A New Technique for Mammograms Enhancement and Nipple Location Detection Based On Pixels Contrast Enhancement and Edge Technique.

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Abstract:
Background: Breast cancer is one of the biggest killers in the world, and early diagnosis is essential for improved prognosis. Mammograms are X-ray images of the breast which are used to early detect breast cancer. Also, Mammography is specialized medical imaging for scanning the breasts. Computer aided diagnosis systems (CAD) play a major role in the early diagnosis of breast cancer. Extracting the breast region precisely from a mammogram is an essential component of CAD for mammography. The purposesin this work arepresenting automaticallyenhance of the mammogram image to helping the physician's to detect the cancer in the breast and proposed limited area in the breast body to find thenipple location in it.
Methods:The proposed methodof nipple location detection employs a threshold technique withpixelscontrast enhancementto analysis all pixels in the image for finding the pixels that representing nipple location. also, using pixels contrast enhancement with compare among these pixels to achieve better contrast of mammogram image   .
Results: The proposed techniques are tested with the digital mammogram images from MIAS dataset. The mammogram enhancement and nipple location detection methods are applied on more than 60 images and achieved 97.1% segmentation accuracy and achieved 93.2% enhancedmammogram.
Conclusion: The proposed preprocesses steps and segmentation algorithm show promising results in terms of both qualitative and quantitative analysis.
Key Word: mammography, mammogram enhancement , breast cancer, nipple location, nipple segmentation.

I.   Introduction

Breast cancer is the leading cause of death among women. The National Cancer Institute estimates that one out of eight women in the United States will develop breast cancer at some point during her lifetime[1].Breast cancer is the second common cancer in women after skin cancer in the U.S. Both men and women can have a breast cancer, but there are about 100 times more new cases of breast cancer in women than in men every year[2]. Beginning in the 1980s, screening mammography led to sweeping improvements in early detection of breast cancer[3].Mammography is a specialized medical imaging that uses a low-dose x-ray system for scanning the breasts. A mammography exam, called mammogram, helps in the early detection and diagnosis of the breast diseases in women[4].Breast cancer screening with mammography has been shown to be effective for preventing breast cancer death[5].

With increasing awareness about breast cancer, thousands of mammograms are captured annually in screening centers. Due to mismatch between the number of experts available and the screening mammograms generated, the role of Computer Aided Detection systems to automate the diagnosis of screening mammograms has gained significance. This work deals with one of the commonly detected anomaly in mammogram known as mass. A mass is defined as a space-occupying lesion seen in more than one projection varying in size and shape[6].

The images provided by different patients have different dynamics of intensity and present a weak contrast. Moreover the size of the significant details can be very small. Several research works have tried to develop computer aided diagnosis tools that could help the radiologists in the interpretation of the mammograms and could be useful for an accurate diagnosis[7,8,9].Contrast enhancement and brightness preserving of digital mammograms is very important for early detection and further diagnosis of breast cancer. The fundamental

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enhancement needed in mammography is an increase in contrast. Contrast between malignant tissue and normal dense tissue may be present on a mammogram, but below the threshold of human perception[10].The nipple is considered as a reference point for the alignment or registration of different mammographic projections, current and prior mammograms, or right and left breast images to compare the corresponding regions for detecting lesions visible in the mammogram or changes that have occurred in the breast tissue patterns, or for the reduction of false positives in lesion detection[11].

In this paper, the digital mammogram images enhancement is proposed to obtained the better show information in breast body in the mammograms to detect the cancer. Moreover, proposed another algorithm for detection of nipple location as a reference point for any foreign body to the breast.

II. Material And Methods

The proposed processing algorithm techniques were testedon the images collected from popular publicly availableMIAS dataset[12]. This datasetcontains MLO digital mammogram images obtained from 161patients; per patient two images were collected consistingboth left and right mammograms. This dataset includes malignant, benign and normal cases. The images arearranged in pairs of left and right mammograms, odd filename numbers are used for all rightmammograms and even filename numbers are used for allleft mammograms. All the digital mammogram images have a spatial resolutionof 200 micron per pixel and have (1,024 x 1,024) total pixelswith 8 bit gray level resolution.

