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Impulse Noise Removal Based On Advanced Modified Decision Based Unsymmetric Trimmed Median Filter Technique

Nitesh Pal, Mr. Pradeep Yadav

Abstract— **Removing or reducing impulse noise is a very active research area in image processing. Removing Salt and Pepper noise is considered to be very important in the domain of image restoration, but it is a somewhat more challenging topic than removing pure noise. Therefore, relatively fewer works have been published in this area. In this paper the novel approach has been presented 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%. The performance of the proposed method is analyzed by using various qualities of metrics, such as Mean Square Error (MSE) and Peak Signal to Noise ratio (PSNR). Simulation results clearly show that the proposed method is out performs both in qualitative as well quantitative fidelity criteria, when it is compared with MDBUTMF.**

Index Terms— **image processing, impulse noise, median jilter, noisedensity, IEF.**

I. INTRODUCTION

Noises introduced into digital images during acquisition and/or transmission stages can be adequately modeled by either Additive Gaussian White Noise (AGWN), impulse noise, or Mixed Gaussian and Impulse Noise (MGIN) [16], [20]. AWGN, which is inadvertently introduced to an image during its acquisition stage, can be modeled as adding to each image pixel a value from a zero-mean Gaussian distribution. An ideal filter for removing AWGN would be able to smooth pixels within a distinct local region of an image without reducing the sharpness of the edges of that region. A Gaussian filter, which is a linear filter, can smooth noise out very efficiently; but, it does this at the price of significant edge blurring. To overcome this drawback, some nonlinear filters have been proposed [19], [23] that focus on using local measures of an image to detect the edges and smooth them less than other parts of the image. The most possible type of noise is impulse noise which can also be called as salt & pepper noise, Impulse noise, generally caused by transmission errors, can be modeled by randomly replacing a portion of the pixels with random pixels, while leaving the remaining pixels unchanged.

The filters specifically developed for AWGN removal do not work well on impulse noise, because these filters consider the impulse noise pixels as edges, and preserve them. Different kind of filters that aim at removing impulse noise have been proposed, and were summarized by Yildirim et al. [74] as follows: 1) standard median filter [24], [65], which replaces the center pixel of a filtering window with the median value of all pixels in that window, has decent performance in terms of noise removal, but it also blurs image details thin lines even at a low noise level; 2) modified versions of the median filter, e.g., weighted and center-weighted median filters [37], [75], [76], which give more weights to certain pixels in the filtering window, gain improved performance in terms of preserving image details at the cost of reduced noise removal capability; 3) approaches based on impulse detectors, which aim at deciding whether the center pixel of the filtering window has been corrupted by noise or not, There are many variants in median filter such as Standard Median Filter (MF), Adaptive Median Filter (AMF), Adaptive Weighted Algorithm (A WA), Switching Median Filter (SMF), Decision Based Algorithm (DBA), Decision Based Unsymmetric Trimmed Median Filter (DBUTMF) and Modified Decision Based Unsymmetric Trimmed Median Filter (MDBUTMF). The drawback of standard Median Filter (MF) [1] is that it is effective when the noise density is below 20%, if it is more than 20% the edge as well the image details are lost. Adaptive Median Filter (AMF) [2] gives better performance at low noise densities.

The Modified Decision Based Unsymmetric Trimmed Median Filter (MDBUTMF) [7] method doesn't provide better visual and quantitative fidelity. The proposed Advanced Modified Decision Based Unsymmetric Trimmed Median Filter (AMDBUTMF) method provides better visual quality and gives reduced Mean Square Error (MSE) and better Peak Signal-to-Noise Ratio (PSNR) values than existing methods.

The rest of the paper is organized as follows. A brief introduction of Modified Decision Based Unsymmetric Trimmed Median Filter is given Section II. Section III describes about the proposed algorithm. The detailed description of the proposed method is illustrated in Section IV. Simulation results with different images are presented in Section V. Finally the paper is concluded with conclusions in Section VI.

II. MODIFIED DECISION BASED UNSYMMETRIC TRIMMED MEDIAN FILTER

The basic concept behind this filter is to reject the noisy pixel from the selected window size of 3x3 with a processing pixel P_Y. If $P_Y = 0$ or 255 then P_Y is a corrupted pixel. If the selected window contains all 0's and 255's, then the pixel P_Y is replaced with the mean element of the window. If the selected window does not contains all elements as 0's and 255's, then

Nitesh Pal, Department of Electronics & Communication Engineering, M.Tech Scholar, Kanpur Institute of Technology, Kanpur, India.

