INTERNATIONAL RESEARCH JOURNAL OF PHARMACY

www.irjponline.com

ISSN 2230 – 8407

Research Article

PERFORMANCE ANALYSIS OF NOISE FILTERS USING HISTOPATHOLOGICAL TISSUE IMAGES IN LUNG CANCER

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Article Received on: 11/11/16 Revised on: 13/12/16 Approved for publication: 08/01/17

DOI: 10.7897/2230-8407.080110

ABSTRACT

Digital Image Processing employing unique algorithms have found applications in many different fields. Noises associated with the histological images were needed to be removed for better image processing and diagnosis of cancer disease. Three different types of noise such as additive, random impulsive and multiplicative are normally associated with the any image. Here in the present work planned to remove the noise on medical cancer histological images for effective diagnosis of lung cancer. Since the type of noise is unknown, four basic filters viz., Average, Median, Gaussian as well as Wiener filter were analysed on the MATLAB platform. Further the filter performance through PSNR and MSE analysis. The intensity plot has also been drawn to describe the working of image filters. Overall filter experiments and its performance analysis conclude the median filter was effective in removal of the noise associated with the histological slides. The performance analysis was concluded that average median filter was effective for removing noise in biological sample.

Keywords: Histological image, Digital Image Processing, MATLAB, Noise removal, Image filters.

INTRODUCTION

Digital image processing involves the application of unique computational algorithmic methods to perform processing over digital images. Image processing has been widely used in many different fields such as medical diagnostics, forensics and cinematography etc., The Image processing encompasses both low level programming such as noise removal and up to high level of processing like segmentation and feature extraction[1]. Noise removal is an important and preliminary step in any digital image processing. Noise is nothing but the variation of random image intensity[2]. Here the true pixel intensity values were shredded by some false values. Noise in any image may occur at different levels such as image caption or its transmission[3]. In the digital images, the primary source of noises are:

a) insufficient lighting and temperature for the imaging sensor,

b) the image sensor may be affected due to environmental conditions,

c) presence of the dust particles over the screen,

d) interruption at the transmission channel. The type of the noise that arises commonly in the images are classified into three types. They include a) Impulsive noise b) Additive noise c) Multiplicative noise[4].

In case of impulsive noise, many different values were randomly added to each pixel of an image. Pixel is the basic unit of any image. The impulsive noise is also called as random noise and it appears as black and white dots throughout the image. Additive noise is the one, where a certain value is uniformly added over all the pixels of the image. In contrast, in the multiplicative noise some values are multiplied uniformly in all the pixels[5].

Likewise, the different types of noises and various types of image filters are also available for specific type of noise. In recent times, most employable filters for image denoising process include Average (Mean), Median, Gaussian and Wiener filter[6]. The different noise algorithms help in smoothening of the intensity values throughout the image and thus codes for the noise removal ability. Noise removal is very important and that directly correlates the quality of the image in further processing. When we consider the medical MRI images, some sort of speckle noise will be associated with it. But the histological images of certain tissues and cells will be found off with a kind of additive noise, as they were captured with the digital camera[7]. In the present study, we have analyzed the differential ability of image filters in removing the noise associated with cancer histology images. The study also compared the performance ability of the different noise filters by image Qualitative analysis in histological images.

MATERIALS AND METHODS

Collection of cancer images from database

The first step initiates with the collection of different cancer histology images from the online database ITK. The collected images were grouped based on the knowledge of the tissue types and stored as separate folders for the further processing.

Image Filtering

To remove the type of noise associated with the histopathological images, we employed the following four different types of filters.

Mean Filter

An averaging filter or Mean filter is mainly useful for removing the grain type noise from an image. Here the pixel values will be set as average of the neighborhood pixels. It is a kind of linear filter and employs a mask over the pixels in the image for denoising[8].The averaged pixel values will be assigned to the center pixel of the mask. One of the main disadvantage of the mean filter is it fails to preserves the edges of an image.

