GREEN REALITY

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Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Thesis on "**Green Reality**" is a bonafide work of Pawan Shukla, Yavar Vazir, Vishvesh Dhobe, Vishal Kriplani and Tejas Deo submitted to the Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur in partial fulfilment of the award of a Bachelor of Engineering, in Computer Science and Engineering has been carried out at the Department of Computer Science and Engineering, Shri Ramdeobaba College of Engineering and Management, Nagpur during the academic year 2019 – 2020.

Date:

Place: Nagpur

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DECLARATION

We, hereby declare that the thesis titled "**Green Reality**" submitted herein, has been carried out in the Department of Computer Science and Engineering of Shri Ramdeobaba College of Engineering and Management, Nagpur. The work is original and has not been submitted earlier as a whole or part for the award of any degree / diploma at this or any other institution / university.

Date:

Place: Nagpur

Name , signature & roll numbers of group members -

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75	77	70	69

Tejas Deo

66

Approval Sheet

This thesis entitled "Green Reality" by Pawan Shukla, Yavar Vazir, Vishvesh Dhobe, Vishal Kriplani and Tejas Deo is approved for the degree of Bachelor of Engineering.

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ABSTRACT

With the increasing population, the human race is developing, and the quality of life is rising at a fast pace. With all these developments, life is getting better but at the cost of harm caused to the environment. This cost is ignored by the people, just because it didn't affect them directly. With the use of satellites and street views, it's possible to analyze the remote areas. The harm caused to the environment so far cannot be undone, but measures can be taken to prevent future damages. Technology can be used to create the awareness about how people's lives have been affected by the environment, how they can deal with drought, humidity, and degraded soil, using remotely sensed images and Google Street View (GSV) images with the help of Image Processing and Machine Learning.

Once the GSV data is analyzed, a GVI (Green View Index) value will refer to the greenery in that particular region. Once the GVI values are obtained a KML file is generated, it will be integrated with the Geo Engines so that it will be reflected on the map. The work of Plotting the KML to the Map is done using the Node.js and Google Maps Static API. The Web App will be responsible for showing the data of different Cities and a Comparison with the help of graph.

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Chapter 1

Introduction

1.1 Motivation

With the increasing population, the human race is developing, and the quality of life is rising at a fast pace. With all these developments, life is getting better but at the cost of harm caused to the environment. This cost is ignored by the people, just because it didn't affect them directly. Deforestation has increased drastically, resulting in loss of habitat, water in the atmosphere, etc. Technology has advanced to the extent that it can be used to treat the environment for betterment. With the use of satellites and street views, it's possible to analyze the remote areas. The harm caused to the environment so far cannot be undone, but measures can be taken to prevent future damages. Technology can be used to create the awareness about how people's lives have been affected by the environment, how they can deal with drought, humidity, and degraded soil, using remotely sensed images and Google Street View (GSV) images with the help of Image Processing and Machine Learning.

1.2 Aim & Objective

To obtain and perform the GVI (Green View Index) analysis so that this analyzed index can be used to increase the green cover, to upgrade the present infrastructure, to address the problems of water scarcity and deforestation and to find out the most effective ways to deal with these issues, making the world ready for a better future.

1.3 Benefits

The Green View Index (GVI) calculated will give a clear idea about the green density of a particular region and thus will contribute to take necessary action to save green cover.

As the green cover increases, the result will be decreased pollution rate and better rainfall solving the problem of water scarcity.

Awareness will be spread among the people about regions having a low GVI thus motivating them to plant more trees, save water, contributing to the environment with sustainable urban development.

1.4 Brief Description of System

Once the GSV data is analysed, a GVI (Green View Index) value will refer to the greenery in that particular region. Once the GVI values are obtained a KML file is generated, it will be integrated with the Geo Engines so that it will be reflected on the map. The work of Plotting the KML to the Map is done using the Node.js and Google Maps Static API. The Web App will be responsible for showing the data of different Cities and a Comparison with the help of graph.

Chapter 2

Literature Review

2.1 Digital Image Processing

- Digital Image Processing deals with processing digital image by means of a digital computer in order to get enhanced image either to extract some useful information.
- It is also used in the conversion of signals from an image sensor into the digital images.
- Digital Image Processing is a software which is used in image processing. For example: computer graphics, signals, photography, camera mechanism, pixels, etc.
- Digital Image Processing provides a platform to perform various operations like image enhancing, processing of analog and digital signals, image signals, voice signals etc.
- It provides images in different formats.

2.2 Neural Networks

A neural network is a series of algorithms that endeavors to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates. In this sense, neural networks refer to systems of neurons, either organic or artificial in nature. Neural networks can adapt to changing input, so the network generates the best possible result without needing to redesign the output criteria. The concept of neural networks, which has its roots in artificial intelligence, is swiftly gaining popularity in the development of trading systems.

Neural networks, in the world of finance, assist in the development of such process as time-series forecasting, algorithmic trading, securities classification, credit risk modeling and constructing proprietary indicators and price derivatives.

