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EFFICIENT IMAGE ENHANCEMENT TECHNIQUES FOR MICRO CALCIFICATION DETECTION IN MAMMOGRAPHY

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ABSTRACT

In this paper, the effect of an image preprocessing stage and the parameter adjusting of a computer-aided detection (CAD) system for the detection of micro calcifications in mammograms is verified. The pre-processing of images play a vital role in efficient segmentation because of several factors which affects the efficiency and accuracy of further processing.One of the best methods for breast cancer early detection is mammography. Three filtering methods were implemented. Which are mean, median and the Unsharp mask filter. The filter-performances of the algorithms are compared based on peak-signal-to-noise ratio (PSNR) and mean squared error (MSE) values. Large values of PSNR and small values of MSE indicate less noise power irrespective of the degradation process. Experimental resultsfound that the Unsharp mask filter has given PSNR= 76.6133, MSE= 0.001429 with noise density 0.005 for salt-and-pepper, Gaussian, Poisson and speckle noise.

Keywords: Mammography Image Enhancement, Pre-Processing, Micro Calcification Detection, PSNR, MSE.

I. INTRODUCTION

Breast cancer is one of the most common diseases of cancer among women and in this world. It is the second upcoming cause of death after lung cancer [1],[7]. Mammography is an efficient imaging technique for the detection and diagnosis of breast pathological disorder. For the last 10years, mammographic interpretation was assisted by computer based techniques which are used either visualization tools or second option instruments [9],[6],[2]. A computer-aided detection (CAD) system consists of several functional blocks. The modules are data acquisition, preprocessing, segmentation, feature extraction, feature selection and classification.

This paper is organized as follows: section II presents the literature review on previous work in this area of research. Section III Proposed methodology pre-processing techniques are presented. Section IV presents the results and comparison tables. Finally Section V deals with important conclusion and future scope from the present study.

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II. LITERATURE REVIEW

In this preprocessing step the detected noise is filtered from an image using different filters. Noise reduction is a very important requirement in image processing. Noise in any historical document creates unpleasant situation for human perseverance. Images are generally affected by noise during to acquisition process [11],[8]. Most of the images are assumed to have wide variety of noise. Differentalgorithms are adopted depending on the noise model. A good noise reduction method can provide better perseverance by preserving an important characteristic of image. Image enhancement is the method of manipulation of pixels of images by reducing noises and increase the image contrast and brightness using different filtering methods.

III. METHODOLOGY

The frame work of proposed approach is shown in Fig 1.

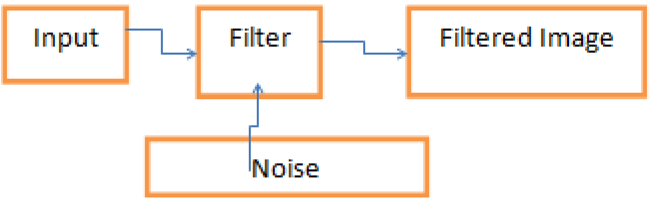


Fig 1: Basic Block Diagram of a Filter.

3.1 Data Collection

It is critical to get original medical images for experimentation due to privacy issue. In this work data is collected from Mammographic Image Analysis Society (MIAS). It contains 322 images. It belongs to 3 types: normal, benign and malignant. Malignant images are considered as abnormal.

3.1.1 Filters

1. Unsharp mask.

The unsharp filter is a simple sharpening operator which derives its name from the fact that it enhances edges (and other high frequency components in an image) via a procedure which subtracts an unsharp, or smoothed, version of an image from the original image..

Unsharp masking produces an edge image $g(x,y)$ from an input image $f(x,y)$ via

$$g(x,y) = f(x,y) - f_{smooth}(x,y)$$

$f(x,y)$ Where $f_{smooth}(x,y)$ is a smoothed version of.

Filter is mask which is used on an image to change the pixel values according to the mask used.

