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Computer-Aided Detection of the External Borders of the Breast in Digital Mammogram Images

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***Abstract*— Many image processing techniques over the last two decades have been about intense assist radiologists in the diagnosis of breast disease, Studies have shown that early detection of these diseases increases the rate of healing.**
After that digital mammogram images appeared the most popular technique for detecting breast disease Computer-Aided Detection (CAD) provide several characteristics, including detection of breast limits and through which the image segmentation into several areas.
In this paper, we provide an innovative algorithm for finding breast dimensions to extract external breast borders in its various forms (hanging and non-hanging), where many experiments of more than 60 cases for digital mammogram images of different problems from the famous database MIAS (Mammographic Image Analysis Society) was processed and tested and showed good results.

***Keywords*— image processing, region of interest algorithm, breast cancer**

I. INTRODUCTION

Several techniques are used in medical imaging, mammography device known as Mammogram. This technique is approved techniques based on the detection of breast cancer as a means for early detection of any abnormalities in the breast. The advantages of this technique from those of medical imaging devices are cheap price, security, and ease and speed of use[1].

These days a large proportion of old women suffer from breast lesions, especially breast cancer, which increases the risk of breast cancer with aging women . Therefore, women who are less than 40 years do not need to mammography because young women's tissue denser (containing less fatty tissue) and cannot be note small cancers easily [2,3].

The computer programs and algorithms have assisted in the diagnosis of abnormal situations in digital mammogram images. Some of these algorithms are used image segmentation technique and other processing stages. Whereas others are used the whole image to find some points , lines or regions based on image segmentation proprieties referencing to its position[4],[5].

This work has been proposed a gradual computational algorithm rely on segmenting the mammogram image to find the edge of the region of interest (ROI) to extract breast scheme and refine its border.

II. ALGORITHM OF EXTRACTING BREAST SCHEME

In general , the most difficulties faced by the specialists in the discipline of image processing and analysis based on CAD such as the analysis of mammogram is to determine the ROI ,which is the breast area scheme regardless to any data in the image. Therefore, intensified efforts to extract the external borders of the breast, which represents the dividing line between breast mass, and other surrounding areas, i.e., the image background.

Fig. 1 shows, the stages of the algorithm to find breast external borders, these stages follow steps for processing the mammogram image. It is divided into two parts , which are image preprocessing and image processing to locate and identify the external boarder of the breast.

To clarify this algorithm , each stage is explained separately as the following:

A. Stage 1

The Matlab® Image Processing Toolbox is used to process the mammography image digitally in order to convert it into a matrix to be manipulated later [6].

B. Stage 2

This stage is used to unify the direction of the breast because some of the images were captured from the left side and the others from right. Therefore, edges filtering is used to find the breast boarder, and then convert to right template side [6] as shown in Fig. 2.

C. Stage 3

This stage is to convert the digital gray image (0-255) to the binary image , which is black and white pattern (0-1) . Accordingly, Fig. 3 illustrates the original and binary transformation images . This process is termed Logical Convert that aims to transform the intensity of the pixel density of 256 colors to only two colours, black and white .

Therefore, it is to facilitate the search for a point through the intensity of their density [6],[7].

