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Image Noise and Edge Filtering - A Survey, Analysis using MATLAB

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Abstract - Removing noise from the pictures could be a nice challenge for the researchers. Edge detection is a picture process technique for locating the boundaries of objects among pictures. Edge find filters look for borders betIen totally different colors so will find contours of objects. There are lots of image processing techniques to be available to apply and remove noise and signal based problems in an image. I surveyed noise filters and edge filters in concept view and also analyzed with the help of MATLAB. Analysis work is based on filter name,analysis output and pseudo code. I analyzed basic noise and edge filtering techniques in initial research work. I worked out with Gaussian noise, salt and pepper noise, speckle noise filter, poisson filter, median filter, wiener filter, sobel filter, prewitt filter, Robert filter, Laplacian filter and finally I calculated PSNR(Peak Signal to Noise Ratio) value also.

Keywords **- Noise Filters, Edge Filters, Noise Removal, Edge Detection.**

1. Introduction

There are several factors that cause noise in digital pictures. the most factors occur throughout image acquisition, conversion and transmission. a number of the factors are environmental conditions and quality of image sensing parts.

White Noise: Fourier spectrum of a noise is constant is called white noise[1].

Gaussian Noise: is created in a picture by factors appreciate electronic circuit noise and device noise that square measure caused by poor illumination and warmth[1].

Salt and pepper noise is called impulse noise[1].

Periodic noise is caused by electrical or electromechanical interference[1]. Filtering operation is performed directly on the pixels of an image is called spatial filtering[1]. Blurring is a removal of small details from an image before object extraction[1]. Median filtering replaces each pixel in the input image by the median of gray levels in the neighborhood[1]. Mean filters are the spatial filters which are used for noise reduction[1]. Harmonic filter can be used to remove noises such as salt noise and Gaussian noise[1].

Filtering in frequency domain is the process of modifying the transform of an image using a filter function and taking the inverse of the result to get the processed image[1].

Homomorphic filtering is the process of improving the appearance of an image by simultaneous gray level range compression and contrast enhancement[1]. Edge is a set of connected pixels that is boundary betIen two regions[1]. Edge detection is the common approach used for detecting meaningful transitions[1].

2. Literature Survey

Noise and edge filters are Gaussian noise, salt and pepper noise, speckle noise filter, poisson filter, median filter, mean filter, wiener filter, sobel filter, prewitt filter, Robert filter, Laplacian filter, Lee filter, Kaun filter.

2.1 Gaussian Noise

It is statistical noise having a probability density function (PDF) equal to that of the normal distribution, which is also known as the Gaussian distribution[3].

2.2 Salt and Pepper Noise

Salt and pepper noise for which a certain amount of the pixels in the image are either black or white[4].

2.3 Speckle

It degrades the quality of the active radar, medical ultrasound and optical coherence tomography images[5].

2.4 The Mean Filter

It could be a linear filter that uses a mask over every picture element within the signal. [6].

2.5 Shot Noise or Poisson Noise

It could be a variety of electronic noise which may be sculpturesque by a Poisson method[7].

2.6 Median Filter

It is a nonlinear digital filtering technique, often used to remove noise[8].

2.7 Wiener Filter

It is to compute a statistical estimate of an unknown signal[9].

2.8 Sobel Filter

It used to detect edges[10].

2.9 Prewitt Filter

It is used to detect edges11].

2.10 Robert Filter

It is used to detect edges based applying a horizontal and verticle filter in sequence[12].

2.11 Laplacian Filter

It is a derivative operator its uses highlight gray level discontinuities in an image[13].

2.12 Lee Filter

It is able to smooth away noise in flat regions[14].

2.13 Kaun Filter

It transforms the multiplicative noise model into an additive noise model[15].

3. Analysis

Main part of this work is to survey noise and edge filters and analyzed it with the help of MATLAB.

3.1 Gaussian Noise Filter

Gaussian filter could be a filter whose impulse response could be a Gaussian perform. Gaussian filtering g is employed to blur pics and eliminate noise and detail. Gaussian Filter is employed to blur the image.

It used to reduce the noise and the image details.

Fig. 1. Input Image[16]

Fig. 2. Gaussian Noise filter.

