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Novel Approach For Crop Height Measurement Through Images

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ABSTRACT

Agricultural statistical systems, a fundamental element of plant science and research is much required currently for working out the agricultural policy of a nation and hence the victuals status of the globe. Crop condition monitoring through an assortment of methodologies is one such important information for the authorities to manage and adjust the grain distribution with nation and so attracted the researchers now-a-days a lot. Few of the necessitated decisive information, to be extracted from the crop for the analysis are i. Measurement of growth or height of the crop, ii. Estimation of chlorophyll content. iii. Disease level of the crop. Out of these three , the proposed work extract the first one say the measurement of the height of the crop at periodic intervals through image modeling especially, for the rice crop. An automatic image processing technique is deployed to detect rice crop height by capturing the crop images using a digital camera. The camera set up with sensors, communication and control unit in the paddy field referred as field server captures the paddy images at consistent intervals during a day. A marker bar is also to be installed in the focus area of the digital camera so that the captured images will be always having the marker bar providing a reference level for the measurement of the height of the crop. Acquired images from the field sever with marker bar should go through four modules for the automatic measurement of the growth of the paddy. First module separate the color bands in RGB model and then computes three more components referred as Excess red, green and blue for the clear vision of the marker bar with that of the crop. Subsequent modules perform filtering and then segmentation with simple thresholding where the binary image consists of only the marker bar and the crop to be measured.

Index terms : Crop Height, Field server, segmentation etc.,

1. INTRODUCTION

Agriculture, the cultivation of plants, fungi, and other life forms for food, fiber, biofuel, medicinals used to sustain and enhance human life. Being the key development in the rise of sedentary human civilization, whereby farming of domesticated species created food surpluses that nurtured the development of civilization. Consequently, the demand of modernization of the agricultural also gets increased. Today, India ranks second worldwide in farm output. Also most of the European countries economy habitually depends on agriculture production. Government across the world emphasizes the need for the increase in the production of the manual cereals includes wheat, rice etc. Arithmetical facts have great influences in working out agricultural policy making on the price, circulation of grains and commiserate track. The fundamental of crop growing model is to reflect the crop growing process with mathematical formula. Diagnosing the model asses the crop condition from the aspect of the environment influences the crop growth. Factors in the model include the crop penology, its growing stage, fertilizing situation, water stress, happen of crop diseases, spreading of weed and dough assessment. Few of the above mentioned parameters can be computed more precisely and timely with image processing algorithms. Rice crop height is an important agronomic trait linked to plant type and yield potential.

Image- based crop growth measurement has been shown to be effective in measuring and modeling crop plant growth in laboratory or greenhouse by Van Henten and Bontsema, in 1995 [1] , which in turn is improved by Morden et.al [2]. Stereo vision has been applied in to several agricultural applications. Tebourbi et al. [3] developed a stereo vision system for measurement of soil texture and recommended that stereo vision be applied to crop growth sensing. Matsuura et al. [4] developed a transplant population growth analysis system that estimated average height, leaf area, projected leaf area, and mass volume with good correlation to destructive measurements. Lines [5] et.al., developed a stereo vision system which estimated the mass of free-swimming fish with a mean measurement error of 18%. The use of field servers or automatic weather stations has been suggested as a solution to continuously monitor the status of a crop [6-10]. Fukatsu et al. [11] developed a field server with a web server to monitor environmental parameters of interest via the Internet. In Qing [12], tree height measurement methods and tools have been introduced since tree height is one of the most important factors in forest resource management.

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Based on the above literature, proposed algorithm aims at measuring the height of the crop by acquiring images from the field server unit. Section II described the hardware requirement of the work fro capturing the image and also for collection few information associated with environmental settings . Section III explains about the various processes to be done for the measurement of the height of the crop. Section IV discusses about the data collected and analysis was carried out through various stages of the image processing. Section V is the conclusion part and the last section is about to converse the future expansion associated with this proposal.

