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Mammogram of Breast Cancer detection Based using Image Enhancement Algorithm

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***Abstract*— Principle objective of Image enhancement is to process an image so that result is more suitable than original image for specific application. Digital image enhancement techniques provide a multitude of choices for improving the visual quality of images. A frequency domain smoothing-sharpening technique is proposed and its impact is assessed to beneficially enhance mammogram images. This technique aims to gain the advantages of enhance and sharpening process that aims to highlight sudden changes in the image intensity, it is usually applied to remove random noise from digital images. The already developed technique also eliminates the drawbacks of each of the two sharpening and smoothing techniques resulting from their individual application in image processing field. The selection of parameters is almost invariant of the type of background tissues and severity of the abnormality, giving significantly improved results even for denser mammographic images. The proposed technique is tested breast X-ray mammograms. The simulated results show that the high potential to advantageously enhance the image contrast hence giving extra aid to radiologists to detect and classify mammograms of breast cancer.**

***Keywords*— Fourier transform, Gabor filter, Image, enhancement, Mammograms, Segmentation**

I. INTRODUCTION

Recently studies show that one in 10 women will contract breast cancer in their lifetime, and that breast cancer is the leading cause of death of women between the ages of 35 and 54. Every year 27% of the new cancer cases in women are breast cancers [1]. Although X-ray mammogram detection is best way of screening the breast cancer and ultrasound method is more popular because of its non-invasiveness and low cost [3]. Due to high noise, low contrast radiologists cannot detect and classify the tumor or dense in breast cancer. Image enhancement is a best way for the diagnostic reliability by reducing noise effects in mammogram and filtering is a challenging process in ultrasound image processing since the noise is of unknown source with non specific form and trend. Several algorithms have been proposed to enhance the signal-to-noise ratio and to eliminate noise speckles.

These filters include but are not limited to: Fractal Analysis [4], Fuzzy Logic approach [5], and wavelet analysis [6]. In this work we develop a new hybrid image enhancement technique that simultaneously smoothes the image to achieve optimal contrast. The best parameters are determined using experimental methodology..

II. IMAGE ENHANCEMENT

Image enhancement is basically improving the interpretability or perception of information in images for human viewers and providing `better' input for other automated image processing techniques. The principal objective of image enhancement is to modify attributes of an image to make it more suitable for a given task and a specific observer. During this process, one or more attributes of the image are modified. The choice of attributes and the way they are modified are specific to a given task. Moreover, observer-specific factors, such as the human visual system and the observer's experience, will introduce a great deal of subjectivity into the choice of image enhancement methods. There exist many techniques that can enhance a digital image without spoiling it. The enhancement methods can broadly be divided in to the following two categories, Spatial Domain Methods and Frequency Domain Methods, figure 1 shows the techniques of enhancement of image.

In spatial domain techniques [9], we directly deal with the image pixels. The pixel values are manipulated to achieve desired enhancement. In frequency domain methods, the image is first transferred in to frequency domain. It means that, the Fourier Transform of the image is computed first. All the enhancement operations are performed on the Fourier transform of the image and then the Inverse Fourier transform is performed to get the resultant image. These enhancement operations are performed in order to modify the image brightness, contrast or the distribution of the grey levels. As a consequence the pixel value (intensities) of the output image will be modified according to the transformation function applied on the input values.

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Image enhancement is applied in every field where images are ought to be understood and analysed. For example, medical image analysis, analysis of images from satellites etc.

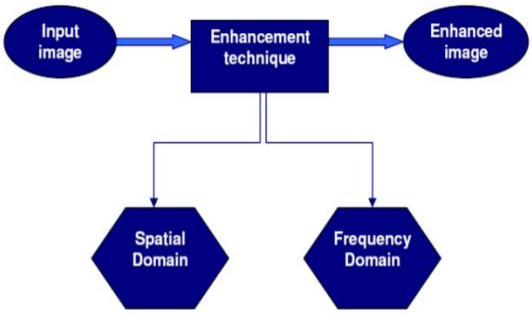

FIG.1: IMAGE ENHANCEMENT TECHNIQUES

In digital image processing some general image intensification method like average value filter, the low pass filtering, the edge enhancement and so on mainly aim in the image the stochastic noise, but in the fuzzy image's grain line flaw belongs to the constitutive noise, therefore is not ideal to the image's enhancement effect. The essential procedure is to the primitive gradation image after the low-pass filtering, the histogram transformation and so on general image intensification method carries on processing, carries on the binaryzation and refinement processing. This way's basic flaw will be the binaryzation and refinement processing will not only lose the useful pictorial information. Also has some algorithms is carries on the image enhancement on the primitive gradation image. The people proposed uses has the direction and the frequency selection characteristic band pass filter carries on image enhancement processing the thought. Figure.2 shows the basic diagnosis Process.

