Development of a Tool for Quantitative Evaluation to Improve Early Detecion in Breast Cancer

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Abstract—The present paper describe a development of a tool for the quantitative evaluation of contrast-enhance magnet resonance of the breast, in order to improve early detection in breast cancer. Through this tool, the analysis of images was planned to be carried out using wavelets so that the mortality rate due to breast cancer could be reduced.The analysis of the breast MR images were carried out by using wavelet transforms.The development of tool involves three phases. Initially a Breast MR Images for the analysis and to get basic information about the images was taken fromAdvanced Center for Treatment, Research, and Education on Cancer (ACTREC). Further a algorithm was development for the efficiently detection of cancerous cells. Finally, the algorithm was implemented in MATLAB. The presence of noise was then removed by using de-noising and filtering. The DWT was used to separate the frequencies. Further the detection of tumor was done by using IDWT and thresholding. From result it is found that the proposed algorithm was found to be well and can used for identification of tumor level in the earlier stage.

Keywords*-Breast cancer, tumor, imageprocessing, wavelet.*

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I. INTRODUCTION

The continuous development in the field of image processing opens various fields in science and technology. It gives improved pictorial information for human interpretation and processing of image data for storage, transmission, and representation for machine perception. Thereafter, the availability of graphics software, large size memory device and personal computer make the Image Processing popular. The image processing significantly used for Remote Sensing, Medical Imaging, Non-destructive Evaluation, Forensic Studies, Textiles, Material Science, Military, Film industry, Document processing, Graphic arts Printing Industry [1]. The advanced screening programs playing a very important role in medical field toreduced death rate due to the cancer [2]. Image processing and features extraction techniques are used to assist radiologist for detecting tumor. Many researcheswere reported on the diagnosis and detection of breast cancer using various image processing [3-5]. Detection breast cancer is quite a challenging job. Specially, Cancer is collection of multiple diseases. Thus, every cancer is different from every other cancer that exists. Breast Cancer is one of the major diseases for death among ladies in world wide. The survival probability of the patient is dependent on the tumor size at detection time. The early stage detection of breast cancer is most effectively treated. The larger a tumor, the larger is the probability for the presence of metastases in vital organs. Therefore there is need to detect the tumor in first stage for digenesis and curing it. Early detection of the tumor is critical for a good prognosis.

There are five techniques for detection of breast cancer, among this detection using MagneticResonance Imaging(MRI) is observed to best method. The various techniques are developed to detect the cancer or micro calcification from mammogram images but this algorithm is developed by taking Breast MR Images into consideration

- More sensitive than mammograms, ultrasounds, and clinical breast exams.
- Useful for women at high risk for breast cancer.
- Finds invasive breast cancer well.
- Excellent at imaging around breast implants.
- Accurately images implant ruptures and leaked material.
- No compression of breast tissue.
- Effectively images dense breast tissue.
- Images both breasts simultaneously (useful for symmetrical comparison).

By considering above issues in present paper we develop a tool for the detection of breast cancer tumor from breast MR image. Further the algorithm presented here was implemented in MATLAB.For the development and implementation of tools was based on the paper published [6].

II. WAVELET DECOMPOSITION

A wavelet is consist two orthogonal functions: the scaling function or father wavelet $\phi(t)$ and the wavelet function or mother wavelet $\psi(t)$, By using these function we obtain a complete set of wavelet .The scaling and wavelet functions are shown in below respectively,

$$\int_{-\infty}^{\infty} \phi(t)dt = A \text{ and } \int_{-\infty}^{\infty} \psi(t)dt = 0$$

Where A is a constant,The energies of these functions are finite, which means

$$\int_{-\infty}^{\infty} |\phi(t)|^2 dt < \infty \text{and} \quad \int_{-\infty}^{\infty} |\psi(t)|^2 dt < \infty$$

The scaling function and the mother wavelet are orthogonal to each other:

$$\int_{-\infty}^{\infty} \phi^*(t)\psi(t)dt = 0$$

ψ (t) is a small wave or a wavelet, which is localized in time. In this wavelet set, there is only one scaling function, other elements are the wavelets. The thinner daughter wavelet is derives by the mother wavelet for appropriate amount of scaling. Scaling used to make object thicker or thinner. When the combination of scaling is done, then similar size of the wavelets are obtained at various scales, and that is the one complete orthogonal set, having all element has a finite size [7].For generating data structure the DWT is used, which contains $\log_2 n$ segments of various lengths, by the vector length of 2^n a different data can be fill or transform.

