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# Seed Point Localization using Quad Tree Decomposition and Active Contour

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***Abstract:*** ***Based on Quad tree decomposition, the seed point is localized inside the tumor in which it can be found near the boundaries of the tumor and can be spread outside the tumor. To improve this limitation, this paper tries to provide an automatic method for finding the seed region at the centroid of the tumor. Two criteria consolidated iterative quad tree decomposition (QTD) and Active contour of the sore are thus intended to localize the seed point. One method is to choose the region where the seed point is found and the other is to limit it at the centroid. Moreover, This paper made it possible on 50 breast tumor ultrasonic images. If the seed point is located at the centroid of the tumor, it shows the proposed method is to be correct, else the method is a failure. As the experiment results show, this method in this paper can automatically find the seed point at the centroid of the tumor with an accuracy rate of 99%.***
***Keywords: Seed region growing. Iterative quad tree. Ultrasonic breast tumor. Active Contour***

## I. INTRODUCTION

Breast cancer remains one of the major issues in the medical field, also it has many forms and a large number of women are suffering from it. The detection of suspicious tumors by breast ultrasound or X-ray is assumed to be the best method for the treatment of diseases at the right time. Because of the low-cost, portability and versatility, breast ultrasound is widely used. Out of various processing methods for breast ultrasound image, the breast tumor segmentation plays an important role. It gives the results which not only help the doctors for medical judgments, but also helpful in discriminating malignant from benign breast tumors. But also, there are various limitations of ultrasound images which makes it difficult to segment the region of interest(ROI), such as speckle noise, low contrast, and blurred boundaries, Hence, it needs to be the manually segmented by experts, which requires much time and labor, and moreover it depends on the experience of the experts. Then the region-growing method was utilized to segment ROI automatically, which was seem to be more convenient. Then it is found that the selection of seed point is required for the favorable results of region-growing segmentation. But, earlier seed points were selected manually because of the immaturity in methods of image processing. For the fully automatic segmentation of breast tumor, it is needed to utilize the automatic method to select the seed point region with accuracy. It is concluded that the pixels having the local maximum gray level values could be taken as the seed points, which automatically segmented the breast masses in digitized breast tumor images. In the view of radiologists who utilized the rules for detecting the ultrasound breast lesions [1]. It is pointed out the average intensity and texture probability values for a circular region around each potential seed point. The seed point with the maximum value was taken as the true seed point [2]. It has been noticed that the run length parameter calculated from the co-occurrence features could be employed to select the seed point of the ultrasound images [3]. Their results verified that the proposed algorithm was efficient in selecting seed point without manual intervention. In 2008, fully taking both gray information and spatial information of the ultrasonic images into account, It is selected an iterative threshold value for binarizing the image in both the cases of background and foreground. After the cancellation of the limit-connected regions, the creators characterized a score equation roughly to look for the lesion region with the extreme value from the rest regions. Finally, the focal point of the minimum rectangle which contained the sore region was taken as a seed point. Quantitative investigation comes about that the method could effectively find the proper seed point with an accuracy rate of 95.2 % [4]. In the seed point selection, the thing which matters is how to hit the seed point inside the affected region. Earlier studies customarily supposed the lesion to be appeared in the mid of the image, but it cannot always be contented practically and can weaken the results. To get the better position of lesion, an algorithm based on QTD and active contour is proposed in this paper to localize the seed point at the centroid. By using the gray scale and space data of the ultrasound images with their characteristics, the effective quad tree algorithm is proposed to locate the seed point automatically. There is a presumption for the execution of the method: the lesion region is not in contact with the edges of the image (nor with the top neither with the bottom). Therefore, it is just needed to adjust these parameters.

## II. IMAGE PREPROCESSING

### *A. Speckle Reduction*

The difficulties in ultrasound images such as attenuation, speckle, shadow and signal dropout are a major limitation on image quality in ultrasound imaging. Due to the intricacy of speckle measurements, the conventional filtering methods such as median filter, Gauss filter and so on, could not prevail to balance between speckle concealment and feature preservation. We use the anisotropic diffusion method to not only evacuation the noise but also reserve or even enhance the image edge information. In this study, the iteration times is set as 30 in the anisotropic diffusion method.