A neural network contains layers of interconnected nodes. Each node is a perceptron and is similar to a multiple linear regression. The perceptron feeds the signal produced by a multiple linear regression into an activation function that may be nonlinear.

In a multi-layered perceptron (MLP), perceptron's are arranged in interconnected layers. The input layer collects input patterns. The output layer has classifications or output signals to which input patterns may map.

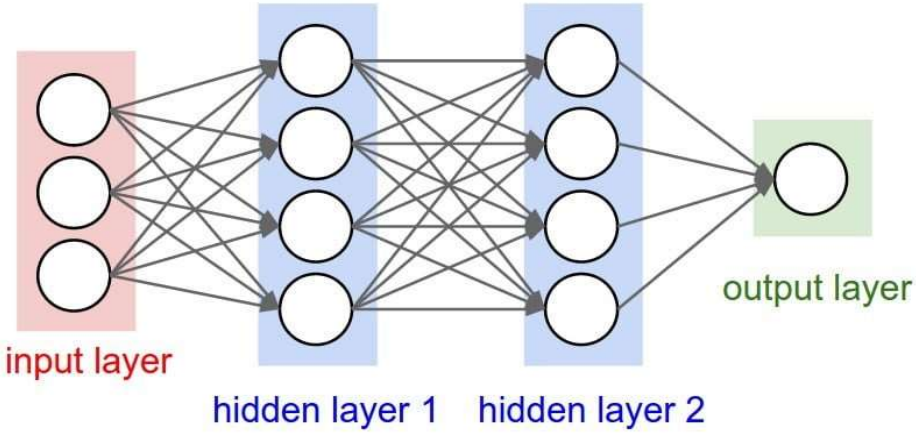

Fig 1 Neural Network Architecture

What is YOLO?

YOLO is an extremely fast real time multi object detection algorithm. YOLO stands for “You Only Look Once”.

The algorithm applies a neural network to an entire image. The network divides the image into an S x S grid and comes up with bounding boxes, which are boxes drawn around images and predicted probabilities for each of these regions.

The method used to come up with these probabilities is logistic regression. The bounding boxes are weighted by the associated probabilities. For class prediction, independent logistic classifiers are used.

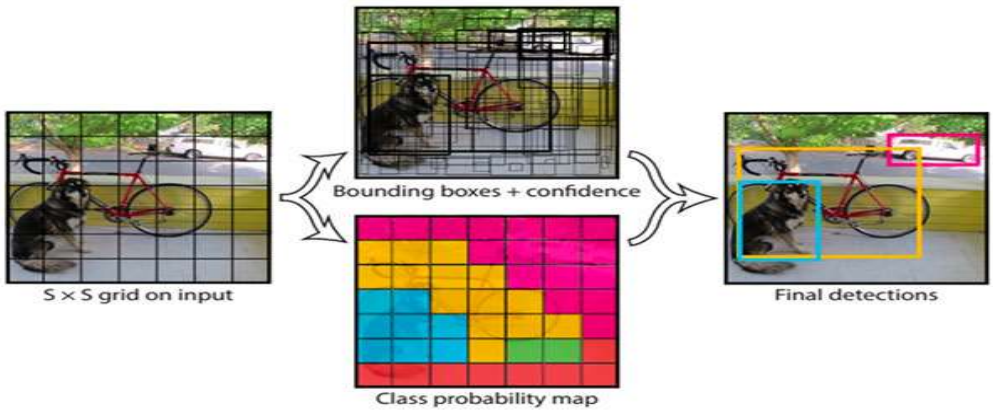

Fig 2. Example of YOLO Algorithm

2.3 KML and Google Maps

KML File:

A file with the .KML file extension is a Keyhole Markup Language file. KML files use XML to express geographic annotation and visualization by storing locations, image overlays, video links and modeling information like lines, shapes, 3D images and points.

Various geospatial software programs use KML files since the purpose is to put the data into a format that other programs and web services can easily use. This included Keyhole Earth Viewer from Keyhole, Inc. before Google acquired the company in 2004 and started using the format with Google Earth.

Google Earth/Maps:

Google Earth is a computer program that renders a 3D representation of Earth based primarily on satellite imagery. The overlay created using KML file are then plotted by using the Google Earth or on Google Maps using its API key which gives the representation of particular data on the map.

Chapter 3

Analysis, Design and Implementation

3.1 Analysis

The project has been divided into six parts:

1. Select the Region and mark Checkpoints.
2. Collecting the data (images) from Google Street View.
3. Removing the objects from the images.
4. Segment the images.
5. Calculating the Green View Index (GVI) of images and Prepare an excel File.
6. Analyzing the output and adding it to the Site.
7. Select the Region and mark Checkpoints.

1. Select the Region and mark Checkpoints.

- This is the first step, first a region where Google street view is available is selected.
- Certain check points are selected (figure 4), with around 500-600 m minimum distance between them.
- All the latitudes and longitudes of the checkpoints are stored in a excel file (figure 3).

