Methods for Liver Tumor Segmentation and Detection: A Review

Mr Vishwajit B. Mohite[1] Prof.Mrs. P. P. Belagali[2]
[1]M.E. Student [2]Assistant Professor
[1,2]Department of Electronics & Telecommunication Engineering
[1,2]Dr.J.J.M.C.O.E, Jaysingpur, Maharashtra India

Abstract— This paper presents the different segmentation and detection techniques for liver tumor. Liver Cancer is one of the most difficult cancer to heal and the number of deaths that it causes generally increasing. The signs and the symptoms of the liver cancer are not known, till the cancer is in its last stage. So, early detection is the main problem. Computed Tomography (CT) is highly accurate for liver cancer diagnosis. Manual identification of hepatic liver tumor done by trained physicians is a time-consuming task and can be subjective depending on the skill, expertise and experience of the physician. The sophisticated hybrid systems are proposed in this paper which is capable to segment liver tumor from a liver CT image and detect liver tumor automatically.

Key words: CT Images, Image Segmentation, Liver Tumor Detection

I. INTRODUCTION

Liver tumor is one of the highest causes of death due to cancer. An accurate detection and proper segmentation of liver tumor from CT image is of high significance especially for early detection and diagnoses of cancer. Liver tumor segmentation can be formulized as a pattern recognition problem, where a given voxel is to be assigned a label, either a tumor or non-tumor class. Previously, detection or segmentation of liver tumor is done by experienced clinicians, but it is too time consuming and subjective depending on the skills and experiences of the clinicians. Thus minimal user involvement with reliable detection and segmentation of liver tumors is highly aspired [1].Researchers in the past have investigated this topic.

Jin Wei Xu[2], proposed method can provide an effective quantitative analysis of cancer stem cell images in terms of cell account, morphology and classification .When a whole image is under process without being divided into several blocks, most cell can be detect from background with good segmentation accuracy. Once whole image could be divided into a few sub images the performance of this method would be improved. The double thresholding method it delivers the most favorable results on both segmentation accuracy and processing time. Kaur [3] set the normal threshold nodule value in preset database. These values indicate that image nearby these range on subtraction may considered for the normal value. After changing the contrast value from the obtained image we need to difference the threshold value from the preset database and mark the boundary where more changes are obtained when whole scan for this process is completed, detect the area and segment it. Obtain part may be affected with cancer. Ms. Vincey Jeba Malar.V [4] proposed work was carried out in 4 phases. In first phase, image acquisition of liver features and the second phase is removal of the noise. Third phase is related to the segmentation of ROI features of liver which can be determined using segmentation algorithm such as region growing approach. Fourth phase is feature extraction, it extract the corresponding liver nodule. Yu Masuda [5] proposed a new method to detect tumors automatically in CT image. By using contrast enhancement with PDFs of different tissue classes in a newly devised histogram transformation method, they can enhance the image contrast. Moreover, by using the EM/MPM algorithm, detect tumors more accurately. They plan to improve work to handle the large morphology variation of tumors. The Otsu [6] algorithm is an example of algorithms based on the relationship between the pixels of the object and background. In this approach, the histogram is divided into two class (C0 and C1) representing the object and the background. The color responsible for its division is the threshold value and calculated by function minimization. Joshi et al [8] the proposed segmentation method improves the segmentation performance compared with the conventional process based on a regular gray value. The presented system for segmentation of liver tumor is able to reliably segment the tumor in the used patient database. Successive training of several classifiers using additional probability features proved useful, as did the proposed standardization method.

II. MATERIALS AND METHODS

The Computed tomography (CT) image allows good detection rates for most tumor types. The segmentation of liver tumors is challenging due to the small observable changes between normal tissues and tumors

Many image segmentation methods for medical images has been proposed, the image segmentation method of liver tissue proposed in this study is,

A. Pre-Processing

The pre-processing is used to smoothness, enhance, and remove noise that caused by defects of CT scanner, improve quality and emphasizes certain features of an image so that it makes segmentation or recognition easier and more effective.