1. Proposed Mammograms EnhancementAlgorithm.

In this algorithm, digital mammogram image enhance is presented,where digital mammogram enhancement became more important due to its characteristics and high features in showing details that may be vague, unclear, or perhaps hidden in the image, as we scanned and analyzed a large number of mammograms to understand the perception of image properties, and through analysis, digital images were divided into three types, according to the intensity of the brightness (pixel density), as in Figure1.

1- Low Brightness density image.
2- Medium brightness density image.
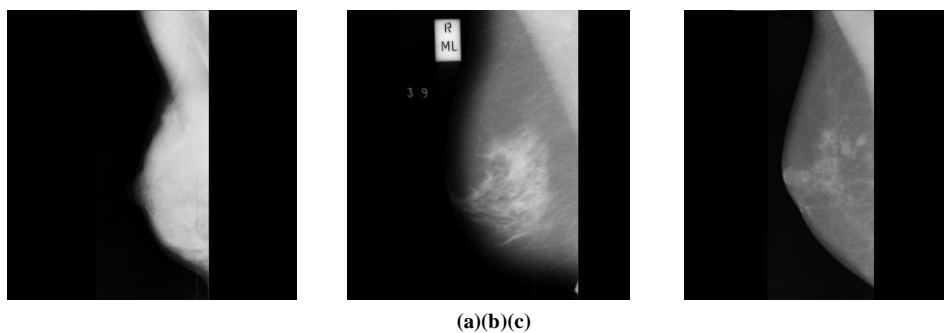**3- High brightness density image.**

(a)(b)(c)
Figure 1: Shows Brightness of digital mammogram, **(a).** High brightness,
(b). Medium brightness, **(c).** Low Brightness

Figure2 shows the algorithm stages used to implement this technique to improve the digital mammogram image.
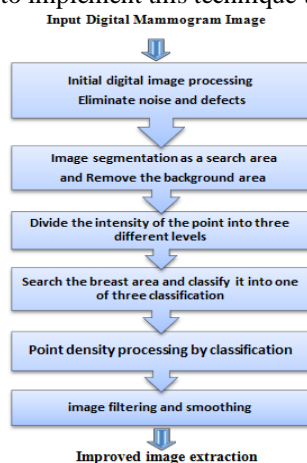

Figure2: Algorithm for enhance digital mammogram.

After the mammogram image classification for the previous three types, the treatment stage begins to improve the image, by analyzing the image and classifying it into one of these categories, then the treatment is applied to this classification. Since the algorithm begins with the initial treatment,which was mentioned earlier in the previous algorithm, the algorithm continues to implement the remaining stages of it, and we will deal with each of these stages separately as follows:

Stage 1; This is the aforementioned preliminary treatment stage to remove noise and defects in the image.

Stage 2; Image segmentation is one of the most difficult digital image processing techniques, and at this point this technique has been used to segment the mammogram into two main parts, the breast mass region and the posterior region.

Stage3; After analyzing more than 60 digital mammograms, there are three different point intensity levels ranging from(0 - 255) in the breast mass area. These levels are defined within threespecific levels that represent the point density, and these levels are as follows:

- **The density of points ranges between: (135 - 150).**
- **The density of points ranges between: (150 - 170).**
- **The density of points ranges between: (170 -200).**

Stage 4; After determining the levels that represent the differences in the intensity of the point density in the breast mass, the work of this stage begins, which examines the area of the breast density and determines the density of points in this mass and classifies them into one of the three above mentioned rates.

And then we treat this region according to the level that it was classified by, by reducing the intensity of the point density that falls within this rate, and this allows the appearance of the most contrasting densities in the image, which allows the display of information or data vague or hidden in the image and this leads to the visibility of any foreign body (It may be a tumor) in the breast mass.