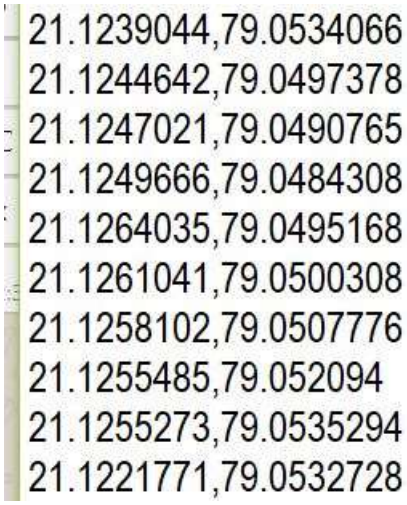

Fig 3. Latitude and longitude File

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Fig 4. Plotted points on Ramdeobaba College Satellite View

2. **Collecting the data (images) from Google Street View.**

- Images are taken from the Google street View API (Static Street View API)(fig).
- The Http request is made for collecting the images.
- HttpRequest:- http://maps.googleapis.com/maps/api/streetview?size=400x400&location=40.7225780677,%20-73.9871877804&fov=90&heading=270&pitch=10&sensor=false
- The size of the images is set constant for all the images i.e. 400x400.
- Also the fov, pitch, and heading parameters are set accordingly for generating a image.

Fig 5. VNIT Campus GSV image

3. **Removing the objects from the images.**

- For removing objects from the image such that for the GVI calculation the greenery from objects and reflection of trees in objects (reflection of tree on car) YOLO object detection algorithm is used. YOLO is deep learning-based object detector. YOLO use a one-stage detector strategy. YOLO works on Microsoft COCO dataset.

- After detecting object present in COCO dataset by YOLO algorithm that coordinates are taken. The pixels of objects are then set as RGB (255,255,255) i.e. white. Then segmenting and GVI calculation is done on that images.

