iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** X **Month of publication:** October 2021

DOI: https://doi.org/10.22214/ijraset.2021.38607

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

Canopy of Plant and Leaf Area Measurement Using MATLAB

Rahul Dogiparthy
Student, CVR College of Engineering

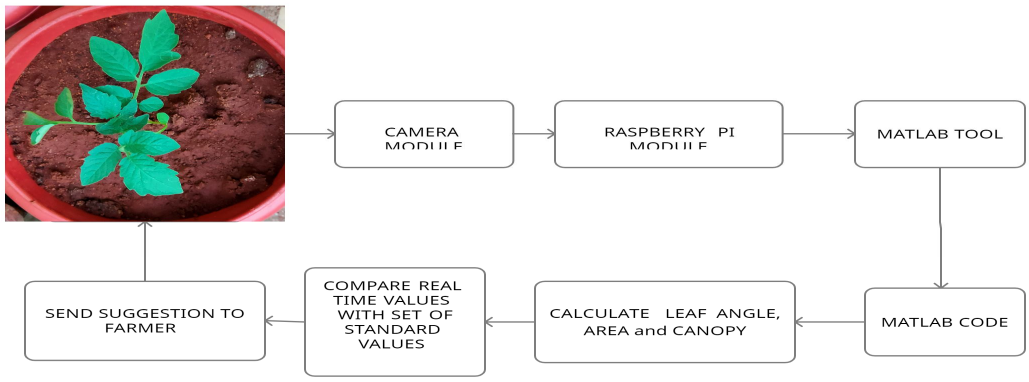
Abstract: ***Agricultural productivity and efficiency are at the center of many of the debates, policies and measures concerning the farming sector. Farmers will need to increase crop production, either by increasing the amount of agricultural land to grow crops or by enhancing productivity. Agriculture being the largest sector of Indian economy struggling very hard to provide enough returns for the farmers and one of the major reasons for this is the inability of the farmer to analyze the end productivity weeks before the produce comes to hand or in the initial stages of crop.***
Leaf area and Canopy are important traits of plants by which end productivity can be analyzed in the early stages of the crop. Leaf area and canopy of the leaf are the functions of water, nutrients and sun light intake. So, they provide efficient information regarding the plant health status. By comprehending health condition of the plant necessary supplements are given to increase productivity. A sophisticated MATLAB code is developed which takes the pictures and computes the leaf area and canopy.
Keywords: Productivity, Leaf area, Canopy, Traits, MATLAB.

I. INTRODUCTION

Agriculture is the largest sector in Indian economy. Being, largest sector it also provides greater employment but over the years agriculture is not given much importance and a farmer had never got enough returns for his hard work. There are many reasons for this, major reasons being over production and under production. Whenever there is over production of crop farmer will not get minimum support price. Moreover, supply will be much larger than demand due to which large amounts of crop will go waste. On the other hand, under production is a curse for farmer despite of their hard work. All these reasons comes' towards a single point called productivity. Due to lack of knowledge of nutritional levels of soil and over usage of fertilizers and pesticides productional imbalance is taking place. If a farmer can analyse the productivity of his crop much ahead of getting actual product, it will be a revolution in agricultural sector. Predetermination of health of plant can be a path breaking technique for farmers across the country. We have considered tomato plant as our test specimen and conducted research on its growth and applied the technology to predetermine the health of plant using leaf area and canopy measurements.

II. METHODOLOGY

A. Block Diagram



Fig, 1 Block diagram of the process

B. Description

The raspberry pi camera module is used to capture the leaf image of tomato specimen and sent to the server in real time. The Raspberry pi is programmed in such a way that the camera module interfaced with it will capture the images of the plant daily at a particular time. A MATLAB code is developed to simulate the Leaf area and Canopy. The captured image is taken as input by the code and area and canopy are simulated according to the requirement with some image processing techniques.

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An absolute difference of these values of any two days are calculated by the code and it then compares them with the standard measurements simulated in intel cluster software (Healthy specimen). According to the variation of the absolute difference with standard values productivity of the crop is analysed. If there is a large deviation, we suggest farmer that production will be low and there is a need to provide manure. After providing manure we will once again test the values and give suggestions.

