ENHANCEMENT OF MICRO CALCIFICATIONS IN MAMMOGRAMS

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Abstract
Mammogram enhancement is required as an early step to detect the breast cancer. Since the calcification area is dark and images have low contrast, it results in difficulty in image enhancement. Various techniques have been developed till date based upon multi-scale morphology and wavelet transformations. Herein, a new enhancement algorithm has been developed based upon multi-scale morphology. The two parameters dilation and erosion have been scaled. The contrast and brightness of the mammogram images is adjusted and then proposed threshold value is applied. The mini MIAS database is used to check the performance of the proposed algorithm and comparing it with the existing techniques.
Keywords: Mammogram, Morphology, MIAS

I. INTRODUCTION

Cancer refers to multiple growths of cells in parts of body and spread in other body parts. breast cancer which is commonly found cancer in women. In India breast cancer is the growing rapidly and accounts for 25% to 31% of all cancers found in women. In various surveys it is witnessed that the age of developing breast cancer is 50 to 70 years but the recent studies have shown the age shift for this disease and now it has reached to 30 to 50 years and in young this type of cancer is more aggressive. Proper precautions and treatment can only be achieved by Awareness and understanding of this disease and will help the doctor in making correct decision. It is the second most fatal cancer after cervical cancer found among women. Studies suggest that age, family, Gene changes, radiation therapy, breast density, drinking alcohol etc (Source: Biomedical Image Analysis, By Rangayan) are the common reasons of the breast cancer. The life time probability of the cancer is 1 out of 22 women in India and its current incidence rate is 24.6. The various indications of Breast Cancer are as follows:

- A change in the shape or size of the mature breast.
- Thickening found in the breast area or a lump in armpit area.
- A change in shape of nipple.
- Leakage of some sorts of fluid from nipple.
- A change in the skin of the breast.

A change in texture and/or colour of the areola or the nipple. Identification on the basis of signs and symptoms are the basis of diagnosis of the disease. Naked eyes can never detect breast cancer. Fading and flow of hormones may be the reason of lumps and bumps. There may be many other sources such as sunburns, radiation treatment and infections which result to changes in the texture of breast. Medical professionals are required to get a clear diagnosis for such cases. Women, who are between 20 and 30 years of age, should have regular breast checkups annually and in case if abnormalities are found, one should go for ultrasound and mammogram to know the exact cause.

1.1 Breast Cancer Types: Calcifications, Masses, Bilateral asymmetry and Architectural

distortion are the common symptoms of breast cancer.

1.2 Digital mammography

For detection of cancer at an early stage, Mammogram is the best standard. Mammogram is an X-ray image of breast. Dedicated mammography machine is used to compress the breast to even out the tissue during the procedure, to enhance the quality of image. Images of the breast are taken from both front and side. On the day of investigation patient should not apply and deodorant or powder because it will mimic like calcium spot. Screen-film cassettes were used to perform mammography some years ago but now, digital detectors are being used to perform mammography known as Full Field Digital Mammography (FFDM).

1.3 Mammogram Enhancement using CAD

To reduce the number of cases undetected by mammogram, enhancements are introduced using Computer-aided diagnosis (CAD). The output of computer indicating the potential of abnormalities can be very useful to assist the radiologists. especially in the screening of calcium deposits. Some times these Calcium deposits are very small in size .If they are covered by breast tissue we may not be able to see them. If breast tissue is very thick again we can miss deposits. Noise can be recognized as deposits or vice-versa.

The basis purpose of any CAD system is to promote any second option to be radiologist based on the extracted features and then classification of the lesion as the malignant or the benignant using a standard classifier .

2. Problem Formulation

Enhancement of mammogram is an essential preliminary step in accurate detection of breast cancer problem. The enhancement remains a difficult task as mammogram is low contrast images and generally the area is dark. In spite of the most complex algorithm developed the enhancement of mammographic image remains hot topic of research.the focus is to to propose an algorithm for enhancement of microcalcification in mammograms.and Comparison with standard enhancement techniques.

3. Literature Survey

Tomar et al. (2009) in their paper describes that a mammograms can be used to diagnose the abnormality in breast tissues. Initially the various ways to diagnose cancer in an x-ray are calcification contents and spicular lesions. Various detection systems can be used to extract these features. Neural network, wavelet and fuzzy logic are the common approaches employed for this purpose.

Bouyahia et al. (2009) in their paper presented and developed different wavelet based techniques for automatic microcalcifications detection. The initial task done is enhancement of calcium deposit. A pre-processing step is done to enhance the quality of mammograms and make the lesions more visible. The image enhancement techniques proposed were contrast stretching, unsharp masking and the morphological operations. The contrast was enhanced by combining these different forms of image enhancement.

