Image De-Noising using Decision Based Enhanced Window Median Filter with Multiple Scannings

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Abstract – Image restoration is defined as a process to restore the degraded image to gain its original information. Number of algorithms and filters were proposed to denoise the image but results were not efficient. The idea of making an algorithm to vanish the impurities of the image has taken advance steps. Proposed algorithm also deals with clarity of noisy image after restoration at different noise densities.

Index Terms – Denoised image, Noise Density, PSNR, MSE, BER.

1. INTRODUCTION

Image processing is an electronic meadow in which the image is processed into functional entity called as the pixel and a number of actions depending upon the image impurity undergo on these pixels. Basically, noise is an undesired indication that dispels the quality of an image. Noise in an image can be explained as a degradation which hides the original image and real information. Noise is when disturbing ailments are added up on to an image then it shred down the obligatory particulars of the image. However, image restoration or removal of noise from the image is indispensable and crucial matter to look upon.

Image Restoration is a field of Image Processing which deals with recovering an original and sharp image from a degraded image using a mathematical degradation and restoration models. Images are produced to record or display useful information. Due to imperfections in the imaging and capturing process, however, the recorded image invariably represents a degraded version of the original scene. The undoing of these imperfections is crucial to many of the subsequent image processing tasks. There exists a wide range of different degradations, which are to be taken into account, for instance noise, geometrical degradations (pincushion distortion), illumination and color imperfections (under / overexposure, saturation), and blur.

Blurring is a form of bandwidth reduction of an ideal image owing to the imperfect image formation process. In addition to these blurring effects, noise always corrupts any recorded image. Noise may be introduced by the medium through which the image is created (random absorption or scatter effects), by the recording medium (sensor noise), by measurement errors due to the limited accuracy of the recording system, and by quantization of the data for digital storage. There are number of noises that can create imperfections in the images the most commonly known noises are Gaussian noise in which the actual pixel of the image is misrepresented from original value by a miniature sum. Due to this, the image becomes faintly malleable and blurry. Impulse noise that is basically introduced due to the bit error in transmission, faulty memory locations or timing errors in analog-to-digital conversion and also introduced during image acquisition stage. Salt and pepper noise in which noisy pixel is the extreme gray level of the image (0 or 255).

Salt and pepper noise has two intensity values for gray level 8-bit image 0 and 255. This type of noise occurs due to bit error during the transmission of the signal or communication. It creates high saturated and impulse noise in the image with high density which is easy to grab but difficult to procure from a noisy image.

Many different algorithms and filters have been introduced for image restoration. Some state of art filters like SMF which is effective only for the low density noises and makes image blur on processing the large window sizes proved an unstable method to improve and find noise .However the problems with SMF are expected to be overcome with the introduction to AMF which works on the high density noises but in order to remove the noise the image is turned into blur image causing the imperfections in terms of blurring. The research does not vanished for finding the better algorithm for denoising images so again the new MDBUTMF algorithm is proposed which stabilized the images with its working. It defines the fixed window size of 3*3 and works well for high density noises by replacing the defected pixel by mean of processing window. It gave a new point in the field of image restoration but there were some problems that could not be fixed like when it processes the image it leaves a dark patch behind in the restored image.

2. RELATED WORK

This section discussed about the literature review. This dissertation figured the different researches given by different researchers.

In 2010, Aishwarya, K., Jayaraj, V., Ebenezer. [7], a new algorithm to sort high-density salt and pepper noise using modified sheer sorting method is proposed. It has low computation time when compared to other standard algorithms. This method proved to be effective and has better visual appearance and quantitative measures at higher noise densities as high as 90%.

In 2011, T.Veerakumar, S.Esakkirajan and Ila Vennila. [8**]** A new algorithm is proposed for removing the salt and pepper noise from videos. A window size is selected for processing the noisy pixel the size of the window is 3*3. In the selected window the intense value for 0's and 255's is checked and processed for noisy windows and if noise free pixels are found in the window then corrupted window is replaced by mean of the trimmed window.

