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Analysis and Comparison of Image Enhancement Techniques for Improving PSNR of Liver Image by Median Filtering over Wiener Filtering

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Abstract

Aim: The purpose of this study is to use median filters and wiener filters to minimize noise in liver images in order to improve them. In addition, the output of both filters was analyzed based on their Peak Signal to Noise Ratio (PSNR). **Materials and Methods:** The research includes two groups; each group has a sample size of 20. Grayscale medical images collected from the kaggle website were used in this research. Samples were considered as (N=20) for guided filter and (N=20) for fast bilateral filter with total sample size 40 calculated using clinicalc.com. Image enhancement is used to enhance the niceness of a picture for the visible notion of human beings. The kaggle website was used to collect data for this study. According to clinical.com, samples were considered as size 20 for PSNR ratio of image G power of 80%, and total sample size determined. Using matlab programming and a standard data set, the Linear filtering, Median filtering were computed. **Results:** According to Matlab simulation results, unique median filters have a PSNR of 48.1240, while wiener filters have a PSNR of 67.8360. Comparison of PSNR values are done by independent sample test using IBM-SPSS software. There is a statistical insignificant difference between both techniques. The significant value of PSNR (Peak Signal to Noise Ratio) (0.409) and p>0.05 was found in the statistical analysis. **Conclusion:** On ultrasound liver pictures, the innovative median filter gives greater PSNR than the wiener filter for medical image enhancing purposes, according to this study.

Keywords

Filtering,Smoothing, Median Filter, Wiener Filter, Image Processing, Ultrasound, Liver cancer.

Imprint

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Introduction:

At present, the researchers are inquisitive about growing an powerful computerized Computer Aided Diagnosis (CAD) device that facilitates the radiologists to categorize exceptional liver most cancers pictures for an correct prognosis for US signal (Loizou and Pattichis 2008; Afzalpulkar et al. 2016; Nayak et al. 2021; Szeliski 2010)). An computerized CAD device has numerous ranges as follows: Data preprocessing, photograph segmentation, function extraction, selection, and in the end classification. Innovative image enhancement technique for improving PSNR of liver image (Bagus 2015; Annisa, Latifah, and Rusyadi 2021; Arce, Bacca, and Paredes 2005; Viero and Neuvo 1993; Sovilj-Nikic 2009; Vertan et al., n.d.; Cappellini 1980; Karvelis and Fotiadis 2007; "Color Image Filtering and Enhancement," n.d.; Jackson and Sovakis 2005; Yang 2013; Yuwono 2015; Yang 2012; Hansen and Higgins, n.d.)). The first step is preprocessing, which carries out exceptional quantization and sampling price for digitizing the photograph signal (Loizou and Pattichis 2008; Afzalpulkar et al. 2016; Nayak et al. 2021; Szeliski 2010)). Ultrasound imaging, additionally referred to as sonography, is a clinical imaging modality which makes use of high-frequency sound waves to provide photographs of the inner of the body (Bagus 2015; Annisa, Latifah, and Rusyadi 2021; Arce, Bacca, and Paredes 2005; Viero and Neuvo 1993; Sovilj-Nikic 2009; Vertan et al., n.d.; Cappellini 1980; Karvelis and Fotiadis 2007; "Color Image Filtering and Enhancement," n.d.; Jackson and Sovakis 2005; Yang 2013; Yuwono 2015; Yang 2012; Hansen and Higgins, n.d.)). Ultrasound imaging makes use of a transducer that's located immediately at the skin ((Loizou and Pattichis 2008; Afzalpulkar et al. 2016; Nayak et al. 2021; Szeliski 2010)).

