Noise Reduction and Segmentation of Ultrasound Images using Active Contours

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Abstract--- *Ultrasound Imaging or Ultrasonography is a medical procedure for diagnosis of abnormalities. Manual method of abnormality detection and segmentation is difficult because chances of faulty segmentation is possible due to large dataset and variation of accuracy. So, computerized automatic segmentation is required because automatic segmentation is effective and accurate for detection of abnormalities. This paper is presented with the Segmentation of fibroid from 2D Images such as Ultrasound. Here Active Contour method is used to segment a fibroid from an Ultrasound Image. Fibroid is a noncancerous tumor that grows in female body and that causes infertility. Preprocessing is also be done before segmentation, as ultrasound image has poor image quality and contains the noise of type speckle. So median filter is applied to clear the noise.*

Keywords--- *Active Contour, Diagnosis of Abnormalities, Segmentation, Ultrasound Image.*

I. INTRODUCTION

DIGITAL Image Processing is a vast area of research and innovations including Computer Science. One of the main application of Image Processing is medical image diagnosis. There are many imaging modalities exists such as - X-ray, CT-scan, MRI and Ultrasound. Ultrasound imaging has advantage over other imaging modalities, because ultrasound image is adaptable, transferable comparatively safe and cost effective. Sonography is an vital procedure in medicinal area to detect the abnormalities.

Radiologists are very good for detecting and extracting the abnormal regions using Ultrasound imaging modality. But when the size of the database is large that leads to inefficiency and distinguishing of contour variations leads to an increase in delineating faults. So there is a need of development of computer assisted and automated segmentation. Ultrasound Imaging is harmless and effective diagnosis method to detect abnormalities in the human body, which can particularly detect in female body such as, tumors classified as cancerous and non-cancerous tissues. Fibroid is a non cancerous tumor which grows in female uterus. Detecting fibroid from Ultrasound Image is very challenging task, as it has low contrast artifacts and suffering from speckle noise. So, various preprocessing

techniques and segmentation methods are reviewed to use in the present study.

II. RELATED WORK

The Review of Related Literature means the study of earlier researches done in the selected area of a researcher and make sure that the problem statement is original and not the duplicate work which is already done or it is the improvement of the existing work using new methods and techniques. The problem statement must be more specifically defined.

Ultrasound Imaging is a procedure used for the tracing out of abnormalities. Here the Author used Extra-Energy Reduction function to remove extra energy from an ultrasound image. Extra energy is nothing but noise signal that reduces the quality and destroys the structure of images. Even the characterization fails because of excessive energy. In the vector field, the x & y co-ordinates are used to represent the energy in x & y direction. Finally, it is ensured that the image should not contain excessive energy, instead the energy is uniformly distributed to make the Image Ideal. This technique suppresses the noise very effectively without the loss of details and also improves the edge information when compared to some speckle denoising methods [1].

Some of the filters try to reduce the speckle noise without considering its relevance for the characterization of the tissue nature. However, the speckle noise is the implicit response of echo signals in tissues which provides key features for the diagnostic purpose. Some speckle filters are iterative processes due to these, the loss of information is increased. These iterative processes are diffusion filters, which produces over-filtering because of the promoting loss of relevant information for diagnostic purpose. Here, to overcome the over-filtering problem, the author proposed an anisotropic diffusion filter using probabilistic-driven memory mechanism [2].

Here the author used breast masses contained Ultrasound Image as input. This Image contains Texture features and Morphological features. Preprocessing Method is applied to clean the image without losing the fine details, such as Non-Local Means (NLM) filter is used to remove the noise from both the features of the image. This filter is a very effective method for noise removal because it also preserves the fine details at the tumor region in 2D Ultrasound Images which are required for diagnosis [3].

The Ultrasound Image is taken as input, which contains cysts and breast tumor. The subspace based noise reduction technique is used for removal of speckle noise. Speckle noise removal is nothing but through logarithmic transformation converting from multiplicative noise into additive and

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DOI:10.9756/BJSESC.8278

decomposing the noise image to noise subspace and signal subspace[4].

Most of the researchers proposed and used various speckle noise reduction filters but very rarely the Median filter is used. This Median Filter is mainly used to remove the speckle noise and also salt and pepper. So, this method is used in the present experiment.

Here, the author used an Automatic Region Growing Method for segmentation of Liver tumor from ultrasound images. Initially, this seed point is selected automatically from abnormal region, then Region Growing Method is applied. Region Growing Method selects automatically one pixel from abnormal region and grows by adding adjacent pixels to that till all the pixels are dissimilar. An automatic selection of seed point is fast as compared to Manual seed selection and the former detects accurate locations from abnormal region[5].

The original image is converted into binary image by applying the Threshold value. Later mask is created and placed over the original image, moved from one location to another. Then Bounding Box technique is used for boundary removal. The columns and rows are deleted to trace the fibroid region. So, the particular region of interest is traced. Then by considering x & y co-ordinate values, the centroid point is marked and find out the other points. Finally the fibroid object region is obtained and required contour part is extracted[6].

Here, the author is used liver ultrasound image as input image. Initially converting an grey scale ultrasound image into binary image using the threshold value. After enhancement of ultrasound image, the segmentation is performed by using watershed algorithm. The image is modified using watershed technique with the visualization process based on the contrast of the image, the watershed segmentation has given the good results[7].

