



ALGORITHM TO EXTRACT VEGETATION COVER AND BARREN LAND REGION IN AN AERIAL IMAGE

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Abstract - Humans recognize objects despite variation through cognition and recognition mechanisms with natural intelligence. But this task is still a challenge for computer vision systems in general. Due to vast applications and enormous data (images) available in this advanced era, human interaction in computer vision systems consumes a lot of time and manpower. Every object has a unique structure and it occupies a definite position and space on the background in an image. Identifying and classifying the objects in an image is a challenging problem. Therefore, there is need for identifying the objects at different orientations and scale using machine intelligent machines which are robust and fast. In this paper, an attempt is being made to develop code for identifying and classifying objects without prior knowledge of the context of the area in the image.

Index Terms— Pre Processing, Image Stitching, Image Registration, Image Segmentation, Mean Shift Algorithm, HSV Modelling, Vegetation, Barren Land, Image Analysis.

I. INTRODUCTION

Registration of images is easy for humans as we rely heavily on our visual capabilities. Even half a glance at something is enough for us to get a general idea and even identify, classify and scan for differences in an object. Training the computer to similarly identify and classify objects accordingly is a mammoth task. An Image is an array, or a matrix, of square pixels (picture elements) arranged in columns and rows. An image is a single picture which represents something. It may be a picture of a person, of people or animals, or of an outdoor scene, or a microphotograph of an electronic component, or the result of medical imaging.

The primary objective of this paper is to register and identify the objects in an image without any prior knowledge of the context of the image and finally provide a clean description of the image.

II. RELATED WORK

H. Fadaei et al [1] discuss about the extraction of texture features from high-resolution remote sensing imagery that provides a complementary source of data

for those applications in which the spectral information is not sufficient for identification or classification of spectrally similar landscape features. High spatial resolution satellite imagery and Aerial photography have been applied to estimate tree density. In this paper, identification and delineation of tree crown, estimation of tree density by counting trees per hectare, the analyses of image segmentation, classification, texture and comparison with aerial photography, estimation of vegetation index and introduce a new method for calculating tree density on the basis of pixel-based of classification.

D. Girish et al [2] discuss about an Image Processing Method for counting the number of trees in a High Spatial Resolution Satellite Image using Texture Approach. A hierarchical strategy is followed for detecting, delineating and counting the trees in an image. Texture Approach Algorithm converts the RS Image into HSI Image for a more qualitative analysis of the image data. Image delineation is done approximately for using existing methods but does not gives the accurate tree count. This Algorithm gives accurate image delineation and also gives accurate tree count with the usage of a Structured Element in Image.

Yihong Gong discusses about a novel system that strives to achieve advanced content-based image retrieval using seamless combination of two complementary approaches: on one hand, a new colour clustering method to better capture colour properties of the original images is proposed; on the other hand, expecting that image regions acquired from the original images inevitably contain many errors, he makes use of the available erroneous, ill-segmented image regions to accomplish the object region-based image retrieval. An effective image indexing scheme to facilitate fast and efficient image matching and retrieval is also proposed. The carefully designed experimental evaluation shows that the proposed image retrieval system surpasses other methods under the comparison in terms of not only quantitative measures, but also image retrieval capabilities.

