Red, Green, and Blue. That's why we will use the RGB format as our data points. And use a csv file with around 1000 colour names and the RGB values to detect the exact colour range.

alice_blue	Alice Blue	#f0f8ff	240	248	255
alizarin_crimson	Alizarin Crimson	#e32636	227	38	54
alloy_orange	Alloy Orange	#c46210	196	98	16
almond	Almond	#efdecd	239	222	205
amaranth	Amaranth	#e52b50	229	43	80
amber	Amber	#ffbf00	255	191	0

Then those ranges would be feed to get the actual colours. Like in the below Images we can see the colour pallet to choose the colour range from. In the same way we have used out test images to get the colour range. The range is mainly set between the HSV of brown colours.

5. Procedure:

Here we will be discussing the exact method used to detect the infected region and also the video Processing part.

Technology used here is Computer Vision and tools such as Python language.

There are 2 code files used "Detect Color.ipynb" and "Detect Infected Tree.ipynb"

Detect Color:

Here on the mouse click we take the pixel value which is a set of RGB between 0-255. Then the value of that pixel is shown on the screen.

After storing the multiple range of values, we can conclude the approx. range of

values.

For colour range we have used colors.csv where the values of pixel input is used to detect and compare colours of the region.

Detect Infected Tree:

For Detecting the Infected region, we are reading the video frames as an image input and then storing it in a form of array where the values range from 0-255.

Then those values are converted into HSV. And the Lower and Upper range of values found using the “Detect color.ipynb” are matched in the Frames array.

As the pixel values are matched the masked images is mapped over the original frame to highlight the Affected region.

Technical Terms:

HSV: The HSV or Hue, Saturation and Value of a given object is the colour space associated with the object in OpenCV where Hue represents the colour, Saturation represents the greyness and Value represents the brightness and it is used to solve the problems related to computer vision.

Below we can see the HSV Range.

Blending two images: An interesting dyadic (two-input) operator is the *linear blend operator* using the below formula

$$g(x) = (1 - \alpha) f_0(x) + \alpha f_1(x)$$

By varying α from 0⟶1 this operator can be used to perform a temporal *cross-dissolve* between two images or videos

Frame: A **frame** is one of the many still images which compose the complete moving picture.

RGB Vs BGR: RGB stands for Red Green Blue. Most often, an RGB colour is stored in a structure or unsigned integer with Blue occupying the least significant “area” (a byte in 32-bit and 24-bit formats), Green the second least, and Red the third least.

BGR is the same, except the order of areas is reversed. Red occupies the least significant area, Green the second (still), and Blue the third***.***

6. Experiment and Output:

Below we can see the output where the affected region is Highlighted in blue.

Original Image

Output Image

After Multiple Application and Experimentation, we have got the range which is properly fitted with the input video range

lower_range = [10, 0, 0]

upper_range = [40, 170, 170]

7. Future Works:

We can also extend the solution finding using advanced modelling techniques like Deep Learning, where models can be trained using Neural Network and weights can be saved to detect the affected and natural area.

8. Conclusion:

We have successfully implemented the code for detecting the Infected Trees. In the Output video we can see the regions highlighted as affected regions. To achieve this, we have to calibrate many colour ranges and rgb, bgr and hsv conversions.

9. References:

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