2. Mean Filter

Mean filter is a method it calculates the mean value of the mask used and replaced that value with the old one. This process applies on total image. The image can be enhanced accordingly [4].

Mean Filter

X1 X2 X3

X4 X0 X5

X6 X7 X8 replace the X0 by the mean of X0~X8 is called “mean filtering”.

3. Median filter

Median filter it calculates the median and replaced those values and gets the enhanced image[3],[5].

Median Filter

X1 X2 X3

X4 X0 X5

X6 X7 X8 Replace the X0 by the median of X0~X8 is called “Median filtering”

. *Mean Square Error,*

The mean-square error calculated by using the formula

M and N are the rows and columns I1 input image I2 is a noisy Image

$$MSE = \sum_{M,N} \frac{[I1 - I2]^2}{M * N} \qquad (1)$$

.

Peak Signal Noise Ratio

The peak signal to noise ratio calculated by using the formula

$$PSNR = -10log10 \frac{R^2}{MSE} \qquad (2)$$

R is the maximum pixel value. it is in dB.

Implementation:

Step 1.First we have taken input image.

Step 2.Adde different noises one at a time.

Step 3.Then with different noise densities applied to a filter.

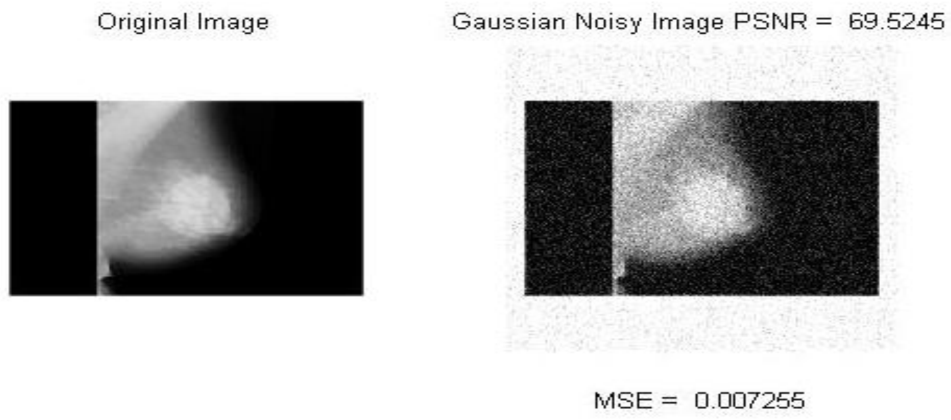
Steps 4.We get the filtered output image.

Step 5.From that output image we calculate the MSE and PSNR.

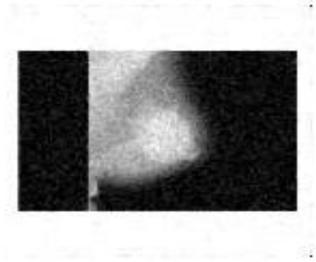
Step 6.Validation among the filter which is the best one based on PSNR and MSE values.

We tested 30 different images. Output images and comparison tables are shown below [10].

