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Edge Preserved Image Denoising using Median Filter

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Abstract

Digital images are often corrupted by many types of noise including salt-and-pepper, which are normally affect the acquisition and transmission. Impulse noise which is a set of isolated pixels can make a great difference on the configuration of image. It is often caused by malfunctioning pixels in camera sensors, faulty memory locations in hardware or transmission of the image in a noisy channel. It is essential to eliminate salt-and-pepper noise in the image and to preserve the image edge and integrity. The proposed method consists of a detection stage where the noisy pixels are detected and followed by filtering which replaces only the noisy pixels. The noisy pixels are detected by taking the minimum and maximum gray level intensity values in the sliding window. Then these detected noisy pixels will be restored by the median value of the noise free pixels in the sliding window, and then the median filtering is used to handle the conflict of noise suppression and edge-preserving. The proposed method is convenient and efficient on removing salt and pepper noise in the image and at the same time can achieve good performance of edge preserving, even when the image is corrupted by salt and pepper noise of higher density. Simulation results shows that it can remove salt and pepper noise effectively with edge-preservation compared to other existing nonlinear filters. Thus the proposed method is simple to realize and it is simulated by using MATLAB.

I. INTRODUCTION

Image sequences have conquered their place among the most important information carriers in today's world. Their applications such as broadcasting, video- phone, traffic observations, surveillance systems, autonomous navigation and so on. The field of digital image processing refers to processing digital image by means of a digital computer. It encompasses processes that extract attributes from images including the recognition of individual objects.

Digital images are often corrupted by many types of noise including salt-and- pepper noise, which are normally acquired during image acquisition and transmission. Impulse noise which is a set of isolated pixels can make a great difference on the configuration of image. It is essential to eliminate salt-and-pepper noise in the image and preserve the image edge and integrity. Normally the pixels which have maximum and minimum gray level intensity value in the sliding window are the pixels that are corrupted by the salt and pepper noise.

The proposed method concentrates on image denoising where impulse noises in images are removed. Impulse noise is found in situations where quick transients such as faulty switching, during imaging, due to transmission errors, malfunctioning pixel elements in the camera sensors, faulty memory locations, and timing errors in analog-to-digital conversion. An important characteristic of this type of noise is that only part of the pixels is corrupted and the rest are noise-free.

This paper deals with the image restoration which is a highly developing and gaining importance, because of the significant increase in the use of digital images over the internet and in enhancement of the images in various fields of research like.Section 2 describes the system specifications .Section 3 deals with the description, problem definition and overview of the project. Section 4, simulation results and the performance analysis comparisons between the existing and proposed algorithm are discussed.Section 5 describes the conclusion and future enhancement of the project is discussed.

II. PROPOSED SYSTEM

In the proposed method there is one stage of detection and two stage of filtering. In the first stage, the maximum and minimum gray level intensities in the sliding window of the noisy image are considered as the threshold value to detect the presence of noise. In first stage of filtering, these detected noisy pixels are replaced by the median value of the noise free pixels. In second stage of filtering directional difference median filtering is used for noise suppression and edge-preservation. The proposed method is convenient and efficient on removing salt and pepper noise in the image, and at the same time can achieve good performance of edge preserving, even when the image is corrupted by salt and pepper noise of high density.

In the process of image acquisition and transmission, impulse noises often cause serious degradation of the image quality. Among the various filtering algorithms that have been proposed, the family of median filters is the most popular and holds a dominant position in this area for its simplicity. The most representative paradigm in this family is known as “Switching Median Filtering” (SMF), which partitions the whole filtering process into two sequential steps – noise detection and filtering. By utilizing the priority knowledge obtained from the noise detection step, the filtering step could be more targeted and does not need to touch those uncorrupted pixels. Obviously the accuracy of the noise detection is critical to the final result. In terms of the conflict of noise suppression and edge-preserving, our proposed method takes directional difference method to handle it.

III DESCRIPTION & OVERVIEW OF THE SYSTEM

As in image enhancement, the future ultimate goal of restoration techniques is to improve an image in some predefined sense.Restoration attempts to reconstruct or recover an image that has been degraded by using a priori knowledge of the degradation phenomenon. Thus restoration techniques are oriented toward modelling the degradation and applying the inverse process in order to recover the original image.

In the proposed method corrupted pixels are detected by using the minimum and maximum gray level intensity values in the sliding window and the detected noisy pixels replaced by the median values of noise free pixels and the directional difference filter is used for edge preserving and effective noise suppression. The intensity of the noisy pixel will be distinct from its nearest surrounding pixels. Based on this criterion the proposed method focuses on noisy pixel detection.

In the first stage, select the window size as 3x3, then the maximum and minimum gray level values in the window are to identify the noisy pixels. In next stage, these detected noisy pixels will be replaced by the median value of the noise free pixels. In last stage the corrupted pixels which are left unchanged in the previous stage are restored by using directional difference filters, it also provides better noise suppression and edge preservation. The proposed method works well for highly corrupted images with noise densities as high as 60 % with better PSNR value and improved visual quality.The description of the algorithm has two stages, they are

- Noise Detection Algorithm Along with Adaptive Median Filtering
- Directional Difference Filtering Algorithm

IV. SIMULATION RESULTS

The threshold values are optimized to get better restoration. The proposed method restores highly corrupted images with noise densities as high as 60% with improved PSNR values. The tuning parameters are optimized to yield good result for all noise densities. Hence the fixed values of the tuning parameters give consistent PSNR values and also MSE value is much reduced.The proposed method is compared with the existing methods. Three different test images are used and the corresponding PSNR values and the MSE values are compared. It can be seen that in the proposed method the PSNR values are consistent and gives good PSNR for highly corrupted noise with better image quality. The noise mask is used for processing only the noisy pixels whereas retaining the noise free pixels. Pixel by pixel processing enables better image restoration and visual quality.

