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Removing Impulse Noise in Gray Scale Images using Min Max and Mid Point Filters

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Abstract: Images are frequently corrupted with impulse noise during acquisition and transmission. Noise should be removed while keeping the fine details of the image as one. More than a few algorithms have been projected to remove impulse noise from the corrupted images. So, in this paper we propose a new method called INR-method based on adoptive efficient Min-Max filter and Mid-point filter that can remove impulse noise from the corrupted gray-scale images. It is found that our experimental results are effective and efficient when compared to an Intelligent Recursive algorithm based on lifting filter.

Keywords: Min-Max filter, Mid-point filter, Gray-scale images, Impulse noise.

I. INTRODUCTION

An Efficient noise reduction technique is required for any type of image before performing the operations on the images. Noise should be removed while maintaining the fine details of the images for further processing. Various methods have been proposed to estimate the intensity values of noise pixels. Some of the best existing methods are Detail Preserving Regularization method (DPR) [1], Open Close Sequence filter (OCS) [2].

Two common traditions of impulse noise are

a) Fixed-valued impulse noise (FVIN) also known as salt and pepper noise (SPN)
b) Random-valued impulse noise (RVIN)

The FVIN is commonly modeled by

$$y_{i,j} = \begin{cases} (0, 255) & \text{probability } p \\ (x_{i,j}) & \text{probability } 1 - p \end{cases}$$

where as x is the original image, y is the corrupted image and p is the noise density respectively. The coordinators of the image are i, j. This representation implies that the pixels are randomly corrupted by two fixed extreme values 0 and 255 with the same probability.

Median filter [3] [4] is well known method that can remove salt and pepper noise from images. The median of brightness in the neighborhood is not affected by individual noise spices. Median filtering is a nonlinear smoothing method that also reduces the blurring of the edges. Its disadvantage is the distortion of corners and thin lines in this image. The Impulse noise of gray scale image is different from impulse noise of binary image. The impulse noise removal in binary image is different from removal of impulse noise in gray scale image. Salt and pepper noise could be distinguished as pixels having more difference in terms of amplitude when compared with neighborhood pixels.

In this paper we propose an Impulse Noise Removal method (INR-method in short) based on min-max filter and mid-point filter that can effectively remove impulse noise from corrupted image which gives fine details of image in terms of visualization for further image processing. It does not need any threshold parameters and it gives good quality in image visualization when comparing with Intelligent Recursive Algorithm (IRA) [5].

The rest of the paper is organized in four sections. Section II, briefly describes the previous image pulse models for image restoration. Section III describes the proposed method. Section IV deals with experimental results by using proposed method. Section V we deal with future scope and conclusion of this paper.

II. IMPULSE NOISE MODEL

Noise reduction is an important technique to store the images and do the further processing on images. The IRA is used to remove impulse noise reduction in grayscale and binary images using lifting scheme. Using this algorithm on gray scale images detailed coefficient is calculated by the absolute difference between the current pixel value and the mean of good pixels around the pixel. On top of binary image each pixel counts the nearby good pixels. If ruined pixels were found in this window then window size increased to 5 or the algorithm counts number of black pixels and the number of white pixels. The existing pixel

value is replaced by the value whichever is establish greater, that gives the restored image.

Many algorithms and effective methods are proposed and used to remove noise in gray scale images. One of the algorithms is IRA an impulse noise removal in gray scale and binary images using lifting scheme. Noise cancellation using lifting filters is not new and it is implemented in [6]. The lifting scheme is used earlier for image sampling in [7] and adaptive versions of lifting scheme have been used for image construction and image compression. CWM [8] is superior enhancement to median filter. Within this more weight is given to the center than its neighborhood pixels. The center weighted median filter gave more priority to the existing pixel, and it preserves the image particulars. Noise reduction is less when center pixel is corrupted. Switch-based adaptive weighted mean filter (SAWM) [4] is used to replace each noisy pixel with the weighed mean of its uncorrupted neighbors. Once compared with IRA our INR-method based on min-max and mid-point filters can efficiently remove impulse noise from the corrupted image. Our experiment results show the efficiency of our method.

III. PROPOSED METHOD

In Figure 1 we take input image as noise image. By using noise detection method noise detection can be calculated by applying midpoint filter on the noise image. De-noised image can be obtained which we can store them for further purpose.

A. INR-Method:

Input – Noisy Image H

Output – De-noised image.

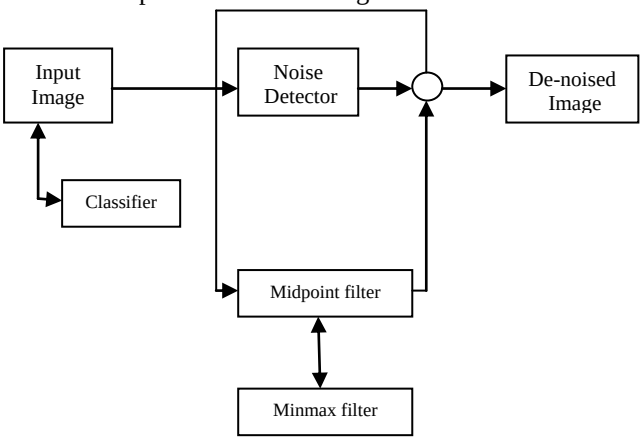


Figure 1. Frame work for INR-method

B. Procedure:

Step1: Initialize window size w = 3
Step2: Read X(i, j) for every pixel repeat step3 to step 5
Step3: If X(i,,j) is not equal to impulse pixel go to step6.
Step4: calculate mid(X(i,j))=[min(x(i,j)+maxX(i,j)]/2
for every pixel p in the window of intensity P_g
determine midpoint value
Step5: Move next window
Step6: If right hand column of the window is not at the right hand edging of the image go to step3.
Step7: If the bottom row of the window is not at bottom of image go to step2

In the proposed algorithm we taken gray scale image and for every corrupted pixel we count the surrounding good pixels. Compute minimum and maximum values of the pixel and computes average of minimum and maximum values. If the pixel is not a noise pixel, take next corrupted pixel. This process is repeated for every corrupted pixel on the image.