Bozek et al. (2008) in paper describes that to fully treat cancer one have to find its presence of new palism as early as possible. Computers can play major role in detecting early signs of the cancer because of limitations of human observers. Breast lesions and their features are discussed in depth in this paper. This paper also presents some of the developed computer-aided detection and diagnosis methods for breast lesion.

Alolfe et. al. (2008) in their paper illustrates that the deposits seen in x-rays of patient in their paper where one shows signs of generally of calcium. A new method has been described in which we can find out lesions in an early stage and this is with the help of CAD system.

Kavitha et al. (2007) explained that early stages of cancer are diagnosed from appearance of deposits in X-Rays. With the help of filter banks, X-rays are further scrutinized.

Hamad et al. (2006) in the paper introduced the use of 2D Wavelets in finding calcium deposits .The paper investigates that this Wavelet method is better than existing techniques.

Sheshadri (2005) in his paper explained the method of segmentation of image. The Algorithm used by him is known as maximize posterior margin and by this he divides the breast tissue into different categories.

4. Methodology

This paper proposed the algorithm for enhancement of micro calcification in mammograms and to comparison with standard enhancement techniques we propose.

4.1 Proposed Algorithm

4.1.1 Multi Scale Morphology

Two basic morphological operations in the gray scale morphology erosion and dilation are as follows

Dilation

$$(f \oplus g_\sigma)(\boldsymbol{x}) = \sup_{t \in \mathcal{G} \cap \check{\mathcal{D}}_{-x}} \{f(\boldsymbol{x}-\boldsymbol{t}) + g(\boldsymbol{t})\}.$$

…….fig3.1

Erosion

$$(f \ominus g_\sigma)(\boldsymbol{x}) = \inf_{t \in \mathcal{G} \cap \mathcal{D}_{-x}} \{f(\boldsymbol{x}-\boldsymbol{t}) - g(\boldsymbol{t})\}.$$

……fig 3.2

Scaling

$$g_\sigma(\mathbf{x}) = |\sigma| g(|\sigma|^{-1}\mathbf{x}) \quad \mathbf{x} \in \mathcal{G}_\sigma,\ \forall \sigma \neq 0,$$

……Fig. 3.3

The scaling comes from using structured scaling functions and for better scaling some conditions are required like the structuring function should monotonically decrease along a radial direction from the origin

4.1.2 Thresholding

Proposed algorithm has been implemented on the set of different mammographic images taken from mini-MIAS dataset. The threshold value t is determined as within Eq. 3.1 to 3.3. This value is taken by convolution of each pixel.

In Equation 3.2 denotes the two-dimensional array multiplication. After computing the threshold value the processed image e (i,j) can be then given as

$$T = \frac{(es(i,k) \times s(p,j))}{s(i,j)} \quad \text{..... (3.4)}$$

where as

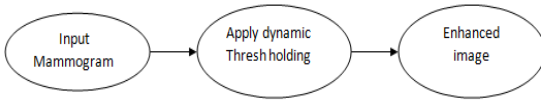
$$s(l,j) = \text{Max}(|g1 * es(i,k)|, |g2 * ks(ij)|) \quad \text{.....(3.5)}$$

while

g1 =[-1, 0, 1], g2 [-1, 0, 1]^t are the masks ..... (3.6)

In Equation 3.2 denotes the two-dimensional array multiplication. After computing the threshold value the processed image e (i,j) can be then given as

$$e(i,k) = \begin{cases} 255, & \text{if } es(i,k) > T \\ 0 & \end{cases} \quad \text{..... (3.7)}$$



Operational Flowchart of proposed system

5. Result and Discussion

The proposed algorithm has been applied to the set of images from the dataset.

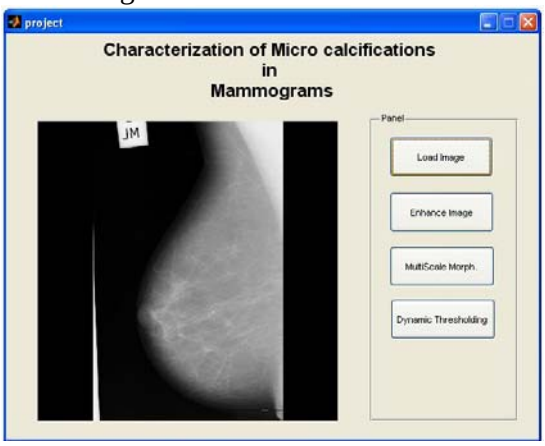


Fig 5.2 After loading the greyscale image (mammogram), The enhance button adjusts the contrast and brightness of the image through histogram equalization.

