

# Image Segmentation Based on Single Seed Region Growing Algorithm

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**Abstract**— in this paper, image segmentation based on single seed region growing algorithm is proposed to implement image segmentation, region boundary detection, region extraction and region information tasks for gray scale images. The proposed method is used to segment number of selected regions (N) in the original image, this started with choosing arbitrary seed point inside each selected region, set intensity value equal to 10% of the (Max-Min) intensity value of the original image. Then region growing algorithm used to test the entire pixels neighbor to the seed point whether they satisfy the intensity range motioned above or not. If they then associated in one region, otherwise it labeled as boundary pixels. This approach has been tested on many medical images to achieve region segmentation with closed boundary, edge map, calculate the minimum, maximum and average intensity of each region, and finally calculate the number of all associated pixels of the segmented region. Our proposed method minimize the computation time. In addition to the precisely output of segmented and extracted regions, another benefit comes from easy implementation of this method.

**Keywords**- *image segmentation, region growing algorithm, gray images, boundary detection*

## I. INTRODUCTION

The segmentation process is extracting and representing information from an image, where the pixels are grouped together into regions of similarity. Region Growing is an approach to image segmentation in which neighboring pixels are examined and added to a region class if no edges are detected. So there are many articles with different techniques were done. In reference [1], a single seed based region growing algorithm (ASSRG) was proposed for color image segmentation. This method starts with the center pixel of the image as the initial seed. Then region growing formula uses three homogeneity criteria local, global and relative, in two steps to label the pixel to a region. It first checks for the color similarity of the pixel with respect to the connected labelled pixel and secondly with the mean value of a growing region. If the similarity criterion is fulfilled then this pixel is included in the growing region. Otherwise the similarity of the pixel with respect to its 8-neighbors is compared with respect to the mean value of a growing region. If the pixel is closer to the growing region then it is included in that region, otherwise it is labelled as boundary pixel.

In reference [2], a region growing technique was presented for color image segmentation. In this technique a single seeded region growing technique for image segmentation was proposed, which starts from the center pixel of the image as the initial seed. It grows region according to the grow formula and selects the next seed from connected pixel of the region. Finally it used intensity based similarity index for the grow formula and Otsu's Adaptive thresholding is used to calculate the stopping criteria for the grow formula. After one region is completely grown, the next seed pixel is selected from the boundary pixel stack. Region merging is performed to reduce over segmentation in the results.

In reference [3], Subsequently, Region Growing Technique was applied on reconstructed image and segmented image was implemented, where firstly noisy image was filtered with the help of various filters. Secondly Filtered Image was reconstructed with the help of Morphological Operations. Furthermore segmented image was divided into sub parts. Finally, Results are analyzed on three bases, firstly on the segmented noisy image and secondly on the filtered segmented image and finally on the sub parts of the noisy and filtered segmented image with four parameters such as PSNR (Peak Signal Noise to Ratio), MSE (Mean Square Error), Mean difference and Maximum difference.

Finally, in 2D gray scale image, the pixels are grouped together according to the rate of change of their intensity over a region. To chief that, there are two main approaches to segmentation, Region Growing and Region Splitting algorithms for more details see [4-6]. In addition to image segmentation our proposed method calculate edge map, extracting the segmented area separately and calculate precisely the statistical region information.

The outline of the paper is as follows: in section II we have presented the region growing technique. Region splitting technique is presented in section III. Section IV describes our proposed method. In section V we present tests and results. Finally conclusion, recommendation and suggestions are presented in section VI and VII respectively.

## II. REGION GROWING

Region Growing is an approach to image segmentation in which neighboring pixels are examined and added to a region class if no edges are detected. This process is iterated for each boundary pixel in the region [7]. In general region growing method is done by examining properties of each block in the

image and merging them with adjacent blocks that satisfy some criteria. That means check the neighbors for the current position within the x and y-bounds. It used one criterion that is to look at the max-min difference and combine adjacent regions whose max-min difference is within a tolerance of the seed blocks. The new region is now the seed and the process is repeated, examining adjacent regions, comparing max-min differences, and adding blocks that are within the tolerance specified by the user (absolute intensity value was set to 10% of (max-min) of gray image. Alternatively, the mean values of the blocks can be used to determine which blocks should be merged. Region growing approach include the following steps: [8]

