International Journal on Recent and Innovation Trends in Computing and Communication
Volume: 5 Issue: 1

ISSN: 2321-8169
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The Preprocessing Methods of Mammogram Images for Breast Cancer Detection

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Abstract— Early detection of breast cancer increases the survival rate and increases the treatment options. In this paper, we present different preprocessing methods for mammogram images. The main goal of the preprocessing is to improve the mammogram image quality and make it ready for the segmentation and feature extraction. Different types of filtering techniques are available for preprocessing. Filters are used to improve image quality, removes the noise, preserves the edges within an image, enhance and smoothen the image

Keywords: Mammography image, Segmentation, Feature Extraction, Wiener Filter

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I. INTRODUCTION

Mammography is at present the best available technique for early detection of breast cancer. The procedure involves compressing the breast between two plates and then applying a small dose of radiation to produce an X-ray image. Mammograms can be used for screening and for diagnosis. Mammography is a radiographic imaging technique and gives detailed information about anatomy, morphology and pathologies of breast for screening and diagnosis of breast cancer. Mammographic image classification is extremely challenging as the suspicious calcification or masses appear as free shape and irregular texture, so no precise patterns can be associated to them. Also it is difficult to detect masses in mammograms because sometimes masses seemed to be similar to normal breast tissues .It is difficult to distinguish between malignant and benign masses. So preprocessing on mammogram picture is prepared which reduce the computational rate and exploit the probability of accuracy.

In this proposed work only digital mammogram images are considered for database and analysis. The images are taken from Mammographic Image analysis Society (MIAS) database.[8]

Figure 1 shows input mammographic images used for analysis. The images include both cancerous and non cancerous images. The cancerous images may be benign or malignant type. Irregular shapes have a higher probability of being malignant and regular shapes have a probability of being benign.

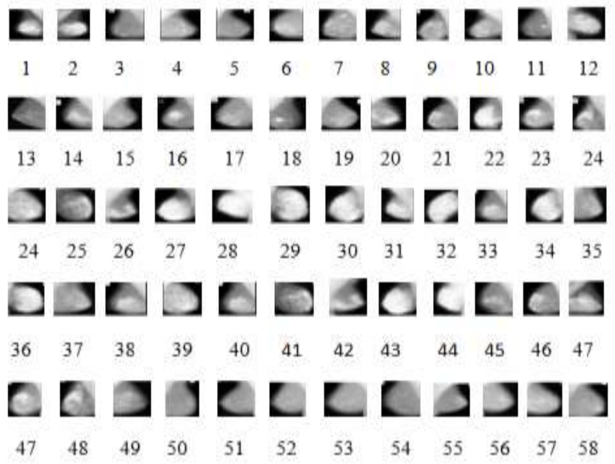

Figure 1: Input images

II. PREPROCESSING

Image preprocessing techniques are essential, in order to find the orientation of the mammogram, to remove noise and to increase quality of image. Digital mammograms are medical images that are hard to be interpreted, thus a preparation stage is required in order to improve the image quality and make the segmentation outcome more correct.

Main objective of this process is to improve quality of image to make it ready to additional processing by removing unrelated and remaining parts in the back ground of the mammogram. Breast border removal and pectoral muscle repression is as well part of preprocessing. The various types of noise observed into mammogram are elevated intensity rectangular tag, low intensity tag, tape artifacts etc.

Generally filters are used to filter unwanted things or object in a spatial domain or surface. Image Filtering is useful for numerous applications, including smoothing, sharpen, remove noise and edge detection. Filter is defined by kernel, which is small array apply to each pixel and its neighbors

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within an image. The noise and high frequency components removed by filters. Various types of Filters are as follows

III. MEDIAN FILTER

A median filter is nonlinear filter is able in remove salt as well as pepper noise. Also median filter tend to keep sharpness of picture edges while removing noise. Figure.2 represents Median Filter for mammogram images and simulation results for input images, salt and pepper noise image, Gaussian noise image, speckle noise image, reconstructed salt and pepper image, reconstructed Gaussian image, reconstructed speckle image, respectively

