

Extraction and Classification of tumor in CT Liver Image

Munipraveena Rela, Research Scholar, Department of ECE, JNTUA, Ananthapuramu, A.P., India, chagpraveena@gmail.com

S. Nagaraja Rao, Professor, Department of ECE, G. Pulla Reddy Engineering College(Autonomous), Kurnool, A.P., India, Suryakari2k9@gmail.com

P. Ramana Reddy, Professor, Department of ECE, JNTUA, Ananthapuramu, A.P., India, prjntu@gmail.com

Article Info

Volume 82

Page Number: 8747 - 8753

Publication Issue:

January-February 2020

Article History

Article Received: 5 April 2019

Revised: 18 Jun 2019

Accepted: 24 October 2019

Publication: 03 February 2020

Abstract:

In this paper, we have extracted liver and tumor region in the CT image. Liver and tumor are extracted by using region growing method, and morphological operations such as filling holes, erosion, dilation and close. Features of tumor such as area and perimeter are calculated using regionprop operation. Using these feature, tumor is classified as benign or malign.

Keywords: Liver cancer, CT image, Region growing, morphological operation, area and perimeter, etc.

I. INTRODUCTION

Liver cancer is starts in the cells of liver. Liver is a largest organ that presents in the upper right side of abdomen, above stomach and below diaphragm.

Hepatocellular carcinoma is the primary liver cancer, which starts in hepatocyte liver cell. Other liver cancer which are less common are intrahepatic cholangiocarcinoma and hepatoblastoma.

Compare to the cancer that begins in liver than cancer spread to the liver from other body parts is most common. That is cancer from colon, lung or breast is spread to liver. Such type of cancer is called metastatic cancer. If cancer spreads for colon to liver, then that cancer is called metastatic colon cancer.

Hepatocellular carcinoma starts in the people with cirrhosis caused by hepatitis B or hepatitis C infection(chronic liver diseases). Hepatocellular carcinoma occur in the people who drink alcohol more and who has growth of fat in the liver. Fig.1showa the imageof liver cancer.Fig.2. is CT image of liver cancer.s,



Fig. 1. Liver cancer



Fig. 2. CT image of liver cancer

II. PRELIMINARIES

To extract the tumor region in Liver image, The CT Liver image must be enhanced. There are different

medical image enhancement techniques are discussed in [1], [2], [4], [6], [10] and [11]. Medical image enhancement techniques based on fusion are discussed in [3], [9]. Image denoising techniques are discussed in [8]. One of the method for CT liver and tumor segmentation is Region based segmentation. Region based segmentation and its application for CT liver image is discussed in this section.

- *Region-based segmentation*

Region-based image segmentation is done by region growing method. In this method, initial seed points must be selected. Hence it is called a pixel-based image segmentation method. If the neighboring pixels of seed points are satisfied some predefined conditions, then these pixels are added to the region. This type of segmentation is used to partition an image into regions.

Seed Points: In region based segmentation, the first method is to select the seed points. Pixels in the region where the image need to be segmented are selected as seed points. Region will be growing from these seed points to adjacent pixels depending on pixel intensity and using 4-connected neighborhood or 8-connected neighborhood condition. If adjacent pixels of seed point are in 4-neighbors or 8-neighbors and have the intensity of seed point then these adjacent pixels will become seed points. This process will be continued till images are segmented into regions.

- *Morphological processing*

Morphological operators are applied on binary image and structuring element which has characteristic of object shape in input image. Usually structuring element is odd sized matrix and its origin is at the center. The structuring element is shifted such that center of structuring element is overlapped with the each and every pixel of the image and the structuring element and image pixels underlying are compared every time.

Erosion and dilation:

The erosion will generate new binary image with the center of structuring as 1 if structuring element completely fits in the image pixels underlying the structuring element, otherwise center will be 0. This process is repeated for all the pixels in the input image. Using erosion, small holes and gaps in the region become larger and small details in the image are eliminated.

The erosion is denoted by $E=A\ominus B$, where A is a binary image and B is structuring element

The dilation of an image produce new binary image with the center of structuring as 1 if at least one pixel value of structuring element fits in the image pixels underlying the structuring element, otherwise center will be 0. Dilation adds a layer of pixels to inner and outer boundary of region with the shape of structuring element. The holes and gaps in the region will be reduced by dilation.

The *opening* of an image A by a structuring element B is denoted as $A\oslash B$ is obtained by performing erosion first and dilation next. This operation eliminates thin bridges between two regions.