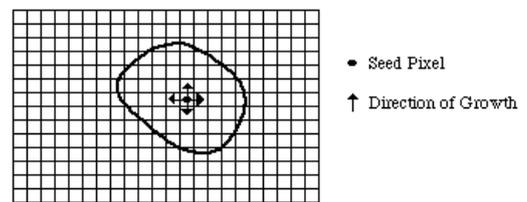
1. An initial set of small areas are iteratively merged according to similarity constraints.
2. Start by choosing an arbitrary seed pixel inside the selected region and compare it with neighboring pixels, see Figure 1.
3. Region is grown from the seed pixel by adding in neighboring pixels that are similar, increasing the size of the region.
4. When the growth of one region stops we simply choose another seed pixel which does not yet belong to any region and start again.

This whole process is continued until all pixels belong to some region and the final result is segmented region with its boundary. The region growing methods often give very good segmentations that correspond well to the observed edges. However starting with a particular seed pixel and letting this region grow completely before trying other seeds biases the segmentation in favor of the regions which are segmented first. This can have several undesirable effects:

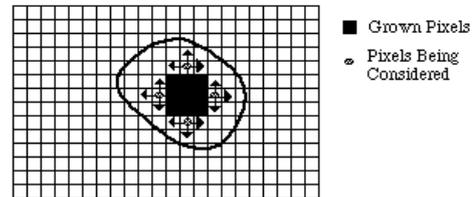
1. Current region dominates the growth process.
2. Ambiguities around edges of adjacent regions may not be resolved correctly.
3. Different choices of seeds may give different segmentation results.
4. Problems can occur if the (arbitrarily chosen) seed point lies on an edge.

To counter the above problems, simultaneous region growing techniques have been developed according to the following:

- Similarities of neighboring regions are taken into account in the growing process.
- No single region is allowed to completely dominate the proceedings.



(a) Start of Growing a Region



(b) Growing Process After a Few Iterations

Figure1. Shows an example of region growing approach

A number of regions are allowed to grow at the same time, but in our case the segmentation process was done region by region using region growing algorithm in [8].

### III. REGION SPLITTING

We explain here shortly the idea of region splitting just for comparison with region growing algorithm. The basic idea of region splitting is to break the image into a set of disjoint regions which are coherent within themselves as follows:[9]

1. Initially take the image as a whole to be the area of interest.
2. Look at the area of interest and decide if all pixels contained in the region satisfy some similarity constraint.
3. If True then the area of interest corresponds to a region in the image.
4. If False split the area of interest (usually into four equal sub-areas) and consider each of the sub-areas as the area of interest in turn.
5. This process continues until no further splitting occurs. In the worst case this happens when the areas are just one pixel in size.

On another hand if only a splitting schedule is used then the final segmentation would probably contain many neighboring regions that have identical or similar properties. Thus, a merging process is used after each split which compares adjacent regions and merges them if necessary. Algorithms of this nature are called split and merge algorithms.

#### IV. OUR PROPOSED METHOD

The proposed method includes the following steps:

1. Read any gray scale image file
2. Then determine the number of the regions that you want to segment, where this image is candidate as input image for region growing algorithm.
3. Choose initial position inside the selected region to get the pixel position concerning to the current axis coordinates.
4. Set positive threshold value to 10% of (max-min) value in the input image.
5. Get initial pixel value and add the initial pixel to the queue.
6. Start region growing algorithm (Region Growing (input image, [ ], intensity value)) with the above parameters, where the first queue position determines the new values.
7. Check the neighbors for current position with the x-bounds, y-bounds, and within intensity range mentioned in step 4.
8. The current pixel is chosen if all properties are fulfilled and add the current pixel to the computation queue.
9. Then using bwboundaries( ) function to extract the enclosing polygon vertices of the segmented region.
10. Finally, display the pixels number of segmented region within the intensity range, segmented region with its boundary, and number of polygon vertices. See figure 2.and edge map, extracted region as in figures (6-9).

