Color and gray scale image denoising using modified Decision Based unsymmetric Trimmed Median Filter

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Abstract: - Image denoising is very important in most of the image processing applications There are different types of noises in the image processing like Gaussian noise, speckle noise, random noise, Salt & pepper noise etc. Among these the Salt and pepper noise is very dangerous noise compared to other noises. A modified decision based unsymmetrical trimmed median filter algorithm for the restoration of gray scale, and color images that are highly corrupted by salt and pepper noise is proposed. The proposed algorithm replaces the noisy pixel by trimmed median value when other pixel values, 0's and 255's are present in the selected window and when all the pixel values are 0's and 255's then the noise pixel is replaced by mean value of all the elements present in the selected window. This proposed algorithm shows better results compared to the Standard Median Filter (MF), Decision Based Algorithm (DBA), Modified Decision Based Algorithm (MDBA), and Progressive Switched Median Filter (PSMF). The proposed algorithm is tested against different grayscale and color images and it gives better Peak Signal-to-Noise Ratio (PSNR) .The proposed algorithm is effective for salt and pepper noise removal in images at high noise densities.

Key-Words: - MF,DBA,MDBA,PSMF.PSNR,

1 Introduction

In communications system, noise is a mostly unwanted random addition to a signal; it is called noise as a generalization of the acoustic noise ("static") heard when listening to a weak radio transmission with significant electrical noise. Signal noise is heard as acoustic noise if the signal is converted into sound (e.g., played through a loudspeaker); it manifests as "snow" on a television or video image[1]. High noise levels can block, distort, change or interfere with the meaning of a message in human, animal and electronic communication The impulse noise in images is present due to bit errors in transmission or introduced during the signal acquisition stage. There are two types of impulse noise, they are salt and pepper noise and random valued noise. Salt and pepper noise can corrupt the images where the corrupted pixel takes either maximum or minimum gray level. Several nonlinear filters have been proposed for restoration of images contaminated by salt and pepper noise. Among these standard median filter has been established as reliable method to remove the salt and pepper noise without damaging the edge details. Main drawback of standard Median Filter (MF) is that the filter is effective only at low noise densities [1].When the noise level is over 50% the edge details of the original image will not be preserved by standard median filter. Adaptive Median Filter (AMF) [2] perform well at low noise densities. But at high noise densities the window size has to be increased which may lead to blurring the image. In switching median filter [3], [4] the decision is based on a pre-defined threshold value. The major drawback of this method is that defining a robust decision is difficult. Also these filters will not take into account the local features as a result of which details and edges may not be recovered satisfactorily, especially when the noise level is high.

To overcome the above drawback, Decision Based Algorithm (DBA) is proposed [5]. In this, image is denoised by using a 3X3 window. If the processing pixel value is 0 or 255 it is processed or else it is left unchanged. At high noise density the median value will be 0 or 255 which is noisy. In such case, neighboring pixel is used for replacement. This repeated replacement of neighboring pixel produces streaking effect. In order to avoid this drawback, Decision Based Unsymmetric Trimmed Median Filter (DBUTMF) is proposed. At high noise densities, if the selected window contains all 0's or 255's or both then, trimmed median value cannot be obtained. So this algorithm does not give better results at very high noise density that is at 80% to 90%. The proposed Modified Decision Based Unsymmetric Trimmed Median Filter (MDBUTMF) algorithm removes this drawback at high noise density and gives better Peak Signal-to-Noise Ratio (PSNR) and Image Enhancement Factor (IEF) values than the existingalgorithm.

2.1 Median Filter

Typically, by far the majority of the computational effort and time is spent on calculating the median of each window. Because the filter must process every entry in the image. The main drawback of the median filter is the same value is used for both noisy and the fine information values and the restored image contains unwanted noise in some regions and loss of information in some regions. It can filter the image in 50% of noisy level. This won't works above 50% noise level.To overcome these drawbacks The Adaptive Median Filter is introduced

2.2. ADAPTIVE MEDIAN FILTER

As an advanced method compared with standard median filtering, the Adaptive Median Filter performs spatial processing to preserve detail and smooth non-impulsive noise. The window is replaced by the mean or the median value.this filter swiches in between Mean and Median.A prime benefit to this adaptive approach to median filtering is that repeated applications of this Adaptive Median Filter do not erode away edges or other small structure in the image.this filter also not able to work at the high noise densities.To overcome this drawback the Decision based algorithem is proposed.

