IMAGE RESTORATION-A REVIEW

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Abstract

In this paper, we present a novel approach to process the image using different filtering methods by Image Restoration. The aim is to enhance the digital image, reconstruct it into the original form from the noisy image. Image Restoration is the process of obtaining the original image from the degraded image given the knowledge of the degrading factors. Digital image restoration is a field of engineering that studies methods used to recover original scene from the degraded images and observations. Techniques used for image restoration are oriented towards modeling the degradations, usually blur and noise and applying various filters to obtain an approximation of the original scene. There are a variety of reasons that could cause degradation of an image and image restoration is one of the key fields in today's Digital Image Processing due to its wide area of applications. In this paper we described the different types of noise and types of blur.

Keywords: *Digital image, Image Restoration, Noise, Blurring*.

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1. Introduction:

A systematic study on importance of image processing and its applications to the field of computer vision is carried out in this paper. An image is defined as an array, or a matrix, of square pixels (elements of picture) arranged in rows and columns. Image processing is a procedure of converting an image into digital form and carry out some operation on it, in order to get an improved image and take out several helpful information from it. Mathematically image processing is defined as the processing of a two dimensional picture by a computer i.e., an image is defined as a function of two real variables, like t(x, y) with an amplitude such as brightness of an image at the coordinate point (a, b). The outcome of image processing can be an image or a set of features or characteristics related to the image. Most image processing methods treats an image as a two-dimensional signal and implementing standard signal-processing techniques to it.

[3]Some of the important applications of image processing in the field of science and technology include:

- Computer Vision,
- Remote Sensing,
- Feature Extraction,
- Face Detection,
- Optical Character Recognition,
- Finger-Print Detection,
- Optical Sorting,
- Medical Image Processing, And
- Morphological Imaging.

In modern sciences and technologies, images also increase a lot broader scopes because of the ever growing importance of scientific apparition (of often large-scale complex logical/investigational data). Examples include microarray data in real-time multi-asset assortment trading in finance or genetic research.

