

Image Restoration using Adaptive Median Filtering

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Abstract – In the field of image processing, image restoration is the most essential task. Image often gets corrupted due to which there is presence of noise in the image. Generally median filter is used to remove the presence of such noise but median filter works fine for about intensity of 20% noise in the image. So in order to get a better image restoration we can use another image restoration technique which is adaptive median filtering which works very well for noise intensity beyond 20%. The benefit of adaptive filter over median filter is that it does not erode away edges or small details in the image.

Key Words: Adaptive median filter, Image Processing, Median filter, Salt and Pepper Noise, Gaussian Noise PSNR.

1. INTRODUCTION

In the field of image processing image gets corrupted during image transmission or acquisition stage due to various influencing parameters such as faulty device etc. Such type of corruption gives rise to noise in the image which affects the information present in the image. The various type of noise that arises in the image is impulse noise also know as salt and pepper noise, Gaussian noise, and speckle noise to name a few [1].

In order to retrieve the original information from the image and eliminate noise from the image we need to apply certain de-noising techniques. These de-noising techniques make use of kernel which is made to convolve over the image and the result obtain through this convolution is a noise free image. The size of kernel (window) used for the same varies and intended output with same also varies.

One such commonly used technique is median filtering. Median filtering works fine when the noise intensity is less but it starts to fail when the noise intensity in the image is high [3].

In order to overcome this problem we can make of spatial filtering technique. One such Filtering algorithm used is adaptive median filter. Adaptive median filtering is better than median as it is a two

step filtering technique. The main advantage of adaptive median filter is that the behavior of the adaptive filter changes depending on the characteristics of the image under filter. Other main feature of adaptive filter is that it works well not only for impulse noise but also for speckle noise and Gaussian noise [3].

2. MEDIAN FILTER

Median filter is the most commonly used filter. It is a non linear method of filtering. The size of the kernel can be of nxn size which is made to convolve or slide over a mxm corrupted image. While performing this operation the median value of nxn kernel on the image is obtained and then the value of a particular pixel is replaced with the median value of the nxn kernel.

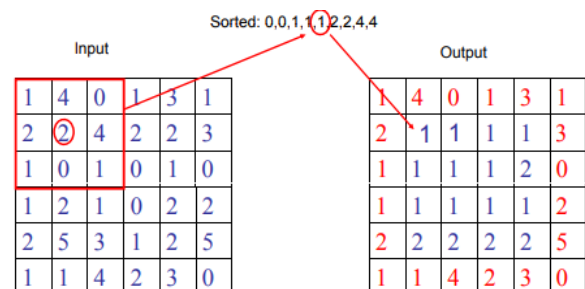


Fig -1: Sorting in median filter.

2.1. Drawbacks of median filter:

- Effective only when the noise is impulse noise (salt and pepper).
- Its output quality deteriorates when the noise is more than 20%.
- It does not work efficiently when the spatial density of noise is high.
- For large kernel size, there is no proper smoothing of the image instead valuable information from the image gets blur.

2. ADAPTIVE MEDIAN FILTER

The adaptive median filter is designed to eliminate the drawbacks faced by the standard median. The main advantage of adaptive median filter is the size of the kernel surrounding the corrupted image is variable due to which better output result is obtained.

The other main advantage of adaptive filter is that unlike median filter it does not replace all the pixel values with the median value.

The working of adaptive filter is a two step process; in the first step its finds the median value for the kernel and in the second step it checks whether the current pixel value is a impulse (salt and pepper noise) or not. If pixel value is corrupted then it changes it value with median or else it retains the value of the gray scale pixel.

By doing this, one can ensure that only the pixels with impulse noise is changed while all other pixel values are retained as they are.

3.1. Implementation of adaptive median filter

Z_{min} = Minimum gray level value in S_{xy} .

Z_{max} = Maximum gray level value in S_{xy}

Z_{med} = Median of gray levels in S_{xy}

Z_{xy} = gray level at coordinates (x, y)

S_{max} = Maximum allowed size of S_{xy}

The adaptive median filter works in two levels denoted Level A and Level B as follows:

Level A: $A1 = Z_{med} - Z_{min}$

$A2 = Z_{med} - Z_{max}$

If $A1 > 0$ AND $A2 < 0$, Go to level B

Else increase the window size

If window size $\leq S_{max}$ repeat level A

Else output Z_{xy} .