The *closing* of an image A by a structuring element B is denoted as $A\bullet B$ is obtained by performing dilation first and then erosion.. the gaps in the image are filled by closing operation.

- *bwtraceboundary*

$B = \text{bwtraceboundary}(BW,P,\text{fstep})$ is MATLAB code is used to obtain the trace of the object boundary in binary image specified by BW. P is a two element vector which will specify the point on the boundary of object from where trace should begin. fstep is a string which specify the direction for next object pixel connect to P such as 'S' for south. The following figure shows different possible strings for fstep. B contains rows and columns of all boundary pixels.

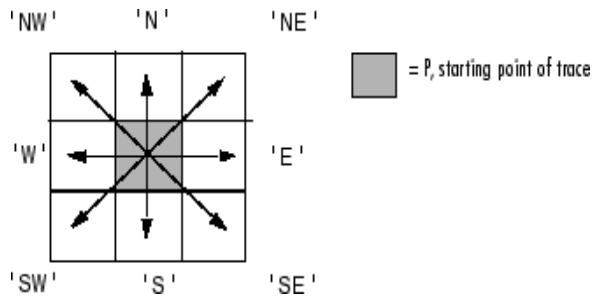


Fig. 3. All possible values for fstep

2)region growing algorithm is applied to segment the liver. To apply region growing algorithm, first seed point must be selected in the image. After observing the input image, seed point is selected in liver region.

3)Liver region is extracted

4)Obtained boundary of liver region using bwtraceboundary

5)To detect tumor region, again region growing algorithm is applied. Here seed point is selected in the tumor region.

6)Tumor in the liver region is extracted

7)Obtained the boundary of tumor using bwtraceboundary

8)Region properties of tumor such as area, perimeter are obtained by regionprops

Regionprops

regionprops is used to measure different properties of region.

stats = regionprops(B,properties) gives the values for properties specified for objects in the binary image. B is input binary image. The string 'all' or 'basic' can be used in the place of properties. If basic is used, then regionprops gives 'Area', 'centroid'and 'boundingBox' measurements. If all is used, then it gives all properties of object such as 'Area', 'BoundingBox', 'Centroid', 'FilledArea', 'FilledImage', 'Image', 'PixelIdxList', 'PixelList', and 'SubarrayIdx'..

III. PROPOSED METHOD

The Block diagram in fig 4 explains the proposed method

The algorithm for proposed method is given as:

1)Preprocessing: the input CT image much be preprocessed before extracting the liver region. The preprocessing includes removing noise, input image dimensionality change, converting input image from rgb to gray scale image.

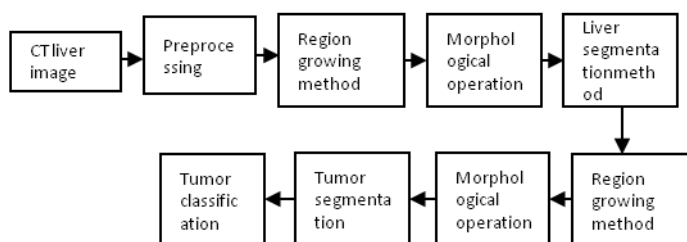


Fig. 4. Block Diagram of Proposed method

IV. EXPERIMENTAL RESULTS

Original CT image is shown in figure 5. Figure 6 is the output after applying Region growing algorithm to figure 5. Morphological operation is applied to fill the gaps in figure 6, the result is as shown in figure 7.

Liver region is segmented, it is as shown in figure 8. Figure 9 shows the trace of boundary of liver region. Figure 10 shows the detection of tumor. Trace of boundary of tumor in CT image is shown in figure 11. Extraction of tumor region is shown in figure 12.

Classification of tumor based on total number of pixels in tumor area is shown in figure 13. Figure 14 to Figure 22 are the outputs obtain for CT image 2. Figure 23 to Figure 30 are the outputs obtain for CT image 3.



