



Plant Growth Analysis Using Image Processing Technique

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Abstract— Agriculture is the most vulnerable section in India for many reasons like degraded farmland, increase in the urbanization, inadequate use of manures and fertilizer, old systems and techniques of farming. To increase the productivity in agriculture there is a need of modern irrigation system. Image processing is a robust technique and its employment in the field of agriculture demonstrate a useful contribution.. In this work the plant images were taken as a input source for growth analysis. A GUI has made using the MATLAB for the same purpose. Here lettuce plants were considered for observation in specific, because of their fast growing feature. Images of fifteen different lettuce plants were taken for a period of ten days. The analysis was based on day-to-day increase in the pixel percentage. The system was able to identify good and low growth.

Keywords— Plant growth analysis, Image processing, Connected component analysis, GUI, Pixel percentage.

I. INTRODUCTION

Image processing is analysis and manipulation of a digitised image, in order to improve its quality using mathematical operations. It is powerful technique that is widely used in various fields for solving complex problems and its contribution in the field of agriculture has been proved a very useful. The modern farming practices such as precision agriculture considers image as important source of information for the plant crop monitoring and analysis. The concepts of plant growth analysis refers to a set of equations by which changes in size of plants over time can be summarised and vivisect in component variables. For the analysis of growth of individual plants it is often applied, but can also be used in a situation where crop growth is followed over time. Irreversible increase in plant size accompanied by a quantitative change in biomass(weight) is called growth. Agriculture is the back bone of our Indian economy. Majority of our population up to 80 percentage depend on agriculture. Due to irregular weather pattern and over usage of underground water it is becoming difficult to practise agriculture. Therefore an automatic monitoring system is needed to increase the productivity.

II. METHODOLOGY

A. IMAGE PREPROCESSING AND ALGORITHM STEPS

Image processing is a method of extracting some useful information from the image by performing some operations on it. The input is an image and the output may be features associated with the image, also it is a type of signal processing.

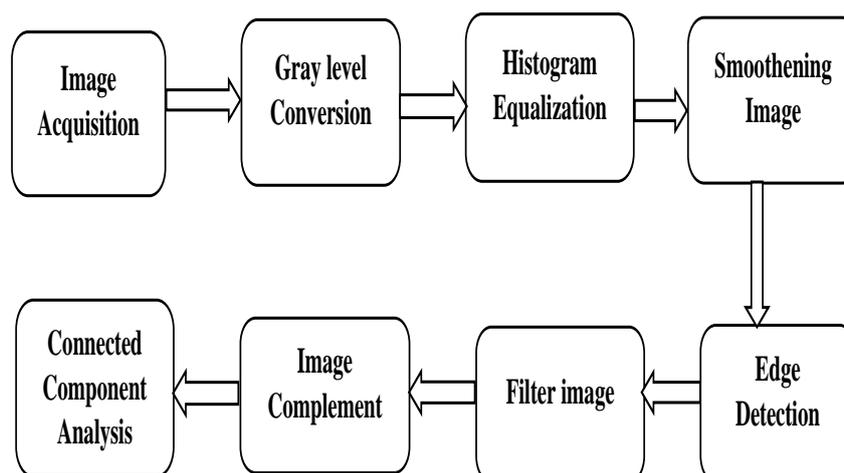


Fig 1: Image Processing Steps
1. Image Acquisition

The process of acquiring image from any specified folder or hardware components like digital camera is called image acquisition. The command `imread('image_name.jpg')` is used to read the image. A grayscale or colour image from the file specified by the string filename, where the string `fmt` specifies the format of the file the command `A = imread(filename,fmt)` reads it.

2. RGB to Grayscale Conversion

The Image need to be converted into grayscale format for post processing. This makes processing much simpler. This is to reduce the processing time for the Algorithms, for processing RGB images are not required. This sort images are also known as black-and-white images, varying from black at the weakest intensity to white at the strongest.