S.R. Herwitz et al [4] discusses about the potential beneficiary of remote sensing in the coffee production. Coffee blossoms do not appear and develop uniformly throughout a plantation. The resulting fruit thus tends to ripen at different times, with spatial and temporal trends that are difficult to track and predict. Thus, there are several crop management aspects that might benefit from airborne observation. Unmanned aerial vehicle (UAV) platforms are evolving rapidly from technical and regulatory standpoints. The primary cultivar grown is yellow catuai (*Coffea Arabica*) which displays green cherries when under ripe, bright yellow when ripe, turning to dark yellow or brown when overripe. Down linked images were converted to TIF format. This rendering process applied a proprietary interpolation algorithm to assign red, green and blue color information to each pixel in the frame. The higher priority frames were brightness- and contrast-enhanced and printed on photographic quality paper. The high-resolution imagery was immediately useful for mapping outbreaks of guinea grass (*Panicum maximum*) within coffee fields. This exotic (African) weed is yellow-green in color and was visually separable from darker green coffee trees. This imagery also showed differences in overall ground cover within fields. Satellites are useful platforms for regional to global data acquisition, yet remain limited in their ability to provide imagery of adequate spatial and temporal resolution for many aspects of commercial agriculture. Conventional reconnaissance aircraft can overcome many of these problems, yet they are hindered by fuel limitations and pilot fatigue. Slow-flying UAVs can essentially act as atmospheric geostationary satellites, providing high resolution, near-real time imagery for localized regions over extended time periods.

Wei Wang et al [5], Aidong Zhang and Yuqing Song in their paper Identification of objects from image regions discuss about the support vector machine classifier method to distinguish between the foreground and the background and disseminate them iteratively in order to identify the individual objects. When “background” and “foreground” are both present, the region is considered to have multiple objects. Otherwise it corresponds to a single object. In this paper, they have propose a model to address the classification problem, by detecting if a certain region contains both “background” and “foreground” regions. SVM is a core machine learning method which is very suitable for binary classification by constructing the solution hyper-planes in the feature space. This paper also discussed about how to select the training feature vectors for the SVM classifier.

III. ARCHITECTURAL DESIGN

The architectural design in Fig. 1 shows the steps taken in order to achieve the final output. First, the aerial video from the UAV is captured.

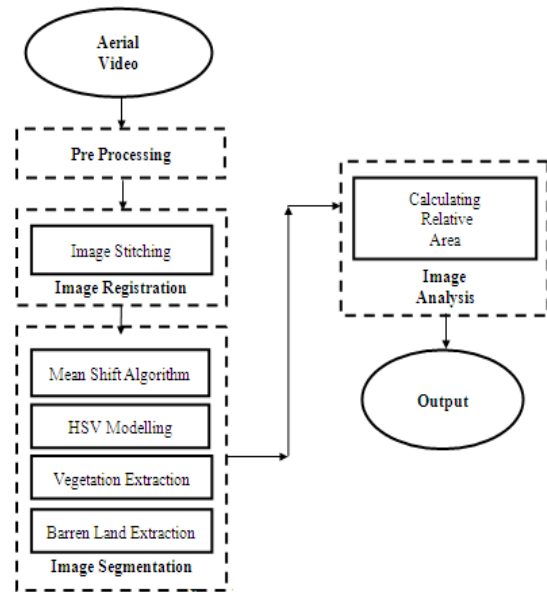


Fig - 1: Architectural Design

Snapshots of overlapping regions of land are taken from the video and used as input. Pre-processing is done to remove distortion from the image. Image registration is wherein the images are stitched together to get a panoramic view. In image segmentation, filtering is done followed by extraction of the vegetation and the barren land regions separately. Image analysis is wherein the relative area of the extracted regions is calculated. The final output is displayed on the console.

IV. IMPLEMENTATION

A. Pre-processing

Pre-processing is the initial stage wherein the aerial video taken from the UAV is used and snapshots of the video are taken. Radial Distortion in the images is removed by using the Open Source software GIMP. Distortion removal aids in retaining only the vital information in the image and removing the curvature of the image as a whole which is basically caused due to the camera being held at an angle rather than parallel to the ground. Another use of distortion removal is it helps stitch the images better. This constitutes the Pre-processing step. Some of the possible distortions are shown in Fig.2

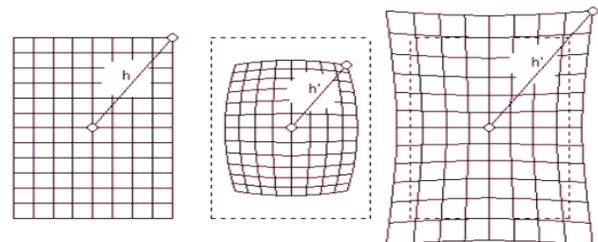


Fig -2: Different types of distortion

B. Image Registration

Image Registration is wherein we register the images by stitching together different images covering parts of the same ground area in order to create a kind of a panoramic view. This is carried out using an inbuilt class of OpenCV called Stitcher Class. This is done because the target area may be difficult to be captured within a single image and therefore more than one image may need to be stitched together to fully capture the target area on the ground. This constitutes the Image Registration step.

