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Impulsive Noise Removal in Standard Images Using Different Filters

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ABSTRACT: The sources of impulse noise in digital images are image digitization or image transmission. Environmental conditions during image acquisition and quality of sensing elements affect the performance of sensors. Images are corrupted by noise during transmission due to interference in the channel which is used for transmission. Image processing is used in various applications such as face recognition, image segmentation, and edge detection. Hence it is necessary to remove noise in image before these subsequent processing. In this paper impulse noise is removed by using median filter, adaptive median filter and DTBDM method.

KEYWORDS: Impulse noise, Median filter, Adaptive median filter and DTBDM.

I.INTRODUCTION

The impulse noises are of two types. First is fixed-valued impulse noise and second is random-valued impulse noise. Fixed value impulse noise is also known as salt and pepper noise. In the former method pixel value of the noisy pixel is either minimum or maximum in grey-scale images. In the latter method pixel value of the noisy pixel is uniformly distributed in [0,255] range in the grey-scale images.The removal of SPN (salt and pepper noise) is easier rather than RVIN (Random valued impulse noise). Most of the reported schemes work well under the SPN but fails under RVIN, which is more realistic when it comes to real world applications. It is also observed the performance of any filtering scheme is dependent on the detection mechanism. The better is the detector, the superior is the filtering performance. Hence the performance of a detector plays a vital role. The detector performance is solely dependent on a threshold value which is compared with a pre computed numerical value. To improve the detector performance need for an adaptive threshold is an utmost necessity which can be automatically determined from the characteristics of an image and the noise present on it. Impulse noise which is added in images can be removed by using median, adaptive median and DTBDM method.

II. MEDIAN FILTER

The median filter is one of the most popular nonlinear filters. It is very simple to implement and much efficient as well. The median filter, especially with larger window size destroys the fine image details due to its rank ordering process. It acts like a low pass filter which blocks all high frequency components of the image like edges and noise, thus blurs the image. As the noise density increases, the filtering window size is increased to have sufficient number of uncorrupted pixels in the neighborhood. Depending upon the sliding window mask, there may be many variations of median filters. In this thesis, Median filter with sliding window (3×3), (5×5) and (7×7) are reviewed. A center pixel, irrespective of either being noisy or not, is replaced with the median value. Due to this, its results are disappointing in many cases. Applications of the median filter require caution because median filtering tends to remove image details such as thin lines and corners while reducing noise.

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III.ADAPTIVE MEDIAN FILTER

For good impulse classification it is preferred to remove the positive and negative impulse noise one after another. There are number of algorithms which resolve this problem, but they are more complex. This algorithm is simple and better performing in removing a high density of impulse noise as well as non-impulse noise while preserving fine details. The size of filtering window of median filter is adjusted based on noise density. This algorithm is based on two level tests. In the first level of tests, the presence of residual impulse in a median filtered output is tested. If there is no impulse in the median filtered output, then the second level tests are carried out to check whether the center pixel itself is corrupted or not. If the center pixel is uncorrupted then it is retained at the output of filtered image. If not, the output pixel is replaced by the median filter output. On the other hand, if the first level detects an impulse, then the window size for median filter is increased and the first level tests are repeated. The maximum filtering window size taken is 11×11 if the noise density is of the order of 70%.

IV.DECISION TREE BASED DENOISING METHOD

The decision tree is a simple but powerful form of multiple variable analysis. It can break down a complex decision-making process into a collection of simpler decisions, thus provide a solution which is often easier to interpret. It has detector and edge preserving filter. To detect the noise it has different modules like Isolation module, fringe module and similarity module.

V. RESULT AND DISCUSSION

The path of the input image is defined in MATLAB. Input image of size 256x256 pixels is used in MATLAB and converted into grayscale image, if image is color image, using matlab code. Random valued impulse noise is added in input images in MATLAB environment. 1%, 2%, 3%, 4%, 5%&15% impulse noise is added and tested for input images.

1. MATLAB Results for Cameraman Image:

The Fig. 1 shows the MATLAB output of denoised image with the original image cameraman. Impulse noise is added with 0.01 noise density. This added noise is removed by using Median filter, Adaptive median and DTBDM method.

