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Reconstruction of Corrupted Image From Salt And Pepper Noise From Median Filter

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Abstract - In this paper, we propose an improved median filtering algorithm. Here, we introduced salt and pepper noise for the image corruption and reconstruct original image using different filters i.e. mean, median and improved median filter. The performance of improved median filter is good at lower noise density levels. The mean filter suppresses little noise and gets the worst results. The experimental results show that our improved median filter is better than previous median filter for lower noise density (upto 60%). It removes most of the noises effectively while preserving image details very well.

Keywords - Median filter, noise detection, PSNR salt and pepper noise

I. INTRODUCTION

Salt and pepper noise is produced at the processes of collection and transmission of digital image. It represents itself as randomly occurring white and black pixels. An effective noise detection method for this type of noise involves the usage of a median filter. Shot and spike noise terms are also used to refer salt and pepper noise. Noise impulses can be negative or positive. Negative impulses appear as black (pepper) points in an image. For the same reason, positive impulses appear white (salt) noise. For an 8-bit image this means that $a = 0$ (black) and $b = 255$ (white). The different types of filters are referred by many authors. In [1-3], different algorithm schemes are proposed to remove salt and pepper noise while preserving its image information. Researches in median filters are continued and came to existence a new median filter is called optimal weighted median filter, is given in [4]. In [5], it is claimed that improved median filter performs better than previous weighted median filter for high quality image restoration. In [6], a new method, called boundary discriminative noise detection (BDND), is proposed from the switching median filter. It is seen that the all proposed algorithm are satisfied if and only if the original image is blurred with salt and pepper noise upto a certain limit. In [7], the technique to remove a different noise; impulsive noise, is proposed when this noise is present in a huge amount.

Our paper is organized as follows, in section I, the research level related to, technique to remove the salt and pepper noise in the image from the median filter, switching median filter and improved median filter and

preliminaries of mean filter, median filter are discussed. In section II, our technique is proposed in algorithm form. In section III, simulation results corresponds to the proposed technique are shown and compared it with the mean and median filter performance. Finally, section IV concludes the paper.

Mean Filter:

The arithmetic mean filtering process computes the average value of the corrupted image $g(x,y)$ in the area defined by S_{xy} . The value of the restored image f at any point (x,y) is simply the arithmetic mean computed using the pixels in the region defined by S_{xy} . In other words

$$\hat{f}(x,y) = \frac{1}{m * n} \sum_{(s,t) \in S_{xy}} g(s,t)$$

This operation can be implemented using a convolution mask in which all coefficients have value $1/mn$. A mean filter simply smoothes local variations in an image.

Median Filter:

The best known order-statistics filter is the median filter, which replaces the value of a pixel by the median of the gray levels in the neighborhood of that pixel-

$$\hat{f}(x,y) = \frac{1}{mn} \sum_{(s,t) \in S_{xy}} g(s,t)$$

The original value of the pixel is included in the computation of the median. Median filters are quite popular because, for certain types of random noise, they

provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filters of similar size.

II. PROPOSED ALGORITHM

In this proposed technique, salt and pepper noise from the corrupted image is removed, the algorithm are presented as below:

Table:1 PSNR Values for Different Filters

Filter	Noise Density								
	10(%)	20(%)	30(%)	40(%)	50(%)	60(%)	70(%)	80(%)	90(%)
Mean	23.59	19.81	17.52	15.75	14.28	13.11	12.01	10.99	10.21
Median	37.20	35.60	32.68	29.41	25.00	20.89	16.48	11.86	8.22
Improved median	27.93	27.73	27.65	26.73	23.74	18.73	13.78	9.67	6.37

Step 2: Sort pixels from the selected window according to the ascending order and find out the median pixel value (denoted by P_{med}), maximum pixel value P_{max} and minimum pixel value P_{min} of the sorted vector V_0 . Now the minimum, maximum and median pixels are of the vector V_0 is P_{min} , P_{max} and P_{med} respectively.

Step 3: Now, the axiom is considered that if the processed pixel follows this condition $P_{min} < p(x, y) < P_{max}$, and $P_{min} > 0$ and $P_{max} < 255$, then it is assumed that the pixel is uncorrupted and it is kept the same value as before. If above condition is not satisfied, then pixel is treated as corrupted pixel and have to correct that pixel from noisy pixel.

Step 4: If $p(x, y)$ is corrupted pixel, then we have the following two cases:

Case 1: If pixels are satisfied this condition $P_{min} < P_{med} < P_{max}$ and $0 < P_{med} < 255$, then corrupted pixel $p(x, y)$ is replaced with P_{med} .

Case 2: If case 1 is not satisfied, then it is considered that the median pixel P_{med} is corrupted with noise. Then the differences between each pixels pair of adjacent pixels across the sorted vector V_0 is performed and obtain the difference vector V_D .

Then find out maximum value in the difference vector V_D and considered this pixel as processes pixel and follow the further step.

Step 5: Steps 1 to steps 4 are repeated until the complete process of removing the salt and peppers noise from the noisy image is done for the entire image.

III. RESULTS AND ANALYSIS

Here, the proposed technique is verified and demonstrated on MATLAB Platform. In this simulation result, 'girl.jpg' image of size 256 x 256 is selected as a original image as shown in the figure 2.a and noise

Step 1: Window size of 3x3 is selected from the noisy image and focused all pixels around the processed pixel $p(x, y)$ in the corrupted image.

density of 60 % of salt and peppers mixed in the original image which produced noisy image as shown in the figure 2.b. Figure 2.c shows the image which is filter with the mean filter and figure 2.d is corresponding the median filter. From the produced images from mean and median filter it can be seen that median filter has better performance than mean filter. the convention median filter and figure 2.d shows the image which is produced with our proposed technique improve median filter.

Fig 1: Plot for PSNR values of Girl image

Moreover, Figure 1 shows the PSNR performance of different filters. Also from the figure, it can be concluded that the performance of mean filter is worst and improved median filter has better performance. For the lower noise density, PSNR values of improved median filter is good but it fall down abruptly and generate a worse result when the noise ratio is high. As the performance of our improved proposed median filter is better than other filters when the noise ratio considered lower than 60 %.

IV. CONCLUSION

The performance of these filters are tested on the well-known standard image (Girl Image) corrupted by salt and pepper noise with equal probabilities. Improved median filter preserves the integrity of edge and detailed information and remove impulse noise effectively, and provide more satisfying visual quality. This proposed improved median filter is used for practical application for removing such types of noise which is present on images.

Fig2: (a)original image (b) corrupted with 60% noise (c)output from mean filter (d)output from median filter (e)output from improved median Filter

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