II. FIELD SERVER

Plant height information can be acquired frequently at low cost by the implementation of a field server and using digital image processing technique. The field server take daily photo of a field where a marker bar of known height is also installed in the camera is field of view. The main goal of installing field server in a farm is to monitor the plant growth, so that resources such as fertilizer and water can be optimally utilized. Field Server is to be erected in the paddy field with the following Components

- ✓ Digital Camera – to capture the paddy images at periodic intervals as per the setting of timer. Two Digital Single-Lens Reflex (DSLR) camera is needed with a mirror and prism system.
- ✓ A tipping-bucket rain gauge -to gather and measure the amount of liquid precipitation over a set period of time.
- ✓ An anemometer -for measuring wind speed, and is a common weather station instrument. Anemometers can be divided into two classes: those that measure the wind's speed, and those that measure the wind's pressure.
- ✓ Pyrometer –To measure broadband solar irradiance on a planar surface; it is designed to measure the solar radiation flux density.
- ✓ Soil moisture sensor measures the amount of moisture found in the soil.
- ✓ Communication unit for the transfer of signals from one component to other
- ✓ Control unit for the flow of various signals at appropriate time
- ✓

However our proposed algorithm mainly focuses on the height of the crop and so looks out only for the output of the digital cameras. Below flow diagram bestows the steps to be followed for the measurement of the height of the crop.

III. Proposed Algorithm

The captured color images are saparted into its three components as red(R) , green(G) and blue(B). Proposed project now computes three more components referred as excess red (E_R), excess greeen (E_G), and excesss blue (E_B) componenets. These componenets found to show more resistance to noise when the environmental changes. Equations for calculating the above three compenents are

$$E_R = 2R - G - B$$
$$E_G = 2G - R - B$$
$$E_B = 2B – G - R$$

The alternating colour pattern is easy for humans to detect and evaluate the height. In contrast, the alternating colors are harder to detect in digital image analysis than a single homogeneous colour, since a homogeneous value for the whole object is easy to separate from other objects.

We initially selected the red band to use as the primary feature in our analysis because in the red band, both the white and red colours of the marker bar will have high intensity values. In contrast, in either the green or the blue band, white areas will have high values but red areas will have low values. Then the three bands are selected in different range of pixel values and tested . Finally it is found excess green provide better performance.

Of the above three the excess green is selected as the primary feature of our analysis since the marker bar , the reference value will be looking as more homogenous in this component and the rmaining information can be easily separtaed. After band selection for the removal of the reduntant data, the edges are to be detected through the spatial filter . Lapalcian filter of first order put into operation both in X and Y axis. Even now the analysis need the marker to be more specific. To extract that featur a directional filter may be employed . Since marker is in the vertical direction , the directional filter may also be employed in the X direction. The algorithm is executed in Matlab and the images in Figure 2 bestows the input image , The red ,green and blue ban images. Figure 3 provides the information of excess red,green and blue bands

The performance of the spatial filter depends on the kernel size. In case if the kernel is larger , the image gets blurred and not able to identify the segmented componenets. On the other band, if a resolution of the marker bar is further from a camera, the marker bar in the image will be constricted. Hence, the kernel should be assigned smaller.

Now segmentation is done throgh simple threshold, and the process converts the gray scale image into a binary image. In the binary image there are a number of vertical white lines, including the marker bar . rthe crop and other noise features. The marker bar is longer than

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any of the noise lines.The height of the crop is then computed using the given formula