3. Image Resizing

Here the image is resized according to the requirement of the algorithm, Since they have some limitation on the size of images. It involves a trade-off between efficiency. Smoothness and sharpness and is a non-trivial process. The size of an image is reduced or enlarged with bitmap graphics, the pixels that form the image become increasingly visible, if pixel are averaged then it make the image appear "soft", else look craggy.

4. Histogram equalization

To improve the contrast in images this process is done. The histogram equalisation can be done automatically by adjusting intensity values. In this process the histogram of the output image approximately matches a specified histogram which involves transforming the intensity values. The intensities can be better distributed on the histogram through this adjustment. Areas of lower local contrast gain a higher contrast by this process.

5. Noise Removal

Noise may be present in the image due to many reasons. The type of the noise corrupting the image decides the nature of the noise removal problem. Several linear and nonlinear filtering methods have been proposed in the field of image noise reduction. Removing the noise is important for further processing.

6. Image Smoothing

Unwanted information in the images can be removed by image smoothing. In image processing, the result of blurring an image by a Gaussian function is Gaussian smoothing. In graphics software this effect is a widely used, typically to reduce image noise and reduce detail. A smooth blur resembling that of viewing the image through a translucent screen is the visual effect of this blurring technique, the bokeh effect produced by an out-of-focus lens or the shadow of an object under usual illumination distinctly different from it.

7. Image Filtering

This technique is used to enhance the image features. Noise or random variations in intensity values often corrupt the images. Salt and pepper noise, impulse noise, and Gaussian noise are some common types of noise. Random occurrences of both black and white intensity values is the characteristics of salt and pepper noise contains. For removing Gaussian noise and other types of noise Linear smoothing filters are good filters.

8. Edge Detection

The pixel where image brightness changes abruptly are edges. An edge is a property attached to an individual pixel and is calculated from the image function behaviour in a neighbourhood of the pixel.

9. Morphological Operations

One can construct a morphological operation that is sensitive to specific shapes in the input image, by choosing the size and shape of the neighbourhood. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbours.

10. Image Compliment

Here the image foreground and background are complemented. The black and white pixels are reversed, in binary image. The darker area becomes lighter and the lighter area becomes darker, in the colour image.

11. Connected Component Analysis

Once the boundaries are detected, it is useful to extract the regions which are separated by the boundary. Connected component is a binary image and is a set of components form a connected group.

B. PLANT GROWTH ANALYSIS SYSTEM FLOW

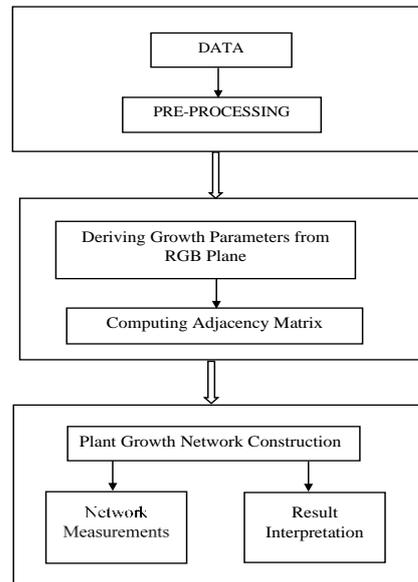


Fig 2: System Flow

1. Plant Growth Parameters

The plant growth can be visualized in terms of the increase in the length or plant height, stem diameter etc. From visible range images of agricultural crop/plant, their characteristics can be derived. By computing the pixel percentage contribution towards plant region in an image we can determine the growth of the plants.

$$P = (NPZ \div YP) 100$$

Where, P – Plant Pixel Percentage, NPZ = number of non-zero pixel, TP = total number of pixel.

2. Plant Growth Characteristics As a Complex Network

Mapping from images to complex network using the parameters derived from the previous section is called as mapping of plant growth parameter as complex network. The network vertices and their relationship creates edges in the plants under observation. The images are mapped to undirected graph $G = (V_i, E_i)$ where V_i and E_i are the set of all nodes and edges respectively in network.

