Deblurring Image and Removing Noise from Medical Images for Cancerous Diseases using a Wiener Filter

Iman Hussein AL-Qinani[1]

[1]*Teacher at the University of Mustansiriyah, Dept. of Computer Science, Education College, Baghdad, Iraq*

---***---

Abstract - *A digital image is a prone to kinds of noise as Poisson noise and Gaussian noise. To get a important results, Filter such as Weiner filter have been suggested to remove noise from Medical Images for Cancerous diseases as Liver Cancer, Colon Cancer, Brain tumor, Lung Cancer, Tuberculosis and stomach cancer .This Paper deals Weiner filter for Deblurring image and noise removing, and It has been calculated Mean Square Error, Peak Signal to Noise Ratio, Root Mean Square Error, and SSIM to measure performance of the Weiner filter. This Paper confirms that wiener filter is a flexible and powerful Technique to de-blurring image and removing noise the medical images. Findings of this suggested paper have been simulated on MATLAB.*

Key Words: deblurring, Wiener filter, medical image, noise, Cancerous.

1. INTRODUCTION

Image processing technologies plays an important role in the development of medical image diagnostic methods that is based on image recognition.

Image may do be distorted by several degradations such as Blurring, frequency distortion, fading and noise. These distortions cause the image quality to degrade completely. Image degradation happens while decompression, processing, storage, display, compression, printing, transmission, reproduction, image acquisition etc [1].

Image blur is a common issue that happens when recording digital images cause to camera vibration, long exposition time, or motion of objects. As a result of this, the recorded image is degraded and the recorded view is unreadable [2].

Powerful linear technique proposed like Wiener filtering is significative only when additive noise is existent [3].

The image quality essentially is measured by the peak signal to noise ratio (PSNR), Mean Square Error (MSE), root mean square error (RMSE) and Structural Similarity Index Image (SSIM). All images of cancer have been taken from various sites from the Internet.

2. RELATED WORKS

Fabijańska and Sankowski (2007) produce a new method of noise reduction. Results obtained for introduced method and compared with results executed with traditional approach. analysesof obtained outcome leads to conclusion that for appropriately chosen number of loops introduced algorithm significantly amelioration signal-to-noise ratio. Results are getting better than median filtration [4].

A study by (Sudha, et al., 2009) this study offered a wavelet-based thresholding method used for noise putting out in ultrasound images. Qualitative and quantitative and comparisons of the results introduced by offered method with the results executed from another speckle noise reduction methods proved its higher performance for speckle reduction[5].

Sukhamrit Kaur (2017) produced a new method will be suggested which will use fuzzy membership values for partly blurred areas and distinguished them by support vector machine algorithm. The fuzzy has perfect decision making and SVM reorganization rate. Therefore suggested recognition method will get better result than previously techniques[6].

3. BLURRING AND IMAGE DEBLURRING

3.1 Blurring

Blur (degraded image) is a kind of decrease in bandwidth of an image produced the damaged picture. When the image is created, several causes happen for the image degradation such as long exposition time by camera to capture the image will result blurring due to camera vibration and motion of objects ect. [6, 7].
Blur described by this equation [8]:

$b = PSF*c + N,$

Where: b the blurring image, h the distortion operator know PSF: Point Spread Function PSF, c the original image and F Additive noise, inserted through image acquisition, that become corrupted image[8].

Commonly techniques used in an image processing for blurring are: 1) Average Blur 2) Gaussian Blur 3) Motion Blur [7, 8, 9].

In this proposed paper, we have been used for blurring technique is Motion Blur.

3.1.1 Motion Blur

The Motion Blur effect is a filter that creates the image seems to be moving by add up a blur in a specified direction. The motion may be planned by angle or direction (0 to 360 degrees or –90 to +90) and/or by distance or intensity in pixels (0 to 999), based on the software utilized [7, 8].

3.2 Image Deblurring

Image deblurring mentions to proceedings that endeavor to reduce the blur rate in a blurry image and give the degenerate image an overall sharpened release to get a clearer image [10].

There are many Deblurring Techniques [6, 8]:
1- Wiener Filter Deblurring Technique
2- Regularized Filter Deblurring Technique
3- Lucy-Richardson Algorithm Technique
4- Blind Deconvolution Algorithm Technique

In this proposed paper, we have been used for deblurring technique is Wiener Filter Technique.

3.2.1 Wiener Filter

Powerful linear techniques such as Wiener filtering are significative only while additive noise is existent [3].

Wiener filter is optimal for enhancement image from the noise and motion blur. This technique is creating an image that is less noise than the original image.

The greatest mechanization for elimination of blur in images consequent to unfocussed optics blur or linear motion is the Wiener filter. Weiner filters are out of the away most common deblurring method used because it mathematically finding on the best output [8].

Weiner filter is a non-blind technique to the recovery of the blurred image. Wherefore chance can be there to clear or reduce the additive noise to several areas. Also compression is done to remove the noise. Input to Weiner filter is a blurred image which is decadent by the additive noise. Its output can be calculated by [6]:

$f = g \times (f + n)$

Here, f is known as a filter applied, n is known as noise which is be added.

4. NOISE

Noise in images can be known as undesirable change of color information and brightness. It can be visual as the images contain grains. There are different sources of image noise. It can be generated at the time of take an image through camera or during transportation. Pixels at noisy image appear different intensity rate instead of real intensity rate. There several noise removal mechanisms that are useful for decrease of different styles of noise rely on the requirement [9].

Commonly techniques used in an image processing for Noise are [9]:

1) Impulse Noise (Salt and Pepper Noise)
2) Gaussian Noise
3) Uniform Noise
4) Poisson Noise
5) Speckle Noise

In this proposed paper, we have been used technique for Additive noise is Gaussian Noise technique.

4.1 Gaussian Noise

Gaussian Noise can be defined as Amplifier Noise or Normal Noise. It can be followed probability distribution function such as normal distribution function. The rate this noise can take out is Gaussian distributed [9].

5. IMAGE QUALITY MEASURES

The image quality is estimated by using a mathematical formularization that aims to assign the value of image distortion [11].

5.1 Mean Squared Error (MSE)

MSE is a measurement of control and quality. The MSE is known as follows [11]:

$$\text{MSE}=\frac{1}{\text{M*N}}\sum_{a}\sum_{b}[A(a,b)-W(a,b)]^2$$

Where (A (a, b)) is the original image and (W(a, b)) is the distorted image that contain (M x N)pixels.

5.2 Root Mean Squared Error (RMSE)

Mathematically it is known as [11]:

$$\text{RMSE}=\sqrt{\text{MSE}}$$

5.3 Peak Signal to Noise Ratio (PSNR)

The rate between maximum possible power of a signal and the power of distort noise called PSNR. Mathematically it is known as [11]:

$$PSNR=20\log_{10}(\frac{MAX_f}{\sqrt{MSE}})$$

MAX_f: The maximum signal value that it is in the original image.