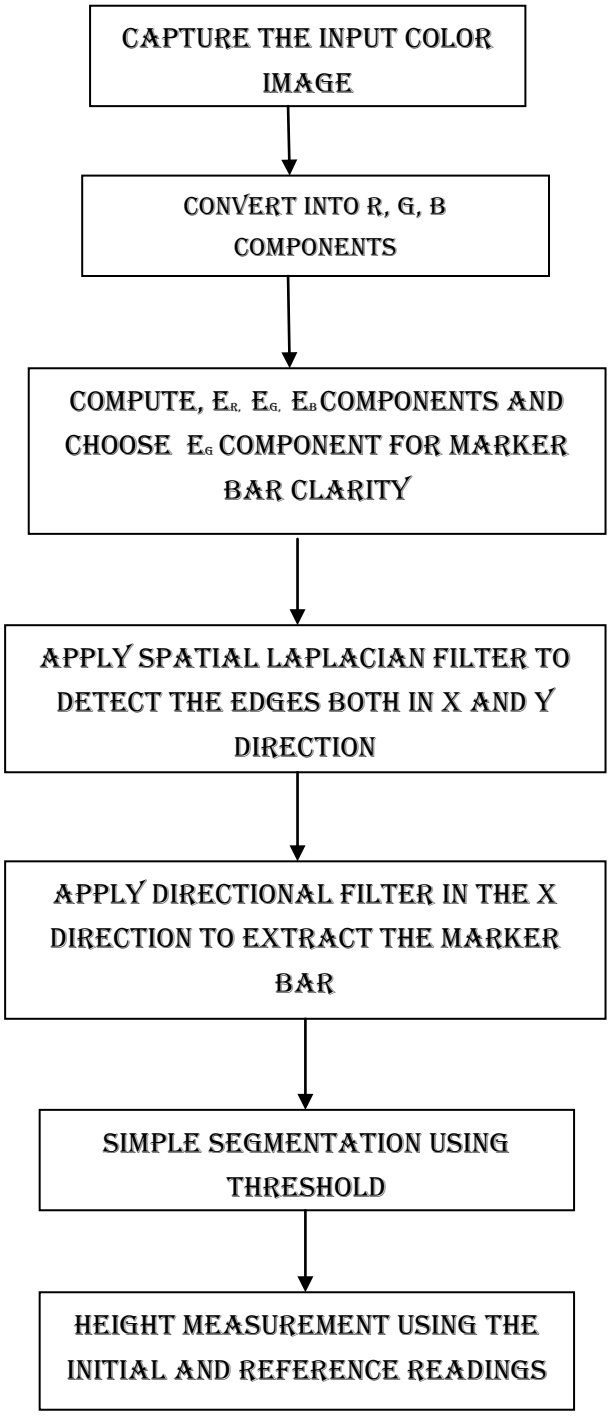

Figure 1. Flow Chart for Height Measurement

$$\mathbf{H = (I-M/2) + L + R,}\ \text{where}$$

H ⟶ Height of the crop
I ⟶ Initial Marker Height in pixels
M ⟶ etected Marker Height in pixels
L ⟶ Initial Marker Height in cm
R ⟶ Initial reeading of the crop

The same exercise may be repeated with the other excess components for analysis. By using multiple marker bars also the experiments may be conducted

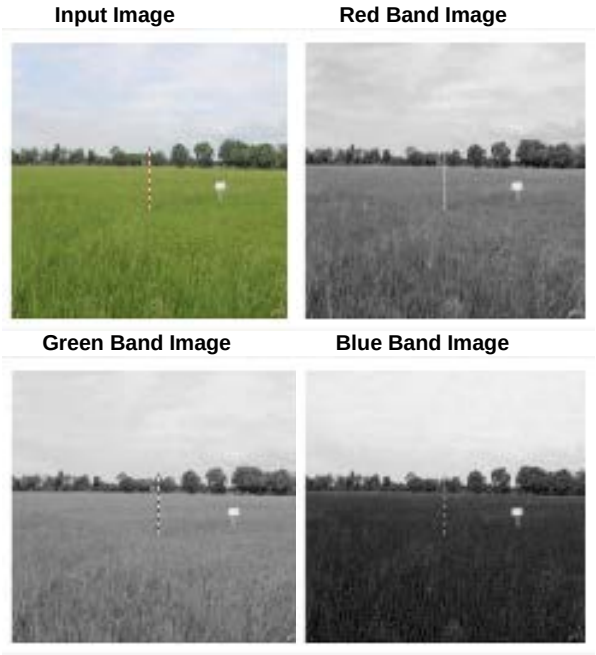

Figure 2. Input and color band images

IV. RESULTS AND DISCUSSIONS

The rice crop area images were taken consistently at a specific time and found to be better in the mid noon. More than 50 images were taken. A value for initial rice crop height is needed for the height calculation. Hence during the initial period the readings were noted. The height are measured manually and compared with automatic calculation . we could possibly introduce a hybrid data analysis method since the other sensors of the field sever provide other information to support estimation of rice crop height. The rainfall is possibly one factor that affects the

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accuracy in the crop height measurement. The measurement may be inaccurate or unreliable when taken during the rainfall

