International Journal of Innovations in Engineering and Technology (IJIET)
http://dx.doi.org/10.21172/ijiet.123.17

Detection and Removal of Salt and Pepper Noise in images by Improved Median Filter

Rupinder Pal Kaur[1], Er. VarinderjitKaur[2], Dr. Naveen Dhillon[3]
[1]Student (M.Tech CSE), Department of Computer Sc. &Engg. R.I.E.T Phagwara
[2]Head of Department, Department of Computer Sc. &Engg. R.I.E.T Phagwara
[3]Principal , R.I.E.T Phagwara

Abstract- It is an enhanced decision based algorithm where noisepixels are detected in several phases based on predefinedthreshold value. The noise pixels are replaced by median wheremedian value is calculated without considering pixel value. As aresult, at high density noise environment it is very efficient to findnoise free median value. The algorithm initially select filtering window for processing corrupted pixel. When all theelements in the window are corrupted, the processing pixel isreplaced by noise free last processed pixel. If the last processedpixel is 0 or 255 then the algorithm will create a filtering windowwith a new dimension to identify pure black and white region ofthe image. Experiments exhibit better result at filteringwindow. In this stage a standard median filtering approach isapplied to determine probable intensity value. If the medianvalue is noise pixel then the algorithm will calculate the meanvalue of all elements in the window. After that, robust estimationalgorithm is applied to the proposed filter to removediscontinuity of pixel intensity and smooth the restored image.Experimental result shows that it can provide very high qualityrestored images, when the noise density is large. In this research, a modified decision based medianfiltering approach is presented for the restoration of gray scaleand color images that are highly corrupted by salt and peppernoise. The proposed Improved Median Filter(IMF) algorithm processes the corrupted image by firstdetecting the salt and pepper noise. The processing pixel ischecked whether it is noisy or noise free. If the processingpixel is lies between maximum and minimum gray levelvalues then it is noise free pixel, it is left unchanged. If theprocessing pixel takes the maximum or minimum gray levelthen it is noisy pixel which is processed by IMF.

I. INTRODUCTION

There aretwo models of impulsive noise, namely, salt and pepper noiseand random value impulsive noise. Salt and pepper also calledas a fixed value impulsive noise because the intensity value ofimages is changed into 0 or 255 when the image iscontaminated by noise. Impulse noise is caused by faultycamera sensors, faults in data acquisition systems andtransmission in a noisy channel. Non linear filtering methodi.e. is Median filter are established as a reliable method toremove or reduce salt and pepper without damaging edge.

Several nonlinear filters have been proposed for restoration of images contaminated by salt and pepper noise. Among of them, Standard Median Filter is effective at low noise densities. Several methods have been proposed to remove salt and pepper noise in higher noise densities.Computational complexity should consider at the time ofimplementing a filtering approach. Implementing a filteringwith 3X3 mask keeps the computation time minimum.

II. SALT AND PEPPER NOISE

It is a form of noise sometimes seen on images. It is also known as impulse noise. This noise can be caused by sharp and sudden disturbances in the image signal. It presents itself as sparsely occurring white and black pixels. An effective reduction method for this type of noise is a median filter or a morphological filter. For reducing either salt noise or pepper noise, but not both, a contra harmonic mean filter can be effective. Median Filtering is highly effective in removing salt-and-pepper noise.

To remove this impulse noise we have filters like Min. filter, Max. filter ,MinMax. filter, Mean filter, Median filter, weighted median filter, Adaptive Median Filter. In this paper we check that which filter is best for impulse noise removal.

III. PROPOSED ALGORITHM

The proposed Modified Median Filter(MMF) algorithm processes the corrupted image by firstdetecting the salt and pepper noise. The processing pixel ischecked whether it is noisy or noise free. If the processingpixel is lies between maximum and minimum gray levelvalues then it is noise free pixel, it is left unchanged. If theprocessing pixel takes the maximum or minimum gray levelthen it is noisy pixel which is processed by MMF. Thesteps of the MMF are elucidated as follows.

Algorithm:

Step 1: Select window of size 3 X 3. Assume that thepixel is being processed is Xij.

Step 2:IfO<Xij< 255 the Xijis an uncorrupted pixel andits value is left unchanged.