5.4 Structural Similarity Index Image (SSIM)

The original and distorted images are split into blocks of size (8 x 8), then the blocks are transform into vectors, and Then (two standard derivations; two means, and one covariance value) are counted as in equations [11].

$$\mu_x = \frac{1}{T}\sum_{i=1}^{T} x_i \quad \mu_y = \frac{1}{T}\sum_{i=1}^{T} y_i$$

$$\sigma_x^2 = \frac{1}{T-1}\sum_{i=1}^{T}(x_i - \bar{x})^2 \quad \sigma_y^2 = \frac{1}{T-1}\sum_{i=1}^{T}(y_i - \bar{y})^2$$

$$\sigma_{xy}^2 = \frac{1}{T-1}\sum_{i=1}^{T}(x_i - \bar{x})\,(y_i - \bar{y})$$

SSIM between images x and y is it is known as [11]:

$$SSIM(x,y) = \frac{(2\mu_x\mu_y + c_1)(2\sigma_{xy} + c_2)}{(\mu_x^2 + \mu_y^2 + c_1)(\sigma_x^2 + \sigma_y^2 + c_2)}$$

Where c1 and c2: are constants.

For good metrical, the values of SSIM and PSNR must be high. As well, the values of RMSE and MSE must be low.

6. EXPERIMENTAL AND RESULTS

6.1 Experimental: Steps of Design and Implementation Wiener Filter

The experiments have been implemented in MATLAB environment on standard 128x128 medical Images.

Step 1: Read Image

Read Original Image, which is RGB image.

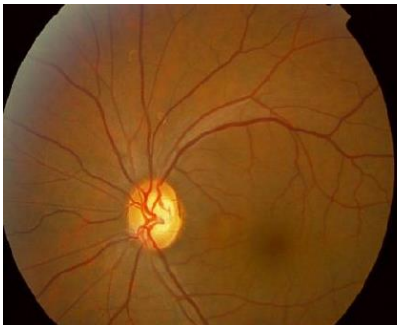


Fig -1: Original image

Step 2: Simulate a Motion Blur

Mimic a blurred image that you might obtain from camera motion. Create PSF, corresponding to the linear motion (LEN=21), at THETA=11.

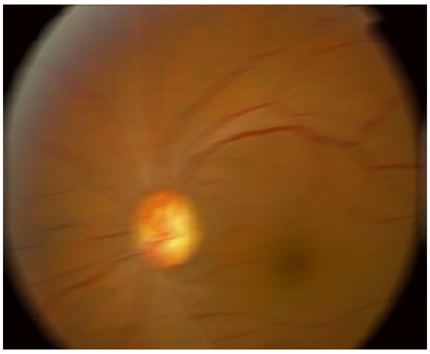


Fig -2: Motion blurred image

Step 3: Restore the Blurred Image

The easy manner syntax for deconvwnr is deconvwnr (k, PSF, NSR), where k is the blurred image, PSF is the point-spread function, and NSR is the noise-power-to-signal-power ratio. The blurred image created in Step 2 has no noise, so we will use 0 for NSR. Using a Wiener Filter has been used to elimination Blurred from image.

Fig -3: Restored blurred image

Step 4: Simulate Blur and Noise

Simulate Blur and Noise is adding noise on Blurred Image.

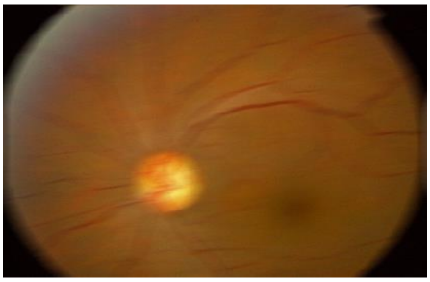


Fig -4: Simulate blur and noise

Step 5: Restore the Blurred and Noisy Image: First Attempt

In our first recovery attempt, we will tell deconvwnr NSR = 0, When NSR = 0 that mean no noise, the Wiener restoration filter is equal to an ideal inverse filter which it may be highly sensitive to noise in the input image such as the next image offers:

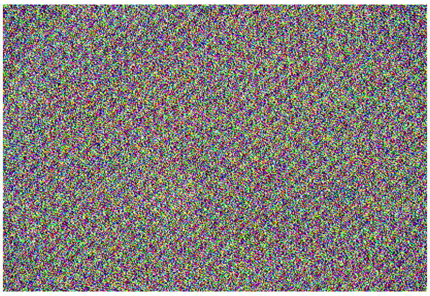


Fig -5: First attempt for restoration of blurred, noisy image

Step 6: Restore the Blurred and Noisy Image: Second Attempt

In second attempt we need an estimate of the noise-power-to-signal-power ratio by NSR = noise_var / signal_var

Fig -6: second attempt for restoration of blurred, noisy image Using Estimated NSR

6.2 Results

In figure (7) shows GUI of the Present method for many medical images (*medical images for cancerous diseases*).

