International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 05, May - 2017

Identification and Counting Trees from Oil Palm Plantations using Digital Image Processing Techniques

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***Abstract*— To monitor production and assess plantation value, oil palm plantation managers must know how many trees are on their plantations, which range in size from less than 40 hectares to as much as 75,000 hectares. Currently, workers are deployed to the plantations to count trees manually. The cost of manual counting is low, but accuracy is doubtful. Using digital image processing technique, design graphical user interface for automated tree counting in oil palm plantations. Performance analysis is done by applying receiver operating characteristic curve. Automated tree counting in oil palm plantations is already done by The Centre for Remote Imaging, Sensing and Processing (CRISP) at the National University of Singapore and they have got 90 % result. But using proposed speeded up robust feature (SURF) algorithm we have got 95 % accuracy.**

***Keywords*— Oil palm plantations, counting trees, digital image processing techniques**

I. INTRODUCTION

Remote sensing is the measurement of object properties on Earth’s surface using data acquired from aircraft and satellites. It attempts to measure something at a distance, rather than in situ, and, for this research’s purposes, displays those measurements over a two-dimensional spatial grid, i.e. images. Remote-sensing systems, particularly those deployed on satellites, provide a repetitive and consistent view of Earth facilitating the ability to monitor the earth system and the effects of human activities on Earth. There are many electromagnetic (EM) band-length ranges Earth’s atmosphere absorbs. The EM band ranges transmittable through Earth’s atmosphere are sometimes referred to as atmospheric windows.

The human eye only detects, viz. the reflective solar radiance humans actually see, that part of the EM scale in the band length range 0.4 – 0.7 µm. But remote sensing technology allows for the detection of other reflective and radiant (e.g. thermal) energy band-length ranges that reach or are emitted by Earth’s surface, and even some Earth’s atmosphere reflects, e.g. the EM reflective qualities of clouds. Hence, for viewing purposes red, green, and blue (RGB) false color assignments are used to express the reflective qualities of objects in these EM band-length groups, and the combination and mixing of these false color assignments express the true physical reflective qualities of all objects present in an image.

A. Remote Sensing Applied to Vegetation Classification

Vegetation is important because it provides a basic foundation for all living beings. Classifying vegetation, using remote sensing, is valuable because it can determine vegetation distribution and occurrence and how such factors as moisture, latitude, elevation above sea level, length of the growing season, solar radiation, temperature regimes, soil type and drainage conditions, topographic aspect and slope, prevailing winds, salt spray and air pollutants influence it. Remote sensing can also be used to detect and prevent the spread of damaged and stressed plants.

Components that are involved in classifying vegetation include images received from satellites, remote sensing images and airphotos, chemical properties and physical properties recorded for the vegetation (including surface texture, roughness and local slope properties).

Interpretation of satellite images of vegetation becomes easier if the researcher understands what plants and tree species are native to the area, and what influences their growth and distribution. Seasonal differences and plant transitional zones will influence the remote sensing image. Of course, if the money is available, field work should still be undertaken, to provide specific information that can't be obtained from the images.

There are several factors that influence the reflectance quality of vegetation on satellite and remote sensing images. These include brightness, greeness and moisture. Brightness is calculated as a weighted sum of all the bands and is defined in the direction of principal variation in soil reflectance. Greeness is orthogonal to brightness and is a contrast between the near-infrared and visible bands. It is related to the amount of green vegetation in the scene. Moisture in vegetation will reflect more energy than dry vegetation.

Leaf properties that influence the leaf optical properties are the internal or external structure, age, water status, mineral stresses, and the health of the leaf. It is important to note that the reflectance of the optical properties of leaves are the same, regardless of the species. What may differ for each leaf, is the typical spectral features recorded for the three main optical spectral domains; leaf pigments, cell structure and water content.

Electromagnetic wavelengths affect different parts of plant and trees. These parts include leaves, stems, stalks and limbs of the plants and trees. The length of the wavelengths also play a role in the amount of reflection that occurs. Tree leaves and crop canopies reflect more in the shorter radar wavelengths, while tree trunks and limbs reflect more in the longer wavelengths. The density of the tree or plant canopy will affect the scattering of the wavelengths.

