A SURVEY ON COLOR IMAGE SEGMENTATION BY AUTOMATIC SEEDED REGION GROWING

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Abstract—Color image segmentation is the process of segmenting the image into multiple subsets. It is an important step towards pattern detection and recognition. A seeded region growing color image segmentation is used to segment the image into homogenous regions. In this paper, we present an extensive survey on research work carried out in the area of color image segmentation by automatic seeded region growing. Survey is extended towards applying region growing method in the field of medical images. Finally, paper is concluded towards the future research work towards recent technology.

Keywords—seeds selection, region growing, region merging

I. INTRODUCTION

Color Image Segmentation is the most important step in image analysis and pattern recognition. Image segmentation is the process of dividing the image into different regions based on color, texture or even both. Color image segmentation mainly depends on discontinuity and similarity of the intensity values. Researchers introduced several color image segmentation algorithms. Choice of the technique mainly depends on the problem considerations. Compared to gray scale images, processing color image is a difficult process. Every pixel in the color image contains information about brightness, hue and saturation. Color images are represented by RGB, HSV, L*a*b, YCbCr models. Color images only provide the complete information about an image and this will be helpful in performing region segmentation

Color image segmentation finds a wider application area in the field of video surveillance, image retrieval, medical imaging analysis and objects classification. Color image segmentation techniques are classified into thresholding, boundary-based, region-based and hybrid based.. Thresholding segmentation is used to separate foreground image from background. Boundary based methods perform region segmentation based on pixel property such as intensity, color and texture which change abruptly between different regions. s edge based segmentation, thresholding based segmentation, clustering based segmentation, graph based segmentation and region based segmentation. Hybrid based methods tends to combine boundary detection and region growing together to achieve better segmentation.

In region based segmentation approach similar pixels are grouped together. A good segmented image should produce homogenous and uniform regions based on color or texture. The segment boundaries should be spatially accurate, smooth but not ragged. Adjacent regions should be different based on region characteristics.

The rest of the paper is organized as follows: Section II highlights the automatic seeded region growing segmentation. Section III discusses the researchers work contributed towards automatic seeded region growing method for color image segmentation. Section IV explains the inferences made out of the literature survey. Section V gives a wider view of seeded region growing method applied for medical images. Section VI gives the conclusion and the future research work in automatic seeded region growing color image segmentation.

II. AUTOMATIC SEEDED REGION GROWING COLOR IMAGE SEGMENTATION

Region based segmentation is a technique used to determine regions directly. The main goal of the region segmentation is to partition an image into regions. Good image segmentation should meet certain requirements:

- Every pixel in the image belongs to a region
- Each region is homogeneous with respect to some characteristics

- No regions overlap

Seeded region growing (SRG) is one of the hybrid methods proposed by Adams and Bishop. It starts with assigned seeds, and grow regions by merging a pixel into its nearest neighboring seed region. Seeded region growing algorithm is used for image segmentation. Fig.1 presents the general block diagram for seeded region growing algorithm. Firstly, the color image is transformed from RGB color space to another color space model. Secondly, automatic seed selection algorithm is used 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. Finally region-merging algorithm is applied to merge similar regions and also smallest regions are merged into their nearest neighboring regions.

Input for automatic seeded region growing technique is an RGB image and the output to be produced is segmented image. The intermediate process is

- Color space model conversion
- Initial Seed Selection
- Seeded Region Growing
- Region Merging

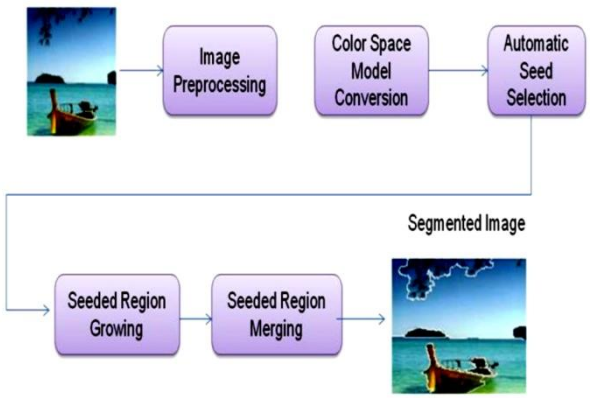

Fig.1.Block diagram for automatic Seeded Region Growing

A. Color Space Model Conversion

A input image is an RGB image. RGB model is suitable for color display, but is not good for color analysis because of its high correlation among R,G and B components. RGB does not represent the perceptual difference in a uniform scale. So, it is necessary to transform RGB model into YIQ, YUV, normalized RGB, HIS, L*a*b* color space models for color segmentation purpose. Every color space model has its advantages and disadvantages.

