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## Identification of Low Growing Zone in Agricultural Land

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### ABSTRACT

The objective of our research is to identify the low growing zone in agricultural land. The agricultural land under study is of the citrus food productive land. In this work, we have collected the image dataset of an orange farm, corresponding to the various stages of its growth and representing plant growth in the form of the height of the plants. On this image dataset, various image processing algorithms are applied. Otsu's thresholding and segmentation are carried out. Further, on the resulting images, the masking technique is applied and finally, the low growing zone is identified in agricultural land. The experimental images show that Otsu's Method is effective in segmenting the images and identifying the low growing region.

Keywords: Segmentation, Thresholding, Image Processing, Otsu's Thresholding, agriculture.

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### 1. Introduction

Image Processing is a computer-based technology, which accomplishes the interpretation, processing, and manipulation of visual data. It plays a major role in our daily life, as well as in fields of science and technology, with applications such as robotics, remote sensing, medical diagnosis etc. Image segmentation is the process of dividing a digital image into multiple segments (sets of pixels, also known as image objects). Segmentation is the process to simplify the depiction of an image into something more meaningful and easier to analyze. More accurately, image segmentation is the process of assigning a label to every pixel in an image such that pixels with a similar label share certain aspects. In digital image processing, thresholding is the easiest way of segmenting images. In this, the value of the threshold is set as constant. If the intensity of a pixel is less than the threshold value, then the pixel is replaced by a black pixel, else if the intensity of a pixel is more than the threshold value, then the pixel is replaced by a white pixel. Generally, we use thresholding as a way of selecting our domain of interest in an image while ignoring the parts that are not relevant to our image. In thresholding, we convert a RGB or grayscale image into a binary image. In simplest thresholding method, if the image intensity  $I_{i,j}$  is less than some fixed constant, called Threshold (T) (that is,  $I_{i,j} < T$ ), then each pixel in an image is replaced with a black pixel or if the image intensity is greater than that constant then the pixel is replaced by a white pixel. Deciding a proper value of threshold plays a vital role in segmentation. For example, if we set the value of the threshold too high, some principal regions (plant pixels) may be merged with other regions (background pixels) which leads to under-segmentation, while if the value of the threshold is set too low, it may lead to over-segmentation.

Our research can be beneficial in the following ways:

1. Land with and without greenery after specific duration of intervals can lead to certain conclusions pertaining to plant health, soil status, watering etc.
2. Barren land/ land without greenery will be properly used for some other cultivation as per the soil quality and conditions.
3. Farmers can earn extra income by using this unplanted land.

Overall, the farmers will be economically sound after identifying low growing zone in the complete agricultural land they possess.

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### 2. Literature Survey

Urban sprawl detection and its analysis were done using the unsupervised classification of high-resolution image data and segmentation on remotely sensed images[1]. Rule based algorithms for SAR image data is used to measure growth, yield and damage caused on rice crops[2]. Drone remote sensing is carried out for forestry research and practices[3] and Use of Drones was used to survey forests, map canopy gaps and measure forest canopy height.

Classification of Paddy crop age detection is done through Ariel Photograph Drone Devices using Support Vector Machine and histogram methods[5]. Rice crop monitoring using multirotor UAV and RGBdigitalcamera[6]and Rice Farming Age Detection Using Drone based SVM Histogram Image Classification[7]rice crop monitoring was done using SVM and AgisoftPhotoscan software.

Image Processing to Transform Agricultural Scenario is discussed [8] and the objective of a Surveyof Image Processing Techniques for Plant Extraction and Segmentation in Field is elaborated. Colour Detection and Colour Index-Based Approaches were used for image processing of agricultural land respectively. In the Colour index evaluation method for plant segmentation from a soil background, a range of 13 RGB and hue-based colour indices were evaluated for their potential to segment wheat seedlings from a red loamy-sand soil background.[10]

In Greenness Identification Based On HSV Decision Tree, the HSV decision tree-based method for greenness identification was used to distinguish thegreen crop from its background[11]. The methodology is used how to identify a number of optimal drone flight variables that should be adopted when measuring tree height the algorithm used SFM and the tool used is python[12] IOT based drones andits usage, as it is a viable solution to overcome variousobstacles that traditional machinery cannot do and wecan conclude that drones or UAVs will be of immensehelp in the field of agriculture [13]

Green Red Vegetation Index (GRVI) is used to study the gaps in sugarcane plantations with UAV images and improvement on the estimates of sugarcane production is discussed[14]. Estimation of crop plant density at early mixed growth stages is doneby taking images from the drone and performing the OBIA algorithm for safflower detection, Imageprocessing(matching), Plant count estimation accuracy Kant[15] Plant Types are identified by taking images with the drone by isolating thevegetation in the image, selecting the desired plants from the set, and estimating the area occupied by this plant using texture analysis and by using Machine Learning Algorithms. [16].

### 3. Study Area and Experimental Setup

The study area chosen for our research as shown in figure 1 is located in Katol taluka of district Nagpur of Maharashtra State, India. It is located at 21°11'07.1"N latitude and 78°35'32.7"E longitude. The farm on which the research has been conducted is of orange plantation. The total area of the farm is 30 acres, but the area selected for our research is of 5 acres. The distance between two orange plants is of 18 feet. The soil used for orange plantation is black soil.

