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# Mammogram Breast Cancer Image Detection Using Image Processing Functions

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**Abstract:** Mammogram breast cancer images have the ability to assist physicians in detecting disease caused by cells normal growth. Developing algorithms and software to analyze these images may also assist physicians in there daily work. This study that shows the outcome of applying image processing threshold, edge-based and watershed segmentation on mammogram breast cancer image and also presents a case study between them based on time consuming and simplicity.

**Key words:** Mammogram image, breast cancer, cancer detection, medical image processing

## INTRODUCTION

The objective of medical image analysis is to acquire useful information about the physiological processes or organs of the body by using external and internal sources of energy. Breast image analysis can be performed using X-rays, magnetic resonance, nuclear medicine or ultrasound. So far the most effective and economical breast imaging modality has been X-ray mammography due to its simplicity, portability and cost effectiveness, an important source of radiological information for breast imaging is the presence and distribution of micro calcifications in the breast, this anatomical information can be obtained with high resolution technology using X-rays, As yet there is no comprehensive imaging modality for all radiological applications and needs, although the ability to computerize and analyze medical images provides a powerful means to assist physicians; thus computer programs, processing methods that get the data and information from medical imaging scanners must be carefully developed to preserve and enhance the most important clinical information rather than introducing additional artifacts. The ability to improve diagnostic information from medical images can be further enhanced by designing computer processing algorithms, application and software intelligently, that is why we proposed an application based on mat lab software to detect cancer in mammogram breast cancer images (Jain, 1989; Dhawan, 2003; Rama, 1992; Beghdadi, 1995; Brink, 1995).

## MATERIALS AND METHODS

Mammogram breast cancer images works with gray level values, the original image was segmented by threshold, edge-based segmentation and watershed segmentation the original image is shown in Fig. 1.

Surface image

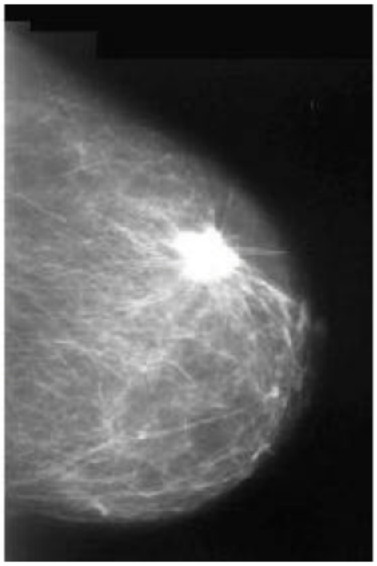

Fig. 1: The original image

We used Matlab software to implement the algorithm because Matlab is a high-performance language for education and research as it integrates computation, visualization and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation and also it has toolboxs for signal processing, neural network, image processing, database … etc., Matlab Image Processing Toolbox is a collection of functions that extend the capability of the Matlab numeric computing environment. The toolbox supports a wide range of image processing operations, such as Image analysis and enhancement. Region of interest operations, linear filtering and filter design.

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(Beucher, 1990), all the functions and equations used in this study are from Matlab image processing toolbox (Matlab software).

## RESULTS AND DISCUSSION

Step 1 of the proposed software is to Read the Images by Matlab software and convert them to matrix of values each value represent two-dimensional light intensity function f(x, y), where x and y denote spatial coordinates and the value of f at any point (x, y), The image contains many objects of different sizes that are touching each other (Rafael, 1977).

Step 2 aims to create the structuring element, because we want to apply dilation and erosion operations and it is an essential part of doing this is to create the structuring element that is used to probe the input image. the structure element is a matrix consisting of only 0's and 1's that can have any arbitrary shape and size, we used Matlab functions to do this as shown bellow

$$\text{origin} = \text{floor}((\text{size}(\text{nhood})+1)/2) \qquad (1)$$

Where nhood is the neighborhood defining the structuring element and the structuring element is a diamond-shaped structuring element that can be shown in Fig. 2 (Matlab software).

