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Image De-noising Using Linear and Decision Based Median Filters

P. Sathya*, R. Anandha Jothi, V. Palanisamy
Department of Computer Applications, Alagappa University,Karaikudi, Tamil Nadu, India

ABSTRACT

Image de-noising is the big problem in image based applications, whereas transferring images through all types of electronic communication. During the electronic communication the impulse noise is caused via uneven voltage. Such kind of noise is necessary to eliminate, using some filtering techniques. In this work, the linear and decision based median filtering (DBMF) techniques are used to eliminate the image impulse noise. In this approach can mainly preserve the image information, whereas suppressing impulsive noise. The proposed filtering techniques are studied with many simulation results using MATLAB. Utmost of earlier known methods are suitable for the de-noising of image corrupted with fewer noise density. Here a proposed decision based method has been offered which produce better performances than linear conventional filters. Finally to compare the quantitative analysis is made by Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR) of different images.

Keywords : Filters, De-noising, density, PSNR, MSE

I. INTRODUCTION

The major objective of this proposed work is to detect the effective and reliable quality image de-noising algorithm of impulsive noise [1]. In this study based on two different types of algorithms such as linear filtering and decision based median filtering (DBMF) techniques have been illuminated in brief. In addition, both filters are applied for removal of impulse noise and compared both filters and their performance. The process of image processing is based on image restoration methods. The captured image normally affected by some corruption or degrade these image is should be needed to estimate and redrawn, because the processed image gives better performance. The image degradation caused by image blurring, motion and noise [2,3] and during the image transmission face a general problem is "Impulse noise "is known as a salt and pepper noise which is produced by uneven voltage which is caused during the transmission or problems made in the communication medium. The fixed values are fixed by the impulse noise like '0' is fixed for pepper noise and 255 for salt noise.

Generally filtering methods can be classified into two types such as linear and non-linear filtering. The linear filtering algorithm works linearly to applies all the image pixels without bothering corrupted or not(uncorrupted) pixels .finally the linear filtering method to applies uncorrupted pixels also filtered and therefore these filtering methods are not perfectly remove impulsive noise. But the non-linear filtering method has two stages one for identifying the corrupted and uncorrupted pixels and the next stage, the corrupted image pixels are only filtered by the specific filtering algorithm [4]. Generally, universally used non-linear filter is median filter which takes the median value to substitute the corrupted pixel, and the non-linear filters only having the quality of removing the impulse noise while conserving the edges.

In this paper, the linear and decision based median filtering (DBMF) techniques are studied effectively and experimentally. The experimental results was getting from different filters, these filters are applied and tested on universally accepted lena and boat images and then the performance was evaluated individually, in this manner finally which filters is best well suitable for an impulse noise modal according to the experimental data attained .
Paper is organized in sections as – Section II discusses various image de-noising methods. Section III discusses proposed DBMF based studies Section IV discusses simulation results and discussion. Section 5 presents conclusion of the experimental study.

II. IMAGE DENOISING METHODS

Generally there are various types of image de-noising methods are established. Further, each and every methods have own advantages and limitations. Those de-noising methods are choose based on the type of image and how munch amount of noise existing in the image. In addition to the following factors are considered like the performance in de-noising the image, computational time and cost. Image de-noising methods are performing various domains such as spatial, frequency and wavelet domain [5]. In this study only based on spatial domain linear filtering and DBMF methods. The linear spatial domain filters are explained below.

A. Spatial Domain Linear Filters

Normally, captured images are not clear; such kind of images affected with various types of noises this noise should be removed by filters this technique is called as image processing. This technique is used for various tasks like interpolation, noise reduction and re-sampling [4]. The selection of filters based on the type and amount of noise existent in image for dissimilar filters can eliminate powerfully. Spatial domain linear filters are given below.

