International Journal of Trend in Research and Development, Volume 4(2), ISSN: 2394-9333
www.ijtrd.com

Comparative Study of Segmentation Techniques on CT-liver Images

[1]A.Mohamed Riyas and [2]Dr.M.Mohamed Sathik
[1]Master of Philosophy in Computer Science, [2]Principal & Research Coordinator
[1,2]Research Department of Computer Science, Sadakathullah Appa College, Tirunelveli, Tamilnadu, India

Abstract: In this paper we present a comparative study of CT liver image segmentation techniques. The aim of this study is to assess the quality of most commonly used segmentation methods globle threshold-iterative method, globle threshold-Ostu's method, local thresholding and Region growing. Based on the metrices MSE, PSNR and SNR, the performance of the methods on CT liver image segmentation are measured and compared. This study is useful to choose a suitable method for computerizing liver diagnostic system.

Keywords*: CT-Liver, Thresholding, Region Growing.*

I. INTRODUCTION

Imaging techniques such as computed tomography (CT), magnetic resonance imaging (MRI), or positron emission tomography (PET) are nowadays standard instruments for the diagnosis of liver pathologies such as cirrhosis, liver cancer, fulminant hepatic failure. Among these techniques, CT images are often preferred by diagnosticians since they provide a more accurate anatomical information about the visualized structures.

Computed Tomography (CT) is quite useful for doctors to analyze the pathological changes of the biological organs. In order to reduce deaths, the diseases must be detected accurately in the early stage. The main problem of liver segmentation from CT images is related to low contrast between liver and nearby organs intensities. Liver sometimes presents in different dimensions and makes the detection and segmentation even more difficult. The liver is a vital organ with vascular, metabolic, secretory and excretory functions. It is extensively perused during liver surgery, special care has to be taken in order to avoid bleedings.

The liver cancer is one of the most common internal malignancies also one of the leading death causes. Currently, the confirmed diagnosis used widely for the liver cancer is needle biopsy. The needle biopsy, however, is an invasive technique and generally not recommended. Therefore, computed tomography (CT) has been identified as accurate non-invasive imaging modalities in the diagnosis of the liver cancer. Many clinical applications for computer aided diagnosis require medical images to be segmented. For example, planning of liver tumor embolization, ablation and surgical resection require precise segmentation of the liver from CT images. Due to the complex shape and the large size of this organ, the manual segmentation is time consuming. In order to increase the efficiency of the clinical work, automatic segmentation methods are needed. A computerized liver CT segmentation system should take less time and should segment the liver accurately. It should be consistent and should provide a system to radiologist which is self explanatory and easy to operate.

II. METHODOLOGY

Image Segmentation

Image segmentation is an important process to extract information from complex images. Segmentation has wide application in medical field. The main objective of image segmentation is to partition an image into mutually exclusive and exhausted regions such that each region of interest is spatially contiguous and the pixels within the region are homogeneous with respect to a predefined criterion. Widely used homogeneity criteria include values of intensity, texture, color, range, surface normal and surface curvatures. Several diagnostics are based on proper segmentation of the digitized image. Segmentation of medical images is needed for applications involving estimation of the boundary of an object, classification of tissue abnormalities, shape analysis, contour detection. Image segmentation and its performance evaluation are important fields in image processing and, because of the complexity of the medical images, segmentation of medical image is still a challenging problem.

A. Thresholding

Thresholding segmentation methods are very simplest and fundamental segmentation methods. A process of creating a black-and-white image out of a grayscale image consisting of setting exactly those pixels to white whose value is above a given threshold, setting the other pixels to black. In this study, totally three types of thresoding algorithms applied. There are,

i) iterative method.
ii) Ostu's method.
iii) Local threshold method.

B. Region growing

Region growing method objective is partition an image into segmented region. Region growing is a region-based sequential technique for image segmentation by assembling pixels into larger regions based on predefined seed pixels, growing criteria and stop conditions. Region growing algorithm also used in our study.

III. EXPERIMENTAL RESULT

Result of applying various segmentation techniques over set of images.