Here, the author is used fetal Ultrasound Image as input image. Multiresolution analysis technique is used for segmentation. Using B-Spline 2D wavelet technique, decomposing the Input Image into multiresolution space and then segmentation is applied. Before segmentation noise reduction method is applied such as Adaptive weighed Median filter, to remove the noise and enhance the ultrasound image[8].

Active contour or snakes are curves which are generated by computer, these curves detect the boundary of the object by moving within an image. Snake is generated based on continuous splines and energy minimization that adopts the mathematical concept. In 1986, Kass et al was originally introduced the Snake[10] and the way how the snake move and minimizing their energy is inspiration for snake or active contours to be implemented.

The Snake or active contour is a curve which is generated by computer, used to detect the boundaries of object in images. The application of curve is to do the breast masses segmentation from ultrasound images. Initially, the Balloon snake is chosen to segment the masses. The segmented part of region by snake(balloon) are compared with the ground truth

that is mass areas traced by the radiologist. With accuracy of 95% the snake successfully segmented the masses [9].

After reviewing these, it is proposed that the Active Contour method to be used for segmentation of fibroids from Ultrasound Images.

III. PROPOSED METHODOLOGY

In the present study it is proposed that segmentation of fibroids are done from 2D Ultrasound Images using Active Contours Method. This method consists of 6 stages - *Reading a Gray Scale Ultrasound Image, Preprocessing, Histogram Equalization, Masking, Segmentation and Feature Extraction*. In Preprocessing stage authors used the effective and efficient speckle noise reduction method such as, Median Filter. In segmentation stage, active contour method is used. The algorithm presented in this paper detects the boundaries and segments that part in the Ultrasound Image using Active Contour Method.

The following stages are -

Figure 1: Flow Chart of Segmentation Process

Description of proposed Fibroid segmentation from Ultrasound Images using Active Contour Method.

- 1) Fibroid Ultrasound Image: Reads Original Fibroid contained Ultrasound Image.
- 2) Preprocessing: Preprocessing is a process to remove the noise, as Ultrasound Image contains speckle noise, so the images are not clearly visible (low contrast), it's difficult to detect the edges. Hence, preprocessing must be done to clean the image, there are various noise removal techniques those have advantages and also disadvantages. Here it is proposed that removal of speckle noise is done by using the Median Filter. In image processing, Median filter is a non-linear noise reduction operation used to reduce "salt and pepper" noise and also speckle noise. A median filter is more effective when compared to convolution and both

have the aim to preserve edges while reducing the noise. So this filter method is used. [12].

- 3) **Histogram Equalization:** Many real images including fibroid ultrasound images exhibit the features such as some amount of brightness variation (e.g. towards center from all the edges). Histogram Equalization means distributing the intensity values or pixel values uniformly throughout the image. Most of the times when image contains noise or brightness variation, the intensity values are not uniformly distributed. When intensities are adjusted, then brightness level is high at peak areas and are compressed at valleys. The grey scale pixel values are uniformly distributed from 0 to 255.
- 4) **Masking:** A mask is also known as filter or spatial filtering. The filtering process is nothing but a mask convolution with an image. Mask of various sizes can be created such as 3x3, 5x5 or 7x7 and the mask moves over an original image. Masks are used to increase the sharpness of an image and to detect the edge details. The Mask can be placed over an image at location (1, 1) that is left, top corner of original image and moving the Mask at each co-ordinate location (x,y) then applying convolution.
- 5) **Segmentation:** Segmentation is nothing but decomposing the image into its constituent parts or regions. These regions are classified as normal and abnormal regions. Abnormal region contains unwanted masses or tumors, those parts must be segmented. Segmentation may fail or succeed, it depends upon the accurate detection of the tumor and exact segmentation. There are various Segmentation algorithms such as Region Growing, Thresholding, clustering methods, Deformable Model, compression based Approaches, Histogram based Image Segmentation and Active Contour Method [11].
- 6) **Feature Extraction:** The Feature Extraction is nothing but to extract the features that are required to detect the abnormalities from 2D image.

Algorithm Works as Follows

- Step 1: Read the Gray scale Ultrasound Image.
- Step 2: Removed the Speckle Noise by using Median Filter.
- Step 3: Histogram Equalization is performed to enhance the Image.
- Step 4: Masking is performed to smooth and sharpening the Ultrasound Image.
- Step 5: Segmented the Fibroid from Ultrasound Image.
- Step 6: Extracting the feature such as region of Interest or Contour.

IV. EXPERIMENTAL RESULTS

In the Experiment, 10 Original Grayscale Fibroid Ultrasound Images are taken as dataset. The Fibroids are segmented successfully from each Ultrasound Image. One sample input and output image is shown in this paper as -

Figure 2: Ultrasound Image

Figure 3: Preprocessing

Figure 4: Histogram Equalization

Figure 5: Fibroid Segmentation

V. CONCLUSION AND FUTURE ENHANCEMENT

The fibroid segmentation from Ultrasound Images by using an Active Contour Method is implemented. This method detects the boundaries of the abnormal regions (Fibroid object) and exactly segments that particular part from Ultrasound Image.

In Future, statistical methods are used to measure the segmented fibroid from Ultrasound Images and compared with Ground Truth by Radiologists and also segmentation to be Proposed on 3D Ultrasound Images.

ACKNOWLEDGMENT

Authors express their gratitude to scanning centres, who helped to undertake this research work.

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