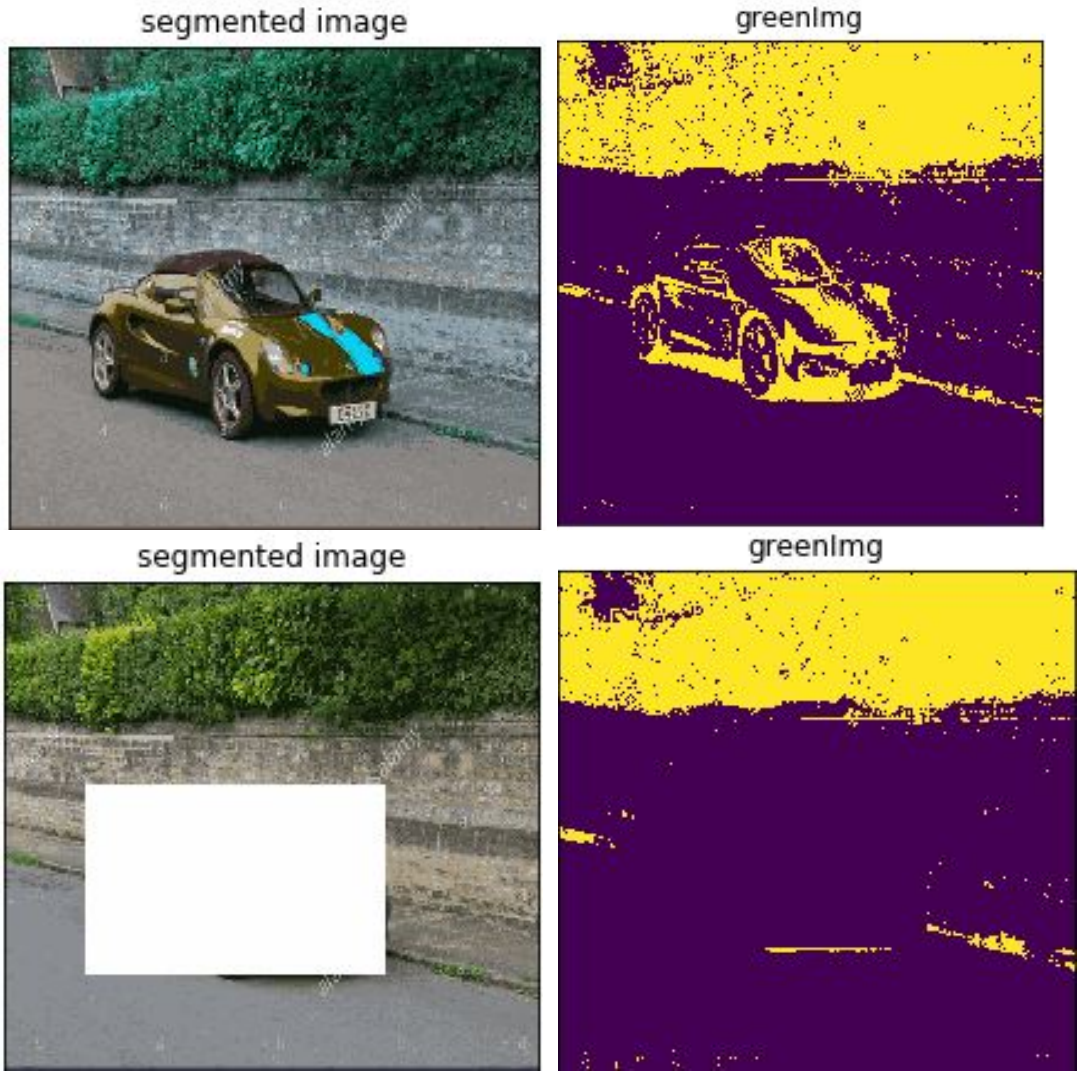

Fig 6. Processing Image

4. Segment the images

- Images sometimes have shiny parts also glare too much.
- It is easy if the image is represented as colored pencil image.
- Therefore Segmentation is used.
- Here K means Segmentation.
- K-means Clustering algorithm is applied to segment image as its make clusters of image as Red cluster, Green Cluster, Blue cluster.(figure 7)

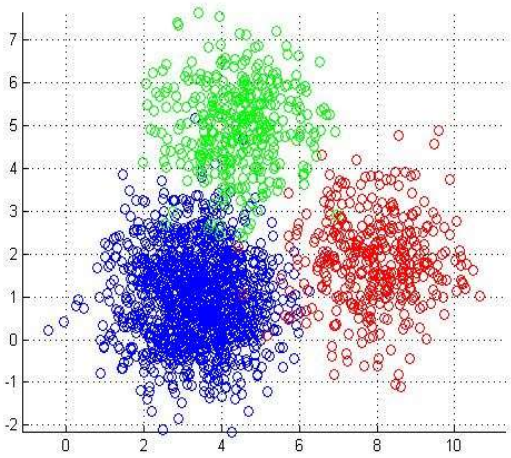

Fig 7. K-means Cluster