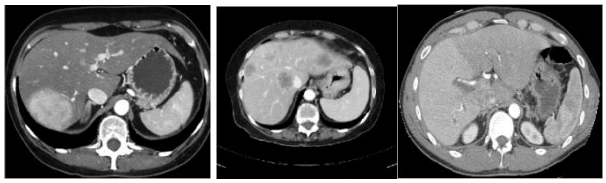

Figure 1: original images

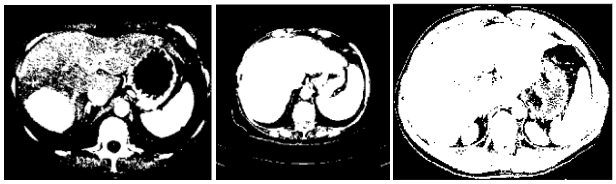

Figure 2: results of iterative method

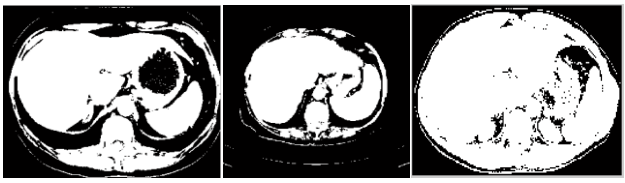

Figure 3: results of Ostu's method

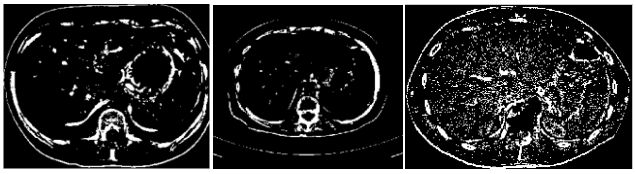

Figure 4: results of local threshold

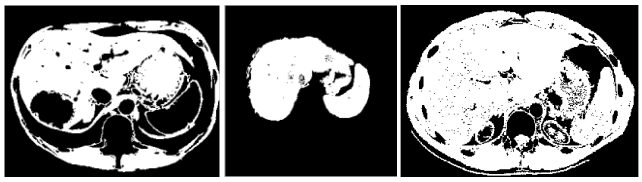

Figure 5: results of region growing

VI. PERFORMANCE METRICS & EVALUATION

1) Mean Squared Error:

It is the mean squared difference between the original image and the segmented image.

$$MSE = \frac{1}{MN}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1}[f(x,y)-\hat{f}(x,y)]^2$$

2) Peak Signal to noise ratio:

It is a classical index defined as the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. MSE (Mean Square Error) is the Euclidean distance between the original and segmented image.

$$\text{PSNR} = 10 * \log_{10}\left(\frac{255^2}{\text{MSE}_{\min}}\right)$$

3) The signal-to-noise ratio:

SNR is used in imaging as a physical measure of the sensitivity of a image. Traditionally, SNR has been defined as the ratio of the average signal value to the standard deviation of the background

$$\text{SNR} = \frac{\mu}{\sigma}$$

Where μ is a average signal value and σ is a standerd deviation of background

4) Performance Evaluation:

Performance is calculated by PSNR, MSE and SNR. Following tables shown the results of PSNR, MSE and SNR values of four different segmentation algorithms.

Table 1: result of MSE, PSNR and SNR of iterative method

Iterative method	MSE	PSNR	SNR
Image 1	0.115004	57.523670	2.035176
Image 2	0.080774	59.058103	2.775523
Image 3	0.091737	58.505380	1.868512
Image 4	0.116585	57.464372	2.090539
Image 5	0.108035	57.795151	1.500410
Image 6	0.119034	57.374078	1.982136
Image 7	0.044961	61.602451	2.650223
Image 8	0.093475	58.423827	2.461607
Image 9	0.084085	58.883621	2.798236
Image10	0.056964	60.574809	2.681319
Avg	0.091065	58.72055	2.284368

