



A Review Paper on Different Noise Types and Digital Image Processing

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Abstract— *Image processing is an emerging technology and image is used in various fields like medical and education. Image may corrupt due to the noise. To remove this noise, in this paper, techniques and various filters are described. Noise reduction is the main focus to retain the quality of the image. Image quality reduces because of the image acquisition or transmission [7]. Before applying further processing on the image, noise should remove from the image. In this paper, various technologies as well as their filters to detect and remove the noise are discussed.*

Keywords—*image denoising, probability density function, gaussian noise, linear and non-linear filters, salt and pepper noise*

I. INTRODUCTION

In the field of technology, digital images usage is increasing day by day. Digital imaging is used in face recognition, signature recognition as well as intelligent bureaus. These images may be corrupted due to some noise issues.

De-noising means to removing noise from the signal. It is also known as noise reduction. Noise is an unwanted signal that may occur in the image. The reason behind the noise in image is Imperfect instruments, problems with the data acquisition process, and interfering natural phenomena can all degrade the data of interest [1]. Furthermore, noise can be introduced by transmission errors and compression.

Image de –noising is the first step in analyzing the data to restore the quality of the image. Noise reduction is the challenging issue for the researchers as it may distorts the actual image and blurring effect of the image. Different methodologies are used in noise modelling explained in this paper. Different images can be denoising with different methodology such as methodology used for satellite images cannot use for medical images. Mathematical formulas are used to show the distortion of the image, where Zero mean does not lose generality, as the non-zero mean can be subtracted to get to a zero mean model according to AWGN (additive white Gaussian noise) technique[6].

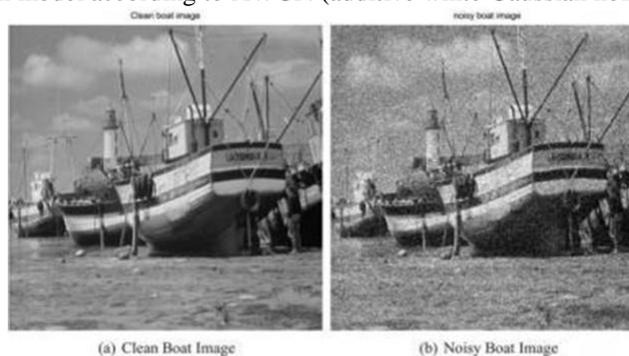


Figure 1 Illustration of noise in the image

IMAGE DENOISING

TYPES OF NOISE:—Noise is an unwanted or distort signal that may corrupt the quality or the originality of the image. Noise has been produced in the image due to transmission. Thus, the main source of image de-noising is Image Digitization. In image processing, noise produces an image that may consist of uneven lines, blurred object, distortion of pixels, corners, background scenes etc. Images are corrupted due to various types of noises in which some of them are Gaussian, photo electronic, impulse noise [1]

. Gaussian noise

Gaussian noise is also known as amplifier noise or electronic noise as it produces from amplifier or detector. It uses Gaussian distribution i.e. normal distribution. Gaussian noise is a statistical noise having Probability Density Function (PDF) which is equal to Gaussian distribution. It is additive in nature, each pixel is independent and signal intensity of each pixel is also independent. Thus, each and every pixel of the image affected. The mean of each pixel of an image i.e. affected by Gaussian noise is zero [1, 6].

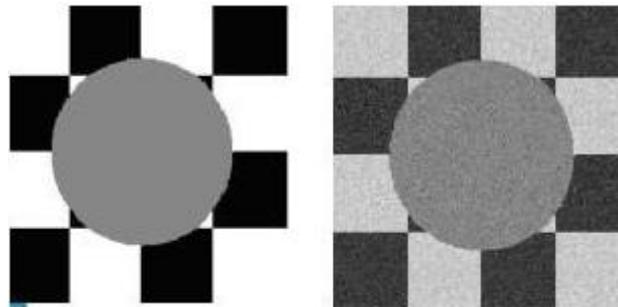


Figure 2 Example of Gaussian noise

. Salt and pepper noise

Salt and pepper noise is also known as Impulse noise, spike noise, random noise or independent noise. The reasons behind the occurrence of this noise are the sharp and sudden changes of image signal, by memory cell failure, by malfunctioning of cameras sensor cells, by synchronization errors in image digitizing or transmission. Dust particle in image acquisition source or overheated faulty component can also cause this type of noise. In this type of noise, the image is corrupted due to black and white dots on it, having dark pixels in bright regions and bright pixels in dark regions. Black and white dot in the image have some noise value i.e. 0 and 1 respectively. Noise value for black is extreme low and for white is extreme high. For 8-bit image the typical value for 255 for salt –noise and pepper noise is 0[1, 3, 5].

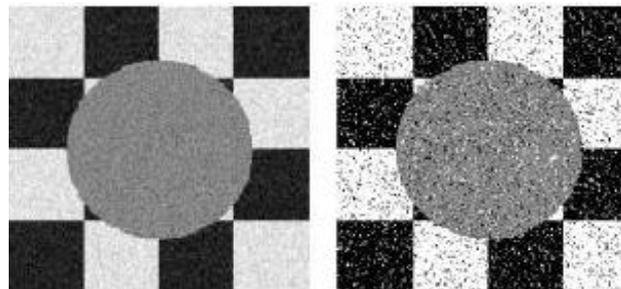


Figure 3 Example of impulse noise

. Poisson noise

Poisson noise is also termed as shot noise. It follows Poisson distribution which is similar to Gaussian distribution. 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 [1, 3, 4].



