IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 14, Issue 1, Ser. II (Jan.-Feb. 2019), PP 26-29
www.iosrjournals.org

A Novel Approach for Image Denoising Using Adaptive Median Filter and Principal Component Analysis

Dr. Reecha Sharma[1], Kamlesh Kaur[2].
Assistant Professor, ECE department Punjabi University, Patiala, India
M.Tech Student, Punjabi University, Patiala India
Corresponding Author: Dr. Reecha Sharma

***Abstract**: Digital images are corrupted by various types of noises. In this paper a methodology is proposed to eliminate salt and pepper noise from digital grayscale images using adaptive median filter and principal component analysis(PCA).The proposed methodology shows better results for peak signal to noise ratio(PSNR) and mean square error(MSE) in differentiation to existing techniques. The proposed filter works efficiently on high noise density (80% and 90%). The adaptive median filter removes the noise from image and principal component analysis algorithm is further applied to obtain sharp edges and boundaries.*

***Key words:** Digital images, denoising, median filter, principal component analysis, PSNR, MSE.*

Date of Submission: 13-02-2019 Date of acceptance: 28-02-2019

I. Introduction

Digital image processing is the field in which digital images are used as input and are processed with the help of digital computer. Digital image is made up of large no. of picture elements known as pixels. Digital image processing field is used to enhance the visual quality of images for better human interpretation. Digital images are effected by various types of noise like Gaussian noise, possoin noise, salt and pepper noise, periodic noise ,exponential noise etc. salt and pepper noise can be produced during acquisition and transmission of digital images[1].

Salt and pepper noise is also known as impulse noise. It consists of random pixels having intensity levels of 0 and 255, spread all over the image. Salt means maximum intensity level i.e. 255 and pepper means minimum intensity level i.e. 0,so it appears as black and white dots on the image. A small quantity of salt and pepper noise can change the appearance of the image to a great extent [2-3].therefore to remove salt and pepper noise from digital images various types of filters have been proposed so far. The linear filters denoised the image but produces blurring effect as well. From the previous research it has been concluded that non-linear filters are best suited for removal of salt and pepper noise because of their better denoising power and edge preservation. Median filter is the most useful non linear median filter [4]. Median filtering is a basic tool for smoothing signals and images [5-8-10].

II. Literature Survey

Various types of median filters have been developed so far for removing salt and pepper noise. In the median filter, pixel window is moved on every pixel one by one .every pixel is changed with the median of the window. The window size should be n×n, where n is an odd number [6]. The main limitation of the median filter is that it also processes the non-noisy pixels therefore some important details of image are lost. Another limitation of median filter is that its performance depends upon the window size [7].to overcome the drawback of processing non noisy pixels the various kinds of decision based filter were developed in [7] [8] . These filters only modify the noisy pixels in an image and non noisy pixels are left unchanged. Adaptive median filters in [9][10] have been developed so as to overcome the effect of fixed window size. In adaptive filters variable window size is used. For low noise density small window size is used and for high noise density large window size is used. In [6] selective adaptive median filter is implemented in which only selected noisy pixels are processed and have variable window size.

