Seed Selection for Color Image Segmentation

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***Abstract*— We propose a method of initial seed selection used for color image segmentation. In this paper Initial seed selection is a starting stage of color image segmentation. This method is based on Ycbcr color model. Here we use two details; one is non-edge pixels and second is smoothness feature of the pixels. The non-edge pixels and smoothness at pixel's neighbor are used as criteria to determine initial seeds in the color image. No-edge information provide those pixels are not on the edge and smoothness provides pixels have high similarity to its neighbors. This method is applied to many color images and experimental results show the effectiveness of the method.**

Keywords-image segmentation; seed selection; non-edge; smoothness.

I. INTRODUCTION

Seed selection often serves as a crucial in initial step before performing high level task such as color image segmentation. It should be noted that there is no single standard approach to seed selection for color image segmentation. The appropriate seed selection technique is select on the basis of type of image and applications.

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.

In this paper a method of initial seed selection is proposed in Ycbcr model. This method is useful for color image segmentation. The non-edge pixels and smoothness at pixels neighbor are used as criteria to determine initial seed.

II. BACKGROUND

In this paper Ycbcr (luminance *Y* and chrominance *Cb* and *Cr* color values as columns) color model is used, which is correspond the human perception . After conversion from RGB to YCbCr the obtain value luminance *Y* and chrominance.

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

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

$$g(i,j) = \frac{1}{9}\sum_{(k,l)\in N(i,j)} Y(k,l)$$

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

III. PROPOSED WORK

The proposed method consists of three modules the first module used YCbCr model to produce conversion from RGB to YCbCr. The second module used to determine non-edge pixels and smoothness at pixel's neighbor. Finally the last module utilizes the both non-edge and smoothness criterion to obtain initial seeds. The following section describes each of the three modules in details.

A. Initil Seed Selection

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 YCbCR value at (i, j) is Y(i, j), Cb(i, j), Cr(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:

$$D = MAX\{max - avg\ ,a$$

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

$$\mu(i,j) = 1 - \frac{1}{2}\left(\frac{h(i,j)-avg}{D}\right)^2$$

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:

$$G = \{g(i,j) \mid 0 \le i \le m,$$

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 t_g and σ_g respectively.

The threshold is defined as:

$$T_g = \begin{cases} t_g - 0.5\sigma_g, & (t_g - 0.5\sigma_g) < 0 \\ t_g, & otherwise \end{cases}$$

An initial seed pixel must have the g-value which is less than T_g.

2) Smoothness

For a pixel at (i, j) the color value at location (i, j) is (Y(i, j), Cb(i, j), Cr(i, j)). We compute distance between original color value and average value as following equation

$$d(i,j)=\sqrt{(Cr-\overline{Cr})^2+(Cb\cos Y-\overline{Cb}\cos\overline{Y})^2+(Cb\sin Y-\overline{Cb}\cos\overline{Y})^2}$$

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

$$D=\{d(i,j)\mid 0\le i\le m,0$$

The value of d(i, j) over N(i, j) can be viewed as a measure of smoothness. Calculate the average and the standard deviation of d-value in the D-image, denoted by t_d and σ_d respectively.

The threshold is defined as:

$$T_d=\begin{cases}t_d-0.1\sigma_d, & (t_d-0.1\sigma_d)<0\\ t_d, & otherwise\end{cases}$$

An initial seed pixel must have the d-value which is less than T_d.

A pixel is classified as seed pixel if it satisfied both above conditions. Fig.1 gives an image and the detected seeds.

IV. Experimental Results

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 are 481×321 or 321×481. We obtain following results.

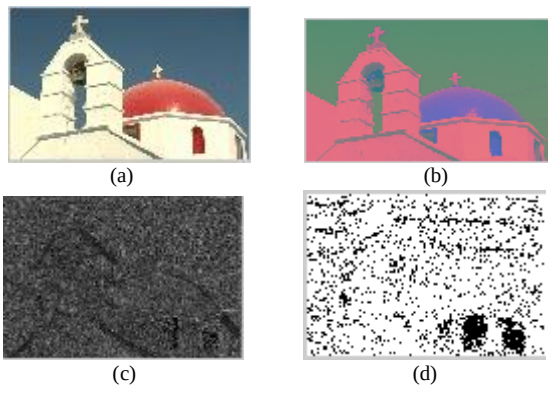

Figure 1. Initial seed selection results of "church": (a) Original image, (b)The Ycbcr image, (c) Non-edge image, (d) Seed pixel image.

V. Conclusion

A method of initial seed selection for color image segmentation is proposed. The non-edge and smoothness at pixel's neighbor are used as criteria to determine seed pixels. Experimental results show that our method can get good seed selection results for next process of color image segmentation.

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