In 2012, Nair, M.S., Raju, G. [4] The proposed algorithm computes the difference measure for each pixel based on the central pixel in a selected window and then calculates the value for each pixel based on the highest difference. The algorithm then eliminates those pixels from the window with very high and very low values, which might represent the impulse noises.

Median filter is then applied to the remaining pixels in the window to get the restored value for the current pixel position.

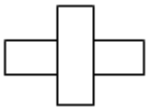
In 2013, Benazir, T.M. ; Dept. of P.G, Appl. Electron., ICET, Muvattupuzha, India ; Imran, B.M.[10] a new algorithm is implemented for the restoration of gray scale images that are highly corrupted by impulse noise (salt and pepper noise). There are two phases in the proposed algorithm. First phase detects whether the processing pixel is corrupted or not. In the Second phase it recreates the corrupted pixel by means of the proposed algorithm. Decision Based Algorithm (DBA) and Modified Decision Based Unsymmetrical Trimmed Median Filter Algorithm (MDBUTMF).

In 2014, Chaitanya, N.K. ; Dept. of ECE, P.B.R. Visvodaya Inst. of Technol. & Sci., Kavali, India ; Sreenivasulu, P.[11] a novel approach for removal of salt and pepper noise from the high density salt & pepper noisy images, using Iterative Modified Decision based Unsymmetric Trimmed Median Filter. The existing MDBUTMF is unable to restore the original image from the noisy one if noise density is more than 70%.

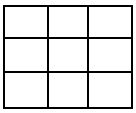
3. PROPOSED MODELLING

There are two different windows taken for processing the image:

W1 is simplified window of (2s+1)*(2s+1) having 5 elements for processing. In this only the single neighbor element is considered.



W2 is full window of (2s+1)*(2s+1) having 9 elements for processing. In this the full window of a corrupted pixel is processed.



In a proposed algorithm the image is denoise through multiple scannings in two phases. The proposed algorithm evaluates better results for noisy pixel of RGB and Gray images.