Total range of articles posted on this subject matter during the last five years in Google Scholar,IEEE xplore, technological know-how direct, we discover four articles in special sites (Bagus 2015; Annisa, Latifah, and Rusyadi 2021; Arce, Bacca, and Paredes 2005; Viero and Neuvo 1993; Sovilj-Nikic 2009; Vertan et

al., n.d.; Cappellini 1980; Karvelis and Fotiadis 2007; "Color Image Filtering and Enhancement," n.d.; Jackson and Sovakis 2005; Yang 2013; Yuwono 2015; Yang 2012; Hansen and Higgins, n.d.). Image enhancement techniques fall into wide categories: spatial area strategies and frequency area strategies ((Bagus 2015; Annisa, Latifah, and Rusyadi 2021; Arce, Bacca, and Paredes 2005; Viero and Neuvo 1993; Sovilj-Nikic 2009; Vertan et al., n.d.; Cappellini 1980; Karvelis and Fotiadis 2007; "Color Image Filtering and Enhancement," n.d.; Jackson and Sovakis 2005; Yang 2013; Yuwono 2015; Yang 2012; Hansen and Higgins, n.d.)). The time period spatial area refers back to the photo aircraft itself, and techniques on this class are primarily based totally on direct manipulation of pixels in a photo ((Bagus 2015; Annisa, Latifah, and Rusyadi 2021; Arce, Bacca, and Paredes 2005; Viero and Neuvo 1993; Sovilj-Nikic 2009; Vertan et al., n.d.; Cappellini 1980; Karvelis and Fotiadis 2007; "Color Image Filtering and Enhancement," n.d.; Jackson and Sovakis 2005; Yang 2013; Yuwono 2015; Yang 2012; Hansen and Higgins, n.d.)). It is used to beautify clinical pix, pix captured in far flung sensing, pix from satellite tv for pc etc.

As indicated previously, the time period spatial area refers back to the combination of pixels composing a photo (Bagus 2015; Annisa, Latifah, and Rusyadi 2021; Arce, Bacca, and Paredes 2005; Viero and Neuvo 1993; Sovilj-Nikic 2009; Vertan et al., n.d.; Cappellini 1980; Karvelis and Fotiadis 2007; "Color Image Filtering and Enhancement," n.d.; Jackson and Sovakis 2005; Yang 2013; Yuwono 2015; Yang 2012; Hansen and Higgins, n.d.)). Spatial area strategies are methods that perform at once on those pixels. Spatial area methods may be denoted with the aid of using the expression. g (x,y) = T [f (x,y)] wherein f (x, y) is the entered photo, g (x, y) is the processed photo, and T is an operator on f, described over a few communities of (x, y) (Bagus 2015; Annisa, Latifah, and Rusyadi 2021; Arce, Bacca, and Paredes 2005; Viero and Neuvo 1993; Sovilj-Nikic 2009; Vertan et al., n.d.; Cappellini 1980; Karvelis and Fotiadis 2007; "Color Image Filtering and Enhancement," n.d.; Jackson and Sovakis 2005; Yang 2013; Yuwono 2015; Yang 2012; Hansen and Higgins, n.d.)). The important technique in defining a community approximately a point (x, y) is to apply a rectangular or square sub photo location targeted at (x, y), as shown. The middle of the sub photo is moved from pixel to pixel starting, say, on the pinnacle left corner. The operator T is carried out at every location (x, y) to yield the output, g, at that location. The system makes use of simplest the pixels with inside the location of the photo spanned with the aid of using the community. Our team has extensive knowledge and research experience that has translate into high quality publications (Chellapa et al. 2020; Lavanya, Kannan, and Arivalagan 2021; Raj R, D, and S 2020; Shilpa-Jain et al. 2021; S, R, and P 2021; Ramadoss, Padmanaban, and Subramanian 2022; Wu et al. 2020; Kalidoss, Umapathy, and Rani Thirunavukkarasu 2021; Kaja et al. 2020; Antink et al. 2020; Paul et al. 2020; Malaikolundhan et al. 2020)

Materials And Methods:

The research work was done in the Department of Biomedical and Engineering at Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai,Tamilnadu, India. The kaggle website was used to collect data for this study. According to clinical.com, samples were considered as size 20 for PSNR ratio of image G power of 80%, and total sample size determined. For checking the Innovative Median filtering and Wiener filtering Classifiers, the proposed work utilizes the MATLAB framework version R2021a. The classifier is executed using the programming tool. This Intel Core i5 processor comes with 8GB of RAM.

