"Noise Detection and Noise Removal Techniques in Medical Images"

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ABSTRACT
In this experimental work we have taken different medical images like MRI, Cancer, X-ray, and Brain and we have calculated standard derivations and mean of all these medical images after finding Gaussian noise and then we have applied median filtering technique for removal of noise. After removing a noise by using median filtering techniques again standard derivations and mean are evaluated. This experimental analysis will improve the accuracy of MRI, Cancer, X-ray and Brain images for easy diagnosis. The results, which we have achieved, are more useful and they prove to be helpful for general medical practitioners to analyze the symptoms of the patients with ease.

Keyword: MRI – Magnetic Resonance Imaging , ROI- Region Of Interest, Median filter, Adaptive filter and Average filter.

I. INTRODUCTION:

a) 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. However 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.

b) Max and Min filter:

The median filter is by far the order-statistics filter most used in image processing; it is by no mean the only one. Max filter, given by

$$f^{\wedge}(x, y) = \max_{(s, t) \in S_{xy}} \{g(s, t)\}$$

This filter is useful for finding the brightest points in an image. Also, because pepper noise has very low values, it is reduced by this filter as a result of the max selection process in the sub image S_{xy}.

The 0 th percentile filter is the min filter.

$$f^{\wedge}(x, y) = \min_{(s, t) \in S_{xy}} \{g(s, t)\}$$

This filter is useful for finding the darkest points in an image.

c) Mid Point Filter:

The midpoint filter simply computes the midpoint between the maximum and minimum values in the area encompassed by the filter. This filter combines order statistics and averaging. This filter works best for random distributed noise like Gaussian or uniform noise.

Alpha-trimmed mean filter:

Suppose that we delete the d/2 lowest and d/2 highest gray-level values of g(s, t) in the neighborhoods Sxy. Let g_r (s, t) represent the remaining mn –d pixels. A filter formed by averaging these remaining pixels is called an alpha trimmed mean filter.

$$\hat{f}(x, y) = \frac{1}{mn - d} \sum g_r(s, t)$$

If we choose d = (mn -1)/2 the filter becomes median filter.

d) 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 better result than linear filtering. The adaptive filter is more selective than a comparable linear filter, preserving edges and other high frequency parts of an image. In addition, there are no design tasks; the wiener2 function handles all preliminary computations, and implements the filter for an input image. Wiener2, however, does require more computations time than linear filtering. Wiener2 works best when the noise is constant-power (“white”) additive noise, such as Gaussian noise.

e) Adaptive median filter:

Adaptive median filtering can handle impulse noise with probabilities. The adaptive median filter is that it seeks to preserve detail while smoothing non impulse noise, something that the traditional median filter does not do.

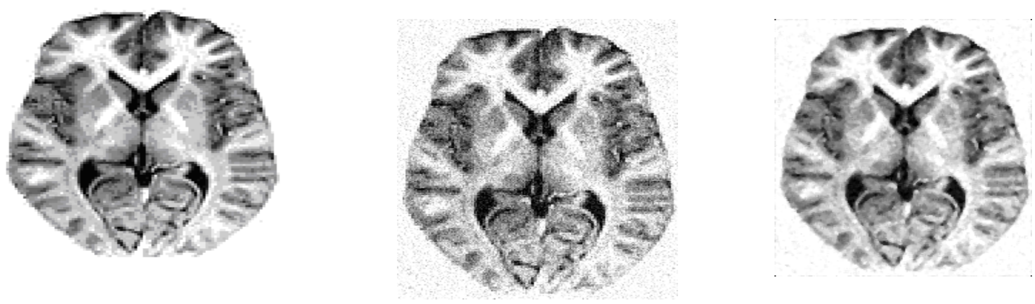
II. METHODOLOGY

Figure shows the different noise which has find in these medical image and after applying the filtering techniques in these medical images and same has been given through histogram as shown in figures

