

DETECTION OF MASSES IN DIGITAL MAMMOGRAM USING NONLINEAR FILTERS

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Abstract - Removing various types of noises in the medical images plays a very important role for the pre-processing modules and also the presence of noise reduces the quality of image and increase the difficulties of diagnosis. In image processing, pre-processing method is the required fundamental step. This step helps to enhance the image visualization by manipulating the dataset for further processing and this technique is also used to remove the distortion from the images. The quality of the image depending upon the tool which is used for image acquisition. In this paper, some of the non-linear filter techniques are applied to the mammogram images for the removal of noise at its initial stage. The performance of these types of filters are compared by using the quality measures via mean square error (MSE) and peak signal-to-noise ratio (PSNR). By this comparison, the best method is selected for pre-processing technique for image that will enhance the visual effect.

Key Words: Mammogram, Maximum filter, Wiener filter, Median filter, PSNR, MSE.

1. INTRODUCTION

A digital mammogram is a process of X-ray examination of the medical images. The electronic breast images provided by digital mammogram can be enhanced by CAD systems. The difference between regular mammogram and digital mammogram is that a regular mammogram system rely on film. But in digital mammogram, the digital images are viewed and stored on a computer. The main advantage of this technique is also easier to view and manipulate the stored images in a computer. Pre-processing techniques are used in the digital mammogram images to removing noises, smoothening and sharpening the images and to remove the contrast of the image, removing blur which occurred during image acquisition by using some filtering techniques. There are many filter techniques are used to enhance images and the enhancement is focus to improve the quality of the image or to obtain certain details.

2. LITERATURE REVIEW

The pre-processing techniques used by Vibha.S.Vyan and Pritirege (2015) was Gabor filter [1]. The advantage of this filter was uniqueness, it is very much specific to a period and scale. The fourier analysis is fast using FFT in gabor filter, the output of this filter is relevant for quantization of stationary signals. But the disadvantage of this technique was FFT requires the size of the image to be about the power of 2 and there is a problem with a boundary condition [3].

The adaptive median filter techniques used by Sumanshrestha (2014) has the advantage of retain edge information in case of high density impulse noises [2]. But the disadvantage is if the impulse noise is greater than 0.2, it does not perform well. The morphological operations used by Yoshitaka Kimori (2015) has enable to detect the various sizes and shapes, including complex shapes. But the disadvantages of morphological operators rely on the motion of infimum and supremum which in turn requires an appropriate ordering of the colors, ie., vectors in the selected vector space [5].

The pre-processing technique which was used by Dr.A.SriKrishna (2014) was Image Normalization [4]. The advantage of this technique is, if images are normalized before the endorsement and the size and location of the endorsements would be consistent among different pages in the dataset and if images are printed, using normalized images would prevent printing problems due to changes in page size and orientation. But the problem faced by this technique is, the image normalization can be a time consuming process and can add a significant amount of time to the e-Discovery export process in large cases and using poorly designed normalization software can result in degradation of overall image quality [6].

The histogram equalization technique used by M.Aarthy and P.Sumathy (2013) was simple and enhance contrasts of an image [7]. But the disadvantage of this technique is, if there are gray values that are physically far apart from each other in the image, then this method fails [10].

The pre-processing technique used by Junn Shan Wenju et.al, (2014) was mean filter [8]. The main advantage of this filter is the variance is reduced. But the problem is the impulse noise is not completely removed and the mean value of all pixels in neighborhood are affected [9].

3. PRE-PROCESSING TECHNIQUES

The main objective of pre-processing technique is to improve or enhance the quality of image data that removes unwanted noises or to boost some image features that are important for further processing. These all are done by using some non-linear filtering techniques and some of the filters are,

- i. Maximum filter
- ii. Wiener filter
- iii. Median filter

3.1 Maximum filter

Maximum filter is a most effective filter that used to remove negative outline noise in image processing. The use of this filter is the computational of binary morphological dilation. It is defined as,

$$\text{Maximum (I)} = \max [I (p+i, q+j)]$$

Where the co-ordinate $p+i, q+j$ is defined over the image I, i, j is defined over the mask M .

In order to find the brightest points in an image, first to find the maximum value in the area by the filter and then reduces the noise because of the maximum operation.

3.2 Wiener filter

Wiener filter is a type of non-linear filter which is used to restore the blurred and noisy images. The gray scale image is filtered by this type of filter. The output of wiener filter is given by,

$$O (p,q) = \text{wiener2} (I (p-i,q-j), nxn)$$

Where, $I (p,q)$ represents the original image and $O (p,q)$ represents the output image and nxn is the size of an image.

3.3 Median filter

Median filter is a type of non-linear filter used to remove noises from the medical images and it has the ability of preserving image details. The identified noises are removed by median filter and value is replaced by the median of neighborhood pixels of an image, while other points remain unchanged. The output of the median filter is,

$$O (p,q) = \text{medfilt2} \{I (p-i, q-j), i,j \in M\}$$

Where, $I (p,q)$ represents the original image and $O (p,q)$ represents the output image. M is the dimensions of the mask and the size is $m \times m$.