III.PROCESS FLOW

A. The images are taken in jpg format by the MATLAB code and will be resized initially. For fast processing the size of the image should be as small as possible. Hence image resizing is needed.

B. Now the user is asked whether he wants to calculate angles of the leaf or leaf area or canopy.

C. To obtain petiole angle of the leaf we need the mark the angle on the leaf. To mark the angle, we need edges of the leaf. In the whole process we are interested only in edges but not on colour and clarity.

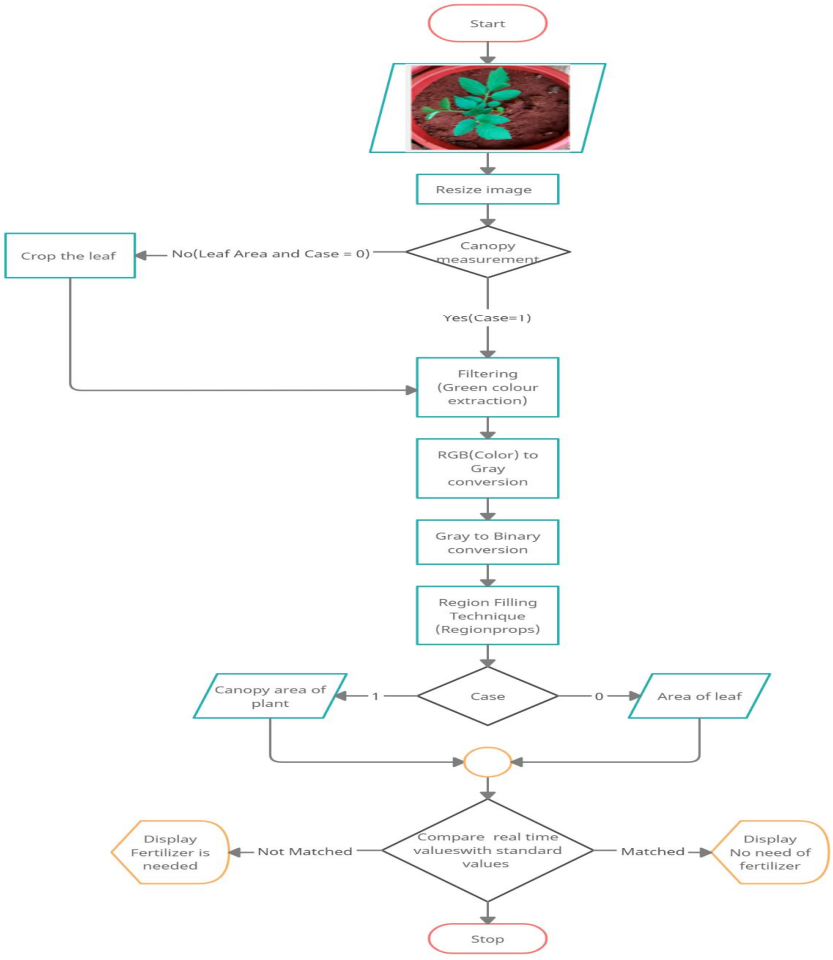
D. So, to find edges we use canny edge detection technique. It filters out discontinuities in the colours of image and provides edges of image.

E. This canny edge detector only takes grey image as input so, colour image is converted to grey. Points are plotted and petiole angle is measured.

F. If user want to calculate canopy of the plant, then initially the green part of the picture is extracted from the image and then the picture is resized and converted to binary.

G. Binary image is inverted and the area of the green part i.e, canopy is extracted in the form of pixels and then that is converted to area.

H. Now, if the area of the leaf is the required measurement, then the picture is cropped to obtain leaf only and then the cropped picture is resized, converted to binary, inverted and then the area is found.