2.3 Decision based Algorithm

In this algorithm, image is denoised by using a 3X3 window. If the processing pixel value is 0 or 255 it is processed or else it is left unchanged.this method can reconstructs the image at low noise densities.and it produces the streaming effect, to overcome this the DBUTMF algorithm was intoroduced.

3.Unsymmetric Trimmed Median filter

This filter is called trimmed median filter because the pixel values 0's and 255's are removed from the selected window. This procedure removes noise in better way than the ATMF. Alpha Trimmed Mean Filtering (ATMF) is a symmetrical filter where the trimming is symmetric at either end. In this procedure, even the uncorrupted pixels are also trimmed. This leads to loss of image details and blurring of the image. In order to overcome this drawback, an Unsymmetric Trimmed Median Filter (UTMF) is proposed. In this UTMF, the selected 3 X3 window elements are arranged in either increasing or decreasing order. Then the pixel values 0's and 255's in the image (i.e., the pixel values responsible for the salt and pepper noise) are removed from the image. Then the median value of the remaining pixels is taken. This median value is used to replace the noisy pixel.

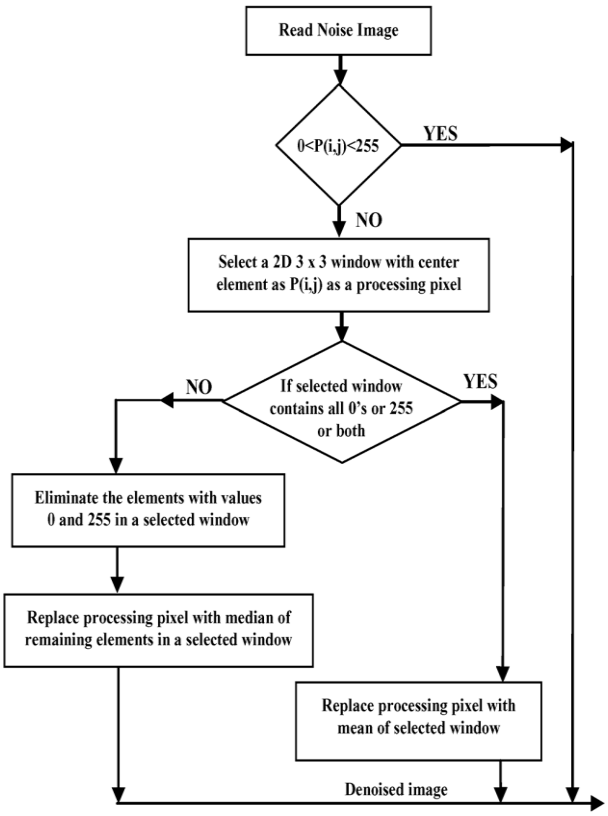


Fig1: flowchart for proposed filter MDBUTMF

Step 1: Select 2-D window of size 3X3. Assume that the pixel being processed is P_{ij}.
Step 2: If 0< P_{ij} <255 then P_{ij} is an uncorrupted pixel and its value is left unchanged.
Step 3: If P_{ij} =0 or P_{ij} =255 then P_{ij} is a corrupted pixel then two cases are possible as bellow.
Case i): If the selected window contain all the elements as 0's and 255's. Then replace P_{ij} with the mean of the element of window.

Case ii): If the selected window contains not all elements as 0's and 255's. Then eliminate 255's and 0's and find the median value of the remaining elements. Replace P_{ij} with the median value.
Step 4: Repeat steps 1 to 3 until all the pixels in the entire image are processed.