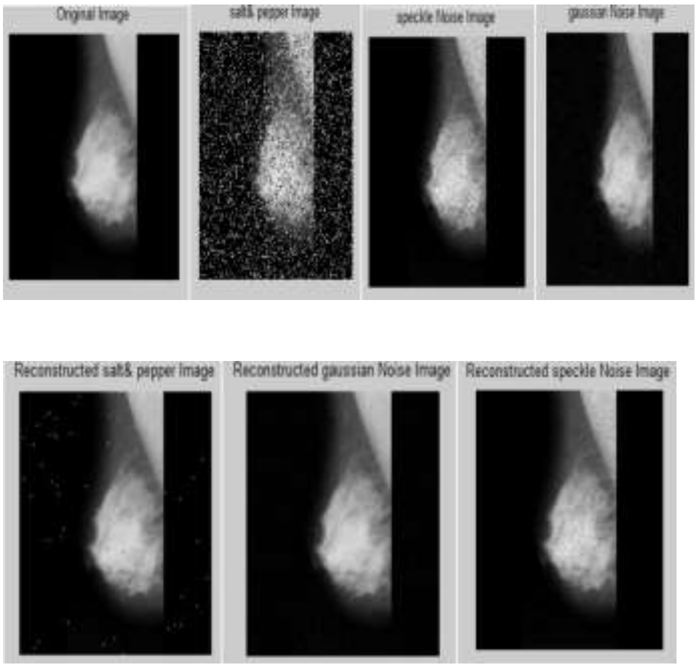

Figure 2: Median filter image

IV. MEAN FILTER OR AVERAGE FILTER

Mean filter replaces every pixel by average value of the intensities in its neighborhood. It can locally decrease variance and is simple to implement. It has effect of smoothing and blurring the image and is optimal for preservative Gaussian noise in sense of mean square error. Speckled image is a multiplicative model with non-Gaussian noise and thus, simple mean filter is not efficient in this case. The goal of the mean filters used to improve picture quality for human viewers. Limitations of average filter are as follows.

i. Averaging operations lead to the blurring of a picture, blurring influence features localization.

ii.If averaging operations applied to a picture corrupted by impulse noise, impulse noise attenuated and gentle but not removed.

iii.A single pixel with a very unrepresentative value exaggerated mean value of all pixels in neighborhood considerably. Figure 3 represents Mean Filter for mammogram images and simulation results for database input images, salt and pepper noise image, Gaussian noise image, speckle noise image, reconstructed salt and pepper image, reconstructed Gaussian image, reconstructed speckle image, respectively.

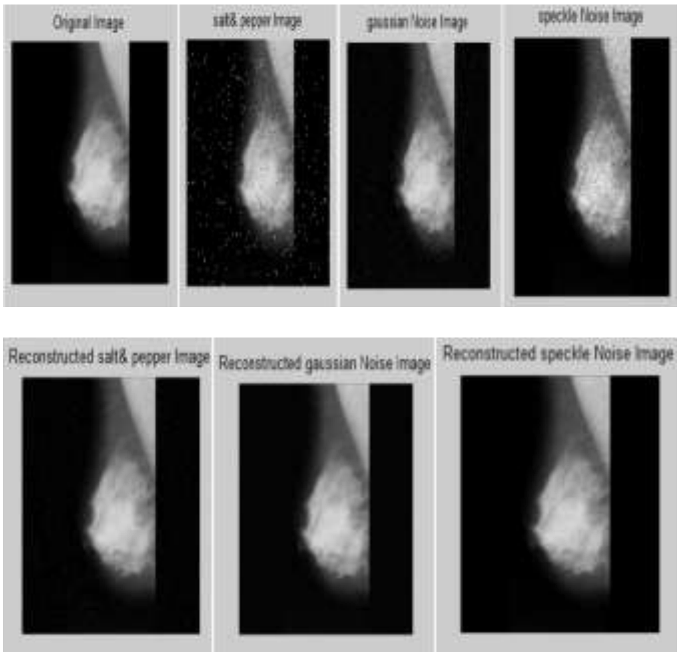

Figure 3: Mean filter image

V. ADAPTIVE MEAN FILTER

In order to alleviate blurring effect, adaptive mean filters have been proposed to achieve balance between clear-cut averaging and all pass filtering. They adapt to properties of image locally and selectively remove speckles from different parts of image. The uses of local image statistics like mean, variance and spatial correlation to effectively detect and preserve edges and features. Speckle noise is detached by substitute it with a local mean value. Adaptive mean filters outperform mean filters, and generally reduce speckles while preserving edges.

Adaptive Median filtering used to smooth no repulsive noise from two-dimensional signals lacking blurring edges and preserved images. This make, it particularly appropriate for enhancing mammogram images. Preprocessing techniques used in mammogram, direction, label, artifact removal, enrichment and segmentations. Preprocessing concerned in creating masks for pixels with highest intensity, It also concerned to reduce resolutions and to segment breast.
Figure 4 represents Adaptive Median Filter for mammogram images and simulation results for database image input images, salt and pepper noise image, Gaussian noise image, speckle noise image, reconstructed salt and pepper image, reconstructed Gaussian image, reconstructed speckle image, respectively.

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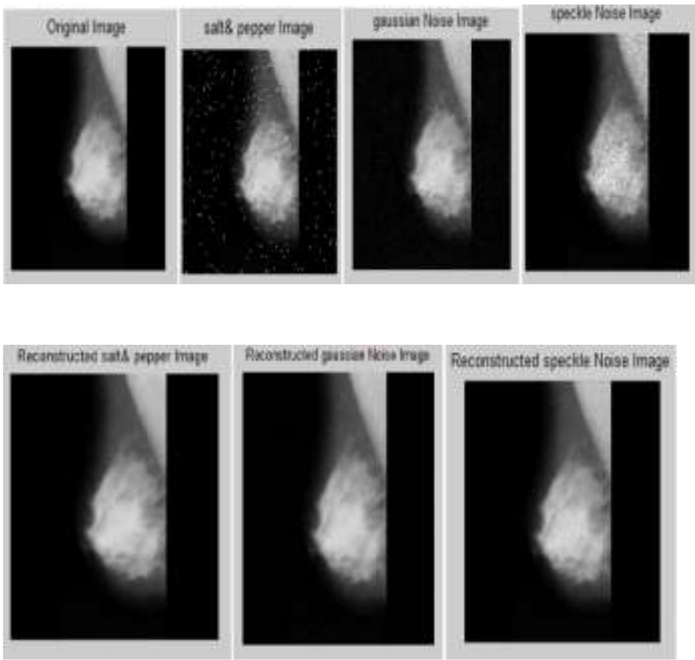