Table - 1: Comparison of Linear and Non-linear filters

Categories	Filters	Effects
Linear Filters	High pass filter	To sharpening and underlining contours of the image
	Low pass filter	Used for reduction of the noise and smoothening out
	Edge detection filter	To detect the all directions of edges and corners in an image
	Corner detection filter	
	Laplace's filter	Sharpening of the image
	Maximum filter	To increase the brightness of the edge objects

Non-Linear Filters	Wiener filter	Restoration of blurred and noise image
	Median filter	Noise reduction without blur effect

4. MATERIALS AND METHODS

Table - 2: Materials and Methods

Parameters	Value
Dataset	MIAS
Number of Mammograms	100
Tools used	MATLAB R2014a

5. RESULTS AND DISCUSSIONS

The proposed methods was applied on different digital mammograms and some results are given below. Each figure indicates the original image, original image filtered by maximum, wiener filter and median filter. By comparison of these three non-linear filters, median filter provides better results with PSNR and MSE values.

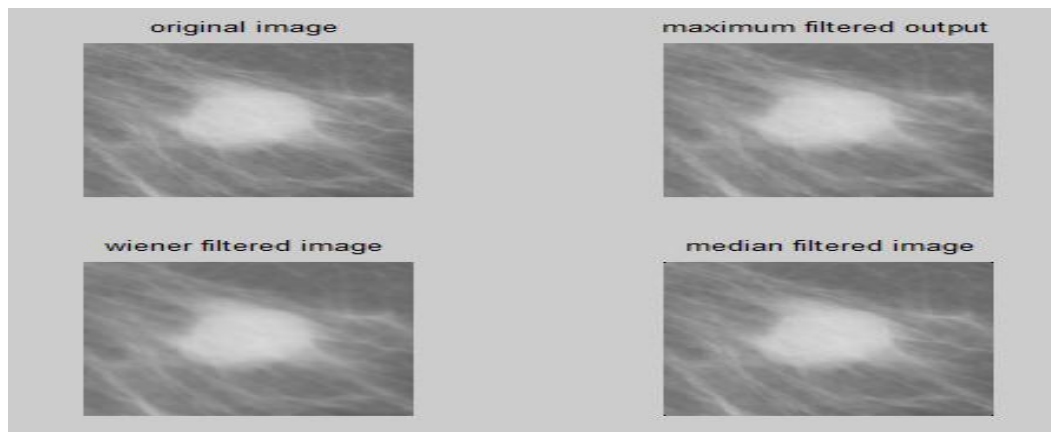


Fig - 1: Original image and original image filtered by maximum, wiener and median filters

Filter type	MSE	PSNR (in dB)
Maximum filter	2.33	36.74
Wiener filter	1.52	46.35
Median filter	0.49	51.28

Table - 3: MSE and PSNR values

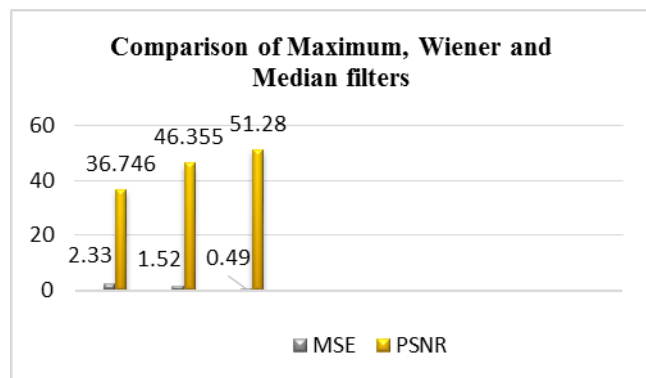


Fig - 2: Graphical representation of MSE and PSNR values

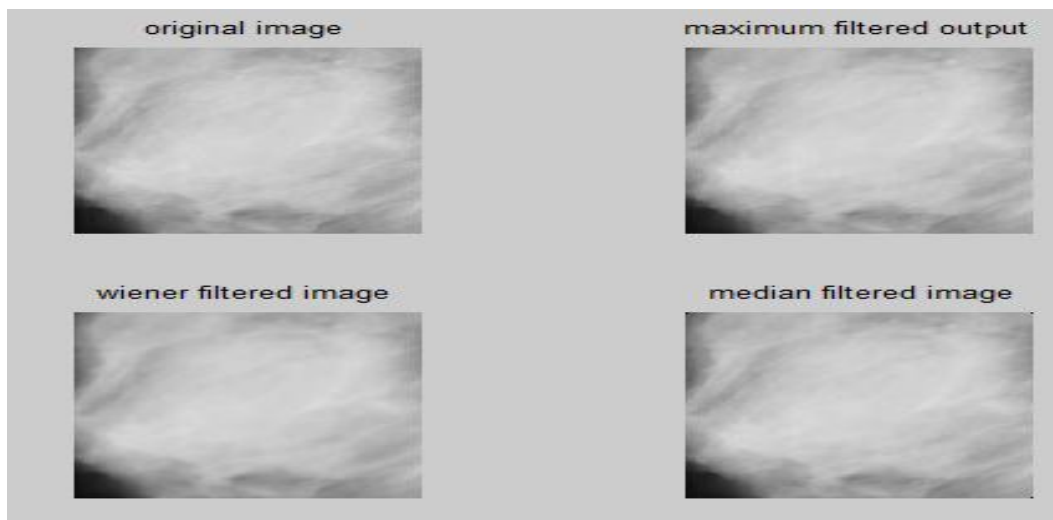


Fig - 3: Original image and original image filtered by maximum, wiener and median filters

