

# Plant Disease Detection Using NDVI and Raspberry PI

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## Abstract

In any agriculture-based context, plant health monitoring is one of the most crucial jobs. Agriculture and related industries are important sources of employment in India. For continuous and long-term plant health monitoring, an effective monitoring system is necessary. The goal of this study is to monitor plant health using the NDVI (Normalized Difference Vegetation Index) computation, which can help distinguish between healthy and unhealthy plants by calculating their NDVI values. A unique camera captures the Near Infrared (NIR) light spectrum to determine the NDVI value. This pricey camera is typically only utilised by the professional plantation business. The photos of the plants were captured using an NIR camera connected to the Raspberry pi. The Raspberry pi is programmed in Python to take photos and calculate NDVI, and the results are relayed to the user using VNC viewer software, allowing them to distinguish between healthy and unhealthy plants.

**Keywords:** NDVI, Plant health, Raspberry pi, Near infrared.

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## I. INTRODUCTION

The normalized difference vegetation index (NDVI) is a simple graphical index of plant greenness and is one of the most commonly used vegetation indices. NDVI has been one of the many successful applications of remote sensing data to problem solving in diverse fields - agriculture, forestry, environment etc. The index has been able to attract hydrologists also, due to its potential to account for spatiotemporal land cover changes in model parameterization of rainfall-runoff models. In all these fields, the usual handling of NDVI is in the form of maps and statistics extracted by carrying out GIS operations on remotely sensed data. In this paper, a novel way is proposed to visualize and extract information from NDVI products. Conceptually, in the line of the hypsometric curve, a curve can be drawn using gridded NDVI data to represent the distribution of the index values across any bounded area such as a hydrological catchment, a floodplain zone, or an administrative unit. It is proposed to call this curve the "endiviometric curve". The use and potential of endiviometric curves are demonstrated by drawing such curves from NDVI values derived from Sentinel-2 data for different geographical units. The results show that apart from being a handy way to monitor vegetational changes, the endiviometric curve can provide insights on many aspects of an ecosystem and complement the existing methods of monitoring inter-annual and intra-year changes. In all, the endiviometric curve can be a useful tool in the planning and management of sustainable ecosystems.

## II SYSTEM DEVELOPMENT

### 2.1 System hardware

The Raspberry Pi Foundation and Broadcom cooperated in the United Kingdom to develop a line of inexpensive single-board computers (SBCs). The Raspberry Pi initiative was created to encourage computer science education in schools and in underdeveloped nations. The initial model was more successful than expected, with robots and other applications selling outside of its core market. Because of its low cost, versatility, and open architecture, it is frequently utilised in a range of industries, including weather monitoring. Due to its embrace of HDMI and USB devices, computer and electronic hobbyists mostly utilize it. Following the release of the second board type, the Raspberry Pi Foundation established a new organisation called Raspberry Pi Trading, with Eben Upton as CEO and responsibilities for technical development. The Foundation was renamed in order to encourage computer science education in schools and developing countries. The Raspberry Pi hardware has gone through multiple generations, each with its own set of features. Memory capacity, networking capabilities, and peripheral device support are all factors to consider. The Raspberry Pi 3 Model B+ processor runs at 700 MHz to 1.4 GHz, while the Pi 4 runs at 1.5 GHz; on-board memory ranges from 256 MB to 8 GB random-access memory (RAM), with only the Raspberry Pi 4 having more than 1 GB. The operating system



Figure 1:Raspberry pi model 3b+



Figure 2:Raspberry pi model

3b+programme memory are kept on MicroSD cards (SDHC on early versions), however some models feature onboard eMMC storage, and the Raspberry Pi 4 can use USB-attached SSD storage for its operating system.

## 2.2 Software system

Raspbian is a Debian-based free operating system created exclusively for the Raspberry Pi. An operating system is a set of programmes and tools that allow your Raspberry Pi to run. Raspbian, on the other hand, is more than just an operating system; it comes with over 35,000 packages, which are pre-compiled software packages packed in a simple format for easy installation on your Raspberry Pi. The initial build of almost 35,000 Raspbian packages optimised for the Raspberry Pi was completed in June of 2012. Raspbian, on the other hand, is still in development, with the goal of improving the reliability and performance of as many Debianprogrammes as possible.