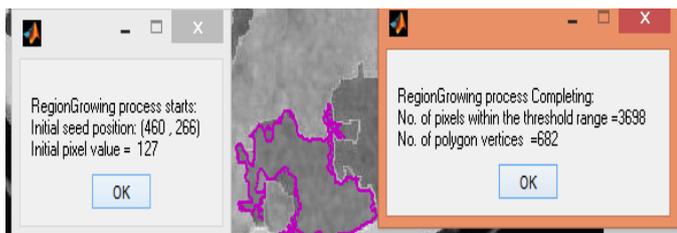


Figure 2 shows the results for each selected region to segment, number of pixels within the threshold value

Another example: segmented the image into 5 regions (see Color edges) in figure 3

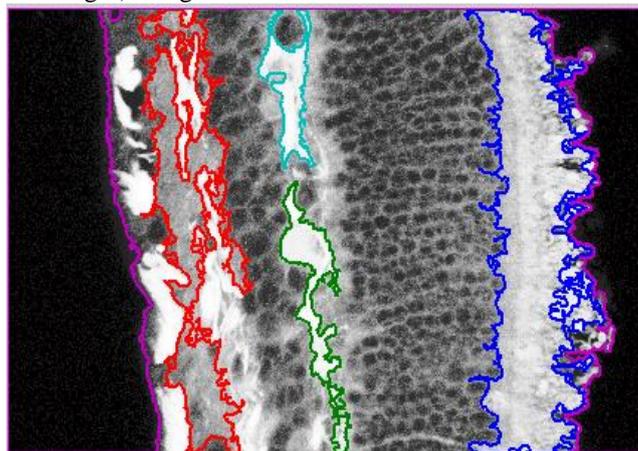


Figure 3 segmented image into 5 regions

#### V. TEST AND RESULTS

The first test represent the original gray image which is the input image to the region growing algorithm, see figure (4).

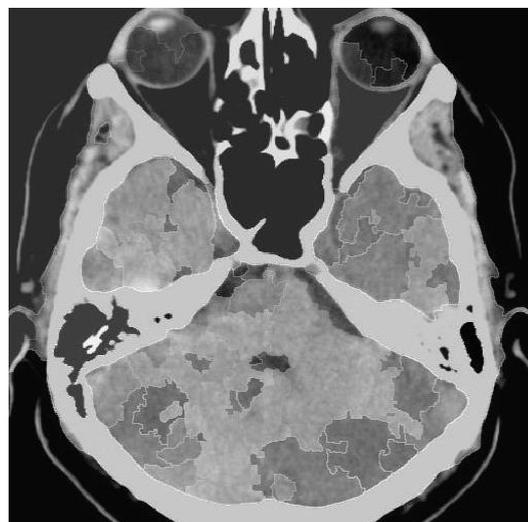


Figure 4 input gray scale image

Figure 5 and table (1) show the number of regions that are chose and their segmented images.

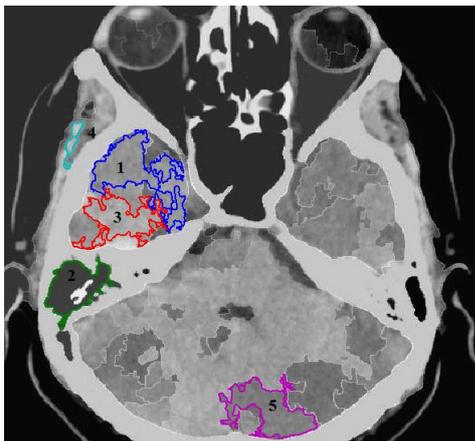
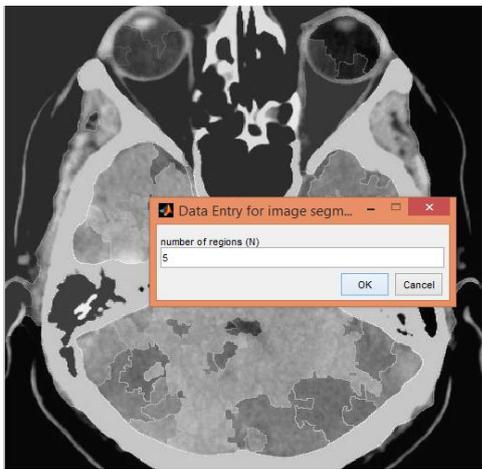


