Color Image Segmentation using OTSU Method and Color Space

D.Napoleon[1]
[1] Assistant Professor, Department of Computer Science
School of Computer Science and Engineering
Bharathiar University, India, Coimbatore-641046

A.Shameena[2]
[2] Research Scholars, Department of Computer Science
School of Computer Science and Engineering
Bharathiar University, India, Coimbatore-641046

R.Santhoshi[3]
[3]Research Scholars, Department of Computer Science
School of Computer Science and Engineering
Bharathiar University, India, Coimbatore-641046

ABSTRACT
Color is one of the properties which add information to the images. This proposed work describes a color image segmentation method based on color space and Otsu Method. To realize an image, one needs to isolate the objects in it and have to find relation among them. The separation of objects is referred as image segmentation. The color supposed by human is a combination of three color stimuli such as red (R), green (G), and blue (B), which forms a color space. Many color models are used to represent the colors like RGB (red, green, blue), CMY (cyan, magenta, yellow),HSV (hue, saturation, intensity), HSL (hue, saturation, luminance).In this proposed work an effort is made to defeat the problems encountered while segmenting an object by using the color properties of the image. Behind pre-processing, the image is converted from RGB image to Gray Scale image. After that the colors pixels are classified using the nearest neighbor rule. Then the scattered plot of the segmented pixel in a*b* are shown. Next, Otsu based color segmentation is performed on Gray scale image to obtain the particular object of interest. The experimental results shown in this paper for the proposed method is effectual in segmenting the images.

General Terms
Digital image processing, Image segmentation.

Keywords
Remote Sensing Image, Otsu method, Image segmentation, L*a*b* Color Space.

1. INTRODUCTION
Image segmentation may be defined as a technique, partition of a digital image into related regions to simplify the image representation into something which provide easy way to analyze [3]. Pixels in the regions are same to each other with respect to some property like color, brightness. In this proposed work we concentrated on the color. The performance of color segmentation may affect the quality of an image understanding system .The most common features used in the image segmentation include texture, shape, and color. In this proposed work, the original image is converted into gray scale image. L*a*b* color space is used to classify the colors like Red and Green from Gray Scale image. Now we can classify each pixel in the image by calculating the Euclidean distance between that pixel and each color marker. The smallest distance will notify that the pixel most directly matches that color marker. Then the separate object in the image is displayed based on color.

After that the nearest neighbor classification separate the different color populations by plotting the 'a*' and 'b*' values of pixels that were classified into separate colors. The Otsu method is a method which is used to maximize the between-class variance, and also a popular non-parametric method for its ease and competence. In this experimental work Otsu method is used to segment the Gray scale image into two or three classes based on color.

2. METHODOLOGY
In this paper, we have considered color uniformity as a relevant principle to partition an image into significantly regions. For this, the color of each pixel is primarily represented in the L*a*b* color space. In this paper, we propose to describe the color image segmentation using color space and Otsu method. In the first section, image is segmented using color space. In second section Otsu method is used to segment the Gray scale image into two or three classes based on color. Figure.1 is given below for Proposed Method.

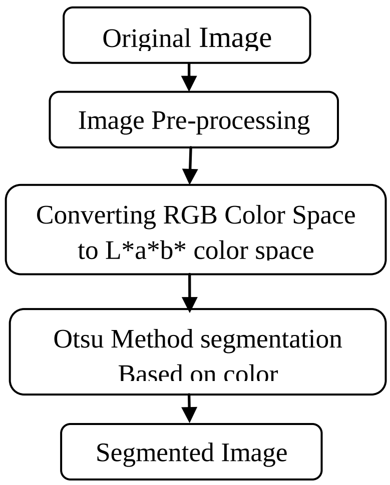


Figure.1 Proposed Method

3. IMAGE PRE-PROCESSING

The first step involves the pre-processing of the image. Pre-processing consists of operations that organize data for subsequent analysis that attempts to correct for methodical errors. The digital images are subjected to several corrections. Once the pre- processing is completed, the analyst may use feature extraction to reduce the dimensionality of the data. The original images are pre-processed to make the dimensionality more flexible to processing which also helps to make the processing faster.