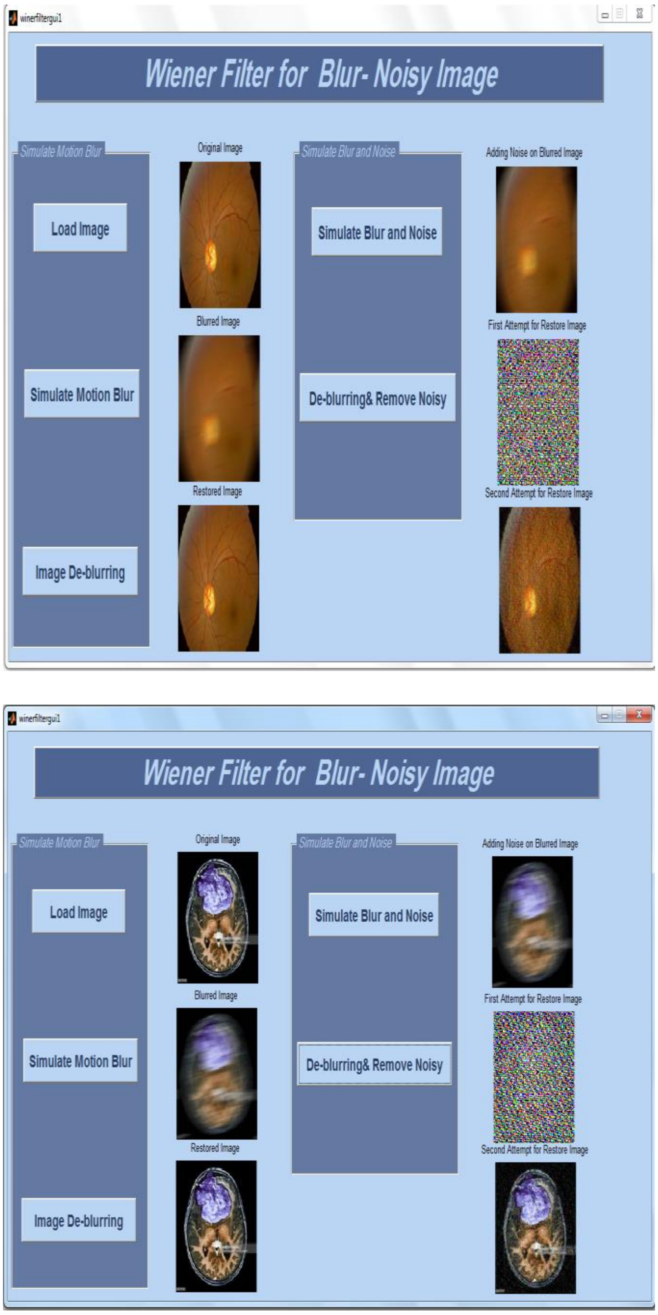
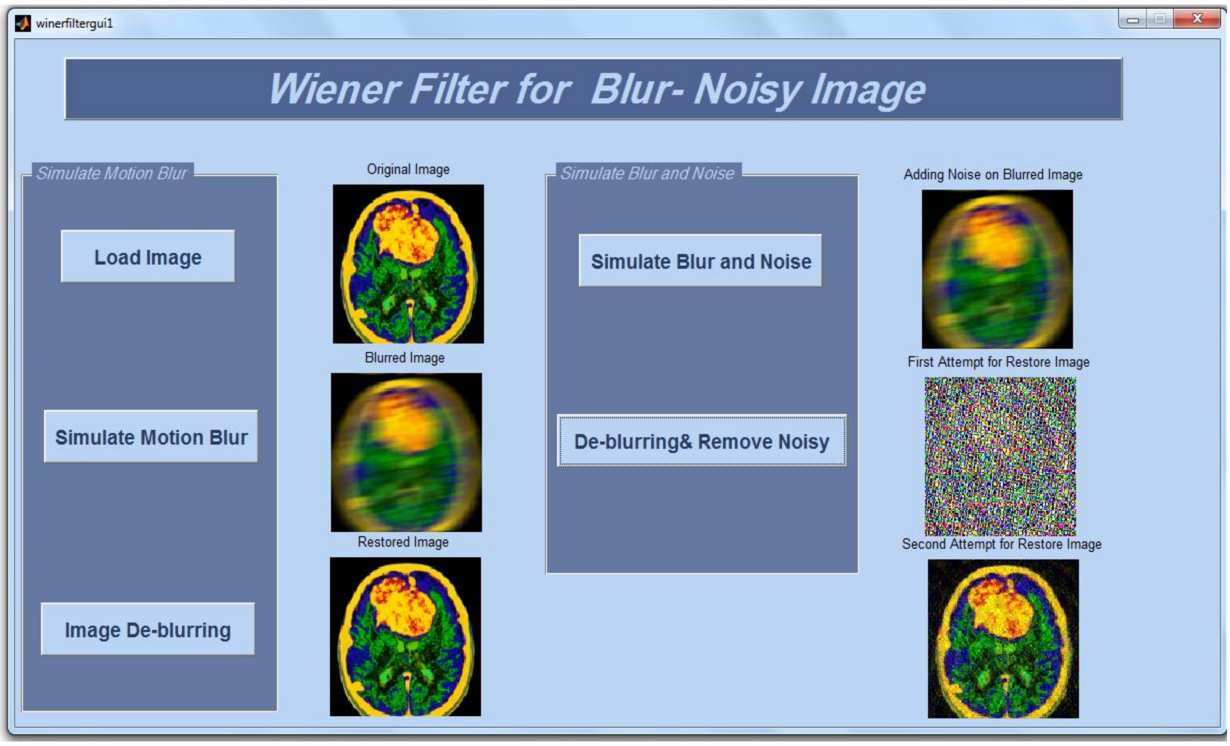
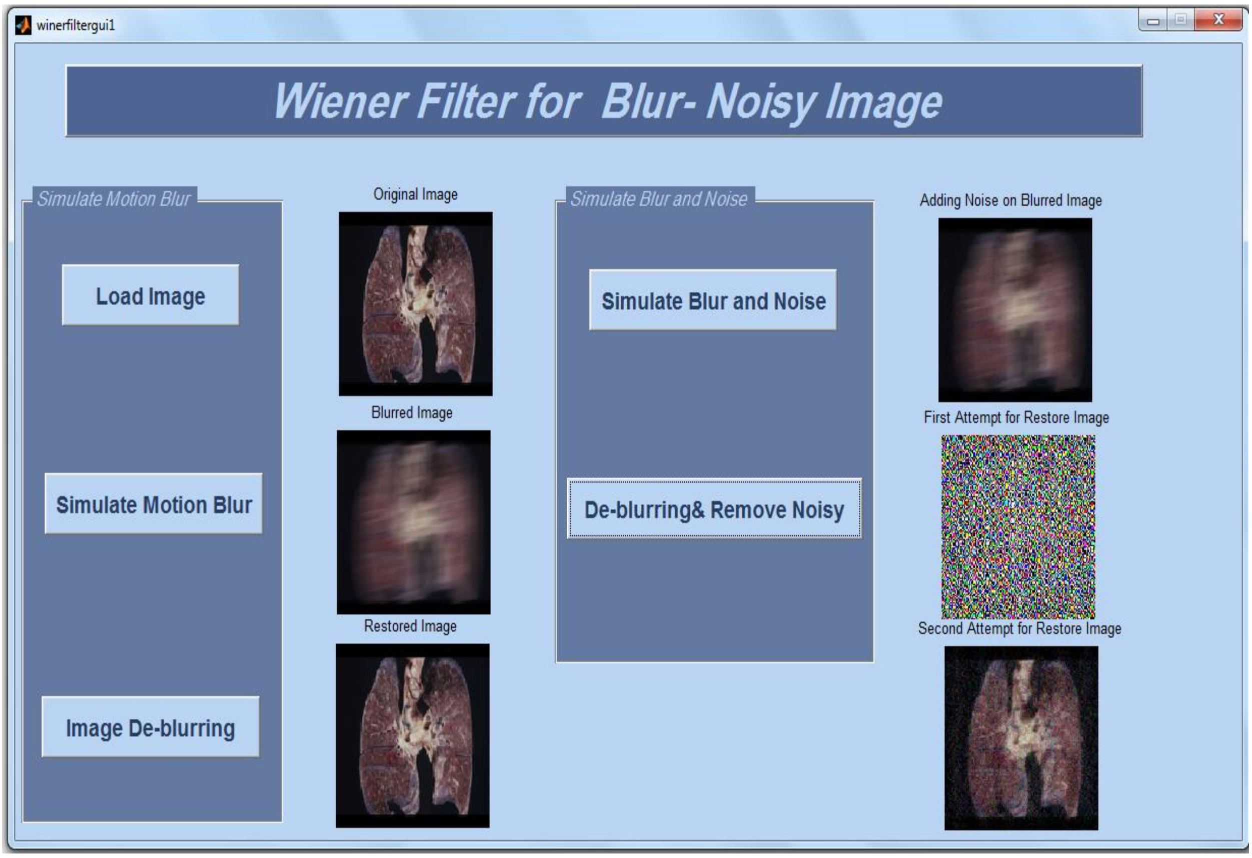
