

Using Center Weighted Mean Filter Technique for Removal of Impulse and Pepper Noise

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Abstract— Impulse noise and pepper noise often disturbs digital images. In image and video processing system, The most common and important processing operation is Image denoising. So many linear and non-linear filtering algorithms are proposed in literature for image denoising. For visual point of view, image edges carry very important detailed information that could have high frequency. In digital image filtering we need good edges and image detail properties which are highly suitable for filters. Linear filters generally disturb sharp edges. It also destroys lines and other fine details that are present in the image. To remove high-density noise in images, we need some improved decision based on nonlinear edge preserving algorithms. For suppressing different types of noise in the image with good edge and fine detail preserving characteristics, the proposed filters are simple and effective. A decision based adaptive recursive weighted mean filter is proposed; the filter uses the mean controlled algorithm for weight calculation. A decision based adaptive window scheme is incorporated in the recursive weighted mean filter. The proposed filter is shown to be effective in removing high density salt and pepper noise quite well with edge preservation.

Keywords — Mean Filter, Salt & Pepper Noise, Unsymmetrical Trimmed Mean Filter, Cascaded Filter, Peak Signal Noise Ratio.

I. INTRODUCTION

A novel switching based adaptive mean filter is introduced to suppress mixed (Gaussian and impulse) noise. Simple decision mechanism is used to detect the impulse noise corrupted pixels. An adaptive mean filter is developed to smooth out the Gaussian noise. The performance of the proposed filter is verified for different test images corrupted by different types of noise, namely, Gaussian noise, impulse noise and mixed noise. Extensive simulation results show that the proposed filter is effective in suppressing different

types of noise with edge and detail preserving characteristics [1].

The major contribution of this research work is summarized and the possible directions for future work are indicated. The usage of visual information has an important role in our lives as multimedia becomes more widespread day by day. Unfortunately, images are often corrupted by noise during acquisition, storage, and transmission yielding degradation at the quality of the images [2]. Therefore, a common problem in many domains of applied science and engineering is the restoration of the corrupted image. Impulsive noise is a specific type of noise, which causes alteration of the pixels in the images so that their gray values do not exhibit compatibility with their local neighborhood. Images are often degraded by impulse noise of short duration and high energy [3]. Thus, the suppression of impulse noise is one of the most important issues in image and video restoration systems [4]. In image denoising, a compromise has to be achieved between noise reduction and the preservation of significant edges, corners and other image details. For the suppression of impulse noise precisely, sophisticated techniques are required to obtain additional information about the image, such as statistics and thresholds that help to determine the replacement values correctly [5]. Hence, the performance of the image restoration algorithm greatly depends on the validity of statistical models used for the noise suppression process.

Window-based filtering algorithms such as median-based filters are well known to suppress impulse noise, but one of their big drawbacks is that they often remove important details and blur the image when large window sizes are used, or noise suppression cannot be obtained sufficiently for small window sizes [6-7]. Another pitfall is that median-based filters, use

the local information and they do not consider the long-range correlation within natural images. In order to overcome this drawback, various generations of the median filter, such as Weighted Median (WM) Filter, Center Weighted are used [8].

Median (CWM) Filter, Recursive Weighted Median (RWM) Filter, Adaptive Median (AM) Filter and decision based median filters are used [9]. Many of the decision-based filters identify the corrupted pixel based on different kinds of noise detectors; for example, detail preserving median based filters. In the existing arithmetic mean filtering techniques, the arithmetic mean will be calculated by considering both noisy and noise free pixels for the replacement of both affected and unaffected pixels. Sometimes, it may lead to some erroneous results. It decreases the quality of the image rather than improving the quality of image by giving highest PSNR ratio [10].

In order to overcome this, in the proposed arithmetic mean filtering technique, the noisy pixels are ignored for calculating the arithmetic mean and replaced the affected pixels only by the calculated arithmetic mean and unaffected pixels are not considered for the replacement to get the highest PSNR ratio for improving the quality of the image.

II. ADAPTIVE TRIMMED MEAN FILTER

A thought behind a trimmed filter is to reject the noisy pixel from the chosen 3×3 window. Symmetrical Trimmed filtering means, the trimming is symmetric at one or both ends using symmetric channel. In this Strategy, the uncorrupted pixels are departed. This prompt causes loss of picture point of view, edges, disturbing the image. So this downside is proposed to check by an Unsymmetrical Trimmed mean filter.