Each and every pixel of the image is checked for the presence of salt and pepper noise. Different cases are illustrated in this . If the processing pixel is noisy and all other pixel values are either 0's or 255's is illustrated in Case i). If the processing pixel is noisy pixel that is 0 or 255 is illustrated in Case ii). If the processing pixel is not noisy pixel and its value lies between 0 and 255 is it left to unchanged and processed to output.

4. Experimental Results

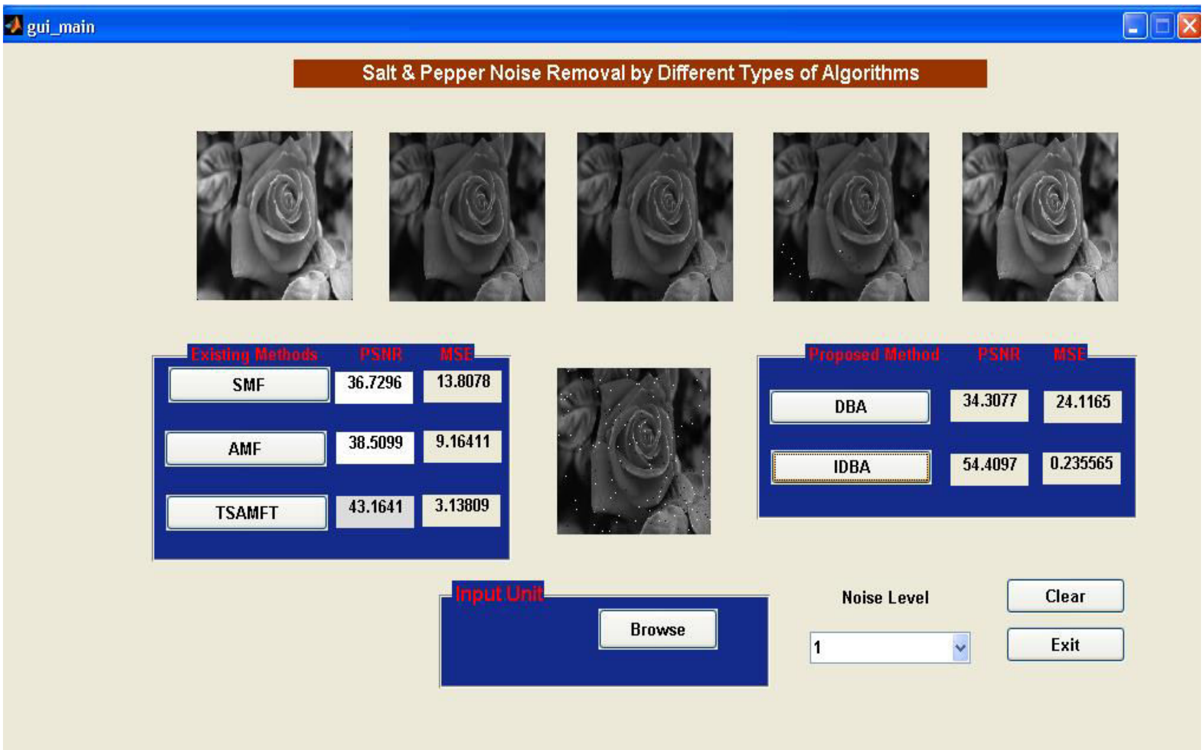
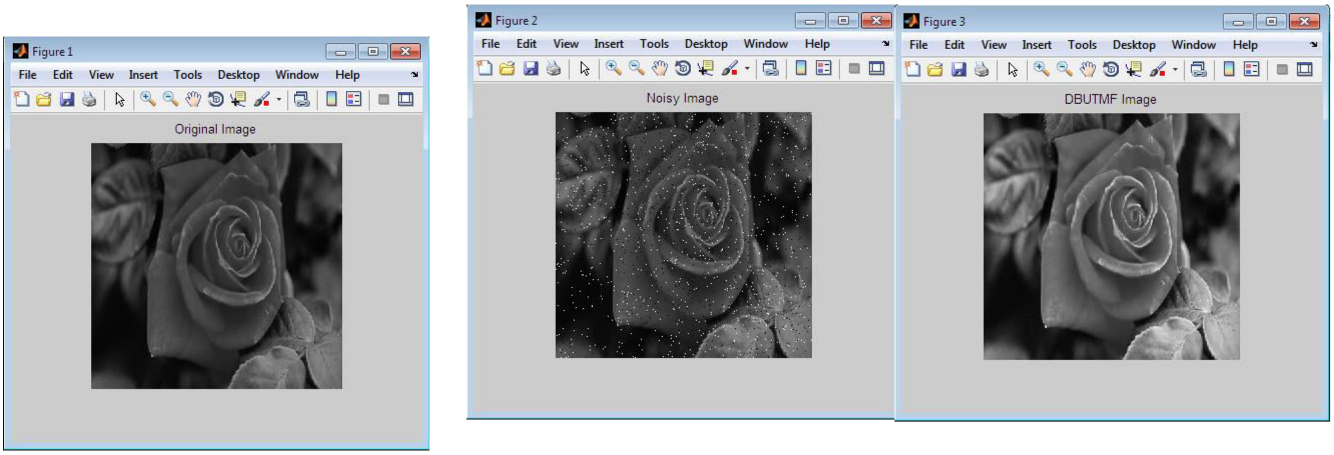