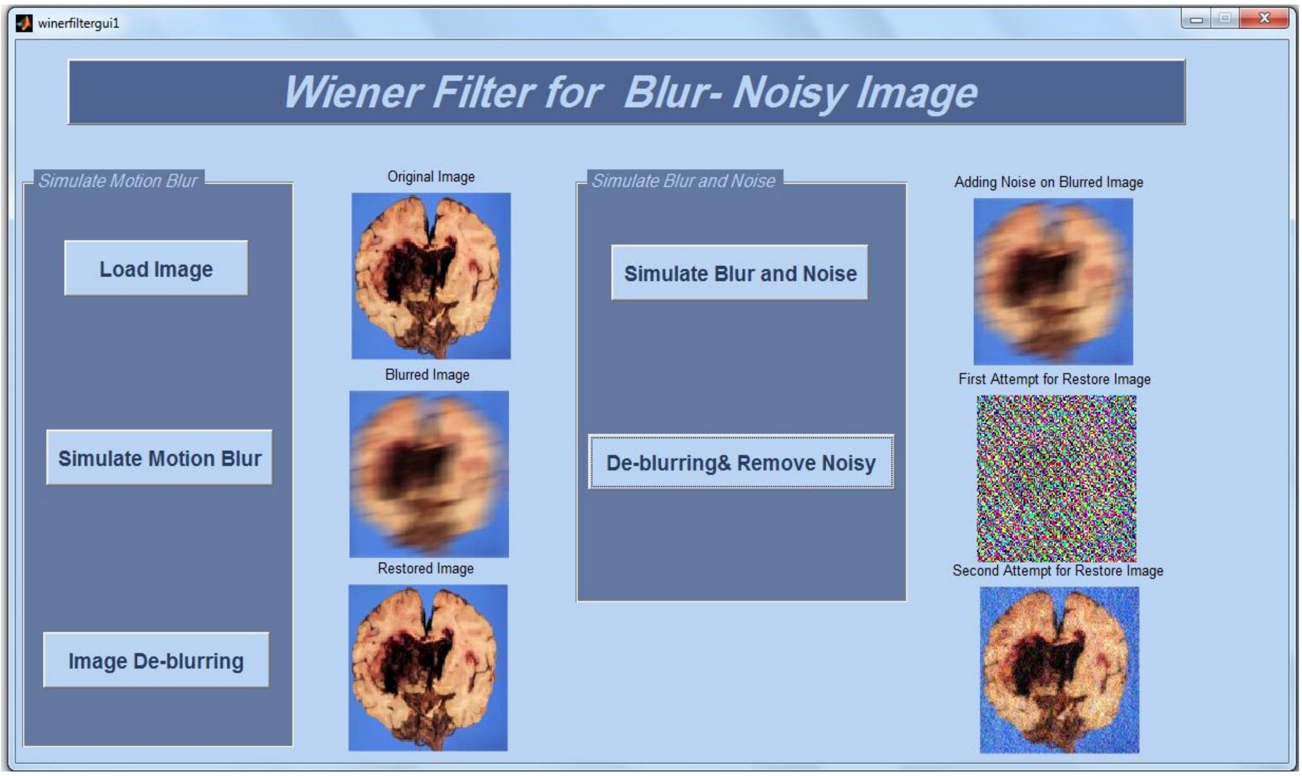
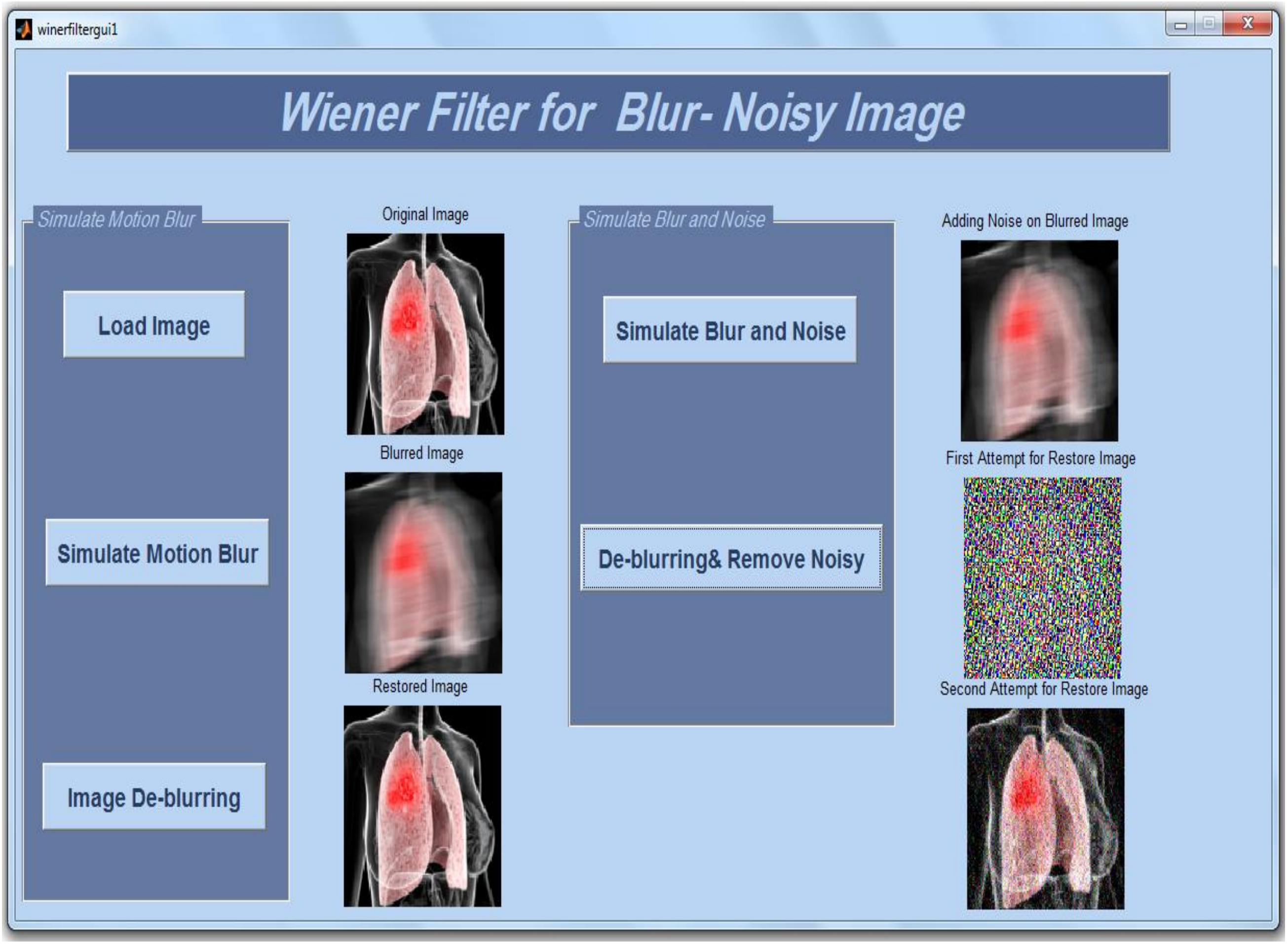