Pseudo code of Gaussian Noise filter is,

```
Img = imread('coins.png');
B = imnoise(Img,'Gaussian',0.04,0.003);
figure,imshow(B);
H = fspecial('Gaussian',[9 9],1.76);
GaussF = imfilter(B,H);
figure,imshow(GaussF);
```

3.2 Salt and Pepper Noise Filter

Due to faulty memory location in hardware. Will alter pixel value to either minimal(0) or maximal(255) for 8-bit gray scale image.

Fig. 3. Input Image(Stanford university medical student (SUMS) frontal facial images database)

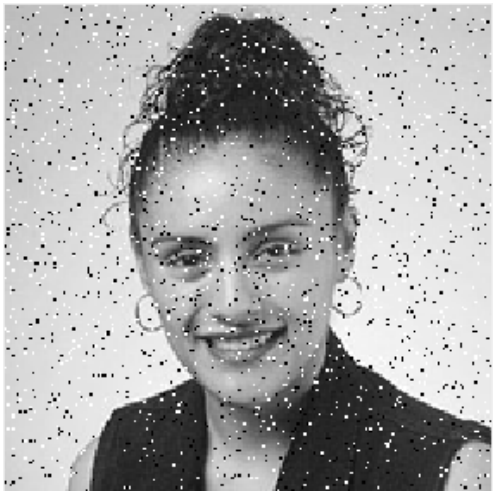

Fig. 4. salt and pepper Noise filter.

```
new_i=imnoise(i,'salt & pepper', 0.05);
axes(handles.axes5);
imshow(new_i);
```

3.3 Speckle Noise Filter

Multiplicative noise.

Fig. 5. Input Image.

Fig. 6. Speckle Noise filter.

```
i=imread('xyz.jpg');
new_j=imnoise(i,'speckle', 0.05);
axes(handles.axes16);
imshow(new_j);
```

3.4 Poisson Noise Filter

Fig. 7. Input Image.

Fig. 8. Poisson Noise filter.

```
i=imread('xyz.jpg');
new_j=imnoise(i,'poisson'); axes(handles.axes16);
imshow(new_j);
```

3.5 Median Noise Filter

Fig. 9. Input Image[17]

Fig. 10. Median Noise filter.

```
I = imread('cameraman.tif');
Y=medfilt2(I,[5 5]);
imshow(Y);
```

3.6 Wiener Noise Filter

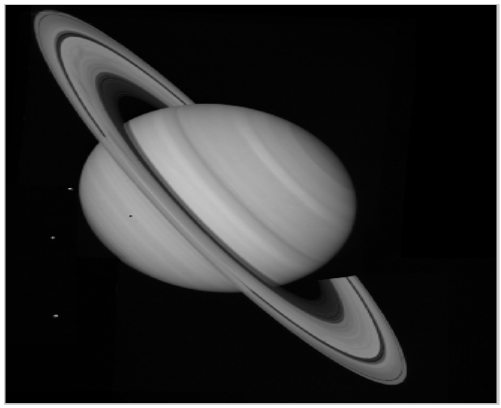

Fig. 11. Input Image[16]

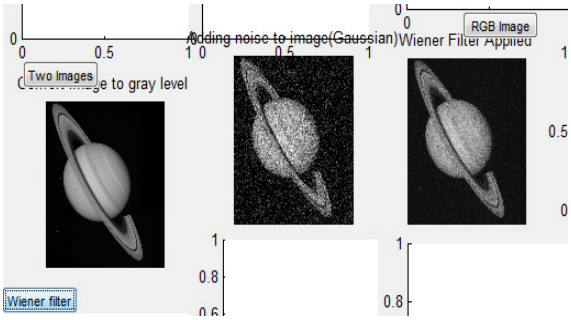

Fig. 12. Wiener Noise filter.

```
newImageRGB= imread('saturn.png');
grayImage = rgb2gray(newImageRGB);
afterWiener=
wiener2(imnoise(grayImage,'gaussian',0,0.025),[6 6]);
```

3.7 Sobel Edge Filter

Fig. 13. Input Image[16]

Fig. 14 .Sobel Edge filter.

```
newImg = imread('waterlilli.jpg');
grayImage= rgb2gray(newImg)
aFilter = edge(grayImage,'sobel');
imshow(aFilter);
```