### *B. Histogram Equalization*

Histogram equalization is a significant application of gray level transformation used in image enhancement processing. [5]
It actually tries to transform the histogram of the original image into homogeneous distribution. [6] [7] [8] It enhances the contrast of the overall by enhancing the range of the pixel gray value.
Taking a 2-D image P(i. j) with discrete gray levels of $[P_0, P_1, P_t \ldots\ldots P_{L-1}]$, the occurrence probability of a pixel level $P_t$ will be

$$E(P_t) = \frac{x_t}{X}, 0 \le t \le L-1$$

Where, $x_t$ is the number of pixels in gray level $P_t$ and X refers to the total number of pixels in the image.
The cumulative density function is defined as:

$$CDF(t) = \sum_{n=0}^{t} E(P_n), 0 \le t \le L-1$$

In other words, the histogram equalization is a design that maps the input image into the entire dynamic range $[P_0, P_{L-1}]$.

### *C. Automatic Seed Selection Algorithm*

Quad tree is a tree data structure in which every node either ends up on a leaf having interesting spatial information, or subdivided itself into further four level Quad trees. [9] Quad trees are mostly used to divide a 2-D space by partitioning it into four quadrants. QTD is a data structuring technique used for storing 2D data with efficiency. [10].There are two ways of QTD: one is bottom-up and another is top-down. [11] We are employing top-down in this paper. The core idea of top-down Quad tree is to decompose internal node into further 4 children according to the decided threshold. If the change in highest and lowest pixel values in every sub-block is smaller or equal to the decided threshold value, the sub block need not to be further decomposed. If the difference is coming out to be greater than the threshold value, then the sub block will be decomposed into four sub blocks as shown in Figure 1 [12]
The next step after two preprocess phases i.e. speckle reduction and histogram equalization is to convert the gray level to double precision and after that normalize it so that it can become the floating point numbers from 0 to 1.
Pre-decomposition, ultrasound images of breast are changed into the size of 512×512. Further, the images can be divided into sub blocks in nine different sizes of 256×256,128×128,64×64,32×32,16×16,8×8,4×4,2×2 and 1×1 respectively. Post decomposition
Before the QTD, breast ultrasound images are converted into the size of 512 × 512. Accordingly, the images can be decomposed into sub-blocks in 9 sizes of 256 × 256, 128 × 128, 64 × 64, 32 × 32, 16 × 16, 8 × 8, 4 × 4, 2 × 2 and 1 × 1 respectively. Post each QTD, the smallest sub-block in the image will appear in the region with the most dramatic gray value variation. The more homogeneous the range is, the larger the span of the sub-square will be. The tumor has larger homogenous echoic appearance when contrasted to other structural areas of the image. Therefore, sub-blocks with larger sizes frequently emerge in the inner regions of the tumor or the muscle regions at the base of the image where the gray values change smoothly. On the other hand, sub-squares with smaller sizes oftentime show up in the locale along the tumor margin which associates with image edges and near the highest point of the image. Hence, the seed point can be chosen approximately among the sub-squares of larger sizes. Keeping in mind to check whether the seed is situated in the internal locales of the tumor, the image is decomposed again by controlling the threshold into a smaller one. The algorithm can be portrayed as follows:

*1)* Set the threshold as 0.5/2n − 1, (n = 1, 2, ….. $n_{max}$ natural number).

*2)* Disintegrate the breast ultrasound image by using the diverse thresholds in sequence. for n = 1 to n max. In the nth decomposition, since the dark esteems close to the edge of the image are also little, which is even close to the gray values in tumor, the related sub-squares associated with the edge of the image are disposed of. In this manner, the largest size of sub-blocks among the rest of the sub-squares can be found.

