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Analysis of Enhancement Techniques for Medical Images

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Abstract : Image processing techniques are particularly used for the enhancement techniques in various applications and domains. In particularly medical applications are used to analysis for sustainable and unsustainable image quality. In this article have been analysis preprocessing techniques for enhancing of mammogram image. The preprocessing system has are presenting for enhancement by using the noise removal, filtering and contrast enhancement methods respectively and analyzing the performance. We are also observing the results step by step with pixel intensity and image quality. The preprocessed images are analyzed by taking in future clustering process.

Keywords: Noise, Filter, Pixels, Enhancement.

1. INTRODUCTION

A Digital image is a categorization of a two-dimensional image as a finite set of digital values, called picture elements or pixels. Digital Image Processing (DIP) is widely used for two main process namely (*a*) Improving the pictorial information for human explanation (*b*) Processing the image data for representation, storage and transforming for self-determining machine perception. The usage of digital image processing techniques has exploded and they are now a days used for many tasks in various areas (*i*) Image enhancement or restoration (*ii*) Medical visualisation (*iii*) Industrial inspection (*iv*) Artistic effects (*v*) Law enforcement. Imaging technique in the field of Medicine has supported the medical practitioner to diagnosis and to see the internal organs of the human body for identifying the defected parts. It widely helps in performing keyhole surgeries rather than opening the body with scalpel[1].

The infectious diseases mostly caused by abnormal cells it's grown and attack healthy cells in the human body. In particular the defect of breast cancer to starts in the cells of the breast as a group of cancer cells that can then occupy the surrounding muscles are spread to other areas of the human body. Breast cancer has become the most common cancer in India cities, and slowly becoming common across the rural areas. It has accounted of about 25% to 32% of all female cancers in major cities. The aims of these investigations are: with the **Clinical Examination** of the experienced medical professional, the Palpation of the tumour in the breast for reasonably good idea for diagnosing with a cancer or not. **Breast Cancer Diagnosis** by using image based prediction is done using various visualization techniques**.** The MRI Images taken for cancer could be categorized as mammogram, ultrasound and magnetic resonance imaging. **Tissue Diagnosis** is done to identify the presence of cancer by observing the involved tissue under microscope. A breast biopsy is a test used to remove the tissue or sometimes fluid from the doubtful area. The removed cells are examined under microscope and subjected to further test to identify the presence of breast cancer.

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In this research, the mammogram images are used for the detection of Breast cancer as they are the initial method used for identification of cancer by Oncologist and to have more accuracy. AS such the mammogram images are difficult to interpret. Therefore these images are processed in a way that they can be further used for segmentation which supports the oncologists for the identification of Micro-calcification or Mass in the breast to carry out for further diagnosis. Preprocessing in image data includes removal of unwanted or irrelevant areas and to make prominent area of interest by increasing the contrast of the images. Image denoising has become an essential exercise to be done on Mammography images during diagnosis since they are mostly affected by shot noise or poison noise. This paper, will propose an image resolution enhancement and denoising technique. This research paper is structured as follows, in Section 2 discusses about methods and materials used for this research work related to existing preprocessing methods

2. REVIEW OF LITERATURE

Faten Robiul Hoque and Juan Zapata discussed with filtering. Filter is the common technique for Salt-and-pepper noise, Amplifier noise and Poisson noise are decrease. The technique is most popular for filtering procedure among the diverse spatial filters that with success removed the noise from a inaccurate image however it's the effect of possibly blurring the image.

Dipti Deodhare, NNR Ranga Suri has discussed the image enhancement techniques in particularly form based intelligent character recognition, and the works includes functional components for boundary detection, masking, color correction, filtering, and image extraction.

Tae Keun Kim and Bong Soon Kang have proposed a system for contrast enhancement with the filtering techniques for objects that are moving or sequence framing images. This system can be used in different applications like moving object, video cameras and target video camcorders.

3. PROPOSED METHODOLOGY

In this process we select the digital mammogram since they are the most effective technique for early detection of breast cancer. The mammographic images used in this experiment are real time images collected from Aarthi Scans. The images are arranged in pairs of mammograms where each pair represents the left and right breast of a patient. Those images can be categories as the following dataset, which are benign, malignant.

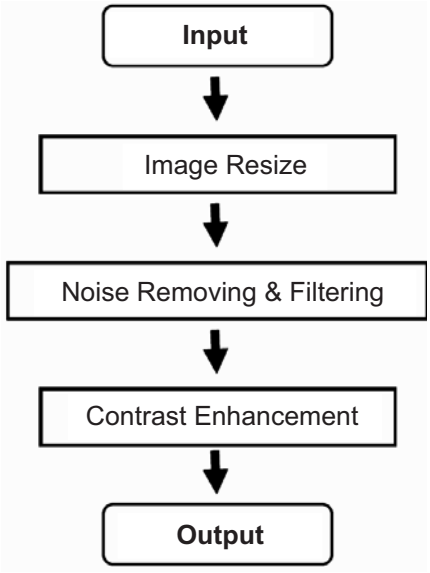


Figure 1: Proposed Preprocessing Methodology

Image enhancement technique is defined as a method in image processing such that the result is much more suitable than the original image used for a specific application. This improvement of the digitally stored image is prepared with the help of the MATLAB software.