B. Automatic Seed Selection

For automatic seed selection, the following three criteria must be satisfied.

- Seed pixel have high similarity to its neighbors.
- For each region , minimum one seed pixel
- Seeds for different regions must be disconnected

C. Seeded Region Growing Segmentation

Initial seeds are selected by seed selection algorithm and then segmentation is done by region growing process. Region growing is done by comparing the seed pixel with neighboring pixel with the threshold. If the pixels are above the threshold are grouped to form a single region. Region growing process continued until all the pixels are grouped into any of the region. After grouping due to the presence of noise over-segmentation arise and this is avoided by region merging process.

D. Seeded Region Merging

Several seeds are generated to split a region into several small ones. To overcome the over-segmentation problem, we apply region margining. Two criteria are used: one is the similarity and the other is the size. If the mean color difference between two neighboring region is less than a threshold value, we merge the two regions. The result of region-merging depends on the order in which regions are examined. The next criteria are to check the size of regions. If the number of pixels in 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.

The major advantages of seeded region growing color image segmentation are

- region growing approach is simple
- can correctly separate the regions
- region borders are perfectly thin and connected
- highly stable even to noise image
- multiple criteria cab also be chosen

Though they are several advantages still the most important issue to be considered while implementing seeded region growing color image segmentation is

- Suitable selection of seed point
- More image information required
- Choice of minimum area threshdd value
- Choice of similarity threshold value

III. LITERATURE SURVEY

Automatic SRG color image segmentation algorithm starts with assigned seeds, and grow regions by merging a pixel into its nearest neighboring seed region. Region growing is a technique for extracting a region of the image that is connected based on some predefined criteria may be intensity information. Region growing is an approach to image segmentation in which neighboring pixels are examined and added to a region

class of no edges are detected. This process is iterated for each boundary pixel in the region. If adjacent regions are found, a region merging algorithm is used in which weak edges are dissolved and strong edges are left intact. Frank Y. Shih [21] proposed an automatic seeded region growing algorithm for color image segmentation. The input RGB color image is transformed into YCbCr color space. Initial seeds are automatically selected. Based on the seed pixels, color image is segmented into regions where each region corresponds to a seed. Finally, region merging is used to merge similar regions. Frank Y. Shih produces good results which are also compared with existing algorithms.

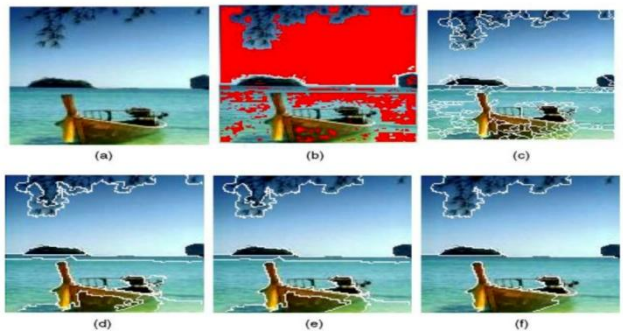

Fig.2. Stages of Automatic Seeded Region Growing[21]

Jia -Nan Wang [18] proposed an automatic seeded region growing algorithm for color image segmentation. The method uses regions instead of pixels as the seed for SRG. First, the input RGB image is transformed into HSI color space. Watershed segmentation is used to get initial over-segmented regions. Automatic region seeds are selected based on selection criteria and then images are segmented into regions. Finally region merging method is used to merge similar regions. Compared with pixel-based SRG algorithm yielded better results.

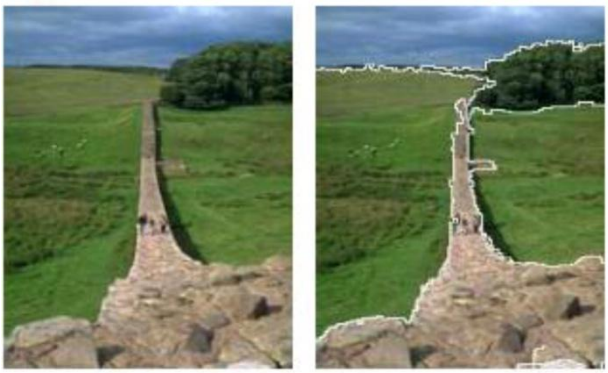

Fig.3. Automatic Seeded Region Growing Segmentation [18]