C. Image Segmentation

Image Segmentation is wherein we divide the image into segments in order to further analyse the image. First we employ filtering to remove high spatial frequency noise which may be introduced during the analog to digital conversion process. This process is carried out using the Mean-Shift Algorithm. It takes a part of the image in the form of a matrix, calculates the mean of the pixels covered in that region and substitutes it for every pixel. After iteration, it moves to the mean of the matrix. This means that after iteration, it moves to the denser part of the image each time. This is specifically done in order to help in the extraction of the vegetation cover and barren land region from the image. Extraction is carried out using HSV Modelling which stands for Hue, Saturation and Value and it is the most optimal colour space when we want to detect colours. The vegetation cover and barren land regions in the image are extracted into separate binary images wherein the black and non-black regions depict the background and foreground regions respectively. Using these images and the original stitched image and the source mask, the vegetation cover and barren land regions are extracted into two separate images. This constitutes the Image Segmentation step.

D. Image Analysis

Image Analysis is wherein we take the binary images of the vegetation cover and the barren land regions and calculate the percentages of their relative areas by measuring the total number of pixels and individually measuring the number of non-black pixels in each of the two binary images and calculating their percentage. Prior to this, we need to remove the unnecessary extra parts of the image which get added while stitching. After removing the extra regions, the total and individual measurements are taken and used for the calculation of the percentage of the relative area with respect to the stitched image.

V. ALGORITHM/FLOWCHART

A. Image Stitching Algorithm

Step 1: Initially, check if the input to the program is only a single image then show the error message else go to step2

Step 2: Access the image from the argument then check whether it is suitable to stitch if it is not suitable then display error message else go to step3.

Step 3: read the image and check if it is empty display error message otherwise push the current image back and read the next image and so on.

Step 4: after reading all the images create a stitcher object and then stitch the images using stitch function of stitcher object.

Step 5: check the status whether the images can be stitched or not. If the status doesn't match then display the error message else write the stitched image into a file.

B. Mean Shift Algorithm

Step1: Initially, load the image which is to be filtered.

Step2: Inputs to this program are: i) distance function for measuring distance between pixels i.e., Euclidean distance; ii) A radius. All pixels within this radius will be accounted for calculation; iii) A value difference. From all pixels inside radius r, we will take only those values are within this difference to calculate the mean.

Step 3: Convert the input image from BGR to LAB color format.

Step4: Access each pixel value of the image which is in LAB color format.

Step5: Mean Shift defines a window around each data point within the radius r.

Step6: Access each pixels within this radius r, we will consider only those differences which are within the value difference and computes its mean.

Step7: Mean Shift shifts the centre of the window to the mean then go to step5 till it converges. After each iteration, the window shifts to a denser region of the dataset.

Step8: Assign a new value of L, A and B to the result image.

Step9: Convert the result image from LAB to BGR color format.

Step10: Save the result image into a file.

C. Vegetation Extraction Algorithm

Step1: Initially, load the input image.

Step2: Convert to HSV color space. We are going to convert the input image to HSV color space since it is the most optimal color space when we want to detect colors.

Step3: Create a mask. To extract the object we need a mask. The mask is an image where the location of the object is set to 255, and the rest pixels are set to 0. To create this mask, we define the upper and lower HSV values to extract the vegetation.

Step4: There can be "holes" in the threshold image because of noise. To eliminate the holes, we find the contours and fill the interiors.

Step5: Extract the objects. Given the mask from the previous operation, we can extract the object using Logical Operation AND.