4. COLOR SPACE

Color space conversion is the translation of the representation of a color from one source to another. This usually occurs in the context of converting an image that is represented in one color space to another color space. Color space defined by the CIE, is based on one channel for Luminance (lightness) (L) and two color channels (a and b). The 'L' channel, or Lightness, is the easiest to know as it is a Grayscale and a and b are chromatic components. It has no color value at all; it just contains the contrast between the lightest and darkest points in the image. The 'a' is the color balance between Green and Magenta, and the 'b' is the color balance between Blue and Yellow. Wherever the channel is mid grey there is a balance between the dual colors. The L*a*b* model is a three-dimensional model; it should be in a three-dimensional space. To convert digital images from the RGB to the L*a*b* color space is given by the following formula [2].

$$\begin{pmatrix} L^* = 116 f(Y/Y_n) - 16 \\ a^* = 500[f(X/X_n) - f(Y/Y_n)] \\ b^* = 200[f(Y/Y_n) - f(Z/Z_n)] \end{pmatrix}$$

Where,

$$f(t) = \begin{cases} t1/3 & \text{if } t > (6/29)3 \\ 1/3(29/6)2t + 4/29 & \text{Otherwise} \end{cases}$$

Xn, Yn and Zn are the CIE XYZ tristimulus values of the reference white point

To convert digital images from the RGB to the CIEXYZ color space is as the following formula.

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \begin{pmatrix} 0.608 & 0.174 & 0.201 \\ 0.299 & 0.587 & 0.114 \\ 0.000 & 0.066 & 1.117 \end{pmatrix} \begin{pmatrix} R \\ G \\ B \end{pmatrix}$$

5. COLOR-BASED IMAGE SEGMENTATION USING THE L*A*B* COLOR SPACE

The basic aim is to identify different colors in image by analyzing the L*a*b* color space. The entire process can be summarized in following steps.

Step 1: Read the color image.

Step 2: Convert color image into Gray scale image.

Step 3: The L*a*b* color space is derived from the CIEXY tristimulus values. The L*a*b* space consists of a luminosity 'L*' layer, chromaticity layer 'a*,' ‘b*’, in that 'a* indicating where color falls along the red to green axis, and layer 'b*' indicating where the color falls along the blue to yellow axis. The approach is to choose a small sample region for each color.

Step 4: Now we can Classify Each Pixel Using the Nearest Neighbor rule for each color marker. Each color marker now has an 'a*' and a 'b*'value. The Euclidean distance is used to identify the closest pixel which matches that color marker.

Step 5: The results of Nearest Neighbor Classification is displayed. The label matrix contains a color label for each pixel in the image. By using the label matrix we can separate objects in the original image by color.

Step 6: Display 'a*' and 'b*' Values of the Labeled Colors. Now we can see the plot of 'a*' and 'b*' values of pixels that were classified into separate colors. For display purposes, label each point with its color label [1].

6. OTSU METHOD FOR COLOR BASED IMAGE SEGMENTATION

Threshold is a simple but effective method for image segmentation techniques. Threshold is used to haul out an object from its background by using an intensity value t (threshold) for each pixel such that each pixel is classified either as an object point or a background point. The purpose of this operation is that objects and background are separated into non overlapping sets. The Otsu method is a method that maximizes the between-class variance and a popular non-parametric method for its ease and effectiveness. Experimental method show that, it leads to a correct threshold value and get an ultimate result in segmenting. In Otsu's method, search is made for the threshold that minimizes the intra-class variance, defined as a weighted sum of variances of the two classes is given as