Median Filter

A kind of non-linear filter, which are often used in the image processing to remove the noise is the median filter. One of the major advantage of the median filter is, it strongly preserves the edges of an image[9,10] . It detects the median unbroken pixel value of the image and applies the same pixel throughout the Figure 1. Moreover, the median filter enables the elimination of image noise values with larger intensity. Mathematically, the median filter can be explained as,

$$y(t) = \text{median}((x(t-T/2),x(t-T+1),\ldots,x(t),\ldots,x(t+T/2)) \quad (1)$$

where it represents the size of the image window.

Gaussian Filter

Gaussian filter is one another noise removal option. A Gaussian filter mathematically modifies the input image by applying convolution with a Gaussian function[11]. It is a kind of linear filter for the noise removal. It is a 2-D convolution operator that is used to remove the noise and details of the image by blurring the image. It is similar to the mean filter, but it employs a different bell shaped Gaussian kernel hump.

Wiener Filter

The Weiner filter performs the spatial smoothing of the image and main theme is sort-out the noise with corrupted signal. These filters try to perform filtering from a different angle when compared to other filters. Moreover, they will apply a statistical approach for selecting the desired frequency response[12]. Any wiener filter can be characterized with the assumption, requirement and performance. The performance of the wiener filter was made by the mean square error calculation.

Performance Measurement of the Filters

The performance of the different noise removal filters was quantified by measuring the Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSR) as well as in terms of image visual appearance[13]. Performance of all algorithms is tested with the histological Images. The Statistical Measurement for PSNR and MSE are given below.

Intensity Plot Analysis

To assess the working the various filters, intensity plot of the raw as well as processed image was plotted. This shows the variation in the intensity of the raw image against the filtered image. When the plot is linear, it shows there is no change in image intensity. The same way when there will be variations in the plot, it indirectly indicates that the image was processed by the filter.

RESULTS

Filtering of Images with different filters

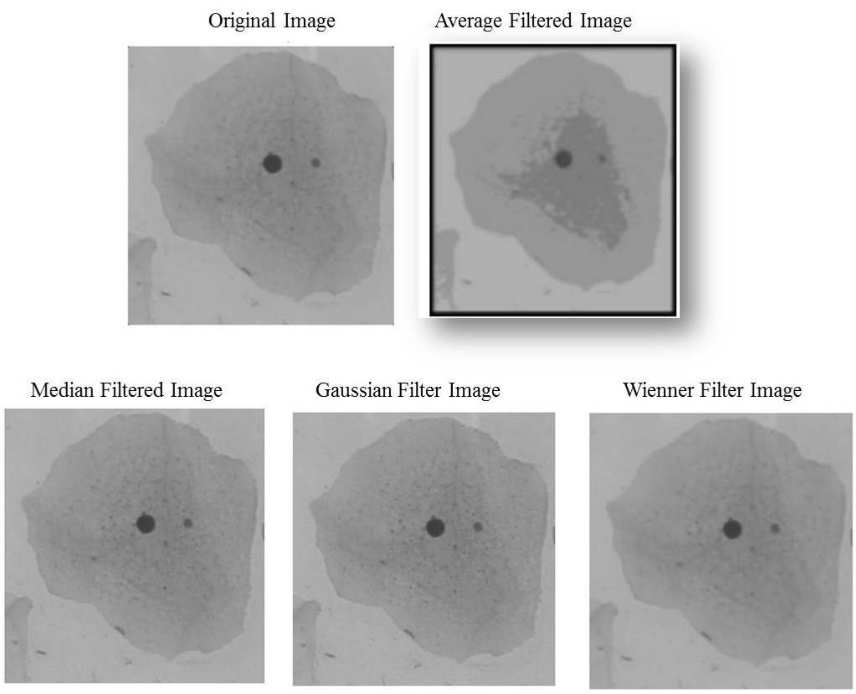

Figure 1. Pap smear image treated with four different types of filters

The images collected from the ITK database was subjected with the noise removal filter algorithms such as Mean, Median, Gaussian and Wiener filter. Figures 1, 2 & 3 shows the different processed images of various tissue samples. The visual observation of the three image sets shows that the mean filtered image was reduced in information when compared with the original image. In case of the median filtered image, the edges of the objects were greatly preserved and image background information has also been cleared to project the actual image data. Gaussian filter in the processing reduces the high frequency noise data and it preserves the low frequency actual image information. The wiener filtered image was blurred up to a certain level but the originality of the structures was maintained. The visual observation concludes that the median as well as Gaussian filtered image were residing the actual information without the noise. Further the results of the PSNR & MSE analyses helps in choosing the best operating filter histology noise.