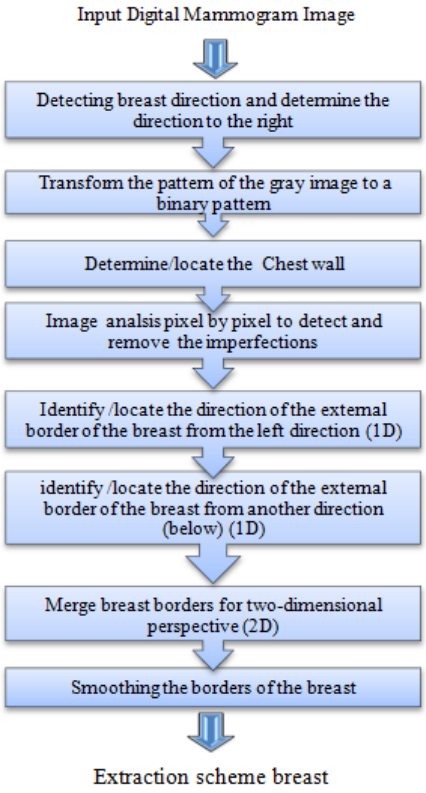


Fig. 1 Algorithm of Identify the Breast External Borders

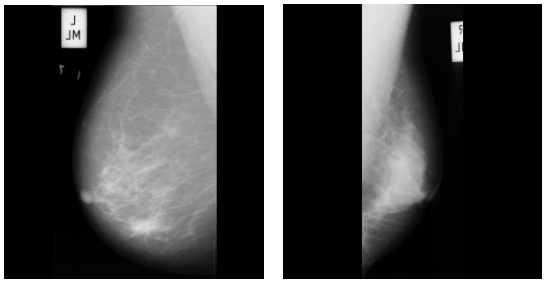


Fig. 2 Perspective left and right breast

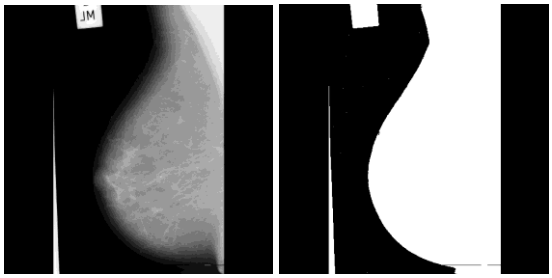


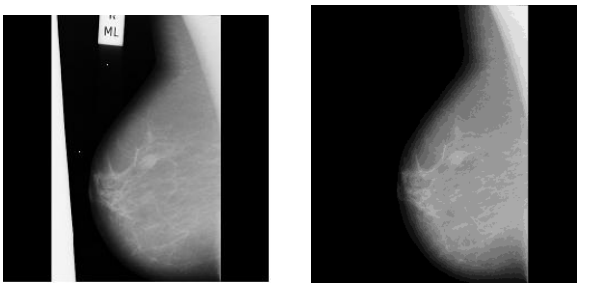
Fig. 3 Original image and logical transferred

D. Stage 4

This stage is to determine the chest wall by searching in the mammogram image matrix for pixels that represent the chest wall, which represents the breast borders from the right side.

E. Stage 5

This stage is to analysis each pixel in the image to determine and remove any imperfections [6],[8] as shown in Fig. 4. This technique is named morphological operations , which are based on searching in the digital matrix to discover any pixel does not belong to the breast mass, and then removed it from the image [8].



(A) Original image (B)The image after cleaning

Fig. 4 Removing of defects and noise

F. Stage 6

Fig. 5 illustrates this stage by finding the external borders of the breast is started where searching the pixels, which represents the external borders of the beginning of the breast image from the left and ends at the chest wall, which previously extracted in stage 4. Therefore, this search represents the perspective of one dimensional (1D)[5],[9] .

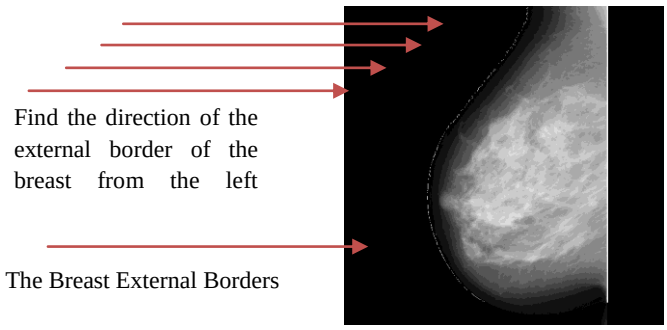


Fig. 5 Searching from one direction (1D)

G. Stage 7

This stage starts and complements the previous stage. However, The bottom perspective is considered by searching the pixels that represent the lower external borders of the breast as shown in Fig. 6. This technique is characterized over

some previous work that it can be processed the mammogram images with sagging breast[6],[10].

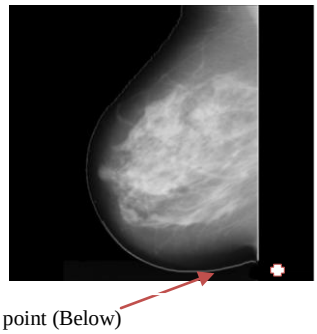


Fig. 6 External borders of the breast (breast scheme)

H. Stage 8

This stage is the final stage for the external borders of the breast and merging the two previous phases (left perspective-below perspective) to construct a two-dimensional perspective (2D) as shown in b below Fig , this technique provides more space to deal with all forms of the breast (normal and hanging) [5],[11].

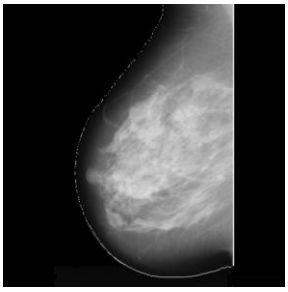


Fig. 7 Merge from two perspectives (2D)

I. Stage 9

Fig. 8 illustrates the final external outer of the breast, which is a supplementary final stage for smoothing the edges of the outer border of the breast, and filtering the image from any remaining noise to provide the final image , and then let the option for the user to save it or not [6], [8], [12].

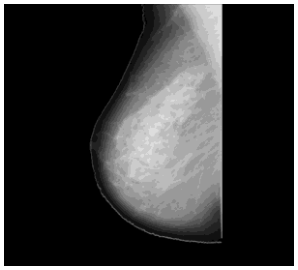


Fig. 8 The final external outer of the breast

III. Results and Discussion

After considering the problems that faced the researchers in previous studies, and processing many groups of images, we classified the images into two shapes of the breast:

- Breast least fat (slung).
- Fatty breast or breast older (hanging).

This work introduced a technique, which deals with all the images of two shapes, where is process the images from different perspectives, the first perspective shoes the breast interface, and the second shows the hidden part (drooping) of the breast. The results are shown in the following table:

TABLE I
RESULT DETECTION

Result	Good	Acceptable	Unacceptable
Total No. (60)	43	13	4
Percentage	71%	%21	%8
	92%	8%	92%

IV. Conclusions

This paper is proposed an algorithm, for processing a digital mammogram image, to find the dimensions of breast extraction scheme, and improve its border. Two-dimensional has been extracted with good results and relatively satisfactory, after the application of the algorithm on 60 samples from the database community famous image analysis for breast screening MIAS.

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