The picture with the pixel values 0's and 255's are rejected from the picture and the remaining pixel's average estimation is taken. This average quality is utilized to supplant the uproarious pixels so the pixel values 0's and 255's are rejected from the choose window and the channel is called trimmed average channel. This system remove clamor in preferred path over the ATMF.

III. PROPOSED ALGORITHM

The proposed Modified Decision Based Unsymmetric Trimmed Mean Filter (MDBUTMF) algorithm processes the corrupted images by first detecting the impulse noise. The processing pixel is checked whether it is noisy or noisy free. That is, if the processing pixel lies between maximum and minimum gray level values then it is noise free pixel, it is left unchanged. If the processing pixel takes the maximum or minimum gray level then noisy pixel is processed by MDBUTMF.

The formation of the tainted pictures by first disappearing the Salt and Pepper contamination when Gaussian (ADBUTMF) method cascaded with the adapted decision based unsymmetrical trimmed mean filter. The handling pixel is checked whether it is uproarious or boisterous free. That is, if the transforming pixel lies in the middle of maximum and minimum gray level values then it is noise free pixel, it is left unaltered or intact. In the event that the handling pixel takes the most extreme or least gray level then it is boisterous pixel which is prepared. The steps of the proposed algorithm are clarified as takes after.

ALGORITHM

Step 1: A 3×3 two dimensional window is selected as processing window and consider the pixel being modified is X_{ij}

Step 2: If then is an uncorrupted pixel and its value is left unchanged. This is discussed in Case III) of Section IV.

Step 3: If more than one pixel is a corrupted pixel in the selected window then two cases are possible as given in Case i) and ii).

Case i): If the selected window carry, all the pixel values as 0's and 255's. than increase the window size 4×4 and find non zeros and 255 value. and save this value to replace X_{ij} of the element of window.

Case ii): processing and neighboring pixels contains some pixel values which is selected by salt and pepper noise. Value of processing pixel is '0' i.e. from the selected window ,the salt and pepper noise is removed.

$$\begin{bmatrix} 78 & 90 & 0 \\ 120 & \langle 0 \rangle & 255 \\ 97 & 255 & 73 \end{bmatrix}$$

Where “0” is processing pixel, i.e. So it is elimination of 0's and 255's. (78, 90, 0 120 0 255 97 255 73) is the I D array of the above matrix. The pixel value of selected window will be (78, 90, 120, 97 73) if 0's and 255's is removed. So 91 is mean value, Although the processing pixel is replaced by 91.

Step 4: Repeat steps 1 to 3 until all the pixels in the entire image are processed. The pictorial representation of each case of the proposed algorithm is shown in Fig.1. The detailed description of each case of the flow chart shown in Fig. 1 is illustrated through an example.

ILLUSTRATION OF THE PROPOSED ALGORITHM

Each pixel element of the image under observation is performed replacement with; if necessary each and every pixel image is interchange with salt and pepper noise. Required cases are shown in this Section. If the processing pixel is noisy and all other pixel elements are 0's or 255's is shown in Case I. If the noisy pixel is processing than all the other pixel elements are 0's or 255's is explained in Case ii. If noisy pixel is not processing pixel than its value lies between 0' to 255 as explained in Case iii.

Case i): Processing & neighboring pixel selected by the window contains salt & pepper noise as contains all pixel values that add salt & pepper noise to the image so the windows size is increased and search out if any non 0's or 255 is present to interchange the processing pixel.

$$\begin{bmatrix} 0 & 255 & 0 \\ 0 & \langle 255 \rangle & 255 \\ 255 & 0 & 255 \end{bmatrix}$$

where “255” is processing pixel, i.e (2,2).

Ex. 1: In this example, the selected window has seven values which are 255 and remaining two values are 0, thus all the pixels in the window are 0 or 255. If we apply MDBUTMF to this window then the pixel will be replaced with the mean of the elements which is 198.

Ex. 2: Let's find out how this pixel will be handled in proposed algorithm. Since 7 pixels are 255, it will be processed in Step 3a and processing pixel will be set as 255. As discussed earlier, the assumption is that processing pixel belongs to some white patch in the image, so it is optimum to set the pixel to maximum gray level i.e. white.

Ex-3: In second example, the selected window has three values which are 255 and remaining six values are 0, again all pixels in the window are 0 or 255. As in Ex. 1, if we apply MDBUTMF to this window then the pixel will be replaced with the mean of the elements which is 85.