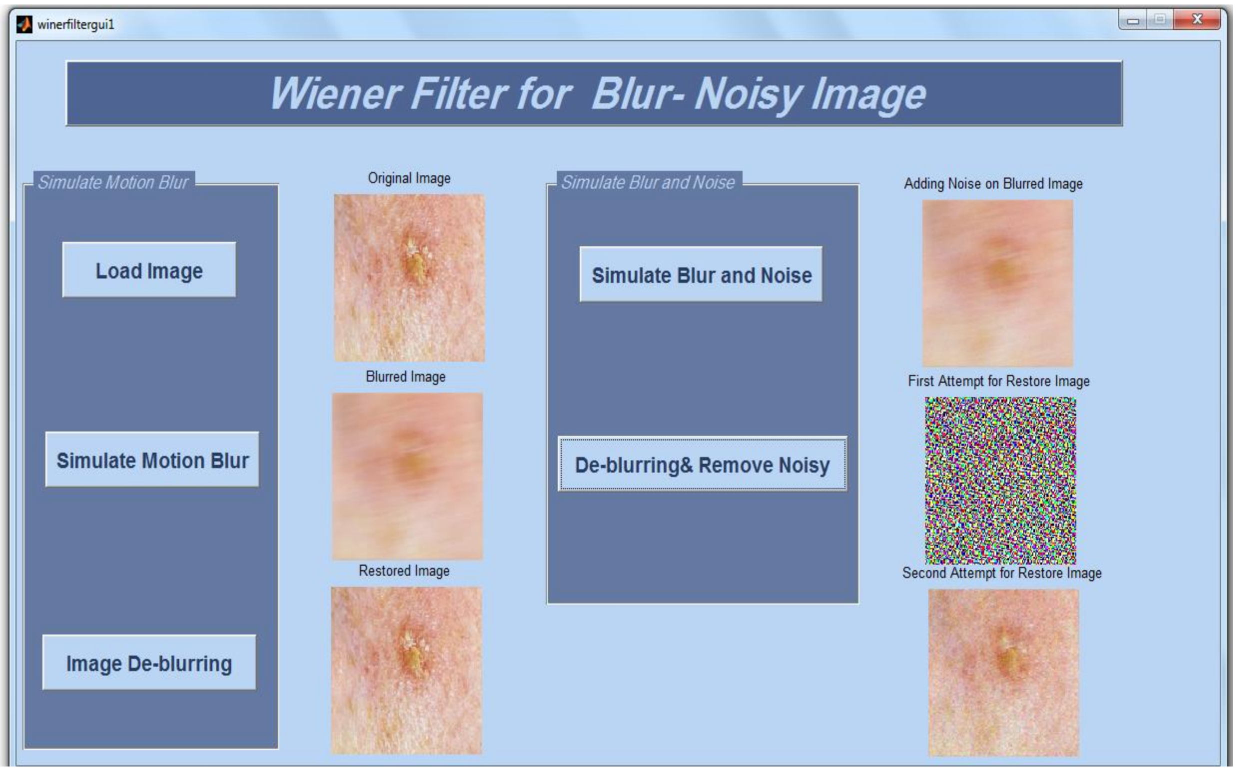
Fig -7: GUI of the Present Method for Many Medical Images

