RESEARCH ARTICLE OPEN ACCESS

A New Proposed Modification on the BDND Filtering Algorithm for the Removal of High Density Impulse Noise

S. Shalimettilsha[1], R. P. Anto Kumar[2]
[1]PG student, Dept. of Computer Science and Engineering, St. Xaviers Catholic College of Engineering, Chunkankadai
[2]Professor, Dept. of Information Technology, St. Xaviers Catholic College of Engineering Chunkankadai

Abstract
The standard median filter is one of the most popular filters for removing impulse noise. The main effectiveness of this median filter is result in degradation of image quality. BDND filtering is an one of the important filtering algorithm which remove high density impulse noise (up to 90%). But some issues related to this algorithm which degrades its performance. To avoid this issues there are two modifications in this algorithm which improve image quality and improve the performance of the BDND algorithm.
Keywords—Impulse noise, median filter, noise detection, switching median filters.

I. INTRODUCTION

Noise being random errors in the image. Due to faulty sensors images which is corrupted with an impulse noise. Noise which takes minimum and maximum grey values [1] when compared to their neighboring pixels. Pixels brighter than their neighbors are high intensity values are called salt and pixels darker than their neighbors are low intensity values are called pepper [9]. This could affect image quality and degrade its performance.

In order to restore the original value of noisy pixel filtering techniques are applied with reducing noise and protect the edge details of an original image. The standard median filter [9] is a one of the popular median filter which removes low density impulse noise and also degrades the performance of an image. Because this type of the median filter [8] is applied to all pixels in the image, which cannot detect noisy and noise free pixels. To avoid such issues use a detection mechanism [4] before filtering operation. The switching median filter [2] is a one of the filter which detect noisy and noise free pixel in an original image.

The noise adaptive soft-switching median filter [7] classifies pixels into noise-free pixels, isolated noisy pixels, non-isolated noisy pixels. But it fails to detect some of the noisy pixels, especially when the noise density is high.

II. EXISTING SYSTEM

The BDND filter is operate efficiently compared to other filter, even when the noise density is high. BDND filtering algorithm [6] contain two steps, first one is detection step. In this step noise in the pixel is detected and in these step pixels in the image is classified into three groups lower intensity impulse noise and higher intensity impulse noise. The pixel with higher intensity and lower intensity is taking as noisy pixels.

Once the noisy pixel is detected the second step is filtering step [3]. In this step noisy pixel value is replaced with an original pixel value. This filter is applied to a noisy pixel only. The median filtering operation is applied to uncorrupted pixels in the filtering window. The difficult parameter defined in the filtering step of the BDND algorithm is the size of the window. Here 3×3 window size is used as an initial size of the filtering window. The number of noisy pixel in the filtering window must be less than the half of the pixels in the window. If the number of noisy pixel is greater than the half of the number of pixels in the window, then the window is expanded outward by one pixel in all directions. This will repeated until the number of noise free pixel in the window is greater than or equal to the number of pixel in the window [5]. The maximum window size is reached and there is no noise free pixel is found means window is expanded until one noise free pixel is found. This filtering step is performing well even when the noise density is high.

There are two main drawback found in the filtering step. First, expanding the window until the number of noisy pixel is less than the number of pixels in the window may provide blurring of image. Second, Filtering step replace the noisy pixel with an original value by computing median value of noisy free pixel found in the window without any regard to the spatial relationship. This also affects the quality and edge details in the filtering image.

To avoid such kind of problem in the BDND filter there are two modifications on the filtering step of the BDND algorithm.

III. PROPOSED SYSTEM

To avoid problem in an existing system, there are two modifications on the filtering step of the BDND algorithm first, expansion of filtering window. Second, incorporating spatial and intensity information.

A.Expansion of Filtering Window

Size of the filtering window is start with 3×3 that is centered in the noisy pixels. Two considerations is there (i) Number of noise free pixel Nn is greater than or equal to half of the number of pixel in the window.
(ii)Number of noise free pixel is not zero.

If any of this condition is violated then the size of the window is expanded outward by on pixel in all directions.

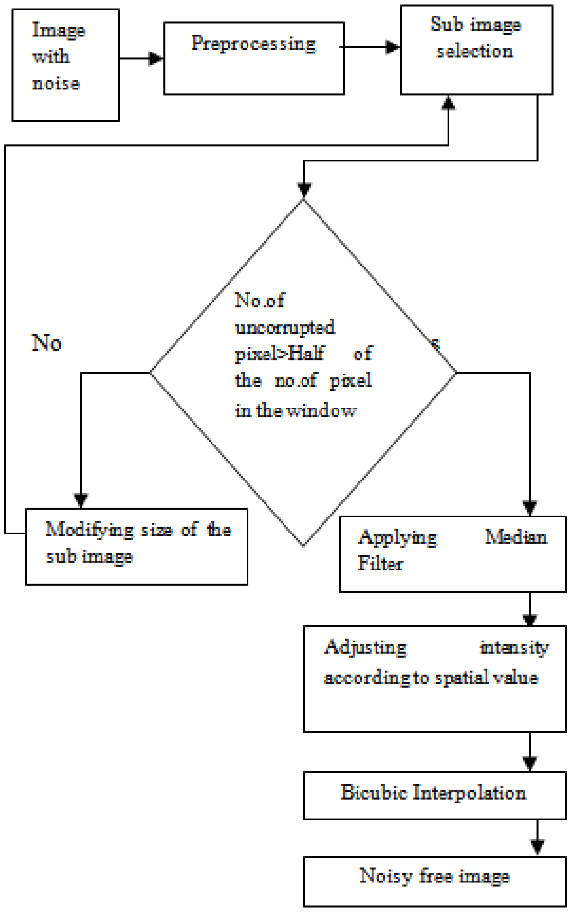


Figure 1.Diagram for Proposed System

20	23	20	21	22
21	22	19	18	152
21	20	22	152	151
20	21	150	151	153
150	22	151	153	149