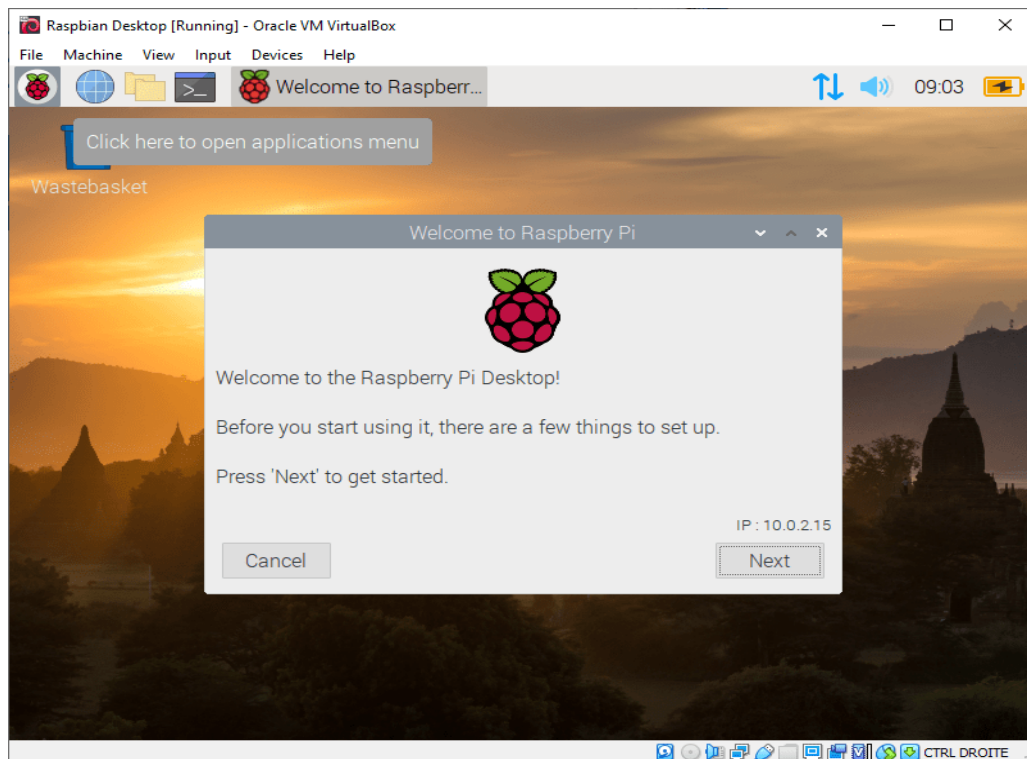


Figure 3:Raspbian operating system view

### 2.3 Hardware setup

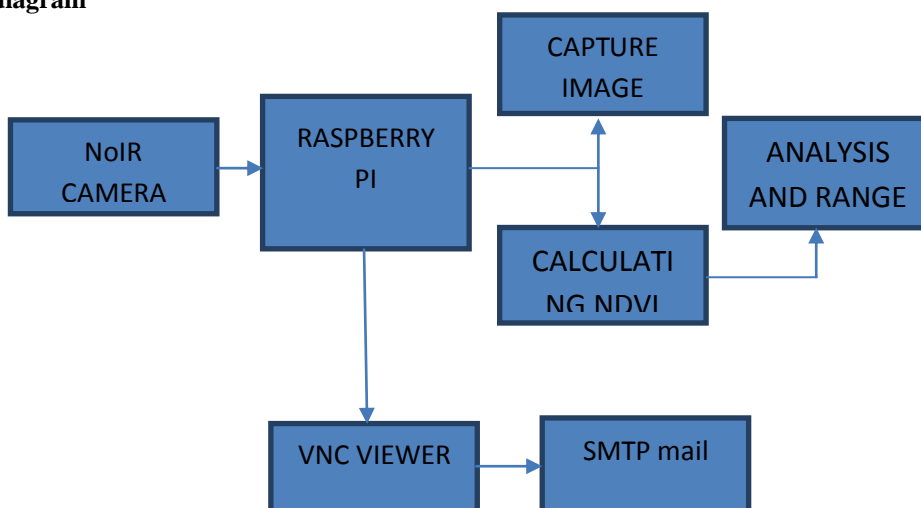
Hardware system of this is proposed below. In that NoIR camera module is interfaced with Raspberry pi model 3B+ board.