3. Complex Network from Plant Pixel Percentage

For selected days of observation of the plant, the plant pixel percentage is computed. Based on each day observations different networks can be created. The observation matrix's heavy side function is used to create the adjacency matrix for a single day observation.

III. RESULTS

There are 2 module in the opening UI they are

- Process image
- Analysis

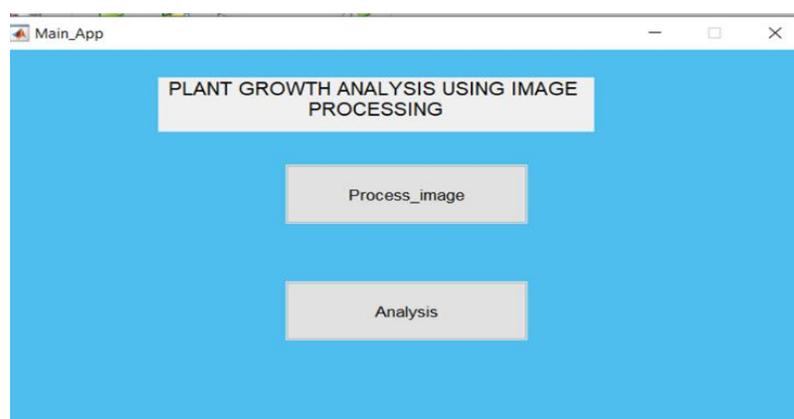


Fig 4: Main App

1. Process Image

Here the complete steps involved in the image processing process are displayed. This is applied to the dataset to obtain the output resultant images.

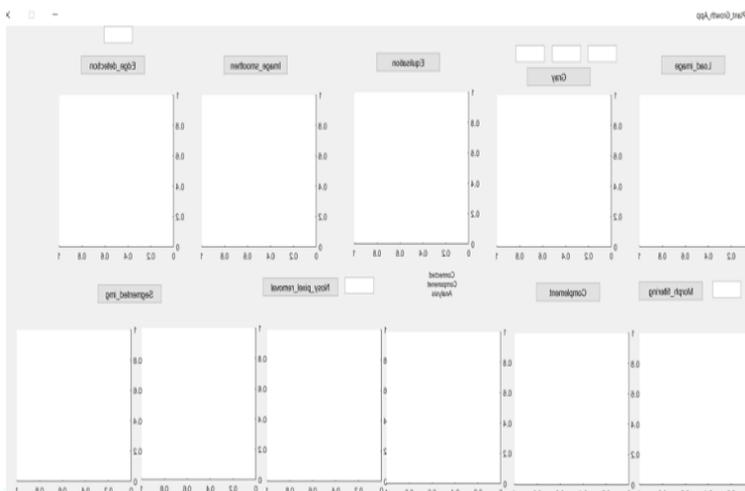


Fig 5: Plant Growth App

By Selecting on the load image, a window will pop.