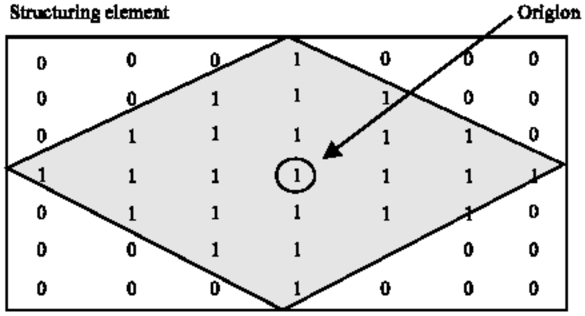
We also used dilation and erosion functions to accept structure element objects and this objects is called STRELs. And we used the strel function to create diamond shape, After that we Decompose the Structure Element and to enhance the performance, the strel function might break the structure elements into smaller pieces, a technique known as structuring element decomposition (Rafael, 1977).

Step 3 of the proposed software is to Enhance the Image Contrast and to do this we used imtophat and imbothat functions in Matlab image processing toolbox that returned the top-hat and bottom-hat transformations, respectively, of the original image the result of this step is shown in Fig. 3 and 4 and the equation used to do this is shown in (2) and (3) (Rafael, 1977, Matlab software).

$$\text{Itop} = \text{imtophat}(\text{afm, se}) \qquad (2)$$

$$\text{Ibot} = \text{imbothat}(\text{afm, se}) \qquad (3)$$

Step 4 exaggerate the gaps between objects, the top-hat image contains the peaks of objects that fit the structuring element. To do this we used the imbothat function which shows the gaps between the objects. To