Mao Xinyan [16] proposed a color image segmentation method based on region growing and ant colony clustering. First, the input RGB image is transformed into HSI color space. Seeds are automatically selected based on edge information. Seed regions begin to grow based on color and spatial information. Selection criteria and then images are segmented into regions. Ant Colony clustering methods is used to merge different regions of homogeneity. Experimental results shows that this method reduces the calculation and cycles by traditional method

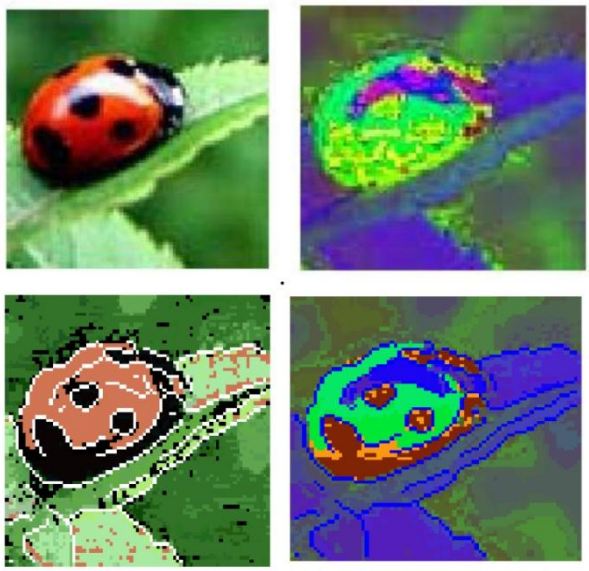

Fig.4. Ant Colony Clustering and Seeded Region Growing Segmentation[16]

Chaobing Huang [13] proposed a automatic seed selection and region growing algorithm. The criteria selected for automatic seed selection are non-edge based on fuzzy membership and smoothness at pixel's neighbor. Seed pixels are then merged to form seed region if they are connected. A seeded region growing method is used to segment the image based on seed regions. Experimental results show the effectiveness and efficiency of the method.

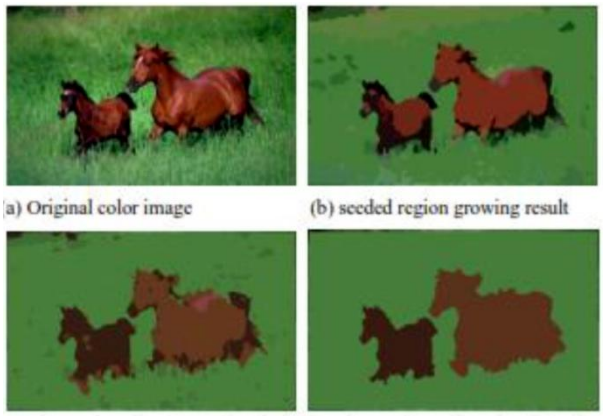

Fig .5. Process of Seeded Region & Region Merging [13]

Yashpal G. Mul [7] presented a color image segmentation based on automatic seed pixel selection. First, the input RGB color image is transformed into HSV color space. Second, initial seed are selected based on statistical measure of non-edge and smoothness. Third, the seed pixels are merged to form seed region if

they are connected. Fourth, a seeded region growing method is used to segment the image based on seed regions. Finally, region-merging is used to merge similar or small regions.

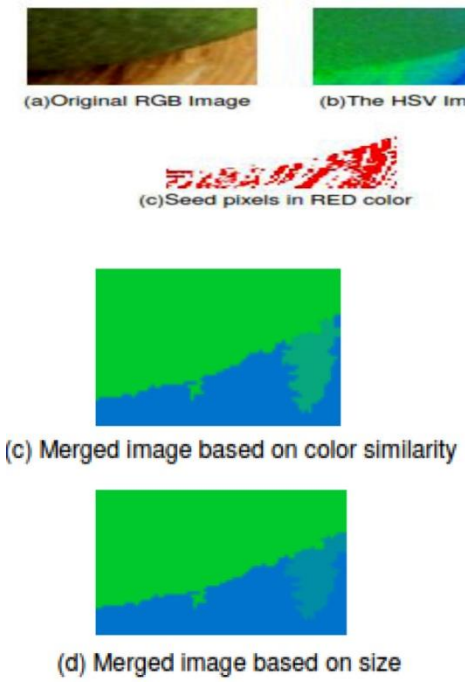

Fig.6. Process of Seeded Region Growing[7]

A summary of the work done by the researchers are listed below in Table 1.

