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Image Enhancement Based on Contextual Threshold Segmentation on Various Noise Deduction in Mammogram Images

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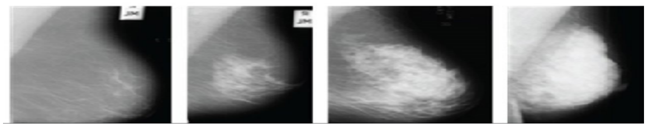
Abstract: ***Due to deficient performance of X-ray on mammographic images are generally noisy with poor radiographic resolution. This leads to improper visualization of lesion details. The Image enhancement techniques are important for visual inspection. In this paper the combined features of enhancement technique and contextual thresholding method for segmentation with Adaptive volterra filters are usedto minimizing the effect of noises in the mammogram images. After the process of de-noising, the enhanced results will be segmented. Then we calculate the extracted tumor portions and it has been compared by the various quality metrics as Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR), Mean Absolute Error (MAE) and Root Relative Squared Error (RRSE) etc...This enhanced de-noising technique is used to tested more images and the performance evaluated based on their MSE and PSNR.The proposed enhanced de-noising technique gives better result than existing de-noising technique.***

Keywords: Mammogram Images, De-noising, enhancement technique, Adaptive Volterra filter (AVF).

1.Introduction

Being a low-estimations X-beam examination, it presents unimportant dangers from radiation presentation. Nonetheless, mammographic screening still represents a couple of confinements like: lower detection rates as the detected tumor may have poor prognosis and detection of false positives which may prompt pointless biopsies. Mammographic pictures are for the most part loud because of poor execution of X-beam equipment



(A) (B) (C) (D)

Figure1: Normal and Abnormal imaging samples: (a) Normal (b) First stage or starting stage (c) Second stage (d) Higher stage of tumor portion Images are analyzed from this dataset. System and also contain poor contrast. There are many enhancement techniques have been solved for the enhancement of the mammograms. It is over here that the role of mammogram enhancement techniques comes into process for contrast improvement of the targeted lesion with respect to its background. Some of the mammogram enhancement technique developed so far are reviewed and discussed in the subsequent paragraphs. Lojacono, R. et al. [1] satisfactorily removed the adverse Effects of noise but were less flexible in approach, as more than one parameter has to be varied for different types of images. On the other hand, enhancement using adaptive histogram equalization [2] Different types of filters is used to remove the noise in mammogram images. Generally, Medical images are affected by various types of noises like salt and pepper noise, Gaussian noise, Poisson noise etc. To remove these noises by using some filtering techniques. Whether the nonlinear filters give better outcomes than linear filters. The main aim is removing the noise in Mammogram images without loss of any quality information and preserving the edge features.

2. Related Works

Linear filters [3] generally exhibit simplicity in design, analysis and synthesis, but do not give impressive results for images coupled with signal-dependent or multiplicative noises as well as for those with Non-Gaussian statistics. Noises removed by the linear filters often leads to image blurring as edges could not be preserved in some times. To over-come this drawback non-linear filters came into existence [3-4]. These filters are created by models which utilize Volterra filters, order statistics filters [5], and morphological filters [6]. The use of non-linear filters provide efficient image filtering results not only by suppressing effect of noises but also by preserving edges of the image. The only dis advantage is the non-linear filters is that it requires a large number of coefficients for designing. Hence, many techniques are developed to re-duce the number of independent weighted coefficients of the non-linear filters [7-8]. The quadratic filters are the normal form of the non-linear filters. But, do not possess simpler characterization as required for linear filters in frequency domain [9]. Volterra series offers a simplified and manageable approach to introduce non-linear effects during conventional linear analysis. Volterra filter is a type of non-recursive filter as their output is dependent only on the present and past values of input samples These filters find significant usage in various image processing applications like: contrast enhancement, edge detection, segmentation and also in restoration of images blurred by physical phenomena. This paper presents a new Adaptive Volterra

Filter (AVF) for enhancement of digital mammograms. The operational response of the proposed filter is categorized into three different types on the basis of the category of background tissues in the mammograms. These filters provides promising contrast enhancement of lesion with due suppression of background noises.