Table 2: result of MSE, PSNR and SNR of Ostu's method

Ostu's methods	MSE	PSNR	SNR
Image 1	0.120907	57.306289	2.013949
Image 2	0.084307	58.872143	2.751471
Image 3	0.125046	57.160095	1.994757
Image 4	0.119149	57.369912	2.083133
Image 5	0.168770	55.857853	1.778774
Image 6	0.138231	56.724738	1.981647
Image 7	0.045684	61.533140	2.640159
Image 8	0.101784	58.054015	2.432098
Image 9	0.087958	58.688063	2.823851
Image10	0.057210	60.556121	2.678212
Avg	0.104905	58.212240	2.211650

Table 3: result of MSE, PSNR and SNR of local threshold method

Local threshold	MSE	PSNR	SNR
Image 1	0.149747	56.377227	0.601245
Image 2	0.272955	53.769900	0.536226
Image 3	0.157390	56.161024	0.806477
Image 4	0.139618	56.681382	1.237316
Image 5	0.122246	57.258455	0.907701
Image 6	0.150422	56.357696	1.075751
Image 7	0.143911	56.549876	0.626293
Image 8	0.212571	54.855755	0.799992
Image 9	0.310523	53.209873	0.698356
Image10	0.160096	56.087004	0.944844
Avg	0.181948	55.730820	0.823420

Table 4: result of MSE,PSNR and SNR of region growing method

Region growing	MSE	PSNR	SNR
Image 1	0.296771	53.406594	0.723067
Image 2	0.121714	57.151803	1.871532

Image 3	0.233151	54.454427	1.338111
Image 4	0.245433	53.371571	0.961627
Image 5	0.226363	55.727621	0.937152
Image 6	0.256514	53.273918	1.221838
Image 7	0.063499	60.103145	1.897364
Image 8	0.223351	54.171292	1.795964
Image 9	0.313259	53.125626	1.788912
Image10	0.074052	59.311054	1.703273
Avg	0.185412	56.358820	1.213170

CONCLUSION

In this study, four different segmentation algorithms applied to set of CT-liver images. iterative threshold, ostu's method, local threshold and region growing algorithm's results were obtained and compared from the MSE, PSNR and SNR metrices. These results can help the better segmentation technique selection for the computerized CT-liver diagnosis.

References

[1] Rajesh Dikshit, Prakash C Gupta, "Cancer mortality in India: a nationally representative survey" Published Online in The Lancet, vol. 379, pp. 1807-1816, May 2012

[2] S.Priyadarsini and Dr.D.Selvathi, "Survey on Segmentation of Liver from CT Image" IEEE international conference on Advance communication control and computing technologies, pp. 234-238, August 2012.

[3] Priyanka Kumar, Shailesh Bhalerao," Detection of Tumor in Liver Using Image Segmentation and Registration Technique "IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 9, Issue 2, Ver. VIII (Mar - Apr. 2014), PP 110-115

[4] Dr. Alyaa H. Ali, Entethar M. Hadi," Diagnosis of Liver Tumor from CT Images using Digital Image Processing" International Journal of Scientific & Engineering Research, Volume 6, Issue 1, January-2015, ISSN 2229-5518

[5] Kumar, P. Bhalerao, S. 2014, "Detection of Tumor in Liver Using Image Segmentation and Registration Technique" IOSR Journal of Electronics and Communication Engineering (IOSR-JECE). Vo.9, No.2, PP: 110-115.

[6] S. Saranya, Dr. M. Pushparani," Liver Tumour Detection for Ct Images" International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169,Volume: 4 Issue: 4

[7] Abdel-massieh,N.H.,Hadhoud,M,M.,and Amin, K.M., "Fully automatic liver tumour segmentation from abdominal CT scans," IEEE International Conference on Computer Engineering and Systems(ICCES),pp.197-202,2010

[8] Ahmed M.Mharib,"Survey on liver CT image segmentation methods",Artificial Intelligence Review VOl.37,8395,Springer 2011

[9] http://www.mathworks.com

[10] Dr. P. V. Ramaraju, G. Nagaraju,V.D.V.N.S.Prasanth, B.Tripura sankar, P. Krishna, V. Venkat "Feature Based Detection Of Liver Tumour Using K-Means Clustering And Classifying Using Probabilistic Neural Networks" International Journal Of Engineering And Computer Science ISSN:2319-7242 Volume 4 Issue 5 May 2015.