### III. DESIGN METHODOLOGY

This plant health detection system is developed with raspberry pi and NoIR camera module. For the programming python programming language used. This raspberry pi system is powerful enough to process the images. It comes with supported OS called raspbian. Using these advantages we can make powerful devices. Here the camera module inserted through camera connector in the raspberry pi module. and it used to take pictures of plants. After installing raspbian image in SD card I inserted in raspberry pi and powered up the system. First the raspberry pi system was configured using PUTTY software. And then through VNC viewer software we can see the raspberry operating system over windows OS. After opened should configure initial setups for cameras and for its desktop. Then python IDE installed by using terminal and created the code for this system. Whenever we run the python script using terminal or python IDE, we can see the output. The connected camera takes picture and then that taken image is assigned to the original variable and it is stored wherever the python script is stored at this location it is stored. Then two functions are created which are used to convert the original image to contrasted and NDVI images. In these function body, all the parameters should follow while converting the image. Finally it converts 4 types of images. Those contrasted, NDVI, NDVI contrasted and color mapped. Basically NDVI contrasted image is the output image, but can't see the difference. For human visible purpose NDVI contrasted image is converted into color mapped image.

#### 3.1 Block diagram



### 3.2 Raspbian Installation

To function, your Raspberry Pi need an operating system. That's it. Our official supported operating system is Raspberry Pi OS (formerly known as Raspbian). If your SD card does not yet include the Raspberry Pi OS operating system, or if you want to reset your Raspberry Pi, you can quickly install Raspberry Pi OS. To do so, you'll need a computer with an SD card port, which is found on most laptops and desktop PCs. It is finally ready after completing all of the essential stages..

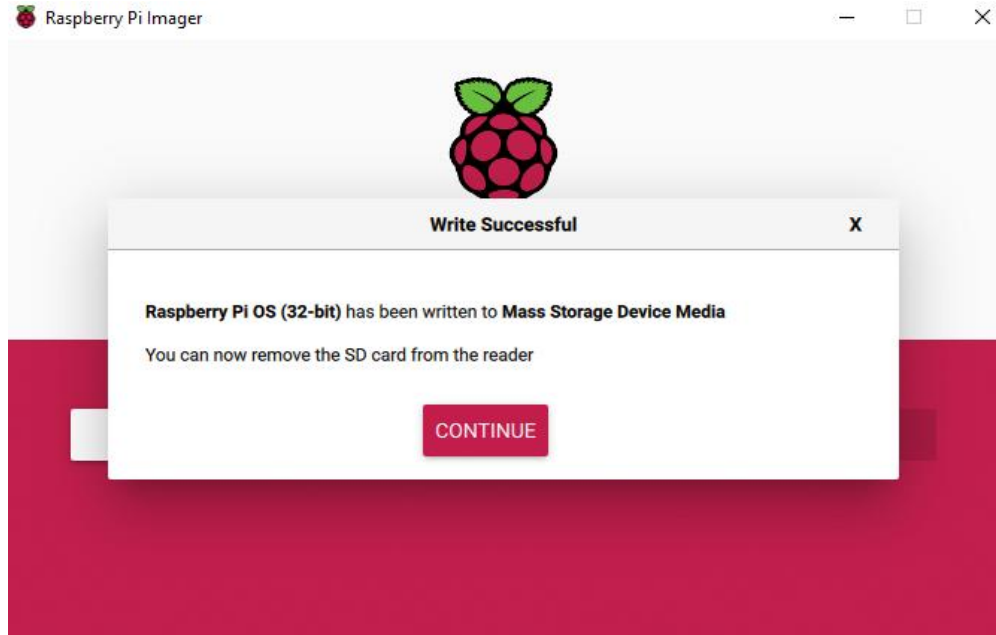


Figure 5:Raspbian installation

### 3.2 Putty configurations

PuTTY is a software tool that allows you to access the Raspberry Pi command-line interface from your desktop or laptop computer. It opens a terminal window on your computer using SSH (secure shell), which you may use to send instructions to the Raspberry Pi and receive data from it. Other programmes for accessing the Raspberry Pi terminal exist, but PuTTY is by far the most popular.