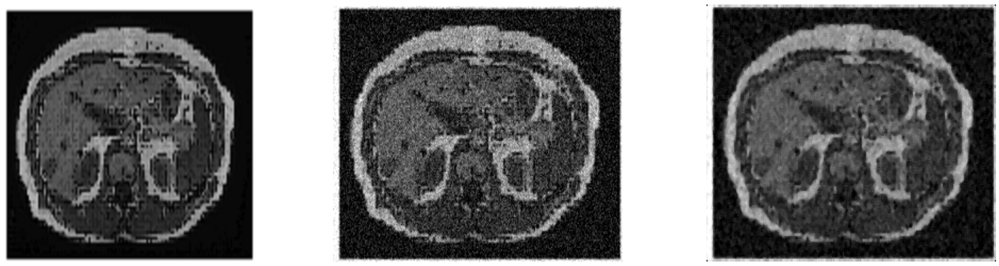
Table1.1

Noise removal using Median Filter for Gaussian Noise.

Image	Original Image		Noisy Image		Filtered Image	
	Std	**Mean**	**Std**	**Mean**	**Std**	**Mean**
MRI	70.0623	182.2473	68.2208	185.1690	65.6146	187.0641
Cancer	61.2939	62.4918	62.9288	71.4946	57.0552	69.2566
X-Ray	65.4542	145.4757	67.6951	151.9010	64.4928	152.6100
Brain	91.0872	85.9561	87.8697	94.0962	87.6892	92.7760



(a) Original MRI image (b) Finding a Gaussian noise in MRI Image (c) Applying median filter



(a)Original image (Cancer image) (b) Finding a Gaussian noise In cancer image (c) Applying median filter

(a) Original x-ray image (b) Finding Gaussian noise (c) applying median Filter

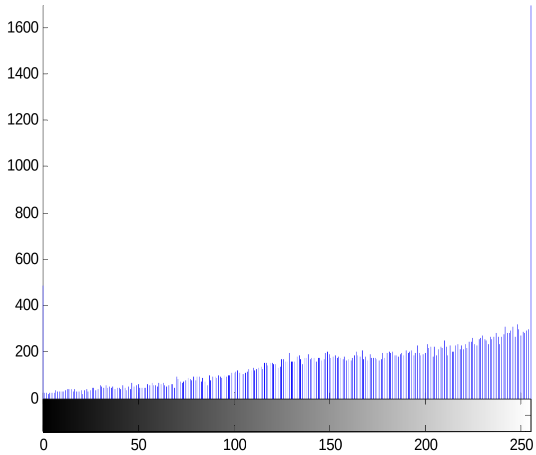
(a)Original image (Brain image) (b) Finding a Gaussian noise in brain image (c) Applying median filter

Fig1.1.1 Shows finding the Gaussian noise in MRI, Cancer, X-ray and brain images and applying the median filter on these images.

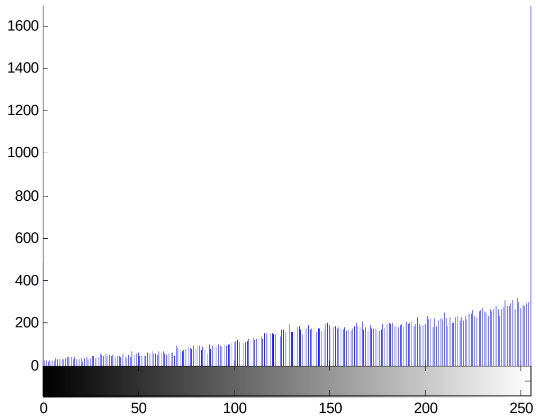
The following figure shows the noise pattern for the MRI, Cancer, X-ray and brain images. In these medical images after finding the Gaussian noise we have taken a region of interest for noisy images and the histogram shows the noise pattern that is it is the Gaussian noise.