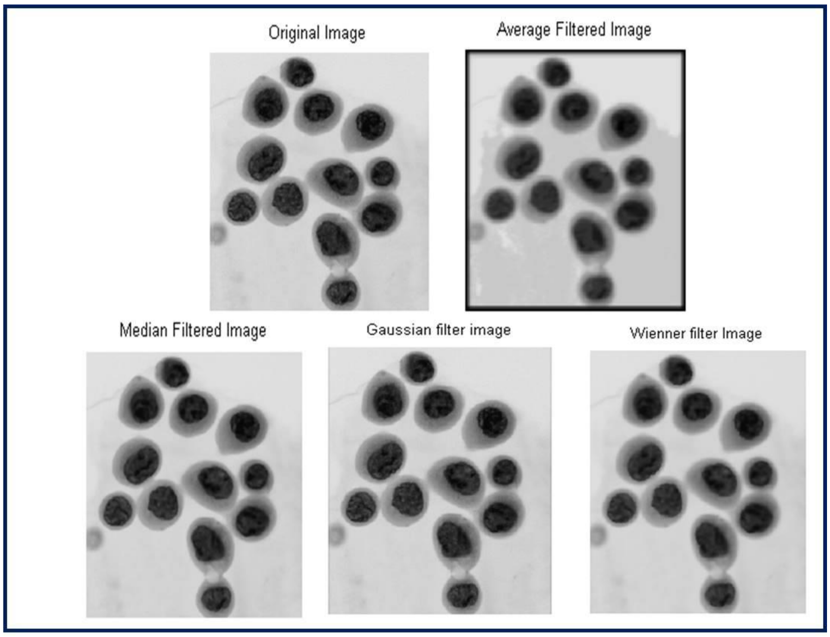

Figure 2. Breast cancer histology treated with four different types of filters

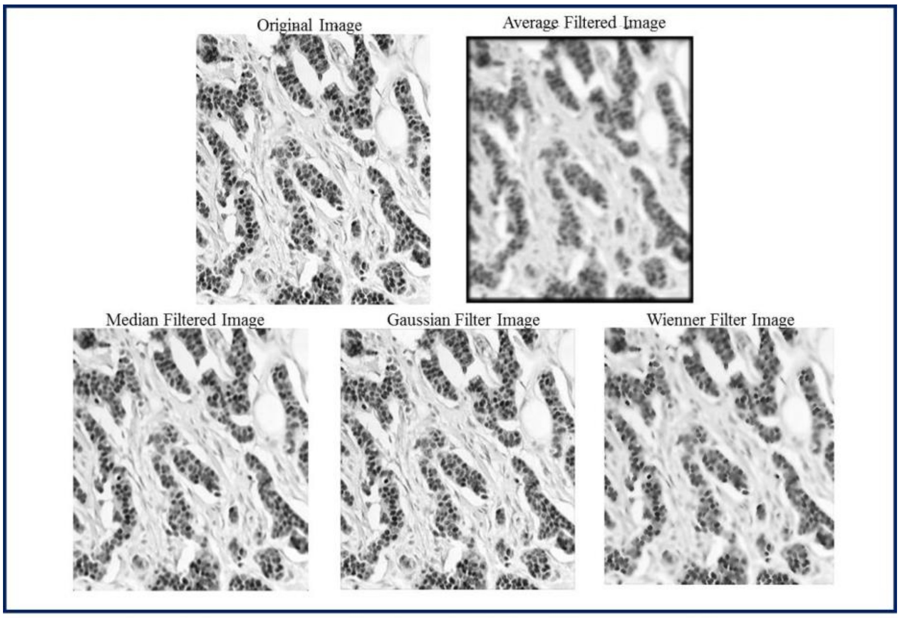

Figure 3. Lung cancer histology treated with four different types of filters

Performance analysis of different filters

Table 1: Performance Analysis of different filters on Pap smear image

Type of Filter	Image	PSNR	MSE
Gaussian Filter	Pap smear image	38.37	10.64
Median Filter		46.53	1.46
Mean Filter		32.13	12.74
Wiener Filter		46.176	1.58

