IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Issue-3, Mar 2019 E-ISSN: 2347-2693

Color Image Segmentation using Region Growth and Merge Improved Technique

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DOI: https://doi.org/10.26438/ijcse/v7i3.10701072 | Available online at: www.ijcseonline.org

Accepted: 17/Mar/2019, Published: 31/Mar/2019

Abstract**—** Image segmentation is a very challenging task in digital image processing field. It is defined as the process of takeout objects from an image by dividing it into different regions where regions that depicts some information are called objects. There are different types of image segmentation algorithms. The segmentation process depends upon the type of description required for an application for which segmentation is to be performed. Hence, there is no universally accepted segmentation algorithm. This method is applied to many color images and experimental results show the effectiveness of the method.

Keywords— image segmentation, edge detection, smoothness, seed selection, region growing, region merging.

I. INTRODUCTION

In this paper a method of initial seed selection is proposed on the basis of HSV model. The non-edge pixels and smoothness at pixels neighbor are used as criteria to determine initial seed. Also region growing is used to segment the image based on seed regions and region merging is used to merge the small regions.

In color image segmentation seed selection, region growing and region merging are important stages. It should be noted that there is no single standard approach to perform seed selection, region growing, and region merging for color image segmentation. The appropriate technique is select on the basis of type of image and applications.

For color images, a number of approaches have been proposed from processing individual planes [Chaobing Huang et.al.,2006] to true vector-based approaches[1]. Ugarriza et al. [2] proposed a technique of initial seed selection. This technique uses vector field for edge detection and RGB to L*a*b conversion of image pixels to calculate the threshold by using adaptive threshold generation method. This method uses approximate calculation of threshold. The problem is that approximate calculation does not lead proper conclusion.

Fan et al. [3] presented an automatic color image segmentation algorithm by integrating color edge extraction and seeded region growing on the YUV color space. Edges in Y, U, and V are detected by an isotropic edge detector, and the three components are combined to obtain edges. The centroids between adjacent edge regions are taken as the initial seeds. The disadvantage is that their seeds are over-generated. H.D. Cheng, 2002. The computational load of computing edges on individual planes can be much smaller than that of computing edges on the color vector [4].

Seeded region growing (SRG) is one of the hybrid methods proposed by Adams and Bischof [10]. It starts with assigned seeds, and grow regions by merging a pixel into its nearest neighboring seed region. Mehnert and Jackway [11] pointed out that SRG has two inherent pixel order dependencies that cause different resulting segments. The first-order dependency occurs whenever several pixels have the same difference measure to their neighboring regions. The second-order dependency occurs when one pixel has the same difference measure to several regions. They used parallel processing and re-examination to eliminate the order dependencies. Fan et al. [3] presented an automatic color image segmentation algorithm by integrating color edge extraction and seeded region growing on the YUV color space. Edges in Y, U, and V are detected by an isotropic edge detector, and the three components are combined to obtain edges. The centroids between adjacent edge regions are taken as the initial seeds. The disadvantage is that their seeds are over-generated.

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difference measure to their neighboring regions. The second-order dependency occurs when one pixel has the same difference measure to several regions. They used parallel processing and re-examination to eliminate the order dependencies.

In order to obtain satisfactory segmentation result we proposed a color image segmentation with region growing and merging. The rest of this paper is organized as follows. Section 2 will briefly intro- duce the color image segmentation with region growing and merging Section 3 will introduce the proposed algorithm in detail. The experiment result and analysis will be given in Section 4 and the final Section is conclusion.

II. METHODOLOGY

The proposed method consists of three modules the first module used HSV model to produce conversion from RGB to HSV this color model is used to determine non-edge pixels and smoothness at pixel's neighbor. These non-edge and smoothness are criterion to obtain initial seeds. In second module region growing method is used to separates the pixels on the basis of regions finally the last module is region merging to merge small regions to segment the image properly. The following section describes each of the three modules in details.

The initial seed pixel should have high similarity to its neighbors and not on the edge. Therefore the following two criteria must be for initial seed selection. One is no-edge and other is smoothness. No-edge means that the pixels are not on the edge and smoothness means that pixels having high similarity to its neighbors.

Given color image I of size m by n pixels the HSV value at (i, j) is h(i, j), s(i, j), v(i, j). And N(i, j) denote 3x3 neighborhood of pixel at (i, j).

1) No-edge

A method for edge detection using a fuzzy edge measure is presented. Let us find out average, maximum, minimum values of hue value over N(i, j).To find these values for every pixels padding is required. Because corner or side pixels of the image do not able to form matrix N(i, j), Padding operation perform vertically and horizontally on both side of the image by adding identical pixel as its neighbor. Denote the average, maximum, minimum values by avg, max, min respectively. Define the following parameters:

$$D= MAX \{max-avg, avg-min\}$$

A π type fuzzy function is used to compute $\mu(i, j)$ for all (i, j) N(i, j), $\mu(avg-D) = \mu(avg +D)=0.5$ and $\mu(avg)=1$.
Let(I,j) be the hue value of a pixel at (I, j), the fuzzy function is define as following:

$$\mu(i, j)= 1-1/2(h(I, j)-avg/D)2 \quad ---(1)$$

But in case the value of min, max and avg are same means the value of D is zero and in fuzzy function its computed value is infinity. To avoid this problem whenever value of D is 0, put D=1.The fuzzy entropy is defined below:

$$e(i, j) = \mu(i, j) \log(\mu(i, j)) - (1- \mu(i, j))\log(1- \mu(i, j)) \quad ---(2)$$

