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Noise Removal Histogram Scaling (NRHS) Model for Ultrasound Screened Breast Cancer Images.

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ABSTRACT

Noise Removal in medical images is a fascinating area of image processing. Finding the effective way for a quality image is the eventual aspire of this representation. Therefore, implementation of an ultrasound breast cancer medical image with Noise Removal Histogram Scaling (NRHS) model is becoming a popular approach. The scheme of this investigation is to provide a mirror image to exactly find the cancer characteristics such as tumour edges, nodes, shape, size etc. with high quality. The proposed model pre-processes the original image by converting it into a grayscale format. This output image is scaled with histogram equalization for equal distribution of pixels. The median filter is used with a subtraction method for better visibility without blurring the image. And, finally the output images will be suitable for edge detection. The error ratio of a noisy image is calculated with PSNR and MSE values. It brings that if PSNR value is above twenty then the image is slightly improved in its quality. The highest PSNR value than MSE value is predicted as the best quality for removing the noise in the ultrasound medical image. This research work provides evidence with high visibility using NRHS Model.

Keywords: Noisy image, Ultrasound, breast cancer, histogram, scaling, measurements.

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INTRODUCTION

Image filtering is a process of removing the unclear particles in an image. An ultrasound screened images naturally a defected image in the sense the objects related to the characteristics of cancer are not visibly seen in the viewer. Also, for any automatic prediction of cancer the input should be a quality image.

Filtering on the medical image is to give the best quality appearance. The filtration can be of two ways (i.e.) images can be processed either by linear filter or by non filter. A pre-processing result is again used for further processing for getting the edges of an image. The theme of this research is to produce a quality image with all minute particles that should be clearly noticed. Subject to this, median filter can be implemented along with histogram scaling for noise removal in an image.

The second derivative filtering is used for removing the unused particles in a medical image.

Applying a second derivative filter is as similar to laplacian filter where the edges of small particle in an unclean images are seen quite well. In case of laplacian filter after dividend of the image one part value will be with positive values and the mirror part will be of negative values. These values are obtained because in the first derivative of the maximum and minimum edge values. The negative values will be displayed in image as black and the positive values will be displayed as white as output. If the image is processed with 3X3, then the filtration will be in the form of

(a) Positive Filter

$$(i,j) = \begin{matrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{matrix}$$

(b) Negative Filter

$$(i,j) = \begin{matrix} -1 & -1 & -1 \\ -1 & 16 & -1 \\ -1 & -1 & -1 \end{matrix}$$

The unevenly disseminated values in an ultrasound image give the reason for non clear objects in an image. It can be solved by statistical histogram scaling which spreads a mean value to all the pixels in an image to give a clear appearance by removing the noises in it.

The background subtraction method[7] involves for exploring the useful information in an image. Histogram scaling of an image is a dynamic process of covering the entire image with mean value equalization.

Section 2 deals with works done by authors; Section 3 explains the proposed methodology for removing the blurred constituent part in an ultrasound breast cancer image; Section 4 shortly explains the results related to the new methodology along with discussions; and finally Section 5 with concludes the findings.

EXISTING METHODS

T.Jagadesh[2] et al., designed an algorithm for denoising an image. To retain all sample information from the image PCA a correlation method is implemented. The feature selection is carried by wavelet transformation. The PSNR value gives better quality to the image.

Moussa Olfa[3] et al., a new framework is designed for removing the speckle noise. Trilateral filter and stationary wavelet transform methods are implemented to develop a multi-scale version. The performance and effectiveness give a better noise reduction.

Rani [4] et al., emerged a fuzzy based application for filtering an image and to restore the images with removing the noise in it. The centre pixel of the image is checked whether the image is noisy in nature. Conversion of images to grayscale and then process with filtering technique will present better solution.

Chandel[5] et al., explains the algorithms and techniques used for filtration noisy images with systematic backdrop.

Bhateja, Vikrant [6], et al, developed A modified speckle suppression algorithm for breast ultrasound images using directional filters. It uses directional average filters for removing noises. Threshold value with entropy improves the performance

NOISE REMOVAL HISTOGRAM SCALING (NRHS) MODEL

Pre-Processing

Ultrasound screened breast cancer images are of noisy in nature. Preprocessing in the proposed methodology come through initially converting the image into grayscale. Every ultrasound images are consisting of three channels (Red, Green, and Blue) which in processing remains to be unchangeable. So it is converted into grayscale.

