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A Review of Noises in Image and Filtering Techniques

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ABSTRACT: Images are often degraded by noises. Noise can occur or be obtained during image capture, transmission, etc. The de-noising of the image is an important job in image processing. If the noise removal technique is not appropriate, then the image quality gets affected. Several techniques for noise removal are well established in colour image processing. The noise filtering technique is based on the type of image noise.This paper present and compares different filtering techniques on different image noises.

I.INTRODUCTION

Noise in an image is a random discrepancy of the image strength and would be visible as grains in the image file. It might come in the image as the effects of basic physics-like photon characteristics of light or heat/thermal energy inside the image sensors [9]. The noise might occur during the capturing of the image or during the transmission of an image. The image is stored digitally in computers as a matrix grid. This matrix grid has pixel intensity for each pixel. When noise is generated, the pixel value in the matrix grid changes its intensity rather than the true pixel value obtained from the original image.Noise is an undesirable effect produced in an image. If an image is being sent digitally via satellite or wireless transmission or through networked cables, errors are expected to occur in the image signal.

Noise removal function is the method of removing or diminishing the noise from a given image. The noise removal function lessens or eliminates the visibility of noise by polishing the full image except for the areas adjoining contrast boundaries. The areas near low contrast details can be obscured by these methods [8]. Various noises have unique characteristics which make them distinct from other noises. Image noise is an unwanted by-product of the image taken. Image noise can also be introduced due to a shaky hand capturing an image.The noises which are common in an image are [6] a) Impulse noise b) Additive noise c) Multiplicative noise.

II. CAUSES OF NOISE IN IMAGE

There might be different reasons for the introduction of noise in an image. The volume of the corrupted pixels will decide the intensity of the noise. The main causes of noises in the digital medium are:

a) The image sensor may be corrupted by environmental conditions during image capturing.
b) Inadequate light levels and temperature of the sensor may introduce noise in the image
c) Interference in the transmission medium may also affect the image.
d) The presence of dust particles may also introduce noise in the image.

III.TYPESOF NOISE

The type of disturbance in the signal determines the ways noise is produced in an image. There are some standard noises that we can expect, hence those noises are investigated for eliminating or reducing through different filters. Various types of Image noise are Amplifier noise (Gaussian noise), Salt-and-pepper noise (Impulse noise), Poisson noise, Quantization noise (uniform noise), Film grain, Speckle Noise (Multiplicative noise), Anisotropic noise and Periodic noise.

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IV. AMPLIFIER NOISE (GAUSSIAN NOISE)

Gaussian noise named after the German mathematician Carl Fredrich Gauss, is a statistical noise having probability density function (PDF) equal or similar to that of the normal distribution also known as Gaussian Distribution [12] i.e., the values the noise can tackle are Gaussian distributed. It is a perfect form of white noise due to the random fluctuations in the signal [5]. In colour cameras, the amplification used in the blue colour is more than the red or green colour which leads to more noise in the blue channel. Amplifier noise is a big part of the noise in an image sensor due to constant noise in the dark part of an image. In Gaussian noise (usually) a small amount of value of the pixel is changed from its original value [3]. A histogram is a plot of the amount of distortion of a pixel value against the frequency of occurrence, shows a normal distribution of noise. The Gaussian distribution is usually good compared to other distributions is due to the central limit theorem which says that the sum of different noises tends to reach a Gaussian distribution.

The PDF of a random Gaussian variable is:

$$p_G(z) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(z-\mu)^2}{2\sigma^2}}$$

In which z denotes intensity, $\bar{z}$ would be the mean (average) of z, and σ is z's standard deviation.

V. POISSON NOISE (PHOTON NOISE)

Poisson noise or shot noise is a type of noise that can be caused when to provide detectable statistical information, the quantity of photons sensed by the sensor is not adequate [7]. Poisson noise has a root-mean-square value which is relative to the square root of image intensity, and noises at different pixels are independent of each other. Due to the dark leakage current in the image sensor, there can be more shot noise in addition to the Poisson noise which would be known as "dark shot noise".

VI. FILM GRAIN

The Film grain is a signal-dependent noise that is related to shot-noise. Digital photography does not have film grain, since the cameras don't use photographic film for any grain to exist. It is a random optical texture of treated film which is caused by minute particles of metallic silver or dye clouds made up of silver halide which has received enough photons. If the film grains are equally divided or scattered equally in an area and if every grain has an independent chance of becoming into a dark silver grain after capturing the photons, then the quantity of those dark grains would be random with a binomial distribution.