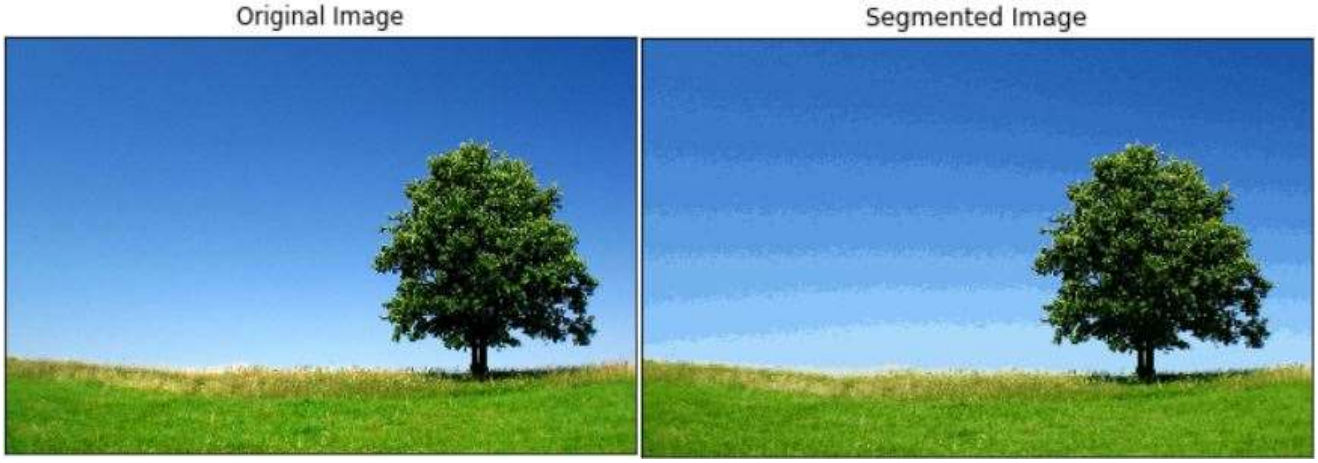

Fig 8. Original and Segmented Image

5. Calculating the Green View Index (GVI) of images and Prepare an excel File.

- For Calculating the GVI we calculate the green area pixels in image and also calculate the total area of image i.e. 400x400.
- A binary image is generated where green area is white and other area is black(fig).
- For this we do operations in image as mentioned in figure 9.
- For calculating the threshold OTSU BINARIZATION ALGORITHM is used.