Level B: $B1 = Z_{xy} - Z_{min}$

$B2 = Z_{xy} - Z_{max}$

If $B1 > 0$ And $B2 < 0$ output Z_{xy}

Else output Z_{med} .

3.2. Flowchart:

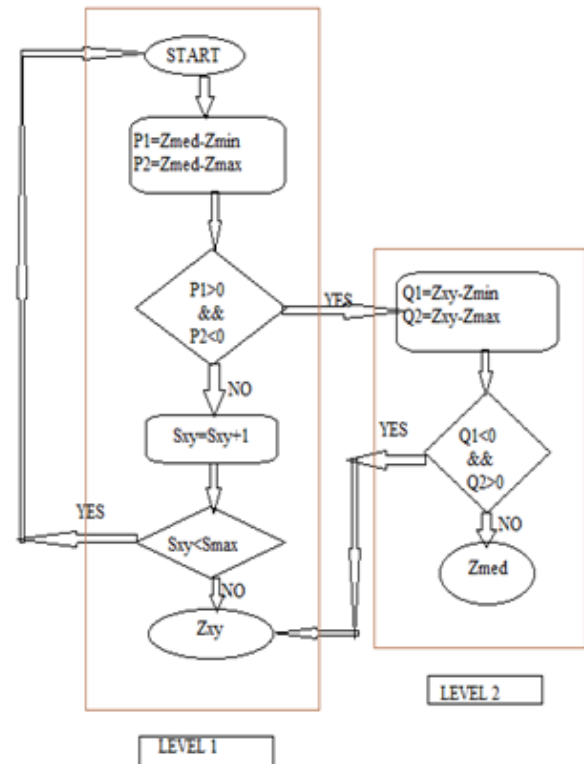


Fig-2: Algorithm used for adaptive median filter

4. RESULTS:

The standard median filter and adaptive median is been implemented using MATLAB Software. The PSNR (peak signal to noise ratio) is been calculated to understand the efficiency of both the filters. Basically when more is the PSNR value better is noise reduction by the filter.

From the calculated values we can observe that the adaptive median filter has better noise filtering capacity than the standard median filter.

Table-1: PSNR Value for salt &pepper noise

Noise percentage	Median Filter (3x3)	Median Filter (5x5)	Adaptive Median Filter
10%	14.9433	14.625	41.8677
20%	12.009	11.8033	41.8702

30%	10.2944	10.1596	41.8816
40%	9.1065	8.9761	41.8675
50%	8.0873	8.0011	41.8810

Table-2: PSNR Value for Gaussian noise

Noise percentage	Median Filter (3x3)	Median Filter (5x5)	Adaptive Median Filter
10%	19.5683	18.6263	43.2747
20%	19.7813	18.8621	44.4432
30%	20.5014	19.5324	45.4093
40%	21.8413	20.7830	46.0971
50%	23.3442	22.1562	46.5204

Table-3: Output for salt & pepper noise.