The proposed approach is depicted in Figure-1

The steps in the proposed for preprocessing technique (Simultaneous Noise Removal, filtering and Contrast Enhancement)

1. The real time mammographic image is acquired from the Aarthi scan centre
2. The Color image is converted to Gray scale image.
3. To resize in different size in given image
4. Noise from the gray image is removed by using the filtering technique
5. Contrast of the image is enhanced by applying the Adaptive Histogram Equilization to the step 4 image
6. The obtained image is the enhanced output image

4. PREPROCESSING

Pre-processing is an important step for used in mammogram, orientation, label, artifact removal, enhancement and segmentations. The preprocessing involved in color conversion, image resize, noise removing and enhances the quality and produces an image in which minutiae can be detected correctly [20].

4.1. Gray Scale Conversion

Grayscale representations are preferred over colored ones as it simplifies the algorithm and reduces computational requirements. Indeed, color may be of limited benefit in many applications and introducing unnecessary information could increase the amount of training data required to achieve good performance. For example, assume a simple de-noising application of a color image[10]. It will need to de-noise in the each channel, and this appears to be a duplicate process to be simplified and it can convert the given image to gray scale and deal with that.

4.2. Image resize

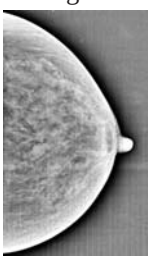
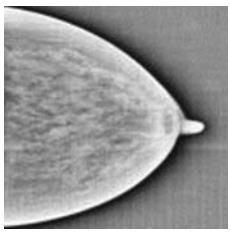
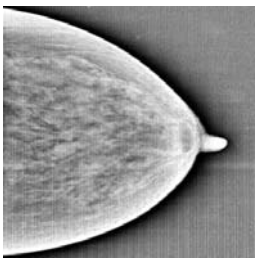
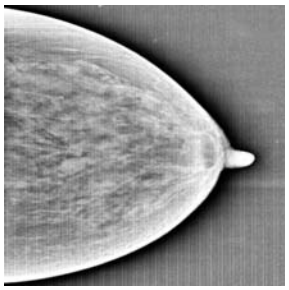
Images		Original 			
Size		255x478	128x128	256x256	512x512
Pixel Count	White	121890	16384	65536	262144
	Total	17371190	2335271	9340983	37362173
Size in kb		55.9	3.26	11.5	40.5

Figure 2: Image resize

Image resizing is an important role in image processing technique, to enlarge and reduce the given image size in pixel format. Image interpolation in to two ways image down-sampling and up-sampling is necessary when resizing the data to match with either the essentials of the output display[3]. However it is more capable to transfer low-resolution forms to the client, a guesstimate of the high-resolution of the original may be necessary when donating the final visual data[5]. Thus, the accurate resizing of image is a

necessary step in many methods, stretching from several applications for critical functions in the field of medical, defense sectors and etc. To resizing the given data, there are several techniques which have been developed[4, 7].

In this section have used is nearest neighbor technique, a process that is not only fast but also it doesn't introduce any artificial data in the final output are shown in Figure-2. Though, despite the speed can be calculated, this technique suffers from the fact that the resulting image often contains block artifacts, which are not only visually noticeable but naturally it also can drastically have negative affected error calculations used to compare methods[8]. So there are two additional techniques namely bilinear and bicubic interpolation[9].

4.3. Noise Removing

Image noise is defined as the random variation identified in brightness or colour information in images produced by medical devices or scanners. Image noise is generally observed as an undesirable by-product during image acquisition. Noise is often defined as the uncertainty in the signal due to random fluctuations in signals. There are many causes for these fluctuations. All medical images contain some visual noise. The presence of noise gives an image a mottled, grainy, textured, or snowy appearance[11]. Several types of noise exist and the most common noise found in medical images is explained below.

Salt-and-Pepper Noise : Salt and pepper noise is noise that is most frequently seen in an image. It denotes as randomly occurring black and white pixels. Salt and pepper noise sneaks into image in conditions where rapid transients, such as defective swapping, take place. It is also called as impulsive noise or spike noise.

Gaussian Noise : Gaussian noise is statistical noise that has a probability density function (pdf) of the normal distribution, also known as Gaussian distribution. In Gaussian noise, each pixel in the image will be changed from its original value by a (usually) small amount[12].