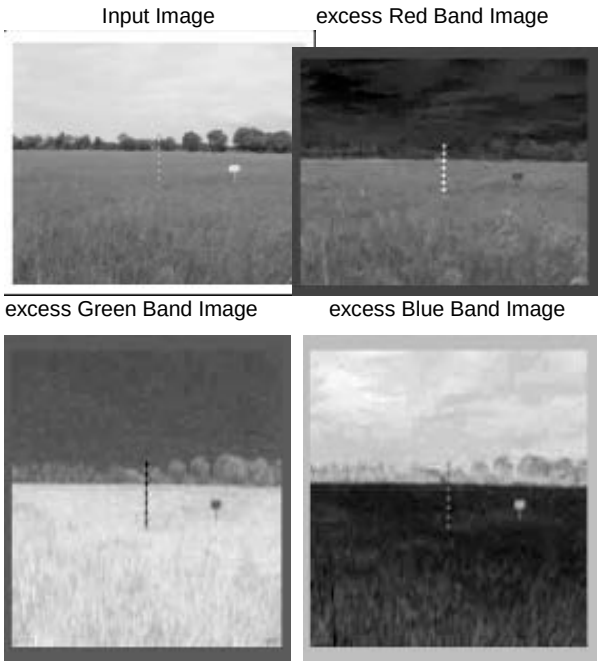

Figure 3. Excess Band images

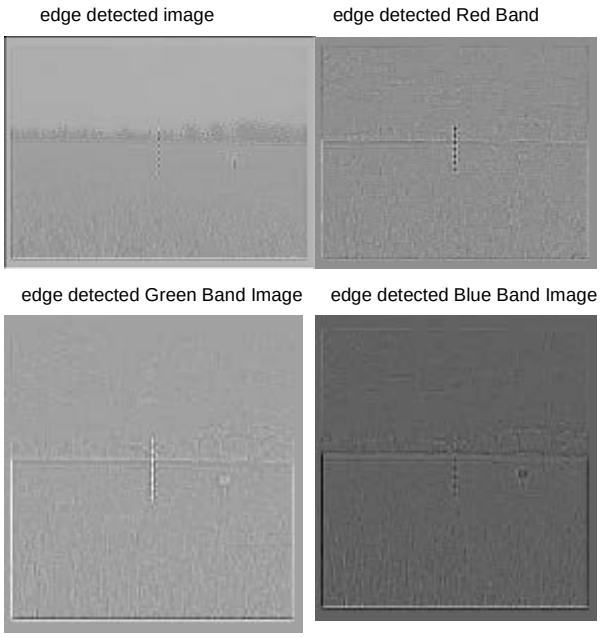

Figure4. Edge detected band images

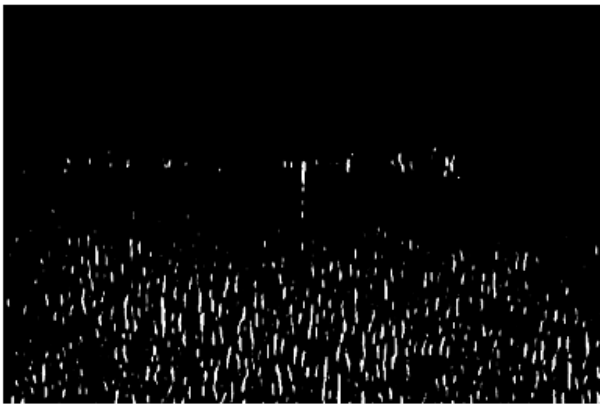

Figure 5.. Segmented image with more noise lines(RB)

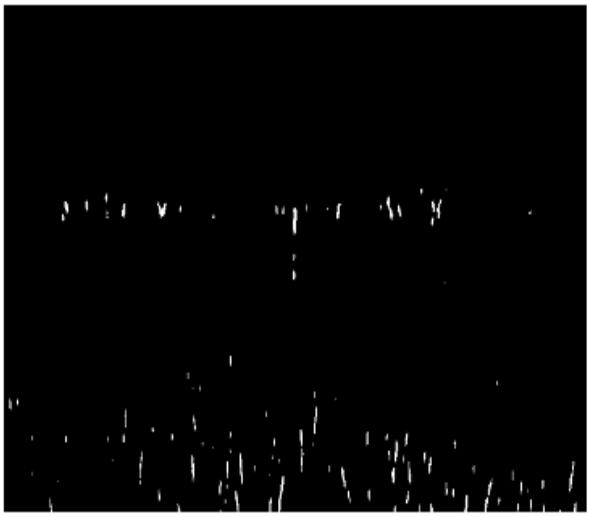

Figure 6.. Segmented image with more noise lines

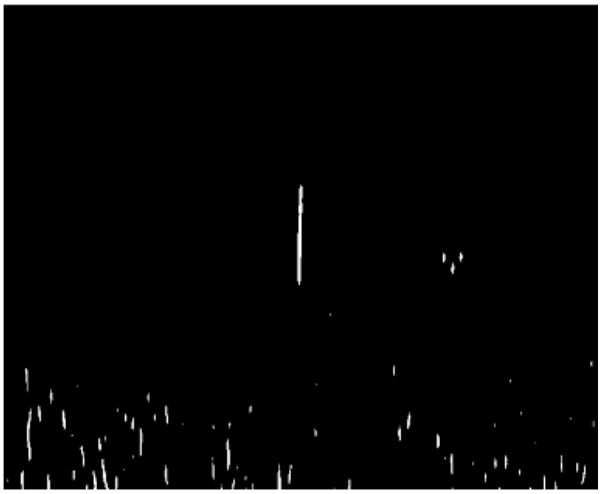

Figure 7.. Segmented image with clear marker bar

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