Stage 5; This is the final stage in the image, as it follows the filtering and smoothing technology of the image, and it shows any abnormal body in the breast mass in a more distinct and clear way, which makes it easy to identify and detect easily. The following figure shows the advantage of this technique.
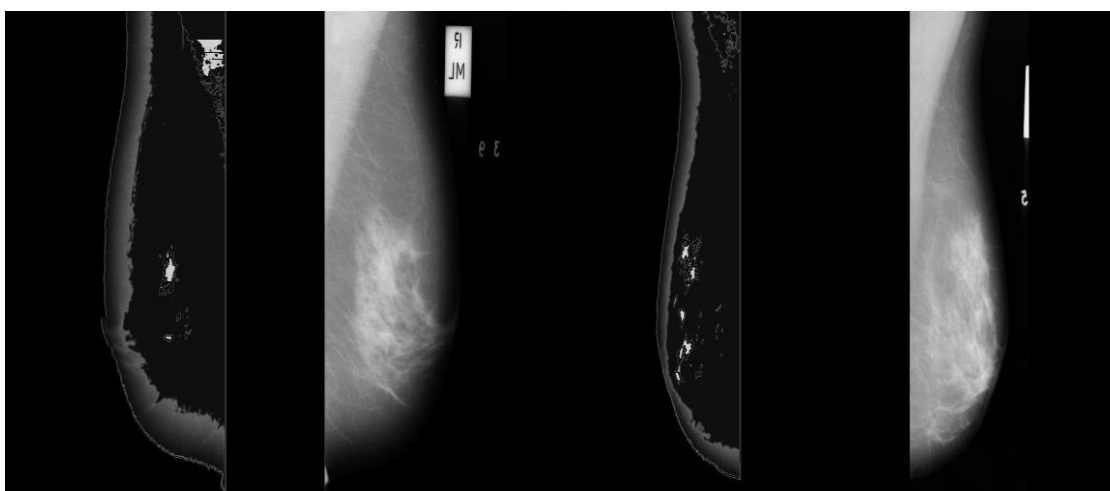
(b)(a) (b) (a)

Figure 3:shows enhancement technique for digital mammogram image. (a). original image ,
(b). the image after enhanced technique

2. Proposedalgorithm for detection of nipple location.

This proposal presenting a method for detection of nipple region, these propose is provides assistance to diagnostic and surgical specialists, as sometimes surgeons are unable to determine the center of the foreign body in the breast accurately, and from this this algorithm is characterized by defining a region as a reference

point through which we can determine the location of the foreign body relative to the location of nipple anywhere on the breast body.

Figure. 4 shows, the stages of the algorithm to find the location of the nipple and identify it on the mammogram image, where this algorithm begins with initial stages, from reading to the digital mammogram image and ending with removing noise and defects, and these stages are the primary treatment steps.The next three stages are consecutive technical stages in this algorithm for finding a nipple and appears it on the image. To illustrate this algorithm, each stage is explained separately as follows:

Stage 1;This stage we are analyzing the mammogram image with pixel by pixel using the Matlab tools to search   on a specific area that represents the triangle nipple area in the breast body and this stage its important and appears in the next stage and we will explain that in the next stage.

Stage 2;After applying the previous stage,its importance related to this stage appears, as the technique of this stage has the primary goal of saving time of processing by reducing the search area in the image instead of being search in all pixels in the image, it will be reduced to a small area.

The previous stage limitsanarea in the breast body, this area define cross section area between center point of vertical line and center of horizontal line of the breast body. This cross produced a small area as a triangle shape as shown in Figure 5,a , this area is nipple location area. This proposed present triangle area for nipple location will not come out of this triangle. Thus, we have restricted the location of the nipple to a specific and small regionin the image in which to search, which facilitates and saves processing time.
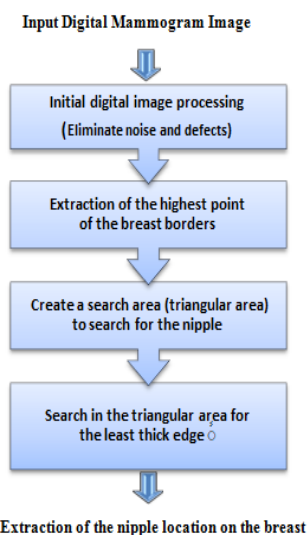

