International Journal of Scientific Engineering and Technology ISSN : 2277-1581
Volume No. 6, Issue No. 7, PP : 247-249 1 July 2017

Segmentation of Liver Abnormality based on Label Connected Component Algorithm

Jayanthi Muthuswamy
Department of ECE, New Horizon College of Engineering, Bangalore, K.S. India
Corresponding Email : jayanthi.sathishkumar@live.com

Abstract: Medical imaging uses a non invasive method to view the internal structure of human body. This helps the radiologists to study and visualize the region of interest for treatment planning and surgery. Computer tomography imaging gives detail view of soft tissues of abdominal organ. The objective of the proposed work to segment the liver from abdominal CT image using segmentation technique. The method uses bilateral filter for pre processing and for finding the liver region, label connected component algorithm is proposed . The performance of the algorithm is compared with ground truth from experts. The performance measures includes Dice coefficient, misclassification rate and the volume of liver .

Keywords : Computer tomography imaging (CT), Bilateral filter, Label Connected component algorithm (LCC)

I. Introduction

Medical imaging [2]plays an important role in the field of medical science. This imaging produces an image of internal structure without operating on it. The different imaging modalities are Ultrasound, computer Tomography imaging , Magnetic resonance imaging etc. Among all, CT imaging is more preferable, since they have good spatial resolution, less expensive and operator independent .This accurate imaging gives detail view of internal structure of abdominal organ. In the proposed method, this imaging is considered for experimental discussion.

In medical science, extracting the liver from abdominal CT scan is a difficult and challenging task due to the high overlapping organs in the abdomen. Manual segmentation is time consuming and tedious. An interpretation and segmentation results varies from experts to experts. These factors motivated to develop an automatic segmentation of liver from abdominal CT imaging

CT images uses x - ray beams to capture the internal structure of human body .Many artifacts are present in CT imaging . To remove the artifacts , pre processing is essential. The objective of pre processing is to enhance an image , remove the noises and improve the quality of segmentation results. In the proposed work, Bilateral filtering is used. Many researchers have proposed , developed different methods and techniques for liver segmentation. The developed methods over the recent years which includes thresholding methods aided by morphological operation, de-formal model, region based segmentation, active contours, cluster based methods and watershed transformation [1,2,3,9 and 10] .

In [1], author proposed comparative study of liver segmentation based on various segmentation methods. The author discussed various methods for segmenting the liver. S.Priyadarsini et al [4] have presented a comparative analysis of various segmentation techniques of liver abdominal CT image. K mala et al[8] proposed adaptive threshold based morphological processing for liver segmentation.. M.Jayanthi et al [2] proposed an approach for extracting the liver and tumor from abdominal CT images and used for computer aided diagnosis. The author used seeded region growing method and had taken limited amount of image sample and performance measures not evaluated in the work. SS kumar et al [7] have developed a CAD system for segmenting the liver and tumor extraction. The drawback is selection of seed point. The problems in existing systems are high processing time and over segmentation. In the proposed work, segmentation method is used to improve the accuracy of the system. The rest of the paper is organized as follows: material and methodology are described in section II. The proposed method results are discussed and explained in section III. Finally, the paper is concluded in section IV.

II. Material and Methodology

A. Computer Tomography

Computer Tomography [2] scan combines series of X-ray images taken from different angles and use computer processing to produce cross sectional images of the human body. During surgery, this imaging allows the surgeons to look into structure without relying on previous scan. This also helps radiologists to diagnosis the diseases and to confirm the presence of tumor, size and exact location of it. Liver is the largest organ in the abdomen and reddish in color, feels rubbery to touch.

B.Bilateral filtering

Bilateral filter [11] is a non linear, non iterative, noise reducing smoothing filter which is developed by Tomasi. This filter is obtained by the combination of two Gaussian filter .One filter works with partial domain and other one works with intensity domain. The intensity value of each pixel is replaced by a weighted average of intensity values from nearby pixels. The weight function depends on spatial distance and intensity difference.

Spatial distance is calculated as

$$s_d(p,q) = e^{-||p-q||^2/2\sigma_{sd}^2} \quad (1)$$

Intensity difference is calculated as

International Journal of Scientific Engineering and Technology
Volume No. 6, Issue No. 7, PP : 247-249
ISSN : 2277-1581
1 July 2017

$$I_d(x,y) = \mu + \frac{\sigma^2 - v^2}{\sigma^2}(I_0(x,y) - \mu) \quad (2)$$

At pixel p

$$Bif(p) = \frac{1}{C}\sum_{q \in \gamma(p)} Bif(q) s_d(p,q) I_d(p,q) \quad (3)$$

Where C is a normalization factor $C=\sum S_d(p,q)\, I_d(p,q)$ and $\gamma(p)$ shows the spatial neighbourhood of Bif(p). Above formula is used to replace each pixel by the weighted average of values from nearby pixels.