3. Proposed Work

The main objective of this work is removing the noises in the Mammogram images without loss of pixels or information. First, the pre-processing done by gray scale level, contrast, histogram with Adaptive volterra filter after that the tumor portion has been enhanced and extracted easily then area of tumor can be calculated. The outcome of this approach has moved to measure the quality using different quality metrics with its original or input image. And mean while this approach is compared with other existing filters such as observed that Gaussian high pass filter (GHPF), Median filters (MF) and sharpening frequency domain filters (SFDF). The performance of these filters are compared using the statistical parameters such as Mean Square Error(MSE) , Peak Signal to Noise Ratio(PSNR), Mean Absolute Error(MAE) and Root Relative Squared Error(RRSE).The study shows that the Adaptive volterra filter reconstructs a high quality image than other filters. The proposed technique is more accurate and effective for the mammogram image tumor detection.

4. Methodolody

In this paper, we approached a new technique based on Mammogram image and it has different phasesas,

1. Pre-processing (gray scale level, contrast, histogram and Adaptive volterra filter)
2. Tumor area has been deducted and extracted from the image.
3. Quality measurement has been calculated for all filters denoised images and find the best quality measure. In this hybrid approaches of Adaptive Volterra filter (AVF) is detect the tumor in short time accurately and also compared some filtering techniques are used to remove noises as well as the timeand getting the image by sharpening operation. The Combine features of the filters are compared with quality measurements and also getting the good noise less image. So this Adaptive Volterra filter(AVF) techniques is gives the better results.Over all process of the block diagram is shown in Figure1.

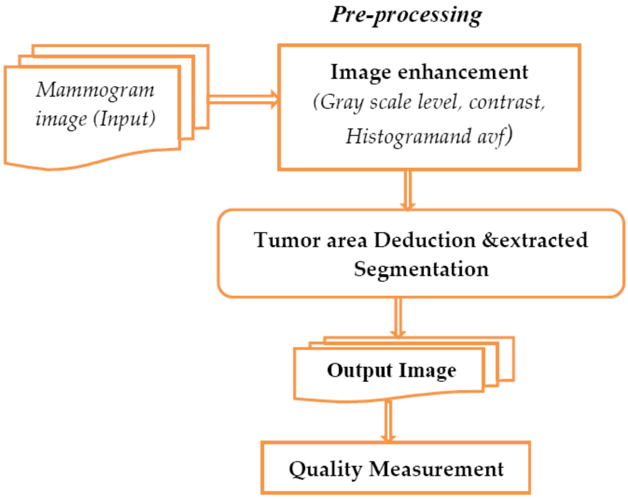


Figure 1. Flow Diagram for proposed work

4.1 Database

The MiniMIAS database containing left and right breast images and we take 50 patients is used in this study. All images containing speculated masses and a selection of normal types are considered. All images should have 1024 X 1024 pixels and at 8-bit grey scale level. In the analysis of results within the study, and we use the following methods.

4.2 Pre-Processing

The input of Mammogram images are pre-processed by means of three processes as, (i) Gray scale level, (ii) Contrast image and (iii) Histogram Equalization. The collection of mammogram images from various resources has different from one image toanother image and pixel may differ in the tumor.

- The Gray level has been applied to improve the contrast of the image. This process can be achieved byadjusting the grey level and dynamic range of the image, which is the deviation between minimum and maximum pixel value.
- Contrast enhancements improve the perceptibility of image has been enhancing the brightness difference between images and their backgrounds. A contrast stretch improves the brightness differences uniquely across the dynamic range of the image, whereas tonal enhancements improve the brightness differences in the shadow (dark), midtone (grays), regions at the differences in the other regions.
- Histogram equalization is used for contrast adjustment using the image histogram When ROI is represented by close contrast values, this histogram equalization enhances the image by increasing the global contrast.
- The commonly most of the real life and practical systems are nonlinear. These nonlinearities can bedisplayed by Volterra power series. With input vector x[n] and output vector y[n] , aN*th*order Volterra filters realized by

$$y[n] = h0 + \sum_{r=1}^{\infty} \sum_{n1=1}^{N} \sum_{n2=1}^{N} \dots\dots \sum_{nr=1}^{N} hr[n1, n2 \dots . nr]$$

.

x[n-n1]x[n-n2]……x[n-nr]

Where r indicates the order of nonlinearity. When r = 1, then then system is linear and when r = 2 the system is quadratic and so on. hr [n1, n2 . . . nr] is the rth order Volterra kernel. The Volterra kernel is one of the main issues in polynomial signal processing. When no input is present, $h0$ is the constant offset and the output is null. Behaviorto the Volterra filter weights, the output y[n] is linear. Much of the nonlinearity is comprised of the quadratic components has inherent the non-linearity in mammogram images and using this AVF it equipped with memory.

