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ANALYSIS OF GABOR FILTER AND HOMOMORPHIC FILTER FOR REMOVING NOISES IN ULTRASOUND KIDNEY IMAGES

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ABSTRACT

Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention. The major drawback in the medical sector is the noise in medical images that causes so many problems while diagnosing, hence there is a chance for wrong treatment .There are different types of noises such as Gaussian noise, salt and pepper noise, etc,. In order to get the clear image, these noises should be removed with the help of filters. The proposed approach aims at reducing the noise in ultrasound kidney image by using Gabor and Homomorphic filter. Among these two filters Homomorphic filter yields the best result as its PSNR ratio is high and MSE is low when compared to Gabor filter.

Keywords: *Gabor, Homomorphic, Filter, PSNR, MSE, Ultrasound, etc..,*

I. INTODUCTION

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image.

Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention.”Medical imaging” tests create images of various parts of the body to screen for or diagnose medical conditions. Examples of medical imaging include CT scans, MRIs and mammograms.

Noise is the result of errors in the image acquisition procedure that result in pixel values that do not reflect the true intensities of the real scene. It can be produced by the sensor and circuitry of a scanner or digital camera. The major problem in today's scenario is the noise in medical images that causes so many problems while diagnosing .The different types of noises are Gaussian noise, salt and pepper noise, shot noise, quantization noise, film grain, anisotropic noise.

In order to get the clear image, these above mentioned noises should be removed with the help of filters. The different types of filtering technique include average, disk, mean median, Gaussian, Laplacian, motion, Perwitt, Sobel, Gabor and Homomorphic filter. Among these filters we use Gabor and Homomorphic technique for de-noising the noise in medical images. Gabor filters are Band pass filters which are used in image processing for feature extraction, texture analysis, and stereo disparity estimation. Homomorphic filtering is a generalized technique for signal and image processing, involving a nonlinear mapping to a different domain in which linear filter techniques are applied, followed by mapping back to the original domain.

In this paper we have briefly discussed about the denoising in ultrasound kidney image by using Gabor and Homomorphic filter and hence the stimulated result and the performance by using those filters has been mentioned.

II. LITERATURE SURVEY

The paper is about FPGA based denoising method with T-model mask architecture design for removal of noises in images. Usually captured image is affected by noise. The main problem of the various denoising technique is degrading the image information. Hence in this paper an efficient VLSI implementation of trimmed median filter algorithm with T-model mask technique is used for removal of impulse noise is proposed. The proposed algorithm removes the noise presented in digital images without degrading the image information.

The title of the paper is reduction of FBM noise in brain MRI images. In medical image processing, image restoration plays a major role of reducing the details of the images and to retain the images up to its quality. FBM noise is caused by Brownian motion. It is caused by random movement of tiny particles that are suspended in the brain fluid and it greatly affects the brain MRI images. By using wavelet threshold and shrinking techniques the images can be reconstructed.

Medical image such as ultrasonic image of liver and kidney and retinal images are often affected by various types of noise. All image restoration technique attempts two various types of noise Adaptive weighted median filter is used for removing the Gaussian and salt and pepper noise in retinal image because this filter proves to be the best in terms of all performance metrics.

Evaluation has been done to different enhancement techniques and that is applied to the ultrasonic kidney. Five common enhancement techniques are used in this (spatial, frequency, histogram, morphological and wavelet filter).In conclusion it seems that morphological filtering seems to the best option (for measuring MSE and PSNR. If the evaluator is concerning more on the kidney edges, median filtering histogram equalization should be taken into consideration.

Ultrasonic imaging is commonly used for medical diagnostics. The quality of ultrasonic images is limited, mainly due to speckle noise. The main is to study and compare the different methods of speckle noise suppression in

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ultrasonic images. The advantage of multi-resolution analysis for speckle noise is that it can reduce noise while preserving the future structure of the reconstructed image.

The system called Non-invasive ultrasound the agnostic that tracks moment in an affected area by irradiating the area with high intensity. The problem associated with the kidney stone motion tracking by ultrasonography is described. In order to overcome these problem , we consider two approaches.

- Minimizing the serving error.
- Reducing the effect of the serving error in order to enhance safety.

In this they implemented bilateral filter for medical image demising. Its formulation and parameter is easy but the performance of bilateral filter depends upon its parameter. Hence have applied bilateral filtering on images that are corrupted by additive white Gaussian noise with different values of variances. It is a non-linear and local technique that preserves the features while smoothing the images. Therefore it removes the additive white Gaussian noise.

This paper proposed a denoising method of medical images through thresholding and optimization using a stochastic and randomized technique of genetic algorithm. The noisy images are partitioned into fixed sized blocks and then transform it into wavelet domain.