Table 2: Performance Analysis of different filters on Breast cancer image

Type of Filter	Image	PSNR	MSE
Gaussian Filter	Breast Histopathology	36.25	15.17
Median Filter		38.50	18.44
Mean Filter		30.671	22.18
Wiener Filter		32.94	33.29

Table 3: Performance Analysis of different filters on Lung histopathology

Type of Filter	Image	PSNR	MSE
Gaussian Filter	Lung Histopathology	36.0695	16.20
Median Filter		39.40	7.51
Mean Filter		26.058	21.34
Wiener Filter		30.25	20.131

The condition for the best image quality was their PSNR value must be high and MSE values must be low. From the performance analysis of Pap smear images, the median filter shows higher PSNR of 46.53, which is followed by the wiener filter was 46.176. Gaussian filtered image possessed a value of 38.37 and the mean filter maintained the low PSNR value. On the whole, the performance of median filter for the Pap smear was good and also, they possess a low MSE value of 1.46. In a similar kind for the other two image types such as breast and lung histology, the median filter possessed a higher PSNR of 38.50 and 39.40 and low MSE of 18.44 and 7.51 respectively. The overall results of the performance analysis select the median filter as the best for the image histology noise. It also reported that the median filter was effective in removing the salt and pepper noise[14]. The median filter is also employed successfully for canny based edge detection[15]. Similarly, median filter alone are used for grey scale image processing[16,17].

Intensity Plot Analysis

The intensity plot algorithm reads in two images and at every pixel level it compares the varying intensity between the two images[18]. The intensity plot of the two original images provides a straight line since the intensity of all the pixels will remain the same Figure 4. On the other hand, the comparison of an original and median filter image shows an intensity plot of greater deviation from the two-original image plots[19]. Finally, it confirms the working of the median filter on the histology slide. With this we suggest that the intensity plot can be greater employed for analyzing the working of different image filters[20].

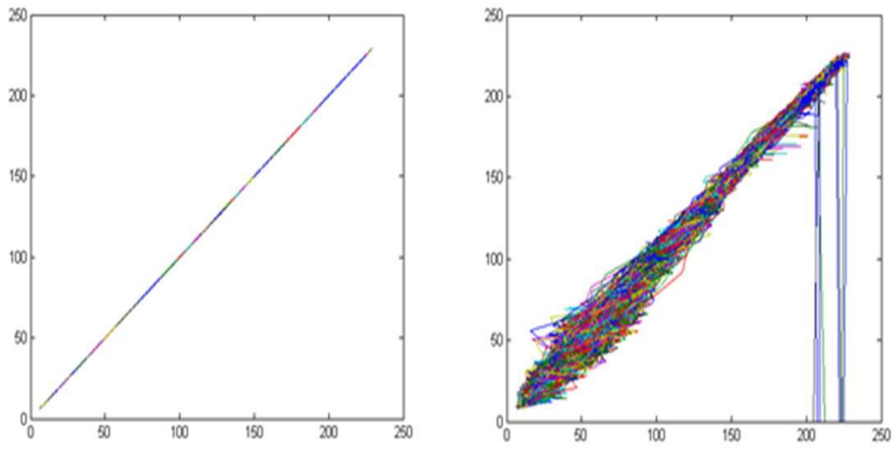

Figure 4. Intensity Evaluation of the original and Processed Images
A – Two original images has been compared
B – An original and a median filter image has been compared

CONCLUSION

Four kinds of filters have been applied over the three different tissue images such as Pap smear, Breast and Lungs. The result of PSNR & MSE analysis shows that the Median filter was efficient in removing the noise associated with the histology slides. Further the intensity plot analysis also conveys the functioning of median filters over histology images. Over all, we conclude that median filter was best in cancer histology noise removal.