Table 1 : Summary of automatic seeded region growing

Researchers	Color Space Model used	Automatic Seed Selection Criteria	Seeded Region Growing	Seeded Region Merging
Frank Y.Shih[21]	YCbCr	Pixel similarity Relative Euclidean Distance	Distance Metrics	Color Similarity Size
Jia-Nan Wang[18]	HSI	Pixel similarity Relative Euclidean Distance	Mean Hue difference	Mean Hue, Mean Saturation Size
Mao Xinyan[16]	HSV	Pixel similarity Relative Euclidean Distance	Color and spatial	Ant Colony Clustering
Chaobing Huang[13]	HSV	No-edge based on fuzzy entropy Smoothness	Region Color	Region Color, size
Yashpal G.Mul[7]	HSV	No-edge Smoothness	Region Color	Region Color, size

IV. INFERENCES

Researchers proposed several automatic seeded region rowing algorithm with its variation in color space model usage, automatic seed / region selection criteria, seeded region growing criteria and region merging criteria. Inferences made out of the survey are listed below

- Performance of the algorithm depends on seed / region selection
- Expensive computation involved
- Criteria used for seed selection
- Dependency and order in selection of seed region
- Not able to distinguish the shading of real images
- Noise or variation of intensity results in holes

Based on the inference made, a new algorithm to be proposed for performing automatic seeded region growing for color image segmentation with improved performance when compared with the existing traditional methods.

V. APPLICATIONS

In computer vision, segmentation refers to the process of partitioning a digital image into multiple segments. Image segmentation is used to locate objects and boundaries in images. As medical images are mostly fuzzy in nature, segmenting regions based intensity is the most challenging task. Segmentation of medical images used seeded region growing techniques is popular due to its ability to involve high-level knowledge of anatomical structures in seed selection process.

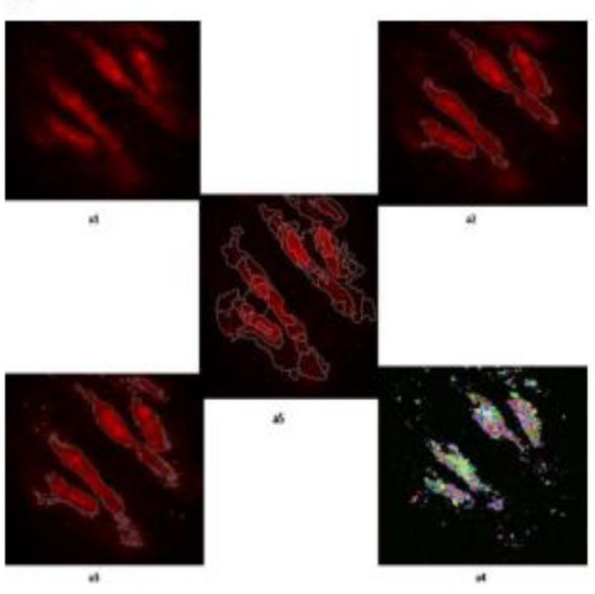

Fig 6. Comparative results of Seeded Region Growing [10]

A summary of the work done by the researchers are listed below in Table 2.

Table 2: Summary of automatic SRG for medical images

Researchers	Images	Automatic Seed Selection Criteria	Region Detection
B.Senthilkumar[12]	Breast Cancer	Haris Corner Detect	CG-1
Juan Shan H.D[17]	Breast ultrasound images	Texture and Spatial features	Neutrosophic logic
Regina Pohle[15]	CT & MR images	Homogeneity parameters	-
Harikrishna Rai G.N.[14]	CT Angiography images	Gradient Based Homogenity Criteria	Stack Based Region Growing
M.M.Abdesamea[10]	Cellular Images	Pixel intensity & position	Filtering

VI. CONCLUSION

Automatic seeded region growing color image segmentation segments the color images into homogenous regions. The major process are color space model conversion, seed selection, seeded region growing and finally region merging process. Various algorithms proposed are discussed under the literature survey and survey ends by highlighting the issues to be resolved. Automatic seeded region growing image segmentation also implemented in the field of medical images. An automatic seeded region growing color image segmentation algorithm to be proposed to design an efficient semantic based image retrieval systems.

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