Step 3: If Xij = 0 or Xij = 255the Xijis a corrupted pixelthe two cases are possible as

given in case i) and ii).
Case i) If the selected window contain not all theelements as O's and 255's, then replace Xij with themedian value of the remaining elements. Replace Xijwith the median value.
Case ii) If the selected window contain all theelements as O's and 255's, then replace the processing pixel with last processed pixel if O<Zi-l,j<255. Otherwise go to step4.
Step 4: Select a new filtering window with a 9 X 9 maskand search for noise free pixels.
If noise free elementsare fond in the selected window, then replace Xijwithmedian value of the remaining elements. Otherwisereplace Xijwith the mean of the element of window.

IV. OBJECTIVES

1.To reduce high density salt and pepper noise from images and restore the lost information without distorting the edges.
2.To improve the quality of image based on the PSNR, MSE and MAE value.
3.To analysis the results of proposed method with conventional median filters.

V. RESULT

The performance of the proposed improved median filter andconventional median filters were analysed for different noise density (ND) of salt and pepper noise added to gray level images. The threshold was varied to obtain maximum PSNR , MSE and MAE.
In the chapter, we use signal-to-noise-ratio (PSNR) ,MSE and MAE metrics to evaluate our method, which contains setting parameters and our experimental results.

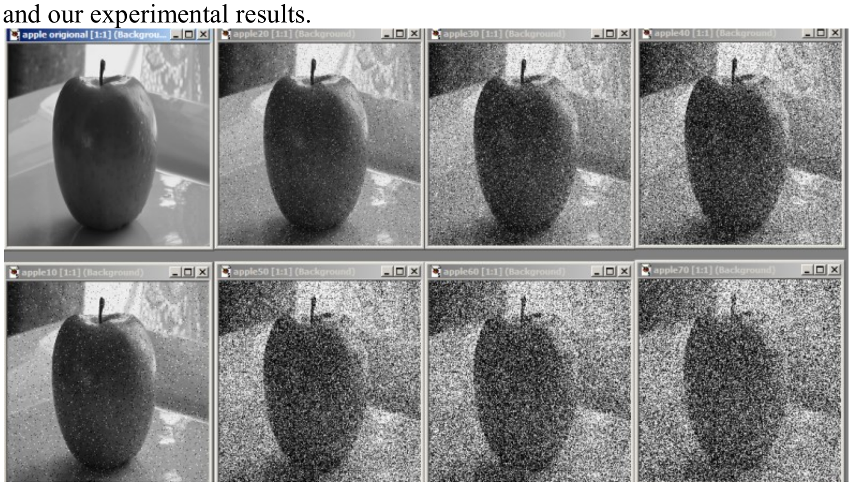

Figure 1Illustrates noisy images for 10%, 20%,30%,40%,50%,60% and 70% noise densities along with their filtered images and the original image of apple.

Table I Comparison of psnr values on apple image for varying noise density

Noise Density	IMF (Proposed Algorithm)	IDBHMF (Base paper)	AMF	MF
10	15.17	11.17	7.34	8.3
20	15.35	11.31	7.36	8.33
30	14.72	11.57	7.23	8.18
40	13.94	11.12	7.07	8
50	13.43	11.28	6.96	7.88
60	13.16	11.3	6.87	7.79
70	13.02	11.33	6.8	7.73

IMF= Improved Median Filter, IDBHMF=Improved Decision Based Hybrid Median Filter,AMF=Adaptive Median Filter, MF=Standard Median Filter

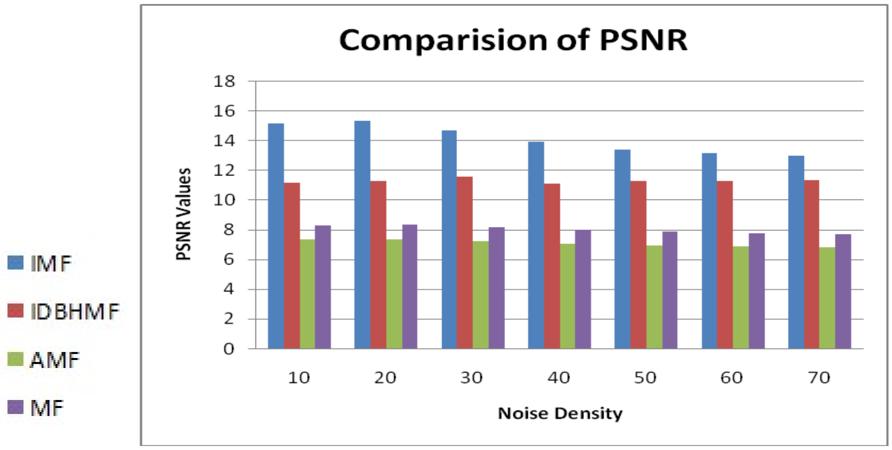

Figure 2 llustratesa graph of PSNR values plotted against density of noise for different algorithms.

