Volume 5, Issue 2, February 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

An Approach for Segmentation of Ultrasound Liver Images and Extracting the Features of Segmented Part

Amritpal Singh*, Anupam Garg
Department of CSE, Punjab Technical University,
Jalandhar, Punjab, India

Abstract— Liver is most important internal organ of the human digestive system. Various tumours are detected in ultrasonic liver images, some of which are normal tumours and some are the cancerous. A cancerous tumour in liver is one of the most terrible diseases. It can be remedy completely by following the appropriate treatment. It can be easily cured if it is diagnosed at an early stage. To segment out the cavities, tissues and tumours in the ultrasound image for the effective and correct diagnosis is very important. Low contrast and various types of noises are the problems in ultrasound images segmentation. In this work an attempt is made to develop an algorithm to solve the problem of image segmentation. The located region of interest is further analyzed and texture features are computed from Gray Level co-occurrence Matrices for further analysis.

Keywords— Segmentation, Texture Features, Tumours, Shape Measurements, Thresh holding

I. INTRODUCTION

Segmentation of ultrasound liver image is an important problem in the field of medical analysis and visualization. The segmentation of ultrasound liver images and extracting the features of segmented part is the primary aim of this work. It motivates its importance in liver cancer detection applications. The development of more efficient and durable ultrasound analysis methods is very important. The quality of ultrasound images is degraded due to the effect of various types of disturbances and it is difficult to detect the correct position of infected organs. The computed tomography (CT), magnetic resonance imaging (MRI) etc is the various techniques of ultrasound imaging, which are used for this purpose. The human experts are very good in segmenting out the required region of the medical image but we need of computer-assisted segmentation because humans lack efficiency when size of data set increases.

Image segmentation is an important process for most of the medical image analysis tasks, which is basic for higher-level image comprehension and analysis. A good segmentation will benefit clinicians and patients as it provides important information for surgical planning, early disease detection and 3D visualization. In order to solve the problems of medical image segmentation, many practical methods have been advanced in this field. Some algorithms in recent times have introduced the concept which depend on modelling the probability density functions, which is quite complex and time consuming and does not properly defined the boundary between two regions or in other words regions are overlap with each other.

The work proposed here suggests an algorithm for segmentation of tumour in liver ultrasound image. The features are extracted from the located ROI (region of interest) and validation of the propose algorithm is done by using a real database or segmentation is performed on real ultrasound images.

Rest of this paper is organized as follows. Section 2 discusses the segmentation process of ultrasound liver images and texture features of the tumour parts of various algorithms. Section 3 explores the proposed work (i.e. novel algorithm of segmentation of ultrasound liver images). Section 4 will discuss various texture features and shape measurements to assess our work. Simulation results will be discussed in section 5 followed by conclusion in section 6.

II. LITERATURE SURVEY

Autonomous segmentation is one of the most difficult tasks in digital image processing. A rugged segmentation procedure brings the process a long way toward successful solution of imaging problems that require objects to be identified individually. On the other hand, weak or erratic segmentation algorithms almost always guarantee failure [5] [6].

A Survey about Ultrasound Image Segmentation, reviews ultrasound segmentation methods, in a broad sense, focusing on techniques developed for medical B-mode ultrasound images. First, it presents a review of articles by clinical application to highlight the approaches that have been investigated and degree of validation that has been done in different clinical domains. Then, it presents a classification of methodology in terms of use of prior information [1].

The ultrasound liver image enhancement based on watershed segmentation method. Image segmentation is an important problem in medical image processing fields. In watershed segmentation, an ultrasound image is transformed into a binary image using the threshold method, which means that the color of the output image appears only black and white. After the image is converted into binary, the image is modified using Watershed technique together with the visualization process. The result is really helpful in medical diagnostics [7].

Segmenting system for ultrasound images is separated into three steps. First, filter noise by using the "peak and valley" with scanning pixels along the Hilbert curve. Then use the "Cubic Spline Interpolation" between local peaks and valleys to smooth the image. Second, it present windows adaptive threshold, to eliminate trial and error, as the method for obtaining the right threshold for beginning segmentation. Third, label distinct, disconnected objects and use our "core area" to detect the object of interest based on the feature knowledge bases. The method was experimented with liver ultrasound images and compared the orientation and centroid feature vectors of our Full Automatic Segmenting Ultrasound (FASU) method with the manual segmentation method [8].