Group 1 has ten liver image examples from CT scans, X-ray scans, and MRI scan images. Using median filtering and wiener filtering, the image samples are used to improve PSNR-based liver imaging. For Group 2 sample processing, X-ray, MRI, and CT scan images were merged to create 10 liver images. The testing environment was created using Matlab R2018a. Following preparation, Matlab code was used to apply median filtering and wiener filtering methods. The PSNR value in liver images was used to evaluate the performance of both approaches. To determine the method's efficacy, this parameter was calculated and validated, and the outcomes of both algorithms were compared to see which performed better.

Statistical Analysis

The statistical analysis was carried out using the SPSS tool. The significance is calculated using Independent t-test. It was performed for the two dependent variables such as packet drop ratio and residual energy. The independent variables are number of nodes, battery power and battery size. Using the SPSS

software the standard deviation, standard error of mean were also calculated.

Results

The PSNR (dB) values of 20 liver pictures taken with the median and wiener filters are shown in Table 1. The median filter has a mean PSNR (dB) of 48.1240, while the wiener filter has a PSNR (dB) of 67.8360. Several stomach photographs from the Cancer Imaging Archive, including CT and MRI scans, are used to test the proposed gadget. We used MATLAB to calculate the noise discount on US liver images using the five filtering algorithms stated earlier in this section.

Table 2 compares the median filter used in picture enhancement approaches with a wiener filter based on PSNR values. The wiener filter has a high PSNR (67.8360dB) while the median filter has a low PSNR (48.1240dB). The wiener filter has a large standard deviation (7.40587) while the median filter has a low standard deviation (7.21460).

Table 3 demonstrates a sample test of PSNR-based picture improvement utilizing the Wiener and median filter techniques using an independent sample.

Table 1

Tabulation explains the PSNR value of median filter and wiener filter algorithms.These were obtained by simulating the ultrasound liver images in Matlab software. These 20 samples were taken from the dataset and is used for comparing both the algorithms

S.NO	PSNR of Median filter	PSNR of Wiener filter
1	38.56	37.56
2	39.67	38.67
3	41.38	40.38
4	44.75	43.75
5	47.97	45.97
6	49.53	48.53
7	53.60	54.60
8	53.98	55.98
9	55.43	56.43
10	56.87	58.87
11	57.40	59.40
12	58.94	60.94
13	59.34	61.34
14	63.56	62.56
15	65.89	64.89
16	67.75	69.75
17	70.45	72.45
18	74.63	75.63
19	74.87	77.87
20	79.53	79.53

Table 2

The table shows mean values of PSNR for the 20 samples, standard deviation and standard deviation mean error obtained using SPSS software for both median filter and wiener filter.

	Group	N	Mean	Std. Deviation	Std. Error Mean
Filtering 1	Median Filtering	20	48.1240	7.21460	1.61323
	Wiener Filtering	20	67.8360	7.40587	1.65600

The significance p-value with two tails is 0.003. PSNR is noteworthy at 0.003 with a standard mean difference of -19.71200 and a standard error difference of 2.31190. The lowest result in the test confidence interval is (-24.39219), while the highest is (-19.71200). (-15.03181). With a 95 percent confidence interval, the mask filter-based picture enhancement method outperformed the wiener filtering method in an independent sample T test.

Figure 1. illustrate the matlab simulation results of mask filter and wiener filter (a) Input image (liver image) (b) Enhanced result of median filter (c) Enhanced result of wiener filter.

Figure 2.shows the graph obtained using SPSS that compares PSNR of Median filter and Wiener filter. From the graph it was observed that Median filter has better PSNR compared with the Wiener filter on liver image. In the graph, Group (Median filter and Wiener filter) are represented as X-axis and PSNR represented as y-axis with +/- 1 SD.

