Image Denoising Using Hybrid Filter

Rekha Rani, Sukhbir Singh, Amit Malik

Abstract: Image Processing is the vast area in the field of research. There are various techniques used to remove Present noise. This paper represents obstacles related with image during transmission. The salt & pepper noise, Gaussian noise, impulse noise, Rayleigh noise are the such type of noise that are produced during transmission. Noise arises due to various factors like bit error rate, speed, dead pixels. The images become blurred due to camera movements, object movement or displacement of pixels. This paper deals with removal of combination of Gaussian noise, Rayleigh noise, impulse noise and blurredness, salt and pepper noise simultaneously from the image. The hybrid filter is such a tool that makes it successful to remove these noise form images and provide clarity to picture while preserving its details.

Keywords: PSNR, bit-rate, MSE, Weiner Filter, Multi adaptive filter, Median filter.

I.INTRODUCTION

Image optimization, compression, recompression, resizing, restoration are the basic problems in image processing. This causes disturbance to image environment. To improve the image quality, maintaining its finarity, clarity and speedy movements various types of filters are used in research. I have used hybrid filter that is combination of weiner filter and madian filter to remove the upcoming noises in image enhancement.It maintains intensity, luminanace and density of imgae.The hybrid filter removes cc, blurredness at one time.

II.OBJECTIVE

The main objective of my Thesis is to design a such type of filter that can remove mixed type of noises from the image. There are filters available which can remove only single type of noise from the images, but there are no one filters available which can remove noise simultaneously from the images. I am trying to design such type of filter which can remove following noise simultaneously from the images.

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- To remove the salt & pepper Noise, Gaussian noise, impulse noise, Rayleigh noise from the image
- To remove the blurring effect from the image.
- The blocking and blurring effects introduced by image Processing could be compared objectively.
- It introduces various types of artifacts, such as blockiness, blur, noise etc.

III. PERFORMANCE COMPARISON OF MEDIAN AND WIENER FILTER

Image filtering algorithms are applied on images to remove the different types of noise that are either present in the image during capturing or injected into the image during transmission. The performance of the Wiener Filter after denoising for Speckle and Gaussian noisy image is better than Median filter. The performance of the Median filter after denoising for Salt & Pepper noisy image is better than Wiener filter.

A. Multi-level Adaptive Median Filter

This paper shows a two-phase scheme for removing salt-and-pepper (impulse) noise. In the first phase, an adaptive median filter is used to identify pixels which are likely to be contaminated by noise. In the second phase, the image is restored using a specialized regularization method that applies only to those selected noise candidates. This scheme can remove salt-and-pepper-noise with a noise level as high as 90%. Even at a very high noise level, the texture, details, and edges are preserved accurately.

B. Hybrid Filter

This method incorporates improved adaptive wiener filter and adaptive median filter to reduce white Gaussian noise and impulse noise respectively. The fundamental superiority of the proposed operator over most other operators is that it efficiently removes Gaussian and impulse noise from digital images while preserving thin lines and edges in the original image.
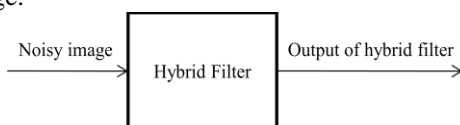

Figure 1: hybrid filter

This hybrid filter consists of the median filter and the wiener filter. The following diagram shows this structure:
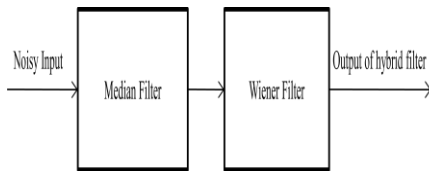
Figure 2: Structure of hybrid filter

IV. DESIGN PROCEDURE OF HYBRID FILTERING

The following steps are followed when we filtered the image:

- If the image is colored convert it in the gray scale image.
- Convert the image to double for better precision.
- Find the median by sorting all the values of the 3*3 mask in increasing order.
- Replace the center pixel value with the median value.
- Estimate the Signal to Noise ratio.
- Deconvolution function is applied to filtered the image.