Table 2 Comparison of MSE values on apple image for varying noise density

Noise Density	IMF (Proposed Algorithm)	IDBHMF (Base paper)	AMF	MF
10	1975.31	4965.43	11994.74	9614.36
20	1892.71	4798.55	11935.13	9536.22
30	2190	4523.86	12288.65	9885.74
40	2620.52	5019.6	12742.89	10294.68
50	2951.65	4833.77	13085.4	10591.07
60	3140.58	4817.8	13361.83	10810.88
70	3240.15	4777.85	13567.07	10956.35

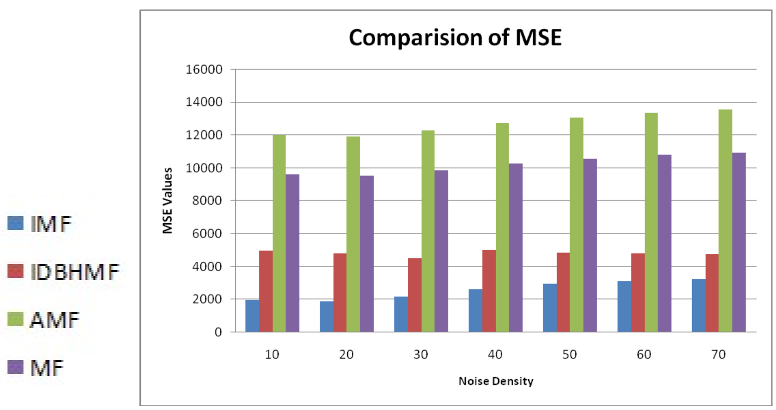

Figure 3 Illustrates a graph of MSE values plotted against density of noise for different algorithms.

Table 3 Comparison of MSE values on apple image for varying noise density

Noise Density	IMF (Proposed Algorithm)	IDBHMF (Base paper)	AMF	MF
10	25.57	38.88	100.84	85.96
20	25.07	37.81	100.87	85.76
30	27.59	35.46	100.97	87.03
40	30.53	37.25	101.38	88.56
50	32.19	34.59	101.64	89.01
60	32.21	33.16	101.85	90.4
70	33.1	32.01	102.07	90.83

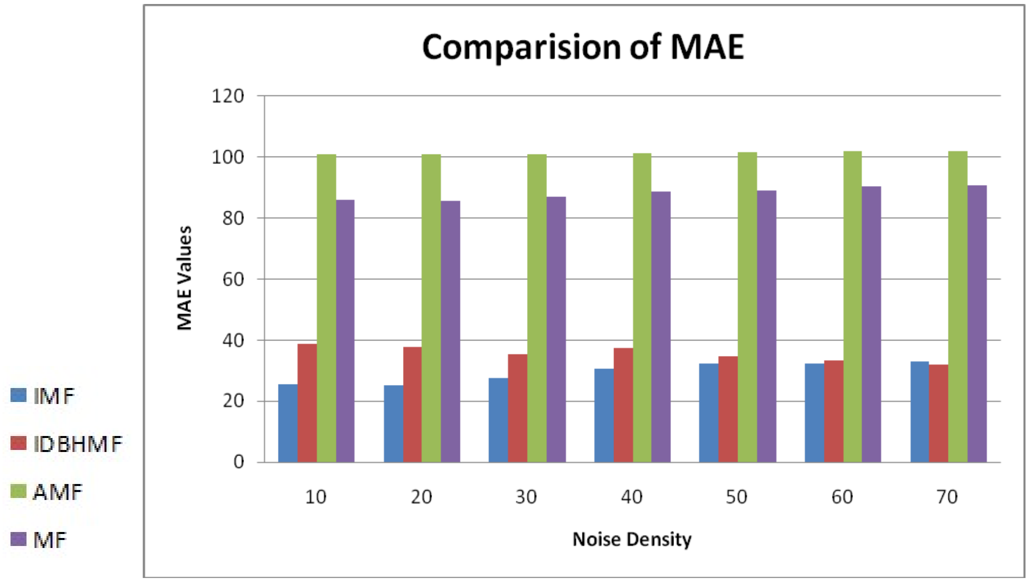

Figure 4 Illustrates a graph of MAE values plotted against density of noise for differentalgorithms.

