IMPULSE NOISE REMOVAL USING MEAN BASED LEADING DIAGONAL ALGORITHM

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Abstract

The article considers the prefect impulse noise free images. The images which are captured from camera and mixed with the unwanted signals due to vibrations, humidity, dust, smoke, etc., in image processing, the above factors are common in imposing noises in the captured images. The research is to make the noise free image with the consideration of restore fine details of image. This leads to efficient noise removal in outcome. The impulse noise removal algorithm based on sorting methods on this paper considers Mean Based Leading Diagonal method without sorting to improve the computational speed of algorithm execution and preserve the fine details of images affected by impulse noise. The proposed method is compared with Standard algorithms of existing Mean Filter (MF) and Existing Alpha Trimmed Mean Filter.

Keywords : *Industrial automation, impulse noise, Leading Diagonal, original pixel*

I. Introduction

The impulse noises are induced images by transmitting and receiving the images through communicative medium and improper function of Charge Coupled Devices (CCDs).The communication medium is affected by Interferences by means of mechanical, electrical disturbance in harsh Industrial environment. The noise is representing by extreme brightness variation of light represented as "0" and "255" digital values. These values are called Impulse noise. They are linear and non-linear filter methods to remove the impulse noise. The non-linear method is efficient method. The Standard Median Filter is efficient to remove the impulse noise and it leads blur in high noise density [1]. The Mean Filter (MF) is replaced processing pixel by mean value of masked window.The Alpha Trimmed Mean Filter is sorting the pixel elements of masked window and trimmed the extreme value of minimum and maximum pixel element of selected window and calculated the mean. This mean value is replaced with the central pixel of selected window [2].The Leading Diagonal Sorting algorithm (LDS) is the method to remove noise in gray images by the 3×3 matrix of Diagonal with increase the speed of operation where it process only diagonal elements of masked window [3][4].Cascade Decision Based Filtering

Algorithm is cascade the Modified Decision Based Median Algorithm (MDBMA), Direction Based Filter (DBF) and Modified Unsymmetric Trimmed Mean Filter (MUTMF).

The de-noised image of cascade filter is shown that the preserve edges and fine details of images but consumes more time to execute algorithm because it involves four filters are cascaded [5] and trimmed filter is an efficient algorithm. It trimmed the noisy pixel and finds the median

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or mean of trimmed value is based on noise density [6]. If the masked window contains each and every elements are noisy then mean of the masked window is used to replace the noisy processing pixel [7]. The trimmed filtering is implemented in fuzzy based algorithms to enhanced the efficiency [8].The noise removal is an important process in industrial applications for inspection of automation [9] and biomedical applications [10].

In this paper, we proposed Mean Based Leading Algorithm in two ways; first it detects the noise, second it removes the noise. Proposed method is evaluated and compared with existing methods for high range of noise density from 10% to 50%.

The rest of the paper is organized as follows: section II covers the materials and methods. Illustration of ILDS algorithm is described in section III. Section IV explains the experimental results with help of the tables and the figures. Section V summarizes the conclusion.

II. Materials Methods

The proposed sorting algorithm reduces the noise in the given image. Figure 1 shows the flowchart for proposed framework. The steps of the proposed framework and two case (1) and (2) are used for identified and eliminate the noises is given as follows

D1	D2	D3
D4	D5	D6
D7	D8	D9

Figure 1. 3 X3 Masked Window with Leading Diagonal elements

Step 1 : Select a two dimensional moving window with a window of size 3×3 as sub matrix among the entire image. Assume that the Leading Diagonal Elements (D3, D5 and D7) of masked window as processing pixels.

Step 2 : Check the Leading Diagonal Elements of window for the condition, if each and every element of processing pixels (D3, D5 and D7) is greater than zero and smaller than 255, then processing pixels is not a noisy pixel and its value is left intact.

Step 3 : If the processing pixels (D3, D5 and D7) is salt (0) and pepper (255) noise then the noisy pixel is replaced by mean value of Leading Diagonal elements of 3X3 masked window.

Step 4 : Repeat steps 1 to 3 until all the pixels in the entire image are processed.

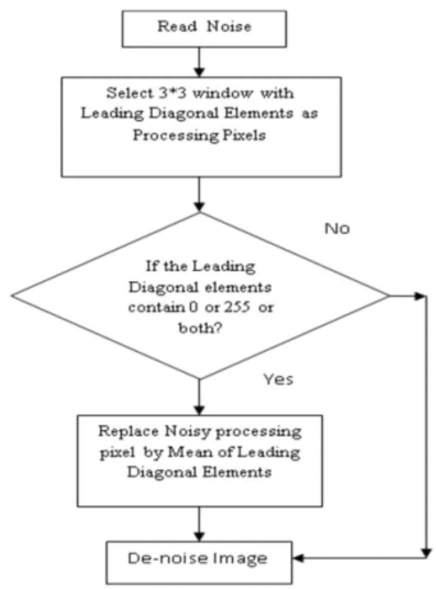

Figure 2. Flow Chart of proposed algorithm

III. Example Issustration For Proposed Algorithm

Step 1 : To check whether left diagonal pixel in the selected 3 x 3window is affected by noise element 0 or 255

$$\begin{bmatrix} 12 & 142 & (0) \\ 0 & (255) & 26 \\ (0) & 255 & 0 \end{bmatrix} \longrightarrow \begin{bmatrix} 12 & 142 & (85) \\ 0 & (85) & 26 \\ (85) & 12 & 0 \end{bmatrix}$$

