

Color Image Segmentation based on Initial Seed Selection, Seeded Region Growing and Region Merging.

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Abstract — With the growing research on image segmentation, it has become important to categorize the research outcomes and provide readers with an overview of the existing segmentation techniques in each category. In this paper, different image segmentation techniques are elaborated. The categories defined are not always mutually independent. Hence, their interrelationships are also stated. Finally, conclusions are drawn summarizing commonly used techniques and their complexities in application.

Keywords - image segmentation; Image; Segmentation; Model

I. INTRODUCTION

Image Processing is a technique to enhance raw images received from cameras/sensors placed on satellites, space probes and aircrafts or pictures taken in normal day-to-day life for various applications. Various techniques have been developed in Image Processing during the last four to five decades. Most of the techniques are developed for enhancing images obtained from unmanned spacecrafts, space probes and military reconnaissance flights. Image Processing systems are becoming popular due to easy availability of powerful personnel computers, large size memory devices, graphics software's etc.

Image processing is a rapidly growing area of computer science. Its growth has been fueled by technological advances in digital imaging, computer processors and mass storage devices. Fields which traditionally used analog imaging are now switching to digital systems, for their flexibility and affordability. Important examples are medicine, film and video production, photography, remote sensing, and security monitoring. These and other sources produce huge volumes of digital image data every day, more than could ever be examined manually.

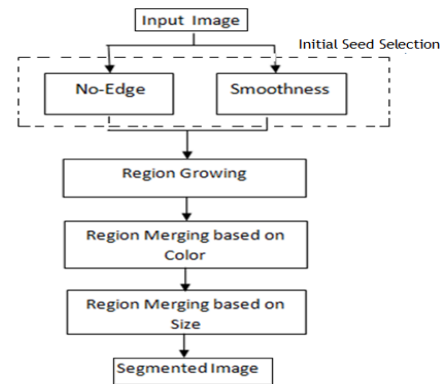
Digital image processing is concerned primarily with extracting useful information from images. Ideally, this is done by computers, with little or no human intervention. Image processing algorithms may be placed at three levels. At the lowest level are those techniques which deal directly with the raw, possibly noisy pixel values, with denoising and edge detection being good examples. In the middle are algorithms which utilize low level results for further means, such as segmentation and edge linking. At the highest level are those methods which attempt to extract semantic meaning from the information provided by the lower levels, for example, handwriting recognition.

II. BACKGROUND

In this paper HSV (Hue Saturation, value) color model is used, which is correspond the human perception^[1]. After conversion from RGB to HSV the obtain value H, S, V are the hue, saturation, bright component values.

III. PROPOSED WORK

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 which based on color and size



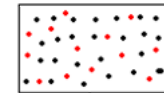
A. Initial seed selection

The initial seed pixel should have high similarity to its neighbors and not on the edge. Therefore, two criteria must satisfy for initial seed selection.

- I. No-edge – means that the pixels are not present on edge.
- II. Smoothness – means that the pixels having high similarity to its neighbors.

The no-edge uses UVL color model to extract the edges from the image and smoothness uses HSV color model to detect pixels high of similarity to its neighbor. The no-edge pixels and smoothness at pixels neighbor are used as a criteria to determine initial seed.

$$d(i,j) = \sqrt{(v-v')^2 + (s \cosh h - s' \cosh h')^2 + (s \sinh h - s' \sinh h')^2}$$



Contents

• seed pixel

• non-seed pixel

standard deviation of d-value in the D-image, denoted by t_d and σ_d respectively.

Fig:- Seeded and non-seeded pixels

The threshold is defined as:

a) No Edge

No edge pixels are those pixels that are not present on the edge. After selecting a seed pixel some color space value gets involved to satisfy this no-edge criteria. e.g. Given color image I of size m by n pixels the LUV value at (i, j) is L(i, j), U(i, j), V(i, j). And N(i, j) denote 3x3 neighborhood of pixel at (i, j). To process every pixel in the image 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. To extract the edge information from the image relative Euclidean distance is used. The relative Euclidean distances (in terms of LUV) of a pixel to its eight neighbors is calculated as

$$D = \frac{\sqrt{(L-Li)^2 + (U-Ui)^2 + (V-Vi)^2}}{\sqrt{L^2 + U^2 + V^2}}$$

Where i = 1,2,...,8.

The performance of using relative Euclidean distance is better than using normal Euclidean distance. For each pixel, the maximum distance to its neighbors is calculated as

$$d_{max} =$$

Where i = 1,2,...,8

A seed pixel candidate must have the maximum relative Euclidean distance to its eight neighbors less than a threshold value. If the pixel satisfied above condition it means that the pixel satisfied no-edge criteria and eligible for the seed pixel.

b) Smoothness

Smoothness is another type of criteria linked to those seed pixels having high similarity in color to its neighbors.