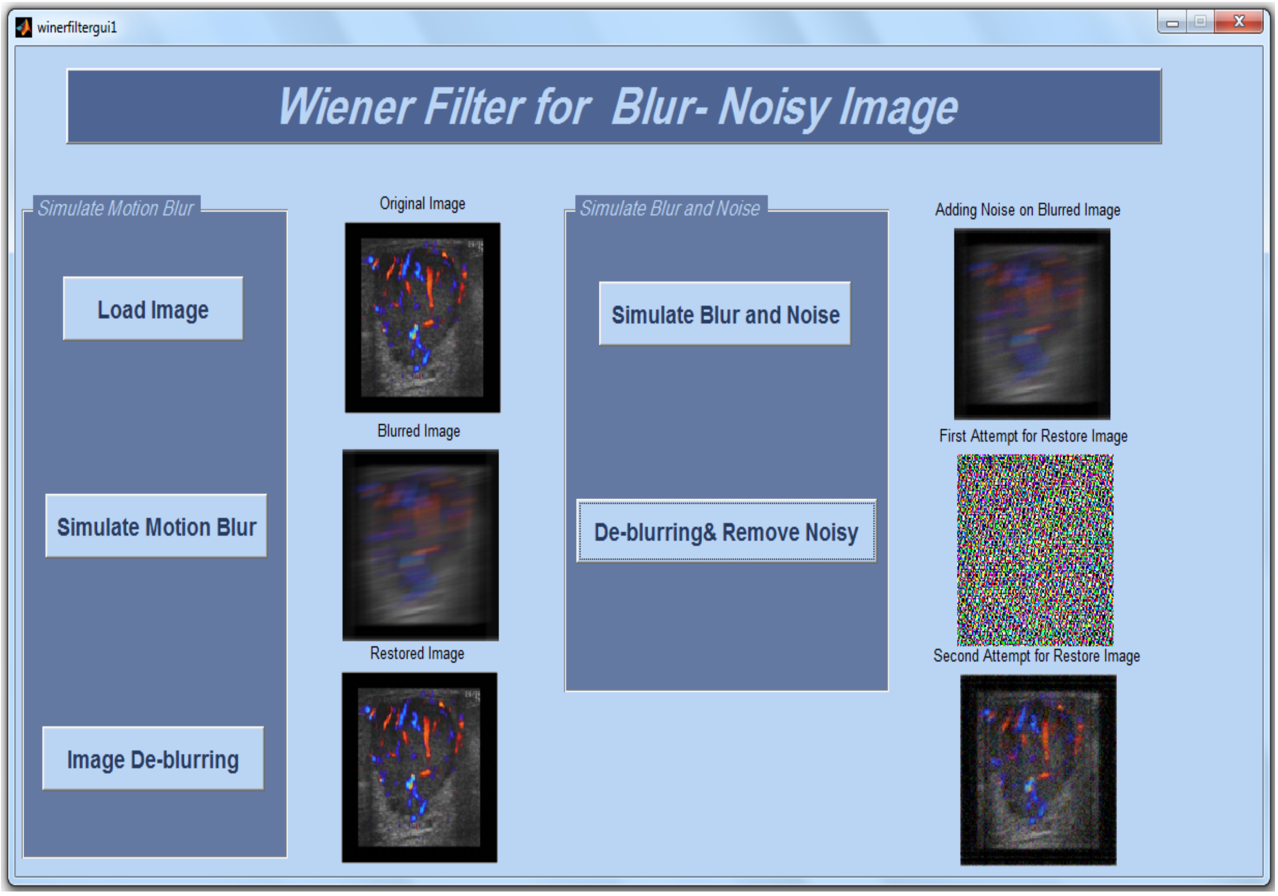

winerfiltergui1
Wiener Filter for Blur- Noisy Image
Simulate Motion Blur
Load Image
Simulate Motion Blur
Image De-blurring
Original Image
Blurred Image
Restored Image
Simulate Blur and Noise
Simulate Blur and Noise
De-blurring& Remove Noisy
Adding Noise on Blurred Image
First Attempt for Restore Image
Second Attempt for Restore Image

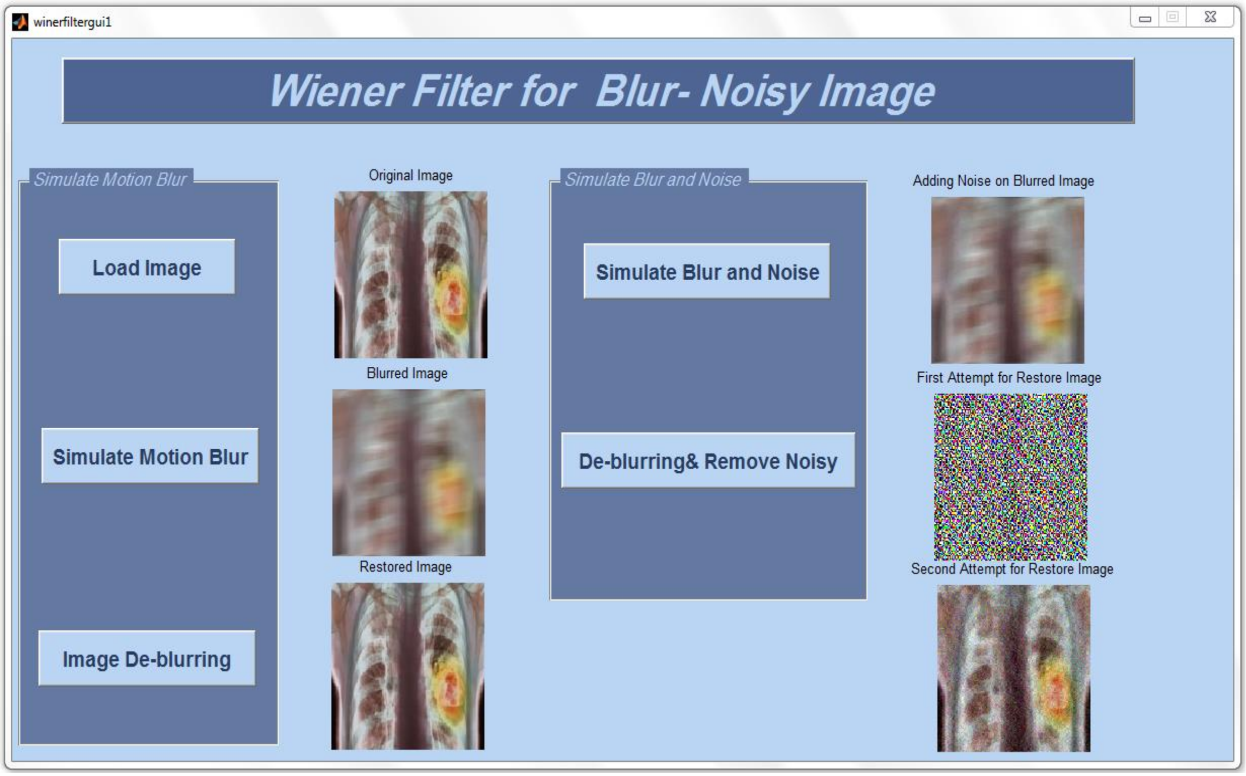

winerfiltergui1
Wiener Filter for Blur- Noisy Image
Simulate Motion Blur
Load Image
Simulate Motion Blur
Image De-blurring
Original Image
Blurred Image
Restored Image
Simulate Blur and Noise
Simulate Blur and Noise
De-blurring& Remove Noisy
Adding Noise on Blurred Image
First Attempt for Restore Image
Second Attempt for Restore Image


winerfiltergui1
Wiener Filter for Blur- Noisy Image
Simulate Motion Blur
Load Image
Simulate Motion Blur
Image De-blurring
Original Image
Blurred Image
Restored Image
Simulate Blur and Noise
Simulate Blur and Noise
De-blurring& Remove Noisy
Adding Noise on Blurred Image
First Attempt for Restore Image
Second Attempt for Restore Image


winerfiltergui1
Wiener Filter for Blur- Noisy Image
Simulate Motion Blur
Load Image
Simulate Motion Blur
Image De-blurring
Original Image
Blurred Image
Restored Image
Simulate Blur and Noise
Simulate Blur and Noise
De-blurring& Remove Noisy
Adding Noise on Blurred Image
First Attempt for Restore Image
Second Attempt for Restore Image


winerfiltergui1
Wiener Filter for Blur- Noisy Image
Simulate Motion Blur
Load Image
Simulate Motion Blur
Image De-blurring
Original Image
Blurred Image
Restored Image
Simulate Blur and Noise
Simulate Blur and Noise
De-blurring& Remove Noisy
Adding Noise on Blurred Image
First Attempt for Restore Image
Second Attempt for Restore Image


winerfiltergui1
Wiener Filter for Blur- Noisy Image
Simulate Motion Blur
Load Image
Simulate Motion Blur
Image De-blurring
Original Image
Blurred Image
Restored Image
Simulate Blur and Noise
Simulate Blur and Noise
De-blurring& Remove Noisy
Adding Noise on Blurred Image
First Attempt for Restore Image
Second Attempt for Restore Image


winerfiltergui1
Wiener Filter for Blur- Noisy Image
Simulate Motion Blur
Load Image
Simulate Motion Blur
Image De-blurring
Original Image
Blurred Image
Restored Image
Simulate Blur and Noise
Simulate Blur and Noise
De-blurring& Remove Noisy
Adding Noise on Blurred Image
First Attempt for Restore Image
Second Attempt for Restore Image