A. Continuous Wavelet Transform

The CWT is used to check the change in the width of the window for every single component .The continuous wavelet transform is,

$$CWT_x^{\psi}(\tau, S) = \Psi_x^{\psi}(\tau, S) = \frac{1}{\sqrt{|S|}} \int x(t)\psi^*\left(\frac{t-\tau}{S}\right) dt$$

B. Discrete Wavelet Transform

The DWT is a sampled version of CWT and the resolution is depends on its significant amount of time and resources. This Transform (DWT) is fast computation and based on sub-band code. It is used to reduce the computation time and resources.it is easy to implement. In CWT, by using a set ofbasis functions the signals are analyzed which are relate to each other by simple translation and scaling. To represent a time-scale of the digital signal, the digital filtering techniques isused. in which by passing different cutoff frequency at the different scales for the analysis of the signal. It is passed through a series of high pass filters to analyze the high frequencies, and it is passed through a series of low pass filters to analyze the low frequencies [8].

The 2-D discrete wavelet transform carried by the multi-resolution representation of fragment the frequency spectrum of an image I given to a low-pass sub-band image cA^j and a set of band-pass sub-band images with horizontal is given to the cDH^j, vertical is given to the cDV^j, diagonal orientation cDD^j, j = 1,…,L, where L is the number of levels for a representation. Generally speaking, multi-resolution representations are implemented by a cascade of analysis/synthesis (A/S) filter banks. Mothers wavelet h(x) is use for multi-resolution decomposition (analysis) and g(x) for reconstruction (synthesis) of the original image from its multi-resolution representation. To implement discrete wavelet transform using filters was developed by Mallat.

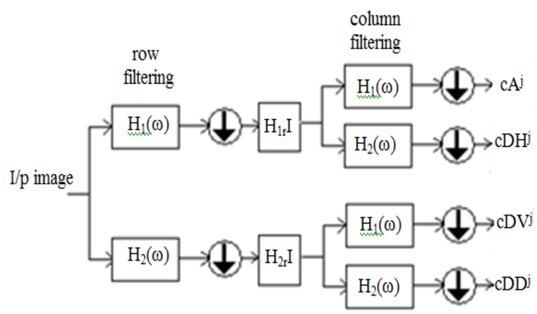

Figure 1:Wavelet-based sub-band decomposition

From figure 1 the wavelet $h_1(x)$ and $h_2(x)$ are applied to the rows of the image I. The filter $h_1(x)$ is a low-pass filter with frequency response H_1 (ω) and $h_2(x)$ is a high pass filter with frequency response $H_2(\omega)$. By filtering the image I with $H_1(\omega)$, low-frequency is obtained (background). By filtering the image with $H_2(\omega)$, the high-frequency is obtained (edges). After down sampling by a factor of two, two sub-bands are obtained: $H_{1r}I$ and $H_{2r}I$ (the subscript r suggests that the filters are applied to rows of the image I). The filters $H_1(\omega)$ and $H_2(\omega)$ are then applied to the columns of the subbands $H_{1r}I$ and $H_{2r}I$, followed by down sampling by a factor of two, and the following four subbands are obtained: cA^j, cDH^j, cDV^j and cDD^j. The sub-band cA^j contains the smooth information of the image, and the sub bands cDH^j, cDV^j and cDD^j contain the detail information of the image. Then the cA^j sub-band of the frequency domain is segmented into four sub-bands at the second level decomposition, and so on [9].

III. ALGORITHM USED

In present work the breast MR images for cancer detection were taken from Advanced Center for Treatment Research and Education in Cancer (ACTREC). Thealgorithm presented here was implemented in MATLAB 7.10. These algorithms were modified according the parameters of the Breast MR Images. Figure shows the proposed breast cancer detection algorithm. There are certain steps through which the image passed these are as follows

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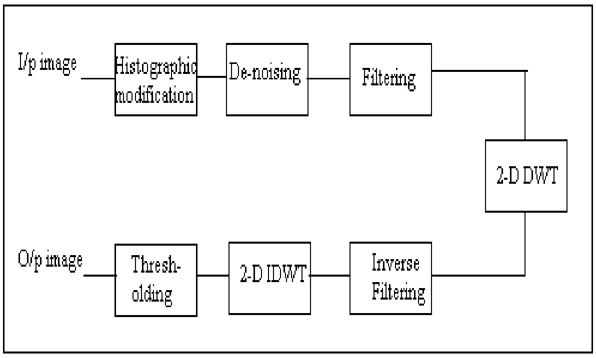

Figure 2:- proposed Breast cancer detection algorithm

As shown in figure 2 the different stepsof algorithm is to be followed….The original image of cancer is given to the histogram by using the histogram modification technique to contrast the original image or bounding the values of pixel in the range of [0- 255]. After the modification, de-noising is used by the median filter for the purpose of un sharp masking and it is emphasize in the strong edge of the image. Images are taken from the digital and conventional cameras may consist of noise. The noise present in original signal was removed using filter. The bi-orthogonal wavelet is used for the wavelet decomposition of image. Figure 3 shows the (a) Morlet wavelets and (b) Meyer wavelets for decomposition and reconstruction.