C.Label Connected Component

To obtain the largest area of contour ,connected component algorithm [1] is used. It is a graphical approach for effective segmentation algorithms . The algorithm works well for medical images. To compute connected components [1] of an image, split the image into horizontal runs of adjacent pixels, and then label the runs uniquely. In the second pass, adjacent runs of different labels are merged. The algorithms ensure regions of similar value are labeled with one label.

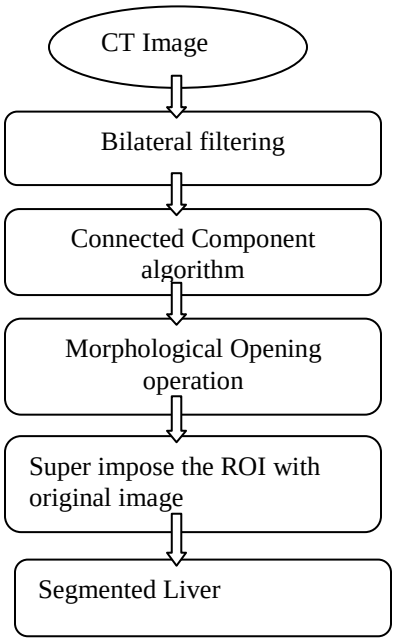


Figure 1 Flowchart of proposed method

D. Proposed Methodology

The proposed work flow chart is shown in the Figure 1.
The proposed work has many phases Each phase is explained in detail .

Phase 1: Image Acquisition

CT scan uses x-ray beam to capture multiple slice images with slice thickness. This slice thickness is used for volume measurement of region of interest.. The database for the proposed work is taken from diagnostic scan centre and from internet. Our database includes fatty liver, liver with cancer and cirrhotic liver. Selection of suitable slices in CT dicom File is more important. . Liver distribution varies from one slice to another . Moreover liver occupy the largest portion in the abdomen. And middle slice is preferable and it shows the detail view of all organs. This middle slice is suitable for segmentation.

Input: Image in DICOM format.
Output : JPG format (after apply acculite software for conversion)

Phase 2: Pre Processing

Input: JPG CT Image/BMP image
Output: Pre processed Output

This phase is to remove the noise CT image and improve the quality of an image. Steps is given below:

1.Convert that CT image(bmp or jpg) to grey scale image.
2.Define the bilateral filter parameter w, σsd and σid
3.For all the pixel, do the following steps 5,6,7
4.Calculate the spatial distance using the equation 1
5.Calculate the intensity difference using the equation 2
6..Apply the filtering values on CT grey scale image using the equation 3.
7.Get the resultant pre processed image**.**

Phase 3: Segmentation

Apply label connected component algorithm. The algorithm has two module: (i)Labelling of connected components (ii)Search for the largest component.
Steps involved in connected component labelling: (i).Take the filtered image as the input. (ii).Scan all 'P' pixels from left to right and top to bottom.i.e scan pixel by pixel (iii).Check the condition if the pixel 'P' is not equal to background then if only one of two top and left neighbours has a label e then mark P with e Else if these two neighbours have the same label then mark p with e Else if then mark P with min(top pixel, left pixel) (iv).If the condition is not satisfied then assign new label to pixel P

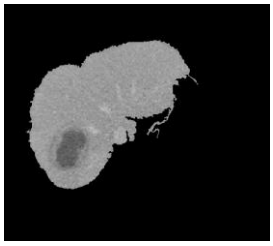
Phase 4: Post processing

For the output of label connected component, apply morphological opening filter is used to fill the holes. The superposition of the contour on the original image allows us to deduct the region of the liver. To obtain the liver region, liver mask is multiplied with original image. By applying ,dynamic thresholding , tumor portion is extracted.

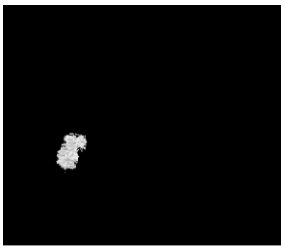
III. Results and Tables

(a)

International Journal of Scientific Engineering and Technology
Volume No. 6, Issue No. 7, PP : 247-249
ISSN : 2277-1581
1 July 2017



(b)



(c)

Figure 2 Proposed method results.(a) Pre processed Image (b) Proposed method output (c) Tumor detection

The proposed approach is analyzed, applied and tested on abdominal CT image dataset .In this work, 25 Images is taken for analysis. All images are axial images. The proposed works are carried out on Pentium processor and implemented in Matlab 9.