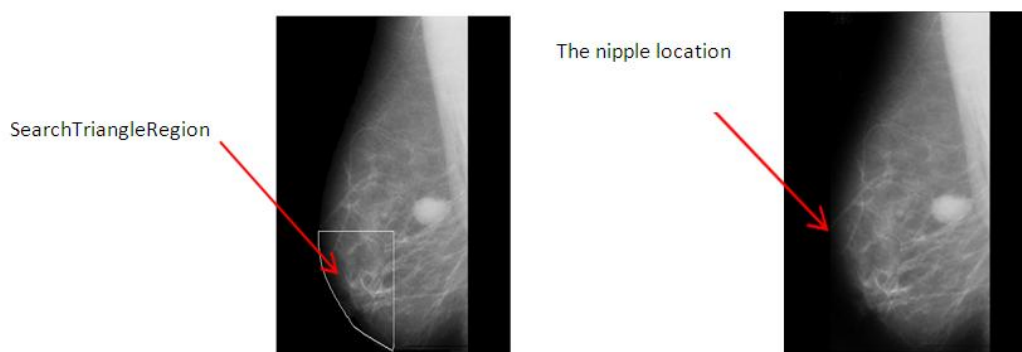**Figure4:**Proposed algorithm to extract nipple location.

Figure 5: shows the nipple location in original mammogram image and search triangle area .
(a). proposed search area , **(b).** nipple in the breast.

Stage 3; After processing in pervious stages to create search area of the nipple, At this stage, the borders of the breast were extracted to make sure and verify the nipple's location, whether it is within the proposed triangle area

or not. After analysis the breast border note that the thickness of breast border (skin of breast) contain the lowest density points, as shown in Figure6,a. less thickness in the skin represents the location of the nipple, as shown in Figure6,b,c.
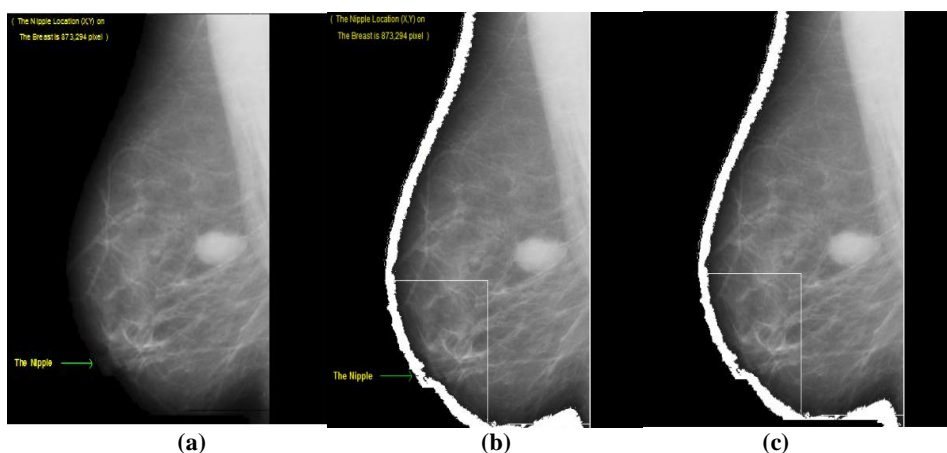

(a)   **(b)**   **(c)**

Figure6:(a). Point extraction on the of location the nipple in the breast. **(b).** Calculate the least thickness in the outer limit within the area of the triangle. **(c).**Show the outer limit of the breast mass With the highest contrast