4.3Detect and Extract Tumor Portion

After enhancement image is utilized for segmentation and it will helps to find the tumor portions easily. Here we use Noncontextual thresholding method to find the tumor portion without noise. The tumor portion should be calculated by single and discontinuity and calculate the uniform region pixel and grouping together according this region calculation the tumor should extracted easily. At this stage is tried to locate all edge paths that are circular or terminate either on the right base line or the top of the image, forming a closed structure. Locating all the edge paths that originates from the bottom margin line namely the first row of the image is started. The algorithm travels individually and generate the plot list. This list is plotted on another image if the edge path is circular after all pixel way on the first row are traversed the algorithm repeats similar scanning and traversal of all pixel paths from the row that is shown by isolating the image vertically into sixteen segments.

4.4 The algorithm steps to detect tumor regions:

1. Scan the image from the right side of the image to locate the rightmost pixel of the breast region and draw a horizontal line along this pixel from top to bottom representing the right baseline or boundary.
2. Scan the image from the left side of the image to locate the leftmost pixel of the breast region and draw a horizontal line along this pixel from top to bottom.
3.Partition the obtained rectangle vertical into sixteen segments and start with the first row of the first segment.
4.Scan the enclosed rectangle from the left side to right, from the first row of the segment.
5.Obtain a pixel that is black indicating an edge path, traverse the pixel path by considering all the surrounding pixels in a right side priority and consider the pixel with the highest priority.
6.The pixels that surrounded the edge pixel, but are of lower priority are stored in a history stack to be used only if the traversal process reaches a dead end.
7. If a dead end is reached, pop out from the history stack a lesser priority pixel and continue with the traversal process.
8. Store the pixels traversed in a plotting list for plotting.
9. If the traversal is terminated, the plotting list is erased and continues from Step5. Else plot pixels from the plotting list.
10. Continue to Step4 till all black pixels, indicating an edge path, is traversed.
11. Move to the first row of the next segment and continue from Step4 to Step9 until the tumor has detect and extract.

The main intention is to segmenting the tumor portion from the mammogram image. By using this contextual thresholding method helps to find the tumors easily.

5. Quality Measurement and analysis

In image enhancement technique is essential for quality of the image is crucial. So the development of image processing algorithms is calculated the quality measures such as MSE, PSNR, RRSE, MAE. The quality of the output image can be tested by exploiting the differences between the corresponding pixels to be calculated.

5.1 Mean Squared Error (MSE)

The Mean square error is help us to find the average squared difference between input and de-noised image.The average of the squares of the errors or deviations are measures and Expressed as:

$$MSE = \frac{\Sigma I, j\ (y\ (I, j) - \hat{Y}\ (I, j))\ 2}{M * N}$$

- calculate the mean squared error
- Find the regression line.
- Σ is nosing image
- Ŷ is restored image
- Y is original image
- M * N Total number of pixels

5.2 Peak signal-to-noise ratio (PSNR)

The PSNR values are computes the peak signal-to-noise ratio, in root power, between two images. In this ratio is often used as a quality measurement between the original and a compressed image.

$$^{PSNR} = 10\log 10\ [(255)2]/Mse$$

The Peak Signal to Noise Ratio (PSNR) error metrics is always higher than the mean square error values. If the finding value is lesser then MSE it may consider as wrong. So always PSNR value should high.

5.3 Mean Absolute Error (MAE)

The mean absolute error (MAE) is a measure of difference between two continuous variables. It is Consider the same elements of the image between two images has taken. Original image may consider start values and second image may consider the same elements as end values and the average vertical distance between each point and the Y=X line, which is also known as the One-to-One line. The average horizontal distance between every point and Y=X line.

MAE=Σ I, j|y (I, j) – Ŷ (I, j)| /M * N

5.4 Root Relative Squared Error (RRSE)

The Root Relative Squared Error is computes the root mean squared error between two numeric vectors of an images.in this error may calculate the tumor position and the depth of the tumor has been calculated accurately.