PHASE-I

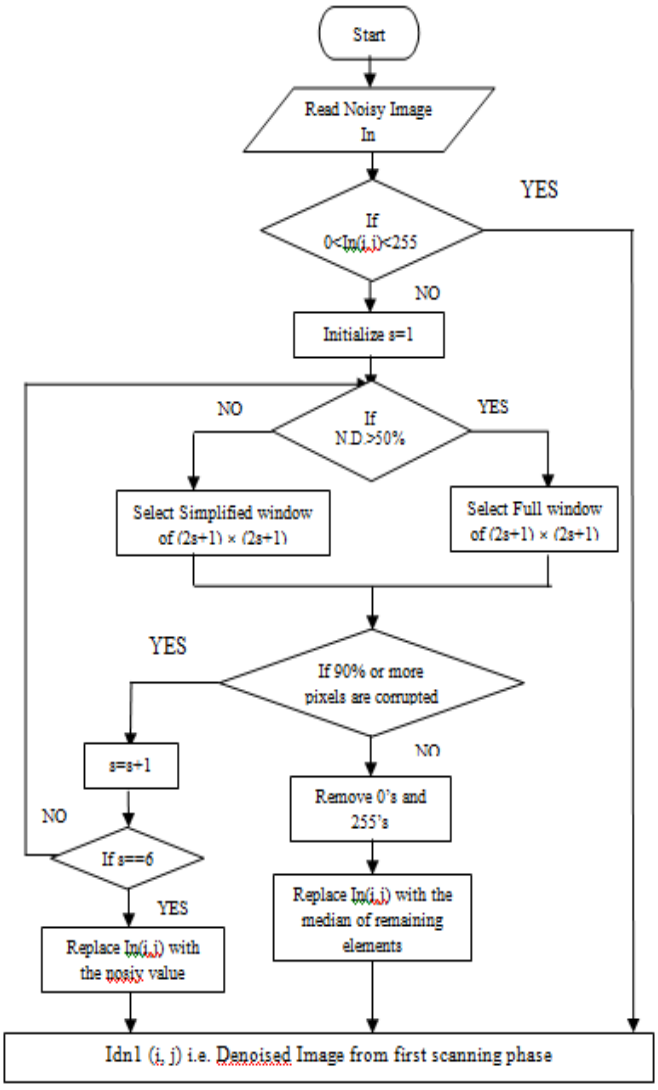


Figure1 (a).Block Diagram of Phase-I

1. Read the original noisy image In.
2. If pixel (i,j) of In are in between 0 and 255 then get denoised image from first scanning phase.
3. If In(I,j). has 0 and 255 values then process image by selecting window size.
4. Check if noise density is less than 50% select simplified window w1, else select full window w2.
5. If number of corrupted pixels is less than remove 0 and 255 values and replace the corrupted pixels with the median of the remaining elements.
6. If 90% or more pixels are corrupted then increase the window size by 1 and check whether s=6 if yes then leave the elements unprocessed for second phase.
7. Get denoised image from first scanning phase.

PHASE-II

1. Read the denoised image from first scanning phase.
2. Initialize window size for the processing image.
3. Repeat the iterative steps of first phase to get denoised image after second scanning phase.

Block diagram

The block diagram of the algorithm is shown in Figure1 (a) & Figure1 (b).

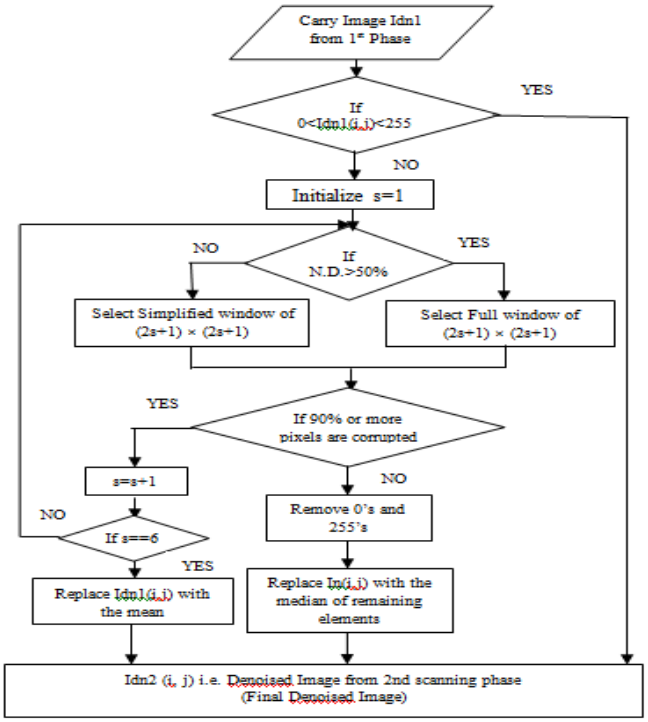


Figure 1(b) Block Diagram of Phase-II

4. RESULTS AND DISCUSSIONS

MATLAB software and Image and Video Processing toolbox is required to conclude the research. In the following study, the standard color image (Lena), and gray-scale image (Jeep) along with natural image captured using camera shot (Sonam) have been used, with varying noise density, ranging from 10% to 90%.