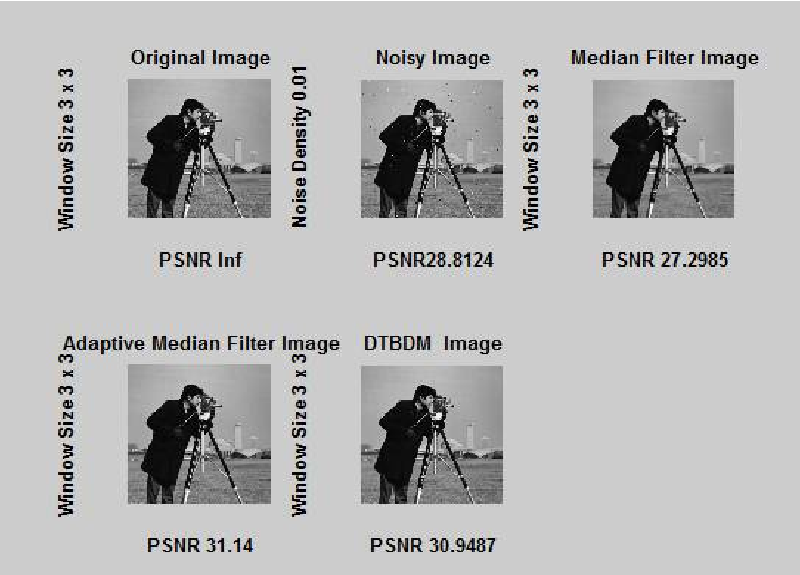

Fig.1. MATLAB Results for 1% Noise Density

The increase in noise variation affects the PSNR of the image. The results for various filter are shown below.

Noise %	PSNR (dB)		
	Median filter	Adaptive filter	DTBDM
1	27.2901	31.0501	30.9085
5	26.9992	28.466	29.4458
10	26.42	25.4895	27.3929
15	25.7885	22.7523	26.1894
20	25.116	20.7683	24.5444
30	23.3273	17.9632	22.0773
40	20.7744	15.853	19.2955
50	18.5566	14.3325	17.1021
60	16.234	12.9687	14.8824
70	14.4371	11.8524	13.1895
80	13.0525	11.0016	11.8553
90	11.7722	10.1552	10.6447
100	10.7674	9.4903	9.7621

Table 1. : PSNR value for different noise density using cameraman image

Fig. 2 gives the graphical representation of the Noise density verses PSNR.

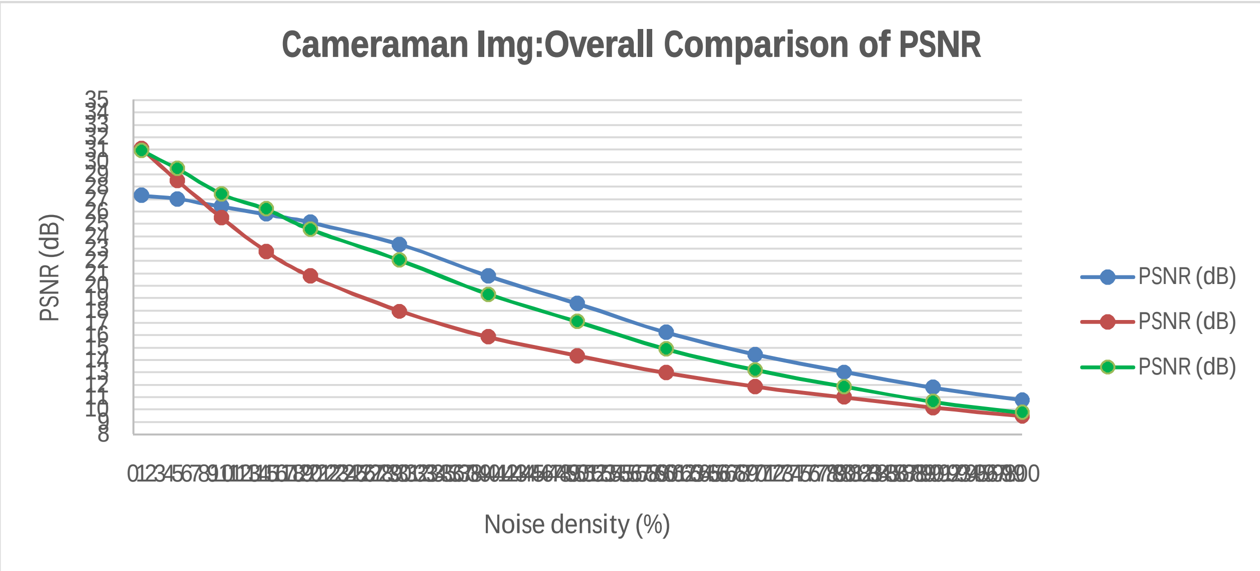

Fig.2 Comparison of PSNR with Different Noise density using cameraman image

2. MATLAB Results for Board Image: Impulse noise is added in Board image and is removed by using different filters.The increase in noise variation affects the PSNR of the image. The results for various filter are shown below.