Segmentation remains a necessary step in medical imaging to obtain qualitative measurements such as the location of objects of interest as well as for quantitative measurements such as area, volume or the analysis of dynamic behaviour of anatomical structures over time. The acquisition of these images is non-invasive, cheap, and does not require ionizing radiations compared to other medical imaging techniques. The automatic segmentation of anatomical structures in ultrasound imagery is a real challenge due to speckle noise. Ultrasound image segmentation methods, focusing on techniques developed for medical, were proposed. The basics on ultrasound image segmentation, basic methods of image segmentation and forming of ultrasound images were discussed and relate the results with clinical application [19].

In the field of Segmentation of Ultrasound Images, main problem is overcome from over segmentation and the merging criteria for various clusters to segment an object. These problems are handled by using the Closest Neighbour Approach for segmentation of ultrasound images and merge various objects for segmentation. Also compare it with other technique of segmentation [17].

The automatic segmentation of anatomical structures in ultrasound imagery is a real challenge due to speckle noise and artifacts which are inherent in these images. In the present study full automatic segmentation has been proposed and statistical features are used in full automatic segmentation system to distinguish between normal and ultrasonic tumour liver images. The noise is filtered using peak and valley method, image is smoothened and again a second stage filter is adopted to further filter the noise and to improve the quality of image [15].

A variety of techniques have been used for measuring texture such as co-occurrence matrix, Fractals, Gabor filters, variations of wavelet transform .The identification of specific textures in an image is achieved primarily by modelling texture as a two-dimensional gray level variation. This two dimensional array is called as Gray Level Co-occurrence Matrix (GLCM). The Gray Level Co-occurrence Matrix, GLCM (also called the Gray Tone Spatial Dependency Matrix) is a tabulation of how often different combinations of pixel brightness values (grey levels) occur in an image.

GLCM Approach is used for Image Texture Feature Extraction. Basically feature Extraction is a method of capturing visual content of images for indexing & retrieval. Extraction of colour, texture and shape specific features is low level image feature. Application of gray level co-occurrence matrix (GLCM) is used to extract compute second order statistical texture features namely, Angular Second Moment, Correlation, Inverse Difference Moment, and Entropy of images. The results show that these texture features have high discrimination accuracy, requires less computation time and hence efficiently used for real time Pattern recognition applications [16].

To reduce the computation burden of the original GLCM computation the Haar wavelet transform is chosen. In Haar wavelet transform the resulting wavelet bands are strongly correlated with the orientation elements in the GLCM computation and the total pixel entries for Haar wavelet transform are always minimum. Thus, the GLCM computation burden can be reduced. Gray Level Co-Occurrence Matrix Computation based on Haar Wavelet gives a slightly better performance compare to the original GLCM computation [14].

Grey Level Co-occurrence Matrices (GLCM) is one of the earliest techniques used for image texture analysis. New feature called trace extracted from the GLCM and its implications in texture analysis was proposed in the context of Content Based Image Retrieval (CBIR). The theoretical extension of GLCM to n-dimensional gray scale images were also discussed. The results indicate that trace features outperform Haralick features when applied to CBIR [20].

III. PURPOSED APPROACH

Although many different types of techniques are available for solving segmentation problem of ultrasound images, but keeping in mind the above discussion the following steps are used to implement the proposed approach.

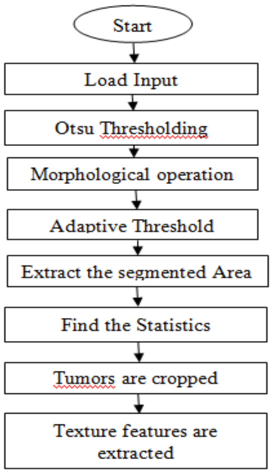


Fig.1 Flowchart for Proposed Work

- To understand the concept of image processing in medical image analysis.
- To understand the concept of liver cancer.
- Literature survey related to liver segmentation.
- Identification of gaps.
- Developing a novel algorithm of segmentation of ultrasound liver images.
- Extracting texture feature from the segmented ROI.
- Validation of the propose algorithm on the real time database.