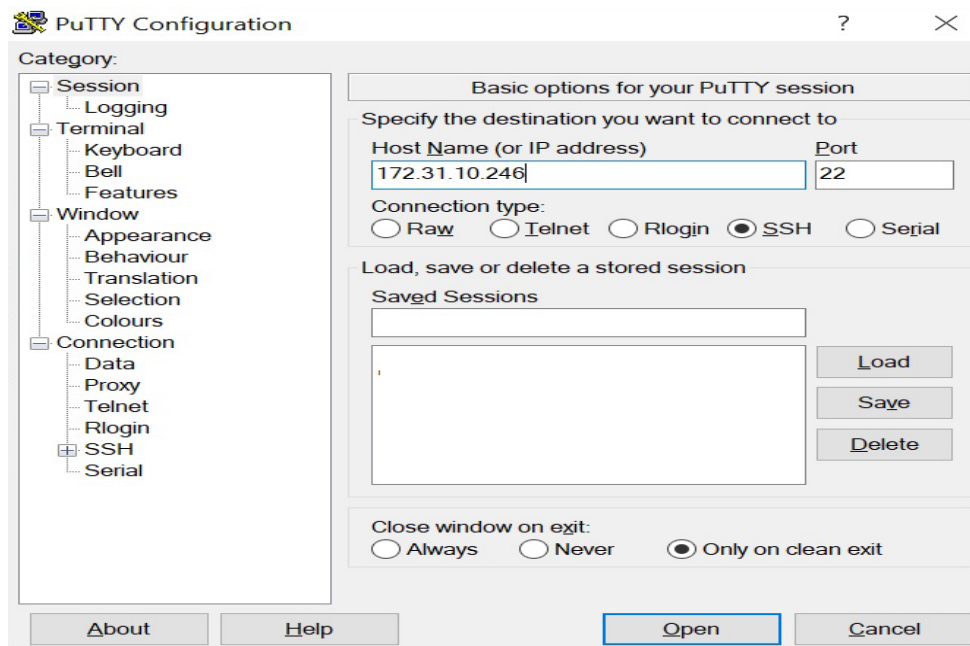


Figure 6:Putty configuration

### 3.3 VNC viewer configuration

The raspberry pi will work on local IP address that is assigned to it. So access raspberry pi through vnc viewer you need to enter its local ip or its username. Here, To access raspberry pi enter raspberry pi or its local ip address in search bar of vnc software. And we need username and its password. By default username is pi and password is raspberry. Everything listed here is shown on the below image.