VII. QUANTIZATION NOISE (UNIFORM NOISE)

Quantization noise is caused by quantizing the pixels of a sensed image to several discrete levels. It has an estimated uniform distribution and might be signal-dependent. It would be signal dependent if other noises cause the wavering or dithering to be applied overtly.

VIII. SALT AND PEPPER NOISE (IMPULSE NOISE)

Salt and Pepper noise is also known as random noise or impulse noise [10] or spike noise or independent noise. Pixels in the image vary in colour or intensity contrary to their surrounding pixels. The salt and pepper deprivation is due to the sharp and abrupt disturbance in the signal of the image. The salt and pepper noise can be caused by dust particles in the camera or due to heaty and defective image sensors. During observation, the image will contain black and white spots [2] which contributes to the name Salt and Pepper. Salt and Pepper noise can also be triggered by dead pixels. Analog to digital conversions or errors in transmission can also cause this noise.

IX. SPECKLE NOISE

This noise can be induced by random values multiplied by the pixel values of an image, so it can be also called multiplicative noise. It is a grainy noise that reduces the quality of active radar and synthetic aperture radar (SAR)

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images [1]. This type of noise is an immense problem in some radar applications. The mean grey level of a local area is increased due to speckle noise. It is far more serious in SAR causing problems in image interpretation [4]. Speckle noise is created due to the coherent processing of back dispersed signals from various distributed points. This type of noise is seen in the conventional radar system when there is an abrupt fluctuation from the return signal of an object having a size less than or similar to a single image processing unit.dfs

X. NOISE REMOVAL USING FILTERING TECHNIQUES

Image noises are an inevitable by-product of capturing an image or transmitting them. In the case of digital cameras, the light which enters the lens misalign with it then an image noise is produced. Sometimes noises are not visible to the naked eye but there might be some kind of noise present. Every type of transmission in electronic devices tends to produce noise. Due to noisy networks, the images are corrupted with impulse noise when they are transmitted over them. There are positive and negative spikes in this impulse channel [3]. The negative spikes are of a smaller value than the background hence they seem like dark spots while positive spikes are of a higher value than the background hence, they seem like bright spots. Noise removal is a significant task in image processing. There are many noise removal techniques available but those filtering techniques should be sued which preserve the quality of the image while removing the noises to the maximum.

XI. ADAPTIVE FILTER

The wiener function applies a Wiener filter to an image adaptively, tailoring itself to the local image variance [3]. The Wiener filter makes a little smoothing if the variance is large. This filter preserves edges and other high-frequency parts of an image compared to the linear filter [11]. As an advantage, the wiener2 function handles all the computations and implementations for an image, but the function needs more computation time compared to linear filters [1].

XII. MEDIAN FILTER

The median filter is mostly used to remove salt and pepper noise. Median filters are broadly used for signal processing and image smoothing. It is a non-linear filter. The big advantage of a median filter over other linear filters is that the median filter can eliminate the consequence of input noise with the humongous values. Median means that it is the set in the middle value when the values are sorted. The big or small noisy values will end up at the top or bottom respectively. Obtaining a median value means that it will replace the noisy values with the ones closest to it.

XIII. ORDER STATISTICS FILTER

Order-Statistics filters are non-linear filters that depend on the ordering of pixels encompassed by the filter area. When the centre part of the pixel in the image area is replaced by the 100^{th} percentile, the filter can be called max-filter. If the same pixel is replaced by the 0^{th} percentile then it can be called the minimum filter.

XIV. EXPERIMENTAL RESULT

The images are noised with Gaussian noise, Poisson noise, Salt & Pepper noise and Speckle noise have been de-noised using three filters Median filter, Adaptive filter, Order Static filter. The corresponding images have been given below. The PSNR values from the experimentation have been given in Table 1 below. The PSNR values have been given in the table below using software Octave version6.3.0. The Gaussian noise is given in Figure 1 while the effect of Median Filter on Gaussian noise is given in Figure 2. The Poisson noise is given in Figure 3, while the effect of Order-Static Filter on Poisson noise is given in Figure 4. The Salt & Pepper noise is given in Figure 5, while the effect of Median Filter on Salt & Pepper noise is given in Figure 6. The Speckle noise is given in Figure 7, while the effect of Order-Static Filter on Speckle noise is given in Figure 8.