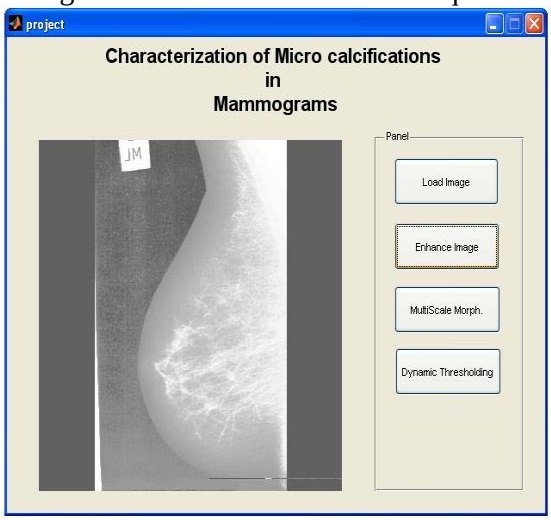


Fig. 5.3 Enhancing the memogram

In fig 5.4 The first image in the upper right corner is the original image, on the right is after dilation, bottom left is erosion and bottom left image is after applying multiscale morphology.

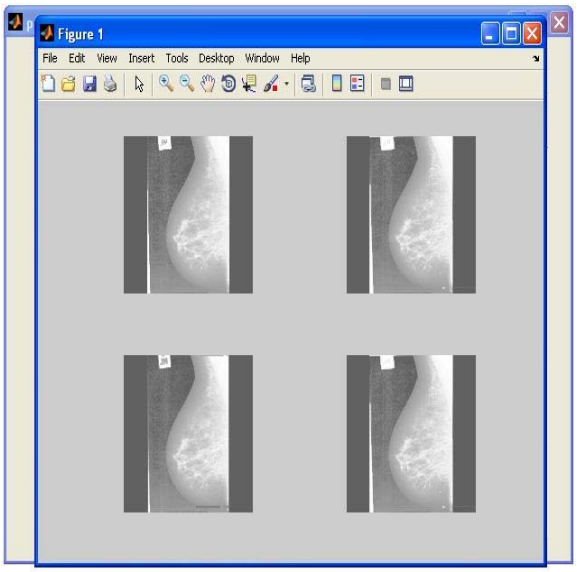


Figure 5.4 After performing multiscale morphology

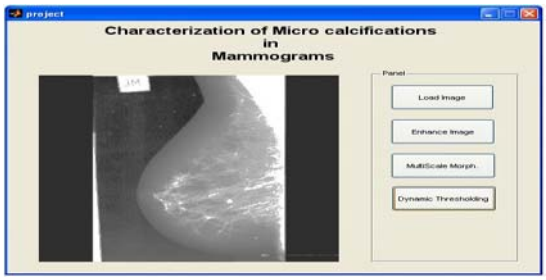


Figure 5.5 Thresholding operation on greyscale image.

It reveals the micro calcification in the mammogram image. Fig 3.6 and Fig 3.7 shows the Comparative Results of enhancements. This thesis is going to have good impact on the overall system as it clearly shows the decomposition using wavelet method.

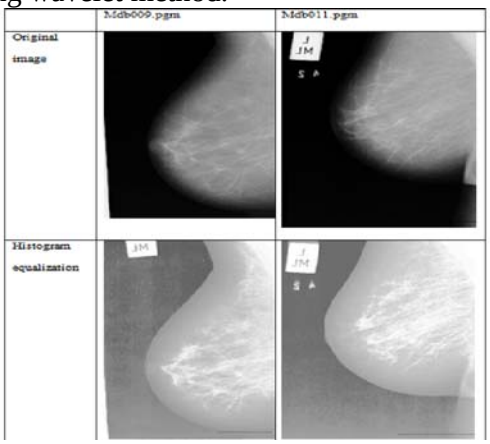


Fig 5.6

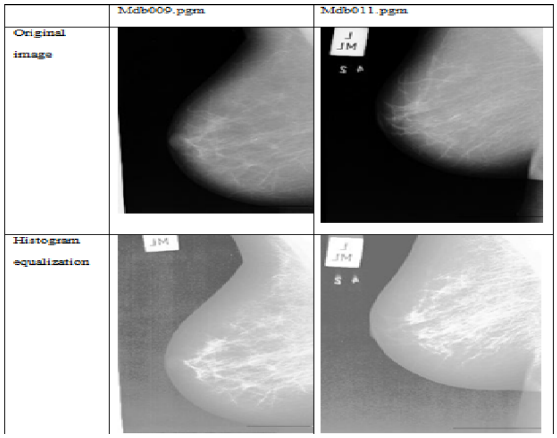


Fig 5.7

It provide improved method with the help of X-rays finding microcalcification and its enhancement in early stage. With the help of histogram equalization and multiscale morphology we have attained good results. For future work there are still many challenges and directions for development of a better enhancement algorithm. It should be kept in mind that identification of coefficients that best represents the mammographic calcification has to be done.

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