B. Linear filters

Linear filtering methods are used to improve the image in various methods. Sharpening the image or object edges, minimize the random noise, modifying uneven illuminations, de-convolution to accurate for blur and image transformation. These methods are carried out by convolving the input image with suitable filters. Generally linear filters are characterized by two types one is Gaussian and another one is average filters. Those filters are normally used in linear filters.

C. Gaussian Filter (GF)

Gaussian filter is a non-uniform low pass filter. Those filters are used to remove noise and unwanted information. GF are best to begin the experimenting and filtering as their intention can be measured by operating just single variable – the variance. GF performance based on the following function.

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

The value of the sigma (the variance) corresponds inversely to the amount of filtering, smaller values of sigma means more frequencies are suppressed and vice versa [6].

D. Gaussian filters properties

- Gaussian noise removed effectively by Gaussian filters
- The weights produce maximum implication to pixels near the edge (to minimize the edge blurring)
- Gaussian filters provide effective computation
- It has symmetric rotation
- The degree of smoothing is controlled by Y (larger Y for more intensive smoothing)

E. Average Filter (AF)

The process of average filtering takes the average of pixels contained in the neighborhood of the filter mask. Average filters take the neighbourhood of the central pixel of the average intensity values and then swaps the pixel with the average value. Generally such kind of filters used to remove irrelevant information's of the image. AF has some limitations that it blurs the object edges on the image [6].

F. Decision Based Median Filter (DBMF)

The process of DBMF to detect the corrupted image pixels and finding whether the pixel values corrupted or not. The some process of DBMF techniques is similar to the Adaptive median filters, generally the pixel values to be managed lies between the minimum and maximum value belong to the window to be processed suppose the pixel value lies among the maximum and minimum value in the window, that pixels value not changed, such type of pixels considered as noise free pixel, otherwise the remaining pixels are replaced by the median value of the window or next nearest pixel value. [7].

Algorithm

Step 1: choose the window and then select the maximum, minimum and median value of the given image window.

Step 2: Let L_{xy} considered as the pixel value

L_{max} is denoted as maximum pixel value

L_{min} is denoted as minimum pixel value

L_{med} is considered as median pixel value

Step 3: if ($L_{min} < L_{xy} < L_{max}$

Then the pixel is not affected with impulse noise.

Otherwise the pixel is considered as affected impulse noise.

Step 4: If L_{xy} is an impulse noise

Else Check ($L_{min} < L_{med} < L_{max}$) or

($0 < L_{med} < 255$)

Then median value is not impulse noise and the filtered image pixel value is replaced by the median value of the window.

Otherwise the median is an impulse noise; the filtered image pixel is replaced by the value of left next nearest neighbourhood pixel value.

Step 5: Those steps are recurring until all the pixels have been tested [8, 9].

III. PROPOSED METHOD OF DBMF

The studied DBMF was used to improve the performance of given image. The functionality of the studied algorithm is similar to the Adaptive Median Filter (AMF). Hence, the slight changes made in AMF of the steps [5] 3and 4 at the end of the step is respect to the AMF technique. Suppose the median value is considered an impulse noise. Then the size of the window is maximized height and width direction, the same steps is recurrent to meet if the new median achieved after maximize the window size. During these processing steps the impulse noise was detected. If the algorithm step meet median value is an a impulse noise yet again, the same algorithm step is repeated until the maximum size is reached, else the filtered image pixels is swapped by the left nearest neighbourhood pixel value as in the DBMF. This modified DBMF algorithm is applied to the corrupted image could be achieved better performance compared with spatial domain linear filters and AMF.

IV. SIMULATION RESULTS AND DISCUSSION

The spatial domain linear filters and DBMF are studied and implementation is tested with two universally accepted images such as lena and boat images achieved in MATLAB. The size of the image is 512 X 512 pixels. Starting before of the filtering process the input image is previously added impulse noise. The noisy images are tested with above mentioned filters and calculate the performance of the proposed filters. The density of the noise from 10 to 50 are added to the image each test is increased density value as 10 and their performance were calculated using MSE and PSNR. The maximum value of the PSNR and the minimum value of the MSE are the shows the best filtering techniques. These results are depicts in table 1, 2 and Figure 1, 2.