(a) Noisy image (Gaussian noise)

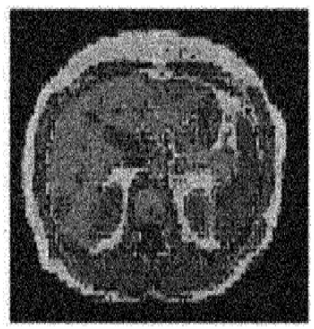
(b) ROI generated for noisy image



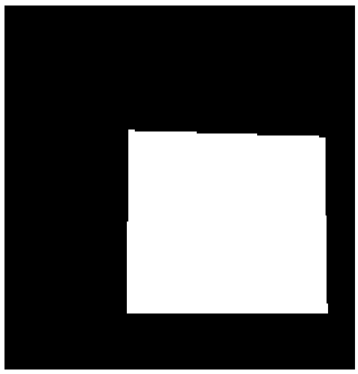
© Histogram for noisy image



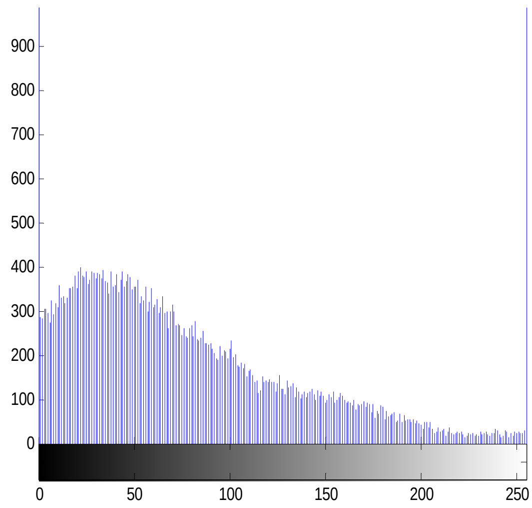
(d) Histogram of ROI



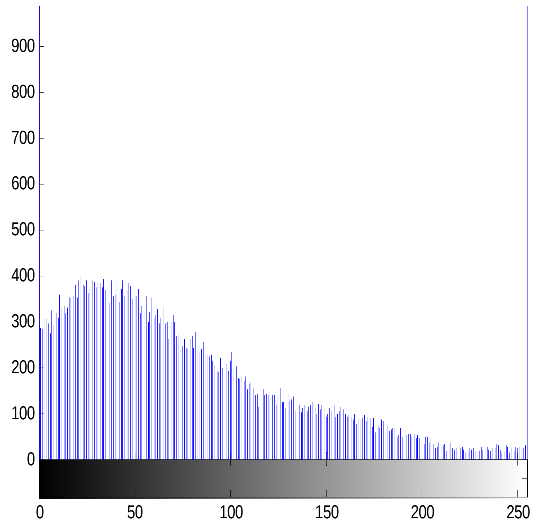
(e) Noisy Image (Gaussian noise)