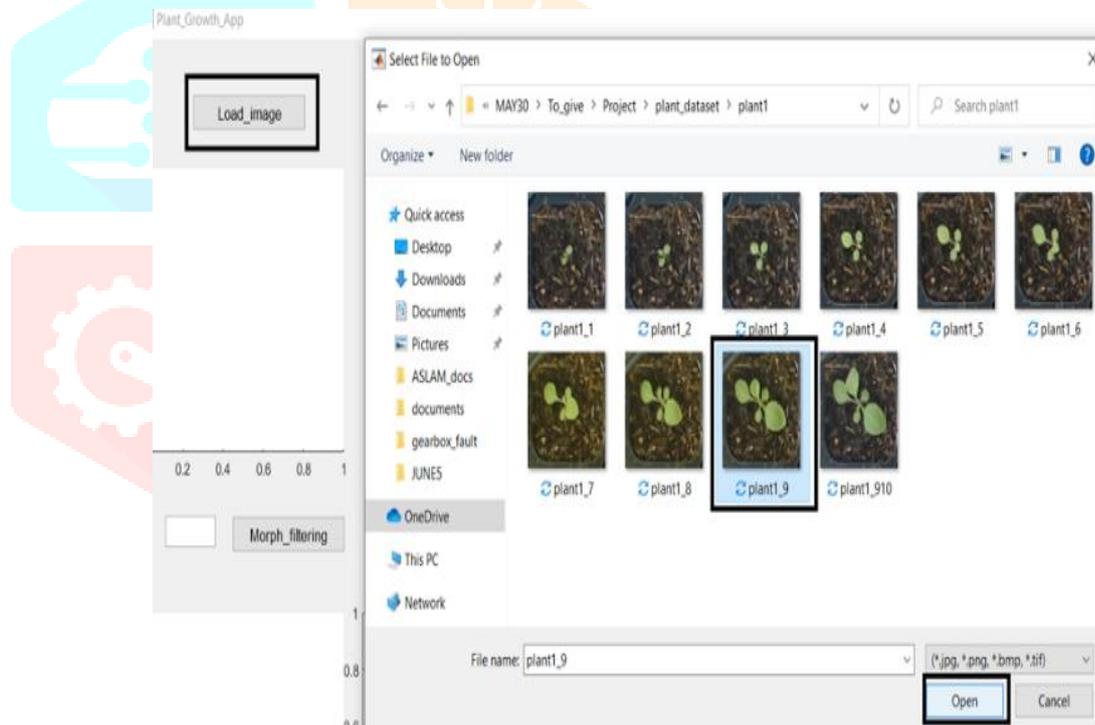


Fig 6: loading a single plant image for processing

The below figure shows the result of image processing operations performed on the selected image.

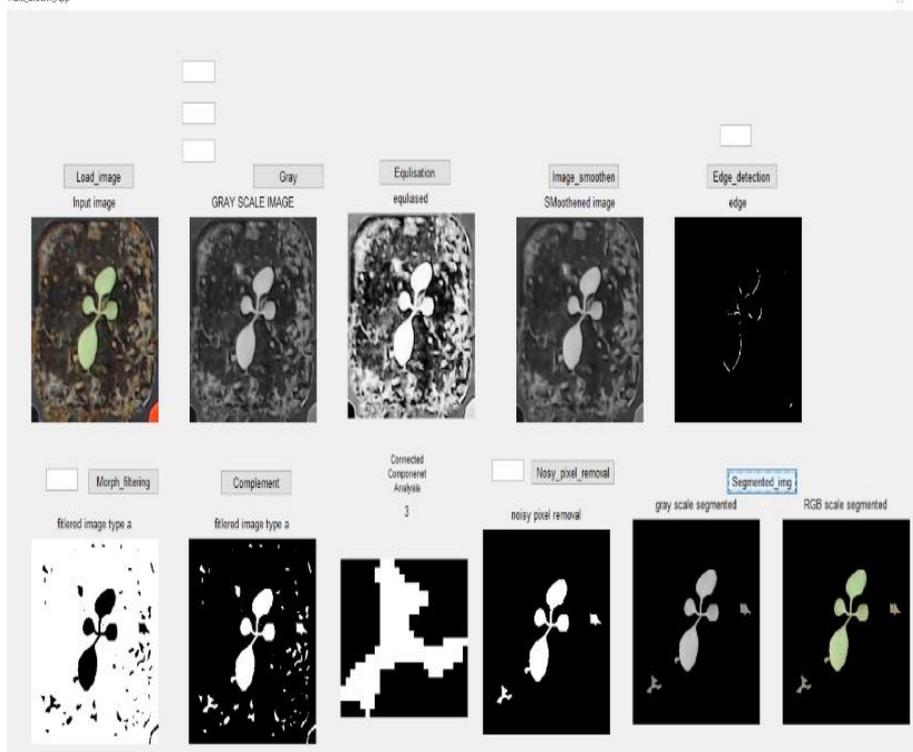


Fig 7: Result of Image Processing Operation

2. Analysis

The output dataset obtained in the previous steps are input to this stage.