C. Min max Filter:

The median filter is far away from the order statistic filter that most used in image processing, it is as a result of no means simply one. The median represents 50^{th} percentile of ranked rest of numbers, the 100^{th} percentile outcomes in the max filter given by

$$\hat{f}(x,y)=[\max_{(s,t)\in Sxy}\{g(s,t)\}$$

The max filter is useful to find brightest points in an image. Pepper noise has very low values it is reduced by this filter as a result of the max selection process in the sub image area.

$$\hat{f}(x,y)=[\min_{(s,t)\in Sxy}\{g(s,t)\}]$$

The 0^{th} percentile filter is min filter. This filter is useful for finding darkest points on the image. It as well reduces the salt noise as a result of min operation.

D. Midpoint Filter:

The Midpoint filter simply computes the midpoint between minimum and maximum values in the area encompassed by filter which combines to organize statistics and averaging. This sort out works best for the randomly distributed noise like Gaussian noise and uniform noise. The mid filter is defined as

$$\hat{f}(x,y)=\tfrac{1}{2}[\max_{(s,t)\in Sxy}\{g(s,t)\}+\min_{(s,t)\in Sxy}g(s,t)\}]$$

It computes 0.5 times sum of maximum and minimum filtering operations.

Figure. 2 (a)

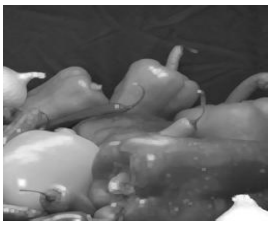


Figure. 2 (b)

Figure. 2 (c)

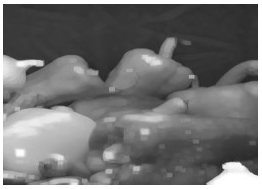


Figure. 2 (d)

The first image Fig. I(a) is the original colour image, second image Fig. I(b) is the grayscale image ,Third image Fig. I(c)is image 20% of salt and pepper noise and Image Fig. I(d) is resultant image with midpoint filter which applied on noise image.

IV. EXPERIMENTAL RESULTS

Experimental results on the image pepper have been presented to show the efficiency of the proposed method. The Algorithm was implemented in the matlab7.5.0 and computed results are compared with visual quality of images in terms of PSNR values. PSNR computes peak signal-to-noise ratio among two images. This ratio is used for valuable measurement between original image and corrupted image. Higher the PSNR then better the quality of corrupted image. The experimental results show the efficiency of the proposed method for de-noising grayscale images corrupted with different levels of noise densities.
PSNR for M x N image is defined as:

$$PSNR = 20 \log_{10}\left(\frac{255}{RMSE}\right)$$

Where Resultant mean-squared error (RMSE) is:

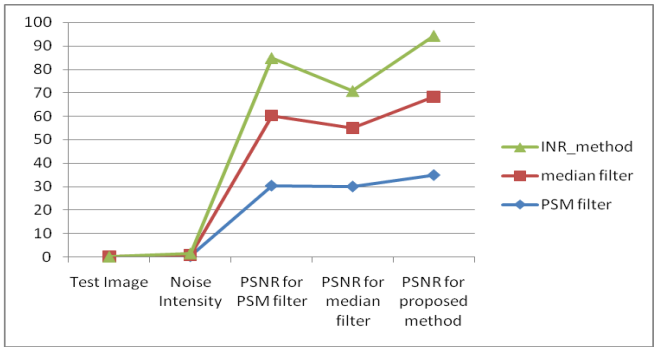
$$RMSE = \text{sqrt}\left(\frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}[I1(i,j) - I2(i,j)]\right)$$

Where I_1 is the original image and I_2 is the restored image.

Table shows the performance of proposed method with other algorithms. our proposed method shows higher PSNR values compared to other median based methods when their noise ratios are good.

Table: 1

Test Image	Noise Intensity	PSNR for PSM filter	PSNR for median filter	PSNR for proposed method
Peppers	20%	30.36	29.98	34.88
	50%	29.82	24.95	33.34
	70%	24.58	15.78	26.02



Graph 1

The above graph specifies that INR-Method gives high PSNR values compred with median filter and PSM filter at different noise impulses.

V. CONCLUSION

We have proposed an improved impulse noise removal method based on min max and midpoint filters that can give us acceptable results in terms of image visualization and image re-establishment. This projected method work well for gray scale images. The projected algorithm yields better results at 20%, 50% and 70% noise densities. The Improvement in the PSNR values compared with other filters Quantifies improvement in the projected method .This development can give us to extract image features and future enhancement of the images.

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