Shot or Poisson Noise : Shot noise, otherwise known as poisson noise, is the dominant noise in the lighter parts of an image from an image sensor is typically that caused by statistical quantum fluctuations, that is, variation in the number of photons sensed at a given exposure level; this noise is known as photon shot noise

Speckle Noise : Speckle noise is a granular noise that inherently exists in and degrades the quality of the active radar and synthetic aperture radar images. In this type of noise are usually seen in ultrasonic medical devices.

4.4. Filtering

Filtering technique for modifying or enhancing an image, in image processing filters are mainly used to suppress either the high frequencies in the image, *i.e.* smoothing the image, or the low frequencies, *i.e.* enhancing or detecting edges in the image. For example, you can filter an image to emphasize certain features or remove other features. A number of techniques are available and the best options can depend on the image and how it will be used.

Image filtering is useful in many applications; this technique includes smoothing, removing noise, edge detection, and sharpening. A filter is a small array defined by a kernel, which is applied to each pixel and it's neighboring within an image.

A. Wiener Filter

The wiener filtering technique will execute an optimal tradeo ff between inverse filtering and noise smoothing. It does the process of removing additional noise and inverting the blurring of images simultaneously. The Wiener filtering is finest in relationships of the mean square error. In additionally, The Wiener filtering minimizes the complete mean square error in the process of inverse filtering and noise smoothing. The Wiener filtering is a linear estimation done on the original image[4]. The approach is based on stochastic framework. The orthogonality principle applied on the Wiener filter in Fourier domain can be expressed as follows:

Where $S_{xx}(f_1, f_2) + S_{\eta\eta}(f_1, f_2)$ are power spectra of the original image and the additive noises, and $H(f_1, f_2)$ is the blurring filter. It is easy to see that Wiener filter has two separate part namely an inverse filtering part and a noise smoothing part. It not only performs the deconvolution by inverse filtering (highpass filtering) but also removes the noise with a compression operation (lowpass filtering).

B. Median Filter

Median filter works on a rectangular regional space S_{xy}. It changes the size of S_{xy} during the filtering operation based on certain conditions as itemized below. Each output pixel contains the median value in the 3-by-3 neighborhood identified around the corresponding pixel of the input images[2]. Zeros will replace the edges of the images [19]. The output of the filter is a single value, which will replace the existing pixel value at the position (x, y) the point on which the space S is centered at the time. The following notations are used:

Z_{min} = Minimum pixel value in S_{xy}
Z_{max} = Maximum pixel value in S_{xy}
Z_{med} = Median pixel value in S_{xy}
Z_{xy} = Pixel value at co - ordinates (x, y)
Z_{max} = Maximum allowed size of S_{xy}

Median filtering is widely used to smooth the non-repulsive noise from 2D signals without blurring edges and preserved images. This makes, it predominantly suitable for enhancing mammogram images.

The median filter is performed for spatial processing to determine the pixels in an image have which has been affected by impulse noise. The median filter classifies pixels as noise by associating each pixel in the existing image to its nearest neighbor pixels. The size of the neighborhood is adjustable, as well as the threshold for the comparison[11]. A pixel that is different from majority of its neighboring pixels, as well as being not structurally aligned with those pixels to which it is similar, is labeled as impulse noise. These noise pixels are then replaced by the median pixel value in the neighborhood that have passed the noise labeling test.

C. Gaussian Filter

Gaussian filter plays the most vital role in both theory and applications. Gaussian filtering is a frequently used image filtering technique which is a WAP with weights defined as

$$\mu_3 = \sigma^{-3} \sum_{I=0}^{G-1} (i - \mu)^3 p(i)$$

$W_{ij} = 0$, where is the L_2 norm. Its smoothing is effectively a local filtering technique[10]. As an image de-noising method, in this filter is well known to over smooth images, resulting in the loss of significant detail, especially sharpening the edge. Gaussian smoothing is low-pass filtering, which suppresses high-frequency details like noises and edges, while preserving the low frequency components of the image, which has no drastic difference. In other words, the filter blurs entirety that is smaller than the feature of original image[13].

4.5. Contrast Enhancement

The major purpose of the contrast enhancement system is twofold; namely locally adaptive histogram equalization and reduction of undesired objects such as noise and blocking object[14]. More specifically, local adaptivity is incorporated by block-based processing, blocking artifact the reduction by overlapping adjacent blocks, and noise is suppressed by spatio-temporal adaptive filtering. The detail of block-overlapped histogram equalization algorithm is summarized as given below without considering image boundary[2].

