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DIFFERENT TYPES OF NOISES IN IMAGES AND NOISE REMOVING METHODS

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Abstract: High quality images are the basic requirement for any digital image processing application system. But acquiring a high quality image is not an easy task. Digital images are often corrupted by noise during their acquisition and transmission process. Image noise is a disturbance or unwanted alteration in pixels in an image which leads to image degradation. Image noise removal is most important pre-processing step of image processing. De-noising is performed to enhance the image by manipulating the image data, to produce a visually high quality image. The objective of the research is to study the different categories of noises, the different sources which are responsible for producing these noises and the noise removal methods. The kind of noise removal methods used to remove the noise depends on the type of noise that occur during transmission and capturing.

Keywords: Noise, Gaussian noise, Salt and Pepper noise, Poison noise, Speckle noise

I. INTRODUCTION

Digital images play an important role in research and technology such as geographical information system as well as it is the most vital part in the field of medical science. Therefore, these images are required in accurate form so that they can be used effectively. But during their transmission and reception they are usually affected by noise [2]. Noise in an image is an unwanted signal or information which corrupt the image and degrade the quality of an image by hiding the important details of an image. A digital image is corrupted by noise during image acquisition or during image transmission. De-noising of the images is an unavoidable, essential pre-processing step for many image processing applications such as image compression, segmentation, identification, fusion, object recognition etc. [1].

II. SOURCES OF NOISE IN DIGITAL IMAGES

There are different factors available for introducing noise in the image. The quantification of the noise will be decided by number of pixels corrupted in the image. The principal sources of noise in the digital image are [4].

The imaging sensor may be affected by environmental conditions during image acquisition. Insufficient Light levels and sensor temperature may introduce the noise in the image.

Interference in the transmission channel may also corrupt the image [4].

If dust particles are present on the scanner screen, they can also introduce noise in the image.

Blur due to miss-focus.

Blur due to motion.

Low light (night photos or dark scenes) [3].

III. TYPES OF NOISE

During image acquisition or transmission, several factors are responsible for introducing noise in the image. Depending on the types of disturbance, the noise can affect the image to different extent [7]. Noise produces undesirable effects such as unseen lines, corners, blurred objects and disturbs background scenes etc. [5]. The types of Noise are following and also shown in fig 1.

- Amplifier noise (Gaussian noise)
- Salt and pepper noise
- Shot noise (Poisson noise)
- Speckle noise[6]

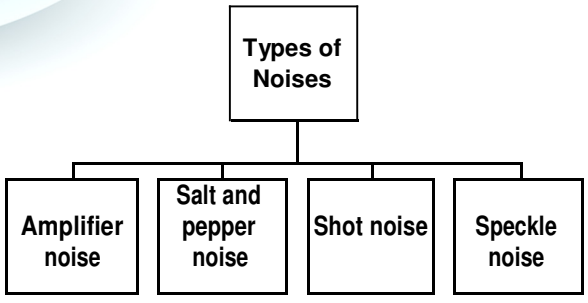

Fig. 1. Types of Image noises

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A. Amplifier noise (Gaussian noise)

Gaussian noise is also known as amplifier noise or electronic noise as it produces from amplifier or detector [8]. It is the most occurring noise. Principal sources of Gaussian noise arise during acquisition e.g. sensor noise caused by poor illumination and/or high temperature, and/or transmission e.g. electronic circuit noise [9].

B. Salt and Pepper Noise

An image containing salt-and-pepper noise will have dark pixels in bright regions and bright pixels in dark regions [6]. Salt and pepper noise is also called as impulsive noise. Impulsive noise generate during data transmission. The image is not fully corrupted by impulsive noise, some pixel values are changed in an image. Image pixel values are replaced by corrupted pixel values either maximum 'or' minimum pixel value. The maximum or minimum values are dependent upon the number of bits used [5]. In salt-and-pepper noise corresponding value for black pixels is 0 and for white pixels the corresponding value is 1. Impulsive noise can be caused by analog to digital converter errors, bit errors in transmission, etc. The salt and pepper noise is generally caused by faulty of pixel elements in the camera sensors, faulty memory locations, or timing errors in the digitization process. Elimination of impulsive noise can be done by using dark frame subtraction and interpolating around dark/bright pixels [5].

C. Shot noise (Poisson noise)

Poisson noise is also termed as shot noise. It appeared on the image due to the statistical nature of electromagnetic waves. This type of noise happens when the numbers of photons that are captured with the sensors are not enough to detect statistical fluctuations in a measurement. Fluctuations of photons are the main reason of Poisson noise [8].

D. 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 in conventional radar results from random fluctuations in the return signal from an object that is no bigger than a single image-processing element [6]. 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. In SAR oceanography, for example, speckle noise is caused by signals from elementary scatters, the gravity-capillary ripples, and manifests as a pedestal image, beneath the image of the sea waves [6].

There are many other noises which may affect digital images. Some of the noises by which images gets most commonly distorted are [10].

Gamma noise

Rayleigh noise

Photon Noise

Brownian noise

IV. Types of Filters

Filters used for image noise removal can be dividing in two categories: linear filters and non-linear filters.

A. Linear filters

Linear filters are used to remove certain type of noise. Gaussian or Averaging filters are suitable for this purpose. These filters also tend to blur the sharp edges, destroy the lines and other fine details of image, and perform badly in the presence of signal dependent noise [8].

B. Non-Linear filters

In recent years, a variety of non-linear median type filters such as rank conditioned, weighted median, relaxed median, rank selection have been developed to overcome the shortcoming of linear filter [8].

V. Noise Removing Methods

A. Removing noise by Mean Filter

Mean filter is also called as linear filter. This filter acts on an image by smoothing it. It reduces the intensity variations between the adjacent pixels. It replaces the centre value of the window with the average values of its all neighbouring pixels values including itself. It is implemented with the convolution mask, which provides the results that is weighted sum of values of a pixel and its neighbours. The mask is square. The 3×3 mask is used. If the coefficient of the mask sum is up to one, then the average brightness of the image is not changed. If the coefficient sum to zero, average brightness is lost, and it returns a dark image [5].

B. Removing Noise by Median Filter

Median filter is a nonlinear filtering technique used to remove noise. After de-noising the edges has to be preserved of the digital image. Median filter remove the noise from the image as well as preserve the edges of image, so median filter is widely used in image processing [5]. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighbouring entries. The pattern of neighbours is called the "window", which slides, entry by entry, over the entire signal. The median is much less sensitive than the mean to external values. Therefore it is better to remove the external values without reducing the image sharpness. It is one kind of smoothing technique [5].

C. Removing Noise by Wiener Filter

Wiener filter is a linear filter. It is an adaptive low pass filter, it uses pixel wise adaption. Therefore this technique is also called as adaptive filtering technique. The method used in this filter is based on the statistics estimated from a local

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neighbourhood of each pixel [5]. It preserve the edges and other frequency parts of an image. However it require more computational time as compared to the linear filtering. For colour image it can be implemented on red, green and blue colour planes separately [5].

VI. CONCLUSION

The Image processing is a widely growing field as many of the nowadays applications are making use of it. Therefore, there is also a need of image de-noising techniques due to introduction of noisy elements during image acquisition. Hence, our concern is to provide a collective brief review of some of these techniques in a single paper to provide ease to the image users. In this paper, different types of noises are discussed and different types of techniques to remove noise from the image. Which technique will apply to which image noise depend on the behaviour and the type of noise or noise image. As there are number of image de-noising techniques used but still there is lot to happen

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