A Cognitive Vision Based Leaf Growth Measurement Technique

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Abstract

Growth analysis of any plant provides a quantitative interpretation of the performance of any plant. To understand the physiology of any plant, growth analysis is a must. With this idea of growth analysis, this proposed work is done. The proposed work describes an image processing technique for estimating the leaf growth based on leaf area measurement. The material used is cheaper and easily available and the approach is non-destructive which provides far better growth analysis than destructive method. The image processing technique for the leaf area estimation was evaluated with graph paper method with the help of regression analysis. The proposed techniques provide a fast and accurate method to determine the leaf growth.

Keywords: Image processing, Betel leaf, Leaf area, leaf growth

1. Introduction

The term plant growth analysis refers to the quantitative methods that are applied to describe and interpret the performance of the plant [1]. The analysis could be carried under natural, semi-natural and controlled conditions. The growth analysis provides an explanatory, integrative, and holistic approach to understand the plant functioning [2]. Growth analysis of plants shows the health of the crop [3-5]. Growth analysis also provides a quantitative approach to analyze and interpret the behavior of the plant or crop. Analyzing plant growth provides the holistic, explanatory, and an integrative approach to interpreting plant physiology, morphology, phenology, and functions often required in research and educational purpose [6,7]. In the present work to analyze the plant growth, the leaves are of main concern. Leaves are the lateral outgrowth of the plants. Plant leaves are spread around the plant stem to absorb the maximum sunlight for the plant. These are the most vital organ for the food production.

The objective of this work is to analyze the growth of the betel leaf. For that image processing technique is applied. Matlab is used as the programming platform. This work is done to provide an easy, accurate, and fast method for the estimation of leaf area which is an important growth parameter. Proposed work is done with the aim that this could be helpful for the plant scientist and researchers in the study of the betel leaf and intern also benefited the farmers to earn more profit.

2. Methodology

The proposed research was conducted in betel leaf garden at Dara. A village under Rajnandgaon constituency in Chattisgarh [8,9]. Images are acquired using a

flatbed scanner at 300 dip, an algorithm for leaf area measurement using image processing technique was developed using Matlab and 0.5 mm^2 grid graph paper was used to validate the electronic leaf area measurement.

To achieve the goal of determining leaf growth via leaf area measurement two different methods are applied for the betel leaf area calculation, first is graph paper method and the second is the proposed technique i.e. the image processing technique.
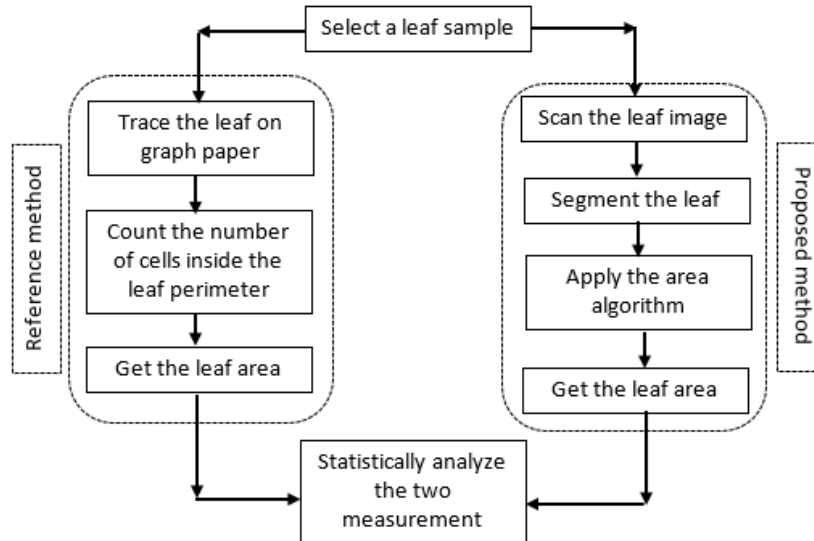

Figure 2.1 Flow of the proposed work.

The above Figure 2.1 has two paths for the two different methods applied for the calculation of the area of betel leaf. In the last step of both the methods calculated area of the leaves is obtained and the two results are analyzed using regression analysis. Regression analysis is performed to show that if there is any significant relationship between independent variable and dependent variable [10]. In the present work area calculated by a graph paper method is independent variable as it is widely used and well known, whereas area calculated by the image processing method is considered as the dependent variable because area calculated by this method should be approximately equal to the area of the graph paper method. The step required to attain the growth parameter is discussed below:

o   Leaf samples were selected
o   Traced on 5 mm grid papers with serial number and scanned simultaneously.
o   Area calculated by the grid counting method and the image processing technique.
o   Compared the area calculated by two different methods.

The fundamental parameter to achieve the leaf growth is the leaf area measurement [11, 12]. To achieve the goal of this proposed work above mentioned steps are to be followed by a top-down order. Every step is taken with the idea to analyze the growth of the betel leaf. The importance of the growth analysis of any plant is explained, hence step by step approach for analyzing the growth of betel vine would be convenient and feasible.

Leaf area measurement plays a vital role in determining the growth of a leaf. The estimation of the betel leaf area in this proposed work is done by image processing technique. As the applied technique is new and requires some proof so that its authenticity can be stabilized. Therefore the proposed image processing technique has been compared with a reference method i.e the graph paper method. It

is the traditional method for the leaf area estimation and applied by many researchers for their work [13, 14].