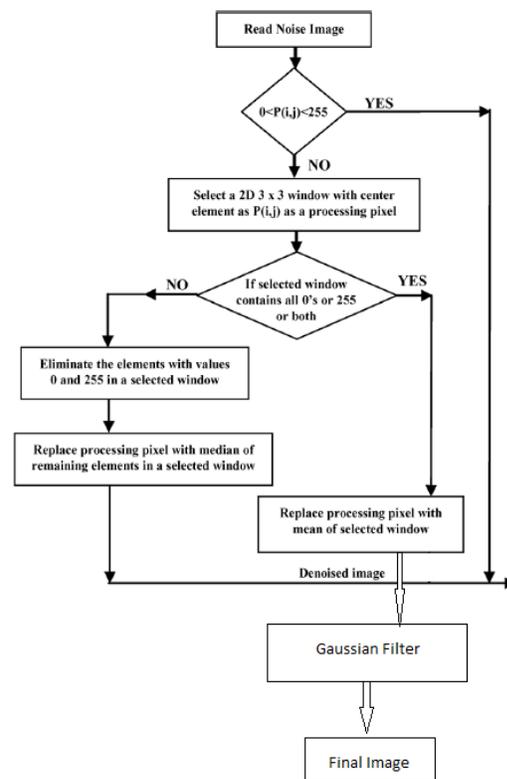


Fig. 1: Flow Chart of Proposed Methodology

In the surrounding window all the elements are 0's and 255's. The mean value is again noisy if it will be either 0 or 255. So the size of window is increased to solve this problem i.e. 4 x 4 then interchange the processing

pixel with that value which is non zero and 205 to check it or the mean of the selected 3 x 3 window is calculated if the expanded window is noisy and the mean value replace the processing pixel [6-10].

Case ii): If processing pixel and neighboring pixel are selected by the salt or pepper noise contains some pixels values. Here processing pixel is 'O' i.e. from the selected window, the salt and pepper noise is removed.

$$\begin{bmatrix} 78 & 90 & 0 \\ 120 & \langle 0 \rangle & 255 \\ 97 & 255 & 73 \end{bmatrix}$$

Where “0” is processing pixel, i.e. So it is elimination of O's and 255' s. (78, 90, 0 120 0 255 97 255 73) is the I D array of the above matrix. The pixel value of selected window will be (78, 90, 120, 97 73) if O's and 255' s is removed. So 91 is mean value, Although the processing pixel is replaced by 91.

Case iii): Further processing does not required by selected window as it contains a noise free pixel as a processing pixel.

For example: It is noise free pixel as the processing pixel is 90. The processing pixel is 90. It does not need further processing because 90 is a noise free pixel.

$$\begin{bmatrix} 43 & 67 & 70 \\ 55 & \langle 90 \rangle & 79 \\ 85 & 81 & 66 \end{bmatrix}$$

Where “90” is processing pixel. Since “90” is a noise free pixel it does not require further Processing.

IV. SIMULATED RESULTS

When applying algorithm is tested and compared with the previous results and parameters corresponding values then the final image received. Noise is differ from 10% to 90%. The PSNR measures Pinioning

performances quantitatively as defined in

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

$$MSE = \frac{\sum_i \sum_j (Y(i,j) - \hat{Y}(i,j))^2}{M \times N} \quad (2)$$

where MSE stands for mean square error, MXN is size of the image, Y represents the original image, bar y(i,j) denotes the de-noised image.

TABLE I

Comparison of PSNR of proposed and existing algorithm at 10% to 90% noise density.

Noise in %	PSNR in DB						
	MF	AMF	PSMF	DBA	MDBA	MDBUTMF	CASCADED
10	26.34	28.43	30.22	36.4	36.94	37.91	37.03
20	25.66	27.40	28.39	32.9	32.69	34.78	34.23
30	21.86	26.11	25.52	30.15	30.41	32.29	33.05
40	18.21	24.40	22.49	28.49	28.49	30.32	31.91
50	15.04	23.36	19.13	26.41	26.52	28.18	30.93
60	11.08	20.60	12.10	24.83	24.41	26.43	29.77
70	9.93	15.25	9.84	22.64	22.47	24.30	28.89
80	8.68	10.31	8.02	20.32	20.44	21.70	28.19
90	6.65	7.93	6.57	17.14	17.56	18.40	28.13

TABLE II

Comparison of IEF values of proposed and existing algorithm at 10% to 90% noise density.