III. PROPOSED METHOD

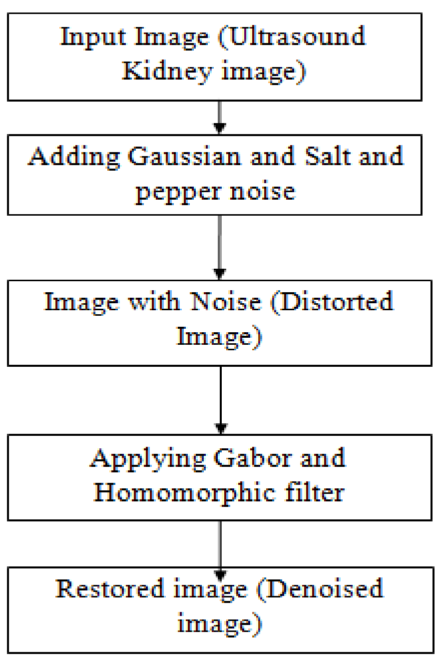

Figure 1: Steps involved in denoising of ultrasound kidney image

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The figure explains the various steps involved in Denoising of ultrasound kidney image. The proposed approach aims at reducing the noise in ultrasound kidney image by using Gabor and Homomorphic filter. Initially the original ultrasound kidney image is taken and is added with the Gaussian and Salt and pepper noise. This step leaves us the noisy image. The noisy image is subjected to Gabor and Homomorphic filter. Then the restored image is formed with the help of these techniques.

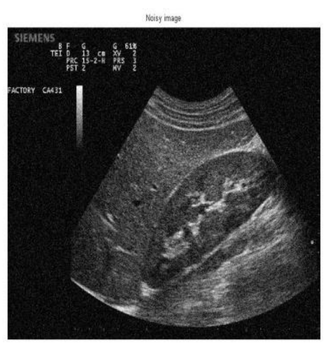
In image processing, a Gabor filter is a linear filter used for edge detection. Frequency and orientation representations of Gabor filters are similar to those of the human visual system, and they have been found to be particularly appropriate for texture representation and discrimination.

Homomorphic filtering is a generalized technique, involving a nonlinear mapping to a different domain in which linear filter techniques are applied, followed by mapping back to the original domain. Homomorphic filter is used for image enhancement. It simultaneously normalizes the brightness across an image and increases contrast.

IV. SIMULATION AND RESULTS

4.1 GAUSSIAN NOISE

a



b

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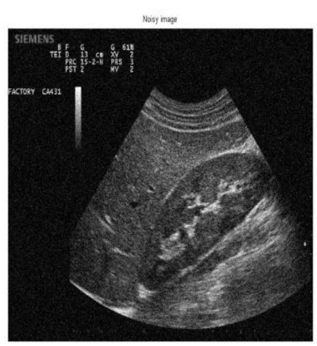
c

Figure 2 Simulation results for Gabor filter

In Figure-2, Figure-a shows the original image and figure-b shows the Gaussian noise added image with variance 0.02. Figure-c shows the denoised image using Gabor filter

a



b

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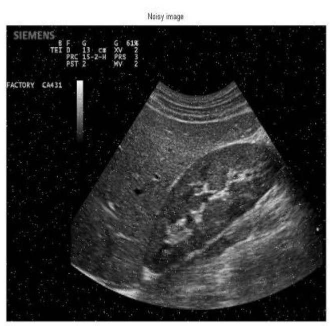
c

Figure 3 Simulation results for Homomorphic filter

In Figure-3, Figure-a shows the original image and figure-b shows the Gaussian noise added image with variance 0.02. Figure-c shows the denoised image using Homomorphic filter

4.2 SALT AND PEPPER NOISE

a



b

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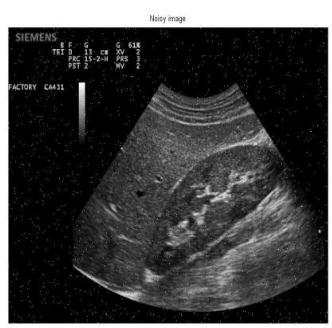
c

Figure 4 Simulation results for Gabor filter

In Figure-3, Figure-a shows the original image and figure-b shows the Salt and Pepper noise added image with variance 0.02. Figure-c shows the denoised image using Gabor filter

a



b

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c

Figure 5 Simulation results for Homomorphic filter

In Figure-3, Figure-a shows the original image and figure-b shows the Salt and Pepper noise added image with variance 0.02. Figure-c shows the denoised image using Homomorphic filter.

V. PERFORMANCE EVALUATION METRICS AND COMPARISON

Peak signal-to-noise ratio, often abbreviated PSNR, is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. PSNR is most commonly used to measure the quality of reconstruction of lossy compression codecs.
PSNR is most easily defined via the mean squared error (MSE). Given a noise-free m×n monochrome image I and its noisy approximation K, MSE is defined as:

$$MSE = \frac{1}{m\,n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

The PSNR (in dB) is defined as:

$$\begin{aligned} PSNR &= 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right) \\ &= 20 \cdot \log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right) \\ &= 20 \cdot \log_{10}(MAX_I) - 10 \cdot \log_{10}(MSE) \end{aligned}$$

For Homomorphic filter the PSNR ratio is high and its MSE is low when compared with the Gabor filter. Hence the Homomorphic filter gives an better result.