Figure 2 shows the overall output of proposed method. Figure 2a pre processed CT image. Apply LCC algorithm for Preprocessed image and detect the contour , corresponding as shown in Figure 2b Extracted tumor as shown in Figure 2c

To understand and evaluate the performance of proposed method , several quality measures can be used .Dice coefficient, True positive rate and misclassification rate.

$$Dice = \frac{2|A \cap M|}{|A+M|} \quad (4)$$

$$True\ Positive\ fraction = \frac{|A \cap M|}{M} \quad (5)$$

$$Misclassification\ Rate = 1 - \frac{|A \cap M|}{M} \quad (6)$$

A is number of pixels of the automatically segmented liver regions and M is number of pixels of the manually segmented liver (ground truth) by the experts. Above metrics are used to find the similarity between automatic and manual segmented output(GT). Table 1 shows the statistical analysis segmented output of proposed method. Proposed method (PM) runs for Dataset contains 15 images but the result shown for 5 test images in the Table 1.

	PM	GT	DICE	TRF	MCF
DT1	41096	42123	0.9877	0.975	0.024
DT2	2788	3103	0.9634	0.929	0.070
DT3	7102	7258	0.9891	0.978	0.022
DT4	13309	13886	0.9788	0.958	0.041
DT5	1344	1942	0.9862	0.972	0.027

For sample database ,

Volume of liver =slice thickness* Area

Area=Number of pixels *Pixel dimension

IV. Conclusion

An approach for automatic segmentation is proposed in this work. The Proposed method uses LCC method to obtain liver contour. The performance of the work is compared with ground truth and further volume measurement is calculated. This measurement is very much essential for liver transplantation and liver surgery in order to find the best donor .

V.Acknowledgement

I would like to thank Professor Dr B Kanmani , Dean of Academics , BMS college of Engineering for their constant encouragement and support for this work.

References

i. *M.Jayanthi, 'Comparative Study of Different Techniques Used for medical image segmentation of Liver from Abdominal CT Scan', IEEE WiSPNET 2016 conference, pp.1462-1465,(2016).*

ii. *Jayanthi, M.,Kanmani, B., 'Extracting the Liver and Tumor from Abdominal CT Images',IEEE, Fifth International Conference on Signal and Image Processing (ICSIP), "pp. 122-125,(2014).*

iii. *Devendra Joshi, Narendra D Londhe, ' Automatic Liver Tumour Detection In Abdominal CT Images', International Journal of Computer Technology and Electronics Engineering (IJCTEE) Volume 3, Issue 1, February (2013).*

iv. *S. Priyadarsini and Dr.D.Selvathi, 'Survey on segmentation of liver from CT images', IEEE International Conference on Advanced Communication Control and Computing Technologies (ICACCCT), pp. 234-238, (2012).*

v. *S.Gunasundari and M. Suganya Ananthi , 'Comparison and Evaluation of Methods for Liver Tumor Classification from CT Dataset', International Journal of Computer Applications ,Volume 39– No.18, (2012)*

vi. *S.S.Kumar, R.S.Moni, I.Rajeesh, 'Automatic liver and lesion segmentation: a primary step in diagnosis of liver diseases', Signal,Image and Video Processing DOI: I0.1007/s11760-011-0223-y, March 31, (2011).*

vii. *Hiroshi Fujita Hiroshi Fujita1, Xuejun Zhang1,2, Shoji Kido3, Takeshi Hara1, Xiangrong Zhou1, Yuji Hatanaka4, Rui Xu3, 'Introduction to CAD System', International Conference on Future Computer, Control and Communication 2010, pp.200-205,(2010)*

viii. *K.Mala, V.Sadasivam, and S.Alagappan, 'Neural Network based Texture Analysis of Liver Tumor from Computed Tomography Images', International Journal of Biological, Biomedical and Medical Sciences, Vol. 2 Issue 1, pp 33-37, (2007).*

ix. *Gao, L., Heath, D., Kuszyk, B., 'Automatic liver segmentation technique for three- dimensional visualization of CT data',. Radiology 201 (1996) ,359–364.*

x. *Bae, K., Giger, M., and Chen, C, 'Automatic segmentation of liver structure in CT images ', Med. Phys. 20 (1993) 71–78.*

xi. *Tomasi, C. and R. Manduchi, Bilateral Filtering Tomasi, C. and R. Manduchi, 1998. Bilateral Filtering for Gray and Color Images: Proceedings of the IEEE International Conference on Computer Vision,Bombay, India,pp 834-846,1998*