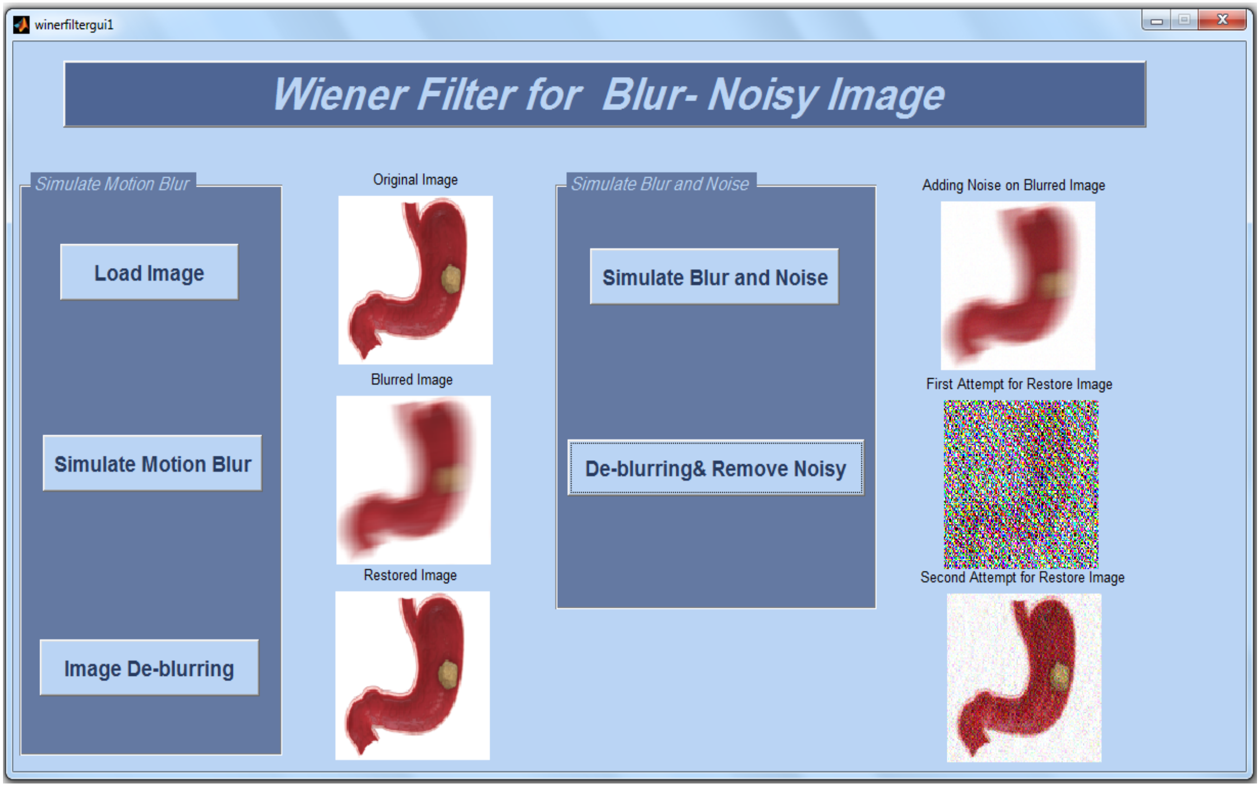
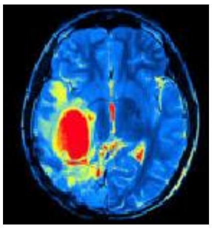
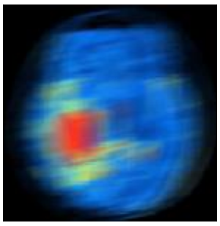
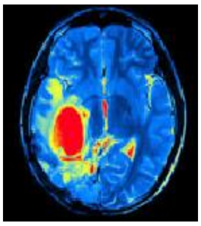
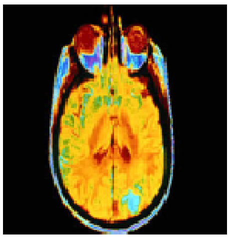
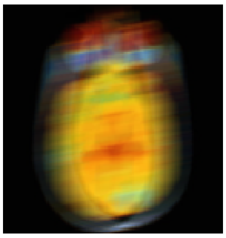
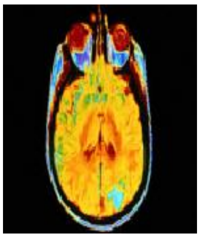
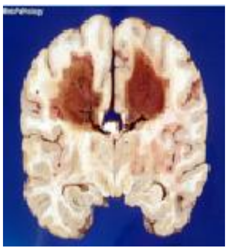
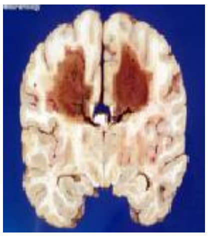
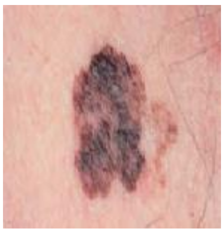
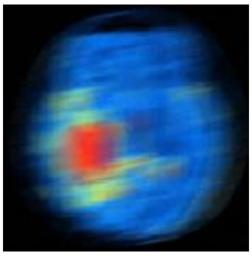
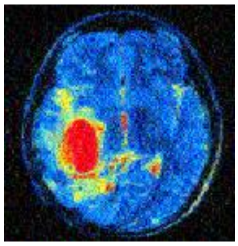
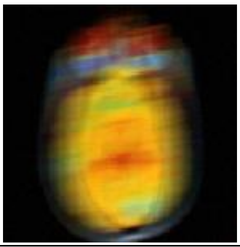
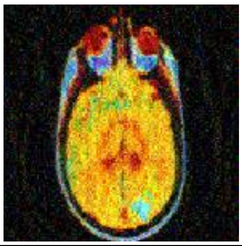
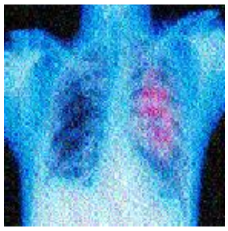
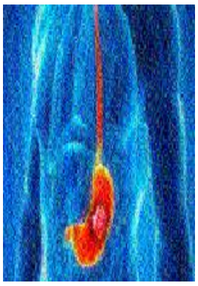

winerfiltergui1
Wiener Filter for Blur- Noisy Image
Simulate Motion Blur
Load Image
Simulate Motion Blur
Image De-blurring
Original Image
Blurred Image
Restored Image
Simulate Blur and Noise
Simulate Blur and Noise
De-blurring& Remove Noisy
Adding Noise on Blurred Image
First Attempt for Restore Image
Second Attempt for Restore Image

Table -1 shows restore the Blurred and Noisy Image for medical images.