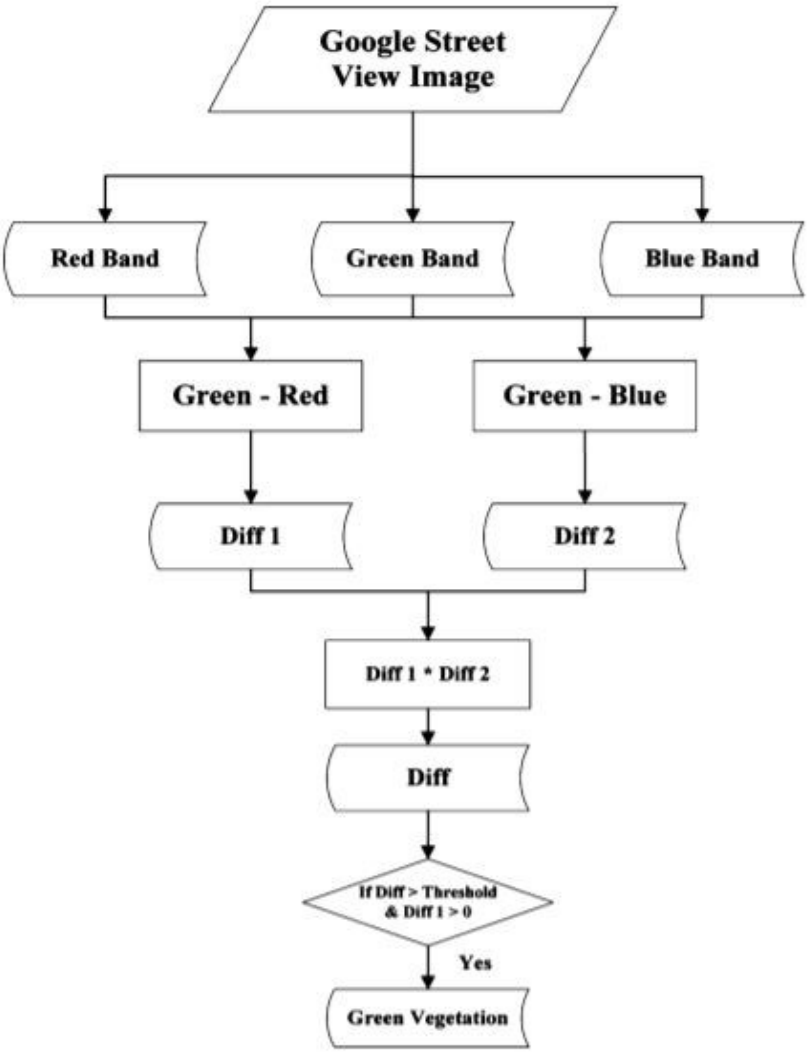

Fig 9. Flowchart of calculation of Green Band

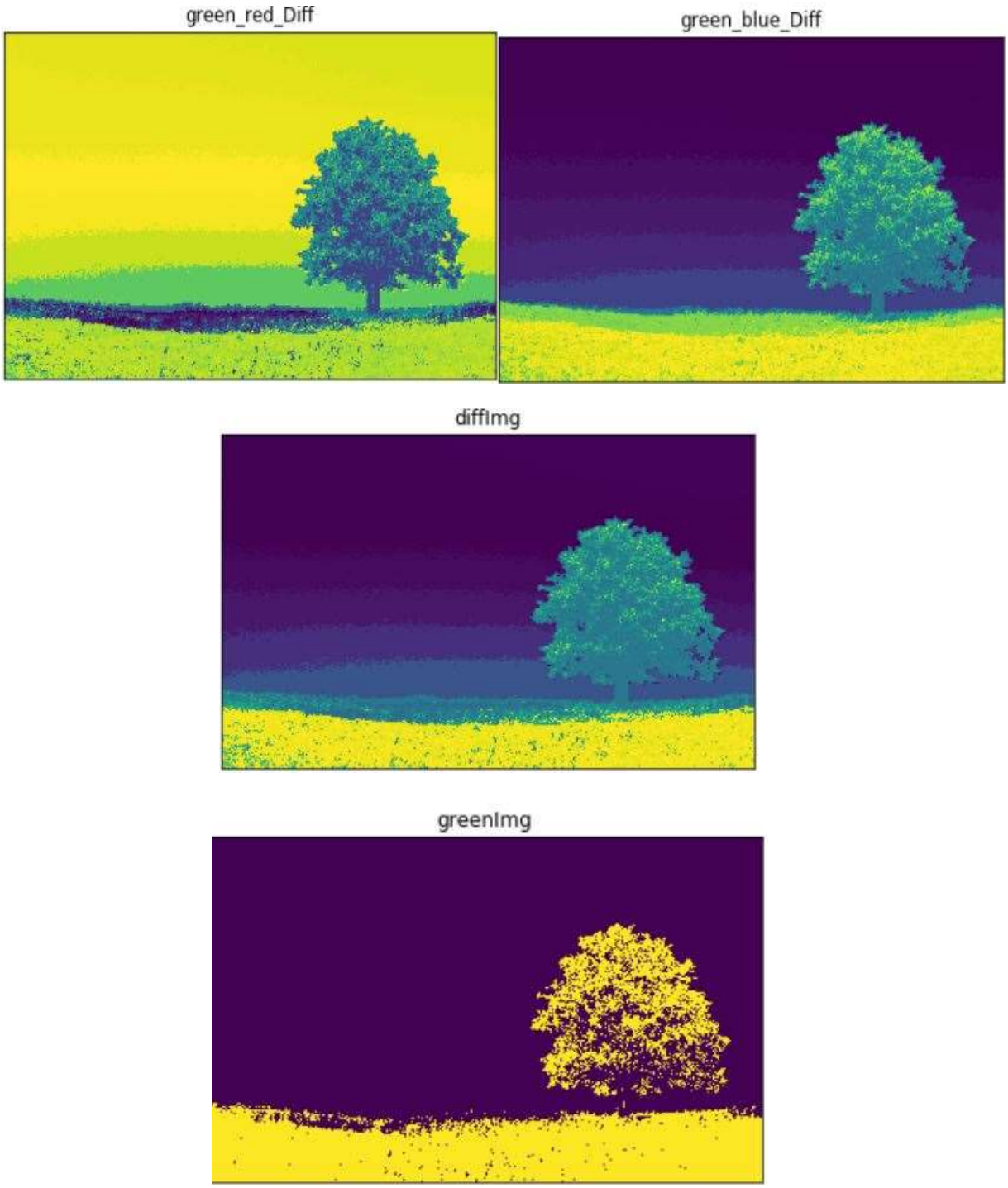

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Fig 10. Image Segmentation based on bands

