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OTSU Thresholding Method for Flower Image Segmentation

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ABSTRACT

*Segmentation is basic process in image processing. It always produces an effective result for next process. In this paper, we proposed the flower image segmentation. Oxford flower collection is used for segmentation.Different segmentation techniques are available. Different techniques and algorithm are developed to describe the segmentation.We proposed a OTSU thresholding technique for flower image segmentation in this paper. which gives good result as compared with the other methods and simple also.Segmentation subdivide the image into different parts.firstly, segmentation techniques and then otsu thresholding method described in this paper.CIE L*a*b color space is used in thresholding for better results.Thresholding apply seperatly on each L, a and b component. accordingly the features can be extracted like shape, color, texture etc. finally, results with the flower images are shown.*

Keywords: *Otsu thresholding, segmentation, CIE Lab color space, Region based segmentation, globle thresholding method.*

I. Introduction

Segmentation technique subdivides an image into different parts. It is a high level task which gives variety of applications including object recognition, scene analysis or image/video indexing[1]. Image segmentation refers to the process of partitioning a digital image into multiple segments i.e. set of pixels, pixels in a region are similar according to some homogeneity criteria such as color, intensity or texture, so as to locate and identify objects and boundaries in an image [2]. Thousands of different segmentation techniques are present in the literature, but there is not a one method which can be considered better for different images, all methods are not equally good for a particular type of image [3].Following are the different steps for the proposed method.

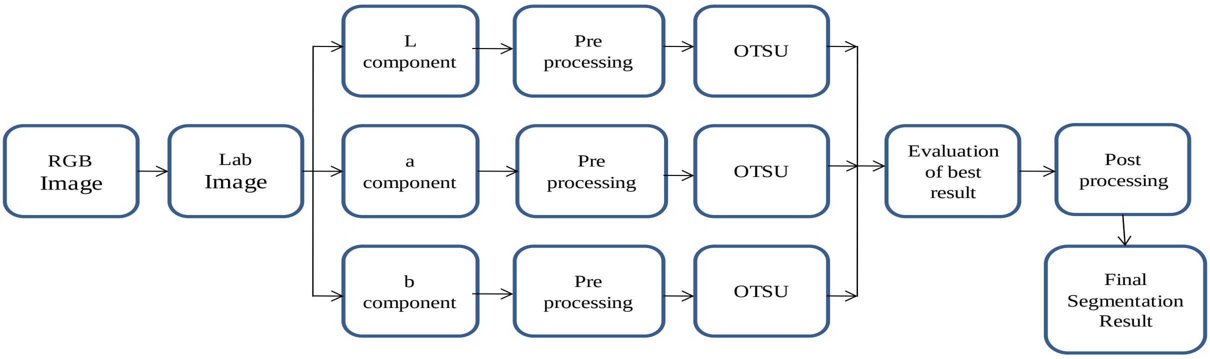

Fig.1.Steps for proposed method

II. Proposed segmentation schema

Normally flower area contain a large green area covered by leaves and the remaining area is of flower which also occupied by its color.The color is discriminative and canbe used as a homogeneity criterion to execute foreground/ background segmentation [8]. In the first step we are converting RGB image into Lab color space. Pre processing has done ,median filter is used for removal of noise present in the flower image.Applying OTSU thersholding on each Lab component separeatly.Finally,by choosing the best result and applying the postprocessing step for removing the all small regions from the background depending upon the threshold value segmentation result will be obtained. Oxford data set is used for this experiment.some of which shown in Fig.2.

Fig.2. Oxford flower collection

III. Segmentation techniques

Segmentation subdivides an image into its constituent region or object. Image segmentation methods are categorized on the basis of two properties discontinuity and similarity [2]. Based on this property image segmentation is categorized as Edged based segmentation and region based segmentation. The segmentation methods that are based on a discontinuity property of pixels are considered as boundary or edges based techniques. Edge based segmentation contains two methods gradient based and gray level histogram method, while region based segmentation contain thresholding, region growing and region splitting and merging [4].

3.1. Thresholding

Thresholding is the simplest segmentation method. Thresholding process convert a multilevel image into a binary image i.e., it select a proper threshold T, to divide image pixels into different regions and split objects from background based on their level distribution. Thresholding creates binary images from Gary-level ones by turning all pixels below some threshold to zero and all pixels about that threshold to one.Their are different types of thresholding techniques.

i) Global thresholding, using an appropriate threshold T:

$$g(x,y) = \begin{cases} 1\ if\ f(x,y) > T \\ 0, if\ f(x,y) \leq T \end{cases}$$

ii) Variable thresholding, if T can change over the image.

a) Local or regional thresholding, if T depends on a neighborhood of (x, y).

b) Adaptive thresholding, if T is a function of (x, y).

iii) Multiple thresholding:

$$g(x,y) = \begin{cases} a, if\ f(x,y) > T2 \\ b, if\ T1 < f(x,y) \leq T2 \\ c, if\ f(x,y) \leq T1 \end{cases}$$

IV. Otsu Thresholding

It is important in picture processing to select an adequate threshold of gray level for extracting objects from their background. Otsu is an automatic threshold selection region based segmentation method.Otsu method is a type of global thresholding in which it depends only on gray value of the image. Otsu method was proposed by Scholar Otsu in 1979. Which is widely used because it is simple and effective [5]. The Otsu method requires computing a gray level histogram before running. However, because of the one-dimensional which only consider the gray-level information, it does not give better segmentation result. So, for that two dimensional Otsu algorithm was proposed which works on both gray-level threshold of each pixel as well as its Spatial correlation information within the neighborhood. This algorithm can obtain satisfactory segmentation results when it is applied to the noisy images [6]. Otsu's method is expected in finding the optimal value for the global threshold. It is based on the interclass variance maximization.