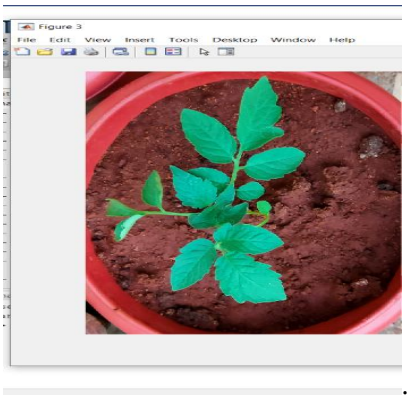


Fig, 2 Process flow diagram

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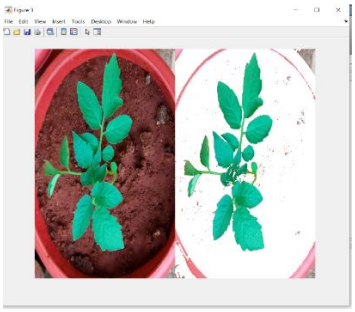
IV. RESULTS AND DISCUSSION

A. *Matlab Input Image*



Canopy Measurement

B. *Filtered Image for Canopy*



After resizing the input image, the image is filtered so as to obtain only green colored parts.

C. *Gray Image for Canopy*

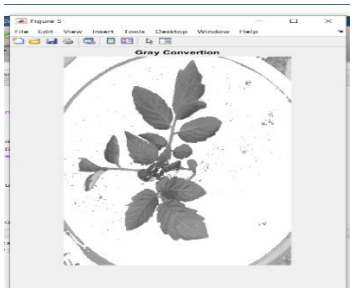
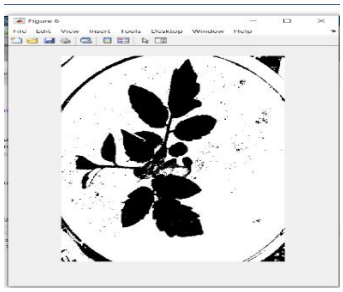


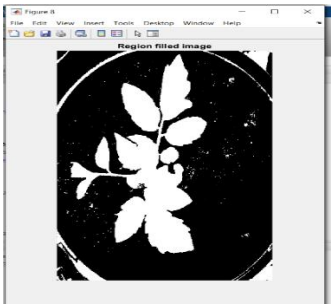
Image is then converted from RGB to grey and grey to binary by Thresholding.

D. *Binary Image for Canopy*



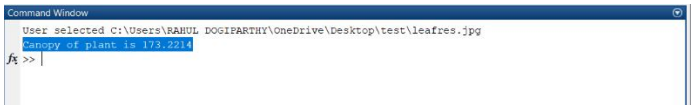
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E. Region Filled Image for Canopy



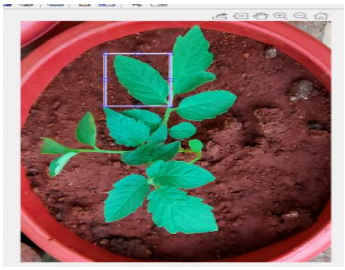
Obtained binary image is inverted and the region is filled.

F. Canopy in Command Window

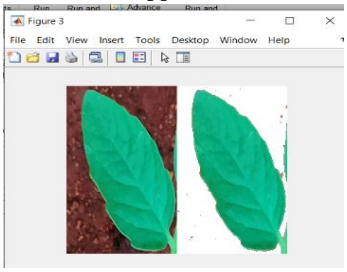


Leaf Area Measurement

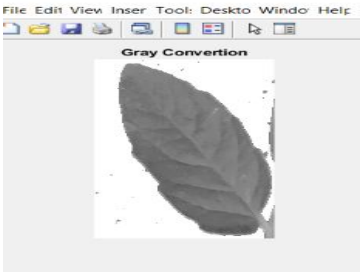
2. Image subjected to crop



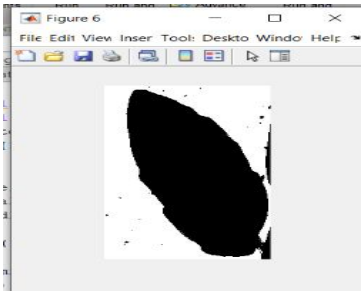
3. Cropped and filtered image



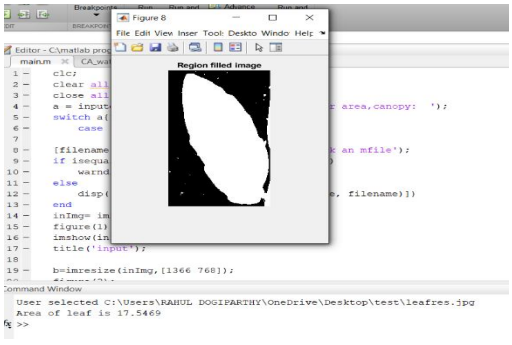
4. Gray converted image



5. Inverted image



6.Region filled image with Leaf Area in command window



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ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

