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HETEROGENOUS FILTER PERFORMANCE COMPARISON ON VARIOUS NOISE HANDLING MECHANISM

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Abstract: Image processing is a technique used in various fields like medical and education. Due to noise image may be corrupt. In order to remove the noise various techniques and filters are provided in the field of image processing. Image filtering also involves calculating the probability density function. This function leads to introduce the clarity within the image. Legion of techniques are present in order to enhance the image but review of only specific techniques which are optimal in nature are discussed. The filters, their advantages and disadvantages are also discussed in this paper.
Keywords: Image processing, noise, filters, enhance, optimal, Probability density function

INTRODUCTION

The image processing is the state of art mechanism used to enhance the image. Before enhancement the noise present within the image must be tackled. The noise can be tackled by the use of filters. The objective of this paper is to study the various filtering mechanism available in order to remove noise from it and then applying enhancement mechanism to make the image better for presentation. Removing the noise from the image is known as denoising. Image denoising is the mechanism by which quality of the image is restored. Noise removal is the challenging task presented to the researchers. [1]The noise within the image is described through the following

Figure 1: Showing noise within the image

Identification of noises within the image is compulsory in order to detect and eliminate the noise from the image.[2] The categorization of noises within the image is described in the next section.

SALT AND PEPPER NOISE

The salt and pepper noise distort the image. The spikes are introduced as the application of salt and pepper noise. The salt and pepper reduce clarity hence salt and pepper noise has to be tackled using filtering mechanism. [3]

Figure 2: Showing Image with Salt and Pepper Noise

In order to tackle this kind of noise median filter is needed. The median filter calculates the values of neighbouring pixel and then replaces the corrupted pixel with the filtered pixel which results in reduction of noise from the image.[4]

GAUSSIAN NOISE

This noise is introduced within the image as a result of difference between the normal distribution and probability density function. The normal distribution sine is different from the expected value hence noise is introduced. In order to handle such a noise Gaussian Filter is utilized. This filter is used in order to normalize the distribution in order to make values of both the distribution equal to eliminate noise [5]

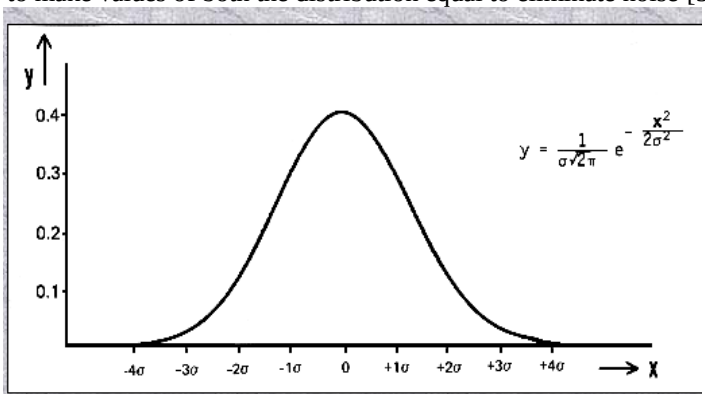

Figure 3: Showing the pulse that occurs when Gaussian noise is introduced.

The Gaussian noise handling is complex since distribution of complex images is also complex.

POISON NOISE

The poison noise is also known as shot noise. The shot noise distorts the image and appears within the image as a result of electromagnetic pulses within the image. It is similar to Gaussian noise emergence within the image.[6]

Figure 4: Showing Poison noise within the image

FILTERING TECHNIQUES

There are legions of techniques available and are used in order to de-noise the image present within the image. Some of the techniques utilized in order to resolve the issues are described as follows

- **MEDIAN FILTER**

This filter is used in order to tackle salt and pepper noise. This type of noise originates when the pixel intensity value goes below 0 or above 255. The mechanism can be devised in order to eliminate the pixel whose intensity value reaches beyond the threshold mechanism. The median of neighbouring pixels are substituted in place of corrupted pixel. [7]

Figure 5: Application of median filter on salt and pepper noise

- **MEAN FILTER**

In this filter the average of all pixel values in the window is replaced with the centre value in the window. It is a simple sliding window spatial filter. The window, or kernel, is usually square but can be any shape.[8][9]–[11]