B. Noise Removal

The most useful technique for removal of blur in images due to linear motion and also due to vibrations. Normally an image is considered as the collection of information and the occurrence of noises in the image causes degradation in the quality of the images. It should be important to restore the image from noises for acquiring maximum information from images.

The CT images contain more Gaussian noise, a Gaussian filter is used for noise removal. The weights are chosen according to the shape of Gaussian function. Gaussian filters are a class of linear smoothing filters. The Gaussian smoothing filter is a very good filter to remove noise drawn from a normal distribution [4]

III. SEGMENTATION AND DETECTION

A. *Otsu's Thresholding:*

In Otsu′s Thresholding, assume that ni is the number of pixels with gray-level, is the maximum gray scale value and F is the total number of pixels in the gray-level image. The probability pi of a pixel with gray-level i in image can be computed as Equation (1):

$$pi=ni/N,\ i=1,2,3,\ldots,L \quad (1)$$

Then separate the pixels into two classes CI and $C2$ by a threshold k; CI denotes pixels gray-scale value is less than or equal k, and $C2$ denotes pixels gray-scale value is greater than k. The probability p$C1$ and p$C2$ of the pixels in $C1$ and $C2$ can be computed as follows:

$$p_{C_1} = \sum_{i=1}^{k} p_i \ \text{ and } \ p_{C_2} = \sum_{i=k+1}^{L} p_i \quad (2)$$

Where the mean m$C1$ and m$C2$ of $C1$ and $C2$ can be computed as follows:

$$m_{C_1} = \sum_{i=1}^{k} \frac{i \times p_i}{p_{C_1}} \ \text{ and } \ m_{C_2} = \sum_{i=k+1}^{L} \frac{i \times p_i}{p_{C_2}} \quad (3)$$

The Otsu′s Thresholding method then computes the optimal threshold opt_k* by minimizing the within-class variance as follow:

$$\sigma^2_{within}(k) = p_{C_1} \times \frac{\sum_{i=1}^{k} N_i \times (i - m_{C_1}(k))^2}{N_{C1}} + p_{C_2} \times \frac{\sum_{i=k+1}^{L} N_i \times (i - m_{C_2}(k))^2}{N_{C2}} \quad (4)$$

Where $FC1$ and $FC2$ are the number of pixels in class $C1$ and $C2$. Otsu ′s Thresholding is finding a threshold by gray-level value distributed which can be determined and distribution of intensity level can be separated into objects and background two clusters.

Otsu′s Thresholding is used for gray scale images to find the appropriate threshold, use the threshold objects extracted from the image and binary image.

B. *Adaptive Thresholding*

Global thresholding, local adaptive thresholding are used to separate the desirable foreground image objects from the background based on the difference in pixel intensities of each region. Global thresholding uses a fixed threshold for all pixels in the image and therefore works only if the intensity histogram of the input image contains neatly separated peaks corresponding to the desired subject and background.

Since the threshold used for each pixel depends on the location of the pixel in terms of the sub images, this type of thresholding is adaptive. An approach to handling situations in which single value thresholding will not work is to divide an image into sub images and threshold these individually Since the threshold for each pixel depends on its location within an image this technique is said to adaptive. We use the adaptive thresholding for segmentation of liver tumor in CT images[7].

Threshold process convert CT image in to binary image. The process of adaptive thresholding is as follows:

1) Adaptive Thresholding divide original CT image into sub images.
2) Utilize a different threshold to segment each sub images.
3) Difficulties occur in subdivision and subsequent threshold estimation. Image Segmentation for sub images without boundaries, variance < 75, so when variance < 100, sub images treated as a single composite image or sub images with boundaries, variance > 100, so when variance > 100, sub images treated separately. In both these cases T is obtained automatically with T0 midway between the minimum and maximum gray level. This process will automatically generate segmented region using gray level.