3.8 Prewitt Edge Filter

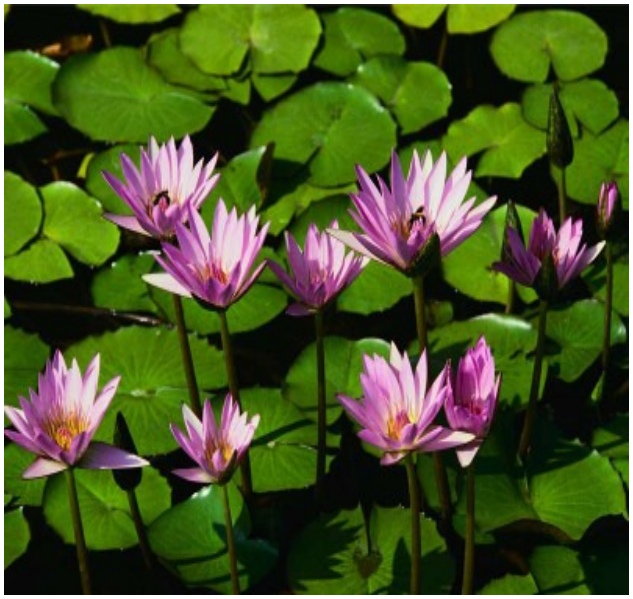

Fig. 15. Input Image[16]

Fig. 16. Prewitt Edge filter.

```
newImg=imread('waterlilli.jpg');
grayImage= rgb2gray(newImg)
aFilter= edge(grayImage,'prewitt');
imshow(aFilter);
```

3.9 Robert Edge Filter

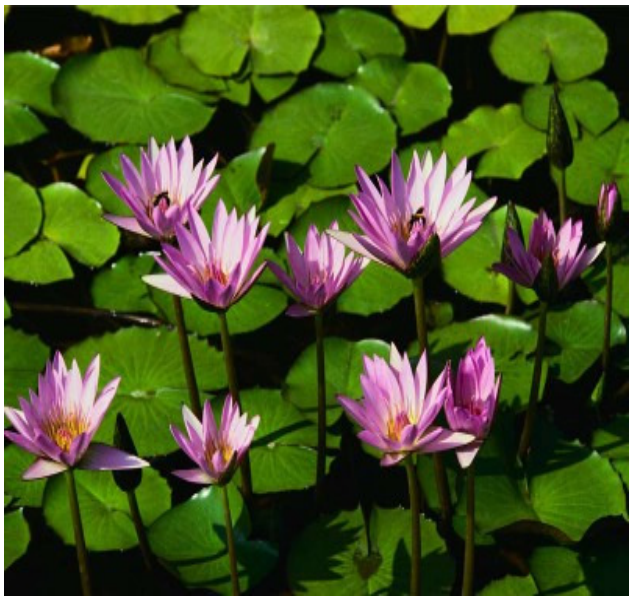

Fig. 17. Input Image[16]

Fig. 18. Robert Edge filter.

```
newImg = imread('waterlilli.jpg');
grayImage= rgb2gray(newImg)
robertsResult = edge(grayImage,'roberts');
imshow(robertsResult);
```

3.10 Laplacian Filter

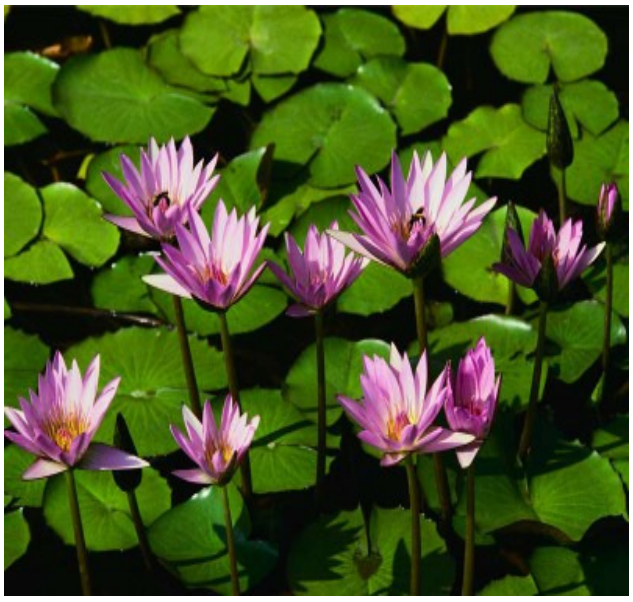

Fig. 19. Input Image[16]

Fig. 20. Laplacian edge filter.

```
newImg = imread('waterlilli.jpg');
lapl=imfilter(newImg,fspecial('laplacian'));
imshow(lapl);
title('Edge detected Image');
```

4. Montage

Montage used for display multiple images. And some examples is in [2].