PROPOSED METHODOLOGY FOR IMAGE DENOISING

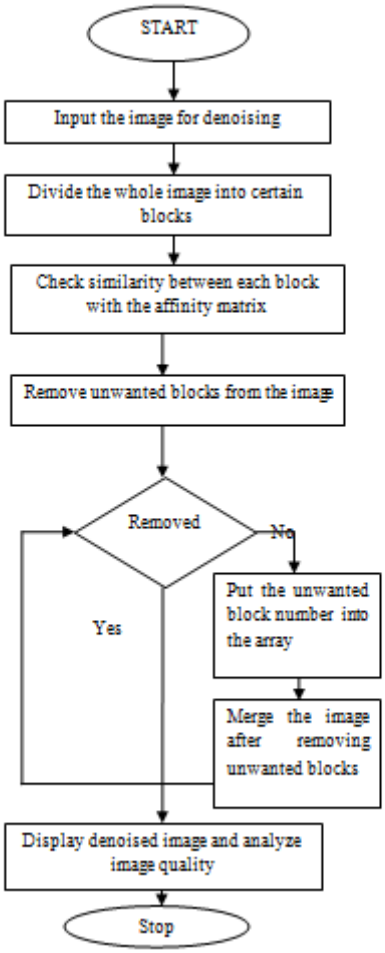

Figure 1: Flow chart for proposed framework

The image denoising means removing the noise efficiently from the image while preventing the important image details. Many methods of image denoising have been proposed earlier but were not as efficient as required. Some earlier filters work well on low noise density while others on high noise density. So a new method is proposed for removing salt and pepper noise from image by using adaptive median filter as well as principle component analysis(PCA).then image is divided into blocks(group of pixels) . The adaptive median filter is used remove the salt and pepper noise from the blocks. PCA algorithm is used to compare the patches for preserving the edges and to have better details of image. The proposed methodology is shown in figure 1.
Select a grayscale image from the available dataset. Add salt and pepper noise to the image. The noise density can be varied from 0% to 90%. Selective adaptive median filtering is performed on the whole image. It will perform filtering operation only on the noisy pixels. The noiseless pixels will remain unchanged. If the selected pixel in window is noisy, then its values is changed with the calculated median of window otherwise the window size is increased and previous steps are repeated. Then divide the whole image into certain blocks. Principal component analysis algorithm is applied on the image blocks .In this step the similarity of each block is checked with the affinity matrix. Unwanted blocks or the blocks which are dissimilar are removed. If all unwanted blocks are removed then denoised image is obtained by merging all the similar blocks together. Otherwise the number of the dissimilar blocks are put into array and the blocks are merged after removing the unwanted blocks.

III. Simulation results

The performance of the proposed algorithm is determined with the help of different grayscale images. For this 5 images have taken namely Lena, cameraman, barbara, lighthouse, bridge, which are accessible in Matlab tool box. But only Lena image is used to show the results. The software used is Matlab r2016. The performance of the method is analyzed at different noise densities varying from 10% to 90%. The proposed

method have better peak signal to noise ratio and mean square error which are defined in (1) and (2) respectively.

$$\text{PSNR in dB} = 10\log_{10}\left(\frac{255^2}{MSE}\right) \quad (1)$$

$$\text{MSE} = \frac{\sum i \sum j \left(Y(i,j) - \hat{Y}(i,j)\right)^2}{M \times N} \quad (2)$$

in which M×N is the size of the image to be denoised. Y is the original image and Ŷ is the denoised image. The proposed filter woks efficiently on low, medium and high density of noise whereas the selective adaptive filter works better only on high density noise. the fig 2 shows the difference of peak signal to noise ratio (PSNR) between the proposed filter and the selective adaptive median filter. The proposed