The relationship between the complete image and the $(m, n)^{th}$ block is represented in Figure-3, where the histogram equalization is performed on the relevant BxB block, and the intensity of the center pixel in the block is transformed based on the equalization[3]. In order to compute the histogram of the next successive $(m, n + 1)^{th}$ block, we add the last column of the new block and remove the first column of the old block.

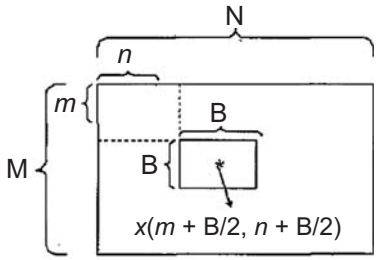


Figure 3: The Performance of Histogram Equalization

5. RESULT AND DISCUSSION

In this section discusses with the experimental results obtained by applying the Wiener, Median, Gaussian filtering techniques; the experimental results are shown as the preprocessed images in Figure-4 for contrast enhancement process.

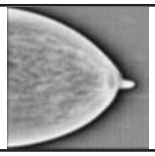
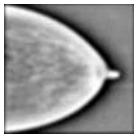
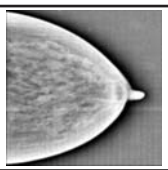
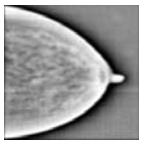
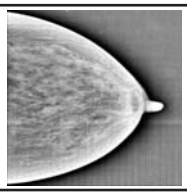
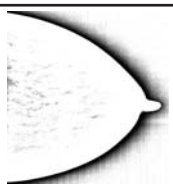
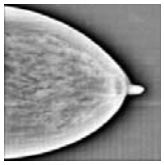
Methods	Wiener filter	Median filter	Gaussian filter	Total Pixel Count
128x128				2335271
kb	2.76	2.64	2.12	
256x256				9340983
kb	8.33	8.34	6.13	
512x512				37362173
kb	29.9	26.4	20.4	

Figure 4: Filtered image with different size

After filtering process, which has been enhanced using histogram equalization, they are subjected with adaptive and block overlapped histogram equalization. The experimental results are shown in Figure-5 for future clustering process.

6. CONCLUSION

This paper fully discussed the mammogram medical image for preprocessing techniques of image processing. In this image detecting noises that have identified as detected noise also removed from the given mammogram images, in the image it can be applied with different filtering techniques namely Gaussian, Wiener and Median filters. The results are analyzed and compared with average pattern of noises and also assessed through the quality. This work we have detected that the choice of filters for de-noising the medical mammogram images depends vitally on the type of noise and type of filtering technique,

which are selected and used. It is remarkable that techniques save the processing time. Additionally the comparison is done for the three types of filter and observes median filter gave the best pixels. This result is analysis will improve the accuracy of mammogram image. The results, which we have achieved, are more useful and they prove to be helpful for medical practitioners to analyze the symptoms in the patients.

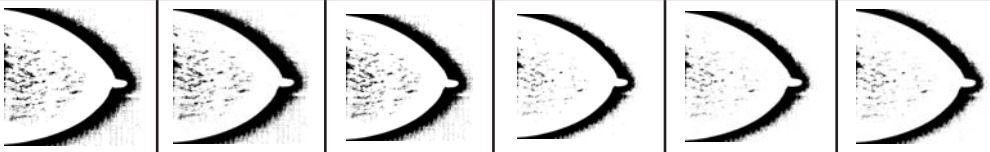
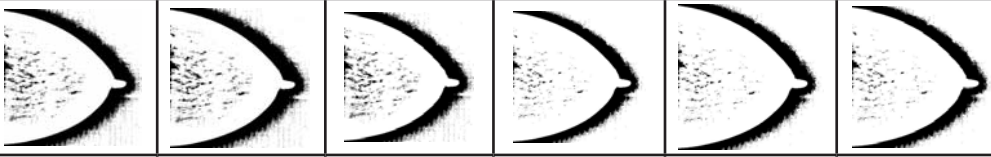
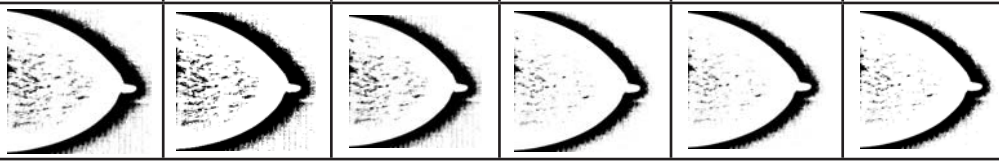
Methods	Adaptive Histogram Equalization			Block-Overlapped Histogram Equalization			Total Pixel Count
	Wiener	Median	Gaussian	Wiener	Median	Gaussian	
128x128							2335271
256x256							9340983
512x512							37362173

Figure 5: Results of Contrast Enhancement images with different filtered images

7. REFERENCES

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