Mr. Pradeep Yadav, Associate Professor, Department of Electronics & Communication Engineering, Kanpur Institute of Technology, Kanpur, India.

eliminate 0's and 255's from the selected window and find the median value of the remaining pixel elements.

The P_Y is replaced with the median value. This process is repeated for the entire image. But MDBUTMF suffers from another issue, it assumes that the all the pixel with 0 or 255 value are noisy and the de-noised images should not have any pixels with extreme gray-level values.

III. PROPOSED ALGORITHM AMDBUTMF

The proposed Advanced Modified Decision Based Unsymmetric Trimmed Median Filter (AMDBUTMF) first detects the noise from the corrupted image. The processing pixel is verified whether noisy or noise free. If the processing pixel value lies between minimum' l' to maximum '254', then it is a noise free pixel. If the processing pixel value is either 0 or 255, then it is a noisy pixel which is processed by AMDBUTMF. The algorithmic steps in this method are as follows,

ALGORITHM STEPS

Step 1: Insert O's to the First Row, First Column and Last Row, Last Column of the image.

Step 2: Select a window of size 3 x3, and consider the Processing pixel is P_Y in the window.

Step 3: Process the corrupted image:

If the processing pixel value lies between $0< P_Y <255$, then it is an uncorrupted pixel and its value is left unchanged.

Step 4: If $P_Y =0$ or 255, then P_Y is a corrupted pixel. The possible cases of processing the pixel:

Case (i): If the selected window contains all 0's and 255's, then P_Y is replaced with mean of the elements in the window.

Case ii): If all the elements in the selected window does not have O's and 255's, eliminate 0's and 255's, sort in the ascending order and find the median value of the remaining elements. Replace P_Y with the median value.

Step 5: Repeat steps 2 to 4 until all the pixels in the entire image is processed.

Step 6: Repeat steps 2 to 5.

Step 7: Remove additionally inserted Rows & Columns of 0's in step 1.

IV. ILLUSTRATION OF AMDBUTMF ALGORITHM

The given image should verify for the presence of salt & pepper noise. If it is noisy, add additional zeros around the comers of the image in order to preserve the edge details. Now the size of the image becomes 258 x 258, then it is easy to process the image with a window of size 3x3, and the processing element as P_Y.

0	0	0	0	0	0
0					0
0		Image			0
0					0
0					0
0	0	0	0	0	0

Case i): If the processing pixel is not a 0 or 255. Then it doesn't require any processing as indicted in the following example.

$$\begin{bmatrix} 12 & 15 & 98 \\ 34 & <25> & 16 \\ 22 & 67 & 66 \end{bmatrix}$$

Where, "25" is the processing pixel (P_Y) . Since "25" is a noise free.

Case ii): If the processing pixel is either 0 or 255 and all the elements in the window are also 0's and 255's, then it requires processing as illustrated.

$$\begin{bmatrix} 255 & 255 & 0 \\ 0 & <0> & 255 \\ 255 & 255 & 0 \end{bmatrix}$$

Where, "0" is the processing pixel (P_Y)' Since all the elements in the window are 0's and 255's. Now the processing pixel should not be replaced with median value, because the median value again becomes either 0 or 255. To avoid this problem processing pixel value should be replaced with mean value. Here the mean value is 170. Replace the processing pixel with 170.

Case iii): If the selected window has the processing pixel value as either 0 or 255 and the remaining pixel values are noisy as well as noise free values, then it requires processing as illustrated.

$$\begin{bmatrix} 167 & 215 & 0 \\ 128 & <0> & 255 \\ 223 & 211 & 90 \end{bmatrix}$$

Where, "0" is the processing pixel P_Y. To eliminate the noise from the selected window, first arrange the above matrix in 1-D array as [167 215 0 128 0 255 223 211 90]. After elimination of 0's and 255's the pixel values in the selected window will be [167 215 128 223 211 90]. Here the median value is 189. Replace the processing pixel P_Y with 189.

V. SIMULATION RESULTS AND DISCUSSION

The proposed method is tested for only salt and pepper noise by using 256x256 gray scale images. The noise density is varied from 10% to 90%. Denoising performances are quantitatively measured by MSE and PSNR.

Peak Signal to Noise Ratios (PSNR) values to determine image quality:

$$PSNR = 20\log\frac{255}{MSE}\ dB \qquad (1)$$

$$MSE = \left(\frac{1}{m^2}\right)\sum_{i=0}^{m-1}\sum_{j=0}^{m-1}(\alpha_{ij}-\beta_{ij})^2 \qquad (2)$$

Where MSE is the mean square error of the two images. Higher values of PSNR mean that the stego-image is more similar to that of the original image.