III. Result and Discussion

First proposal; To obtain high-confidence results, a histogram analysis was applied to the image before applying the processing(the original image) and after applying the processing (enhanced image) to confirm the clarity of the features of the inferred image, where the horizontal level shows the intensity of the pixels that ranges between 0 - 255 And the vertical level shows the count of these pixels. Through Figure8, we notice that the intensity count of pixels located in the region (100-200) is the region with highdensity in the image and includes with it the abnormal region.
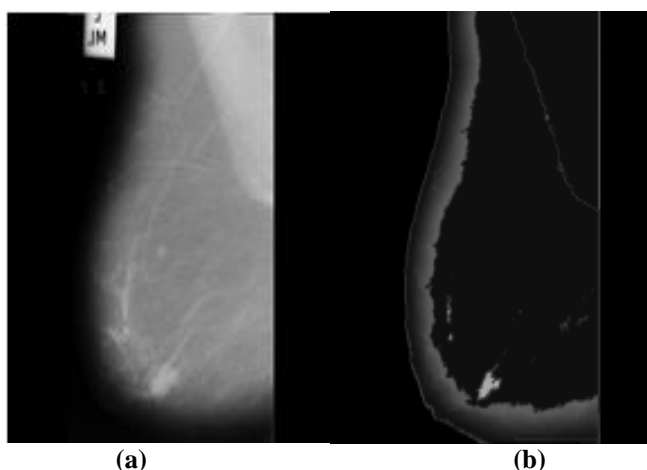

(a)   **(b)**

Figure 7: Shows original image and same image after applied enhancing technique. abnormal features, **(a).** The original image**(b).**Enhancedimage.
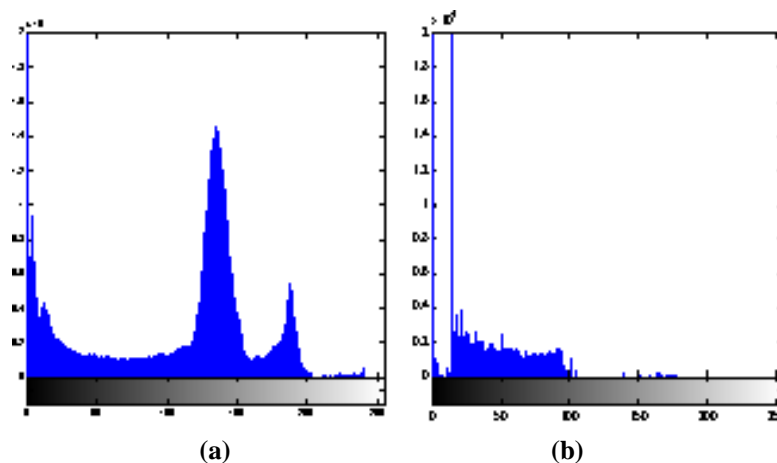
(a)   (b)

Figure8: show the graph of the original image and the output image,
(a). The original photo histogram**(b).** The histogram of the resulting image

Second proposal;after processed a large number of mammogram images from MIAS data base, the mammogram image was divided into two parts according to the state of the nipple:

1. **A prominent nipple.**
2. **A non-prominent nipple.**

Where we note that;thisproposalis working to find the nipple regionin theprominentnipplecases or non-prominentnipple cases . The following table shows the results applied to this algorithm.

Table no 1: Result of 60 cases.

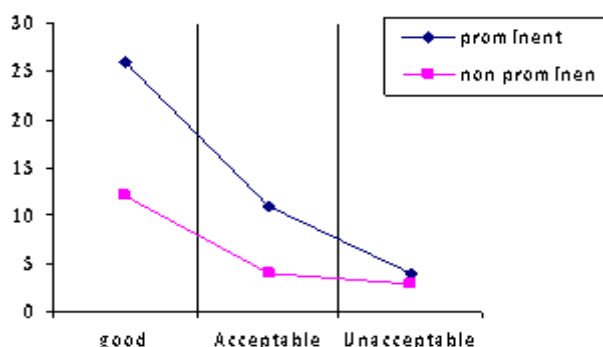| The nipple	good	Acceptable	Unacceptable
prominent	26	11	4
Non prominent	12	4	3
percentage	63%	25%	12%
	88%		12%

Figure8:shows the results trend of detection the nipple location with two types .

IV. Conclusion

In this paper we proposed algorithms to process, enhance and improve the mammogram images using the MATLAB software, where these algorithms tested on more than 60 images of different digital mammograms from MIAS database.

The first algorithm presented a method to enhancement the digital mammogram images to improve the image to detect the abnormal masses in the breast.The second algorithm presented a method to find a reference point location in the breast body (nipple). We applied and tested on many cases of mammograms and was the results are satisfy, and simple.

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