Discussion

Generally the picture enhancement is split into special instructions which include histogram primarily based totally, remodel primarily based totally and protecting primarily based totally technique. Histogram primarily based total enhancement strategies are classical assessment enhancement techniques (Sahu 2012; Gupta, Gupta, and Minocha 2013; Kaur and Kaur 2016; "24 Bit Image Noise Reduction with Median Filtering Algorithm" 2017; Sovilj-Nikic 2009; Sharma et al. 2020; Zhang and Wei, n.d.; Viero and Neuvo 1993; Bankman 2008; Bradbury and Evennett 2020; Erwin et al. 2017; Asokan and Anitha 2020; Bahaghighat and Motamedi 2017; Bovik and Acton 2009; Loizou and Pattichis 2008)). Masking primarily based totally technique is the derived subject of assessment enhancement wherein

Table 3

The table shows the mean difference, standard error difference and significance obtained from SPSS and these were used to find which algorithm gives significant results

		Leven's test for equality of variance		T-test for equality of variance					95% of confidence interval of difference	
		f	sig	t	df	Sig (2-tailed)	Mean difference	Std.error diff	lower	upper
PSNR	Equal variances assumed	.023	.880	-8.526	38	.003	-19.71200	2.31190	-24.39219	-15.03181
	Equal variances not assumed			-8.526	37.974	.003	-19.71200	2.31190	-24.39230	-15.03170

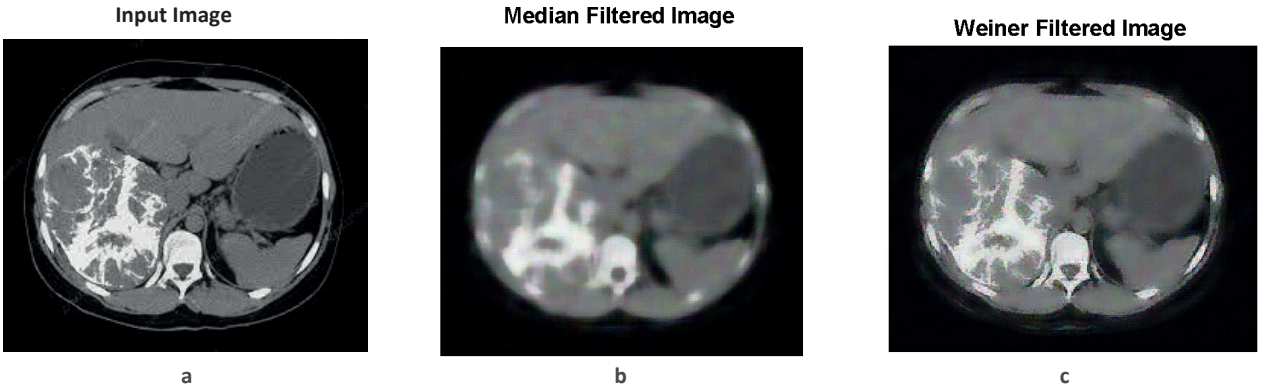

Fig. 1. Matlab simulation results of mask filter and wiener filter (a) Input image (liver image) (b) Enhanced result of median filter (c) Enhanced result of wiener filter.

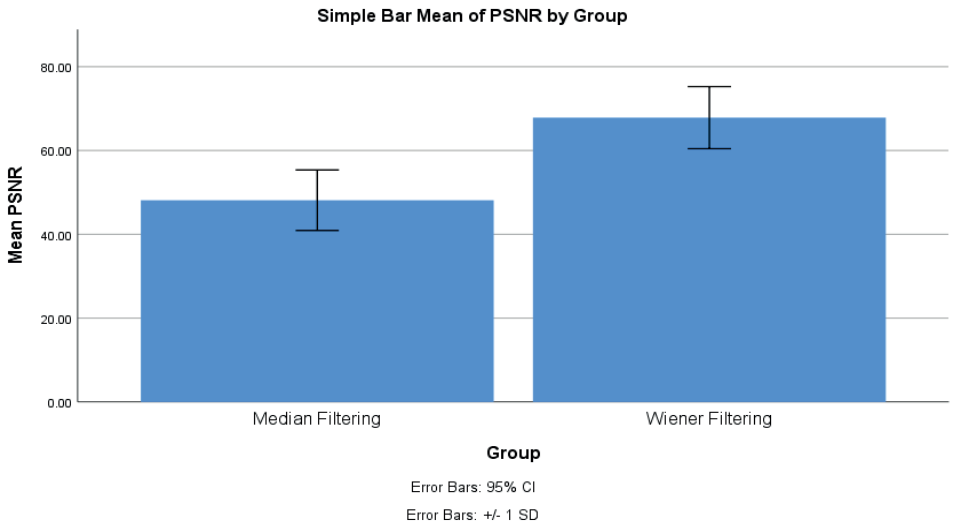

Fig. 2 Graph obtained using SPSS that compares PSNR of Median filter and Wiener filter. From the graph it was observed that Median filter has better PSNR compared with the Wiener filter on liver image. In the graph, Group (Median filter and Wiener filter) are represented as X-axis and PSNR represented as y-axis with +/- 1 SD.