Noise %	PSNR (dB)		
	Median filter	Adaptive filter	DTBDM
1	15.3394	18.1218	18.4591
5	15.2104	17.4059	17.7058
10	14.995	16.4849	16.8275
15	14.7297	15.6627	16.0274
20	14.4237	14.9143	15.3665
30	13.8274	13.5517	14.1031
40	13.1836	12.4236	13.059
50	12.517	11.4628	12.0981
60	16.234	12.9687	14.8824
70	14.4371	11.8524	13.1895
80	13.0525	11.0016	11.8553
90	11.7722	10.1552	10.6447
100	10.7674	9.4903	10.5

Table 2. PSNR of Board Image

Fig 3 gives the graphical representation of the Noise density verses PSNR.

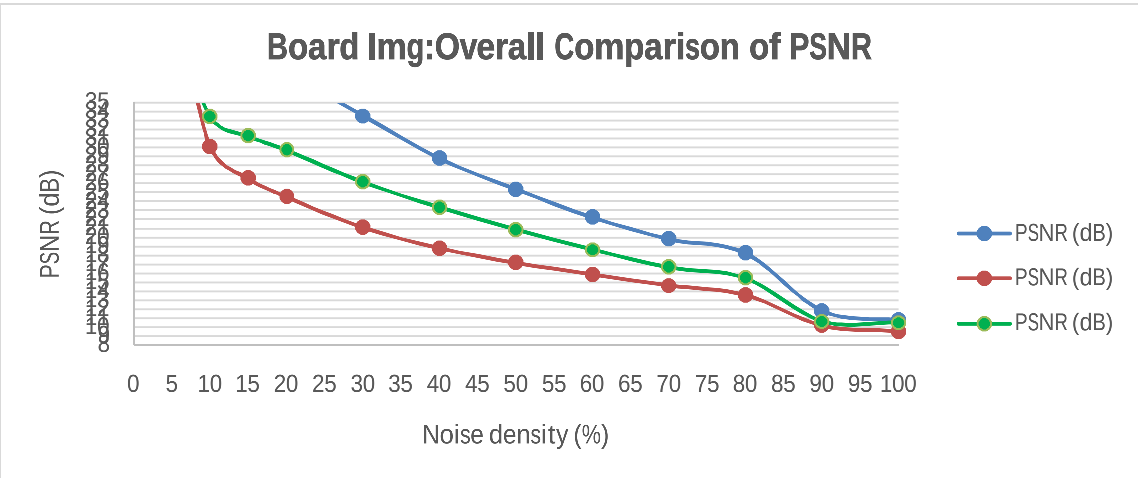

Fig 3. Comparison of PSNR with Different Noise density using Board image

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3. MATLAB Results for Pout Image: Impulse noise is added inpout image and is removed by using different filters.The increase in noise variation affects the PSNR of the image. The results for various filter are shown below.

Noise %	PSNR (dB)		
	Median filter	Adaptive filter	DTBDM
1	42.1811	36.1027	37.1662
5	42.883	45.4654	43.5687
10	41.0631	30.0659	33.4179
15	39.9405	26.5679	31.2613
20	38.208	24.4969	29.707
30	33.5307	21.0734	26.1256
40	28.7797	18.765	23.3126
50	25.3152	17.1456	20.819
60	22.2294	15.8253	18.63
70	19.7772	14.6374	16.6459
80	18.234	13.54	15.453
90	11.7722	10.1552	10.6447
100	10.7674	9.4903	10.5

Table 3. PSNR of Pout Image

Fig 4 gives the graphical representation of the Noise density verses PSNR.