V. PRESENT WORK

Image denoising techniques can be divided into two broad categories:
1. Spatial domain methods, which operate directly on pixels.
2. Frequency domain methods, which operate on the Fourier transform of an image.
Image filtering is the process of removing the noise from the images. Image filtering is a process by which we can enhance images. The purpose of image restoration is to "compensate for" or "undo" defects which degrade an image. Degradation comes in many forms such as motion blur, noise, and camera misfocus.

A. Image restoration

It refers to the recovery of an original signal from the observations. Image enhancement techniques (like contrast stretching or de-blurring by a nearest neighbor procedure) provided by "Imaging packages" use no a priori model of the process that created the image.
Deconvolution is an example of image restoration method. It is capable of:

- Increasing resolution, especially in the axial direction.
- Removing noise.
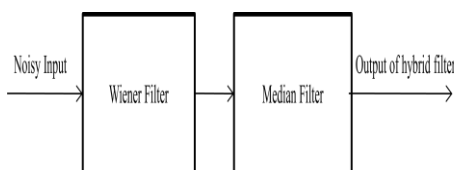- Increasing contrast.

VI. WORK PLAN

Figure 3: Work Plan

This is the structure of the hybrid filter. we first feed the input to the wiener filter than the noise is also blurred due to the deconvolution function, that's why we arrange the median filter first. This all can be shown by figure 4.

Output of Filter

Figure 4: Output of the filter when we first apply wiener filter

Figure 4 shows that the noise is also deblurred. So to remove this condition we arrange median filter first in the hybrid filter. By doing this the impulse noise is removed easily first and then the additive white Gaussian noise and blurring effect.

Hybrid Filter Output

Figure 5: Output of filter when median filter is applied first

VII. SIMULATION & RESULT

A. Additive White Gaussian Noise

The Additive White Gaussian noise to be present in images is independent at each pixel and signal intensity.

Figure 6: shows the pdf of the impulse noise:

7.2 Blurring

When we capture the image, the image is blurred due to the camera's motion or due to the object movement. This phenomenon is known as blurring. The blurring may be linear or circular.

A blurred or degraded image can be approximately described by this equation:

$g = Hf + n$,   where g= The blurred image

H= The distortion operator, also called the point spread function (PSF).

F=original true image, n= additive noise
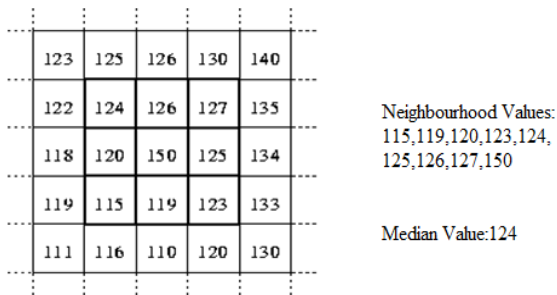
7.3 Median Filter

Figure 7: Illustration of Median Filtering

The median filter gives best result when the impulse noise percentage is less than 0.1 %. [4].When the quantity of impulse noise is increased the median filter not gives best result. Now We consider a sub image area of total image g(x,y) and find the median value.

$$\hat{f}(x, y) = \underset{(s,t)\in S_{xy}}{\text{median}} \{g(s, t)\}$$

Median filter output

Figure 8: Image after Processing from Median Filter

7.4 Wiener Filter

The main purpose of the Wiener filter is to filter out the noise that has corrupted a signal. Wiener filter is based on a statistical approach [13].

The wiener filter is given by following transfer function [4]:

$$G(u, v) = \frac{H^*(u,v)P_S(u,v)}{|H(u,v)|^2 P_S(u,v) + P_n(u,v)}$$

Dividing the equation by P_s makes its behaviour easier to explain:

$$G(u, v) = \frac{H^*(u,v)}{|H(u,v)|^2 + \frac{P_n(u,v)}{P_S(u,v)}}$$

Where H(u, v) = Degradation function

H*(u, v) = Complex conjugate of degradation function

Pn (u, v) = Power Spectral Density of Noise

Ps (u, v) = Power Spectral Density of un-degraded image.