Table 13 Table 4 Shows the psnr values of imf on apple image for varying noise density

Noise Density	IMF
10	15.17
20	15.35
30	14.72
40	13.94
50	13.43
60	13.16
70	13.02

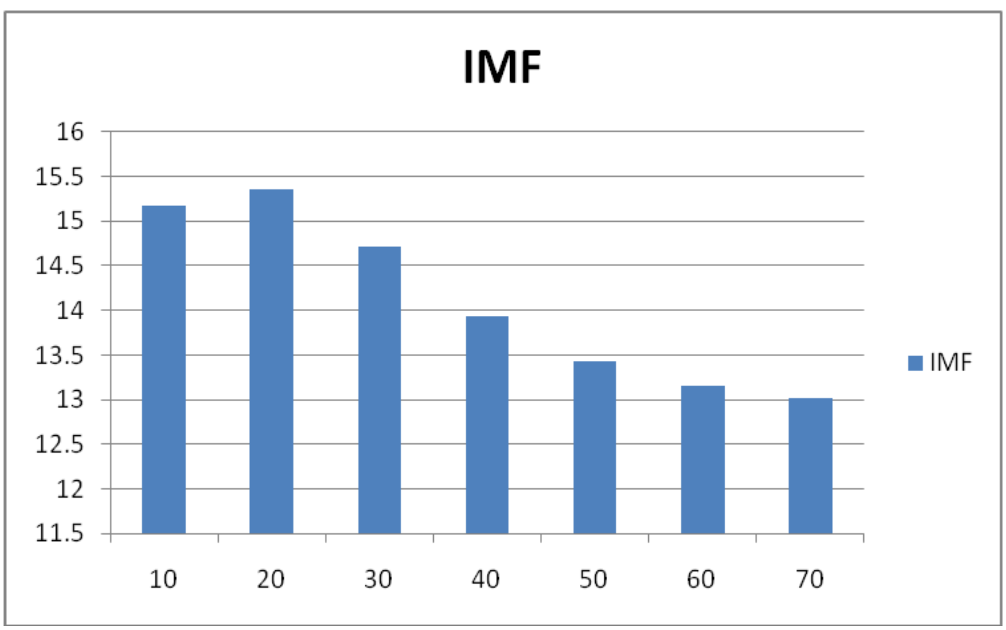

Figure 5 Illustrates a graph of PSNR values plotted against density of noise for IMF.

Table 5 Shows the MSE values of IMF on apple image for varying noise density

Noise Density	IMF
10	1975.31
20	1892.71
30	2190
40	2620.52
50	2951.65
60	3140.58
70	3240.15

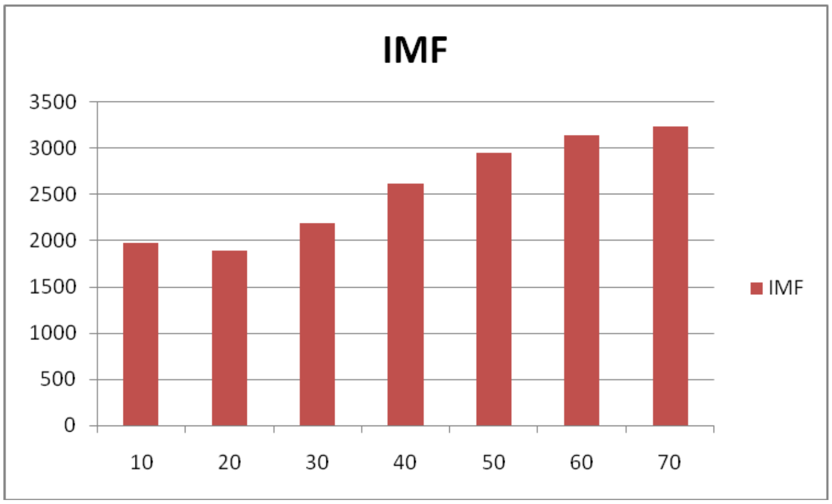

Figure 6 illustrates a graph of MSE values plotted against density of noise for IMF.