5.4 Barren Land Extraction Flowchart

The flowchart in Fig. 3 shows the step-by-step process of Barren land extraction.

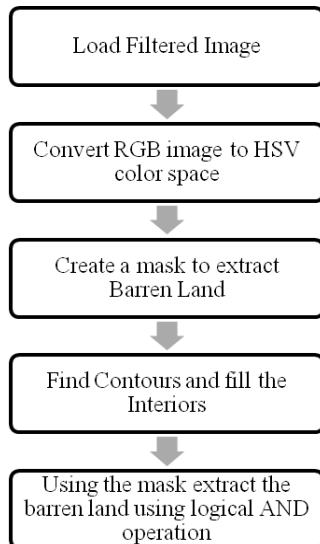


Fig-3: Barren land extraction flowchart

D. Calculation of Relative Area Algorithm

Step1: Load the Binary images obtained from HSV Modelling of Vegetation Extraction and Barren Land Extraction and also load the filtered image.

Step2: Calculate the number of non-black pixels in both Binary images.

Step3: Calculate the area of the image using the filtered image in terms of pixels.

Step4: Use the values obtained from steps 2 and 3 to calculate the relative area by means of calculating the percentage of the presence of the non-black pixels.

Step5: Write the values obtained from step 4 into a text file and display it on the console.

VI. EXPERIMENTAL RESULTS

The images shown below in Fig. 4, 5 are the input images obtained by taking snapshots from the aerial video captured by the UAV after the removal of distortion.



Fig- 4: Input Image 1



Fig-5: Input Image 2

The first intermediate result is the stitched image which is done by stitching the input images together. The resultant image after stitching is as shown in Fig. 6.



Fig-6: Stitched Image

The resultant image after filtering is as shown in Fig.7



Fig-7: Stitched Image after filtering

After filtering the image, we now progress to the vegetation and barren land region extraction using HSV Modelling which results in four separate images wherein Fig. 8 depicts only the vegetation; Fig. 9 depicts the binary image of the vegetation; Fig. 10 depicts only the barren land and Fig. 11 depicts the binary image of the barren land.



Fig-8: Vegetation Extraction

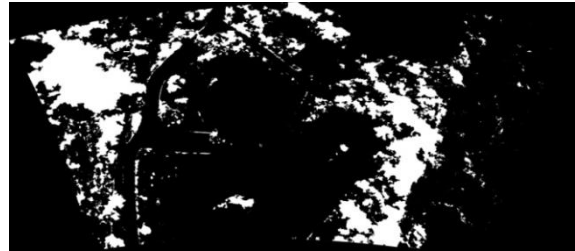


Fig-9: Binary Image of Vegetation Extraction



Figure 10. Barren Land Extraction



Figure 11. Binary Image of Barren Land Extraction

Finally, enter the analysis part of the process. Counting the total number of pixels and also measuring only the non-black pixels, calculate the relative percentage of the vegetation cover and the barren land regions as shown in Figure 12.

```

C:\Windows\system32\cmd.exe
stitching in progress
images stitched
Image filtering in progress
Mean Shift(ms):379683
Image filtered
vegetation extraction in progress
vegetation extraction completed
barren land extraction in progress
barren land extraction completed
Area=12618319px
Vegetation=2617006px
Barren Land=1213723px
vegetation=20.7397%
barren land=9.61874%
Press any key to continue . . .
    
```

Figure12. Relative areas of the regions

VII. CONCLUSION

An efficient and robust system for calculating relative area of Vegetation cover and Barren Land region in an image has been proposed in this paper. The overall algorithm works with minimal parameter dependency. The proposed method can extract the required regions of varying size, shape and color and efficiently reduce the memory consumption with minimal processing time. Experimental results show that the proposed method is a good method to calculate the relative areas of vegetation cover and barren land regions. The results presented in this project can have applications in evaluating the development of a region and evaluating de-forestation or afforestation.

VIII. REFERENCES

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