In the proposed work with the help of two different methods, an effort is made to put forward a relatively easy and accurate technique. On every betel leaf, both techniques are applied and the results of both the techniques are used for further analysis. The calculation of leaf area with two different methods is performed on 100 betel leaves for authenticating the proposed work. A detail of leaf area calculation is provided with the flow diagram of figure 2.1. After obtaining the area from graph paper techniq and image processing technique of a leaf sample, both the leaf area observation are subjected to regression analysis. The result of the analysis are discussed in the result section.

3. Result

To evaluate the estimated image processing method for leaf area measurement, linear regression analysis (figure 3.1) is done. The purpose of using linear regression analysis is that it measures the correlation between one dependent and one independent variable. To start with the regression analysis x-y coordinate plot is to prepare that gives the one line fit plot for the 100 samples.
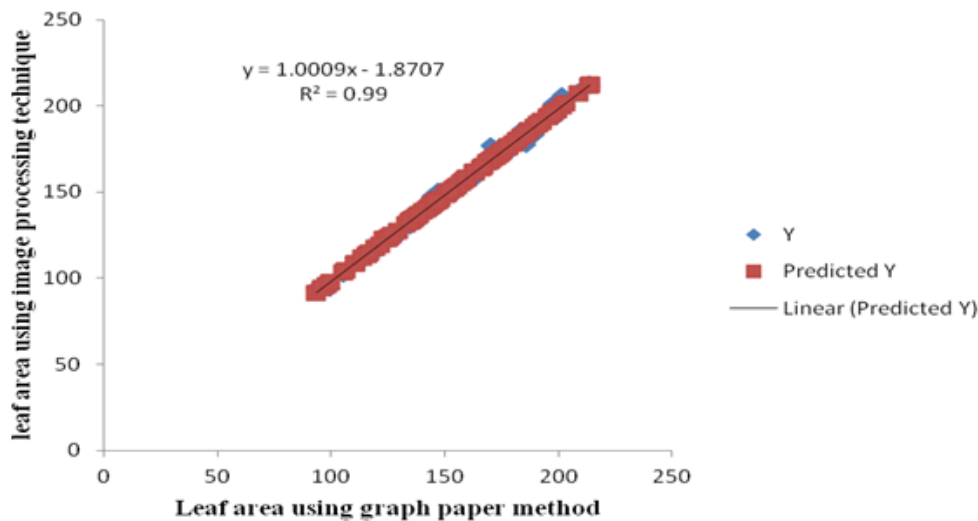

Figure 3.1 A linear regression between leaf area measurement using image processing technique and graph paper method.

Figure 3.2 shows the growth of the betel leaf on every two alternate days, these samples are taken for measuring the growth of the betel leaf. On the basis of leaf area measurement, following bar chart is shown (figure 3.2) which gives the better view of the growth of the betel leaf.
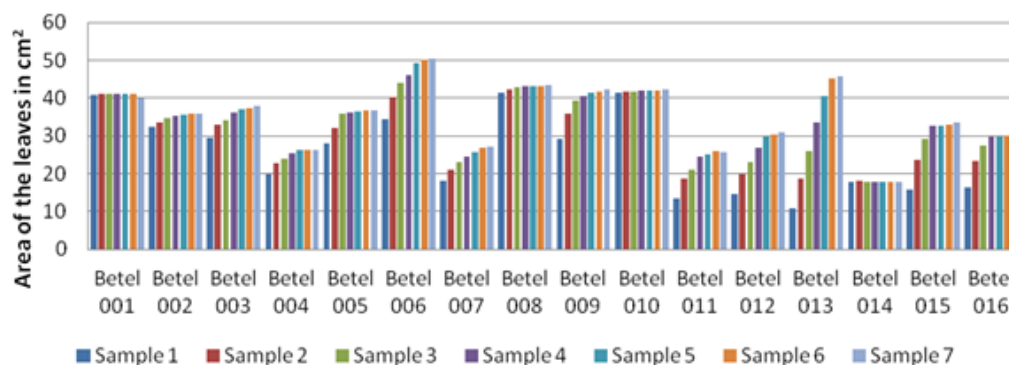
Figure 3.2: Growth of the sixteen betel leaf on the basis of leaf area measurement, taken seven samples from the individual leaf at every two alternate days.

4. Conclusion:

With the help of this proposed work, it can be concluded that the image processing technique could be applied in the growth analysis of the betel leaf. Also, seven samples of sixteen betel leaves are included to show the growth and we can see that some leaves which are affected by some disease do not grow further.

Regression analysis is done in the leaf area estimation technique where we tested the correlation between the graph paper method and the image processing technique. R^2 is found as 99%, which shows that both the methods are highly correlated.

With the help of the analysis and the observations performed we can conclude that this proposed work is helpful in the growth analysis of the betel vine plant. Here a simple and fast technique is provided to find the leaf area directly from the field and with the help of the very easily available devices. So this technique is useful in the growth analysis of the betel leaf which is almost an untouched field if we particularly talk about the betel vine and hence this method will directly affect the farmers who earn their livelihood by this leafy crop.

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