Figure5. Selected five regions to segment

TABLE 1 SHOWS THE RESULTS FOR EACH SELECTED REGION FOR SEGMENTATION (REGION AND ITS BOUNDARY)

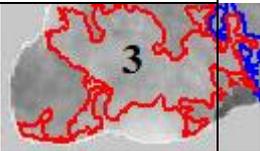
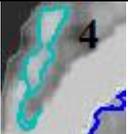
Region number & color boundary	Initial seed position	Initial pixel value	No. of pixels with intensity range	No. of polygon vertices	Segmented image
1 blue	202,128	146	4621	921	
2 green	326, 70	65	2922	355	
3 red	271,122	71	3050	708	
4 White blue	165,80	167	379	140	
5 violet	460,266	127	3698	682	

Figure 6 shows the segmented region with its occupied pixels and edge map

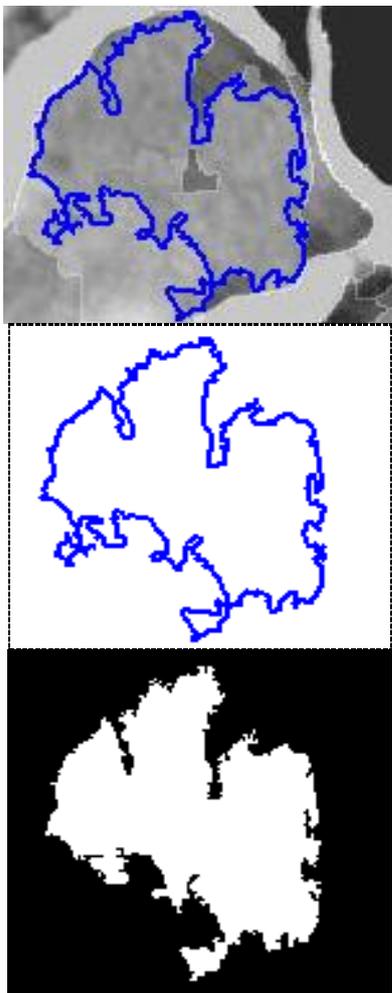


Figure 6 segmented region with edge map

In figure 7, There is another example tested with our proposed technique, Knee segmentation region with edge, extracted region and edge map, see figures 8 and 9. Also the region statistics (mean value, min, max, number of pixels in the ROI , is shown in table 2.

TABLE 2 SHOWS THE INFORMATION DETAILS OF THE SEGMENTED REGIONS RESPECTIVELY.

Region no.	Initial pixel value	Initial intensity	No. pixels of segmented region
1	170 154	98	11449
2	294 169	94	5684
3	198 57	122	376
No. polygon vertices	Min region intensity	Max region intensity	Average intensity
618	74	113	95.4344
412	78	100	88.6605
94	110	125	115.3022

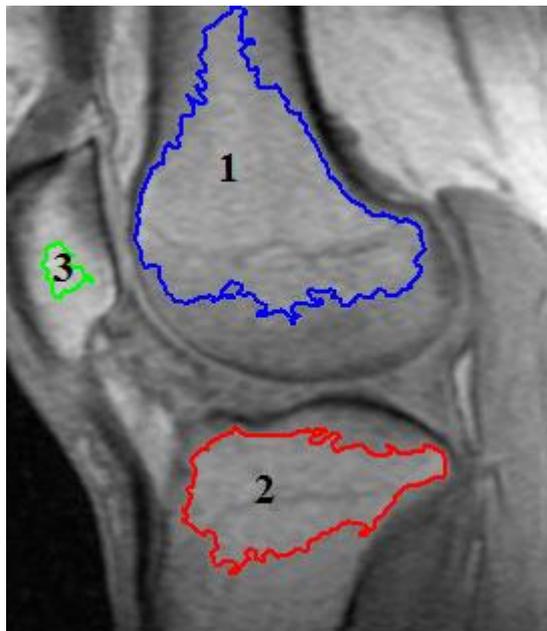


Figure 7. Selected three regions on the original gray image (knee.jpg)