C. *Region Growing Algorithm*

The region growing (RG) algorithm is one of the simplest region-based segmentation methods. It performs a segmentation of an image with examine the neighboring pixels of a set of points, known as seed points, and determine whether the pixels could be classified to the cluster of seed point or not .

The algorithm procedure is as follows.

– Step1. Start with a number of clusters and seed points which have been identified from watershed algorithm, cluster called C1, C2,....,Cn. And the positions of initial seed points is set as P1, P2,.....,Pn.
– Step2. To compute the difference of pixel value of the initial seed point pi and its neighboring points, if the difference is smaller than the threshold criterion that define, the neighboring point could be classified into Ci, where i = 1, 2,....,n.
– Step3. Recompute the boundary of Ci and set those boundary points as new seed points pi (s). In addition, the mean pixel values of Ci have to be recomputed, respectively.
– Step4. Repeat Step 2 and 3 until all pixels in image have been allocated to a suitable cluster. The mean drawback of RG is initial seed-points[9].

The initial seed-points problem means the different sets of Initial seed points cause different segmentation results. This problem reduces the stability of segmentation results from the same image.

D. *Morphological Operator-based Algorithm*

Dilation and erosion are the two main Morpho-logical processing. Dilation expands objects by a structuring element, filling holes, and connecting disjoint regions. Erosion deletes the small region by a structuring element. The main aim of morphological operators is to detect the object forms or shapes from the images based on a set of pre-defined structuring elements. Usually a set of structuring elements (SE) is based on the prior knowledge, and then some morphological operators apply structuring elements to images. Morphological operations based algorithm has several advantages. First it does not need any specific initialization, which makes it possible to design the fully-automatic algorithms. Second it focuses less on the structure of the object of interest. Therefore, it can work well on the liver whose structure varies between different persons [4]

IV. RESULTS AND DISCUSSION

We reviewed the four methods for segmentation and detection of liver cancer. The obtained results shown in the below figures.

In the othsu's thresholding pixel are divided into the two groups and then calculate the mean variance and standard deviations by using this features separate the intensity level by background and objects in to two clusters [7] this is use for segmentation. In adaptive threshold they start the process of segmentation of liver tumor image. Thresholding divide original CT image into sub images. It uses a different threshold value to segment each sub images. This process will automatically generate segmented region using gray level. After thresholding, tumor is segmented from CT image. Tumor is segmented then boundaries are made in segmented region. The original image is shown in the figure1 (a)

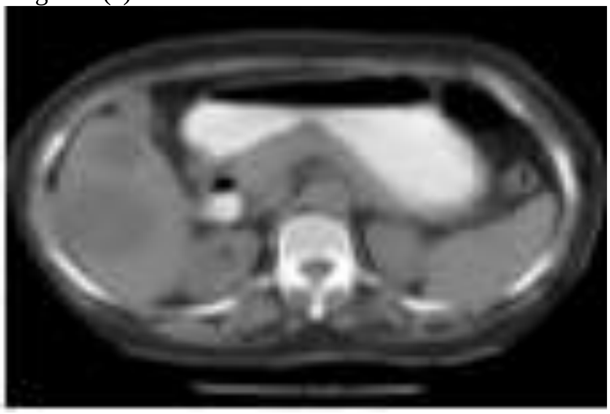

Fig. 1(a): Original Image

After the process of adaptive thesholding in the image affected area is identify easyly and it is indicated by green colour it is shown in figure 1(b).

Figure 2 (a) shows the original CT image of liver figure 2(b) shows image after the region growing method in this segment the image to find the affected area.