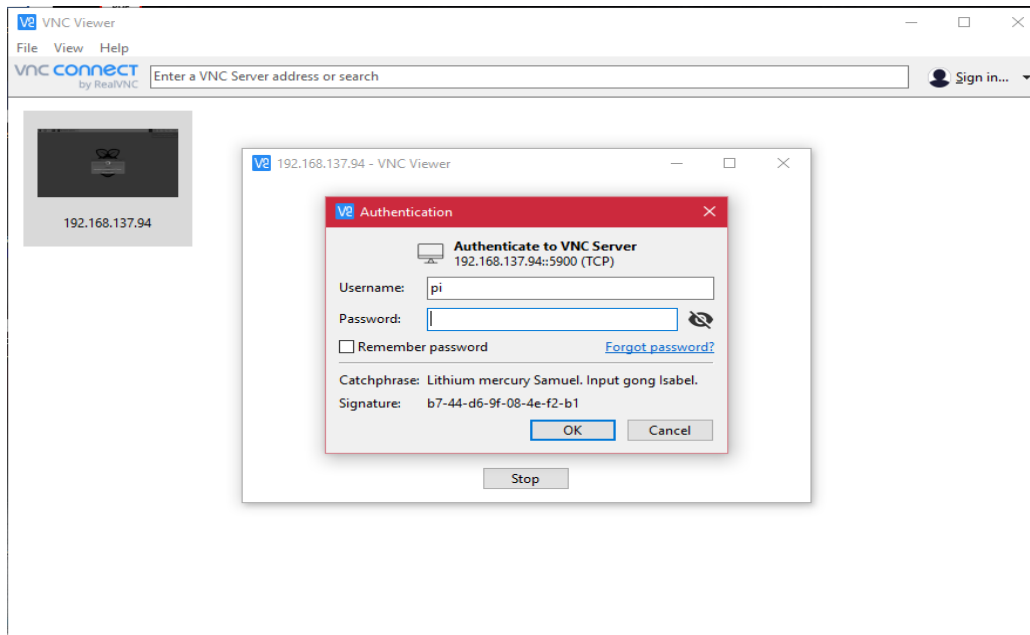


Figure 7: VNC setup

## IV. RESULT AND DISCUSSION

Plants must monitor the different colours (wavelengths) of visible and NIR sunlight to evaluate the density of green area on a piece of land. Some wavelengths of light are absorbed while others are reflected when sunlight strikes objects. Chlorophyll is a photosynthetic pigment present in plant leaves that absorbs visible light (between 0.4 and 0.7 m). The cell structure of the leaves reflects a lot of near-infrared light (between 0.7 and 0.11 m). The higher the NIR band intensity reflected by a plant, the healthier it is. The NDVI is calculated using visible and near-infrared light reflected by vegetation. The majority of visible light is absorbed by healthy vegetation, while the majority of NIR light is reflected by sick vegetation. The NDVI is determined using light reflected by plants in the visible and near-infrared spectrum. Healthy vegetation absorbs the majority of visible light, while sick vegetation reflects the majority of NIR light. The original and color-mapped NDVI images are shown below.



Figure 8: Healthy leaf

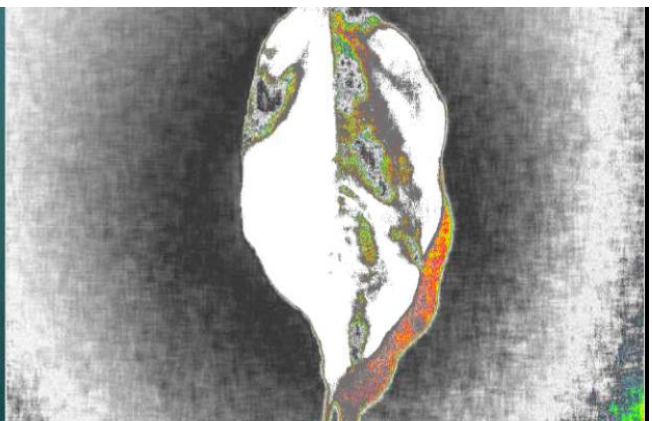


Figure 9: Affected part of the leaf



Figure 10: Healthy leaf

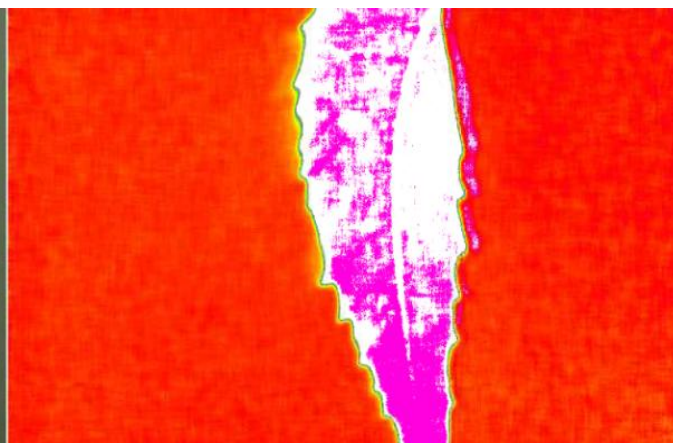


Figure 3.11: Affected part of the leaf

NDVI is calculated as:

$$NDVI = \frac{NIR - VIS}{NIR + VIS}$$

When NDVI is calculated for a specific pixel, the output is a value ranges from -1 to +1. So, no green leaves produce a result around zero. 0 implies no vegetation, while +1 suggests a high density of green space.

## V. CONCLUSION

The wireless technique of plant health monitoring system presents a model based on the NDVI calculation values of healthy and non-healthy plants. It uses a Raspberry Pi and a NoIR camera as a control mechanism. The wireless network is designed with VNC Viewer software for convenient access to live streaming of the region under observation and hence image capture. This strategy focuses on each individual plant, assisting farmers in determining the plant's health. It is inexpensive since it is made of basic hardware materials.

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