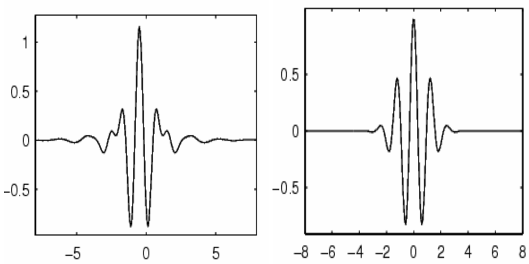

Figure 3:- a) Meyer wavelet b) Morlet wavelet

The original image is reconstructed by using Inverse discrete wavelet transform. The synthesis filters are used in the decomposition of the signal, whichare exactly opposite to the analysis filter. By using universal thresholding technique the approximationcoefficients and unwanted portion in the image are removed. DWT is used to separate the frequencies in image. Finally the detection of cancer was carried out by usingIDWT and thresholding.

IV. RESULT

During the simulation, the threshold values of universal thresholding are taken in the range of 80-110.

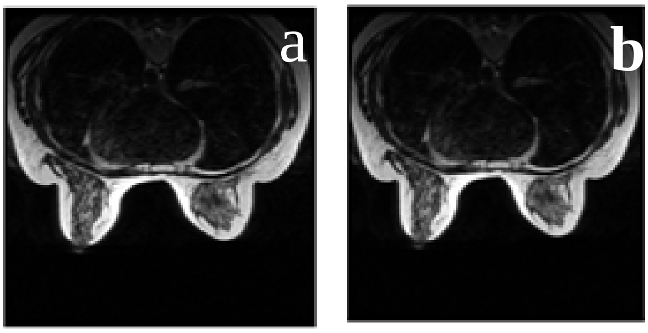

Figure 4:- a) Original Breast MR image b) De-noised image

The figure 4 a shows an original Breast MR image and 4 b de—noised image. Further the image was filtered and cancer tumor was detected.

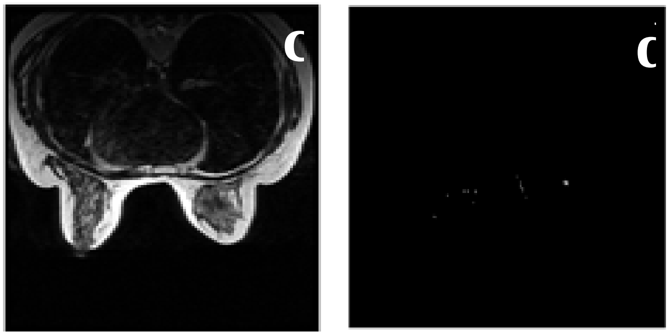

Figure 5:- c) Filtered image d) Detections

The finding observed during the different steps of algorithm is shows in figure 5 and figure 6.

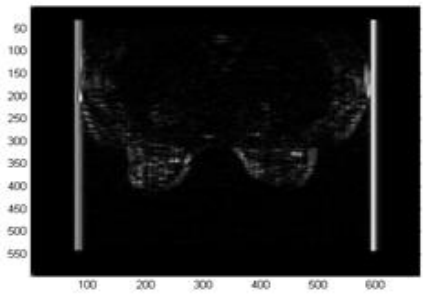

Figure 6:- Reconstructed Breast MR image using Biorthogonal (bior6.S) Wavelet.

V. CONCLUSION

The algorithm was developed for detection of breast cancer from Breast MR Images. The algorithm presented was then implemented in MATLAB. The proposed algorithm helps to detect the breast cancer up to different accuracy depending on used wavelet. The simulation is done on MATLAB 7.10. The detections and reconstruction images with approximation coefficients was carried out by using biorthogonal wavelets. For minimization of errors the thresholding is made stricter so that the results become more accurate. For the minimum size

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of tumors to be detected, the demo image of 256 by 256 pixel images is made and by making pixels of different value with different are in terms of pixels, the algorithm is run. Inverse discrete wavelet transform is used for the reconstruction of the original image using the synthesis filters which are exactly opposite to the analysis filters used in the decomposition of the signal. Before IDWT approximation coefficients are removed and after IDWT the unwanted portion in the image is removed using universal thresholding technique. The proposed algorithm was found to be well and can used for identification of tumor level in the earlier stage.

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