formulated masks are brought to the unique picture to sharpen the bottom picture. Recently a few change techniques have been accomplished in protecting assessment enhancement (Bagus 2015; Annisa, Latifah, and Rusyadi 2021; Arce, Bacca, and Paredes 2005; Viero and Neuvo 1993; Sovilj-Nikic 2009; Vertan et al., n.d.; Cappellini 1980; Karvelis and Fotiadis 2007; "Color Image Filtering and Enhancement," n.d.; Jackson and Sovakis 2005; Yang 2013; Yuwono 2015; Yang 2012; Hansen and Higgins, n.d.) 0. The fundamental gain of Wavelet remodel is that it's far able to provide localization in area in addition to frequency domains ((Bagus 2015; Annisa, Latifah, and Rusyadi 2021; Arce, Bacca, and Paredes 2005; Viero and Neuvo 1993; Sovilj-Nikic 2009; Vertan et al., n.d.; Cappellini 1980; Karvelis and Fotiadis 2007; "Color

Image Filtering and Enhancement," n.d.; Jackson and Sovakis 2005; Yang 2013; Yuwono 2015; Yang 2012; Hansen and Higgins, n.d.)). The wavelet remodel is greatly dependable and it may offer the outstanding facts for distinct resolutions (Bagus 2015; Annisa, Latifah, and Rusyadi 2021; Arce, Bacca, and Paredes 2005; Viero and Neuvo 1993; Sovilj-Nikic 2009; Vertan et al., n.d.; Cappellini 1980; Karvelis and Fotiadis 2007; "Color Image Filtering and Enhancement," n.d.; Jackson and Sovakis 2005; Yang 2013; Yuwono 2015; Yang 2012; Hansen and Higgins, n.d.)). The use of non-linear mapping features derived for projecting a hard and fast discrete wavelet remodel (DWT) presents higher enhancement in clinical snap shots in evaluation to speedy Fourier remodel (FFT) and the traditional wavelet primarily based totally ((Bagus 2015; Annisa, Latifah, and Rusyadi 2021; Arce, Bacca, and Paredes 2005; Viero and Neuvo 1993; Sovilj-Nikic 2009; Vertan et al., n.d.; Cappellini 1980; Karvelis and Fotiadis 2007; "Color Image Filtering and Enhancement," n.d.; Jackson and Sovakis 2005; Yang 2013; Yuwono 2015; Yang 2012; Hansen and Higgins, n.d.)). On the other hand, a multiwavelet gadget decorates the picture with the aid of concurrently supplying best reconstruction even as maintaining length (orthogonality), true overall performance on the boundaries (through linear-section symmetry) and an excessive order of approximation.

Conclusion

Here we describe the manner of bilateral clear out to denoise the clinical images. Its overall performance is advanced than that of linear filters along with Wiener clear out, median filters etc. It offers higher overall performance to put off the noise in an excessive frequency place however it fails to put off noise to low frequency place. However its overall performance isn't first-rate to put off the noise from the picture. The downside of this clear out is that it can't put off salt and pepper noise.These works are used for visible tracking, picture registration, picture segmentation, and picture class etc. We can look at the strategies via means of monitoring, zooming the received effects in consultation of experimental effects. From a majority of these strategies, Weiner and median filters are done properly in phrases of smoothing while as compared to final filtering techniques. Wiener and median filters done properly in phrases of execution time.

DECLARATION

Conflict of Interests

No conflict of interests in this manuscript.

Authors Contributions

KDP was involved in data collection, data analysis and manuscript writing. Author RR was involved in conceptualization, data validation and critical review of manuscript.

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