ACKNOWLEDGMENTS

We would like to acknowledge Mr. S. Niyas, Research Scholar, Indian Institute of Information Technology, Technopark, Trivandrum, Kerala, India and Mr. G. KarthiKeyan, Assistant Professor, St. Micheal College of Engineering and Technology, Sivaganga, Tamil Nadu, India for their constant support and knowledge sharing in successful completion of this work.

REFERENCES

1. John G. Abbott, Thurstone FL. Acoustic speckle: Theory and experimental analysis. Ultrasonic Imaging 1979; 1: 303-324.
2. Alan Bovik, Handbook of image and video processing, Academic Press; 2010. p.1-1384.
3. Patidar P, Gupta M, Srivastava S, Nagawat AK. Image de-noising by various filters for different noise. International Journal of Computer Applications 2010; 9:0975– 0987.
4. Bezerianos A, Tsakalides P. Novel bayesian multiscale for speckle removal in medical ultrasound images. IEEE Transactions on Medical Imaging Journal 2001; 20: 772-783.
5. Hykes D, Hedrick W, Starchman D. Ultrasound Physics and Instrumentation. 3rd ed. Churchill Livingstone; 1985.
6. Agrawal A, Ramesh R. Optimal single image capture for motion deblurring, IEEE conference on computer vision and pattern recognition 2009; p. 2560-2567.
7. Danielyan A, Vladimir K, Karen E. BM3D frames and variational image deblurring, IEEE Transactions on Image Processing 2009; 2:167-186.
8. Maini R, Sohal JS. Performance evaluation of prewitt edge detector for noisy images. VIP Journal 2006; 6:39-46.
9. Church J.C, Chen Y, Stephen VR. A spatial median filter for noise removal in digital images. IEEE Southeastcon 2008; 34:618-623.
10. Maheswari D, Radha, V. Noise removal in compound image using median filter. International Journal on Computer Science and Engineering 2010; 2:1359-1362.
11. Dabov K, Foi A, Katkovnik V, Egiazarian K. Image denoising by sparse 3D transform-domain collaborative filtering, IEEE Transactions on Image Processing 2007; 16:2080–2095.
12. Al-amri S.S, Kalyankar N.V, Khamitkar S.D. Comparative Study of Removal Noise from Remote Sensing Image. International Journal of Computer Science 2010; **7**: 0147-0153.
13. Kaur P, Singh J. A study effect of gaussian noise on psnr value for digital images. International Journal of Computer and Electrical Engineering 2011; 3:1793-8163.
14. Deshpande HKB, Deshpande VP. Fuzzy based median filtering for removal of salt-and-pepper noise. International Journal of Soft Computing and Engineering 2012; 2: 76-80.
15. Angalaparameswari R, Senthilkumar P. Image denoising using median filter with edge detection using canny operator. International Journal of Science and Research 2014; 3:30-34.
16. Mehta D, Chauhan K. Compression of a filtered image using DCT-Technique. International Journal of Electronics and Computer Science Engineering 2012; 2:919-926.
17. Patidar P, Gupta M, Srivastava S, Nagawat A.K. Image de-noising by various filters for different noise, International Journal of Computer Applications 2010; 9:0975– 0987.
18. Islam F. Hasan, N. Begum A. Chowdhury S. Distribution of cancer patients and patterns of cancer treatment at Dhaka medical college hospital Bangladesh. International Research Journal of Pharmacy 2012; 3(4):157-161.
19. Chaitanya P. M. And Sarada P.S. Radiopharmacuticals for imaging of hypoxic tumors : A review. International Research Journal of Pharmacy 2012; 3(11):6-11.
20. Shazia S., Nazneen A. and Ramesh R. M. Application of image processing techniques for characterization of skin cancer lesions using thermal images. Indian Journal of Science and Technology 2016; 9(15):1-7.

Cite this article as:

Kanmani P, Rajiv Kannan A, Deepak Kumar P, Ayyappadasan G. Performance analysis of noise filters using histopathological tissue images in lung cancer. Int. Res. J. Pharm. 2017;8(1):50-54 http://dx.doi.org/10.7897/2230-8407.080110

Source of support: Nil, Conflict of interest: None Declared