Breast cancer detection using image enhancement and segmentation algorithms.

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Abstract

Enhancement of mammography images considers as powerful methods in categorization of breast normal tissues and pathologies. The digital image software gives chance to improve the mammographs and increasing their illustration value. The image processing methods in this paper were using contrast improvement, noise lessening, texture scrutiny and portioning algorithm. The mammography images kept in high quality to conserve the quality. Those methods aim to augment and hone the image intensity and eliminate noise from the images. The assortment factor of augmentation depends on the backdrop tissues and type of the breast lesions; hence, some lesions gave better improvement than the rest due to their density. The computation speed examined used correspondence and matching ratio. The results were 96.3 ± 8.5 (p>0.05). The results showed that the breast lesions could be improved by using the proposed image improvement and segmentation methods.

Introduction

The breast lesion act as the one of the significant problems now a day, the first line diagnosable solution by detecting all lesions of the breast early to help and improving prognosis of cancer and other health problem related to breast [1-3]. More than one diagnostic modalities are used for breast cancer screening like computed tomography, resonance magnetic imaging and ultrasound. All of these modalities don't enough to detect all lesions of the breast in spite of their characteristics such as high sensitivity of soft tissue detection. This shortening of detecting lead to support the final diagnosis decision by other further examinations like biopsy and unfortunately that may increase the anxiety of the patients [4-7]. The digital mammography is superior in detecting breast lesions than other diagnostic modalities. American cancer society recommended that MRI breast investigation should be mandatory for women with previous history of ovarian cancer or positive family history. Nowadays, a new method introduces to detect the beast lesions. This method is called digital mammography. Because its ability to link with image processing software [8-11].

Digital radiography acts as the useful modalities in lesions detection of the breast because its sensitivity and precision that may increase when used by well expert and trained radiologist. Many studies showed that 10-30% lesion of the breast were missing during routine screening [12].

The image processing plays an important role to decrease the cost of screening process by enhancing the result of digital mammography especially in case of small breast lesions. The first significant features of the breast cancer represent as mass with specific site, texture, border and shape, all these characteristics it easy to study under the image processing techniques by using the MATLAB program [14,15]. The idea of image processing by converting the result image into matrix as the binary image in addition to series of processes until reach to the appropriate result that helps to take a decision of diagnostic breast lesions [16,17]. There are many types of techniques used for mammography images detection such as edge-based transform, smoothing, noise removal and extraction techniques. Those methods help the physician in breast cancer diagnosis and monitor the treatment process [18,19].

The Research Method

MatLab software used to implement the algorithm because its high-recital tool for image analysis and its assimilates subtraction. There are many algorithm, which used for contrast augmentation such as image adjustment, noise reduction using wiener transform. By execution those algorithm the intensity of image can be augmented or diminished which is useful in detection of some lesions. Furthermore, the color conversion can increase the lesion appearance and recognition of an object of curiosity. Mammographs are predisposed to diverse kind of noise. Those noise leads to blunders in the image gaining procedure that leads to pixel amounts that do not reflect the true intensities of real scene. The approach often procedure performed using Gaussian filtering as shown in Figure 1. Wiener estimates the local mean and variance around each pixel (Figure 1).
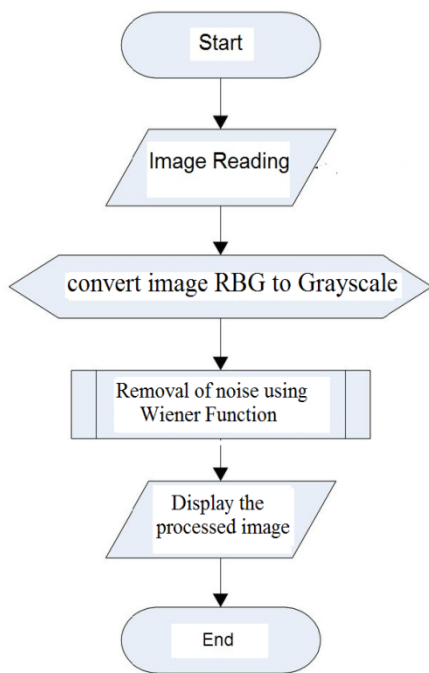

Figure 1. Input to, process, and output of Image enhancement techniques.

$$\mu = \frac{1}{NM} \sum_{n_1, n_2 \in \eta} a(n_1, n_2)$$

and

$$\sigma^2 = \frac{1}{NM} \sum_{n_1 n_2 \in \eta} a^2(n_1, n_2) - \mu^2$$

Where η is the *N*-by-*M* local region of respectively pixel in the mammograph.

v^2 represents the noise alteration.