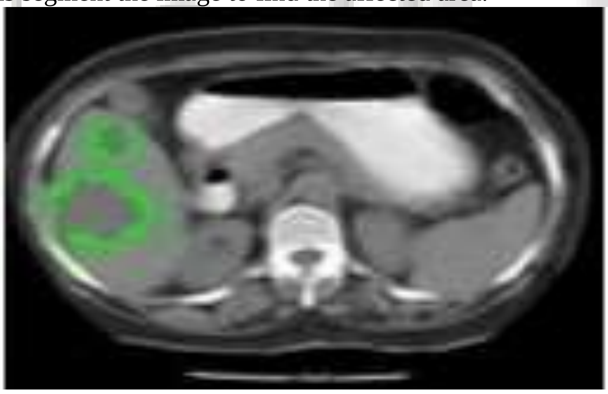

Fig. 1(b): Proessed Image After Thresholding.

After the morphological operation it is detect and indicated by red color it is shown in Figure 2 (c).

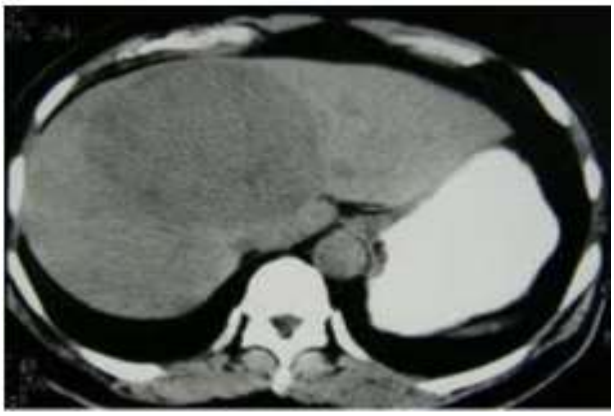

Fig. 2(a): Original Image

Fig. 2(b): Processed Image After Region Growing Operation.

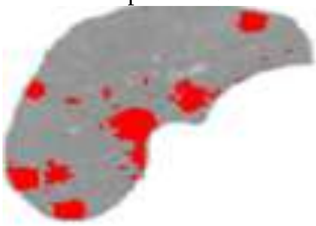

Fig. 2(c): Processed Image after Morphological Operation

V. CONCLUSION

In this paper, a different methods of segmentation the CT images been discussed. This methods works carried out by taking CT images. The presented system for segmentation of liver tumor is able to reliably segment the tumor in the used patient database by using all these methods

REFERENCES

[1] Lin-Yu Tseng Li-Chin Huang “An Adaptive Thresholding Method for Automatic Lung Segmentation in CT Images”2009 IEEE.
[2] Jin Wei Xu, Xiaobo Zhou “A Double Thresholding Method for Cancer Stem Cell Detection”ISPA Sept. 4-6, 2011.
[3] Parminder kaur, Punam bajaj “Lung Cancer Detection Using Threshold Differencing and Contrast Enhancement” (IJLTET) Vol. 3 Issue 1 September 2013.
[4] Ms.Vincey Jeba Malar.V “Computer Aided Diagnosis for liver Cancer Feature Extraction” IJES Volume 2 Issue 11Pages 27-3 2013.
[5] Yu Masuda et al. “Liver Tumor Detection in CT Images by Adaptive Contrast Enhancement and the EM/MPM Algorithm” Department of Science and Engineering, Ritsumeikan Univesity, Shiga, Japan.
[6] N. Otsu, “A Threshold Selection Method from Gray-Level Histogram,” IEEE Transactions on System Man Cybernetics, vol. SMC-9, no.1,pp. 62-66,1979.
[7] Devendra Joshi, Narendra D Londhe “Automatic Liver Tumour Detection in Abdominal CT Images” (IJCTEE) Volume 3, Issue 1, February 2013
[8] Jan Hendrik Moltz, Lars Borneman “Segmentation of Liver Metastases in CT Scans by Adaptive Thresholding and Morphological Processing” Research GmbH – Center for Medical Image Computing, Bremen, Germany.
[9] Ahmed M. Anter∗, Ahmad Taher Azar “Automatic computer aided segmentation for liver and hepatic lesions using hybrid segmentations techniques” Proceedings of the 2013 Federated Conference on Computer Science and Information Systems pp. 193–198 2013IEEE.