Noise Density in %	IEF					
	MF	AMF	PSMF	DBA	MDBA	MDBUTMF
10	10.36	23.20	171.63	390.67	422.58	648.98
20	28.17	37.76	207.31	358.91	377.42	568.43
30	30.02	42.57	190.92	322.89	324.74	590.83
40	23.12	40.98	143.49	268.49	275.24	424.18
50	11.72	36.11	62.98	208.77	217.18	345.13
60	6.73	25.21	6.61	190.70	175.89	261.66
70	3.31	7.89	3.28	128.58	129.65	171.69
80	2.00	2.91	1.98	67.42	73.24	101.72
90	1.37	1.31	1.37	33.85	33.33	34.23

The PSNR values of the proposed algorithm are compared against the existing algorithms by varying the noise density from 10% to 90% and are shown in the table above, the existing algorithms are compared opposite the PSNR values of the proposed algorithm. From the above table it is proved that cascaded Gaussian's performance is better than the existing algorithms at both low high noise densities

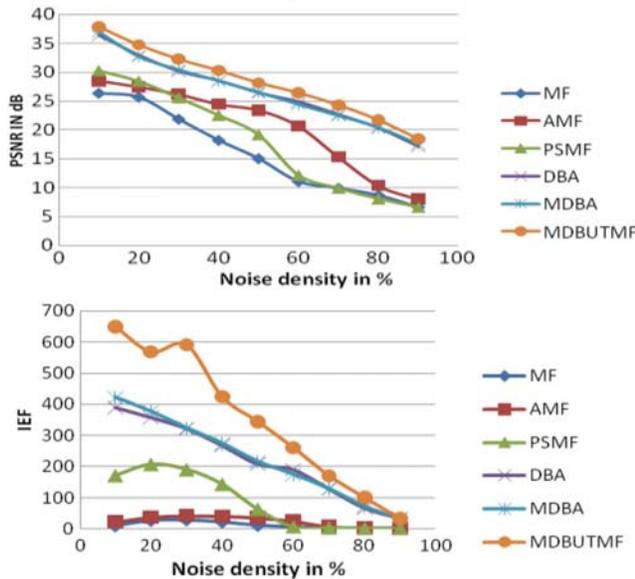
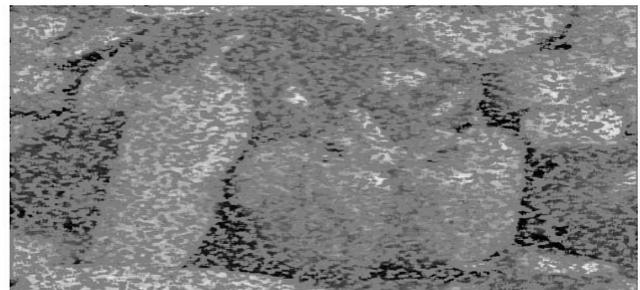


Fig. 2 Comparison graph of PSNR and IEF at different noise densities for different images.



(a)



(b)

The qualitative analysis of the proposed algorithm against the existing algorithms at different noise densities for image is shown in Fig.3. In this figure, the first column represents the processed image using MF at 80% and 90% noise densities. Subsequent columns represent. The processed images for AMF, PSMF, DBA, MDBA, MDBUT MF and cascaded Gaussian are represented by the subsequent columns. The proposed algorithm is tested against images, 10% salt pepper noise corrupts these images. In the figure below. The PSNR values of these images using different algorithms are given in Figure 3. From the figure, it can be proved that the Cascaded Gaussian provides better PSNR values irrespective of the nature of the input image.

To Process the color images which are spoiled by salt and pepper noise is also used in the cascaded Gaussian. The color image of taken into account. In Fig.4, the first column represents The processed image is represented by the first column using MF at 80% and 90% noise densities. Subsequent columns represent The processed images are represented by subsequent columns for PSMF, DBA, MDBA and MDBUTMF.

From the figure, it is possible to observe that the quality of the restored image using proposed algorithm is better than the quality of the restored image using existing algorithms.