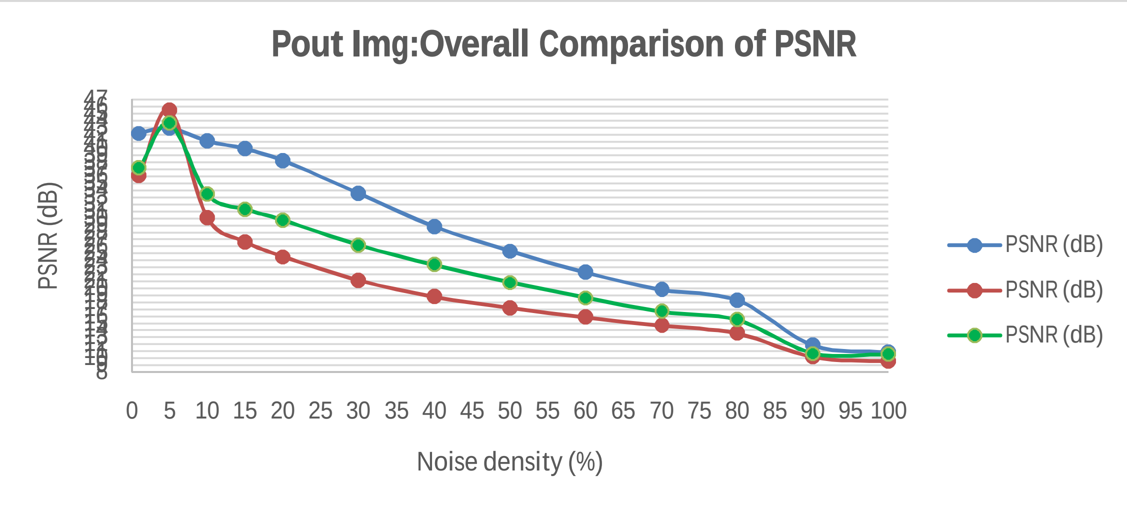

Fig.4 Comparison of PSNR with Different Noise density using Pout image

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Following fig 5 shows MATLAB results of PSNR value in dB for 7 different images.

Sr. No	Image Name	PSNR(dB)		
		0.05 ND	0.1 ND	0.15 ND
1	board	17.6618	16.8167	16.043
2	pout	37.1989	33.4147	31.1956
3	tire	33.8653	30.0666	27.8064
4	rice	35.4031	31.64442	29.4287
5	fabric	35.3089	31.9305	29.4898
6	pears	37.5278	34.0124	31.5775
7	bag	28.5796	26.8094	25.3238

Fig.5 PSNR Performance Measures of MATLAB for DTBDM

Following figuregives the graphical representation of the Noise density verses PSNR.

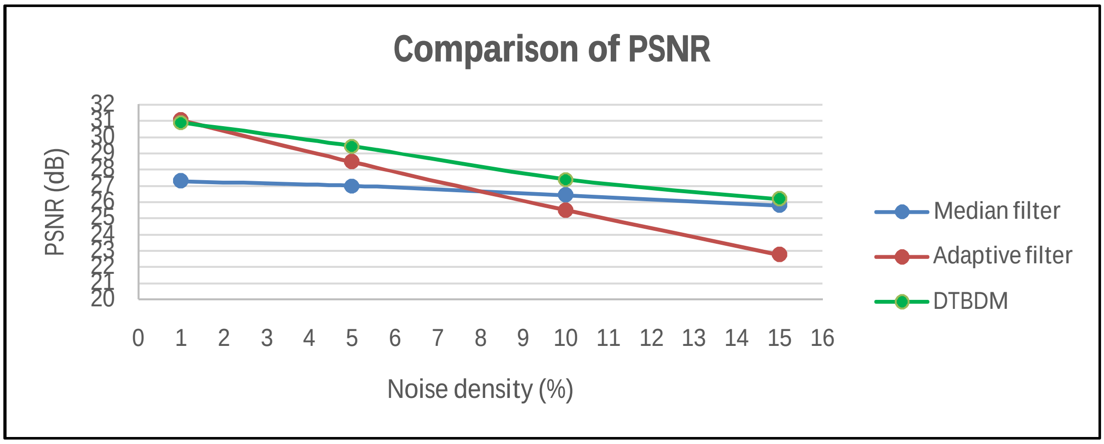

Fig 6. Comparison of PSNR with different Noise Density

Performance Metrics: Performance evaluation metrics like Peak-Signal-to-Noise Ratio (PSNR) is calculated for the input images for median filter and adaptive median filter technique in MATLAB. Peak-Signal-to-Noise Ratio (PSNR) The performance is calculated by PSNR. It is given by eq.

$$PSNR = 10log_{10}\left(\frac{255^2}{MSE}\right)$$

$$MSE = \frac{\sum_{ij}(r_{ij} - x_{ij})^2}{MN}$$

Where, PSNR is peak-signal-to-noise ratio, MSE is mean square error, MxN is size of image, R is original image and X is denoised Image.

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V.CONCLUSION

Image denoising using adaptive median and median filter was also performed and compared. From the image filtering operations performed by adaptive median and median, it was then compared with the proposed method.

1. The PSNR decreases with increase in noise density.
2. The DTBDM method gives better result than those are given by median filter and adaptive median filters.
3. The computational complexity in DTBDM is low compared with other two methods consider. Hence it provide superior quality of result in terms of PSNR and image quality.

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