Figure 1 & 2 shows the results for 50% and 90% corrupted Lena image and the restoration by existing and proposed methods.

The role of color descriptors has been demonstrated to be quite remarkable in many visual assessment tasks. In some other tasks, texture measurements are needed because of irregularly colored or unusual surfaces. As stated before, we have involved size and shape as well as color and texture. The simulation are performed to discuss super resolution, registration, restoration and transformation technique after this result performed, we are apply salt and pepper noise removal based on nonlocal mean filter technique. So first image will act as reference image and we will convert the second image in to the reference co-ordinate system. Here modified decision based trimmed median filter apply to remove the noise and enhanced the image quality

Original image or input images have a RGB combination. Image processing begins with an image acquisition process. The two elements are required to acquire digital images.

EXPERIMENTAL RESULTS OF DIFFERENT IMAGES

Figure 1: Original Image a and b

The first one is a sensor; it is a physical device that is sensitive to the energy radiated by the object that has to be imaged. The second part is called a digitizer. It is a device for converting the output of the sensing device into digital form. For example in a digital camera, the sensors produce an electrical output proportional to light intensity. The digitizer converts the outputs to digital data. During the process of image acquisition noises are introduced.

Convert RGB image or color map to gray scale. First of all we have to convert RGB or color image into gray image by eliminating the hue and saturation information while retaining the luminance. If the input is an RGB image, it can be single, uint eight, uint sixteen, double, or. The output image I has the same class as the input image.

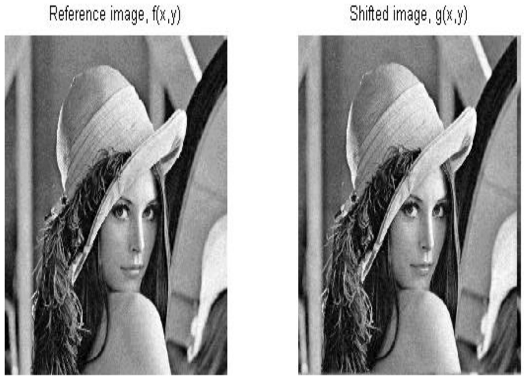


Figure 2: Image shifted based on reference image

Here original image is considered as input image or reference image plot with function x and y and shifted with the absolute value in shifted image, take a cross correlation of the pixel and plot registered image with the absolute value.

Figure 3: Image registered based on reference image

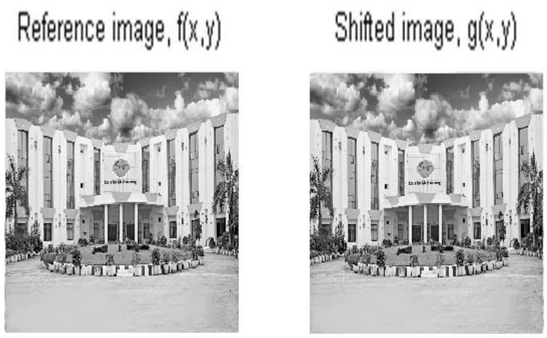


Figure 4: Image shifted based on reference image

So now applied Projective Transformation on image by selecting the control points (which should be common in both the images), the image which is obtained after interpolation of the basic super resolution model is seen in here.