In the above example, processing pixels are 0, 255, and 0. So, all the left diagonal elements are affected by noise pixel '0' and '255'. So replace the left diagonal noise pixels using case 1 condition :

$$\frac{[0 + 255 + 0]}{3} = 85$$

Step 2 : To check whether left diagonal element is corrupted by noise element or not

$$\begin{bmatrix} 12 & 142 & (9) \\ 0 & (89) & 26 \\ (5) & 12 & 0 \end{bmatrix} \longrightarrow \begin{bmatrix} 12 & 142 & (9) \\ 0 & (89) & 26 \\ (5) & 12 & 0 \end{bmatrix}$$

IV. Experimental results :

The performance metrics is tested with sample of gray images of Lena with the size of 512×512 . The image is corrupted by 10 to 50 percentage of noise density. The image performance metric of Peak Signal-to-Noise Ratio (PSNR), Image Enhancement Factor (IEF), Structural Similarity Index (SSIM), Mean Square Error (MSE) are compared with existing algorithms.

Mean Square Error (MSE): Mean square error is defined as

$$\mathrm{MSE} = \frac{1}{xy}\sum_{i=0}^{x-1}\sum_{j=0}^{y-1}(I_{ij} - D_{ij})^2$$

$$\mathrm{PSNR} = 10 \times \log_{10} \frac{255^2}{\mathrm{MSE}}$$

SSIM = $L(O, R)*C(O, R)*S(O, R)$

$L(O, R) = (2\mu_O\mu_R+C_1) / (\mu_O^2 +\mu_R^2+C_1)$

$C(O, R) = (2\sigma_O\sigma_R+C_2) / (\sigma_O^2+\sigma_R^2+C_2)$

$S(O, R) = (\sigma_{OR}+C_3) / (\sigma_O\sigma_R+C_3)$

$C_1 = (K_1*G)^2$, $C_2 = (K_2*G)^2$, $C_3 = C_2/2$

$G = 255$; K_1, $K_2 << 1$, $(K_1=0.001, K_2=0.002)$

$$IEF = \frac{\sum_i\sum_j(\eta_{ij} - r_{ij})^2}{\sum_i\sum_j(x_{ij} - r_{ij})^2}$$

Table 1 : Comparison of PSNR and MSE value between Existing and Proposed Algorithm for Lena Image

Mean Filter		Alpha Trimmed Mean Filter		Proposed Leading Diagonal based Mean Filter	
SNR(dB)	MSE	PSNR(db)	MSE	PSNR(dB)	MSE
21.0694	2.05E+03	21.3498	1.92E+03	21.0656	2.05E+03
16.4198	5.98E+03	16.5463	5.81E+03	16.2825	6.17E+03
14.3366	9.66E+03	14.2842	9.78E+03	14.1131	1.02E+04

Table 2 : Comparison of IEF and SSIM value between Existing and Proposed Algorithm for LENA Image

Noise Density (%)	Mean Filter		Alpha Trimmed Mean Filter		Proposed Leading Diagonal based Mean Filter	
	IEF	SSIM	IEF	SSIM	IEF	SSIM
10	0.2467	0.4823	7.15E-01	7.92E-01	1.01E+00	4.99E-01
30	0.44	0.2512	7.01E-01	3.82E-01	1.06E+00	2.43E-01
50	0.6248	0.155	7.13E-01	1.79E-01	1.07E+00	1.42E-01

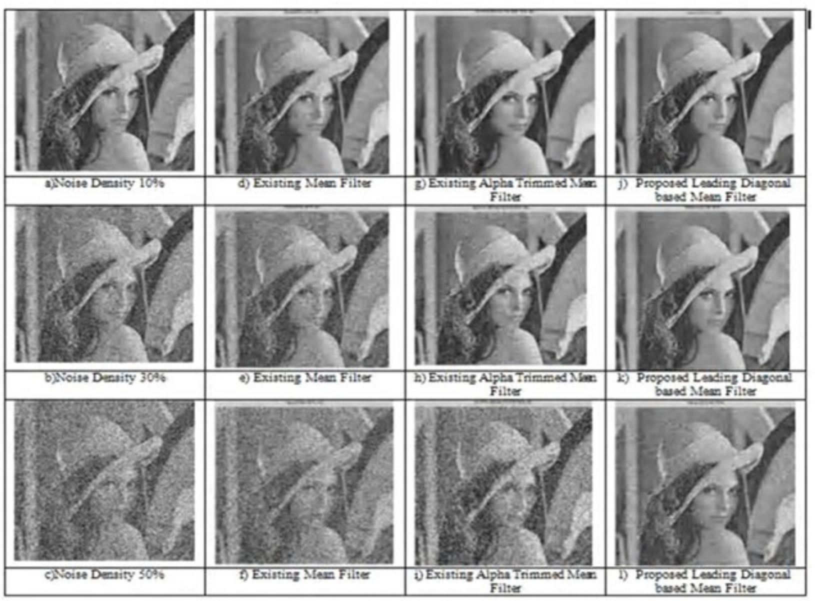

Figure 2. Denoised images compared with existing and proposed algorithms

V. Conclusion & Future Scope

The algorithm is proposed for Salt-and-Paper noise removal in efficient manner to preserve the edges and image quality. The performance metric of PSNR, MSE, IEF and SSIM values are compared with the existing algorithms. The proposed algorithm shows of Mean Based Leading Diagonal algorithm shown better image quality and preserve the edges. The performance of the proposed method has been verified in different noise densities (10% to 50%) on gray scales Lena image. In mere future KHN filter [11] and Gabor filter [12] based noise reduction can be imposed for getting maximum accuracy in the image denoising.

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