Filter type	MSE	PSNR (in dB)
Maximum filter	2.07	37.92
Wiener filter	1.06	47.91
Median filter	0.33	52.93

Table - 4: MSE and PSNR values

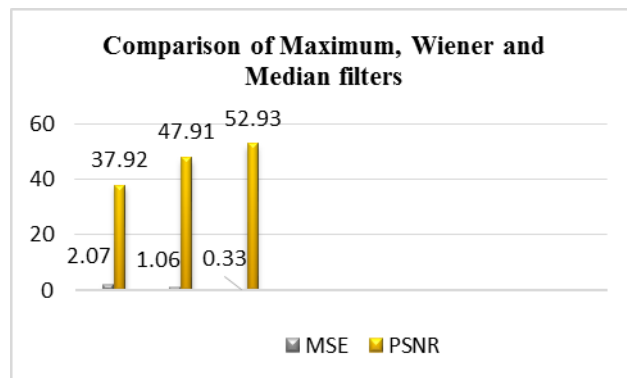


Fig - 4: Graphical representation of MSE and PSNR values

6. CONCLUSION

In the field of medical images, various noises are added in the original image. The noises are removed by using various image filtering techniques. In this paper, the main aim is to remove the detected masses from the original images by using some non-linear filters. By comparison of these non-linear filters, median filter provides better results with PSNR and MSE values.

REFERENCES

- [1] Mohamed Y.Adam., Dr.Mozamel M.Saeed., Prof.Dr.Al Samani A.Ahmaed (2015). "The effect of implementing of Non-linear filters for enhancing medical images using MATLAB", International Journal of Computer Science & Information Technology (IJCSIT) Vol 7, No 6.
- [2] M.P.Sukassini.,T.Velmurugan (2016)."Noise removal using Morphology and Median filter Methods in Mammogram Images", The 3rd International Conference on Small & Medium Business.
- [3] R.Beulah Jeyavathana., Dr.R.Balasubramanian., A.Anbarasa Pandian (2016). "A Survey: Analysis on Pre-processing and Segmentation Techniques for Medical Images", International Journal of Research and Scientific Innovation (IJRSI) Vol III, Issue VI.
- [4] Murat Ceylan., Ayse Elif Canbilen (2017). "Performance Comparison of Tetrolet and Wavelet-Based Transforms for Medical Image Denoising", International Journal of Intelligent Systems and Applications in Engineering (IJISAE). ISSN:2147-6799.
- [5] Ardymulya Iswardani., Wahyu Hidayat (2018). "Moammographic Image Enhancement Using Digital Image Processing Technique", International Journal of Computer Science and Information Security (IJCSIS), Vol. 16, No.5,

- [6] D. A. Zebari, H. Haron, S. R. M. Zeebaree and D. Q. Zeebaree (2019) "Enhance the Mammogram Images for Both Segmentation and Feature Extraction Using Wavelet Transform," *International Conference on Advanced Science and Engineering (ICOASE)*, Zakho - Duhok, Iraq, 2019, pp. 100-105.
- [7] C. Varma and O. Sawant (2018). "An Alternative Approach to Detect Breast Cancer Using Digital Image Processing Techniques", *International Conference on Communication and Signal Processing (ICCSPP)*, pp.0134-0137.
- [8] R. J. Borgli, V. Thambawita, S. Hicks, M. A. Riegler and P. Halvorsen (2019). "Unsupervised preprocessing to improve generalisation for medical image classification," *13th International Symposium on Medical Information and Communication Technology (ISMICT)*, pp. 1-6.
- [9] G. George, R. M. Oommen, S. Shelly, S. S. Philipose and A. M. Varghese (2018) "A Survey on Various Median Filtering Techniques for Removal of Impulse Noise from Digital Image," *Conference on Emerging Devices and Smart Systems (ICEDSS)*, pp. 235-238.
- [10] Dr. Sana'a khudayer Jadwa (2018). "Wiener Filter based Medical Image De-noising", *International Journal of Science and Engineering Applications*. Volume 7–Issue 09,318-323, 2018, ISSN: -2319–7560.
- [11] Leonardo Sacht., Diego Nehab., Rodolfo Schulz De Lima (2018). "Real-time Continuous Image Processing", *International Journal of Image and Graphics*, pp. 167-176.