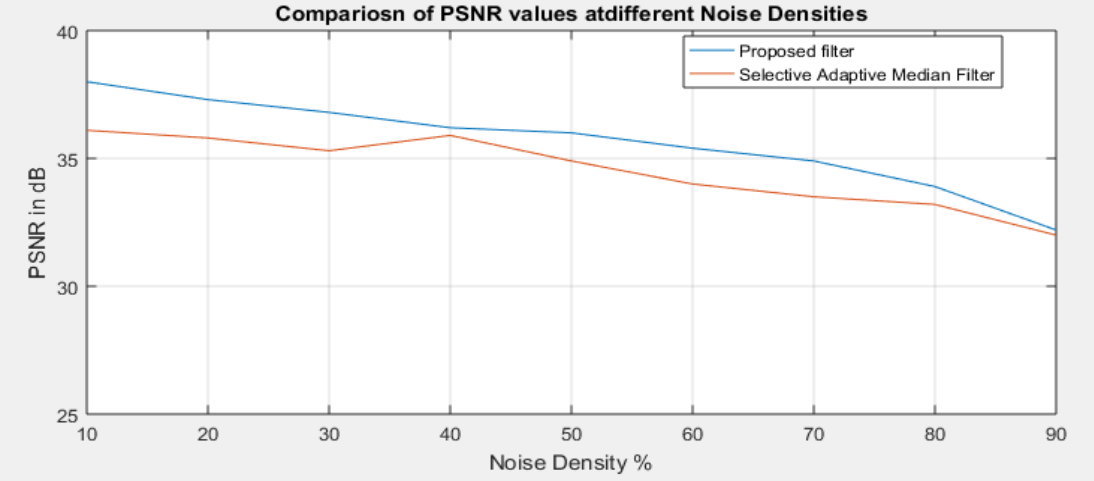

Figure2 Comparison of PSNR at distinct values of noise density for Lena image

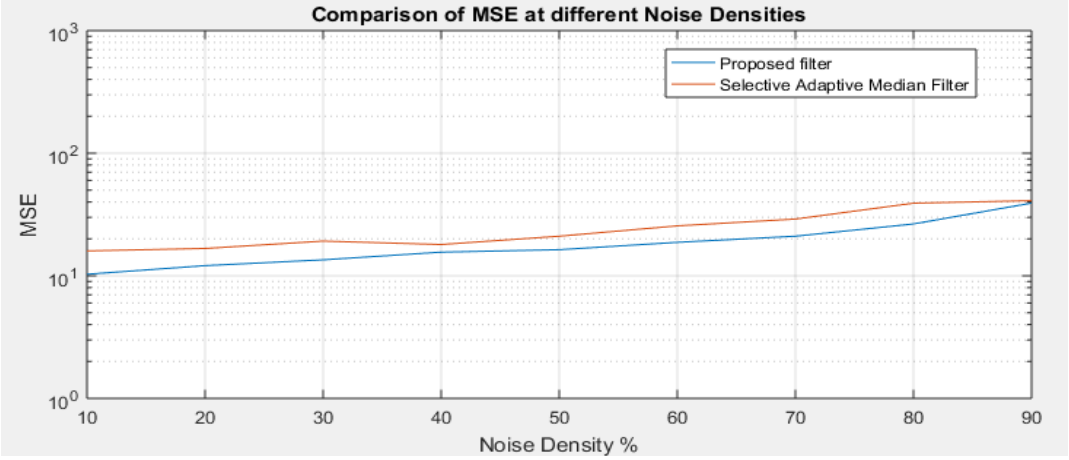

Figure 3 Comparison of MSE at distinct values of noise densities for Lena image

Table 1: Comparison of MSE and PSNR values at different noise densities

Noise Density %	**Selective Adaptive Median Filter**		**Proposed Filter**	
	PSNR	**MSE**	**PSNR**	**MSE**
10	36.1	15.9	38.0	10.3
20	35.9	16.71	37.3	12.10
30	35.3	19.19	36.8	13.50
40	35.8	18.09	36.2	15.59
50	34.9	21.04	36	16.33
60	34.0	25.55	35.4	18.75
70	33.5	29.04	34.9	21.04
80	33.2	39.18	33.9	26.49
90	32.0	41.02	32.2	39.18

filter have better PSNR on various values of noise densities. In fig 3 the difference of Mean square error (MSE) is shown for proposed filter and selective adaptive filter. The values of PSNR and MSE are shown at different values of noise density for both the filters in table1. The table 1 shows lower MSE and higher PSNR in case of proposed methodology.

IV. Conclusion

In this paper the proposed methodology is based on adaptive median filter and principle component analysis. The results have shown that proposed filter works better than the existing filters in form of better PSNR and MSE. Edges and details are preserved on high noise density (80%, 90%) as well. The PSNR is high while MSE is low even at high noise density as compared to existing techniques. In future proposed technique can be used for other types of noise like Gaussian noise, Rayleigh noise etc.

References

[1]. Rafael C. Gonzalez, Richard E. Woods - Digital Image Processing, third edition, Pearson Education, ISBN: 81-7808-629-8.
[2]. E.Jebamalar Leavline and D.Asir Antony Gnana Singh, "Salt and Pepper Noise Detection and Removal in Gray Scale Images: An Experimental Analysis" , International Journal of Signal Processing, Image Processing and Pattern Recognition, vol.6, No.5, pp.343-352, 2013.
[3]. Haidi Ibrahim, Nicholas Sia Pik Kon, "Simple Adaptive Median Filter for the Removal of Impulse Noise from Highly Corrupted Images '' *IEEE Transactions on Consumer Electronics*, Vol. 54, No. 4, NOVEMBER 2008.
[4]. Pei-Eng Ng and Kai-Kuang Ma, "A Switching Median Filter With Boundary Discriminative Noise Detection for Extremely Corrupted Images'', *IEEE Transactions On Image Processing*, Vol. 15, No. 6, June 2006.
[5]. Martin Storath, Andreas Weinmann, "Fast median filtering for phase or orientation data'', *IEEE Transactions on Pattern Analysis and Machine Intelligence* 2017.
[6]. Jayanta Das, Bhaswati Das, Jesmine Saikia and S.R.Nirmala, "Removal of Salt and Pepper Noise Using Selective Adaptive Median Filter'', *IEEE* 2017.
[7]. Shruti Singh, Anil Kumar Tiwari "An Enhanced Decision Based Unsymmetric Trimmed Median Filter For Removal of High Density Salt and Pepper Noise'', *IEEE* 2015.
[8]. S. Esakkirajan, T. Veerakumar, Adabala N. Subramanyam, and C. H. PremChand, "Removal of High Density Salt and Pepper Noise Through Modified Decision Based Unsymmetric Trimmed Median Filter", *IEEE Signal Processing Letters*,Vol.18,NO.5,May2011.
[9]. Anisa Bhatia,"Salt and Pepper noise removal from medical image through Adaptive median filter" ,Proceedings of IT International Conference, 18th August 2013,Bhubaneswar,India.
[10]. Mr.Avadhoot R. Telepatil, Prof S.A.Patil, Mr.Vishal P.Paramane, "A Survey on Median Filters for Removal of High Density Salt and Pepper Noise in Noisy Image" , IOSR Journal of Electronics and communication Engineering (IOSR-JECE) ISSN: 2278-2834, ISBN: 2278-8735.

IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) is UGC approved Journal with Sl. No. 5016, Journal no. 49082.

Dr. Reecha Sharma. "A Novel Approach for Image Denoising Using Adaptive Median Filter and Principal Component Analysis." IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) 14.1 (2019): 26-29.