It is processing method used to categorize or subdivide an image into numerous parts by grouping the pixels according to their features. This paper accomplished to subdivision the mammography using texture scrutiny methods. The study

comprised of different breast conditions. Initially, the breast boundaries itemized and segmented. Then segment the rest of breast soft tissue. Moreover, the mammograph exhibited within the full image as contextual image. Watershed transforms and colors study used to augment the mammographs images (Figure 2). The image recites into the program. In this study, forward algorithm used to change to RGB colour.

The forward algorism

$$L^* = 116\left(\frac{Y}{Y_n}\right) - 16$$

$$a^* = 500\left[f\left(\frac{X}{X_n}\right) - f\left(\frac{Y}{Y_n}\right)\right]$$

$$b^* = 200\left[f\left(\frac{Y}{Y_n} - f\left(\frac{Z}{Z_n}\right)\right)\right]$$

Where,

$$j(t) = \begin{cases} t^{1/3} & if\ t > \left(\frac{6}{29}\right)^3 \\ \frac{1}{3}\left(\frac{29}{6}\right)^2 t + \frac{4}{29} & otherwise \end{cases}$$

Where X_n, Y_n, and Z_n are the tristiulus values of the white point.

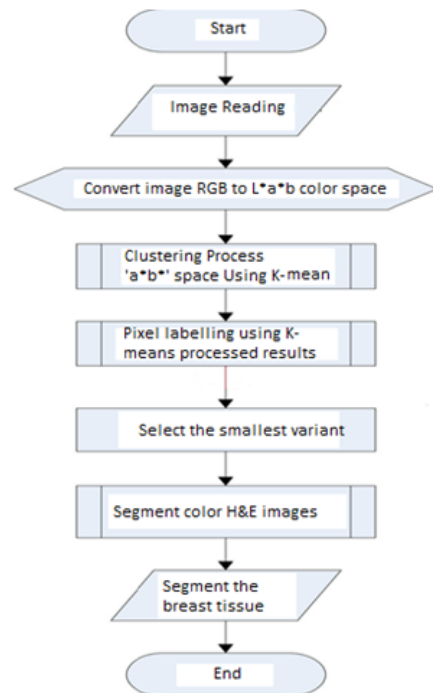The breast images segmented automatically by using color analysis based technique (Figure 2).

Figure 2. Input to, process, and output of segmentation techniques.

Results and Conclusion

In pre-processing stage, the images read and saved as gray scale. Many filters were applied such as white and black filter, sharp image and log transformation. In this stage, the noise was removed followed by sharpening of the images and median

filter application. The median and log transformation give best results comparing with the others. They work through mathematic equations to get rid the unwanted values of pixels and substituting them with wanted ones. They work in extemporized manner (non-linear) that increases the diagnostic and quality values of the images (Figures 3-8).
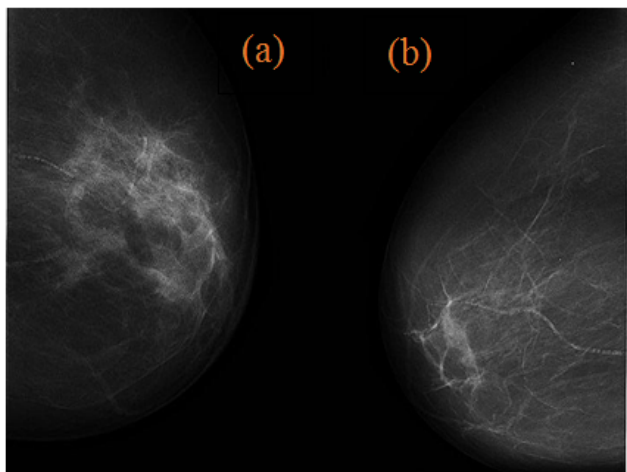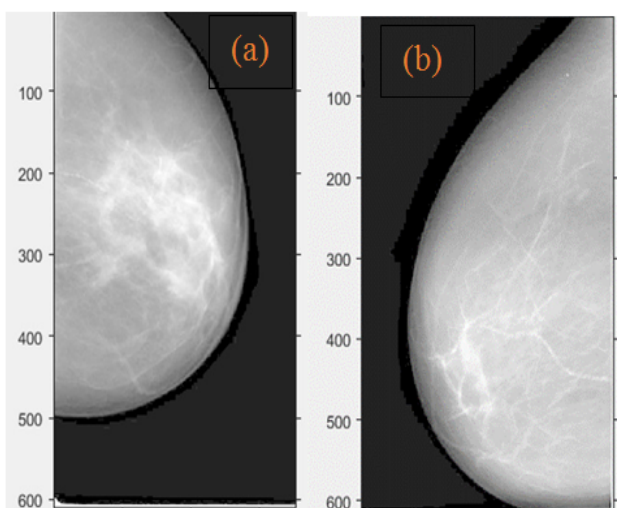

Figure 3. Input image.