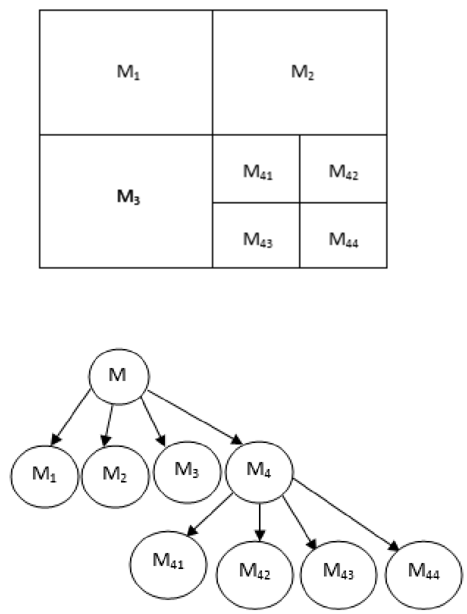


Figure 1 The quad tree diagram

The sum of gray values (SGV) S of these sub-blocks in the largest size is computed by

$$S = \sum_{i=1, j=1}^{n} P(\mathrm{i, j}) \qquad (3)$$

Where, n denotes the extent of the sub-squares, while P (i, j) means the gray value of the (i, j) pixel in the sub-block. The largest size of sub-block with the minimum SGV is taken as the nth target area. In the $(n + 1)^{th}$ decomposition, the sub-blocks which are associated with the edges of the image will be discarded to get the sub-blocks of the most extreme size. After examining the Equation (3), the sub-block of the maximum size with the little estimation of S will be taken as the $(n + 1)^{th}$ target region. The (n + 1)th target locale is taken as the seed point; if the $(n + 1)^{th}$ target is found region inside the $n^{th}$ target region otherwise return

*3)* Arrange all the gray values inside the seed region according to their size and locate the seed point by finding out the coordinates of the minimum gray value.

### *D. Active Contour*

It fragments the 2-D grayscale image into closer view (object) and foundation regions utilizing active contour based division. The output image bw is a binary image where the closer view is white (logical true) and the foundation is black (logical false) [13].

## IV. PROPOSED METHOD:

The proposed method in this paper is locating the seed point at the centroid of the tumor. This method is working on 50 breast tumor ultrasound images. The very first step is to reduce the speckle noise by using speckle noise reduction techniques. Then, histogram equalization followed by normalization of the images. After that the seed point is located by using the QTD method which is followed by Active contour implementation. The final step is to locate the seed point at the centroid of the tumor. The proposed method is efficiently working on 49 images out of 50 images i.e. the proposed method is working with comparatively higher accuracy of 99%.

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## V. EXPERIMENTAL RESULTS AND ANALYSIS:

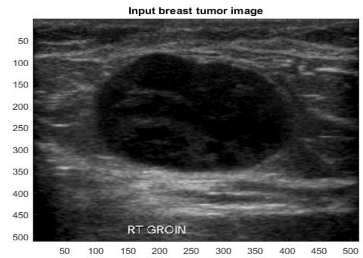


Figure 2: Original Image

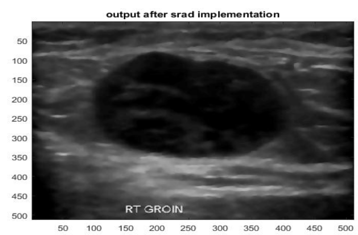


Figure 3: Image after speckle reduction

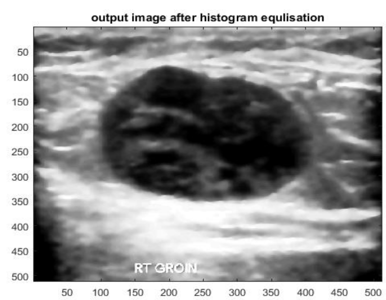


Figure 4: Output after histogram equalization


Figure 5: Image normalization

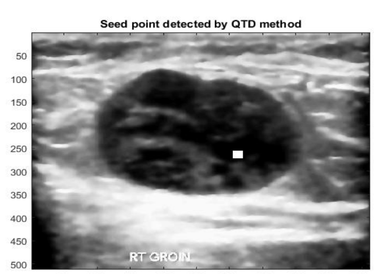


Figure 6: Seed point shown as a white rectangle

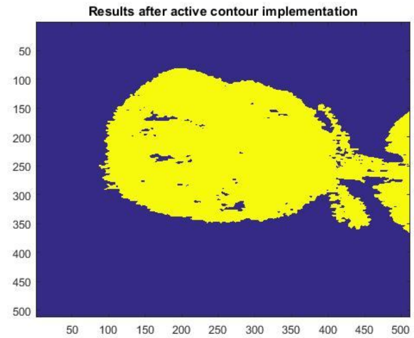


Figure 7: Results after the implementation of active contour

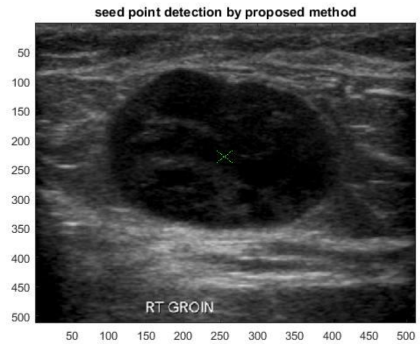


Figure 8: Results after the proposed method

*A Performance*

| | |
|---|---|
| $T_p$ | 49 |
| $F_p$ | 0 |
| $T_N$ | 49 |
| $F_N$ | 1 |
| Performance index | Percentage(%) |
| Sensitivity | 98 |
| Specificity | 99 |
| Accuracy | 100 |

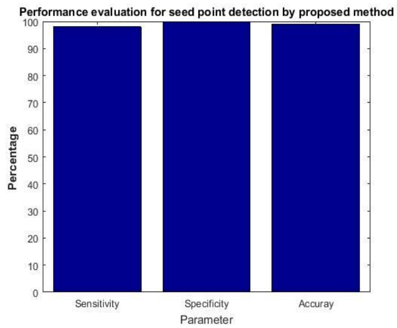


Figure 9:Resulting parameters

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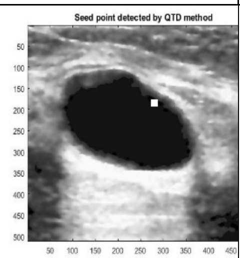
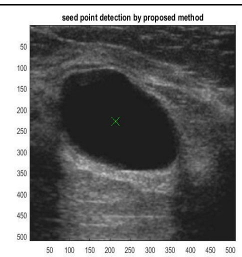
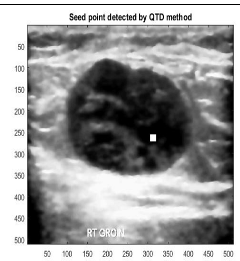
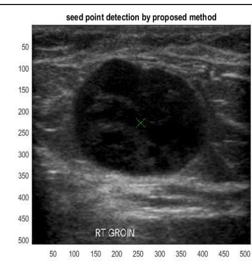
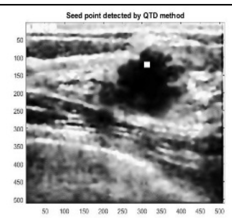
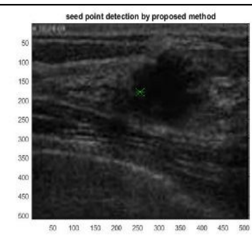
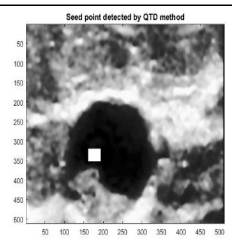
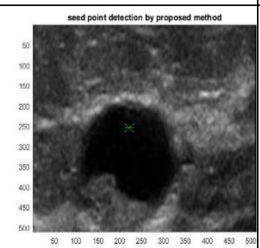
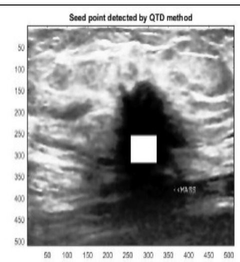
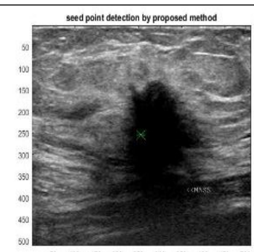
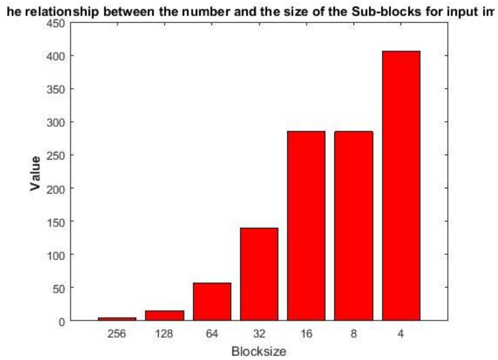
*B Result Analysis*

