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An Evaluation of Different Types of Filters on Roentgenogram

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Abstract : *The x-ray images are corrupted with different types of artifacts among them noise is one. The visualization with accuracy of these (x-ray) images is important for accurate diagnosis. The solution seems to preprocessing of these images. For researchers, to eliminate the noise from an image before further processing is a very important but a great challenge. Noise can corrupt the image during the capturing or transmission of the image. In this study, prime focus is on evaluation of various types of filters on X-ray images. Different types of filters are applied on these corrupted images and comparison of the obtained results show that median filter is better than the others one. The achieved results are more constructive and supportive for further processing.*
Keywords: *Median filter, Noise, Preprocessing, Roentgenogram (X-ray).*

I. INTRODUCTION

In biological, medicine and material research X-ray technology is widely used since Roentgen discovered X-ray in 1895. The screening of chest abnormalities is often based on chest X-ray images (CXR). Now, advance imaging techniques are used in clinical diagnosis such as Computed Tomography (CT) imaging, MRI, PET, OCT etc. but due to high cost of advance techniques in every developing country, chest X-ray imaging is a part of routinely investigation when the person have chest discomfort reported first. Pulmonary disease is one of the leading causes of morbidity and mortality worldwide. However ignored at initial stage by person itself till the discomfort is intolerable and some time medical experts had overlooked the diseases in their first examinations on CXR or misdiagnosed due to overburden in OPD. When lesions were found by advance chest imaging, the patient has missed the best period of treatment. As digital chest radiography replaces conventional film-based method, image-processing capabilities will continue to proliferate. In addition to immediate storage and transmission for remote diagnostics and follow-up, image pre- and post- processing will be widespread. Digital image analysis with image pre and post processing helps reduce perceptual and cognitive errors by highlighting abnormalities and characterizing lung patterns to assist physicians as virtual second opinions. Preprocessing of the digital images is necessary as they are prone to a variety of types of noises [1, 2]. Noise can occur during the digital image acquisition process. Noise in an image arises due to errors as a result of which the true intensities of the real image are not reflected by the pixel values. Noise is a random variation of image Intensity and is visible as grains in the image [3]. Noise means, the pixels in the image show various intensity values instead of true pixel values. The process to reduce or remove the noise from the image is de–noising. The noise removal techniques smoothens the entire image by reducing or removing the appearance of noise leaving areas near contrast boundaries. The noise that usually arises in the image is impulse noise, speckle, and Gaussian noise. The characteristics of different noises make them distinguishable from others [4].
For researchers, to eliminate the noise from an image before further processing is a very crucial but a big challenging task. The accuracy of x-ray images is necessary for early diagnosis. In this study, prime focus is on evaluation of various types of filter on X-ray images. The images are corrupted with different types of noise. Different types of filters are applied on these corrupted images and comparisons of the results are shown in Table 1. The achieved results are more constructive and supportive for further processing.

Primary Sources of Noise
Noise arises in the image during image acquisition or transmission. Noise may be occurring in the image due to different kinds of factors. In the digital images, the primary sources of noise are:
- During image acquisition
- Direct acquisition of the image in a digital format
- Dust particles on the scanner screen
- Interference in the transmission channel
- Inadequate light levels and sensor temperature

A noisy image can be modeled as:
$N(x, y) = O(x, y) + P(x, y)$ (1)
Here O (x, y) is the original digital image pixel value and P (x, y) stands for noise in the image and N(x,y) is the noisy output image [5].

Nature of Noise

Noise is the degradation of the image caused by external disturbance. It occurs when an image is being transmitted from one place to another. The errors present in the image are visible in different ways depending on the type of disturbance [3, 6]. Usually the aim of the researchers is to remove certain kind of noise. So in this study, certain kinds of noise are identified and different techniques are applied to get rid of the noise. Noise of the image classified as Amplifier (Gaussian noise), Impulse (Salt-and-pepper noise) and Multiplicative (Speckle noise) [5]

II. DIFFERENT TYPES OF FILTERS FOR DE-NOISING

Noise is an inevitable side-effect occurring as a consequence of image imprison, these are unavoidable fluctuations which are out of earshot. While capturing an image from a camera or from mobile phone if the light entering the lens changes its alignment with the sensors, it will generate noise to the digital image. Some sort of noise is bound to exist even if it is not clearly visible and is received and transmitted by electronic devices while their propagation from one place to another.