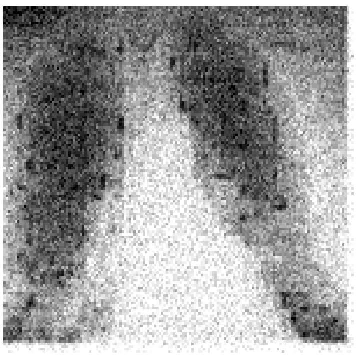
(f) ROI for the noisy image



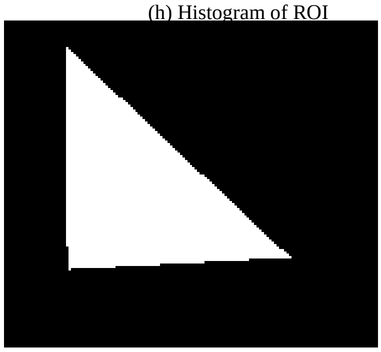
(g) Histogram for the noisy image



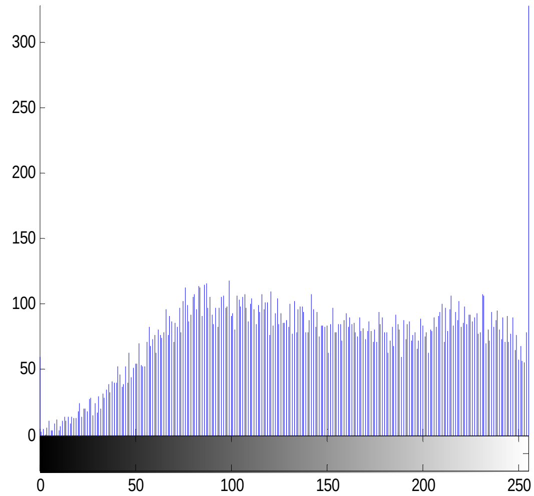
(h) Histogram of ROI



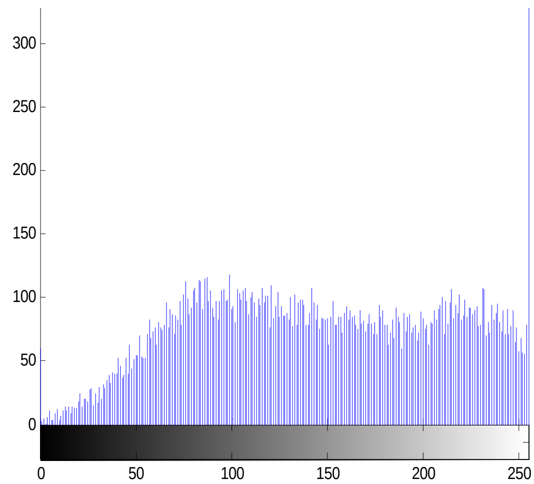
(i) Noisy image (Gaussian)