4.1 Formulation

Considering, the pixels of a given picture be represented in L gray levels [1, 2,…,L]. The number of pixels at level i is denoted by n_i and the total number of pixels by N = $n_1 + n_2 + + n_L$.In order to simplify the discussion, the gray-level histogram is normalized and regarded as a probability distribution [7] :

$$pi\ =\ ni\ /\ N,\quad pi > 0\ \textstyle\sum_{i=1}^{L}, Pi = 1$$

We divide the pixels into two classes CO and C1 (background and objects, or vice versa) by a threshold at level k; CO denotes pixels with levels [1, , k], and C1 denotes pixels with levels [k + 1,…. , L]. Then the probabilities of class occurrence and the class mean levels, respectively, are given by

$$\omega_0\ =\ Pr\ (Co) = \textstyle\sum_{i=1}^{k}\ pi = \omega(k)$$

$$\omega_1\ =\ Pr\ (C1) = \sum_{i=K+1}^{L} pi\ =\ 1 - \omega(k)$$

and

$$\mu_0 =\ \textstyle\sum_{i=1}^{k} i\ \mathrm{Pr}\ (\ i \mid \mathrm{C}_0\ ) = \frac{\mu(k)}{\omega(k)}$$

$$\mu_1 = \textstyle\sum_{i=k+1}^{L} i\ \mathrm{Pr}(i \mid C_1) = \mu_{T-}\ \mu(k)/\ 1 - \omega(k)$$

where

$$\omega(k) = \sum_{i=1}^{k} p_i$$

and

$$\mu(k) =\ \textstyle\sum_{i=1}^{k} ip_i$$

which are the zeroth and the first-order increasing moments of the histogram up to kth level, and

$$\mu_{T} = \mu(L) = \sum_{i=1}^{L} i p_i$$

This is the total mean level of the original picture.We can verify for any value of k :

$$\omega_0\mu_0 + \omega_1\mu_1 = \mu_T , \quad \omega_0 + \omega_1 = 1$$

The class variance is given by,

$$\sigma_0^2 = \sum_{i=1}^{k}(i-\mu_0)^2 \Pr(i\,|C_0) = \sum_{i=1}^{k}(i-\mu_0)^2 p_i/\omega_0$$

$$\sigma_1^2 = \sum_{i=k+1}^{L}(i-\mu_1)^2 \Pr(i\,|C_1) = \sum_{i=k+1}^{L}(i-\mu_1)^2 p_i/\omega_1$$

These required second order cumulative moments. To measure the class separability at threshold level k

$$\lambda = \sigma_B^2 / \sigma_W^2 , \; k = \sigma_T^2/ \sigma_{W,}^2 , \; \eta = \sigma_B^2 / \sigma_T^2$$

where,

$$\sigma_W^2 = \omega_0 \sigma_0^2 + \omega_1\sigma_1^2$$

$$\sigma_B^2 = \omega_0 (\mu_0 - \mu_T)^2 + \omega_1(\mu_1 - \mu_T)^2$$

$$= \omega_0 \omega_1 (\mu_1 - \mu_0)^2$$

and

$$\sigma_T^2 = \sum_{i=1}^{L}(i-\mu_T)^2 P_i$$

are the within class variance, the between-class variance, and the total variance of levels, respectively. well threshold clasess would be separated in gray levels, and this threshold is the best threshold.

$$\sigma_W^2 + \sigma_B^2 = \sigma_T^2$$

It shows σ_T^2 is independent of k.but the fuction of σ_W^2 and σ_B^2 .It also shows that σ_W^2 is based on the second-order statistics (class variances),while σ_B^2 is based on the first-order statistics (class means).

The optimal threshold k* that maximizes η , or equivalently maximizes σ_B^2 is selected in the following sequential search by
using the simple cumulative quantities.

$$\eta(k) = \sigma_B^2 (k)/ \sigma_T^2$$

$$\sigma_B^2 (k) = \frac{[\mu_T \, \omega(k) - \mu(k)]^2}{\omega(k)[1-\omega(k)]}$$

and the optimal threshold k* is,

$$\sigma_B^2 (k*) = max_{1\le k<L} \, \sigma_B^2 (k)$$

from the problem ,the range of k over which the maximum is sought can be restricted to

$$S* = \{k; \; \omega_0 \omega_1 = \omega(k)[1-\omega(k)] > 0, \; or \; 0 < \omega(k) < 1\}$$

We consider it as a effective range of the gray-level histogram, always take into account the maximum threshold value.

V. Experimental result

The evaluation was performed using a flower dataset provided by Oxford University which contains 17 spices of flower having 840 images.some practical results and their threshold values are shown in above figure

original Image L component a component b component

Threshold value for L component = 167
a component = 109
b component = 189.

So b component is having good result rather than L and b in this case.

a) original image b) L component c) a component d) b coponent

Fig.3. RGB to Lab conversion output

VI. Conclusion

In this scenario, we proposed a fast flower segmentation depending upon OTSU thersholding and Lab color space which gives good result. The results are depend on threshold value of each component of image i.e Lab component. Applying OTSU on the three components separately gives good result as compared to other methods. In some cases lost of information which will be overcome by modifying the OTSU algorithm. The pre and post segmentation benifitial to remove the noise. Due to fine segmentation it would be easy to apply feature extraction schema like color,texture,and shape on segmented image. This would be the further work for this process.

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