6. Analyzing the output and adding it to the Site.

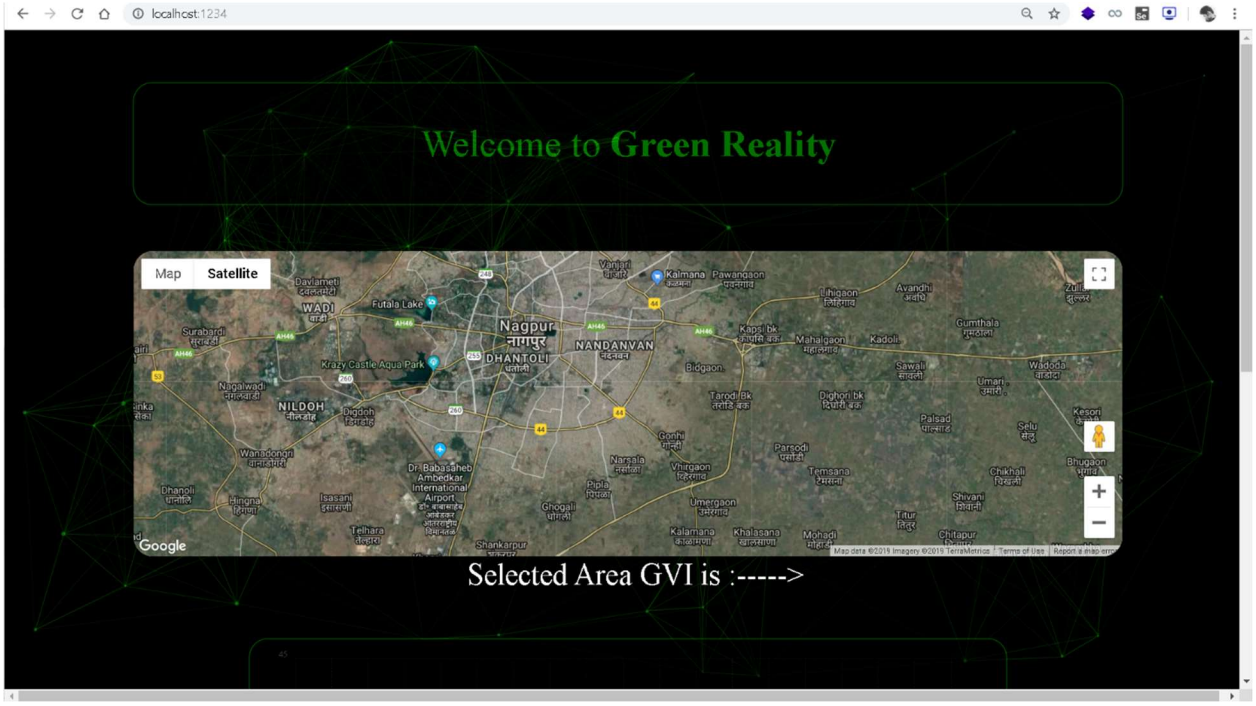

Fig 11. Site Image 1

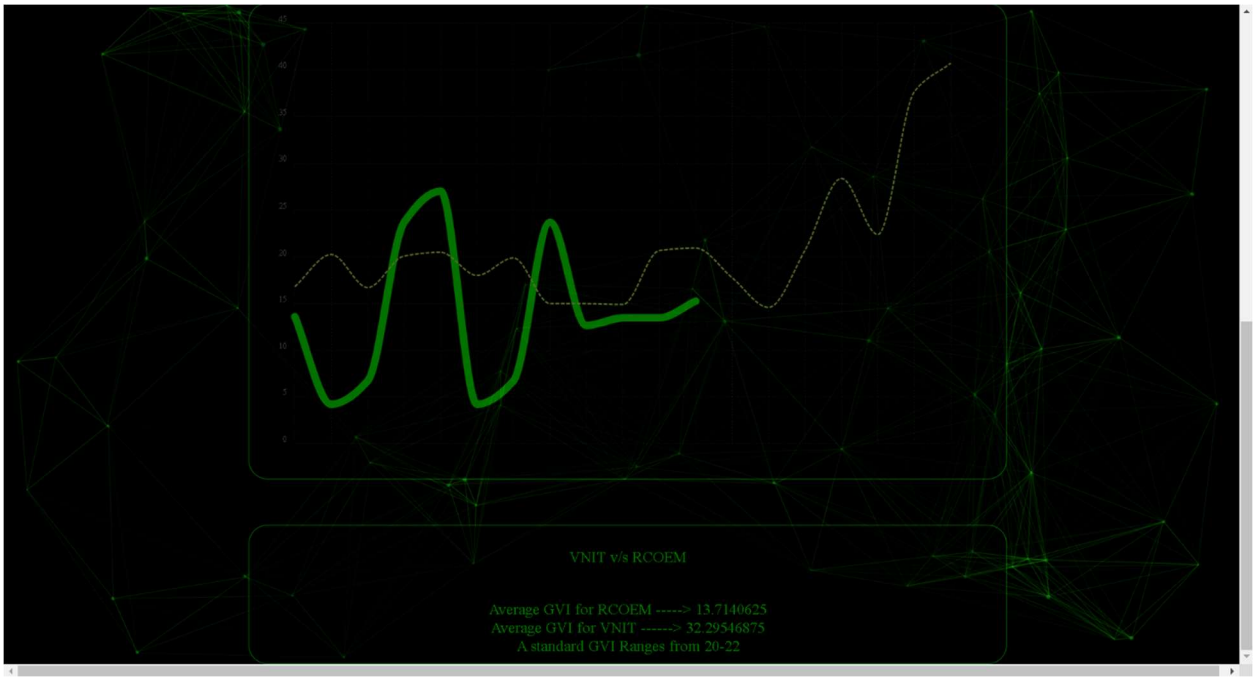

Fig 12. Site Image 2

3.2 Design

- Accuracy in calculating the GVI is important aspect.
- For each check point GVI is calculated ,but for each check point all its images of 360deg is taken and an image is divided into 6 parts of 60deg each.(fig)
- Each image has 3 sights such as -45 deg,0 deg,45 deg. So, in total 6x3 = 18 images are generated for one check point and average of GVI is taken. (figure 13,14)
- As there are many regions where street view is not there so top –view is taken in consideration for that.
- These images of different fov, heading, pitch is generated by querying to the Google Static street API by manipulating its arguments.