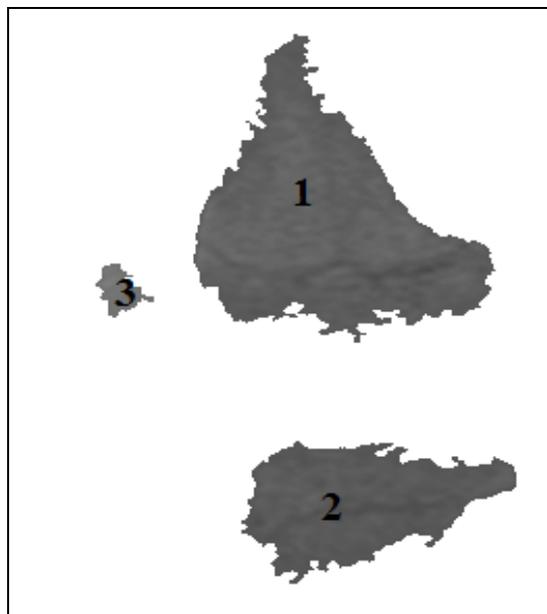


Figure 8 extracted the three segmented regions

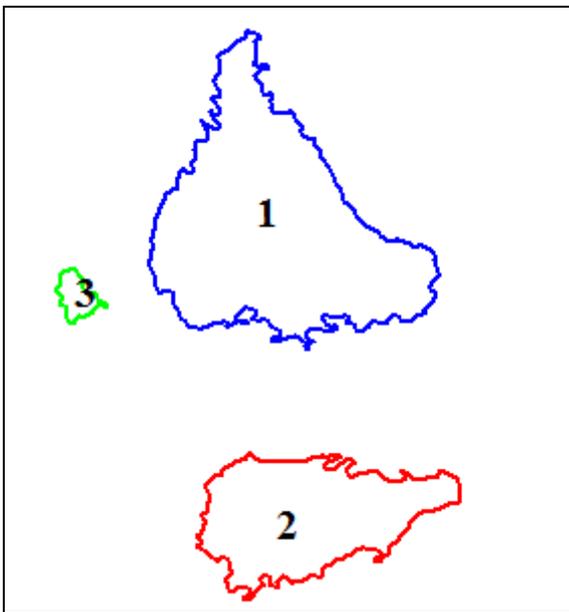


Figure 9 Edge map of three extracted regions

## VI. CONCLUSION

The proposed method shows that it is easy to determine the number of regions, the number of pixels of segmented area, the edge map, and we can extract the segmented regions. On another hand the boundary of the segmented region is accurate. And that is very useful, for example in medical images to highlight a small tumor located very close to dense glandular tissues and calculates number of pixel (area of the tumor) before and after taking medicine to measure the effect of medicine. Also it is useful to extract any region in the image separately for diagnostics and image analysis. On another hand if we cluster the gray image first using clustering technique such as watershed or k-mean...etc and then using our method, that gives very accurate results of edge map, extracted regions, and image segmentation. Finally this approach has been tested on many medical images. And the Computer experimental results show that the proposed method can extract regions of interest in gray biomedical images rapidly and precisely, and indicate that the proposed approach is effective and practicable.

## VII. SUGGESTIONS AND RECOMMENDATIONS

The important that we obtained in our paper is that we can segment and extract separately any number of regions within the origin image we can select any point in original image to be our seed point then we use region growing algorithm to test all neighbors to the seed point within intensity value equal to  $(\max - \min) * 10\%$  of the origin image. If the pixels intensity belong that value so it will be associate in one region otherwise it belong to the boundary of the region. While another papers used region growing technique with seed point at the center of the original image as initial seed, then it grows

according to grow formula and select the next seed from the connected pixels of the region. Then use intensity based similarity and Otsu's adaptive thresholding to calculate the stopping criteria for the growth formula. Some other researchers used color image and merge technique to get final segmentation task for whole image as in ref. [1]

We recommend our method to diagnosis tumors in medical images automatically. So we suggest working with team of specialist physicians to compare and develop our method according to the output results. Also we recommend clusters the image into its homogeneous regions first using clustering algorithms such as watershed and K-mean to get very accurate results, then separated each region precisely using our method for different applications.

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