Figure 4 Adding poisson noise with standard deviation(0.025)

II. CLASSIFICATION OF IMAGE DENOISING TECHNIQUES

Image denoising is the first step in image processing. To detect and then filter the image so that data can be analyzed for further process. Image denoising helps in noise reduction, interpolation and re-sampling. Image is filtered through various techniques that depend on the behaviour and the type of the image. it is the big challenge for the researchers to remove the noise from the image while keeping the details of the image preserved. Basically two methods are used to remove noise named as linear and non-linear methods [4]. Linear methods are fast as compared to non-linear methods but linear methods are not able to preserve the details of the image in comparison to non-linear methods. Further these methods are described as below:-



Figure 5 Description of Filter

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 [4].

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 [4].

DIFFERENT TYPES OF LINEAR AND NON-LINEAR FILTERS

MEAN FILTER:- Mean filter is a type of linear filter that computes average value of the corrupted image in a pre-decided area or mask. Basically, the mask is of 3x3. The window can be of any shape normally square. In the window center pixel intensity value is replaced by that average value. This process is repeated for all the pixel values in the image. This type of filter is appropriate for Averaging or Gaussian filters. Changes in the value depend on the coefficient of the mask sum. 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 is zero, average brightness is lost and it returns a dark image [4, 6].



Figure 6 An example of Mean filtering of a 3x3 kernel of values.

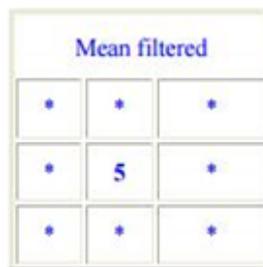
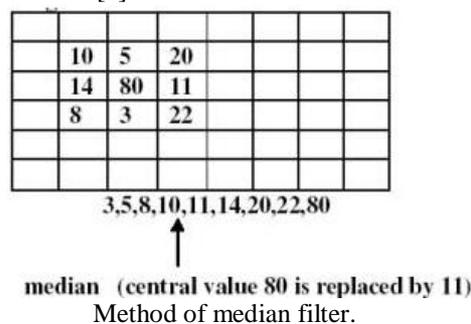


Figure 7 Mean value replacement in filtered values

In this center value which is previously 1 in the unfiltered value is replaced by the mean of all nine value that is 5.

MEDIAN FILTER:- Median filter is a type of non-linear filter. It uses to reduce the amount of intensity variation between one pixel and the other pixel. This technique is much similar to mean filter. In this filter, pixel value of image is replacing with the median value of the neighbourhood rather than mean values. Median filter provides the best result when impulse noise percentage is less than 0.1% [6]



ADAPTIVE FILTERING:- This technique changes the behaviour of the image. It is more selective than a comparable linear filter. It stores the edges and other high frequency parts of an image. This technique uses wiener2 function that handles all the computations and applies filter to the input image. But wiener2 function takes more computational time than linear filtering [1,3,4,6].

III. LITERATURE REVIEW

Monika Raghav et al [3] in this paper, the main focus is on the denoising of the images. Nowadays, the use of image becomes an emerging technology in the field of medical as well as education. But the problem is that it may consist of noise in the image which can distort the quality of the image. Image denoising happens after the image transmission.

Thus, in this paper, image denoising and their effects on the image are described. At the end, some filters are also defined that used to detect the noise and remove it.

Kanika Gupta et al [8] author have been focus on the removal of noise from the original signals. Thus, this paper consists of different techniques that are used to remove the noise. Noise is an unwanted signal that must remove to obtain the quality of the image. Here is a brief discussion on the popular approaches and filters applied on the image.

Rohit Verma, et al [4] image has been using for various purposes and in various fields. While capturing or transmission of image, noise occurs in the process. Thus, before the use of the image noise must be removing. Ample algorithm can be use for this process but it has its own merits and demerits. Techniques that will be used depend on the behaviour and the type of noise. In this paper, different techniques and filters are discussed used in noise reduction.

Priyanka kamboj et al [6] nowadays, image processing is an emerging technology. In image processing, noise reduction techniques are used to improve the quality of the image as well as to retain its originality. In this paper, noise image model describes type of noises that may affect the image. This paper also focuses on the merits and demerits of different approaches like linear and non-linear filtering techniques.

Rahul Singh et al [7] an image is being used everywhere but noise may corrupt the quality of the image. Noise is created either in image acquisition or transmission or any other reason. Many researchers are focuses on the noise reduction and try to figure out the optimum solutions. This paper focuses on various image denoising techniques and their pros and cons as well.

Jyotsna Patil et al [2] in this paper, target is on the image denoising technique. As image obtained after the transmission is often corrupted, so before using it in applications it must be processed. This paper reviews noise models and classification of image denoising techniques.

IV. CONCLUSION AND FUTURE SCOPE

In this paper, different techniques are used 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. Noise model defines the type of the noises their merits and demerits as well. This literature concludes that there is numerous techniques for image de-noising that are applied.

As there are number of image de-noising techniques used but still there is lot to happen. Further studies can be done in this field to provide more effective methodologies. Techniques that are already using may not be able to find the optimum result thus further studies may find the techniques that provide optimum solution to the noise.

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