III. GABOR FILTER ALGORITHM

A Gabor filter is a linear filter whose impulse response is defined by a harmonic function multiplied by a Gaussian function. Because of the multiplication-convolution property (Convolution theorem), the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function.

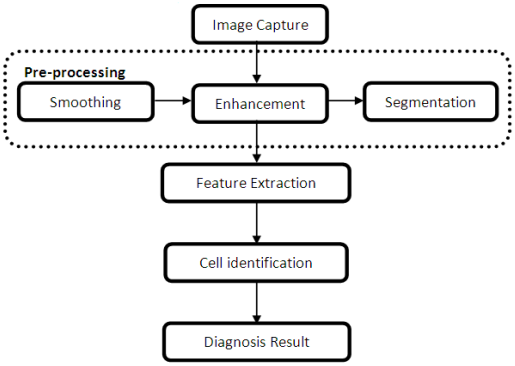

FIG. 2: DIAGNOSIS PROCESS

Gabor filters are directly related to Gabor wavelets, since they can be designed for number of dilations and rotations. However, in general, expansion is not applied for Gabor wavelets, since this requires computation of biorthogonal wavelets, which may be very time-consuming. Therefore, usually, a filter bank consisting of Gabor filters with various scales and rotations is created. The filters are convolved with the signal, resulting in a so-called Gabor space. This process is closely related to processes in the primary visual cortex. The Gabor space is very useful in e.g., image processing applications such as iris recognition and fingerprint recognition. Relations between activations for a specific spatial location are very distinctive between objects in an image. Furthermore, important activations can be extracted from the Gabor space in order to create a sparse object representation.
The Gabor Filters have received considerable attention because the characteristics of certain cells in the visual cortex of some mammals can be approximated by these filters.

In addition these filters have been shown to posses optimal localization properties in both spatial and frequency domain and thus are well suited for texture segmentation problems.

Gabor filters have been used in many applications, such as texture segmentation, target detection, fractal dimension management, document analysis, edge detection, retina identification, image coding and image representation.

A Gabor filter can be viewed as a sinusoidal plane of particular frequency and orientation, modulated by a Gaussian envelope.

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$h(x, y) = s(x, y)g(x, y)$, $s(x, y)$: Complex sinusoid
$g(x, y)$: 2-D Gaussian shaped function, known as envelope

$$S(x, y) = e^{-j2\pi(u_0x + y_0y)}$$

$$g(x, y) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2}\left(\frac{x^2}{\sigma_x^2} + \frac{y^2}{\sigma_y^2}\right)}$$

The fundamental 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. Our emphasis at this stage is to provide the radiologist with a superior image. In the past, several image contrast enhancement methods have been proposed. Many image enhancement approaches in the area of adaptive histogram equalization were proposed. There was a problem in reducing mean brightness change. Adaptive unsharp masking technique as also applied for image contrast enhancement. It also lacks to detect low contrast edges present in the input image. The research works have been one on mammograms for its contrast enhancement and for identification of image features associated with breast cancer. These methods introduced enhancement on mammogram features using adaptive neighborhood method which are also not immune to noise.

From the literature survey on mammogram image enhancement and detection of micro calcification, still it is a problem in obtaining contrast enhancement without losing any relevant information in the original mammogram image. If it is tried to reduce any loss of information, then artifacts would be the next challenge or issue in contrast enhancement of mammogram images. The approach taken in this paper is to propose an optimal contrast enhancement for mammogram images to get both artifacts free and naturalness in the enhanced image. Hence there is a chance to give sufficient quality in the mammogram images to allow the radiologist to make his diagnosis with more confidence. The principal objective of enhancement is to process an image so that the result is more suitable than the original image for a specific application.

IV. METHODOLOGY

We can define image enhancement as away to improve the quality of image, so that the resultant image is better than the original one, the process of improving the quality of a digitally stored image by manipulating the image with MATLAB software.