| | | | | | | |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 |

Fig. 2: Diamond structure element

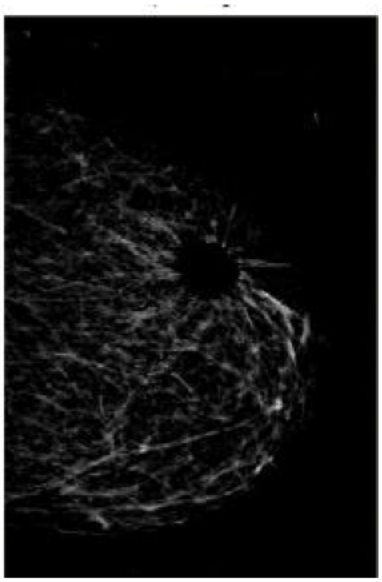


Fig. 3 Top-hat image

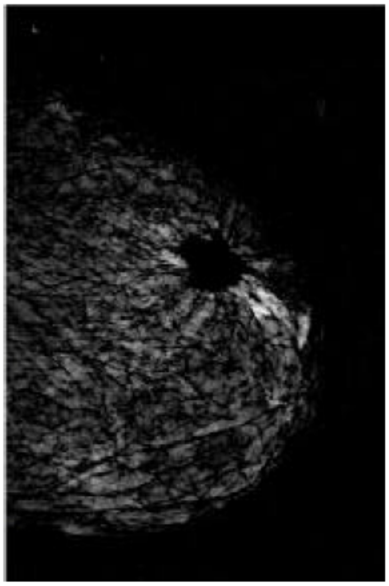


Fig. 4: Bottom-hat image

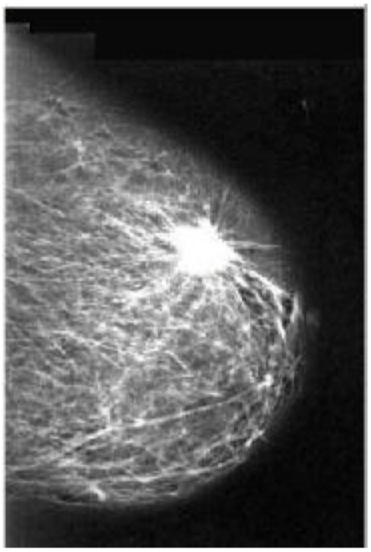


Fig. 5: Original + top-hat - bottom-hat image

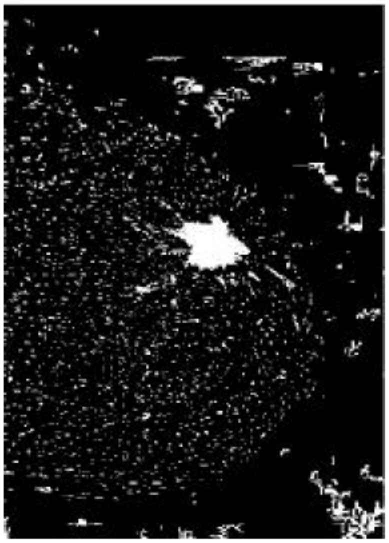


Fig. 7a: Extended minima image

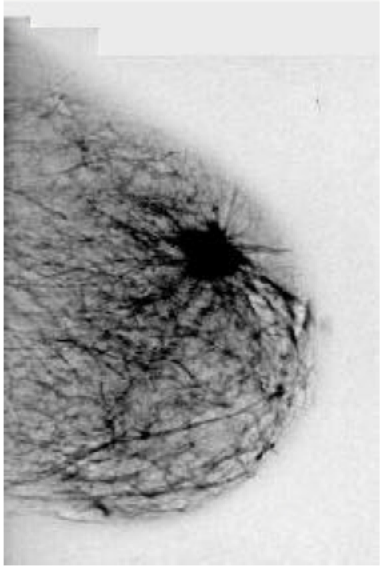


Fig. 6: Enhanced image

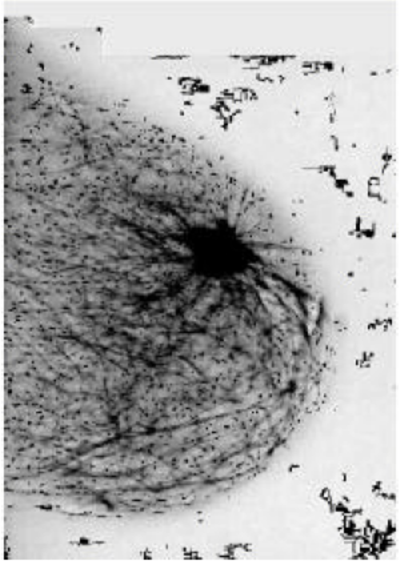


Fig. 7b: Iimposed minima image

maximize the contrast between the objects and the gaps that separate them from each other in our proposed software we added the top-hat image to the original image and then subtracts the bottom-hat image from the result (Fig. 5). Our software uses the toolbox image arithmetic functions, imadd and imsubtract, to perform these operations as shown in (4) (Matlab software).

$$\text{Ienhance} = \text{imsubtract}(\text{imadd}(\text{Itop, afm}), \text{Ibot}) \quad (4)$$

After that we convert objects of Interest to do that we do that by watershed transform that detects intensity valleys in the image and also to do that we enhanced the image by highlighting the intensity valleys using the imcomplement function in the Matlab image processing toolbox as shown in Fig. 6.

After that the proposed software that detects all the intensity valleys deeper than a particular threshold with the imextendedmin functions in the Matlab image processing toolbox. The output of this function is a binary image. The location rather than the size of the regions in the imextendedmin image is important.