R=(0-255) G=(0-255) B=(0-255)	R=(0-255) G=(0-255) B=(0-255)
R=(0-255) G=(0-255) B=(0-255)	R=(0-255) G=(0-255) B=(0-255)

RGB channel range for ultrasound image

0-255	0-255
0-255	0-255

Grayscale range for Ultrasound image

After completion of grayscale processing the pixel values of the high intensity range is scaled towards the spatial parts of the image. Since the theme of this research is to remove the dust particles, i.e. noisy structures in an image, scaling is essential task over it.

Histogram Scaling

A random variation in intensity values is called noise. In ultrasound screed breast images the noises are from the models of sensors. Dynamic histogram equalization is the preferred scaling process. The pixel value of an image is filled continuously to all the cells such that if there is p number of pixels at level x of input histogram and q number of pixels at level y of output histogram, then desired number of pixels in the histogram will be of $p_{i=}q_i$.

An Algorithm for scaling the image,

Step 1: Scan each row of an image to get the maximum pixel range and mark it as k_1.

$$\sum_{i=1}^{k-1} p1 \leq q1 > \sum_{i=1}^{k} pn$$

Step 2: add all the pixel values with the maximum intensity value q1

Step 3: Repeat until end rows in an image. The final image will be in the range from z1, z2,......zm

Architectural Design

The overall constructional design of Noise Removal Histogram Scaling (NRHS) model is depicted below.

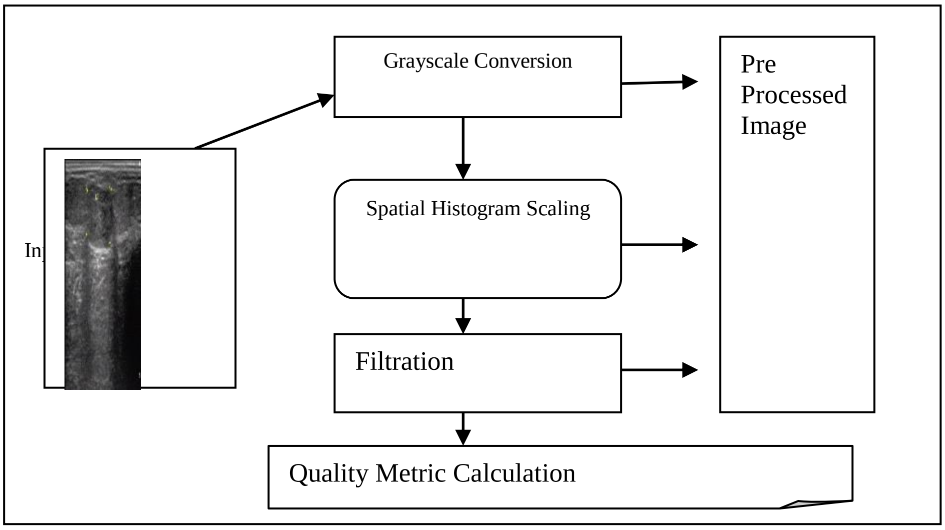


Figure 1: Architecture of NRHS Model

Filtration Techniques

Filtering the noise as stated, is done through controlling the degree of pixels. After scaling the image median filter is implemented to improve the quality of an image. It is the most effective method for removing the salt and pepper noise in an ultrasound image. Also, the detail available in an image will remain the same.

Since, the input to this model is a cancer image, the shape and size of the tumor is the most important attribute for prediction. To obtain it, the edges of the objects in an image should be visibly seen evidently. Thus median filter gives a proper solution for it.

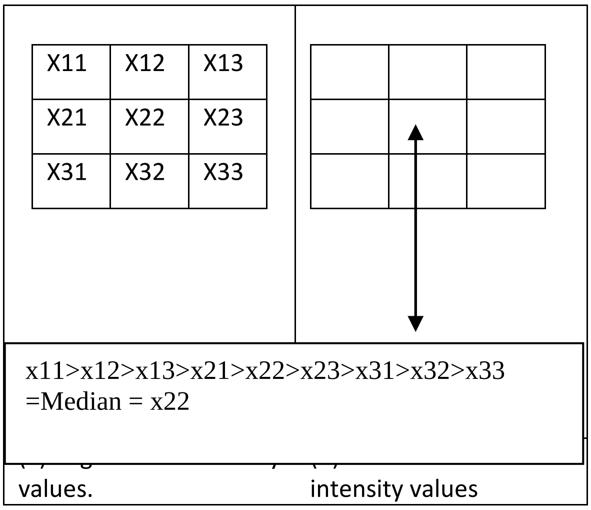


Figure 2: Image filtration format

Quality Measurements

The quality measure outcomes focused on the “quantify that subject”.