Figure 4. Log transform images.

Abdallah [19], Mustra et al. [28] and Rahmati [29] suggested in their study that using the FCLAHE technique would increase the contrast and visibility of the images *via* noise and intensity heterogeneity reduction.

The results of this study showed that the suggested techniques have high matching and corresponding rate comparing with manual subjective analysis. Consequently, application of those techniques will reduce the time and improve the image in good manner.

It is noticeable that using of preprocessing techniques would improve that quality of images if associated with segmentation method. On the other hand, eliminating only noise is not adequate to attain 100% of precision.
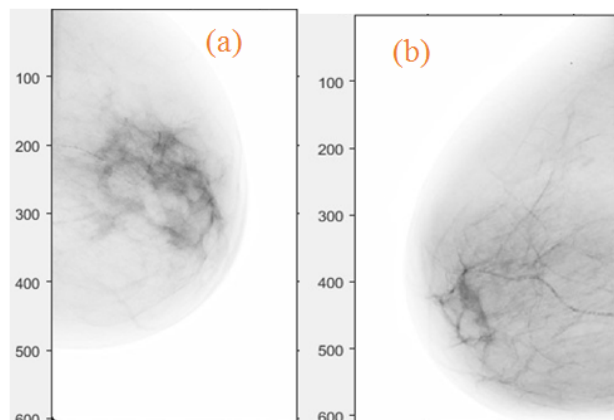
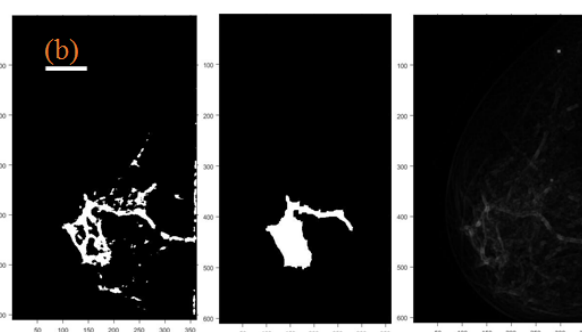

Figure 5. Inverse transform images.
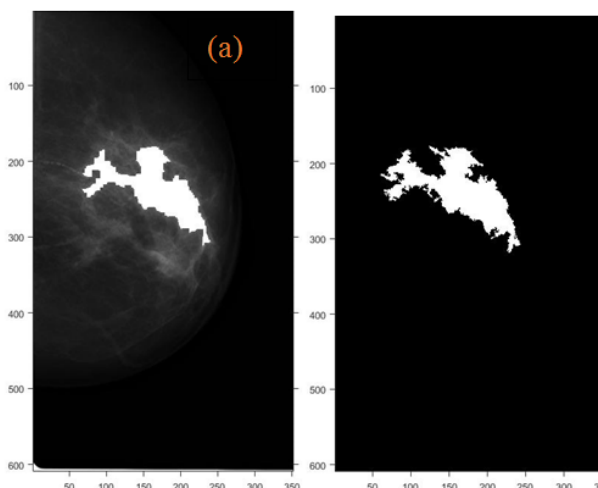

Figure 6. Texture transform images.

Figure 7. Texture watershed images.

Conclusion

Breast tissues segment using segmentation techniques. Texture analysis codes had developed especially for malignant tissues definition. The successfully algorithms used in this study gave high corresponding rate with less signal noise ratio (SNR) comparing with other scientist such as Qin [17], Abdallah [19] and Bushra et al. [21]. This technique is easy to apply unlike the other. Time saving, precision and reiterations are most important characteristics of this technique. In this study, we

offered new techniques, which would help in detection of the tumor in mammography. Based on the results of the segmentation and improvement, we concluded the both methods would improve the images diagnostic value. The future works have to focus on and study detection of the all breast anomalies using other imaging modalities.
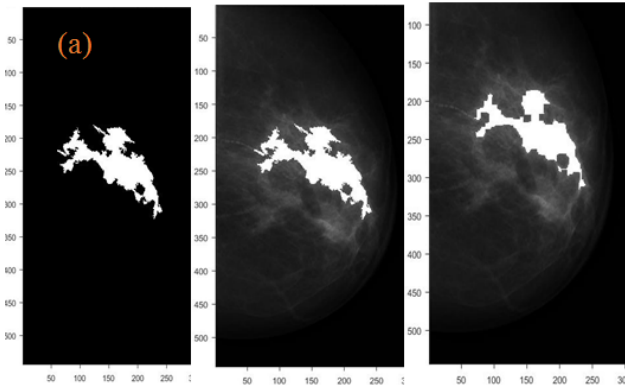

Figure 8. Texture watershed images.

Acknowledgement

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