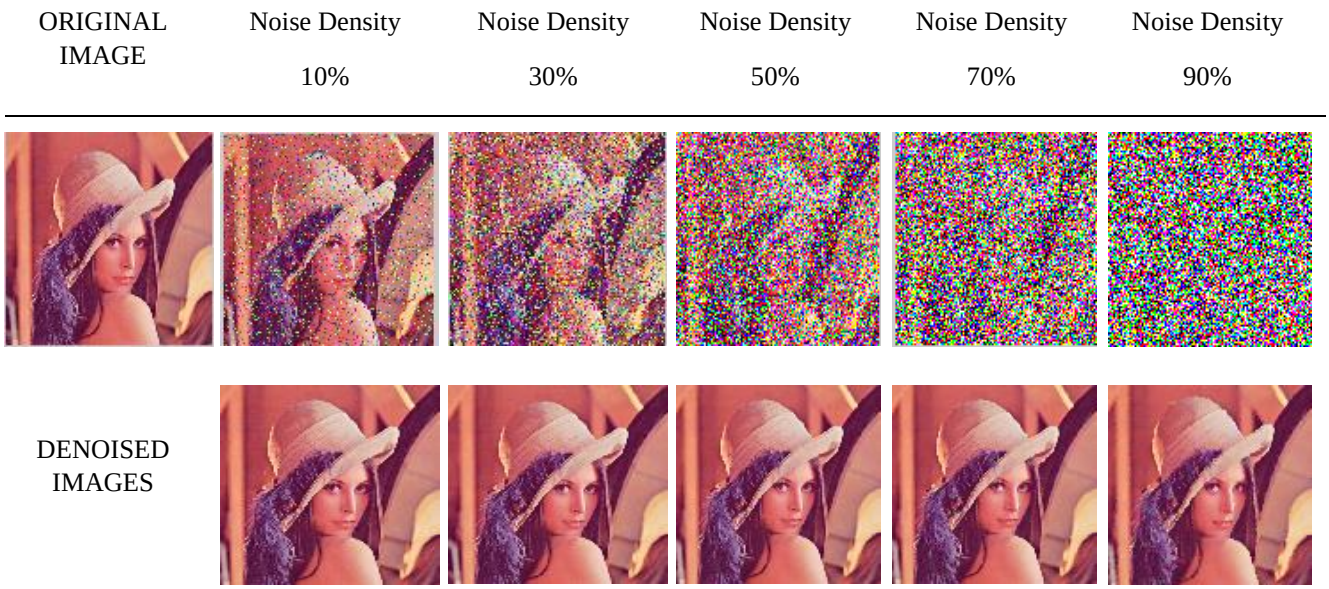


Fig 2 Simulation results of proposed algorithm for Lena image at 10%, 30%, 50%, 70% and 90% noise density. Noise-corrupted image; Output for parameters.

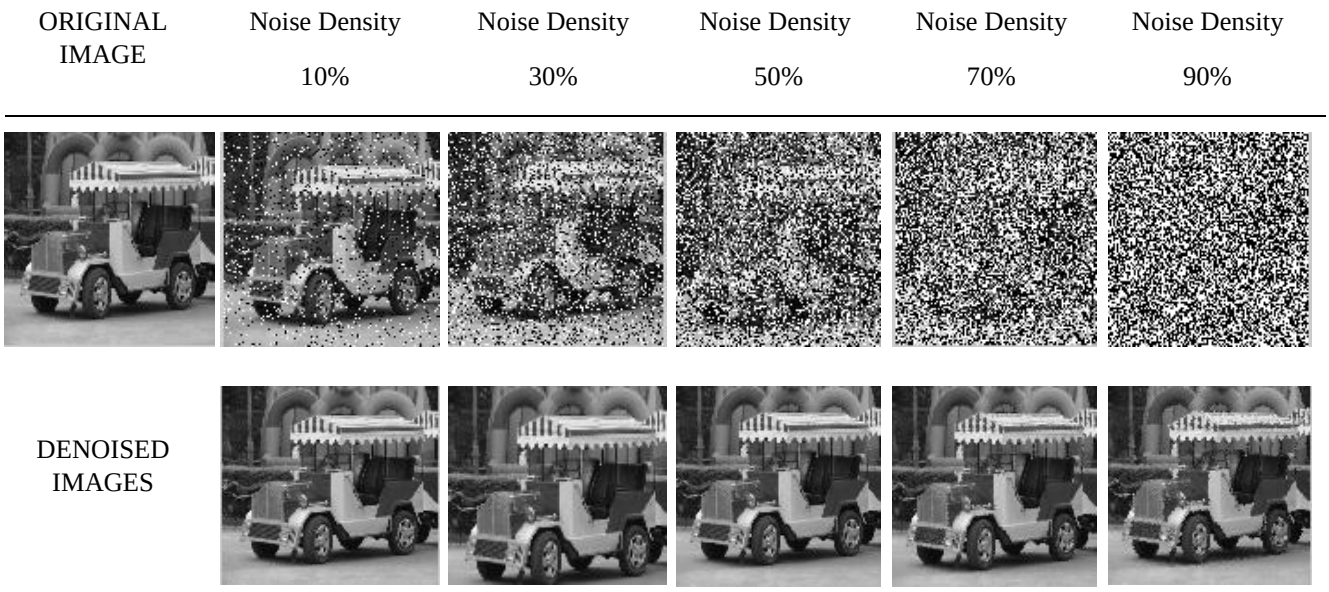


Fig 3 Simulation results of proposed algorithm for Jeep image at 10%, 30%, 50%, 70% and 90% noise density. Noise-corrupted image; Output for parameters

