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The Brief Study of The Different Types Of Noise Model

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Abstract *— In the image processing, images have much importance in the field of research and technology. An image is considered as a collection of information and the occurrence of noises in the image causes degradation in the quality of the images. So the information associated with an image tends to loss or damage. Noise can be also defined as an unwanted entity that corrupts the significant information and disgraces the visual quality of digital image. In this paper we can see how different types of noise will affect the quality of the images and the information in images.*

key words- *Image processing, Sources of image noise, Types of Image Noise*

I. INTRODUCTION

An image may be contaminated by noise at the time of image transmission or image acquisition. Noise is any unwanted information that corrupts an image. It may arise in the image as effects of basic physics-like photon nature of light or thermal energy of heat inside the image sensors. Noise is an error in image acquisition process that results in pixel values that do not reflects true intensities of Real Pictures. From different resources noise comes into an image. There are many different types [5] of noise which can be classified into a) Impulse noise, b) Amplifier noise [1], c) Multiplicative noise, d) Shot noise, e) Quantization noise.

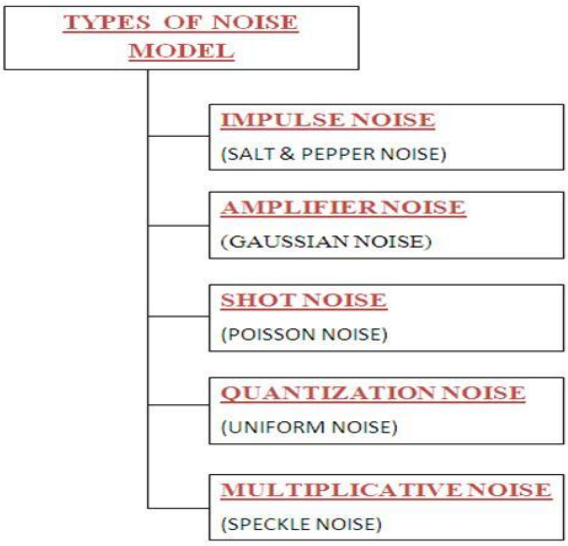
II. VARIOUS SOURCES OF NOISE IN IMAGE

Noise must introduce during acquisition process or at the time of image transmission. There are different factor which may responsible to introduce noise in the image. And the major responsible factors are:

1) The image sensors may be affected at the time of image acquisition.
2) Lacking of light levels and temperature of sensor also occur noise in the image.
3) Obstruction in the transmission channel may corrupt the image.
4) Digital images convert optical signals into electrical signal and then to digital signals and are one process by which the noise is introduced in digital images.
5) By natural phenomena at conversion process each stage experiences a fluctuation that adds a random value to the intensity of a pixel in a resulting image.

III. DIFFERENT NOISE TYPE

Noise is the effect which is undesirable and it is produced in the image. At the time of image acquisition and image transmission several factors are introduced noise in image. Diverse types of disturbance, the noise is affecting the image at various extents. Image noise can be classified as Impulse noise (Salt-and-pepper noise), Amplifier noise (Gaussian noise), Shot noise (Poisson noise), Quantization noise (uniform noise), and Multiplicative noise (Speckle noise).



We can model a noisy image as follows:

$$C(x,y)=A(x,y)+B(x,y)$$

Where A(x, y) is the original pixel value of image and B(x, y) is the noise in the image and C(x, y) is the resulting noisy image pixel value.

A. IMPULSE NOISE (SALT & PEPPER NOISE)

An image containing IMPULSE NOISE (salt-and-pepper noise) [2] will have dark pixels in bright regions and bright pixels in dark regions. This type of noise can be caused by dead pixels, analog-to-digital converter errors, bit errors in transmission, etc. This can be eliminated in large part by using dark frame subtraction and by interpolating around dark/bright pixels.

$$p(z)=\begin{cases} p_a & for \quad z=a \\ p_b & for \quad z=b \\ 0 & otherwise \end{cases}$$