It is quite easy, for example, to make an image lighter or darker, or to increase or decrease contrast. MATLAB also supports many filters for altering images in various ways. The enhancement technique differs from one field to another according to its objective.

We worked in matlab with image processing techniques which detect the tumors/cells in the input mammogram image. For that we uses various image collected from internet open source database. Some of images shown in figure 4. We implemented the functional code for this work using matlab with Pentium core2due window based PC. First steps to select the image and after that apply the algorithm for enhancement.

The most important aims in our project are as follows:

1. To understand the medical background for disease, its types, risks, symptoms, tests and treatments.
2. To recognize the importance of Image enhancement stage by applying several techniques on given images to get better level of quality and clearness.
3. To work on image segmentation algorithms which are playing an effective rule in image processing stages.
4. To obtain the general features from enhanced segmented image which give indicators of normality or abnormality of images.

Figure 3 shows the proposed workflow our algorithm method. At last evaluated result of PSNR for the various images.

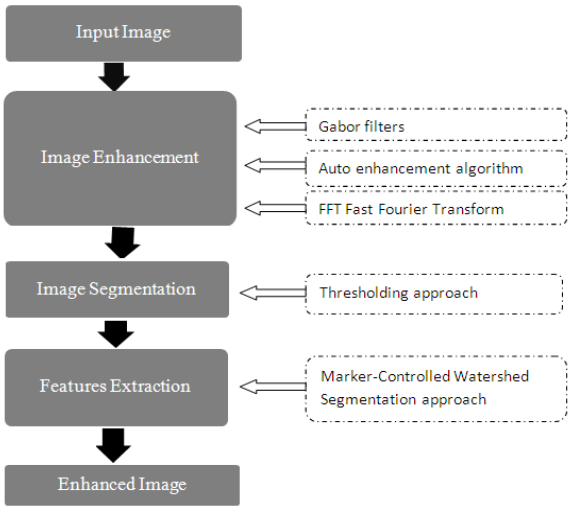

FIG.3: PROPOSED WORK FLOW

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V. RESULTS

Figure 4 and Table 1 shows the simulated result using the Gabor algorithm and compare with various filter methods.

VI. CONCLUSION

In this work, an automated theme for contrast enhancement is devised for mammograms. It consists of series of smoothing, edge detection, histogram modifications, and color mixing to give a better contrast. The result images turned up new areas which might be of diagnostic interest. Combining Gabor algorithm with fast Fourier transform and overlay mask segmentation showed to be a very effective method of eliminating the noise and enhancing edges, thus improving the signal-to-noise ratio. Superimposition of images processed using different techniques into single image within showed to advantageously enhance the visibility and ease the identification of valuable information to the human eye compare to various other methods of filtering.

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TABLE I
SIMULATION RESULTS

Image	Peak Signal to Noise Ratio (dB)				
	Gabor Algorithm	Average Filter	Unsharp Filter	Sobel Filter	Log Filter
Image1 [11]	88.32	42.75	22.55	5.96	5.12
Image2 [12]	88.83	47.17	25.24	8.09	7.69
Image3 [13]	125.27	51.60	44.52	5.86	4.42
Image4 [14]	83.61	50.56	60.30	4.19	3.99
Tumor [15]	101.34	57.93	29.78	6.67	5.857
lobular_carcinoma [13]	Inf	61.81	58.45	4.99	3.73
mediolateral_oblique_spot [13]	128.20	11.80	12.62	0.95	0.23
small_leison [15]	123.11	22.83	19.86	1.64	0.88

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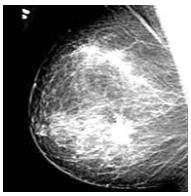
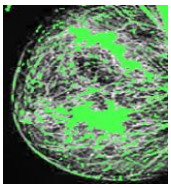
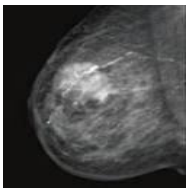
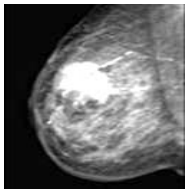
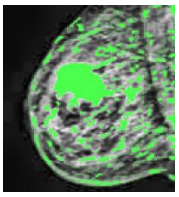
Name of Image	Original Image	Enhanced Image	Overlay mask segmented Image
Image 1 [11]			
Image 2 [12]			

FIG. 4: SIMULATION RESULT OF VARIOUS MAMMOGRAM IMAGES