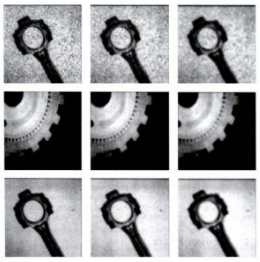

Figure 6: Application of Mean filter

unfiltered values

5	3	6
2	1	9
8	4	7

$5 + 3 + 6 + 2 + 1 + 9 + 8 + 4 + 7 = 45$
$45 / 9 = 5$

-

mean filtered

*	*	*
*	5	*
*	*	*

Figure 7: Mean Filter utilization

- **GAUSSIAN FILTER**

A Gaussian filter is a filtering technique which is used with M X M mask. It computes the weights according to Gaussian function. The Gaussian filtering is very effective to remove the Gaussian noise. The weights that are computed gives the higher significance to the pixels near to edge.[8]
Gaussian function is given below:

$$g(i,J)=c.e\ i^2+j^2/2a^2$$

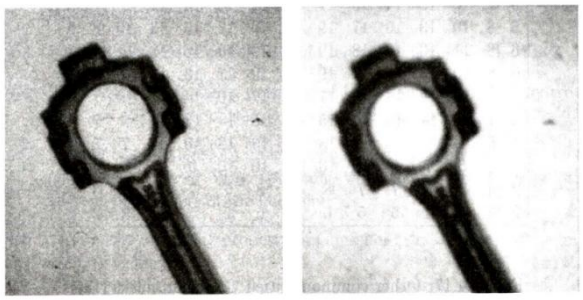

Figure 8: Showing Gaussian Filter utilization

COMPARISON OF VARIOUS FILTERS USED FOR IMAGE PROCESSING

Type of Noise	Denoised Image PSNR					
	Linear Filters		Non Linear Filters			Adaptive Filters
	Gaussian Filter	Average Filter	Median Filter	Min Filter	Max Filter	Adaptive Median Filter
Gaussian noise	23.7253	25.8026	25.4979	14.7697	14.6815	22.7467
Salt & Pepper noise	22.1794	24.9387	30.5088	12.1861	11.7244	37.4839
Speckle noise	22.5712	25.1905	23.3750	14.7026	14.2945	20.7189
Poisson noise	30.0853	27.5862	29.2124	18.8530	18.4931	28.7065
Uniform noise	23.7290	25.4830	30.6693	20.8097	10.9641	34.6640
Rayleigh noise	17.9421	20.7429	27.2467	20.9664	7.0116	29.3020
Erlang noise	25.6125	26.3890	30.9288	20.7841	12.3587	34.9521

Table 1: Showing the performance comparison on Lena Image using various Filtering techniques[12]

Type of Noise	Denoised Image PSNR					
	Linear Filters		Non Linear Filters			Adaptive Filters
	Gaussian Filter	Average Filter	Median Filter	Min Filter	Max Filter	Adaptive Median Filter
Gaussian noise	23.7516	26.0948	25.7364	14.8648	14.6925	22.6735
Salt & Pepper noise	25.0062	25.0062	30.9745	11.7478	11.9887	35.7980
Speckle noise	22.0179	25.1206	22.9734	14.3615	13.8254	20.1106
Poisson noise	30.0707	27.9380	29.3486	18.9826	18.7393	28.5874
Uniform noise	24.3334	26.0411	31.2354	21.2726	11.4607	36.0756
Rayleigh noise	18.4553	21.2884	28.1451	21.4167	7.4662	30.6818
Erlang noise	25.8548	26.7381	31.3529	21.2579	12.6767	36.2143

Table 2: Showing the performance comparison on boat image using various filtering techniques[12]

CONCLUSION

The performance comparison and description of the various images indicates that there exists a need for designing a filter that can handle multiple noises simultaneously. In order to accomplish this combination of filtering mechanism can be used to form hybrid filter. The performance comparison also indicates that Gaussian filter is optimal filter which can be used to de noise image efficiently.

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