(a)

20	23	*	21	*
*	*	*	*	152
21	*	22	*	151
*	21	*	151	*
*	22	*	*	*

(b)

20	23	30	*	22
21	*	*	*	152
21	*	*	*	*
*	*	*	*	*
150	*	151	153	*

(c)

Figure 2.(a)Original Image Window (b)Noisy Image I (c)Noisy Image II

Consider 5×5 image shown in figure 2(a).Suppose that is corrupted with 65% impulse noise shown in figure 2(b) with the noisy pixels indicated by(*).When the filtering step of the BDND filtering algorithm is applied on the central pixel with 3×3 window, here set of noise free pixel Vn is {22,21,151}.This implies Nn is 3, which is less than half of the number of pixels in the window(Np=4.5).This violates the first condition, so expand the window outward by one pixel in all directions. Now size of the window is 5×5,here set of noise free pixel Vn is{20,23,21,152,21,22,151,21, 151,22} this implies Nn is 10,which is also less than half of the number of pixel in the window(Np=12.5). So, again expanding the size of the window. This will leads blurring in the output image.

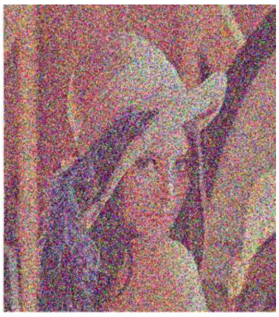
In order to solve this problem following modification is provided. Here estimated noise density 'd' is determined and the total number of pixels Nt in the filtering window is also determined. The number of noise free pixel Nn is less than ½(1-d)Nt then the filtering window is expanded outward by one pixel in all directions. The term (1-d) is the percentage of noise free pixels in the filtering window.

In figure 2(b) when the size of window 3×3,the set of noise free pixels Vn is{22,21,151} and noise density is 65%.this implies Nn is 3.Nt is 9 and percentage of noise free pixel is 40%. Based on these values Nn is greater than ½(1-d)Nt that is (3>1.8), thus the window is not expanded.

B. Incorporating Spatial and Intensity Information

In BDND filtering algorithm normally, noisy pixel value is replaced with the median value of a noise free pixels in the filtering window. This will affect the image quality. In order to avoid such kind of the problem take the replacement value according to the spatial and intensity information. This will increase the performance of the BDND filtering algorithm.

(a)



(b)

Figure 3.(a) Original Image (b)Image corrupted with 80% salt and pepper noise

Performance Analysis of figure 3

Noise Density(%)		PSNR(dB)
Low-Intensity Impulse Noise	High Intensity Impulse Noise	
30	50	7.3172
35	45	17.6832
45	35	17.9835
50	30	6.2572

(a)

Noise Density(%)		PSNR(dB)
Low-Intensity Impulse Noise	High Intensity Impulse Noise	
30	50	9.7040
35	45	16.8886
45	35	16.8766
50	30	10.3974

(b)

IV. CONCLUSION

In this paper, there are two modifications to the BDND filtering step to eliminate the effect of problems on the quality of the filtered image. The result of this algorithm performs well under high noise density. This will improve the performance of the quality of an image.

References

[1] R.A.Hadded and H.Hwang(1995) , “Adaptive median filter: New algorithms and results,” IEEE Trans. Image Process., vol. 4, no.4, pp. 499–502, Apr. 1995.

[2] Kenny Kal Vin Toh, and Nor Ashidi Mat Isa(2010),” Noise Adaptive Fuzzy Switching Median Filter for Salt-and-Pepper Noise Reduction”, IEEE Signal Processing Letters, Vol. 17, no. 3,, March 2010.

[3] Krishnan Nallaperumal, Justin Varghese, S.Saudia, Santhosh.P.Mathew, K.Krishnaveni, and S.Annam(2006), StudentMember, “Adaptive Rank-ordered Switching Median Filter for Salt & Pepper Impulse Noise Reduction”, 2006 IEEE.

[4] Madhu S. Nair, K. Revathy, and RaoTatavarti(2008),” Removal of Salt-and Pepper Noise in Images: A New Decision-Based Algorithm” Proceedings of the International Multi Conference of Engineers and Computer Scientists 2008 VolIIMECS 2008, 19-21 March, 2008.

[5] RemziOten, Member, IEEE, and Rui J. P. de Figueiredo, Life Fellow(2004), IEEE,” Adaptive Alpha-Trimmed Mean Filters Under Deviations From Assumed Noise Model” IEEE Trans. Image Process, vol. 13, no. 5, May 2004.

[6] Pei-Eng Ng and Kai-Kuang Ma, Senior Member, IEEE(2006)” A Switching Median Filter With Boundary Discriminative Noise Detection for Extremely Corrupted Images” IEEE Trans. Image Process, vol. 15, no. 6, June 2006.

[7] D. Sankowski and A. Fabijanska(2010),” Noise adaptive switching median-based filter for impulse noise removal from extremely corrupted Images” Published in IET Image Processing Received on 26th July 2009 ,Revised on 3rd May 2010.

[8] K. S. Srinivasan and D. Ebenezer(2007),” A New Fast and Efficient Decision-Based Algorithm for Removal of High-Density Impulse Noises” IEEE Signal Processing Letters, Vol. 14, no. 3, March 2007.

[9] Xuming Zhang and YoulunXiong(2009),” Impulse Noise Removal Using Directional Difference Based Noise Detector and Adaptive Weighted Mean Filter” IEEE Signal Processing Letters, Vol. 16.