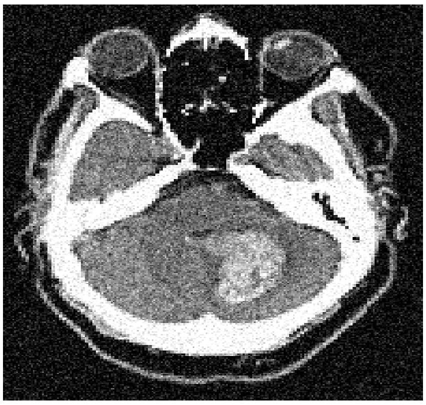
(j) ROI for noisy image



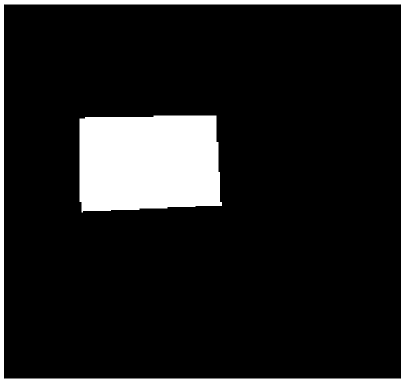
(k) Histogram for the noisy image



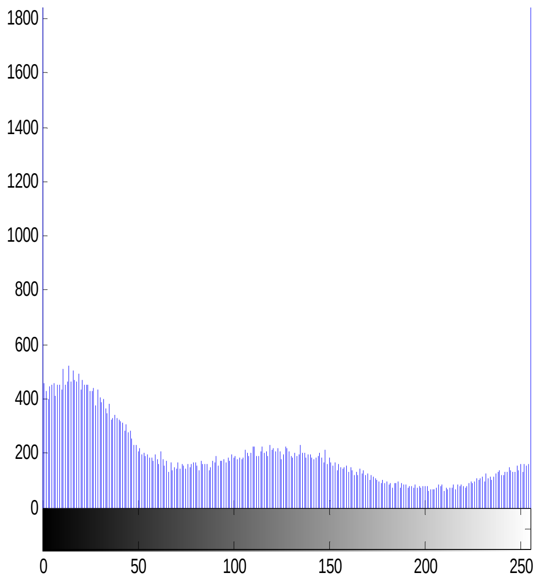
(l) Histogram for the ROI



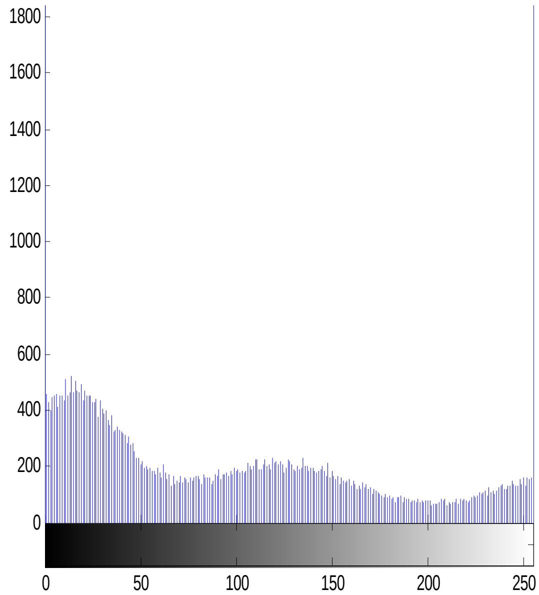
(m) Noisy image (Gaussian noise)



(n) ROI of noisy image



(o) Histogram for the noisy image



(p) histogram for the ROI

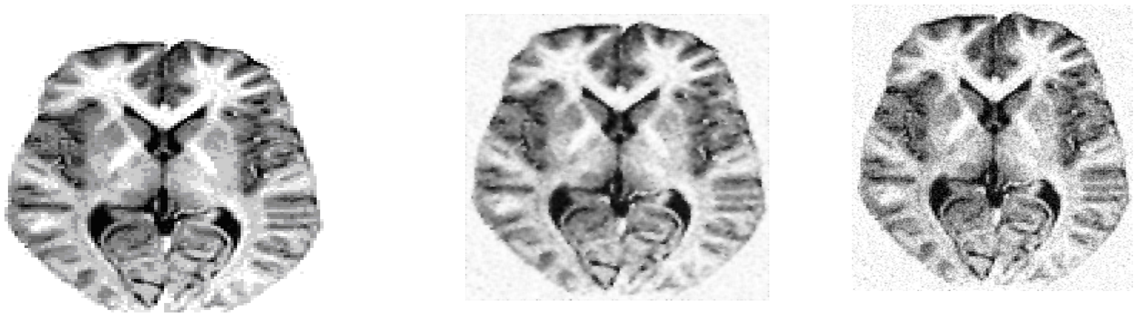
Fig 1.1.2 shows the Histogram for the noisy image and histogram for the selected ROI for Gaussian noise

we taken different medical images like MRI, Cancer, X-ray, and Brain and we have calculated standard derivations and mean of all these medical images after finding Gaussian noise and then we have applied adaptive filtering technique for removal of noise.

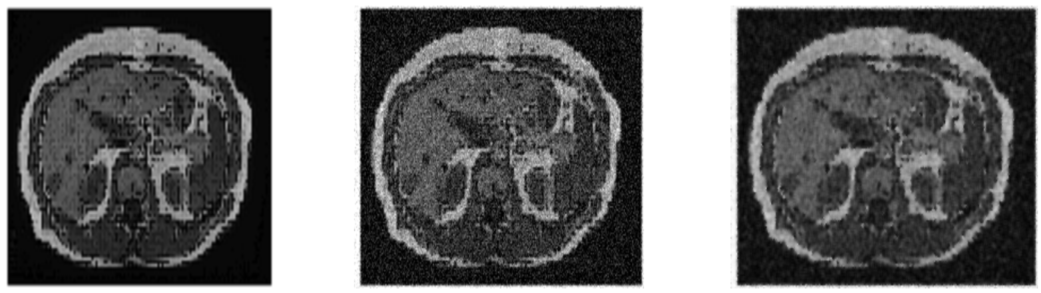
Table2.1

Noise removal using Adaptive Filter for Gaussian Noise.