A. Otsu Thresholding:

The work proposed here suggests a technique which uses clustering method; it is another way to set the threshold so as to try to make each cluster as tight as possible, thus minimizing their overlap. We can’t change the distributions, but we can adjust where we separate them (the threshold). As we adjust the threshold one way, we increase the spread of one and decrease the spread of the other. The goal then is to select the threshold that minimizes the combined spread. It does not depend on modelling the probability density functions; however, it assumes a bimodal distribution of gray-level values. It chooses the threshold to minimize the intraclass variance of the black and white pixels Fig. 2.

B. Morphological operation:

Then morphology tool is used for extracting image components that are useful in the representation and description of region shape, such as boundaries, skeletons, and the convex hull. Morphological operation is used to fills the background region surrounded by a connected border of foreground pixels in the binary image Fig. 3.

C. Adaptive Threshold:

It is used to segment out the actual tumour part. In morphological operation, the tumour parts are eliminated from the actual image (fills holes in the binary image) and then by using adaptive threshold only tumour parts are shown, background is eliminated, shown in Fig 4. After that extract the segmented area and show it on original image and opened in the figure window, which is shown in the following Fig. 5.

D. Statistics:

Area, Centroid, BoundingBox and Orientation are the statistics or shape measurements of the tumour part which are measured and their respective values are shown in Table 1. It gives some useful detail of the tumour that is helpful to analyses the tumour in the body organs.

E. Core area:

The core area of an object is the area which is enclosed by the specific boundary (Fig. 5). It is the region of interest (ROI) which is recognized as a tumour part in the ultrasound images. The ROI is cropped from the actual image and used to extract the texture features.

F. Feature extraction:

Distinct disconnected tumor objects are labeled and the features of these objects are extracted. Texture features of tumours are extracted. The texture features of the segmented ROI are Correlation, Contrast, Homogeneity, Energy and Entropy. These features are use for future purpose for the classification of the tumours

IV. PERFORMANCE METRICS

A. Texture Features

1) Contrast: Measures the local variations in the gray-level co-occurrence matrix.

2) Correlation: Measures the joint probability occurrence of the specified pixel pairs.

3) Energy: Provides the sum of squared elements in the GLCM. Also known as uniformity or the angular second moment

4) Homogeneity: Measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.

5) Entropy: Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image.

B. Shape Measurements

1) Area: The actual number of pixels in the region. (This value might differ slightly from the value returned by bwarea, which weights different patterns of pixels differently).

2) Bounding Box: The smallest rectangle containing the region, a 1-by-Q *2 vector, where Q is the number of image dimensions: ndims(L), ndims(BW), or numel (CC.ImageSize).

3) Centroid: 1-by-Q vector that specifies the centre of mass of the region. Note that the first element of Centroid is the horizontal coordinate (or x-coordinate) of the centre of mass, and the second element is the vertical coordinate (or y-coordinate). All other elements of Centroid are in order of dimension.

*4) Orientation:*The angle (in degrees ranging from -90 to 90 degrees) between the x-axis and the major axis of the ellipse that has the same second-moments as the region. This property is supported only for 2-D input label matrices.

V. SIMULATED RESULTS

For the implementation part MATLAB 7.0.4 is used. It stands for matrix laboratory. MATLAB 7.0.4 is a high level language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problem and solution are expressed in familiar mathematical notation. The proposed technique uses the real set of ultrasound images.

