Performance Analysis of Different Filters for De-Noising Medical Images

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ABSTRACT
Image brightness is generally desirable to be uniform except regions where it changes to form an image. There are factors, however, that tend to produce variation in the brightness of a displayed image even when no image detail is present. This variation is usually random and has no particular pattern. In many cases, it reduces image quality. This random variation in image brightness is designated as noise. In this experimental work, different medical images like MRI, Cancer, X-ray, and Brain images have been considered and have been then used to calculate thestandard deviation and mean of all these images after finding Speckle noise and applyingvarious filtering techniques for removal of noise. This experimental analysis will improve the accuracy of these medical images for easy diagnosis. The results, which have been achieved, are more useful and they prove to be helpful for general medical practitioners to analyze the symptoms of the patient.

Keyword
MRI – Magnetic Resonance Imaging, X-ray,CT, Median filter, Adaptive filter and Average filter.

1. INTRODUCTION
Image noise is a random variation of brightness in images. Images are affected by noises such as salt-and-pepper noise, Gaussian noise, Speckle noise, Poisson noise, etc. All medical images generally tend to contain some amount of visual noise. The presence of noise gives an image a mottled, grainy, textured, or snowy appearance. No imaging method is free from noise, but the prevalence of noise is much more in certain types of imaging procedures than in others. Noise is significant in MRI, CT, and ultrasound imaging. In comparison to these modalities, radiography produces images with the least noise. Images are prone to noise induction where noise can be introduced by the medium of transfer or during image acquisition. Different filtering procedures are used for noise reduction to improve the visual quality and understandability of images. Some of the mainly used filters for medical images include:

Median Filtering: Median filtering is similar to using an averaging filter, in that each pixel is set to an ‘average’ of the pixel values in the neighborhood of the corresponding input pixels. With median filtering, the value of an output pixel is determined by the median of the neighborhood pixels, rather than the mean. The median is much less sensitive than the mean to extreme values. Median filtering is, therefore, better able to remove this outlier without reducing the sharpness of the image.

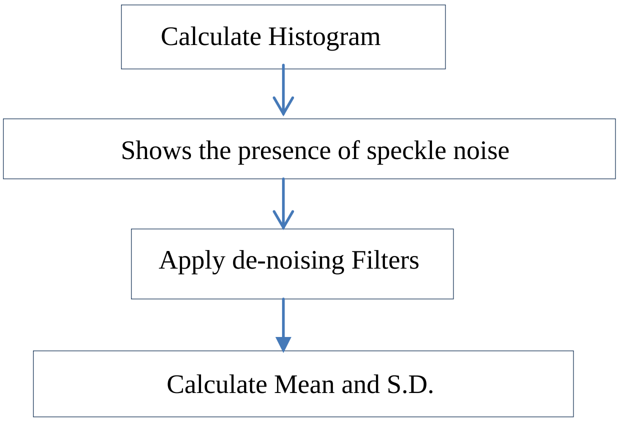
Adaptive Filtering: The wiener2 function applies a Wiener filter which is a type of linear filter to an image adaptively, tailoring itself to local image variance. Where the variance is large, wiener2 performs little smoothing. Where the variance is small, wiener2 performs more smoothing. This approach often produces abetter result than linear filtering.

Averaging Filters: They are also known as smoothing filters. By replacing the value of every pixel in an image by the average of the gray levels in the neighborhood defined by the filter mask, this process results in an image with reduced “sharp” transitions in gray levels. Averaging filters have the undesirable side effect that they blur edges.

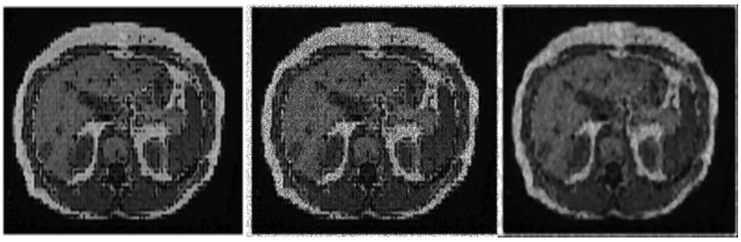
2. METHODOLOGY
The histogram calculation of the considered medical images viz. MRI, CT-scan, X-ray and Cancer images show the presence of speckle noise in the images.

Speckle noise is a granular noise that increases the mean gray level of a local area in an image. This type of noise makes it difficult for image recognition and interpretation. In this noise type, the sample mean and variance of a single pixel is proportional to that of the mean and variance of the local area that is centered on that pixel.

After finding the speckle noise in the considered medical images, median filter, averaging filter and adaptive filter were applied respectively to de-noise the images. The results are shown below and the standard deviation and the mean for the original images, the noisy images and the filtered images are also tabulated respectively.