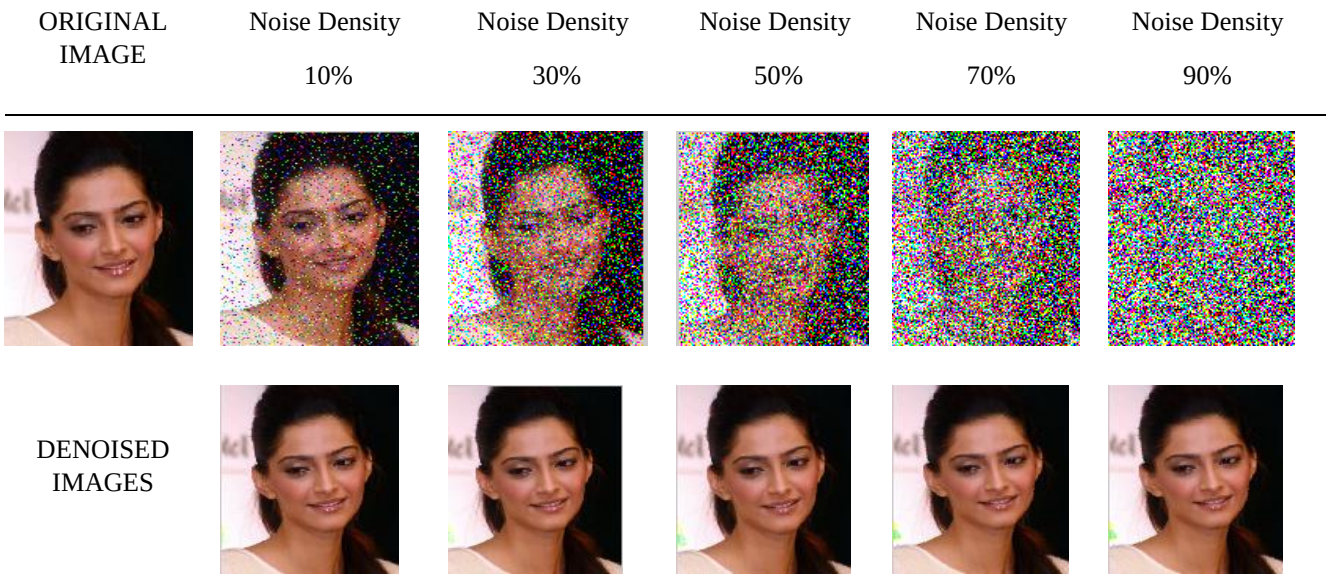


Fig 4 Simulation results of proposed algorithm for sonam image at 10%, 30%, 50%, 70% and 90% noise density. Noise-corrupted image; Output for parameters.

In the following Tables below, the results of the above images are shown. In this, the following parameters PSNR, BER, MSE, IQI, IEF, and SSIM are used. The output for each image is evaluated in tabular form in Tables 1, 2 and 3 with quantitative values of parameters for Lena, Jeep and Sonam images respectively.

NOISE DENSITY	PSNR	BER	MSE	IQI	IEF	SSIM
10%	51.1960	0.0195	0.4937	1	941.7656	0.9963
30%	45.6889	0.0219	1.7547	1	774.0154	0.9859
50%	42.7738	0.0234	3.4332	1	644.8479	0.9684
70%	40.7852	0.0245	5.4270	0.9858	564.2448	0.9391

90%	38.6753	0.0259	8.8206	0.7853	433.7912	0.8544

Table 1 illustrate results of proposed algorithm for Lena image at 10%, 30%, 50%, 70% and 90% noise density. Output for parameters.