Figure 4: Adaptive mean filter image

VI. WIENER FILTER

Wiener filter tries to build an optimal estimate of original image by enforcing a smallest mean square error constraint between estimate and original image. Wiener filter is an optimum filter. Objective of a wiener filter is to minimize mean square error. Wiener filter has capability of handling both degradation function and also noise. From degradation model, error between input signal f (m, n) and estimated signal f (m, n) is given by

$$E(M,N) = F(M,N) - F(M,N) \quad (1)$$

Square error is given by

$$[F(M,N) - F(M,N)]^2 \quad (2)$$

Mean square error is given by

$$E\{[F(M,N) - F(M,N)]^2\} \quad (3)$$

Wiener filters are class of optimum linear filters which occupy linear estimation of preferred signal sequence from another related sequence.

Wiener filtering is superior. It gives the optimal way of tapering off the noisy components, so as to give the best reconstruction of the original signal. Can be applied in spatial basis i.e. delta functions or pixels, Fourier basis i.e. frequency components, wavelet basis, etc. Wiener filtering is a general way of finding best reconstruction of a noisy signal. It applies in any orthogonal function basis and Different bases give different results

In spatial means pixel basis, Wiener filter is usually applied to variation between an image and a smoothed image.

In a wavelet basis, mechanism encode both spatial information and frequency information

It largest magnitude components often have least noise .So Wiener filtering can preserve resolution. In this proposed system, wiener filter is used. Following image is the example of Wiener filter. Figure.5 represents Weiner filters for mammogram images and simulation results for database images input images, salt and pepper noise image, Gaussian noise image, speckle noise image, reconstructed salt and pepper image, reconstructed Gaussian image, reconstructed speckle image, respectively.

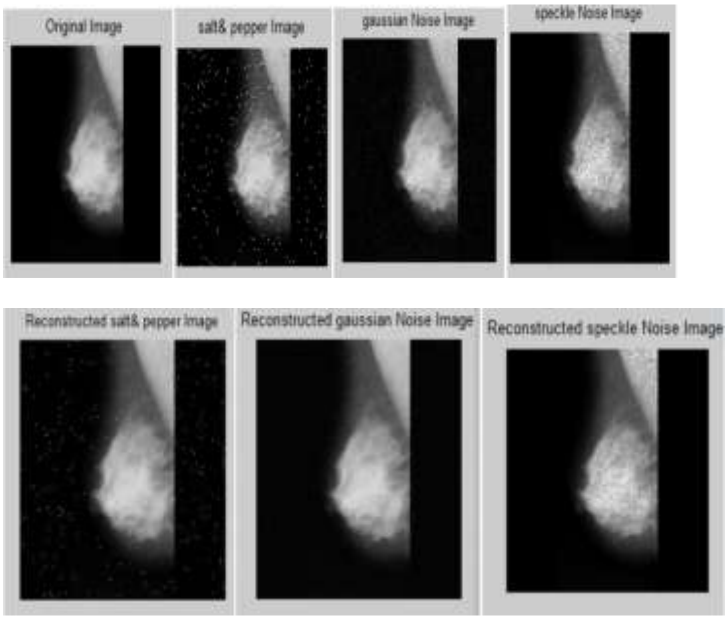

Figure 5: Wiener filter image

VII. PERFORMANCE EVALUATION

The following mathematical metrics are used for the evaluation of the quality of the image.

i)Peak Signal to Noise Ratio(PSNR)
Bigger PSNR point out a smaller difference between the original and reconstructed or segmented image. The smaller value of PSNR means that the image is poor.
PSNR is defined as follow.

PSNR=20log10(1/RMSE)db

ii)Mean Squared error(MSE)
The simplest of distortion measurement is Mean Square Error(MSE),defined as,

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}\|I(i,j) - K(i,j)\|^2$$

iii)Normalized Absolute error(NAE)

It is a measure a measure of how far is the reconstructed image from the original image with the value of zero being the perfect fit.

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It can be calculated as follows.

$$NAE = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}[|f(i,j).f(i,j)|]}{\sum_{i=1}^{M}\sum_{j=1}^{N}|f(i,j)|}$$

iv)Structural Content (SC)

The large value of structural content means the image is poor quality. SC is defined as follows.

$$SC = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}x(i,j)^2}{\sum_{i=1}^{M}\sum_{j=1}^{N}x(i,j)^2}$$

VIII. CONCLUSION

Preprocessing technique for enhancing the content of medical image based on removal of special markings and noise. Removal of noise and special markings will increase the image quality and definitely increase the accuracy in segmentation and feature extraction. Here four types of filtering methods and their simulations are consider in order to obtain noise free images.

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