Then the imimposemin function modifies the image to contain only those valleys found by the imextendedmin function. The imimposemin function also changes a valley's pixel values to zero (deepest possible valley for

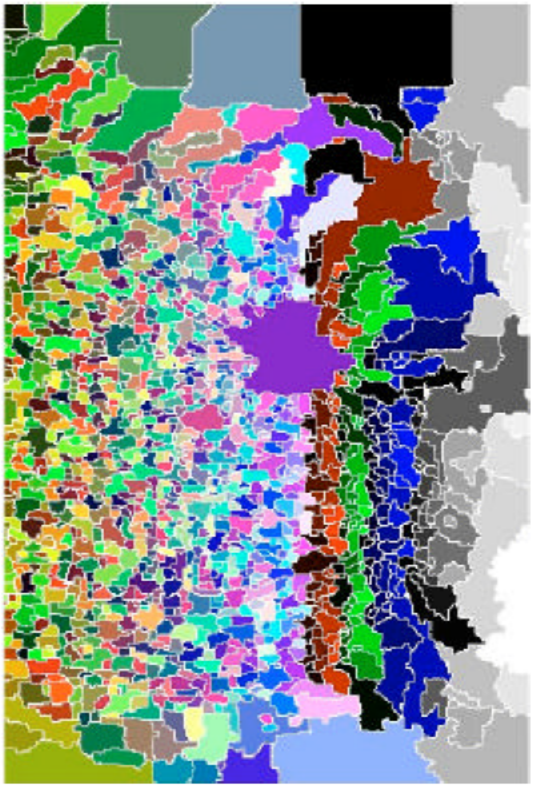


Fig. 8: Watershed segmented image

unit 8 images), all regions containing an imposed minima are detected by the watershed transform as shown in Fig. 7a and b (Matlab software). in step Step 7 is applying watershed segmentation, to accomplish watershed segmentation of the imposed minima image as shown in (5)

$$\text{war} = \text{watershed}(\text{Iimpose}) \quad (5)$$

The watershed function in (5) returns a label matrix containing nonnegative numbers that correspond to watershed regions. Pixels that do not fall into any watershed region are given a pixel value of 0, a good way to visualize a label matrix is to convert it to a color image, using the label2rgb function. In the color version of the image, each labeled region displays in a different color and the pixels that separate the regions display white as shown in Fig. 8 (Matlab software).

## CONCLUSIONS

From the comparison tests that result shown in Table 1 we see the time consuming for every method, the result shows that Threshold is the fastest. But the output image from threshold is not segmented clearly than other method, edge-base and watershed segmentation consuming long time than Threshold but output image is better, also Threshold only segment Gray level images. it's the simplest and didn't segment image clearly its only segment Gray level images and can be determined to segment objects and background, edge segmentation is one of the earliest segmentation approaches and still remains very important. Edge-based segmentations rely on edges found in an image by edge detecting operators -these edges mark image locations of discontinuities in gray level, color.

Table 1: Time consuming for method segmentation

| Method try | Thresholding | Eedge-based | Watershed |
|---|---|---|---|
| 1 | 0.0310 | 2.9140 | 5.0030 |
| 2 | 0.0150 | 2.2130 | 8.5720 |
| 3 | 0.0160 | 2.0730 | 8.0110 |
| 4 | 0.0320 | 2.9250 | 8.1990 |
| 5 | 0.0160 | 2.0960 | 8.9500 |
| 6 | 0.0320 | 2.2220 | 10.5930 |
| 7 | 0.0320 | 2.0650 | 6.7130 |
| 8 | 0.0160 | 2.0970 | 9.0590 |
| 9 | 0.0160 | 2.0500 | 6.0550 |
| 10 | 0.0310 | 2.0500 | 7.8080 |
| 11 | 0.0160 | 2.0340 | 7.9490 |
| 12 | 0.0310 | 2.0970 | 7.7910 |
| 13 | 0.0160 | 2.1430 | 13.4400 |
| 14 | 0.0160 | 2.0970 | 7.8860 |
| 15 | 0.0160 | 2.1280 | 7.8390 |
| 16 | 0.0160 | 2.1120 | 7.8700 |
| 17 | 0.0150 | 2.0660 | 8.0730 |
| 18 | 0.0310 | 2.1430 | 8.7780 |
| 19 | 0.0160 | 2.0500 | 6.0550 |

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