Medical Image	Blurred mage	De-blurring Image after apply Wiener Filter
		
		
		
		
		

Add Blur and Noise to Image	De-blurring Image & remove Noise from Image after apply Wiener Filter
	
	
	
	
	

Medical Image	Blurred mage	De-blurring Image after apply Wiener Filter
		
		
		
		
		

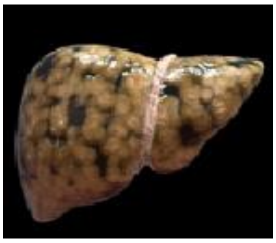
Add Blur and Noise to Image	De-blurring Image & remove Noise from Image after apply Wiener Filter
	
	
	
	
	

Table -2 shows the values of PSNR, MSE, RMSE, and SSIM for Images Using Wiener Filter.

No. Image	Image Quality Measures	value of Quality Measures between Original Image and blurred Image	value of Quality Measures between Original Image and de-blurred Image
1	MSE	0.0057	1.0060e-006
	RMSE	0.0757	0.0010
	PSNR	0.0050	8.7967e-007
	SSIM	0.5176	0.9993
2	MSE	0.0030	3.6024e-007
	RMSE	0.0550	6.0020e-004
	PSNR	0.0024	2.8745e-007
	SSIM	0.7537	0.9988
3	**MSE**	0.0119	1.2089e-006
	RMSE	0.1091	0.0011
	PSNR	0.0095	9.6445e-007
	SSIM	0.3712	0.9993

No. Image	Image Quality Measures	value of Quality Measures between Original Image and image after add noise on Blurred Image	value of Quality Measures between Original Image and Restore Image
1	MSE	0.0057	0.0050
	RMSE	0.0757	0.0708
	PSNR	0.0050	0.0044
	SSIM	0.5082	0.5079
2	MSE	0.0031	0.0028
	RMSE	0.0553	0.0533
	PSR	0.0024	0.0023
	SSIM	0.7263	0.3731
3	**MSE**	0.0120	0.0062
	RMSE	0.1093	0.0787
	PSNR	0.0095	0.0049
	SSIM	0.3472	0.4865

7. CONCLUSIONS

Wiener filter is optimal for enhancement image from the noise and motion blur. This technique is creating an image that is less noise than the degenerate image because Wiener filter is based on statistical method.

ACKNOWLEDGEMENT

The authors would like to acknowledge AL-Mustansiriyah University (www. uomustansiriyah.edu.iq) Baghdad-Iraq for its support to present this work.

REFERENCES

[1] H. Yogita and Y. Patil, "A Survey on Image Quality Assessment Techniques, Challenges and Databases," International Journal of Computer Applications (0975 – 8887) National Conference on Advances in Computing (NCAC 2015), pp. 34 – 38.

[2] I. M. El-Henawy,A. E. Amin, Kareem Ahmed and Hadeer Adel, "A Comparative Study On Image Deblurring Techniques," International Journal of Advances in Computer Science and Technology (IJACST), Vol.3 , No.12, pp : 01-08 Special Issue of ICCEeT 2014 - Held on 22nd December 2014, Dubai.

[3] N. H. Mahmood, M. R. M. Razif and M. T. A. N. Gany, "Comparison between Median, Unsharp and Wiener filter and its effect on ultrasound stomach tissue image segmentation for Pyloric Stenosis," International Journal of Applied Science and Technology , Vol.1 , No.5, pp : 218 -226 ,Centre for Promoting Ideas, USA, September 2011.

[4] A. Fabijańska, D. Sankowski," Image Noise Removal – The New Approach," CADSM'2007, February 20-24, 2007, Polyana, UKRAINE.

[5] S.Sudha, G.R.Suresh and R.Sukanesh," Speckle Noise Reduction in Ultrasound Images by Wavelet Thresholding based on Weighted Variance International Journal of Computer Theory and Engineering, Vol. 1, No. 1, April 2009.

[6] S. Kaur and V. K. Banga, "A Comparative Study of Various Deblurring Techniques," International Journal of Computational Intelligence Research, Vol. 13, No.5 (2017), and pp: 1003-1013, Research India Publications.

[7] R. Kumar and A. Gupta, "Comparative Study of Various Image Restoration Techniques on the Basis of Image Quality Assessment Parameters," International Journal of Computer Science and Technology, Vol. 4, No.2, pp: 274- 279, April - June 2013

[8] S. S. Al-amri, N.V. Kalyankar, "A Comparative Study for Deblured Average Blurred Images," (IJCSE) International Journal on Computer Science and Engineering, Vol. 02, No. 03, pp: 731-733, 2010.

[9] S. Jain, and S.Goswami, "A Comparative Study of Various Image Restoration Techniques With Different Types of Blur," International Journal of Research in Computer Applications and Robotics, Vol. 3, No.11, pp: 54-60, November 2015.

[10] Z.Al-Ameen, G.Sulong and Md. G. Johar, "A Comprehensive Study on Fast image Deblurring Techniques," International Journal of Advanced Science and Technology, Vol. 44, No.11, pp: 1-10, July, 2012.

[11] H. Boztoprak, "An alternative image quality assessment method for blurred images," Balkan Journal Of Electrical & Computer Engineering, Vol. 4, No.1, pp: 46-50, March 2016. DOI: 10.17694/bajece.24838

BIOGRAPHY:

Iman AL-Qinani. She received BSc in computer science from AL-Mustansiriyah University (2004), and MSc in computer science from Al-Balqa' Applied University- Jordan (2011). She has many published papers in the computer science field. Her research interests are in image processing, biomedical, and Artificial Intelligence, She's Associate Teacher in Computer Science at the University of Mustansiriyah, Education College, Baghdad, Iraq.