The term Pn /Ps is the reciprocal of the signal-to-noise ratio

7.5 MSR & SNR

we want to produce an estimate of the original signal that minimizes the mean square error, which may be expressed:

$$\in(f) = E|X(f) - \hat{X}(f)|^2$$

where **E** denotes expectation.

$$SNR(f) = \frac{S(f)}{N(f)}$$

is the signal-to-noise ratio. When there is zero noise (i.e. infinite signal-to-noise), the term inside the square brackets equals 1, which means that the Wiener filter is simply the inverse of the system, as we might expect.

Table 7.5. Simulation Parameters

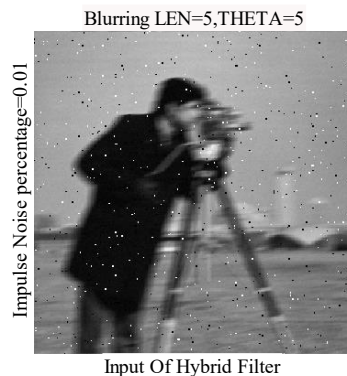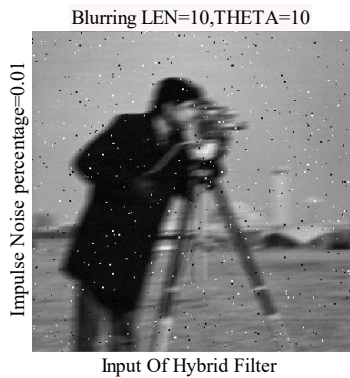| PARAMETERS	VALUE
Blurring Length	0-100
Blurring Angle	0-100
Percentage of Impulse Noise	0-0.2%

Input Of Hybrid Filter

Figure 9: Input of Hybrid filter when the impulse Noise percentage = 0.01 and blurring length =5 and blurring angle = 5

The corresponding output is given in the figure 7.5.2

Output of hybrid Filter

Figure 10: Output of Hybrid filter for MSE =0.005 & PSNR =70.968

Blurring LEN=10,THETA=10

Input Of Hybrid Filter
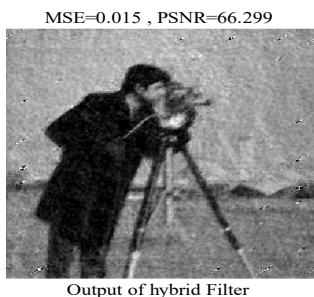
Figure 11: Input of Hybrid filter when the blurring length =10 & blurring angle =10

The corresponding output is given in the figure7.5.4

MSE=0.007 , PSNR=70.016

Output of hybrid Filter

Figure 12: Output of Hybrid Filter for MSE=0.007 & PSNR =70.016

MSE=0.015 , PSNR=66.299

Output of hybrid Filter

Figure 13: Output of hybrid filter for MSE = 0.015 & PSNR =66.299

VIII.CONCLUSION

From the above table we conclude that the PSNR is decreasing and increasing according to the impulse noise percentage. When the impulse noise percentage is high the PSNR is less and when the noise percentage is less the PSNR is high. Figures shows the output of hybrid filter and tables shows the results of performance outputs related to the different noisy inputs with different parameters. We check the performance of hybrid filter at different conditions and conclude that this filter removes most of the noise and recovered the image.

REFERENCES

1. A. K. Jain, "Fundamentals of digital Image Processing", Englewood Cliff, N.J.: Prentice Hall, 1989.
2. R. C. Gonzalez and R.E. Woods, Digital Image Processing, Addison-Wesley, Longman   Inc., 2000.
3. Leslie Stroebel and Richard D. Zakia, "The Focal encyclopedia of photography". Focal   Press, 1995.
4. Gonzalez C. Rafael, Woods E. Richard, "Digital Image Processing" , Dorling   Kinderslet,   3rd edition, 2009.
5. Wikipedia, " http://en.wikipedia.org/wiki/Gaussian_noise", July 2009.
6. Shi Zhong, "Image Denoising using Wavelet Thresholding and Model   Selection",International Conference on Image Processing, 2000,   Vancouver, BC, Canada, Volume: 3, 10-13 Sept. 2000 Pages: 262-265.
7. http://en.wikipedia.org/wiki/Peak_signal-to-noise_ratio
8. http://www.kxcad.net/cae_MATLAB/toolbox/images/f16-14527.htm

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