NOISE DENSITY	PSNR	BER	MSE	IQI	IEF	SSIM
10%	50.6515	0.0197	0.5597	1	2.2854	0.9995
30%	43.8668	0.0228	2.6693	1	1.4429	0.9967
50%	39.9991	0.0250	6.5039	1	976.9963	0.9887
70%	37.0934	0.0270	12.6981	1	702.6255	0.9667
90%	34.3738	0.0291	23.7522	1	482.6838	0.8781

Table 2 illustrate results of proposed algorithm for Jeep image at 10%, 30%, 50%, 70% and 90% noise density. Output for parameters.

NOISE DENSITY	PSNR	BER	MSE	IQI	IEF	SSIM
10%	55.4750	0.0180	0.1843	1	2.3191	0.9973
30%	50.8809	0.0197	0.5309	1	2.2906	0.9938
50%	47.6756	0.0210	1.1105	1	1.7947	0.9874
70%	45.1549	0.0221	1.9842	1	1.4077	0.9764
90%	42.1849	0.0237	3.9318	0.9249	915.9579	0.9309

Table 3 illustrate results of proposed algorithm for sonam image at 10%, 30%, 50%, 70% and 90% noise density. Output for parameters.

The Table 4,5 & 6 illustrate the comparison of quantitative values for different parameters of three different images taken above for experimental results. This information reveals that the proposed algorithm has better and improved results for denoised images than DBCWMF which was known for better results than other state of art filters like SMF, AMF, and MDBUTMF.

5. COMPARITIVE RESULTS:

FILTER TYPE	ATTRIBUTES	NOISE DENSITY (%)				
		10	30	50	70	90
DBCWMF	PSNR	41.76	35.7617	32.49	29.72	25.85
	IQI	1	0.8626	0.999	0.999	0.993
	IEF	458.75	358.0080	269.58	199.34	105.23
PROPOSED ALGORITHM	PSNR	51.1960	45.6889	42.7738	40.7852	38.6758
	IQI	1	1	1	0.9858	0.7853
	IEF	941.7656	774.0154	644.8479	564.2448	435.7912

Table 4 compare the results of proposed algorithm with previous algorithm (DBCWMF) for lena image at 10%, 30%, 50%, 70% and 90% noise density. Output for various parameters is compared.

FILTER TYPE	ATTRIBUTES	NOISE DENSITY (%)				
		10	30	50	70	90
DBCWMF	PSNR	39.4330	32.7680	29.4568	27.0751	24.2432
	IQI	0.9599	0.9535	0.9586	0.9573	0.9515
	IEF	1.2713	699.5645	469.0499	335.5085	159.0674
PROPOSED ALGORITHM	PSNR	50.6515	43.8668	39.9991	37.0934	34.3738
	IQI	1	1	1	1	1

	IEF	2.2854	1.4429	976.9963	702.6255	482.6838

Table 5 compare the results of proposed algorithm with previous algorithm (DBCWMF) for jeep image at 10%, 30%, 50%, 70% and 90% noise density. Output for various parameters is compared.

FILTER TYPE	ATTRIBUTES	NOISE DENSITY (%)				
		10	30	50	70	90
DBCWMF	PSNR	44.9399	40.4138	37.5446	35.1942	31.8391
	IQI	0.9348	0.8997	0.8497	0.7713	0.5432
	IEF	1.5881	1.6266	1.3449	1.0531	535.9819
PROPOSED ALGORITHM	PSNR	55.4750	50.8809	47.6756	45.1549	42.1849
	IQI	1	1	1	1	0.9249
	IEF	2.3191	2.2906	1.7947	1.4077	915.9579

Table 6 compare the results of proposed algorithm with previous algorithm (DBCWMF) for sonam image at 10%, 30%, 50%, 70% and 90% noise density. Output for various parameters is compared.

6. CONCLUSION

This paper proposed a novel embedding approach based on Decision Based Enhanced Window Median Filter Using Multiple Scanning's Method for colored, gray and natural images. From experimental results it is clear that the proposed technique has obtained high PSNR along with good image fidelity for various images which conform DBEWMF Method based image noise removal can obtain better quality denoised image.

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