Fig. 1 Original Image

Fig. 3 E Otsu Thresholding

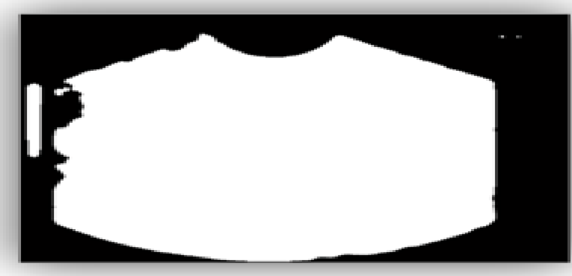


Fig. 4 Morphological operation

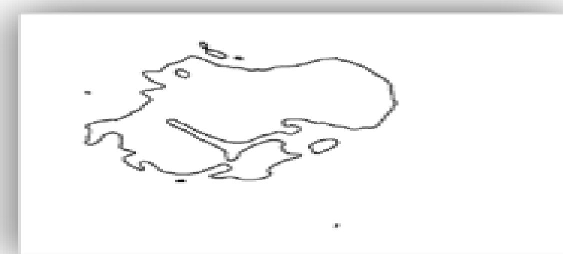


Fig. 5 Adaptive Threshold

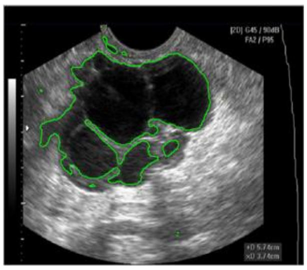
Fig. 6 Extracted area shown on original image

The results of extracted features are shown in the following tables:

TABLE I TEXTURE FEATURES

Name of Image	ROI	Entropy	Contrast	Homogeneity	Energy	Correlation
Cyst2.jpg	cyst2.1.jpg	6.6960	[0.5044 0.4462]	[0.7809 0.7997]	[0.1580 0.1657]	[0.5920 0.6447]
	cyst2.2.jpg	7.3981	[0.4027 0.2392]	[0.8432 0.8876]	[0.1351 0.1522]	[0.9292 0.9577]

TABLE III SHAPE MEASUREMENTS

Image	Area	Centroid	BoundingBox	Orientation
	223289	[312.1587 234.9401]	[0.5000 0.5000 600 452]	0.9842
	43200	[246.6945 185.8584]	[74.5000 81.5000 338 230]	21.6475
	106	[179.5943 112.8302]	[173.5000 106.5000 13 13]	-44.8085
	22	[203.0909 59.7273]	[200.5000 56.5000 5 7]	-61.7912
	116	[216.7759 75.8103]	[207.5000 68.5000 19 14]	-29.9565
cyst2.jpg	427	[334.1218 248.0304]	[320.5000 236.5000 28 25]	35.4310

VI. CONCLUSIONS

It is concluded the shape measurements and texture features of ROI are very helpful to analyses the liver tumors qualitatively /subjectively. In the proposed technique, the required object is segmented from the given set of image components. The results are evaluated and compared subjectively. For future work, it would be interesting to use these result in classification area of the liver tumors. We will use these result to classify the type of tumors: Benign (cancerous) or Malignant (Non-cancerous).

ACKNOWLEDGMENT

We would like to thank all the faculty members of BGIET (Sangrur) for their valuable comments and suggestions that have improved the presentation of this paper.

REFERENCES

[1] Alison Noble, j., (2006) "Ultrasound Image Segmentation: A Survey", IEEE Transactions on Medical Imaging, Vol.No.25, Issue No.8, pp: 987-1010.

[2] Archip, N., Rohling, R., Cooperberg, P., Tahmasebpour, H. and Warfield, S.K.,(2005) "Spectral Clustering Algorithms for Ultrasound Image Segmentation", Springer-Verlag Berlin Heidelberg, pp: 862-869.

[3] Albregtsen, F. (2008) "Texture Measures Computed from GLCM-Matrices", Ph.D Thesis, Image Processing Laboratory, Department of Informatics, Oslo: University of Oslo.

[4] Benco, M. and Hudec, R. (2007) "Novel Method for Color Textures Features Extraction Based on GLCM", RADIOENGINEERING, Vol.No. 16, Issue No. 4, pp: 64-67.

[5] Gonzalez, Rafael C. and Woods, Richards E. (2006) "Digital Image Processing", Pearson Prentice Hall, New Delhi, 2nd ed., pp: 589-656.

[6] Gonzalez, Rafael C. and Woods, Richards E. (2006) "Digital Image Processing with MATLAB", Pearson Prentice Hall, New Delhi, 1st ed., pp: 209-254, 392-439.

[7] Humaimi Mahmood, N., Zulkarnain, N. and Akmar Zulkifli, N.S., (2012) "Ultrasound Liver Image Enhancement Using Watershed Segmentation Method", International Journal of Engineering Research and Applications (IJERA), Vol. No. 2, Issue No.3, pp: 691-694.

[8] Hiransakolwong, N., Hua, K.A., Vu, K. and Windyga, P.S. (2003) "Segmentation Of Ultrasound Liver Images: An Automatic Approach", In IEEE International Conference on Multimedia & Expo (ICME), pp: 573-576.