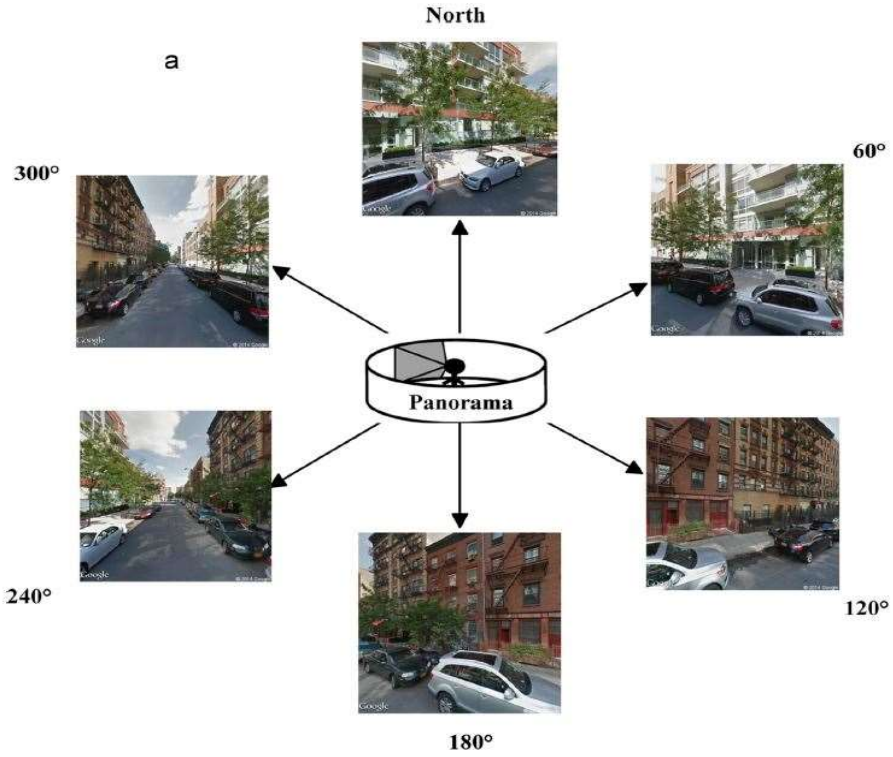

Figure 13. 360 deg image views

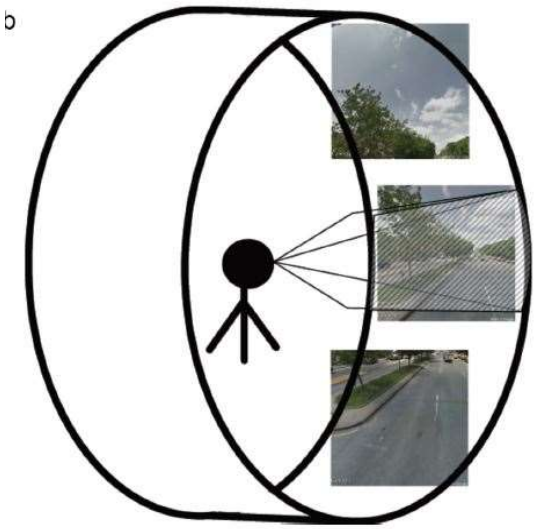

Fig 14. Each degree view

3.3 Implementation

- Majorly, Opencv and Numpy python module is used for implementing the image processing algorithms.
- Requests and Httplib modules are used for requesting to api and receiving the image as response.
- Matplotlib and xlsxwriter modules are used for showing graphs and making the automated output excel file.
- YOLO object detection is used for removing objects.

```
def getImage(lattitude,longitude,heading,pitch):

    URL="https://maps.googleapis.com/maps/api/streetview?size=400x400&location={},{}&fov=60&heading={}&pitch={}&key={}"
    URL=URL.format(lattitude,longitude,heading,pitch,apikey)

    time.sleep(1)

    try:
        response = requests.get(URL)
        img = np.array(Image.open(io.BytesIO(response.content)))  #converting byte array to nparray
```

code snippet for getting image

```
def segmented_image(img):

    Z = img.reshape((-1,3))
    Z = np.float32(Z)

    K=35
    criteria = (cv2.TERM_CRITERIA_EPS + cv2.TERM_CRITERIA_MAX_ITER, 10, 1.0)
    ret, label1, center1 = cv2.kmeans(Z, K, None, criteria, 10, cv2.KMEANS_RANDOM_CENTERS)
    center1 = np.uint8(center1)
    res1 = center1[label1.flatten()]
    output2 = res1.reshape((img.shape))
    return output2
```

code snippet for segmenting image

Chapter 4

Benefits

- Increased Green Cover

The GVI calculated gives us the exact idea of the current scenario of the particular region. Today, Green Cover is a big concern as trees are cut at an enormous rate resulting in lesser greenery and increased problems in environment. The depiction of GVI of particular areas is done through the plotted points on map with varying colors according to the range they fit in. This help initiate individuals as well as organizations especially Governmental and NGO's to take necessary measures to conserve it and prevent from future lessening of green cover.

- Decreased Pollution and Better Rainfall

Once the green cover commences to get dense, it will solve the other environmental problems. Pollution is a big concern and has a harsh effect on not just the environment but also on our lives, posing a great threat to our health. Also, Water Scarcity is another big issue because of increased population causing increased water demand and decreased green cover causing less rainfall to occur. So, measures if taken can help save the green cover to an extent.

- Awareness among People

Once awareness about the GVI of that particular region is spread among the people, some measures will be definitely taken to conserve the green cover and people will start to contribute to save trees, plant more trees, save water, etc. Also, a way for sustainable urban development will be introduced that will help increase the green cover. Some examples of these are Vertical Gardening and Terrace Gardening.

Chapter 5

Future Work

The Project (Green Reality) is based on the emerging technologies such as Image Processing, Neural Network. The introduction of Augmented Reality (A.R) will unleash its major perspectives of operations. In near future the Green Reality can be used to get a real time GVI of an area by a well-trained Neural Network and on ML model. All these things can be done just by using the Camera of Mobile Phones. As the trees are categorized successfully in here, the chances of "predicting the GVI of an area if a virtual tree is planted increases significantly".

If the AR is implemented with the present conclusions, the future app will not only be able to predict the GVI if a tree is planted but also depending upon the vegetation it will plant the trees instead of using a static "Tree Image". If proper hardware is provided one can easily use the Green Reality to larger extents such as calculating the GVI of a City, one nation or even a continent.

Chapter 6

Conclusion

Green Reality provides an effective approach of analyzing the greenery of the region, thus intend to help take necessary immediate actions to save from the day where it would be very late to do anything to save the trees. This would eventually help controlling pollution and water crisis. This Web App can be used by the governmental organizations for tracking the regions of low green density & taking appropriate actions. Green Reality will not only calculate the GVI but it will also help in Urban Planning.

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