C. *Multispectral imaging system*

The sensor is a multichannel detector with a few spectral bands. Each channel is sensitive to radiation within a narrow wavelength band. The resulting image is a multilayer image which contains both the brightness and spectral (colour) information of the targets being observed. Examples of multispectral systems are: QuickBird, LANDSAT MSS, LANDSAT TM, SPOT HRV-XS, IKONOS MS

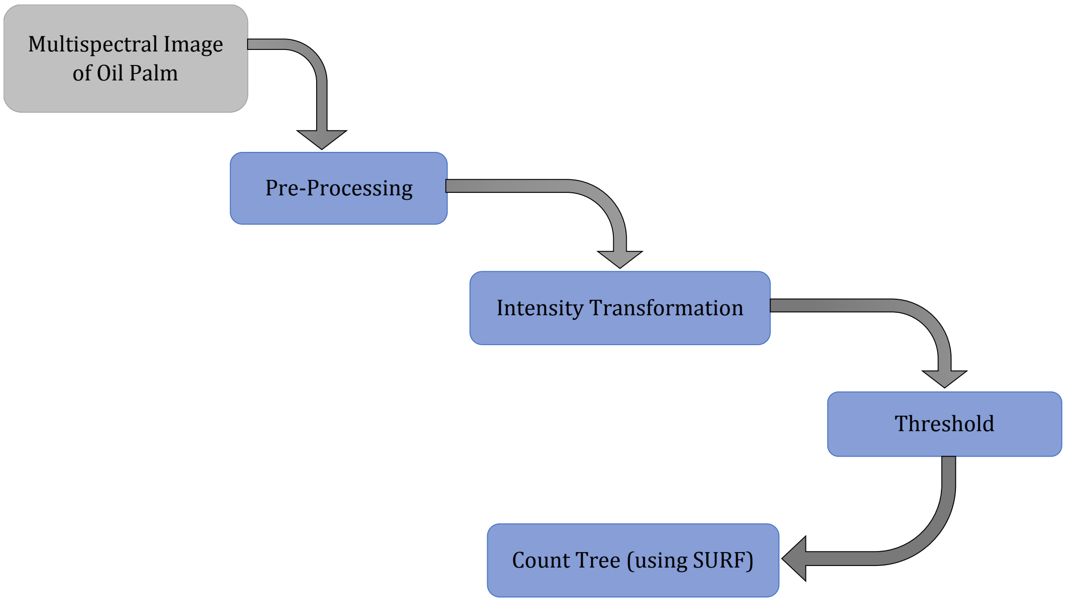

Fig 1: Workflow for Identification and Counting Trees from Oil Palm Plantations

Within the electromagnetic spectrum, bands will produce different levels of reflectance rates. For example, in the visible bands (400 - 700 nm), a lower reflectance will occur as more light will be absorbed by the leaf pigments than reflected. The blue (450 nm) and red (670 nm) wavelengths include two main absorption bands that absorb two main leaf pigments.

The images created by remote sensing will be influenced by these factors: quality, scale and season of photography, film type and background. Other factors that influence vegetation classification are time of day, sun angle, atmospheric haze, clouds, processing errors of transparencies/prints and errors in interpretation the images.

B. *Oil Palm Tree*

Oil palm is an important plantation crop in the tropical regions. In world vegetable oil trade, palm oil is second only to soybean oil. In 1999, world production of palm oil was 20.5 million tons, compared to 24.7 million tons of soybean oil. Oil palm plantation managers are potential users of high-resolution imagery.

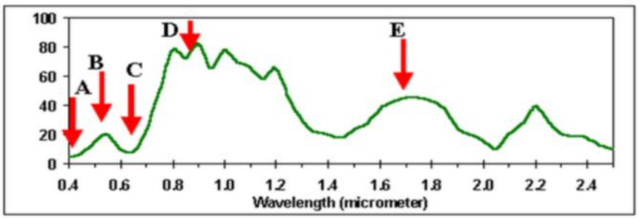

Fig 2: Spectra signature

Typical reflectance spectrum of vegetation. The labelled arrows indicate the common wavelength bands used in optical remote sensing of vegetation: A: blue band, B: green band, C: red band, D: near IR band, E: short-wave IR band.