The plant images that are used we captured from iPhone 11. The first stage images were taken in the year 2019 and the further stage crop images were taken till 2020.

### 4. Methodology

For this study, the algorithms are developed using Python (Jupyter Notebook) software and statistic is generated using image dataset from the year 2018 to 2020. Thus, the data of different periods starting from July 2018 till September 2020 is analysed. Input image data is captured with iPhone 11 and the data is of RGB type. The complete data set is converted into grayscale images. After that, in order to identify the plant region and the barren land, thresholding is carried out. After thresholding is done segmentation is carried out and the low growing zoneis identified.

#### 4.1. Image Dataset and its Conversion from RGB images to Grayscale



Fig. 1 - (a) Stage 1; (b) Stage 2; (c) Stage 3; (d) Stage 4

The various figures indicated above are captured and used for study. The images are of RGB type. When converting an image from RGB to grayscale, the RGB values are taken for each pixel and made as a single value output reflecting the brightness of that pixel. `rgb2gray (RGB)` is the syntax used to convert the true color image to the grayscale image by eliminating the hue and saturation details while preserving the luminance.

### **Otsu's Thresholding**

Otsu's method is a greatly used thresholding technique. It was proposed by Nobuyuki Otsu in 1979. The aim is to find threshold value where sum of foreground and background is minimum. This method works on image histogram and segmenting the object. This technique gives accurate results for bimodal and agricultural images. The histogram consists of two clearly visible peaks, which depicts different ranges of intensity values. The idea is to divide the image histogram into two groups defined as an output of minimization of weighted variance of these classes.

There are two ways of finding threshold value: first method is by minimizing within class variance:

$$\sigma^2(t) = w_1(t)\sigma^2_1(t) + w_2(t)\sigma^2_2(t) \dots \dots \dots (1)$$

Second method is by maximizing between class variance:

$$g(t) = w_1(t)w_2(t)[\mu_1(t) - \mu_2(t)]^2 \dots \dots \dots (2)$$

In this study, Otsu's Thresholding method is used to find the threshold value, which is further used in the segmentation process.

Threshold value is obtained with algorithm 1.

#### **Algorithm 1:**

1. Import the libraries and process the image by filtering it using a 5x5 Gaussian kernel.
2. Obtain image histogram and normalized histogram and save in Q.
3. Create an array of intervals to display in the histogram. Set the range of the array less than infinity.
4. Initialize the value of threshold as -1.
5. For range (1,256); find probabilities, the sum of classes and weights.
6. Define the lower range of the sum of classes. 7. Using probabilities, the sum of classes and weights find mean and variances. 8. Calculate the minimization function.
9. Find Otsu's threshold value with the OpenCV function.
10. Print the value of the threshold.

#### **Segmentation:**

In this study, algorithm 2 is used to segment the gray scaled images obtained into two regions: plant pixels and soil pixels using the threshold value found from Otsu's thresholding method. The complete image is segmented into two regions based on the Otsu threshold value and this algorithm 2 is as follows.

#### **Algorithm 2:**

1. Import libraries and read the grayscale image.
2. Take the shape of image and save in three variables: m, n, o.
3. Find the maximum value of gray level.
4. Take the threshold value and save in T.
5. Initialize an array of zeros and take range of m, n and o in i, j and k respectively.
6. If the range (i, j and k) is less than threshold value, then image pixels will be replaced with black pixels. 7. If the range (i, j and k) is greater than threshold value, then image pixels will be replaced with white pixels.

### **3. Segmentation Results:**

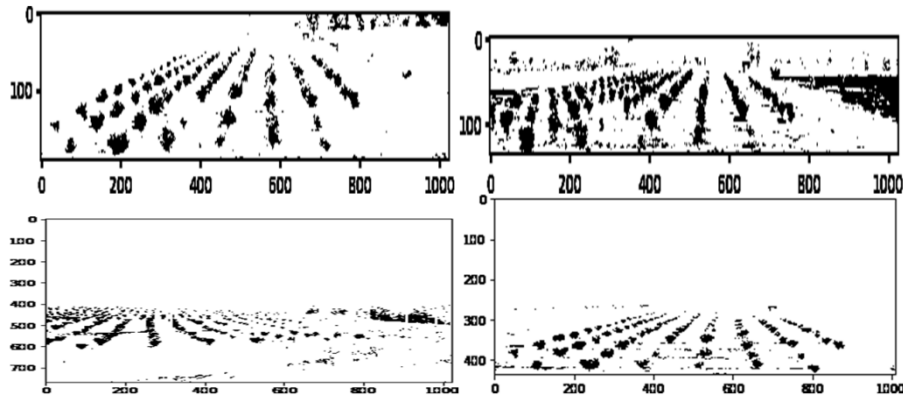


Fig 2: Segmented Output of Input Images. (a) Stage 1; (b) Stage 2; (3) Stage 3; (d) Stage 4

In order to find out the low growing zone in an agricultural land, the area calculation is required to be carried out. The essential requirement in this approach is to find out the co-ordinates of the farm images which will further lead to area calculation. The algorithm used to find coordinates of low growing zone is elaborated in algorithm3.