[9] Howarth, P. and Ruger, S. (2004) "Evaluation of Texture Features for Content-Based Image Retrieval", Springer-Verlag Berlin Heidelberg, Vol.No. 3115, pp: 326-334.

[10] Kumar P, H., Michahial, S. and Prathibha, AM., (2012) "Comparison of Segmentation Methods for Ultra Sound Images", International Journal of Advanced Research in Computer and Communication Engineering, Vol.No. 1, Issue No.2, pp: 50-53.

[11] Kekre, H.B., Thepade, S.D., Sarode, T.K. and Suryawanshi, V. (2010) "Image Retrieval using Texture Features extracted from GLCM, LBG and KPE", International Journal of Computer Theory and Engineering, Vol.No. 2, Issue No. 5, pp: 695-700.

[12] Kokkinos, I., Evangelopoulos, G. and Maragos, P., (2009) "Texture Analysis and segmentation Using Modulation Features, Generative Models, and Weighted Curve Evolution", IEEE Transaction on pattern analysis and machine intelligence, Vol. No. 31, Issue No. 1, pp: 142-157.

[13] Liu, Y., Zhou, X. and Ying Ma, W. (2004) "Extracting Texture Features from Arbitrary-shaped Regions for Image Retrieval", Multimedia and Expo, 2004. ICME '04. 2004 IEEE International Conference, Vol.No. 3, ISBN 0-7803-8603-5, pp: 1891-1894.

[14] Mokji, M.M., Abu Bakar, S.A.R. (2007) "Gray Level Co-Occurrence Matrix Computation Based On Haar Wavelet", Computer Graphics, Imaging and Visualisation, pp: 273-279.

[15] Pradeep Kumar, B.P., Prathap, C. and Dharshith, C.N., (2013) "An Automatic Approach For Segmentation of Ultrasound Liver Images", International Journal of Emerging Technology and Advanced Engineering, Vol.No. 3, Issue No.1, pp: 337-340.

[16] P. Mohanaiah,P., Sathyanarayana, P. and GuruKumar, L., (2013) "Image Texture Feature Extraction Using GLCM Approach",International Journal of Scientific and Research Publications, Vol.No. 3, Issue No. 5.

[17] Rani, N. and Thind, T. (2013) "Segmentation of Ultrasound Images Using Closest Neighbour Approach", International Journal of Recent Technology and Engineering (IJRTE), Vol. No.1, Issue No.6, pp: 101-102.

[18] Ruiz, L.A., Fdez-Sarría, A. and Recio, J.A., (2004) "Texture Feature Extraction For Classification On Of Remote Sensing Data Using Wavelet Decomposition: A Comparative Study", 20th ISPRS Congress.

[19] Saini, K., Dewal, M.L. and Kumar Rohit, M. (2010) "Ultrasound Imaging and Image Segmentation in the area of Ultrasound: A Review", International Journal of Advanced Science and Technology, Vol.No. 24, pp : 41-60.

[20] Sebastian, B.V., Unnikrishnan, A. and Balakrishnan, K. (2012) "Grey Level Co-Occurrence Matrices: Generalisation and Some New Features", International Journal of Computer Science, Engineering and Information Technology, Vol.No. 2, Issue No. 2, pp: 151-157.

[21] Ulagamuthalvi, V., Kulanthaivel, G. and Sridharan, D. (2012) "A novel approach for diagnosing liver lesion images in telemedicine mode," Nitte University Journal of Health Science, Vol.No. 2, Issue No.4, pp: 50-53.

[22] Dhawan, S. and Girdhar, A. (2008) *"Image Segmentation: Objective Evaluation and a New Approach"*, Pragyaan: Information Technology, Vol.No.6, Issue No.2, pp: 16-20.

[23] Dietrich, C. F., Serra, C. and Jedrzejczyk, M. (2010) "*Ultrasound of the liver",* EFSUMB -European Course Book.

[24] Kaur, K. (2013) *"Digital Image Processing In Ultrasound"*, International Journal on Recent and Innovation Trends in Computing and Communication, Vol.No.1, Issue No.4, pp: 338-393.

[25] David Sutton, "Radiology and Imaging for Medical Students", 7th Edition. Churchill Livingstone.