(a) Original MRI image(b) Finding Speckle Noise (c) Applying Median Filter



(a) Original Cancer image (b) Finding Speckle Noise (c) Applying Median Filter

(a)Original Brain image(b)Finding a speckle noise(c) Applying Median filter

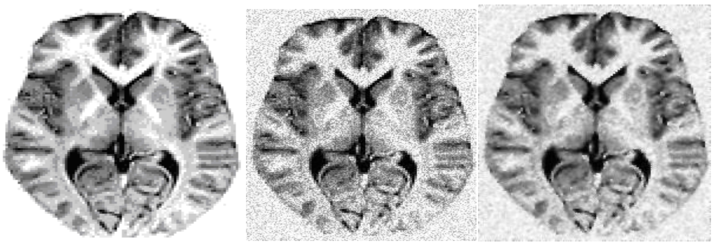
(a)Original X-ray image (b) Finding a speckle noise (c) Applying Median filter

Fig1. Shows finding the speckle noise in MRI, Cancer, X-ray, Brain images and applying the median filter on these images

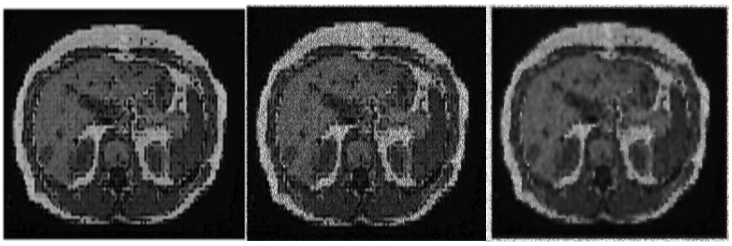
Table 1: Noise removal using median filter for speckle noise

Image	Original Image		Noisy Image		Filtered Image	
	S.D.	Mean	S.D.	Mean	S.D.	Mean

MRI	70.06	182.24	68.78	175.77	66.67	177.90
Cancer	61.29	62.49	61.35	61.61	50.10	57.20
X-Ray	65.45	145.47	66.84	143.19	64.34	143.45
Brain	91.08	85.95	87.67	83.12	87.14	83.03



(a)Original MRI image (b) Finding Speckle Noise (c) Applying Adaptive filter



(a)Original Cancer image (b) Finding Speckle Noise (c) Applying Adaptive Filter

(a)Original Brain image (b) Finding Speckle noise (c) Applying Adaptive Filter

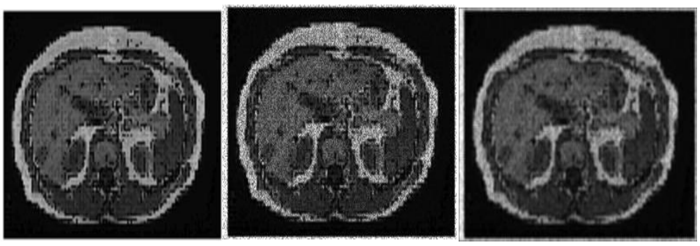
(a)Original X-ray image (b) Finding Speckle noise (c) Applying Adaptive Filter

Fig 2. Shows finding the speckle noise in MRI, Cancer, X-ray, Brain images and applying the adaptive filter on these images

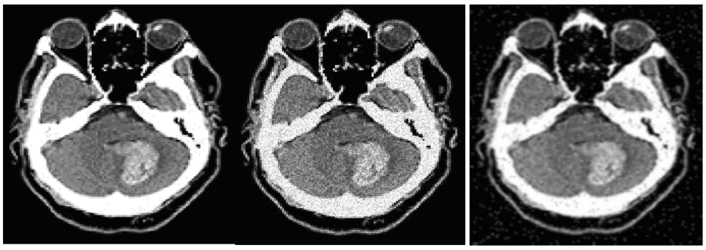
Table 2: Noise removal using adaptive filter for speckle noise

Image	**Original Image**		**Noisy Image**		**Filtered Image**	
	S.D.	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**
MRI	70.06	182.24	68.78	175.77	62.16	175.67
Cancer	61.29	62.49	61.35	61.61	55.63	61.73
X-Ray	65.45	145.47	66.84	143.19	62.15	142.95
Brain	91.08	85.95	87.67	83.12	85.14	83.19

(a)Original MRI image (b) Finding Speckle Noise (c) Applying Average Filter



(a)Original Cancer image (b) Finding Speckle Noise (c) Applying Average Filter



(a)Original Brain image (b) Finding Speckle noise (c) Applying Average filter

(a) Original X-ray image (b) Finding Speckle noise (c) Applying Average filter

Fig 3. Shows finding the speckle noise in MRI, Cancer, X-ray, Brain images and applying the average filter on these images

Table 3: Noise removal using average filter for speckle noise

Image	Original Image		Noisy Image		Filtered Image	
	S.D.	Mean	S.D.	Mean	S.D.	Mean
MRI	70.06	182.24	68.78	175.77	65.23	180.68
Cancer	61.29	62.49	61.35	61.61	53.20	55.23
X-Ray	65.45	145.47	66.84	143.19	67.23	140.55
Brain	91.08	85.95	87.67	83.12	89.32	84.32

3. CONCLUSION

In this work,different medical images like MRI, Cancer, X-ray and Brain have been considered for detecting noises. The presence of speckle noisewas detected as being generally present in all the images. These noises are then removed from the above medical images by applying the various filtering techniques like Median Filtering, Adaptive Filtering and Average Filtering. The results are analyzed and compared with standard pattern of noises and also evaluated through the quality metrics like Mean, and Standard deviation. Through this work, it was observed that the choice of filters for de-noising the medical images depends on the type of noise. Different filters work differently for various images. It can be concluded that the average filter works best for the MRI images; adaptive filter works fairly well for the cancer images; median filter provides good result for the X-ray images and the average filter works well for the brain images. It is remarkable that this saves the processing time. This experimental analysis will improve the accuracy of MRI, Cancer, X-ray and Brain images for easy diagnosis. The results, which have been achieved, are more useful and they prove to be helpful for general medical practitioners to analyze the symptoms of the patient.

4. REFERENCES

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