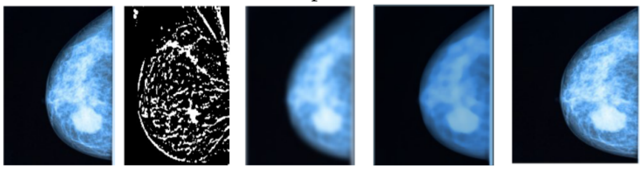
RRSE= Absolute error / Value of thing measured.

6. Result and Discussion

The Proposedmethod of Adaptive volterra filters withcontextual thresholdingare compared in various filtering techniques and it may checked the quality measurement and find the best filtering techniques. Finally we got the best result in AVF with having the high quality image.

6.1 Tools

There are so many number of tools available that is compatible with image processing forsegmentation. Here we use R tool for efficient implementation.



(A) (B) (C) (D) (E)

Figure 2: Comparison of various filters (A) Original image (B) Adaptive volterra filter (C) Gaussian Low Pass Filter (D) Median Filter (E) Sharpening frequency domain filter

Quality Measures	AVF	GLPF	MD	SFDF
PSNR	91.45	89.75	89.62	90.1
MSE	89.62	82.42	79.45	86.45
MAE	70.65	69.23	78.26	72.21
RRSE	86.32	67.83	50.31	62.45

Table 1: comparison in different filtering techniques and quality measurements.

The above table shows the Result of various quality measures and filtering techniques the values of peak signal noise ratio is the high value for all filters but the proposed methods of AVF should had the highest values.

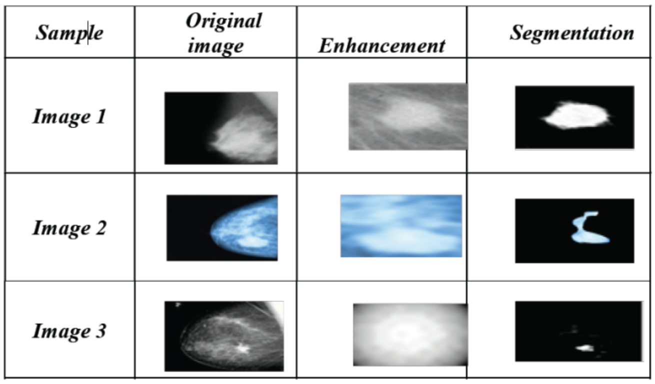


Figure 3: second column Original image, third column Enchancemented image, last column segmented image.

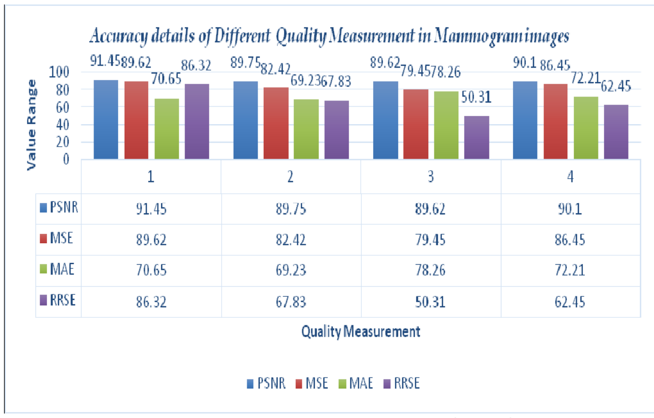


Figure 4: Graphical representation of the filtering techniques and quality measurements.

7. CONCLUSION

This paper we proposednew improved AdaptiveVolterra filter (AVF) with contextual thresholding method is detect the tumor in short time accurately and also observed that Gaussian high pass filter (GHPF), Median filters (MF) and sharpening frequency domain filters (SFDF) are compared for better result and de-noising purposes. When the Voltage problem occurs during the Mammogram screening this method will helps to get the image without noise. The quality measurement which is compared in PSNR, MSE, MAE and RRSE to find the better result by using Adaptive volterra filtersand gives the clear mammogram image. The proposed approach is to improved denoising method. And the results were applied with IQM to find out the dissimilarity between original and de-noise images. The experimental results demonstrate the effectiveness of the proposed work. In future, the tumor region will be segmenting the mammogram images with different segmentation techniqueand algorithms.

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Short Biography

Mrs. M.Punitha is pursuing Ph.D in Madurai Kamaraj University, Madurai. She received the M.Phil Degree in Computer Applications from Madurai Kamaraj University in the year 2017. MCA degree from Fatima College Madurai in the year 2006. She has contributed papers in International Journals and Conferences. Her research interest is in image processing and image segmentation in mammogram images.

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