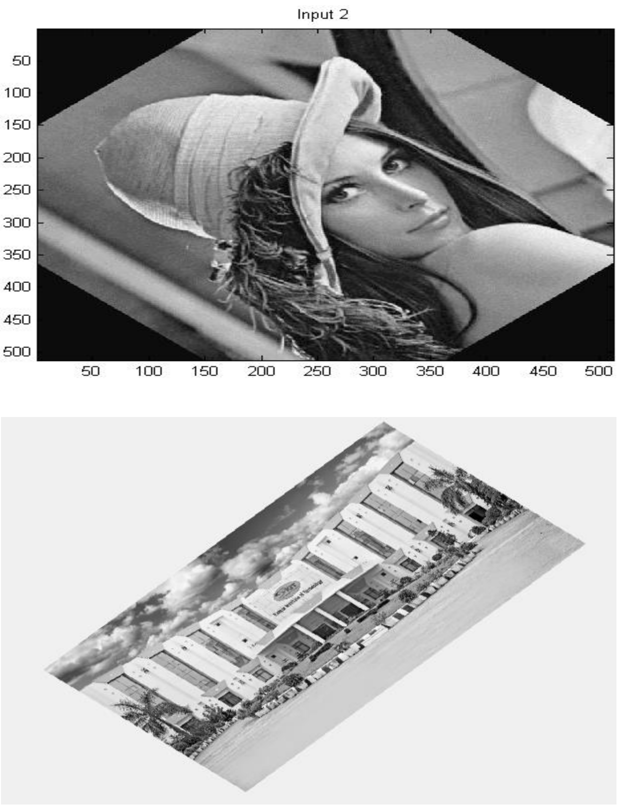


Figure 5: Lena & College Image interpolation

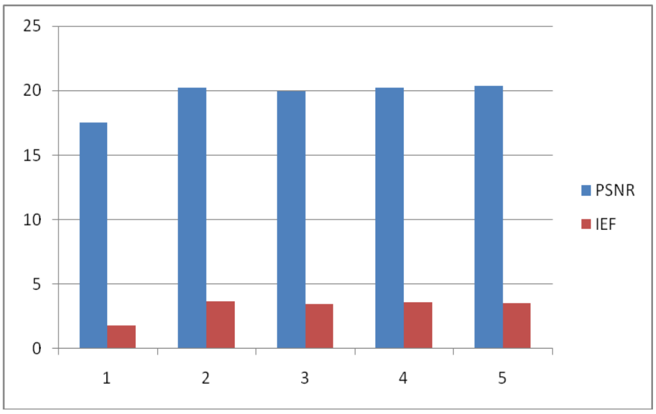
Here used the modified trimmed filter for gray image, first way to apply lossless mode to remove the noise after that add the salt and pepper noise in the image with the padding after a certain iterations apply the components of salt & pepper noise in the image. Now on this stage apply the modified decision based trimmed median filtered, with the help of this filter remove the noise from the image get the output. After this stage calling a new function in Matlab to remove the added padding and again measure the quality output also find out the performance parameters.

Figure 6: Lena & College Image noise removals

The purpose of calculating the performance of the image and after that comparison between then, will show which image are better for noise removing. Such method is mainly due to highly accurate noise detection experienced by the noise detection algorithm having high noise detection ratio and our method performs more desirable than the median filter and other conventional edge preserving method. The (Peak signal to noise ratio) PSNR, (Signal to noise ratio) SNR is high; (mean squared error) MSE is low. This advised method is a fast method for removing salt and pepper noise.

Table 1: Performance Table for same image but for different format

S.No	PSNR	IEF	Image Format
1	17.5103	1.7750	Lena.jpg
2	20.2459	3.6754	College.jpg
3	19.9388	3.4663	College.png
4	20.2150	3.6159	College.bmp
5	20.3459	3.5459	College.gif



1=lena.jpg; 2=college.jpg; 3=college.png; 4=college.bmp; 5=college;

Figure 7: Bar chart of PSNR & IEF

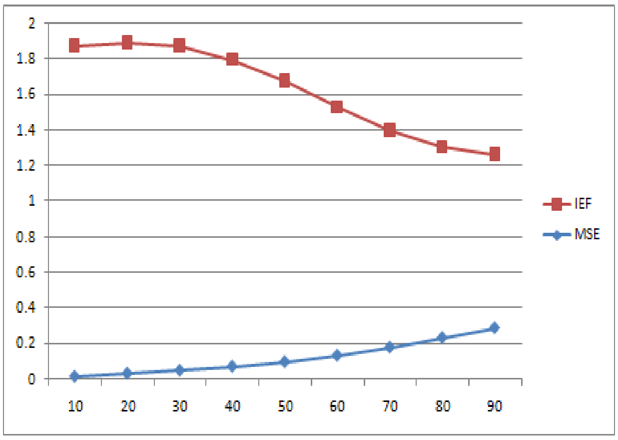


Figure 8: Comparison table of MSE and IEF with Noise

VI. Conclusion

In general, a new algorithm Advanced modified decision based unsymmetrical trimmed median filter (**AMDBUTMF)** is proposed and developed for different de noising images of different format. Simulation results clearly shows that the proposed method is much better in removing the noise with high density compared with the existing methods in terms of PSNR and MSE. The performance of this method is tested for different noise densities with gray scale images. Particularly at high noise densities the proposed method is better in removing the effect of noise. This method is also applicable for another type of noises like speckle, Gaussian, random etc.

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Nitesh Pal, Department of Electronics & Communication Engineering, M.Tech Scholar, Kanpur Institute of Technology, Kanpur, India.

Mr. Pradeep Yadav, Associate Professor, Department of Electronics & Communication Engineering, Kanpur Institute of Technology, Kanpur, India.