Figure 1. (a) Original image (b) Impulse noise image (c) Gaussian filtered image (d) Average filtered image (e) DBMF image

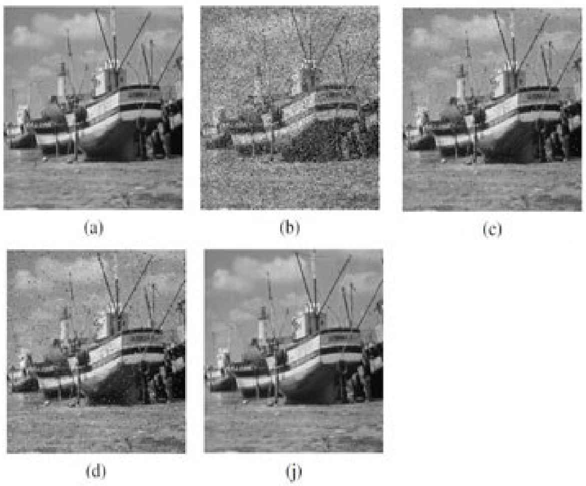

Figure 2. (a) Original image (b) Impulse noise image (c) Gaussian filtered image (d) Average filtered image (e) DBMF image

Table 1. psnr value for fig. 1 at different noise densities

% of noise density	Gaussian Filter	Average Filter	DBMF
10%	22.21	32.52	47.05
20%	20.53	30.62	43.93
30%	19.41	25.64	37.8
40%	17.57	20.79	35.13
50%	14.89	19.07	32.47

Table 2. psnr value for figure 2 at different noise densities

% of noise density	Gaussian Filter	Average Filter	DBMF
10%	27.25	30.17	45.02
20%	23.10	26.28	40.58
30%	20.92	24.59	37.28
40%	18.16	22.16	30.69
50%	15.40	19.98	28.08

The studied algorithm was tested different noise density from 10% to 50% shown in Fig.1 and 2 and the performance are evaluated using PSNR value are depicts in Table 1 and 2. The performance comparison of the both filters we analysed the DBMF gives better performance compared with the spatial domain linear filters. These filtering techniques are evaluated at window size 3 X 3. Generally, the best performance only viewed at low noise density. When the size of the window and the noise density was increased the image tends to viewed in blurring effect and low performance respectively.

After the experimental outcomes, the comparison of the three filters DBMF provide better performance compared with linear filtering methods. The best performance is depends upon the image is being analyzed. After the analysis of filtered image performance of Fig 1and 2 the DBMF provide better performance than the linear Gaussian and average filters. DBMF technique is achieved in maximum noise density the performance was found by PSNR measures and visual effect also provides better performance. The linear filtering techniques are not filtered salt noise perfectly and also the main drawback of this method. The conventional linear technique is takes comparatively high computational time and is not suitable for real time applications. Comparatively DBMF gives better performance for all noise density level. After the analysis we found that DBMF technique can filter the impulse noise, even though blurring cannot be affected when the densities was above 40%. Nevertheless, we tested to increase the noise densities level it offered best results, the blurring of the filtered images inclines to maximize. After the performance wise comparison DBMF produce better outcome than the spatial linear filtering methods depends upon the visual precision and PSNR evaluation.

V. CONCLUSION

Spatial and adaptive filtering methods are studied effectively. The final conclusion of this study expose that the DBMF gives better performance for image de-noising method. The performance evaluation was tested using PSNR measures and visual check. nevertheless, the comparison of the used filtering methods, the progress of the linear filtering method reveal better performance for low and medium level noise densities at the same time computational time is not suitable for real time applications, finally the DBMF techniques are better than linear filters and the computational time for these methods are significantly fewer creation them the perfect method for use in real-time applications.

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