Figure2: Grayscale image Restoration with SMF,AMF,TSAMF,DBA,DBUTMF



3(a) 3(b) 3(c)

3(a).Origional image 3(b).Noisy image, 3(c).Restoration with the proposed MDBUTMF.

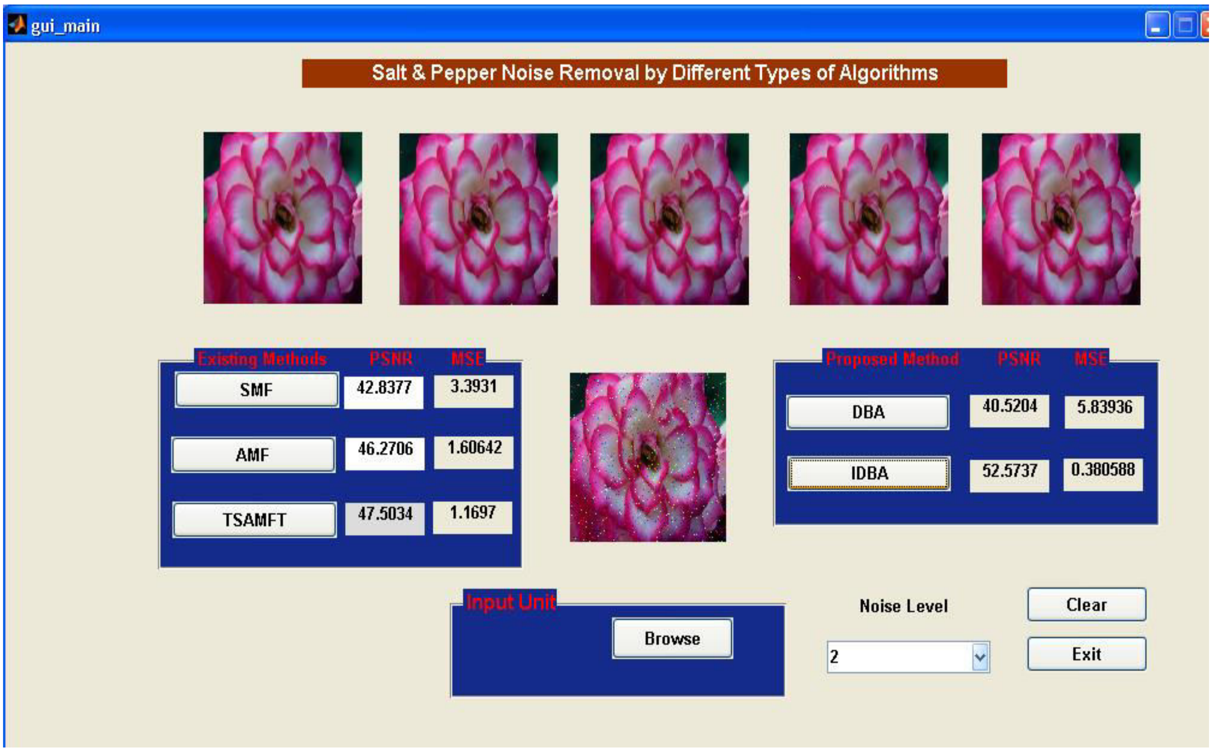


Figure4. Color image Restoration with SMF,AMF,TSAMF,DBA,DBUTMF

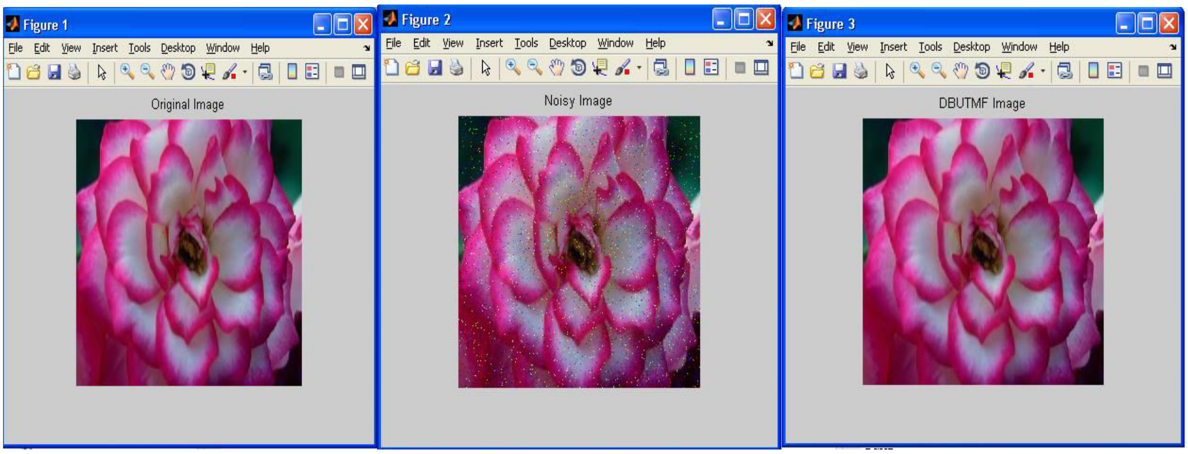


Fig.5(a) **Fig 5(b)** **Fig .5(c)**

Figure5.: (a) Origional image, (b) Image with Noise (c) Restored with MDBUTMF

COMPARISION OF OBTAINED PSNR AND MSE FACTORS AT NOISE LEVEL=1

Parameters	**SMF**	**AMF**	**TSAMF**	**DBA**	**DBUTMF**	**MDBUTMF**
PSNR (dB)	38.6169	42.5331	41.2018	38.605	48.2083	50.3629
MSE	8.9432	3.64252	4.9307	9.38478	1.04911	0.5981

Table.1: For gray scale Images

Parameters	**SMF**	**AMF**	**TSAMF**	**DBA**	**DBUTMF**	**MDBUTMF**
PSNR(dB)	38.6585	41.8274	41.1817	37.8626	47.3169	55.8759
MSE	8.85628	4.40646	4.95354	11.2057	1.26228	0.1721

Table.2: For color Images

VIII. CONCLUSIONS

In this paper, a new algorithm (MDBUTMF) is proposed which gives better performance in comparison with MF, AMF and other existing noise removal algorithms in terms of PSNR and MSE.The performance of the algorithm has been tested at low, medium and high noise densities on both gray-scale and color images. Even at high noise density levels the MDBUTMF gives better results in comparison with other existing algorithms. Both visual and quantitative results are demonstrated. The proposed algorithm is effective for salt and pepper noise removal in images at high noise densities.

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