International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 5 May 2023, pp: 712-714 www.ijaem.net ISSN: 2395-5252

Gallstone Segmentation and Extraction from Ultrasound Images Using Level Set Methed

K.Sathayaraja[1], N.Selvameenaloshini[2], G.Mahalakshmi[3], K.Soundharapriya[4]

Received the B.E Degree from of Thiruuvalluvar College Engg & Technology At Vandavasi. The M.E Degree from KSR College Of Engg & Technology at Namakkal. He is doing Ph.D Degree in Anna University at Chennai. He has been working as Assossicate Professor in Annai Mathammal Sheela Engineering College, Erumapatty, Tamilnadu, India.

She obtained her BE Degree of Medical Electronics at Annai Mathammal Sheela Engg college,Erumapatty in 2023.

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Date of Submission: 08-05-2023 Date of Acceptance: 20-05-2023

ABSTRACT: Calculous disease of the biliary tract is the general term applied to diseases of the gallbladder and biliary tree that are a direct result of gallstones. Gallstone disease is the most common disorder affecting the biliary system. The true prevalence rate is difficult to determine because calculus disease may often be asymptomatic. There is great variability regarding the worldwide prevalence of gallstone disease. Gallstone is a high incidence of gallbladder disease, especially in the india.

Keywords: Image Processing, Segmentation, Extraction, Level Set Method.

I. INTRODUCTION

Gallstones are hardened deposits of digestive fluid that can form in your gallbladder. Your gallbladder is a small, pear-shaped organ on the right side of your abdomen, just beneath your liver. The gallbladder holds a digestive fluid called bile that's released into your small intestine. Gallstones range in size from as small as a grain of sand to as large as a golf ball. Some people develop just one gallstone, while others develop many gallstones at the same time. People who experience symptoms from their gallstones usually require gallbladder removal surgery. Gallstones that don't cause any signs and symptoms typically don't need treatment. This test is the one most commonly used to look for signs of gallstones. Abdominal ultrasound involves moving a device (transducer) back and forth across your stomach area. The transducer sends signals to a computer, which creates images that show the structures in your abdomen.

This procedure can help identify smaller stones that may be missed on an abdominal ultrasound. During EUS your doctor passes a thin, flexible tube (endoscope) through your mouth and through your digestive tract. A small ultrasound device (transducer) in the tube produces sound waves that create a precise image of surrounding tissue.

Blood tests. Blood tests may reveal infection, jaundice, pancreatitis or other complications caused by gallstones.

II. LEVEL SET METHOD

Image Segmentation subdivides an image into its constituent regions or objects. The level of this subdivision depends on the problems which are being solved. Medical image segmentation is an important task for identification and location of tumors, diagnosis, and computer guided surgery etc..Researches we are proposing a level set method, without reinitialization, with certain specific shape model for image segmentation. due to their accuracy and fast speed. In Active Contour model is a useful framework for marking an object outlines in an image. Minimization of energy term, associated with active contour is a sum of two energy functions - internal energy function and external energy function. Ci = (xi ,yi) where i=0, 1, 2, -----, n-1 and energy function for this is given as:

$$E_{snake(contour)} = \int_0^1 E_{internal}(C(s))ds + E_{external}(C(s))$$

Eexternal = Eimage + Econ

Thus energy function for contour is converted into:

$$E_{snake(contour)} = \int_0^1 E_{internal}(C(s))ds + E_{image}(C(s)) + E_{con}(C(s))ds$$

Internal energy is combination of energy of snake contour (Econt) and energy of spline curvature (Ecurv)

Einternal = Econt + Ecurv

This internal energy is given by spline energy curve:

$$E_{internal} = \frac{\left(\eta(s)\,\|\frac{dC}{ds}(s)\|^2 + \psi(s)\,\|\frac{d^2C}{ds^2}(s)\|^2\right)}{2}$$

Here large value of η(s) increases the internal energy of the snake as it stretches more and more and small value of η(s) make energy function insensitive to amount of stretch curve, Large value of ψ(s) C = {(x, y) | ф (x, y) = 0}

Inside region and the outside region of the curve is given by Lipshitz continuous function ф, with following properties:

$$\frac{\partial\phi}{\partial t} + V\,|\nabla\phi| = 0$$

$$\begin{pmatrix} \phi(x,y) > 0 & \text{inside the contour} \\ \phi(x,y) = 0 & \text{at the contour} \\ \phi(x,y) < 0 & \text{outside the contour} \end{pmatrix}$$