Suppose, for a pixel at X(i, j) the color value at location X(i, j) is (H(i, j), S(i, j), V(i, j)). We compute distance between original color value and average value as per the following equation:

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

$$D = \{d(i, j) | 0 \leq i \leq m, 0 \leq j \leq n\}$$

The value of d(i, j) over N(i, j) can be viewed as a measure of smoothness. Calculate the average and the

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.

B. Seeded Region

There are many initial seed pixels. If two initial seed pixels are 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.

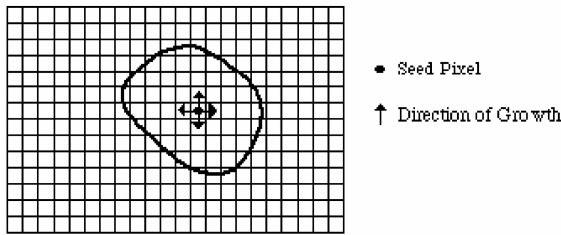
C. Seeded Region Growing

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.

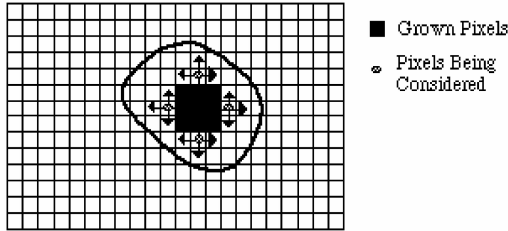
The seeded region growing algorithm is described as following steps:-

- (1) For neighbours 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 neighbours of p have a same label, set p to this label. If the labeled neighbours of p have different labels, calculate the distances between p and all neighbouring regions and classify p to the nearest region. If the distances between p and two neighbouring regions are equal, then classify p to the larger region. Then update the mean of this region, and add 4-neighbour 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, where (h, s, v) is the color value of p, (h, s, v) is mean of the color values in that

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



(a) Start of Growing a Region



(b) Growing Process After a Few Iterations

Fig:- Process of Region Growing

D. Seeded Region Growing

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E. Region Merging

Region merging is the final stage of segmentation. Merging is the process that saves the result of segmentation from over segmentation. Two criteria is used for merging is: color similarity and size.

a) Region merging based on color similarity:

The distance between two regions k, l is calculated by

$$D(k, l) = \sqrt{(\bar{v}_k - \bar{v}_l)^2 + (\bar{s}_k \cos \bar{h}_k - \bar{s}_l \cos \bar{h}_l)^2 + (\bar{s}_k \sin \bar{h}_k - \bar{s}_l \sin \bar{h}_l)^2}$$

The less the distance between two regions are, the more similar between two regions are. If the distance between

two neighbouring regions is less than a threshold value, we merge the two regions, and re-compute the mean of the new region and the distance between the new region and its neighbouring regions. Repeat the process until no region has the distance less than the threshold.

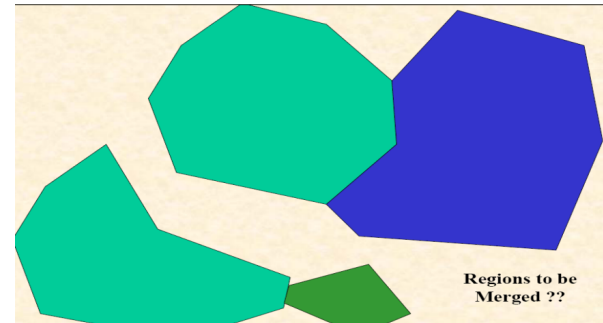


Fig 6.1:-Process of Region Merging

b) Region merging based on size

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. For better results dynamic thresholding also used.

IV. EXPERIMENTAL RESULTS

V.

A. Outcomes of Initial Seed Selection



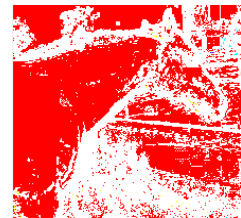
a) Original Image



b) No-Edge Criteria



c) Smoothness criteria

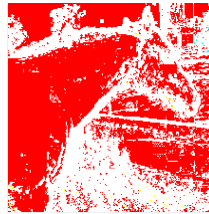


d) Seeded Image

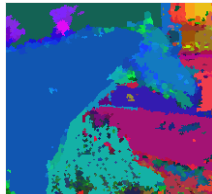
V. FINAL OUTCOME



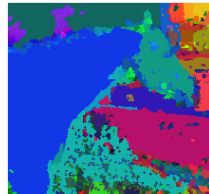
a) Original Image



b) Seeded Image



c) Region Grown Image



d) Color Merged Image



e) Size Merged Image

CONCLUSION

The method firstly the color image is transformed from RGB to LUV color space. Secondly, we apply initial seed selection (SRG) making use of both non-edge and smoothness to obtain initial seeds. Thirdly, the seeded region growing algorithm is used to segment the image into regions, where each region corresponds to one seed. Fourthly, the initial regions are merged based on the region or can say size distance defined by the color spatial and adjacent information; the good segmented color image will be the output at last. We will try our method can get good results for the process of color image segmentation.

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