II. METHODOLOGY

To monitor production and assess plantation value, oil palm plantation managers must know how many trees are on their plantations, which range in size from less than 40 hectares to as much as 75,000 hectares. Currently, workers are deployed to the plantations to count trees manually. The cost of manual counting is low, but accuracy is doubtful. Using digital image processing technique, detection and counting is done. Following are the mathematical formations.

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A. Green Channel Separation

In Preprocessing taken Green channel from rgb image because Green channel has high Intensity as compared to Red and Blue.

$$g = \frac{G}{(R+G+B)} \qquad (1)$$

B. Enhancement

For Image Enhancement Histogram Equalization is used

$$h(v) = \text{round}\left(\frac{cdf(v) - cdf_{min}}{(M\times N) - cdf_{min}} \times (L-1)\right) \qquad (2)$$

Here cdf_{min} is the minimum value of the cumulative distribution function, M × N gives the image's number of pixels and L is the number of grey levels.

C. Intensity Transformation Function (Remove Shadow)

Then for removing the shadow we have used Intensity Transformation function

$$s = T(r) \qquad (3)$$

Where T is Transformation and r is Intensity

D. Detect SURFFeatures (For Counting of Tree)

Then for counting the trees, used the Speed up Robust Features

$$I_{\Sigma}(x,y) = \sum_{i=0}^{i\le x}\sum_{j=0}^{j\le y} I(x,y) \qquad (4)$$

Given an input image I and a point (x; y) the integral image $\boldsymbol{I}_{\Sigma}$ is calculated by the sum of the values between the point and the origin.

III. RESULT

By using MATALB 2013a and Image processing technique design one graphical user interface for Automated Tree Counting in Oil Palm Plantations. And for classification receiver operating characteristic curve is used and this algorithm archives 95% true positive rates.

A. Receiver Operating Characteristic Curve

A receiver operating characteristic (ROC) or simply ROC curve, is a graphical plot which illustrates the performance of a binary classifier system as its discrimination threshold is varied. It is created by plotting the fraction of true positives out of the total actual positives (TPR = true positive rate) vs. the fraction of false positives out of the total actual negatives (FPR = false positive rate), at various threshold settings. TPR is also known as sensitivity or recall in machine learning.

Table 1: Receiver Operating Characteristic (ROC) Curve

Sr. No	Image Object	Manual Classification	TP	TN	FP	FN
1	Tree 1	Tree is visually good	1	0	0	0
2	Tree 2	Tree is visually good	1	0	0	0
3	Tree 3	Tree is visually good	1	0	0	0
4	Tree 4	Tree is not visually good	1	0	0	0

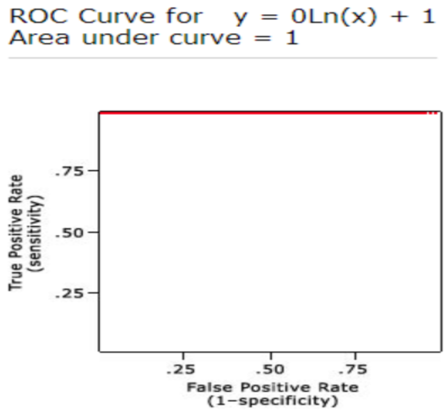

Figure 3: Receiver Operating Characteristic Curve

IV. CONCLUSION

Vegetation is important because it provides a basic foundation for all living beings. Remote sensing can also be used to detect and prevent the spread of damaged and stressed plants. Using digital image processing technique and MATLAB 2013a software, we design graphical user interface for automated tree counting in oil palm plantations. Performance analysis is done by using receiver operating characteristic curve. Proposed algorithm got 95 % accuracy for counting the trees.

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