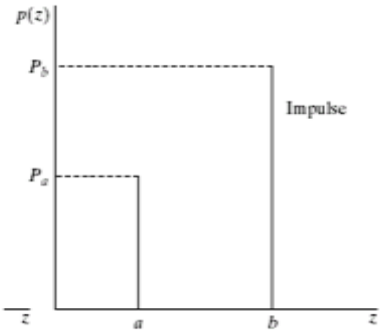


Figure: 1 original image and image with impulse noise

B. AMPLIFIER NOISE (GAUSSIAN NOISE)

The standard model of AMPLIFIER NOISE is additive [3], GAUSSIAN, independent at each pixel and independent of the signal intensity. In color cameras where more amplification is used in the blue color channel than in the green or red channel, there can be more noise in the blue channel .Amplifier noise is a major part of the "read noise" of an image sensor, that is, of the constant noise level in dark areas of the image .

GAUSSIAN NOISE

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

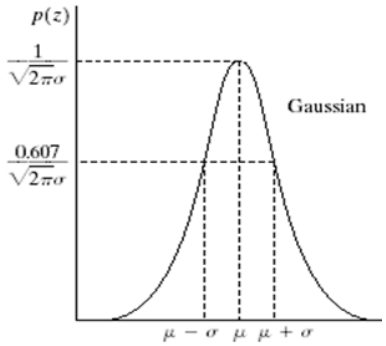


Figure: 2 original image and image with gaussian noise

C. SHOT NOISE (POISSON NOISE)

POISSON NOISE or SHOT NOISE [3] is a type of electronic noise that occurs when the finite number of particles that carry energy, such as electrons in an electronic circuit or photons in an optical device, is small enough to give rise to detectable statistical fluctuations in a measurement

Figure:3 original image and image with **poisson** noise

D. *QUANTIZATION NOISE (UNIFORM NOISE)*

The UNIFORM NOISE cause by quantizing [5] the pixels of image to a number of distinct levels are known as quantization noise. It has approximately uniform distribution. In the uniform noise the level of the gray values of the noise are uniformly distributed across a specified range. Uniform noise can be used to generate any different type of noise distribution. This noise is often used to degrade images for the evaluation of image restoration algorithms. This noise provides the most neutral or unbiased noise.

UNIFORM NOISE

$$p(z) = \begin{cases} \frac{1}{(b-a)} & \text{if } a \le z \le b \\ 0 & \text{otherwise} \end{cases}$$

$$\mu = (a+b)/2; \qquad \sigma^2 = (b-a)^2/12$$

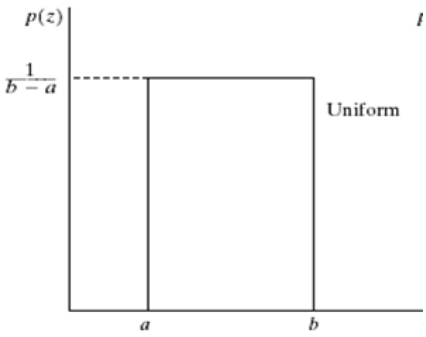


Figure: 4 original image and image with **uniform** noise

E. MULTIPLICATIVE NOISE (SPECKLE NOISE)

SPECKLE NOISE is a granular noise that inherently exists in and degrades the quality of the active radar and synthetic aperture radar (SAR) images. Speckle noise [3] in conventional radar results from random fluctuations in the return signal from an object that is no bigger than a single image-processing element. It increases the mean grey level of a local area. Speckle noise in SAR is generally more serious, causing difficulties for image interpretation. It is caused by coherent processing of backscattered signals from multiple distributed targets.

Figure:5 original image and image with **speckle** noise

CONCLUSION

In this paper, we have discussed different types of noise that slink in images during image acquisition or transmission. Light is also thrown on the causes of these noises and their major sources. In this paper five types of noises (Salt and Pepper, Gaussian, Shot, Speckle and Poisson noise) had been added to the original clean "Lena" image. We observed that all noise causes degradation in the image quality which results in loss of information.

FUTURE WORK

In the image degradation we can apply the filtering methods and to prevent image from the adverse effect of noise.

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