Fig. 5. Original CT image1

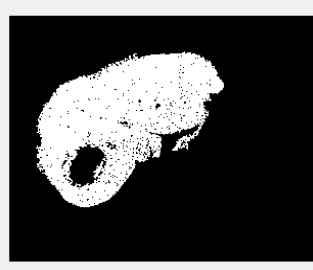


Fig. 6. Region growing output

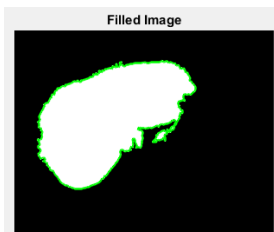


Fig. 7. morphological



Fig. 8. Liver segmentation operation



Fig. 9. liver boundary

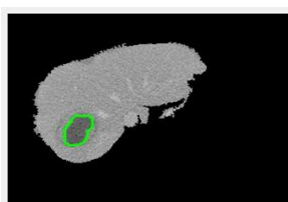


Fig. 10. Tumor detection



Fig. 11. Tumor Boundadary

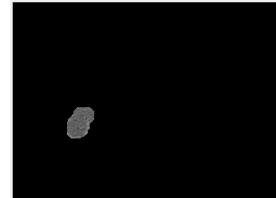


Fig. 12. Tumor Extraction

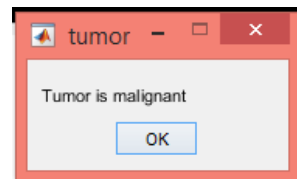


Fig. 13. Tumor Classification



Fig. 14. original CT image2



Fig. 15. Region growing output

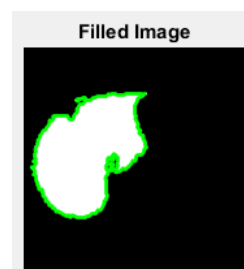


Fig. 16. morphological

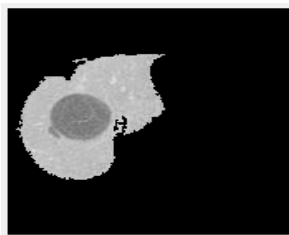


Fig. 17. Liver segmentation operation

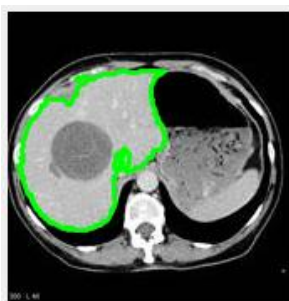


Fig. 18. liver boundary

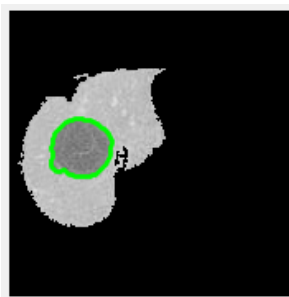


Fig. 19. Tumor detection

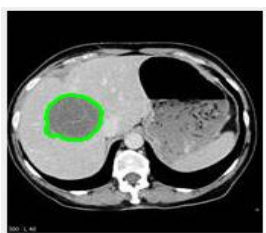


Fig. 20. Tumor Boundary

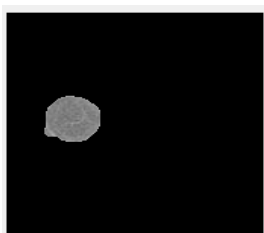


Fig. 21. Tumor Extraction

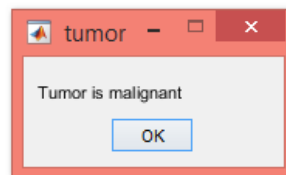


Fig. 22. Tumor Classification



Fig. 23. original CT image3

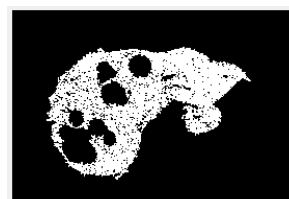


Fig. 24. Region growing output

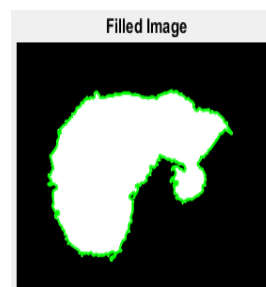


Fig. 25. morphological operation

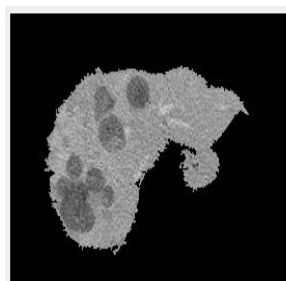


Fig. 26. Liver segmentation

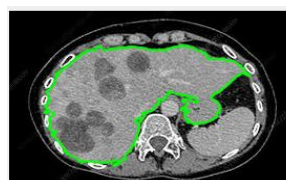


Fig. 27. liver boundary

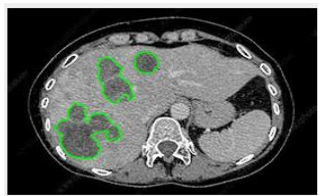


Fig. 28. Tumor detection

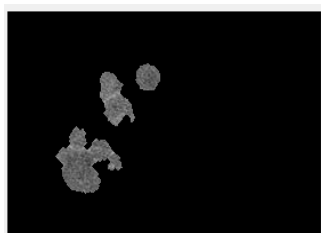


Fig. 29. Tumor extraction

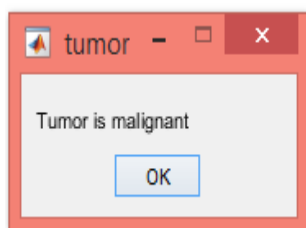


Fig. 30. classification of Tumor

Area and perimeter of tumor region is calculated using regionprop code. Area and perimeter of tumors in CT image1, CT image2 and CT image 3 are shown in Table1.