Representation of Level set function with contour changes positionsThe evolution equation for level set function ф for the above equation can be written in general form as a non-linear Partial Differential Equation

$$\frac{\partial\phi}{\partial t} + V\,|\nabla\phi| = 0$$

This equation is called level set equation. Here V is given velocity field called speed function for Image segmentation part. Function V depends on only image data and level set function ф. Now one question arises, how to evaluate contour with level set equation? We try to explain this by using figure 3.2:

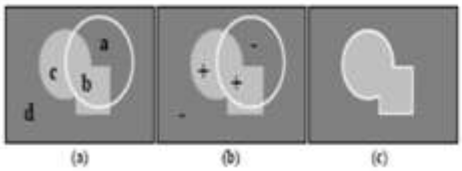

Figure3.2: Illustration of Contour evolution (a)-symbol of each area, (b) – The sign of update value in each region, (c) – final evolution result

Level set method with reinitialization has disadvantage as, this method is not able to work with signed distance function, and Level set method without reinitialization also has Once we get the initial shape model we get the location and size of the segmented region for shape model. We have used Chan-Vesemodel for getting information of segmented region, using following equation:

$$\Delta\phi = \delta(\phi)\left(\mu\, div\frac{\nabla\phi}{|\nabla\phi|} - \lambda_1(u_0 - c_1)^2 + \lambda_2(u_0 - c_2)^2 - \upsilon\right)$$

where u0 is the original image, ф is the level set function, μ, λ1, λ2, υ are parameters which adjust the weights, c1 and c2 are average gray level intensity in ф > 0 region and ф < 0 region respectively, δ is the Dirac delta function and calculated as:

$$\delta(\phi) = \frac{1}{\pi}\cdot\frac{\epsilon}{\epsilon^2 + \phi^2}$$

then we can use this location and the size of the inside region of the shape model, and after that this location can be used as zero level set function for level set equation. Reinitialization is the process of periodically reinitializing the level set function during the evolution for maintaining stable curve evolution.

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where λ > 0, υ is time step function, and Lg (ϕ) and Ag (ϕ) are given as:

$$L_g(\phi) = \int_{\Omega} g\delta(\phi)\,|\nabla\phi|\,dxdy$$
$$A_g(\phi) = \int_{\Omega} g\,H(-\phi)\,dxdy$$

where δ is dirac delta function and H is Heaviside function. Further we define the total energy of contour as:

The Dirac function in equation is used for smoothing and is given as :

$$\delta_\epsilon(x) = \begin{cases} 0 & |x| > \epsilon \\ \frac{1}{2\epsilon}\left[1+\cos\left(\frac{\pi x}{\epsilon}\right)\right] & |x| \le \epsilon \end{cases} \quad \text{---(2)}$$

In the proposed method, the time step υ is chosen as 10. Range of detection of time step with some restrictions has been described .

III. COMPLETE ALGORITHM FOR THE PROPOSED METHOD

Steps of the proposed algorithm are as follows:
1) Apply Gaussian Convolution function for smoothness of image.
2) Apply Dirac function into smooth image.
3) Establish the initial shape model
4) Find the region of segmentation from established shape by using equation (1) and equation (2).
5) Use value got from step 4 for determining the contour.
6) Initialize the level set function in image region R. (Negative value indicate that contour is inside the region, positive value indicate that contour is outside the region and zero value indicate that contour is at the region).
7) Iterate following steps for the user defined number of iterations:
7.1. Call level set function with updated value.
7.2. Update contour with update value.

IV. CONCLUSIONS

Gallstones belong to the high incidence of gallbladder disease in northwestern India. To dates, there are only few works studying on gallstone ultrasound image segmentation. This paper presents a variational level set framework for gallstone ultrasound image segmentation.

REFERENCES

[1]. Intelligence MDAI 2010, pp. 163-174, 2010.
[2]. S. Bodzioch and M. Gisela, "New approach to gallbladder ultrasonic images analysis and lesions recognition", Computerized Medical Imaging and Graphics, vol. 33, no. 2, pp. 154-170, Jan 2009.
[3]. J. Noble and D. Boukerroui, "Ultrasound image segmentation: A survey", Medical Imaging IEEEN Transactions, vol. 25, no. 8, 2006.
[4]. Ying-bin Hou and Y. Xiao, "Active snake algorithm on the edge detection for gallstone ultrasound images," 2008 9th International Conference on Signal Processing, 2008, pp. 474-477, doi: 10.1109/ICOSP.2008.4697173.
[5]. S. Sari, N. Zainuddin, M. N. Mohd, N. S. AfifiMohdTaujuddin and H. Roslan, "BiT C Detector: Gallstones Detection for Ultrasound Images," 2019 IEEE International Conference on Signal and Image Processing Applications (ICSIPA), 2019, pp. 89-94, doi: 10.1109/ICSIPA45851.2019.8977753.