Image Processing Lab

Batch 9:

Ajay Viswanathan [09EC3509]

Sourin Sutradhar [09EC3514]

Experiment 9

Image Segmentation based on Region Growing Technique

PROBLEM OBJECTIVE:

Write C++/Image-J modular functions to perform the following on grayscale Lungs CT image using Region Growing technique based on 8-conncetivity.

(a) Extract the left lung from the image after Segmentation.
(b) Extract both lungs from the image after segmentation.

Take the optimum threshold value for stopping criteria of the algorithm for given image.

BRIEF THEORY:

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as superpixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s). When applied to a stack of images, typical in medical imaging, the resulting contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms like Marching cubes.

Some of the practical applications of image segmentation are:

- Content-based image retrieval
- Machine vision
- Medical imaging
- Locate tumors and other pathologies
- Measure tissue volumes
- Diagnosis, study of anatomical structure
- Object detection
- Pedestrian detection
- Face detection
- Brake light detection

- Locate objects in satellite images (roads, forests, crops, etc.)
- Recognition Tasks
- Face recognition
- Fingerprint recognition
- Iris recognition
- Traffic control systems
- Video surveillance

Several general-purpose algorithms and techniques have been developed for image segmentation. Here we study the region. The first region-growing method was the seeded region growing method. This method takes a set of seeds as input along with the image. The seeds mark each of the objects to be segmented. The regions are iteratively grown by comparing all unallocated neighbouring pixels to the regions. The difference between a pixel's intensity value and the region's mean, is used as a measure of similarity. The pixel with the smallest difference measured this way is allocated to the respective region. This process continues until all pixels are allocated to a region.

Seeded region growing requires seeds as additional input. The segmentation results are dependent on the choice of seeds. Noise in the image can cause the seeds to be poorly placed. Unseeded region growing is a modified algorithm that doesn't require explicit seeds. It starts off with a single region – the pixel chosen here does not significantly influence final segmentation. At each iteration it considers the neighbouring pixels in the same way as seeded region growing. It differs from seeded region growing in that if the minimum is less than a predefined threshold then it is added to the respective region. If not, then the pixel is considered significantly different from all current regions and a new region is created with this pixel.

One variant of this technique, proposed by Haralick and Shapiro (1985), is based on pixel intensities. The mean and scatter of the region and the intensity of the candidate pixel is used to compute a test statistic. If the test statistic is sufficiently small, the pixel is added to the region, and the region's mean and scatter are recomputed. Otherwise, the pixel is rejected, and is used to form a new region.

A special region-growing method is called -connected segmentation (see also lambda-connectedness). It is based on pixel intensities and neighborhood-linking paths. A degree of connectivity (connectedness) will be calculated based on a path that is formed by pixels. For a certain value of two pixels are called -connected if there is a path linking those two pixels and the connectedness of this path is at least. -connectedness is an equivalence relation growing technique.

The first step in region growing is to select a set of seed points. Seed point selection is based on some user criterion (for example, pixels in a certain gray-level range, pixels evenly spaced on a grid, etc.). The initial region begins as the exact location of these seeds.

The regions are then grown from these seed points to adjacent points depending on a region membership criterion. The criterion could be, for example, pixel intensity, gray level texture, or color.

Since the regions are grown on the basis of the criterion, the image information itself is important. For example, if the criterion were a pixel intensity threshold value, knowledge of the histogram of

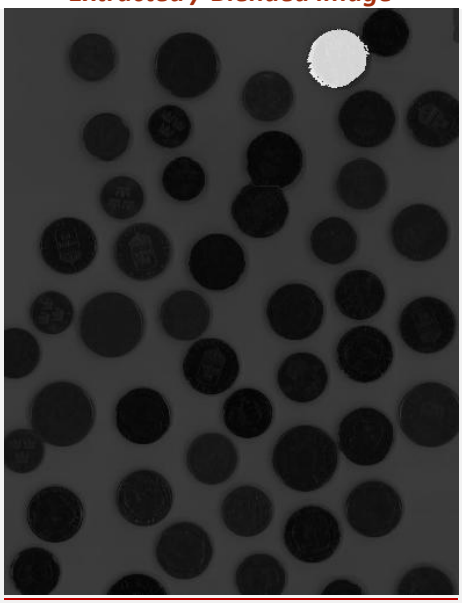
the image would be of use, as one could use it to determine a suitable threshold value for the region membership criterion.

There is a very simple example followed below. Here we use 4-connected neighborhood to grow from the seed points. We can also choose 8-connected neighborhood for our pixels adjacent relationship. And the criteria we make here is the same pixel value. That is, we keep examining the adjacent pixels of seed points. If they have the same intensity value with the seed points, we classify them into the seed points. It is an iterated process until there are no change in two successive iterative stages. Of course, we can make other criteria, but the main goal is to classify the similarity of the image into regions.

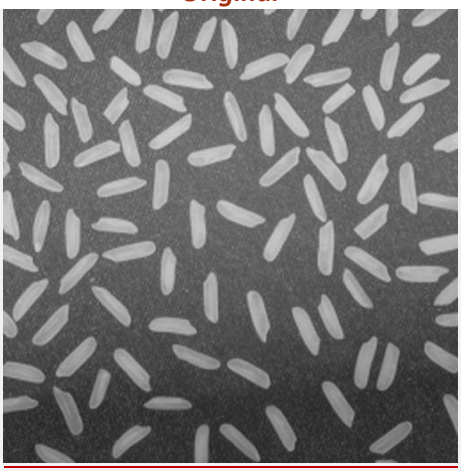
RESULTS:

Original

Extracted / Blended image

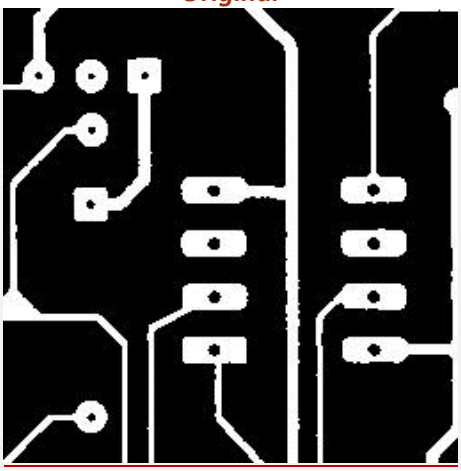


Original

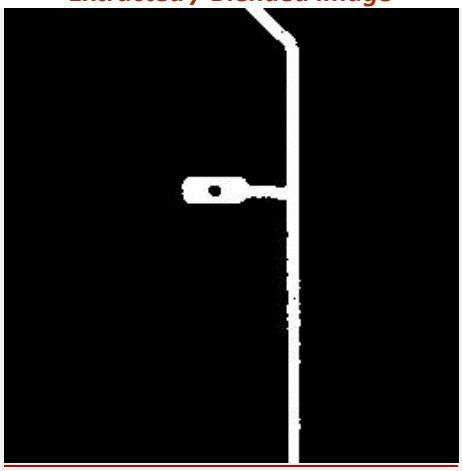


Extracted / Blended image

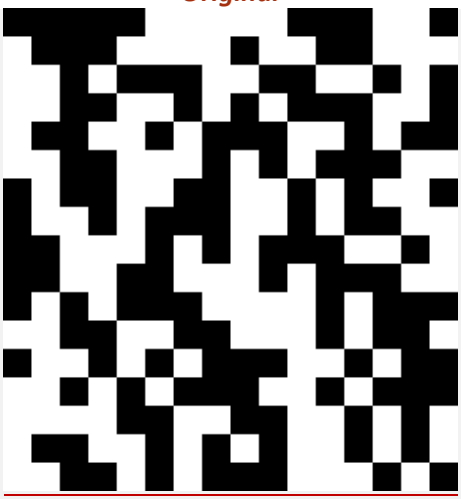
Original



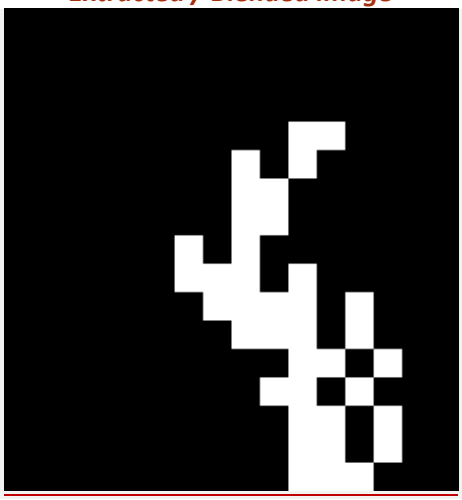
Extracted / Blended image



Original

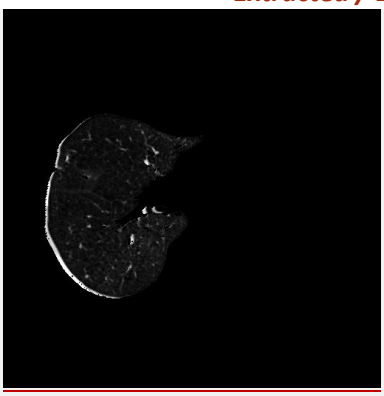


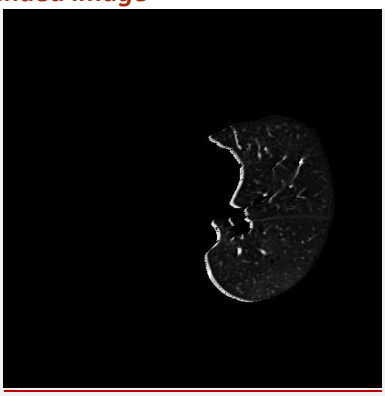
Extracted / Blended image



Original

Extracted / Blended image





DISCUSSION AND INFERENCE:

Some important issues we can conclude about region growing ：

1. ***The suitable selection of seed points is important.***

The selection of seed points is depending on the users. For example, in a gray-level lightning image, we may want to segment the lightning from the background. Then probably, we can examine the histogram and choose the seed points from the highest range of it.

2. ***More information of the image is better.***

Obviously, the connectivity or pixel adjacent information is helpful for us to determine the threshold and seed points.

3. ***The value, "minimum area threshold".***

No region in region growing method result will be smaller than this threshold in the segmented image.

4. ***The value, "Similarity threshold value".***

If the difference of pixel-value or the difference value of average gray level of a set of pixels less than "Similarity threshold value", the regions will be considered as a same region.

The criteria of similarities or so called homogeneity we choose are also important. It usually depends on the original image and the segmentation result we want.

We briefly conclude the advantages and disadvantages of region growing.

Advantages ：

1. Region growing methods can correctly separate the regions that have the same properties we define.

2. Region growing methods can provide the original images which have clear edges with good segmentation results.

3. The concept is simple. We only need a small number of seed points to represent the property we want, then grow the region.

4. We can determine the seed points and the criteria we want to make.

5. We can choose the multiple criteria at the same time.

6. It performs well with respect to noise.

Disadvantage ：

1. The computation is consuming, no matter the time or power.

2. Noise or variation of intensity may result in holes or over-segmentation.

3. This method may not distinguish the shading of the real images.

We can conquer the noise problem easily by using some mask to filter the holes or outlier. Therefore, the problem of noise actually does not exist. In conclusion, it is obvious that the most serious problem of region growing is the power and time consuming.