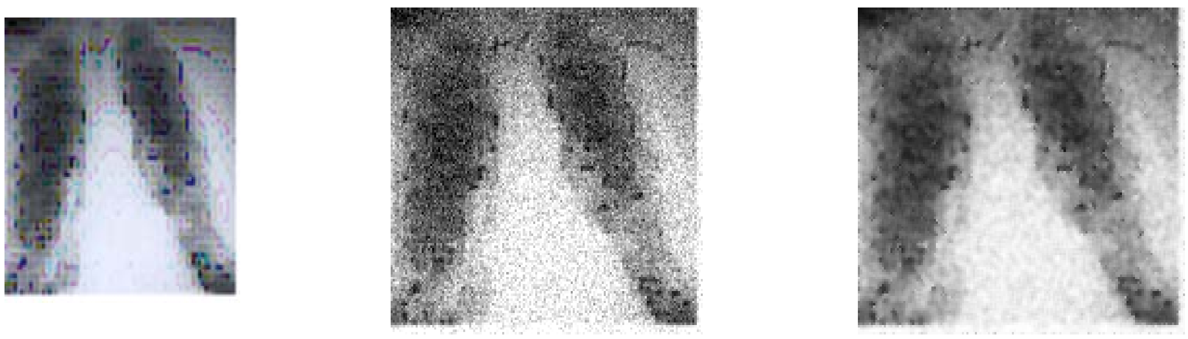
Image	**Original Image**		**Noisy Image**		**Filtered Image**	
	Std	**Mean**	**Std**	**Mean**	**Std**	**Mean**
MRI	70.0623	182.2473	68.2208	185.1690	63.2881	185.0748
Cancer	61.2939	62.4918	62.9288	71.4946	56.4525	71.3725
X-Ray	65.4542	145.4757	67.6951	151.9010	63.1035	151.6546
Brain	91.0872	85.9561	87.8697	94.0962	84.4043	94.0254



(a)Original MRI image (b) finding a Gaussian noise (c) Applying adaptive Filter



(a) Original image (Cancer image) (b) Finding a Gaussian noise in cancer image (c) Applying Adaptive Filter



(a)Original x-ray image (b) finding Gaussian noise (c) applying adaptive Filter

(a)Original image in cancer image (b) finding a Gaussian noise Filter (c) Applying adaptive (Brain image)

Fig2.1.1 Shows finding the Gaussian noise in MRI, Cancer, X-ray, Brain images and applying the adaptive filter on these images.

III. DISCUSSION

As per discussed in chapter4 Different medical images like MRI, Cancer, x-ray and brain images have been studied. After finding the Gaussian noise in MRI image the various filtering techniques like Median filter, Adaptive filter and Average filter have been applied.

We have taken the slandered derivation and mean after filtering the image which is shown in tables. It is found that the Adaptive filter works better for the Gaussian noise because the slandered derivation for the adaptive filter are 63.2881 and the slandered derivation for the Gaussian noise image are 68.2208.

Similarly after finding the Gaussian noise in cancer image the various filtering techniques have been applied and it is found that the adaptive filter works better for the noisy image as the slandered derivation for the noisy image are 62.9288 and standard derivation for the adaptive filtered image are 56.4525.

After finding the Gaussian noise in X-ray image various filtering techniques have been applied and it is found that the adaptive filter works better for the X-ray noisy image. The slandered derivation for the noisy image is 67.6951 and the slandered derivation for the adaptive filtered image is 63.1035.

After finding the Gaussian noise in brain image various filtering techniques have been applied and it is found that the adaptive filter works better for the noisy image. The slandered derivation for the noisy image is 87.8697 and the slandered derivation for the adaptive filtered image is 84.4043.

IV. CONCLUSION

In this work we have taken different medical images like MRI, Cancer, X-ray and Brain for detecting noises. We have detected Gaussian noises. These noises 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 we have observed that the choice of filters for de-noising the medical images depends on the type of noise and type of filtering technique, which are used. 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 we have achieved, are more useful and they prove to be helpful for general medical practitioners to analyze the symptoms of the patients with ease.

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