4.1 Salt and Pepper Noise and Speckle Noise after Montage

```
A = imread('eight.tif');
B = imnoise(A,'salt & pepper',0.05);
C = imnoise(A,'speckle', 0.05);
imshowpair(B,C,'montage');
```

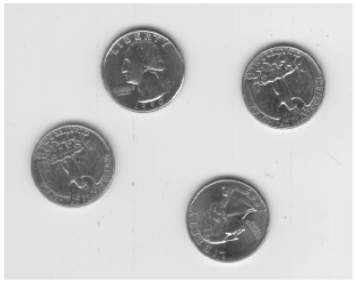

Fig. 21. Input Image[16].

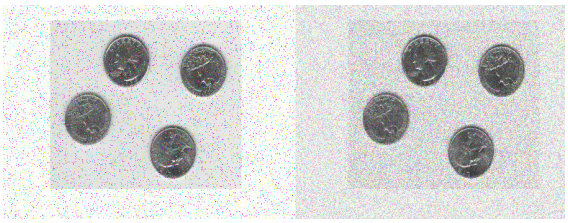

Fig. 22. Montage Image of two noise filters.

4.2 Salt and Pepper Noise and Median Filter After Montage

```
E= imread('eight.tif');
F = imnoise(E,'salt & pepper',0.05);
G = medfilt2(rgb2gray(F));
imshowpair(F,G,'montage');
```

Fig. 23. Input Image[16]

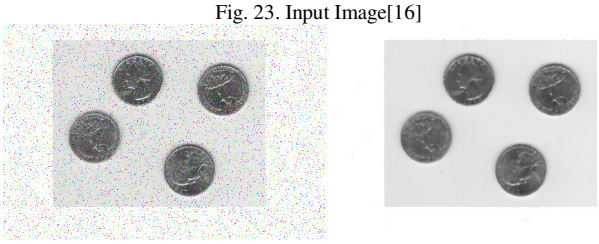

Fig. 24. Montage Image noise filter and median filter.

Table 1:PSNR Calculation

Filters	***PSNR***
Gaussian Noise	25.48
Salt and Pepper Noise	18.07
Speckle Noise filter	18.68
Poisson Noise filter	27.43
Robert filter	5.62
Prewitt filter	5.62
Sobel filter	5.62
Laplacian filter	5.81
Median filter	23.82
Wiener filter	29.47

Table 2: Pseudo code of analysis

Filters	***MATLAB Pseudo Code***
Gaussian Noise	noisyImage = imnoise(grayImage, 'gaussian', 0, 0.003);
Salt and Perpper Noise	noisyImage = imnoise(grayImage,'salt & pepper', 0.05);
Speckle Noise filter	noisyImage = imnoise(grayImage,'speckle', 0.05);
Poisson Noise filter	noisyImage = imnoise (grayImage,'poisson');
Robert filter	noisyImage = edge(grayImage,'roberts');
Prewitt filter	noisyImage = edge(grayImage,'prewitt');
Sobel filter	noisyImage = edge(grayImage,'sobel');
Laplacian filter	noisyImage = imfilter(grayImage,fspecial('Laplacian'));
Median filter	noisyImage = medfilt2(grayImage,[5 5]);
Wiener filter	noisyImage = wiener2(grayImage,[6 6]);

5. Conclusion

I surveyed some noise and edge filters and analyzed some filters Gaussian noise, salt and pepper noise, speckle noise filter, poisson filter, median filter, wiener filter, sobel filter, prewitt filter, Robert filter, Laplacian filter in MATLAB based on pseudo code. And finally I calculated PSNR(Peak Signal to Noise Ratio) value. I have written PSNR calculation program and noted pseudo code of surveyed noise filters.

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