Table 6 Shows the MAE values of IMF on apple image for varying noise density

Noise Density	IMF
10	25.57
20	25.07
30	27.59
40	30.53
50	32.19
60	32.21
70	33.1

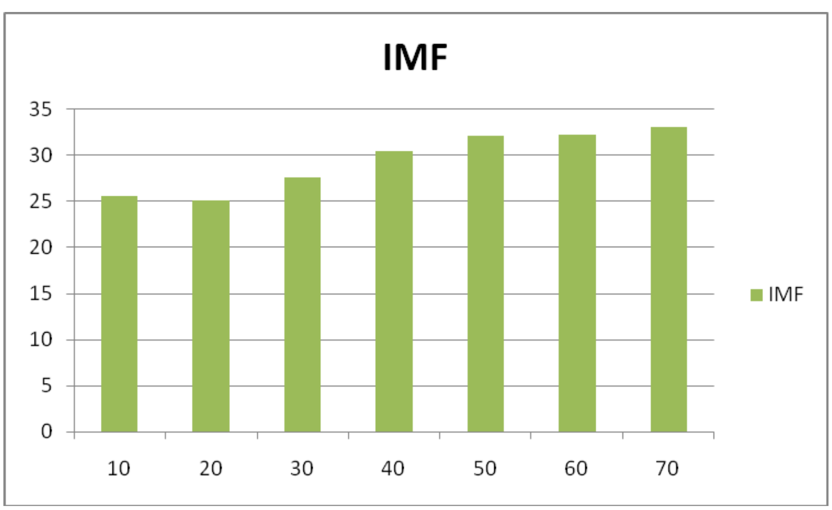

Figure 7 Illustrates a graph of MAE values plotted against density of noise for IMF.

http://dx.doi.org/10.21172/ijiet.123.17

VI. CONCLUSION

In this research, a new algorithm (IMF) is proposed which gives better performance in comparison with MF, IDBHMF and AMF in terms of PSNR, MSE, MAE. Proposed algorithm shows good denosing capability and can also preserve necessary details. The performance of the algorithm has been tested at low, medium and high noise densities on different images.

VII. REFERENCES

[1] Cheng-HsiungHsieh, Chia-Wei Lan, Pei-Wen Chen, Wei-Lung Hung, " Application Of Polynomial Interpolation To Salt And Pepper Noise Removal", Proceedings of the Seventh International Conference on Machine Learning and Cybernetics, Kunming, 12-15 July 2008.

[2] Neela Chithirala#1, Natasha. B#2, Rubini. N#3, AnishaRadhakrishnan, "Weighted Mean Filter for Removal of High DensitySalt and Pepper Noise", 3rd International Conference on Advanced Computing and Communication Systems (ICACCS -2016), Jan. 22 – 23, 2016, Coimbatore, INDIA 2016.

[3] Chen Cong-ping,WangJian, Qin Wu, Dong Xiao-gang, "A New Adaptive Weight Algorithm for Salt andPepper Noise Removal", IEEE Trans, 2011.

[4] GolamMoktaderDaiyan, M. A. Mottalib, "Removal of High Density Salt & Pepper NoiseThroughaImproved Decision Based Median Filter", IEEE/OSAIIAPR International Conference on Informatics, Electronics & Vision 2012.

[5] S.Deivalakshmi1, S.Sarath2, P.Palanisamy3, "Detection and Removal of Salt and Pepper noise inimages by Improved Median Filter", IEEE Trans, 2012.

[6] Hong-Yao Deng, Qing-Xin Zhu, Xiu-Li Song, "A Nonlinear Diffusion For Salt And Pepper Noise Removal", IEEE Trans, 2016.

[7] Lianghan Hu, KinTak U, "Removal of Salt and Pepper Noise with Non-uniformWeighted Mean Partition", IEEE Trans, 2015.

[8] Kohei Inoue, Kenji Hara, and KiichiUrahama, "A Hybrid Method for High Density Salt-and-Pepper Noise Removal", International Conference on Signal-Image Technology & Internet-Based Systems, 2013.

[9] SyamalaJayasree P, Pradeep Kumar, "A Fast Novel Algorithm for Salt and Pepper Impulse Noise Removal using B-Splines forFinger Print Forensic Images", IEEE Trans, 2013.