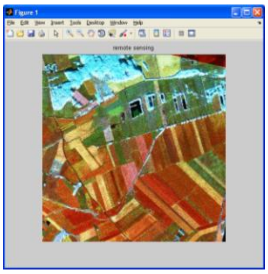
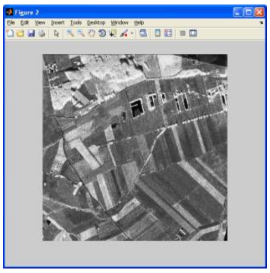
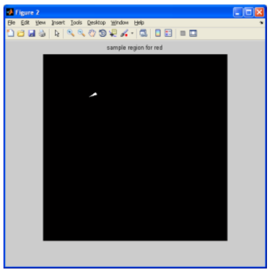
$$\sigma_{\omega}^2(t) = \omega_1(t)\,\sigma_1^2(t) + \omega_2(t)\,\sigma_2^2(t)$$

Weights ω_i is the probabilities of the two classes divided by a threshold t and σi2 variances of these classes[5].Otsu methods shows that minimizing the intra-class variance is same as maximizing inter-class variance which is given below and it is expressed in terms of class probabilities ω_i and class μ_i ,can be updated iteratively.

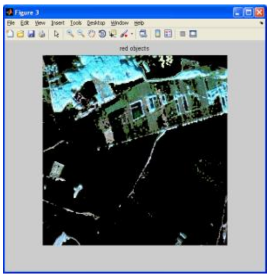
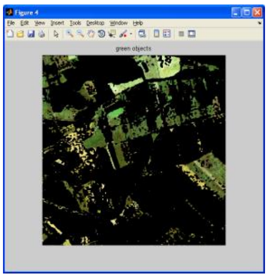
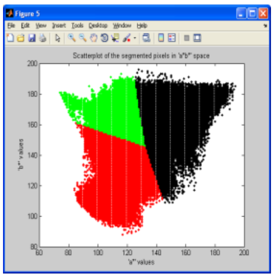
$$\sigma_b^2(t) = \sigma^2 - \sigma_{\omega}^2(t) = \omega_1(t)\,\omega_2(t)\,[\mu_1(t) - \mu_2(t)]^2$$

7. RESULT

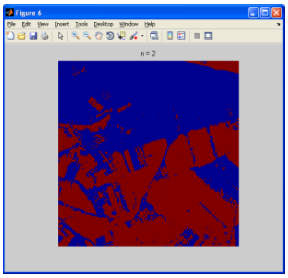
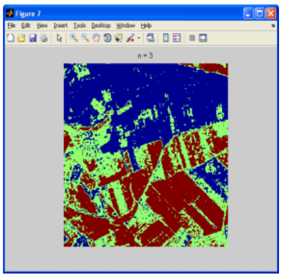
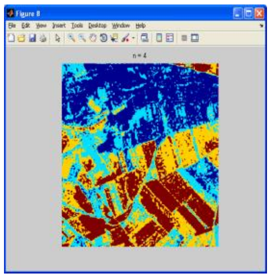
The result of image segmentation is a set of segments that jointly cover the full image, or a set of contours extracted from the image. Each of the pixels in a region is same to some feature or computed property, such as color, intensity and adjacent regions are considerably different with respect to the same feature. The result contours after image segmentation can be used to count regions in an image.

(A) Input image (B) Gray Scale Image (C) Sample Region for Red

(D) Segmented red object (E) Segmented green object (F) Segmented pixel plot

(G) Otsu method when n=2 (H) Otsu method when n=3 (J) Otsu method when n=4

8. CONCLUSION

In this paper the concept of segmentation is based on the color features of an image. L*a*b*results are based more on visual opinion. In this project, this has been implemented by testing a variety of different images. The Otsu method has been implemented to segment the image on the basis of color. The proposed method has been found that it efficiently segment regions and there is no much overlapping and gives us the larger object as the result. The proposed method is significantly lower computational complexity and it is feasible to real-time image processing which is more stable and faster.

9. REFERENCES

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