For every pixel (i, j), let g(i, j) denote the average of fuzzy entropy over N(i, j), that is:

$$e(i, j)= 1/9\sum h(i, j) \quad ---(3)$$

The G-image of I(i, j) is defined as

$$G=g(i, j)\ (0 \le i\le m, 0 \le j\le n) \quad ---(4)$$

The value of g(i, j) over N(i, j) can be viewed as a measure of edge. Calculate the average and the standard deviation of g-value in the G-image, denoted by tg and σg respectively.

An initial seed pixel must have the d-value which is less than Td. A pixel is classified as seed pixel if it satisfied both above conditions. Fig.1 gives an image and the detected seeds.

There are many initial seed pixels. If two initial seed pixels are 4-adjacency, they can be merged to a seed region. Classify seed pixels to seed regions according to 4-adjacency. The algorithm is described as following steps:

(1) For a seed pixel, if it isn't labeled to a region, then, label it to a new region.

(2) Check its 4-neighbors. If there is a seed pixel in its 4-neighbors and it isn't labeled, then label it to the region.

(3) Repeat (2) until all its 4-neighbors are labeled.

(4) For every seed pixel that isn't labeled, repeat (1)-(3) until all seed pixels are classified.

After getting seed regions, every seed region have been labeled with different labels. The mean color value of the seed region can be computed, and it is denoted as color value of the seed region. Seeded region growing can be performed according to 4-adjacency and the color value of seed region. The seeded region growing algorithm is described as following steps:

(1) For neighbors of all seed regions, if they aren't labeled, record them in a list L.

(2) While L is not empty, remove a pixel p and check its 4-neighbors, if all labeled neighbors of p have a same label, setp to this label. If the labeled neighbors of p have different labels, calculate the distances between p and all neighboring regions and classify p to the nearest region. If the distances between pand two neighboring regions are equal, then classify p to the larger region. Then update the mean of this region, and add 4-neighbor neither of p, classified yet nor in L, to L.

(3) Repeat (2) until L is empty.

Note that in step (2), the distance between the pixel p and its adjacent region is calculated by equation (6), where (h, s, v) is the color value of p, (h, s, v) is mean of the color values in that region.

The size of region means the number of pixels in the region. If the size of a region is smaller than a threshold, the region is merged into its neighboring region with the smallest color difference. This procedure is repeated until no region has size less than the threshold. Based on our experiments, 1/100 of the total number of pixels in an image is set as the threshold.

III. RESULTS AND DISCUSSION

The algorithm has been implemented in MATLAB-7 in Window XP and run on CPU 2.80GHz PC. The input images are obtained from Internet. The size of images is 481×321 or 321×481. We obtain following results.

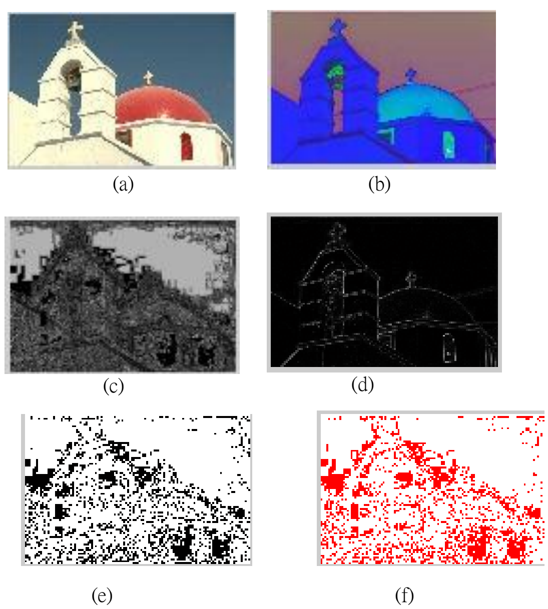

Figure 1. Initial seed selection results of "church": (a) Original image, (b)The HSV image, (c) Non-edge image, (d) Smoothness considered image (e) Seed pixel image, (f) Seed pixels in red color.

The result of initial seed selection shown in figure.1which is used for next process of color image segmentation that is region growing and region merging.

Figure 2. Region growing result of "church"

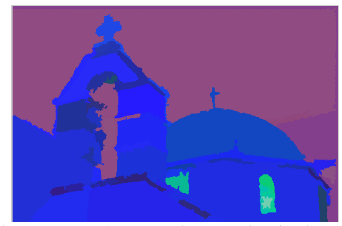

Figure 3. Region merging result of "church"

IV. CONCLUSION AND FUTURE SCOPE

A method of initial seed selection, region growing and region merging for color image segmentation is proposed. The non-edge and smoothness at pixel's neighbor are used as criteria to determine seed pixels and region growing is used for segment the image based on region and last is region merging to merge the small segments of image. Experimental results show that our method can get good results for the process of color image segmentation.

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