IV. EXPERIMENTAL RESULTS

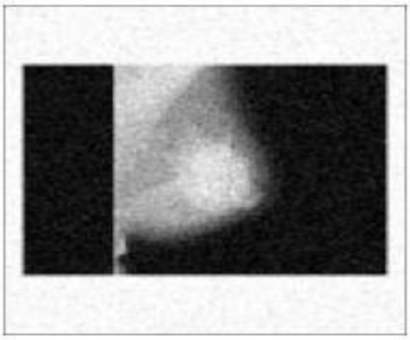


Median Filter PSNR = 73.7899



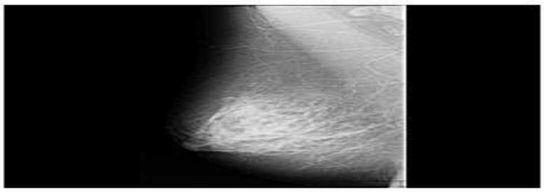
(Gaussian)MSE = 0.0027384

Mean Filter PSNR = 70.148



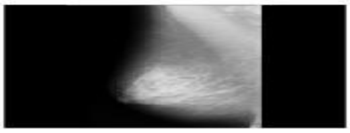
(Gaussian)MSE = 0.006334

Unsharp PSNR = 76.6133

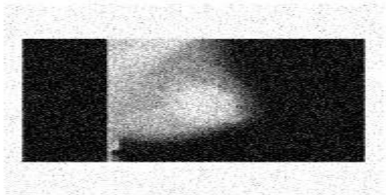


(salt & pepper) MSE = 0.0014294

Original Image

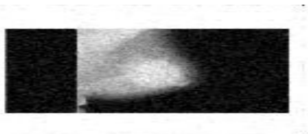


salt & pepper Image PSNR = 59.6042



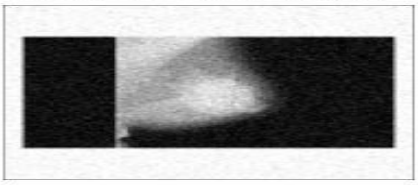
MSE = 0.07123

Median Filter PSNR = 59.8577



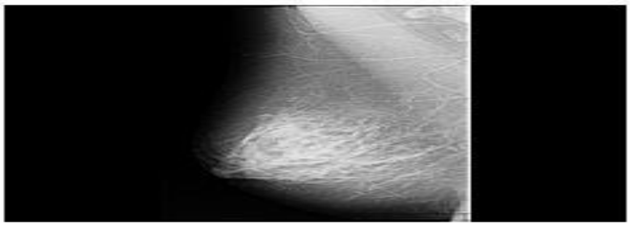
(salt & pepper)MSE = 0.067719

Mean Filter PSNR = 59.7593



(salt & pepper)MSE = 0.069271

Unsharp PSNR = 76.6133



(salt & pepper) MSE = 0.0014294

Comparison of Different Filtering Methods (MSE) Performance Comparison Using MSE & PSNR

PSNR vs. Noise Density

	PSNR			
Nose Den	Noisy	Mean	Median	Unsharp
0.01	70.3148	70.9112	76.5682	76.6133
0.02	70.1902	70.8361	76.1569	76.6133
0.03	70.0455	70.7344	75.5961	76.6133
0.04	69.7391	70.4315	74.5691	76.6133
0.05	69.5133	70.1763	73.7581	76.6133
0.06	69.1148	69.8124	72.8337	76.6133
0.07	68.7496	69.4171	71.9515	76.6133
0.08	68.3702	69.0243	71.1671	76.6133
0.09	67.9775	68.5643	70.3532	76.6133
0.1	67.4906	68.076	69.57	76.6133
0.2	63.6844	64.0026	64.297	76.6133
0.3	60.8029	60.9814	61.0452	76.6133