TABLE I. AREA AND PERIMETER OF TUMOR REGION IN CT IMAGES

Area and Perimeter/CT image	CT image 1	CT image 2	CT image 3
Area & Perimeter of tumor	Area: 850 Perimeter: 107.8520	Area: 1068 Perimeter: 115.3860	Area = 39192 Perimeter = 2.1210e+03

V. CONCLUSION

Region growing and morphological operations applied on different CT images. Area and perimeters are obtained for tumor regions in the image. Using

area of tumor, tumor is classified as malignant or benign. In this method, seed points must be selected manually in liver region and in tumor region. Further study includes application of machine learning and deep learning methods to segmentation of tumor in the liver region without

VI. REFERENCES

- [1] Zohair Al-Ameen, Ghazali Sulong and Md. Gapar Md. Johar, "Enhancing the Contrast of CT Medical Images by Employing a Novel Image Size Dependent Normalization Technique", International Journal of Bio-Science and Bio- Technology, Vol. 4, No. 3, pp. 63-68, Sep. 2002.
- [2] Fathi KALLEL, Ahmed BEN HAMIDA, "A new adaptive gamma correction based algorithm using DWT-SVD for non-contrast CT image enhancement", IEEE Transactions on NanoBioscience Vol. 16 , Issue: 8 , pp. 666 - 675, Dec. 2017.
- [3] P. Sreeja, S. Hariharan, "An improved feature based image fusion technique for enhancement of liver lesions" Biocybernetics and Biomedical Engineering Volume 38, Issue 3, pp. 611-623, May 2018.
- [4] RELA, Munipraveena; NAGARAJA RAO, S. Comparative analysis of image enhancement techniques applied to CT liver image. International Journal of Engineering & Technology, [S.l.], v. 7, n. 3.29, p. 285-289, aug. 2018. ISSN 2227-524X. doi:http://dx.doi.org/10.14419/ijet.v7i3.29.19176.
- [5] Anil K. Jain. "Fundamentals of Digital Image Processing", Prentice Hall Inc., prentice hall international edition, 1989. [https:// www.mathworks .com/ discovery/ digital- image-processing](https://www.mathworks.com/discovery/digital-image-processing).
- [6] Munipraveena Rela , S. Nagaraja Rao, P. Ramana Reddy, "Efficient Image Enhancement Techniques Applied on Medical Imaging-A State- of- The Art Survey", International Journal of Recent Technology and Engineering

(IJRTE), ISSN: 2277-3878, Volume-7, Issue-6S4, April 2019.

- [7] Jayanthi, M.; Kanmani, B., "Extracting the Liver and Tumour from Abdominal CT Images", IEEE, Fifth International Conference on Signal and Image Processing (ICSIP), 2014 .
- [8] Das K., Maitra M., Sharma P., Banerjee M. (2019) Early Started Hybrid Denoising Technique for Medical Images. In: Bhattacharyya S., Mukherjee A., Bhaumik H., Das S., Yoshida K. (eds) Recent Trends in Signal and Image Processing. Advances in Intelligent Systems and Computing, vol 727. Springer, Singapore.
- [9] Huafeng Li, Xiaoge He, Dapeng Tao, Yuanyan Tang, Ruxin Wang, "Joint medical image fusion, denoising and enhancement via discriminative low-rank sparse dictionaries learning" Pattern Recognition, vol. 79, pp. 130–146, Feb. 2018.
- [10] Jinlan Guan, Jiequan Ou, Zhihui Lai and Yuting Lai, "Medical Image Enhancement Method Based on the Fractional Order Derivative and the Directional Derivative", International Journal of Pattern Recognition and Artificial Intelligence, Vol. 32, No. 3, pp. 1857001 (22 pages), 2018.
- [11] Ebenezer Daniel, J. Anitha, "Optimum wavelet based masking for the contrast enhancement of medical images using enhanced cuckoo search algorithm", Computers in Biology and Medicine, Volume 71, Pages 149-155, April 2016.