Table 1 Comparison of performance metrics for Gaussian Noise

S.NO	PARAMETERS	GABOR	HOMOMORPHIC
1	PSNR	56.65	60.56
2	MSE	0.598	0.265
3	TIME ELAPSED	8.98 SEC	2.35 SEC

Table 2 Comparison of performance metrics for Salt and Pepper Noise

S.NO	PARAMETERS	GABOR	HOMOMORPHIC
1	PSNR	56.56	60.98
2	MSE	0.569	0.245
3	TIME ELAPSED	8.58 SEC	2.54 SEC

The following figure shows the comparison of all the metrics for both the filters. Figure 6 and 7 shows the PSNR chart, Figure 8 and 9 shows the MSE chart and Figure 10 shows the time elapsed to produce the denoised image for both Gabor and Homomorphic filters.

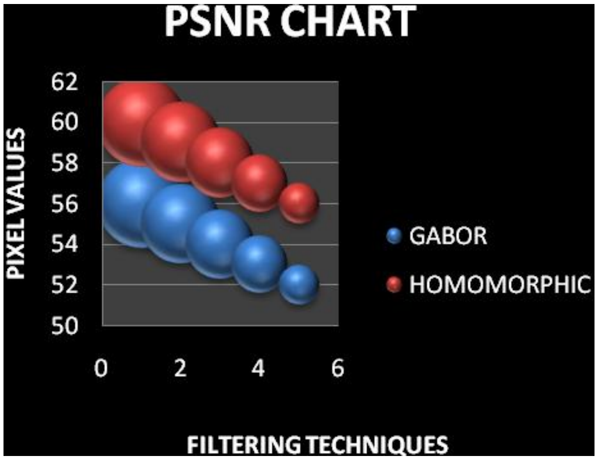

Figure 6 PSNR Chart for Gaussian Noise

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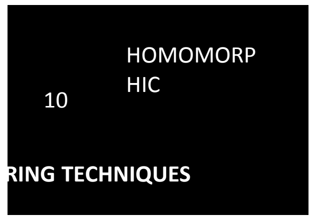

Figure 7 PSNR Chart for Salt and Pepper Noise

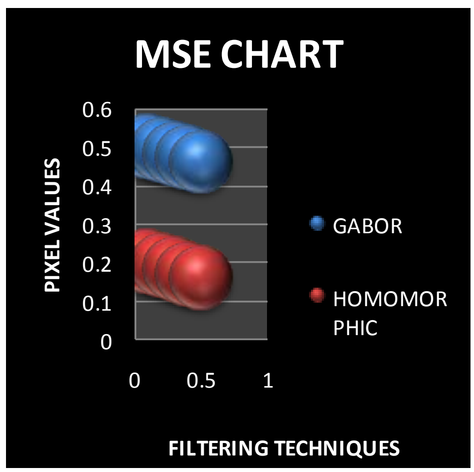

Figure 8 MSE Chart for Gaussian Noise

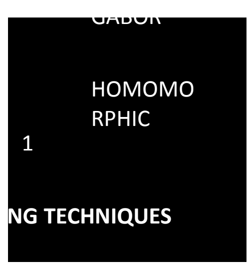

Figure 9 MSE Chart for Salt and Pepper Noise

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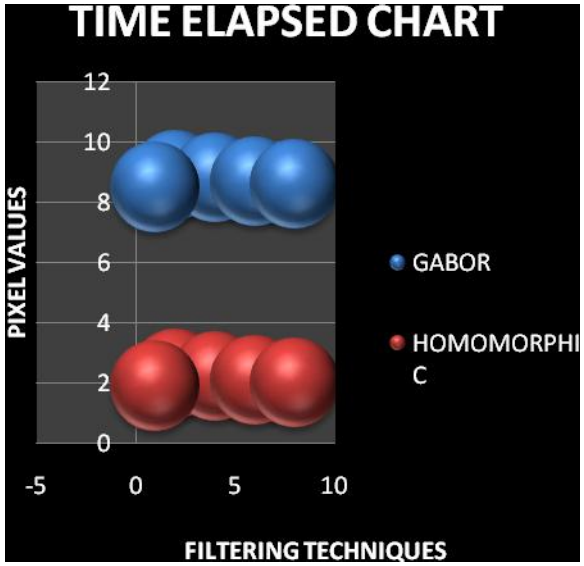

Figure 10 Time Elapsed for the implemented filters

VI. CONCLUSION

The image denoising has become one of the recent research areas in image processing. This paper has proposed denoising ultrasound kidney image by using Gabor and Homomorphic filter. By applying the proposed technique to the noisy image, the Homomorphic produces efficient result than Gabor filter. The noise in the ultrasound kidney image has been cleared. The visibility of the image is increased. The future scope of this paper includes denoising the retinal image, brain MRI image etc,

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