V. CONCLUSIONS

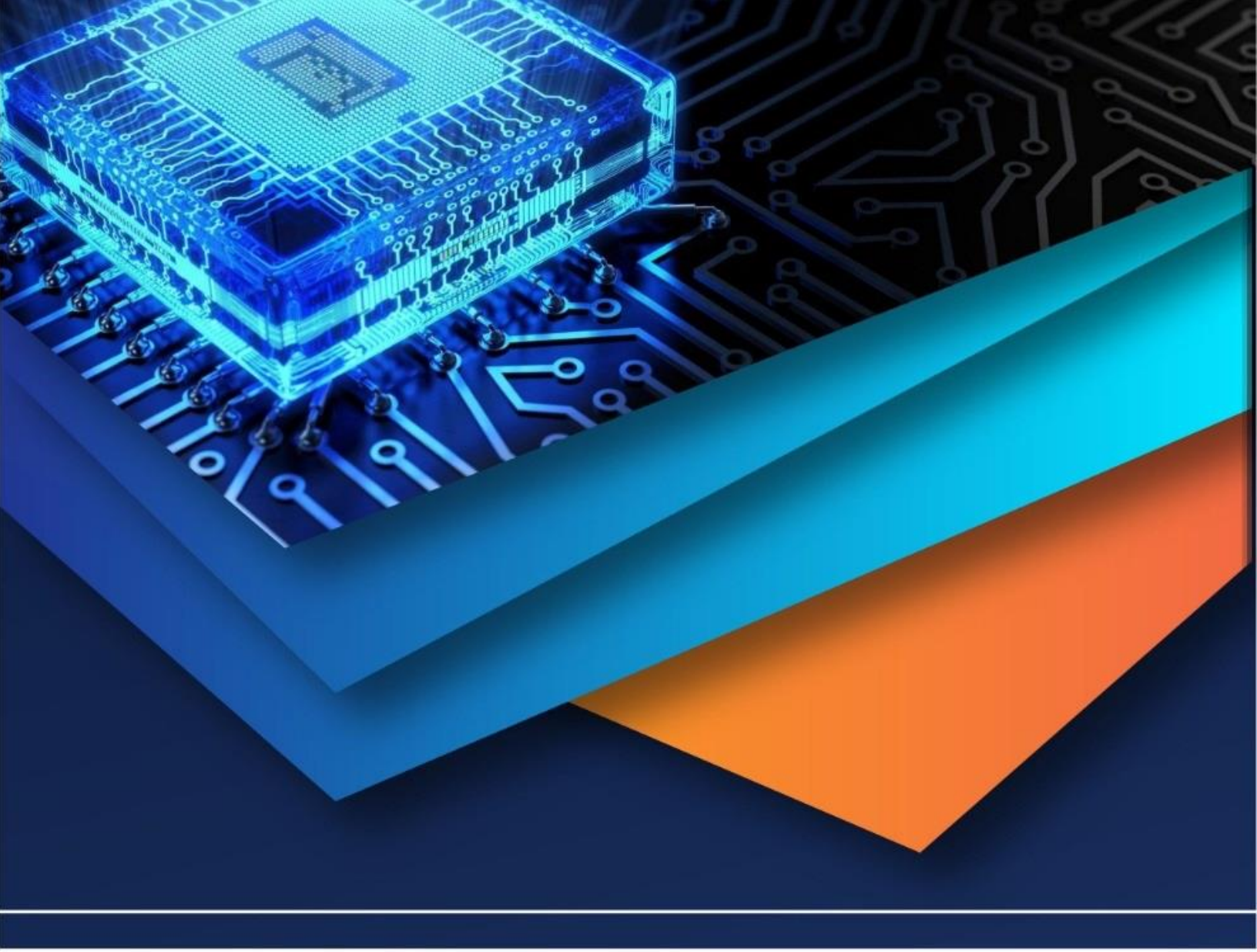
A. This novel technique helps the farmers to know their crop's productivity beforehand.

B. If the estimated productivity is low, they can take necessary measures and increase productivity of farmers which in turn increases their income.

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