When a transmitted impulse propagates along the channel it may get distorted due to channel imperfection and noise adds to this transmitted impulse and the receiver receives a corrupted version of the image. Large positive and negative spikes are embedded in the noise impulse [7, 8]. Preprocessing of an image is a very important job for researcher i.e. removes the noise from the image. There are so many different techniques available for removing the noise but the important task is to choose the best one among them that can remove the noise from the image completely as well as preserving the details of the image at the same time. Two types of noise removal techniques are linear and non-linear. Where linear methods are fast enough, but they do not preserve the details of the images, whereas the non-linear methods preserve the details of the images [8].

III. TEST AND RESULTS


Fig. 3.1 Original Image

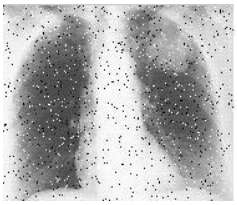
Fig 3.2 Salt & Pepper Noise


Fig 3.3 Gaussian Noise

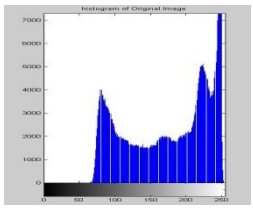
Fig 3.4 Histogram of Fig. 3.1

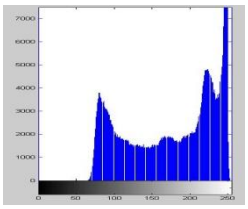
Fig 3.5 Histogram of Fig. 3.2

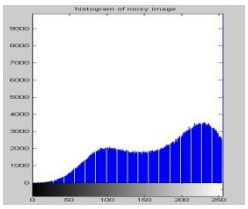
Fig 3.6 Histogram of Fig. 3.3

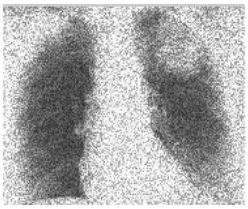
Fig 3.7 Speckle Noise


Fig 3.8 Median Filter


Fig 3.9 Wiener Filter

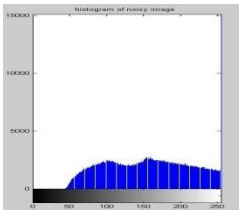

Fig 3.10 Histogram of Fig. 3.7

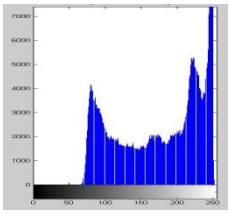

Fig 3.11 Histogram of Fig. 3.8

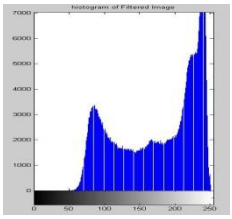

Fig 3.12 Histogram of Fig. 3.9

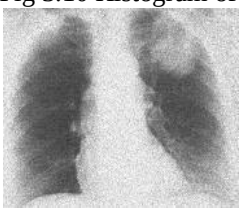

Fig 3.13 Average Filter

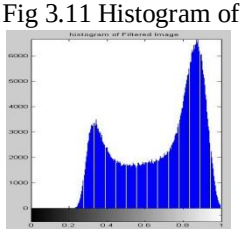

Fig 3.14 Histogram of Fig. 3.13

Table 1 Comparison of Std and Mean of Different Filters

Name of Filter	Original Image		Noisy Image		Filtered Image	
	Std	Mean	Std	Mean	Std	Mean
Median	59.3332	178.0440	62.2091	176.3113	57.7008	175.5340
Wiener	59.3332	178.0440	62.4057	176.3640	59.2483	178.0179
Average	59.3332	178.0440	62.9799	176.7973	62.1684	176.4374

The brief summary of the entire procedure used to enhance the digital chest Images. Using histogram equalization relative contrast is increased in the image. After applying different types of filters on the equalized image, we found that median filter reduces noise, preserving useful information of the image.

IV. CONCLUSION

Noise can corrupt the image during its capturing or transmission. This study shows that different approaches for reduction of noise and image enhancement have been considered, each of which their own limitation and advantages have. The available literature ropes the main advantages of filter the de-noising capability. Different types of filters are applied on these corrupted images and comparison of the obtained results shows that median filter is better than the others one because the median filter conserves the brightness differences resulting in least blurring of regional boundaries. Preserve the positions of boundaries in an image, useful for visual examination and measurement. The results obtained using median filter technique ensures noise free and quality of the image as well.

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