Peak Signal to Noise Ratio (PSNR) & Mean Square Error (MSE)

The output of ultrasound screened images is of signals which displayed as images. The ratio of the power between the signals and the contaminated noise is calculated as PSNR.

To easily process with PSNR, Mean Square Error (MSE) is evaluated to calculate the degree of similarity or the degree between the original image and preprocessed image.

$$Mean\ Square\ Error Q1 = \frac{1}{N}\sum_{i=1}^{N}(x-y)\ 2$$

The error signal in mean square error is defined as $Error_i$=x-y, which is the disparity between original image and deformed signals in an image.

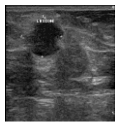
In image processing MSE is often converted in the form of Peak signal to Noise Ratio and is defined as

$$PSNR = 10\ log_{10}\frac{L^2}{Q1}$$

L is range of pixel intensity of an image. Essentially, the range of the image varies from 0 to 255.

RESULTS AND DISCUSSIONS

Noise Removal Histogram Scaling (NRHS) Model puts in plain expression about its superiority in a noisy image. The results obtained in each phase are discussed beneath:

	
(a)Ultrasound image	(b)Grayscale image

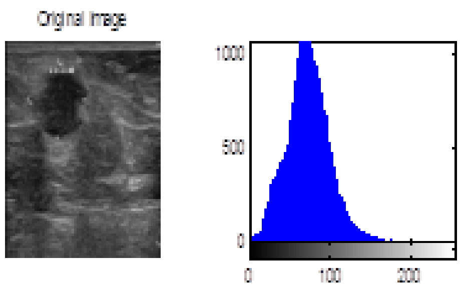


Figure 3: Histogram representation of original ultrasound image

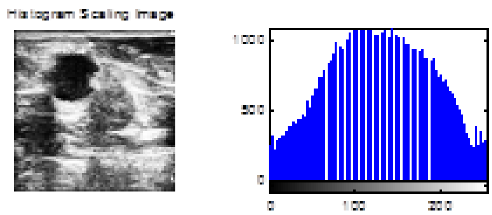


Figure 4: Histogram representation of scaled image

Original Image	**Noisy Image**	**Filtered Image**	**PSNR & MSE**
			MSE= 69.66 PSNR=29.95

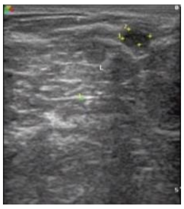
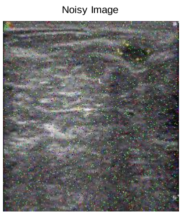
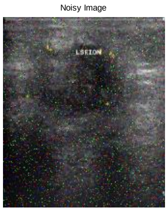
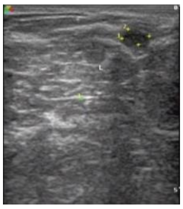
			MSE= 56.12 PSNR=30.14
			MSE= 71.43 PSNR=29.46

Image	Size with noise	Size after NRHS Model
	20.2 kb	16.16 kb
	15.2 kb	12.16 kb
	18.0 kb	14.4 kb

The formulae of Noise Removal Histogram Scaling Model is: visibility metrics of Histogram scaled image / Original ultrasound screened image.

Model	Quality in %
PCA and wavelet transform	89.20
The trilateral filter for despeckling ultrasoud images	88.3
Noise Removal Histogram Scaling (NRHS) model	91.02

CONCLUSION

Many algorithms come through researchers for preprocessing various tasks applicable on medical, authentication, etc. The Proposed method NRHS model has a unique qualification in all about its quality for segmentation. The ultrasound breast cancer images are preprocessed by means of converting into grayscale images and spatial histogram scaling and finally filtering with median filter with subtraction method implies the quality of an image. This methodology gives a high-quality enhancement in the ratio of its quality. Hence, it is suggested to use NRHS model for predicting cancer detection, since, it provides more visibility of the image area for smaller particles.

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