Fig 8: Analysis App

Based on the data the graphs are plotted for analysis.

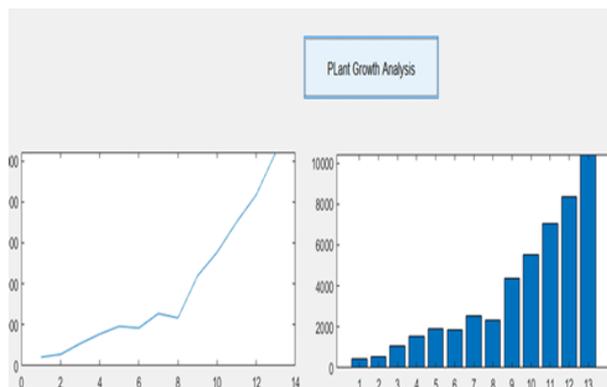


Fig 11: The plant Growth Analysis Represented as plot and Bar Graph

The day-to-day increase in pixel percentage is shown in the tabular column. Based on this the results is declared in the result window as either good or low growth.

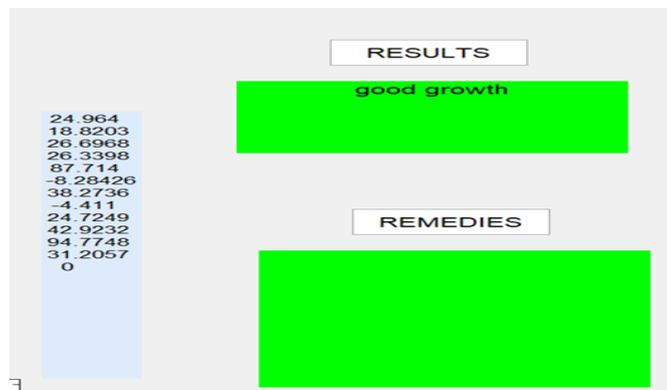


Fig 12: Result Showing Good Growth

Low Growth example

Here the results are shown for the plant which has low growth

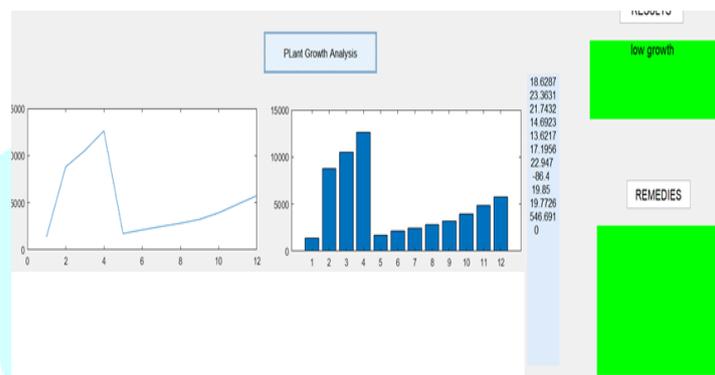


Fig 13: Results Showing Low Growth

Remedies are displayed in case of low growth

plant growth: Average growth

Remedies-----

- [1] Use balanced amounts of plant nutrients, especially nitrogen.
- [2] Ensure good drainage of fields (in conventionally flooded crops) and nurseries.
- [3] It's important to keep soil consistently moist, but avoid overwatering
- [4] Keep fields clean.
- [5] Start feeding your seedlings after they develop their second set of true leaves, applying a ha.
- [6] After four weeks, apply full-strength liquid fertilizer every other week until transplanting.
- [7] Use 'COMPOST' and 'MANURE' Organic fertilizers.

Fig 14: Remedies

IV CONCLUSIONS

The system developed for plant growth analysis using MATLAB with GUI is tested successfully in the present work. The constructed plots and graphs and corresponding measurements were able to identify the healthy, unhealthy and moderate plants under observation. If plant show consistent increase in the pixel percentage are declared as healthy. Otherwise the algorithm declare it as low growth.

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