The Mean Square Error Value (MSE) of the proposed method is comparatively less to the previous methods. It implies that the false and missed detections are less increasing the percentage of right detection. The rate of increase in wrong detection is less than the existing methods and this helps in better restoration of images that are highly corrupted. Thus the results for different methods and the proposed method for

60% corrupted 'Lena' image of 512x512 images is shown below in table 1 & 2 and figure 1.

Table 1: Comparison of PSNR values of proposed technique with existing techniques for 512x512' Lena' image

Noise Density in %	DWMF	EDRIN	RDRIN	Proposed Method
30	1005.1	182.2764	142.5855	62.3867
40	1564.4	373.6041	297.4327	71.6505
50	2201.8	679.3297	574.4358	85.7386
60	3004	1174.6	1016.4	112.8477
70	3823.7	1864.1	1714.8	165.9563

Table 2: Comparison of MSE values of proposed technique with existing techniques for 512x512 Lena image

Noise Density in %	DWMF	EDRIN	RDRIN	Proposed Method
30	18.1087	25.5235	26.5900	30.1799
40	16.1872	22.4067	23.3969	29.5786
50	14.7031	19.8100	20.5384	28.7990
60	13.3538	17.4319	18.0601	27.6059
70	12.3060	15.4260	15.7887	25.9309

Table 3: Comparison of PSNR values of proposed technique with existing techniques for 384x512 peppers image

Noise Density in %	DWMF	EDRIN	RDRIN	Proposed Method
30	18.1818	25.5927	27.0006	33.9014
40	15.9346	22.2179	23.1923	33.0055
50	14.1109	19.0566	20.0746	31.6128
60	12.6763	16.5281	17.2199	30.2138
70	11.4586	14.3798	14.7532	27.2174

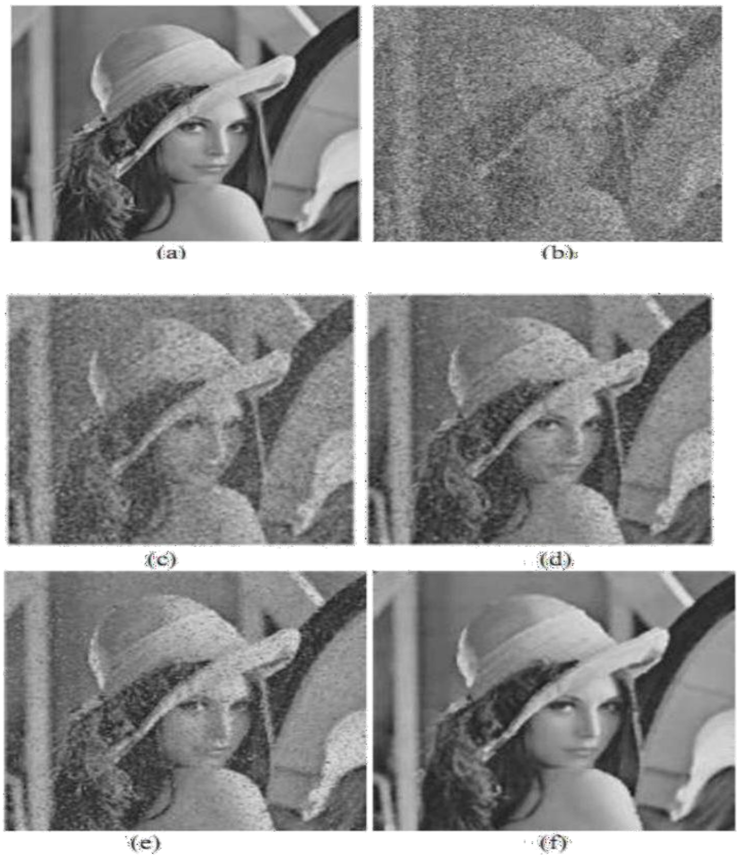

Figure 1: Simulation results for 60% corrupted ‘Lena’ image (a)original image (b) noisy image (c) DWMF (d)EDRIN (e) RDRIN (f) Proposed method

Table 4: Comparison of PSNR values of proposed technique with existing techniques for 384x512 peppers image.

Noise Density in %	DWMF	EDRIN	RDRIN	Proposed Method
30	988.3335	179.3965	129.7239	26.4814
40	1658.2	390.2002	311.7806	32.5482
50	2523.4	808.0132	639.1722	45.8543
60	3511.2	1446.3	1233.4	61.9017
70	4647.5	2371.9	2176.5	123.4067

Figure 2: Simulation results for 60% corrupted ‘cameraman’ image (a)original image (b) noisy image (c) DWMF (d)EDRIN (e) RDRIN (f) Proposed method

Thus the results for different methods and the proposed method for 60% corrupted 'Lena' image of 384 x 512 'Peppers' Images is shown below in table 3 & 4 and figure 2.

V. CONCLUSION

From this proposed method we obtain novel edge preserving method for salt and pepper denoising. The method is actually a combination of switching median filter and directional median method. The advantages of this proposed method are the directional initialization of filtering window size and the precision of median value. Thus, no training or tuning is required. It is ultimate filter for denoising salt and pepper noise. Simulation results show that our proposed method performs better than the median filter and other conventional edge preserving method, even at a high noise level. The PSNR is high; MAE and Processing time is low. This proposed method is a fast method in the algorithm of removing salt and pepper noise.

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