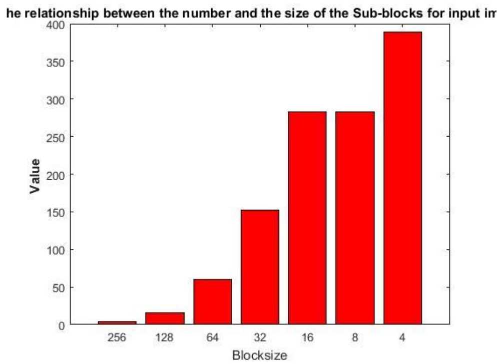
Table 1: The relationship between the number and the size of the Sub blocks and different threshold values for threshold equal to 0.25

| S.No. | Previous results | Proposed results | 256×256 | 128×128 | 64×64 | 32×32 | 16×16 | 8×8 | 4×4 |
|---|---|---|---|---|---|---|---|---|---|
| 1 |   |   | 4 | 15 | 57 | 140 | 285 | 285 | 406 |
| 2 |   |   | 4 | 16 | 60 | 152 | 283 | 283 | 389 |
| 3 |   |   | 4 | 16 | 63 | 183 | 495 | 495 | 966 |
| 4 |   |   | 4 | 16 | 59 | 160 | 339 | 339 | 545 |
| 5 |   |   | 4 | 16 | 60 | 157 | 324 | 324 | 465 |

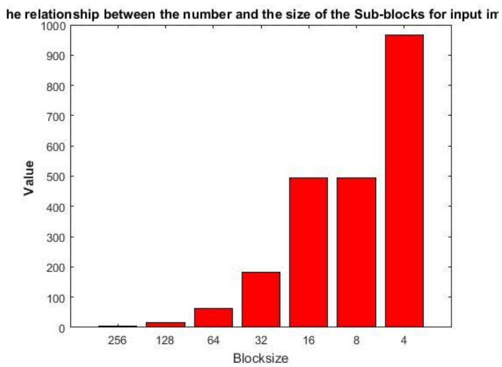
*C. Graphs for Quad-Tree Decompositions*



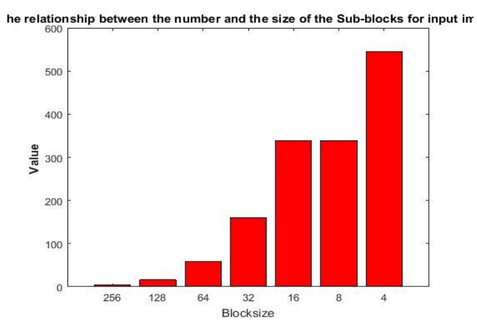

(a)




(b)




(c)




(d)

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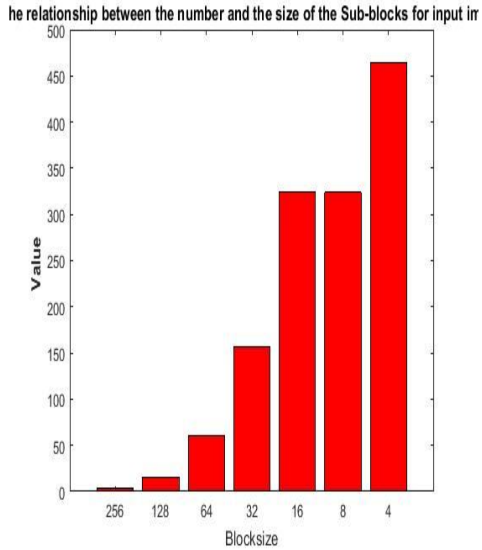


(e)

Figure 10: The relationship between the number and the size of the input images in TABLE:1 (a)For the first image(b) For the second image(c) For the third image(d) For the fourth image(e) For the fifth image

## VI. CONCLUSION

To the experience of the author, this whole project firstly applies QTD algorithm to detect the seed point inside the tumor. Furthermore, taking the benefit of Active contour, the foreground and background form of the image has been found. After that, the successful automatic evaluation of the centroid of the tumor in the image is located . The result of 50 breast tumor images justify the result with the accuracy rate of 99%.

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