**Algorithm 3:**

1. Import the image and display the image using the cv2 library function.
2. Call the set Mouse Callback () function and pass the image window and the user-defined function as parameters.
3. The left mouse click are checked in the user defined function using cv2 library function.
4. The coordinates are displayed on the Shell and on created window.
5. The right mouse clicks are checked in a similar fashion.
6. The cv2.waitKey(0) and the cv2.destroyAllWindows() are used to close or terminate the window.

**4. Low growing region calculation:**

After finding the coordinates, the low growing region is computed using shoelace formula as given here with and applying algorithm 4.

$$\text{Area} = \frac{1}{2} \left| \sum_{i=1}^{n-1} x_i y_{i+1} + x_n y_1 - \sum_{i=1}^{n-1} x_{i+1} y_i - x_1 y_n \right|$$

**Algorithm 4:**

1. Put coordinates of polygon in X and Y and define length of X in variable n.
2. Define class as polygon area and pass X, Y,n.
3. Initialize value of area as 0.0 and take variable j and put j = n - 1.
4. For i in range (0,n), find the area of polygon using Shoelace Formula. Return and print absolute value of area in output.

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**5. Result**

In this study, we have used thresholding which is a part of image segmentation on agricultural land images to identify the low growing region. We have done thresholding by converting original images into grayscale images and did the same thing by extracting R, G, B planes.

The stage wise experimentation on the agricultural land images producing citrus fruits concludes that, in identifying the barren land the segmentation needs to be carried out. Original land RGB images converted into grayscale image can yield more precise and clear output followed by output of images extracted from red plane which intern were better than the green plane output images. The blue plane did not give satisfactory output.

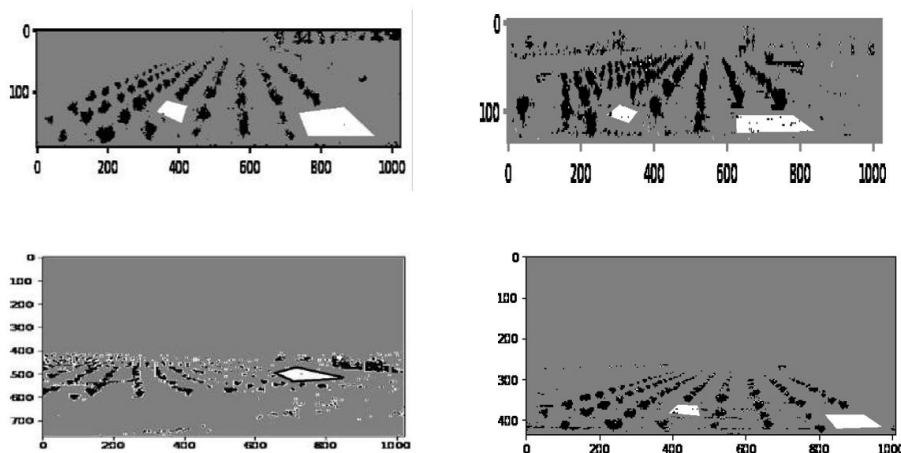


Fig. 3. (a), (b), (c) and (d) The highlighted portion in the above four images show the low growing patch on the segmented images of the farm.

## 6. Discussion and Area Calculations

The total area of the farm is 30 acres. However, the area of the orange farm, upon which we have done our experimentation is 5 acres, which roughly comes to be 217800 sq feet. According to the owner of the farm, there are indeed two main patches of land where either the plants didn't grow or the soil is infertile. The patches of land are roughly 1000 sq feet and 500 sq feet in area. When verified with the results that we got after segmentation, the owner indeed confirmed that they were the same patches of land.

According to the area calculated by us using Shoelace formula from the images, the total area found was 50000 sq units. The area of the bigger patch towards the lower right side comes out to be 600 sq units, while the area of smaller patch towards the left side is 200 sq units.

The ratio found between the areas of the bigger patch and smaller patch comes to be 2 and 2.5 respectively. This difference is due to difference of angle at which the images were taken. Taking into account the angle, we can say that the area found by Shoelace formula and the original area comes out to be approximately same.

## 7. Conclusion

In this work, firstly we have done the literature survey related to agricultural land, and the algorithms are enlisted for the various works done so far. For low growing zone identification, the block schematic is finalised from this literature survey. Then we have collected the image dataset, which is divided into four stages depending on the height of the orange plants. On these images we have applied the algorithms, which were based on thresholding and segmentation and extraction of planes. Firstly, we found the threshold value of the images by using Otsu's Thresholding method. The segmentation was performed and finally low growing zone in the images were identified. Identified the low growing zone using the masking technique. The experimentation results of low growing zone are verified with the actual area (dimensions) of the farm. Further it is concluded that, images converted into grayscale gave more precise and clear output than the output of images extracted from red plane which were better than the green plane output images. Lastly the extracted images from blue colour plane did not give satisfactory output.

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