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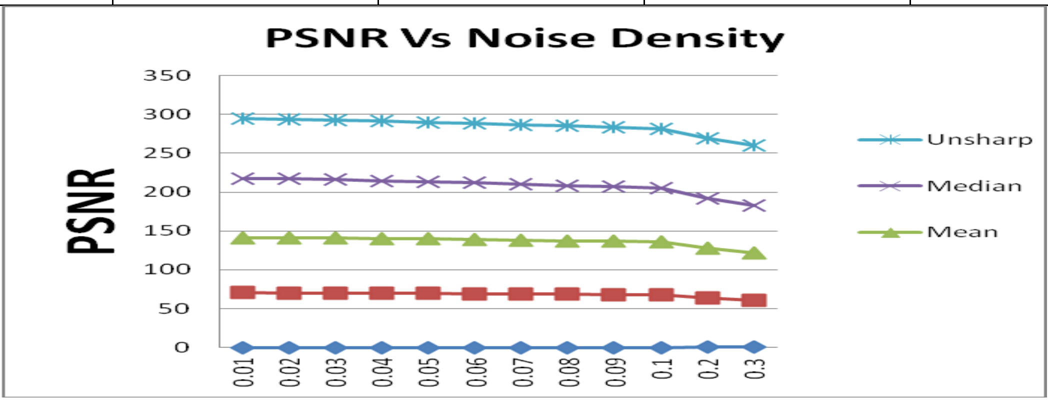
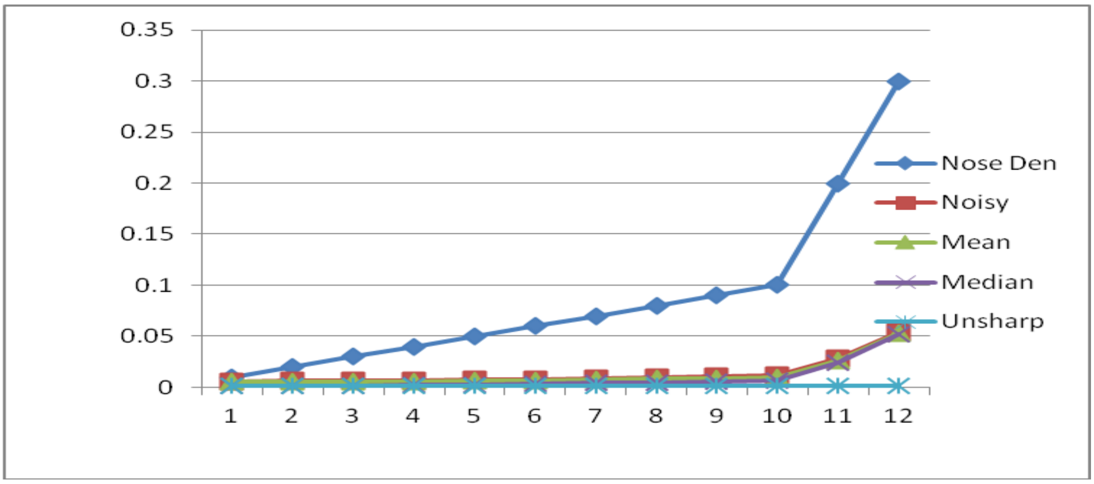
MSE vs. Noise Density

	MSE			
Nose Den	Noisy	Mean	Median	Unsharp
0.01	0.006	0.0053	0.0014	0.001429
0.02	0.0062	0.0054	0.0015	0.001429
0.03	0.0064	0.0055	0.0018	0.001429
0.04	0.0069	0.0059	0.0022	0.001429
0.05	0.0072	0.0062	0.0027	0.001429
0.06	0.0079	0.0068	0.0034	0.001429
0.07	0.0086	0.0074	0.0041	0.001429
0.08	0.0094	0.0082	0.005	0.001429
0.09	0.0103	0.0091	0.006	0.001429
0.1	0.0115	0.0102	0.007	0.001429
0.2	0.0278	0.026	0.0243	0.001429
0.3	0.054	0.0526	0.0518	0.001429





V. CONCLUSION

Three filter techniques have been implemented aiming at the improvement of the performance of a previously developed filter for the detection of micro calcification in digital mammograms. The employment of Unsharp mask filter image quality improved significantly. Salt and peppers Gaussian, Poisson and Speckle noise. The **Unsharp mask** filter outperforms than Median and Mean filter.Experimental resultsfound that the Inverse transform filterhas given PSNR= 76.6133 MSE= 0.001429 with noise density 0.005 for salt-and-pepper, Gaussian, Poisson and speckle **noise.** In this comparison of noise removal filters, the experiment has been conducted for three different type (Normal, Malignant and Benign) 30 images and at various noise levels.

Further research in this area is being carried out to determine efficient pre-processing and segmentation techniques to get better results. To identify and classify the mammogram images as Malignant, Benign and Normal in early detection of breast cancer.

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