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1. **Gaussian Noise and Median Filter**

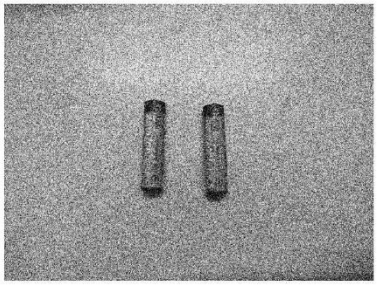

Figure 1. Gaussian Noise Before

Figure 2. Gaussian Noise After

2. **Poisson Noise and Order Static Filter**

Figure 3. Poisson Noise Before

Figure 4. Poisson Noise After

3. **Salt & Pepper Noise and Median Filter**

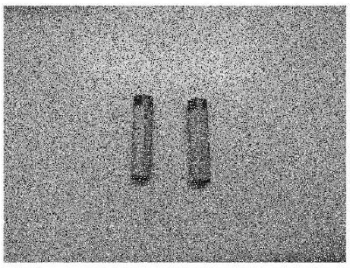

Figure 5. Salt & Pepper Noise Before

Figure 6. Salt & Pepper Noise After

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4. Speckle Noise and Order Static Filter

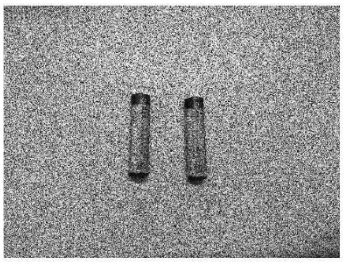

Figure 7. Speckle Noise Before

Figure 8. Speckle Noise After

Table 1: PSNR Values based on different noises and filtering techniques

	Gaussian Noise	Poisson Noise	Salt & Pepper Noise	Speckle Noise
Median Filter	26.34	20.98	34.89	20.78
Adaptive Filter	26.56	20.98	22.39	22.25
Order Static Filter	19.86	21.11	21.100	17.25

XV. CONCLUSION

Different types of noises and filtering techniques are discussed in this paper. Various filtering techniques were tried on various noises. According to the above table, the Median filter is more useful on the Salt & Pepper noise while the Adaptive Filter does a good job on the Gaussian noise and the Order Static Filter does a mediocre job on the Poisson noise.

REFERENCES

1. Aborisade, D.O. 2011 A Novel Fuzzy Logic Based Impulse Noise Filtering Technique, International Journal of Advanced Science and Technology Vol.32.
2. Rafael.C.Gonzalez,RichardE.Woods processing, 3 rd edition, Pearson education.
3. V.R.Vijay Kumar, S.Manikandan, D.Ebenezer, P.T.Vanathi and P.Kanagasabapathy.2007.High Density Impulse noise Removal in Color Images Using Median Controlled Adaptive Recursive Weighted Median Filter. IAENG International Journal of computer10.
4. Stefan Schulte, Valérie De Witte, and Etienne E.Kerre.2007. A Fuzzy Noise Reduction Method for IEEE Transactions On Image Processing Vol. 16,No5,11436.
5. Tom M´elange, Mike Nachtegael,Et Filter for the Removal of Gaussian Noise in Color Image Sequences 1474-1479.
6. Parminder Kaur and Jagroop Singh. 2011.A Study Effect of Gaussian Noise on PSNR Value for Digital Images International journal of computer and electrical engineering Vol. 3, No. 2,1793-8163.
7. Tudor Barbu (2013). "Variational Image Denoising Approach with Diffusion Porous Media Flow". Abstract and Applied Analysis. 2013.
8. M. EmreCelebi, Hassan A. Kingravi, Y. Alp AslandoganNonlinear vector filtering for impulsive noise removal from color images. Journal of Electronic Imaging. 2007,1- 21.
9. Gonzalez R. C., & Woods R. E. (2002) “Digital Image Processing,” 3 rd edition., Prentice Hall, Eng-lewood, Cliffs, NJ.
10. Mrs. C. Mythili and Dr.V.Kavitha. Efficient Technique for Color Image Noise Reduction The Research Bulletin of Jordan ACM,Vol. II (III)
11. Orlando.J,Tobias.2004. Image segmentation by histogram thresholding using fuzzy sets. IEE transaction on image processing, Vol.11, No.12.
12. Mr. Pawan Patidar and et al. Image De-noising by Various Filters for Different Noise in International Journal of Computer Applications (0975 – 8887) Volume 9– No.4, November 2010

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