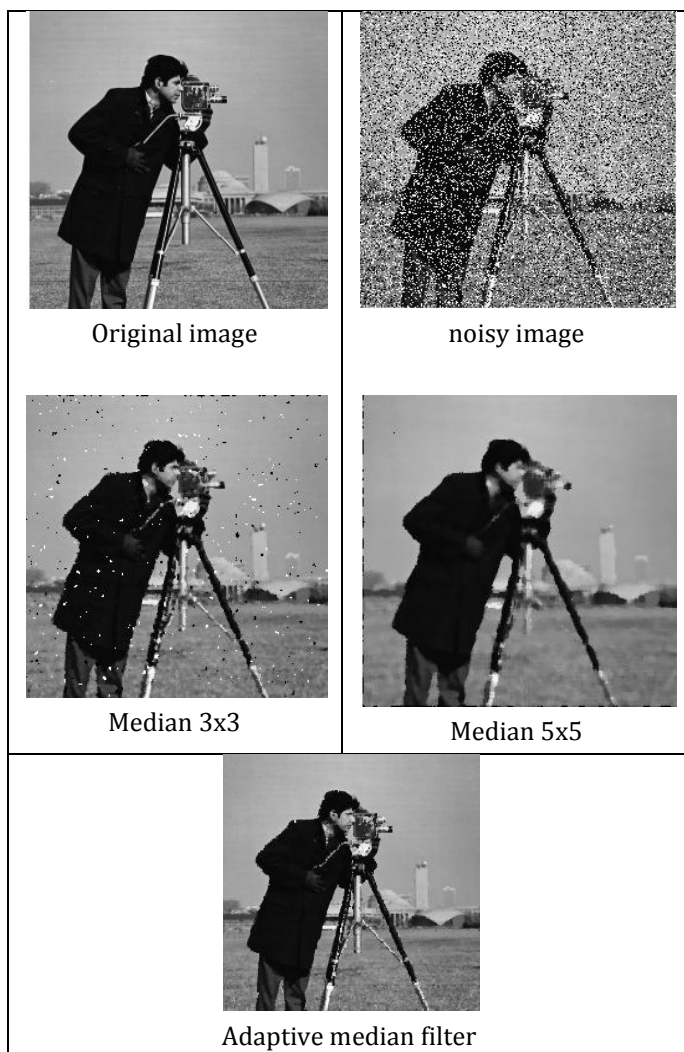
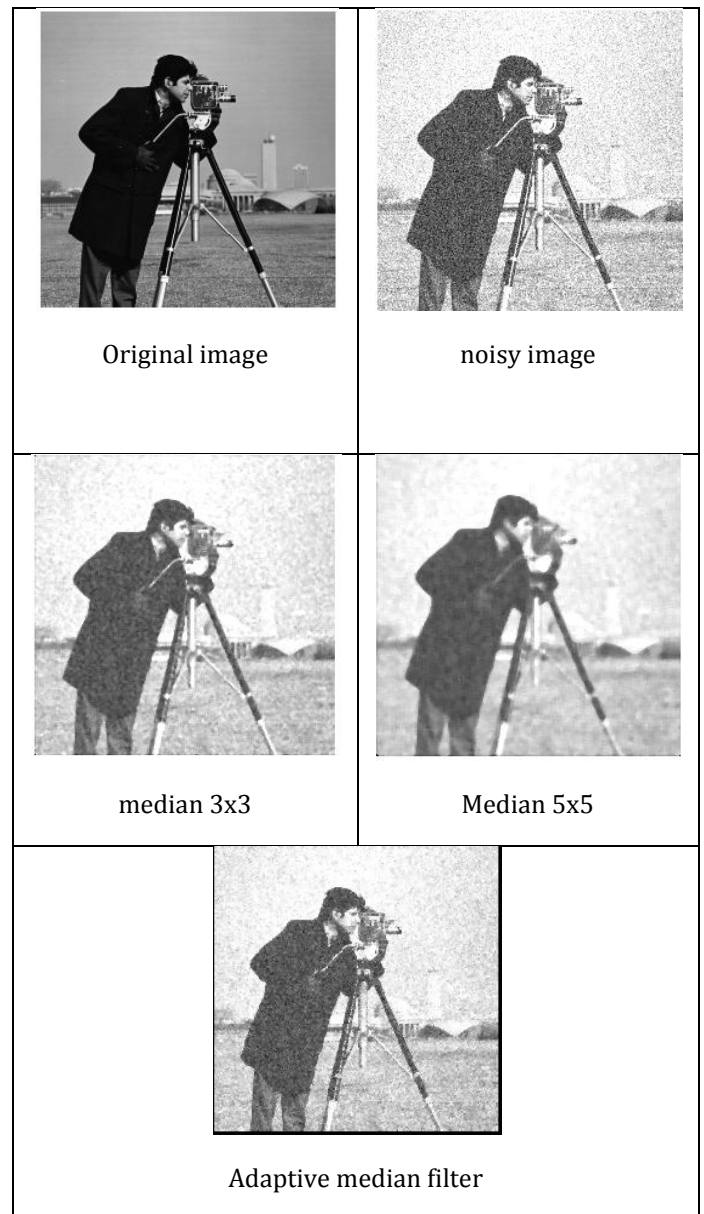


Table-4: Output for Gaussian noise.



CONCLUSIONS

After implementing both standard and adaptive median filter, we can observe that the adaptive median filter works accurately for the impulse noise that is salt and pepper noise.

For Gaussian noise the adaptive median filter gives much better output than the standard median but we can also observe that the output results are not so satisfactory and accurate, so there needs to be some more modification to be done in the proposed model to obtain better results for Gaussian noise.

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