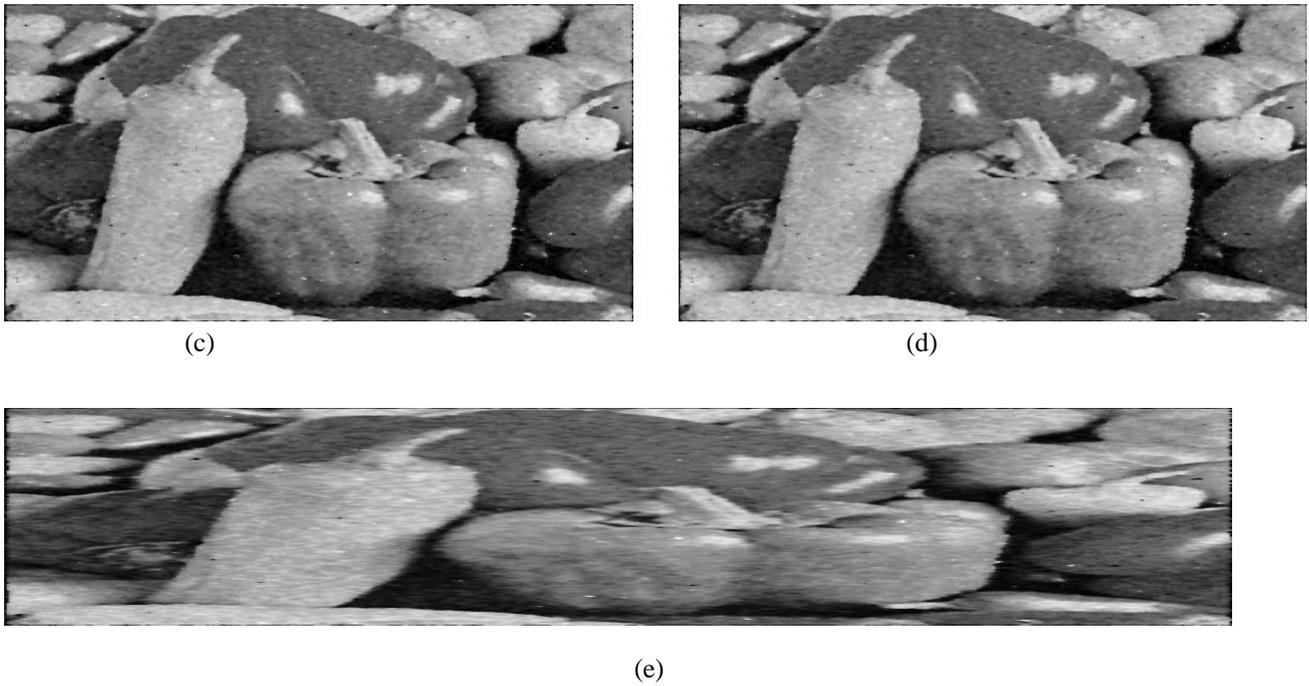


Fig. 3 Results of different algorithms for above image. (a) O/p of Median Filter. (b) O/p of Asymmetric Median Filter (c) O/p of Decision Based Algorithm.. (d) Output of MDBA- UTMF (e) Output of Cascaded Gaussian show processed results of various algorithms for image corrupted by 80% and 90% noise densities, respectively



Fig. 4 Result of the Algorithm on Image with different Noise inputs (a) 60% (b) 70% (c) 80% (d) 90%

V. CONCLUSION

The image retrieval from an image induced with high density salt and pepper noise propose a better algorithm approach. The Proposed Cascaded Gaussian algorithm approach has proved efficient and useful for this task. The existing method like MDBUTMF, MF, AMF and others were compared by this algorithm and so it proved better in performance

in all the available approach currently extant. We get efficient and promising results at the high noise levels of 80%-90% in this method and then it can be void that for high density salt and pepper noise removal, it is an efficient method. As colored or R.G.B. image with the same algorithm or better approach can be done by future experiments.

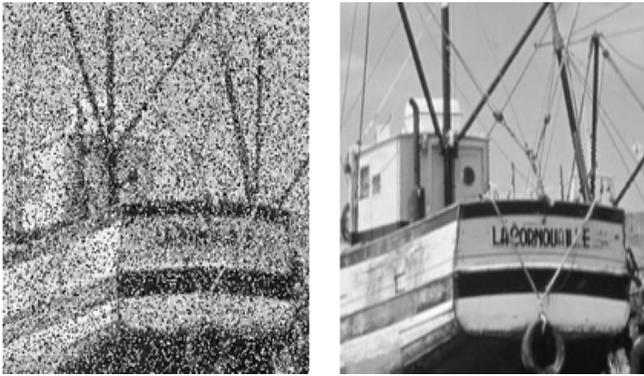


Fig.5 Original & de-noised image (using MDBUTMF)

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