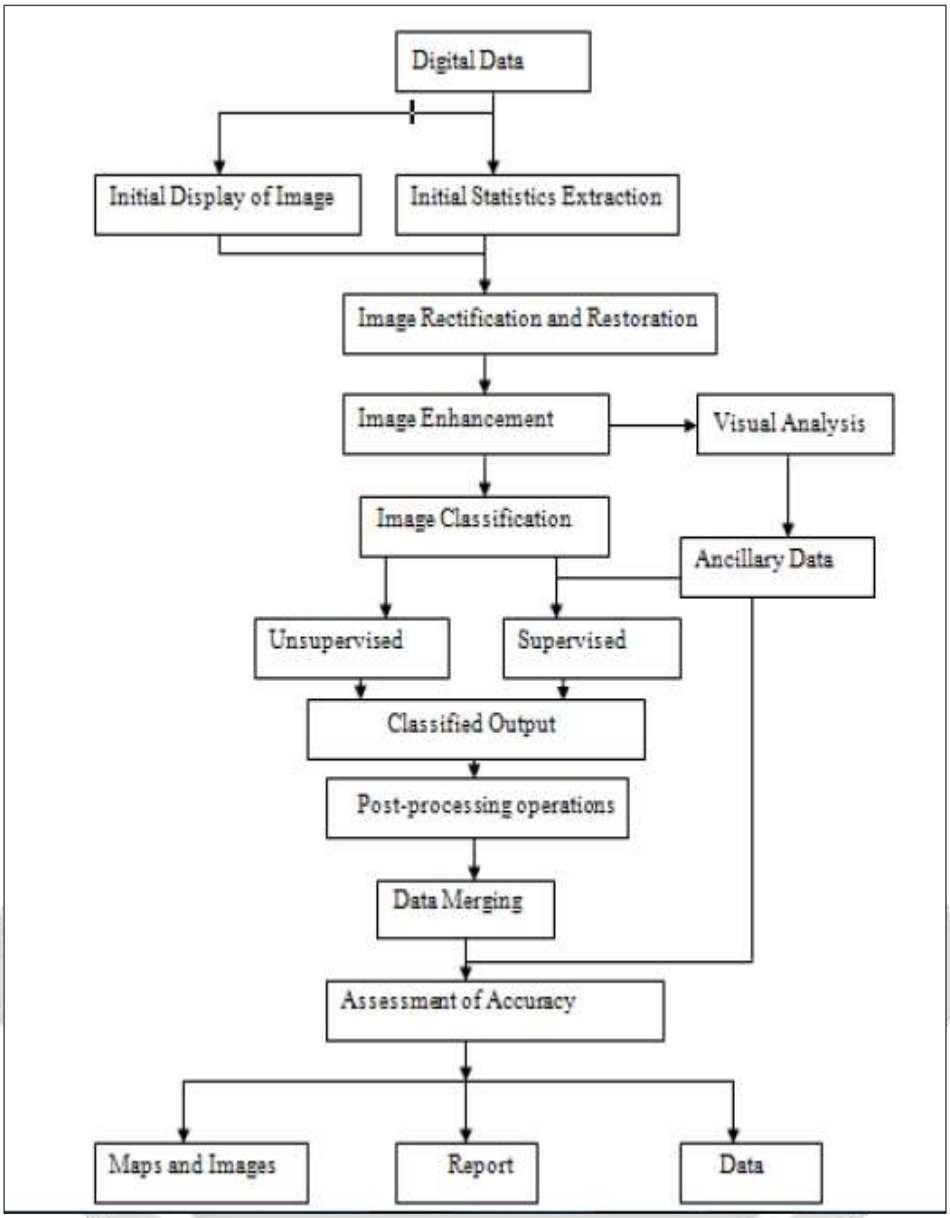

Fig-1. Flowchart of Image Processing Progression [1]

As per the figure we will show that in image processing take digital image then initiation and extraction. **Image Enhancement** Image enhancement encompasses the processes of changing images, whether they are traditional photochemical photographs, digital photographs or illustrations. Conventional analog image enhancing is known as photo retouching, using tools such as an airbrush to change photographs, or editing design with any medium of Traditional art [3]. **Image Restoration** Image restoration is the operation of taking a noisy/ corrupted image and estimates the clean creative image. Altered form may come in many forms such as motion blur, noise, and camera miss-focus Image restoration is different from image enhancement [3]. **Image Compression** The objective of image compression is to decrease insignificance and idleness of the image data in order to be able to store or transmit data in incompetent form. Image compression may be loss [3]. **Character Recognition** It is an ordinary technique of digitizing printed manuscripts such that they can be by electronic means edited, searched, store more closely used in machine processes such as machine translation and displayed online, text-to-speech, key data extraction and text mining. OCR is a meadow of research in intelligence, pattern and computer vision [3].**Biometrics** refers to the automatic identification of humans by their behaviors or characteristics. Biometrics is recycled in computer science as a type of identification and access control [3]. **Object Recognition** Object

detection is a computer technology related to computer vision and image processing that deals with noticing illustrations of semantic objects of a classes such as humans, buildings or cars in digital videos and images [3].

GOALS OF IMAGE PROCESSING The goals of image processing are divided into 5 groups.
1. Hallucination - monitor the objects that are not visible.
2. Image restoration and sharpening - For creating a better image.
3. Image repossession - search for the image of interest.
4. Measurement of pattern – Measures a range of objects in an image.
5. Image acknowledgment – differentiate the objects in an image.

2. Image Restoration

In this paper we discuss about the Image restoration. Image Reconstruction approaches
Repairing or the act of bringing back a system is the act of restoring an image to remove noise and blur is typically an under constrained problem, an alternative image restoration strategy that is capable of reconstructing visually pleasing textures. Information lost during a loss observation process needs to be restored with prior information about natural images to achieve visual realism [7]. Noise in image is the random variation in brightness; color. It includes following approaches:

a) Image denoising - It is the act of removing noise by only blurring neighboring pixels with similar intensities, resulting in edges remaining sharp. Recent developments in denoising image techniques use a continuous function which approximates the exact binomial distribution of events
b) Image deblurring - It is the act of minimizing gap or distance between pixels

Generally, the image restoration concerned with following issues:
a) Better visual quality
b) Lower computational complexity
c) Robustness against image processing

There are various factors which affect the quality of the image such as electrical interference during image acquisition, poor illumination etc. So the image restoration techniques are used to make the corrupted image as similar as that of the original image. Image enhancement is the process in which the degraded image is manipulated and the visual appearance of the image is improved. It increases the contrast of image and is subjective process. But image restoration is a more objective process than image enhancement.

In spatial domain methods, the technique operates directly on the pixels of an image. The spatial domain methods are used for removing additive noise only. The degradation/restoration process can be described as:

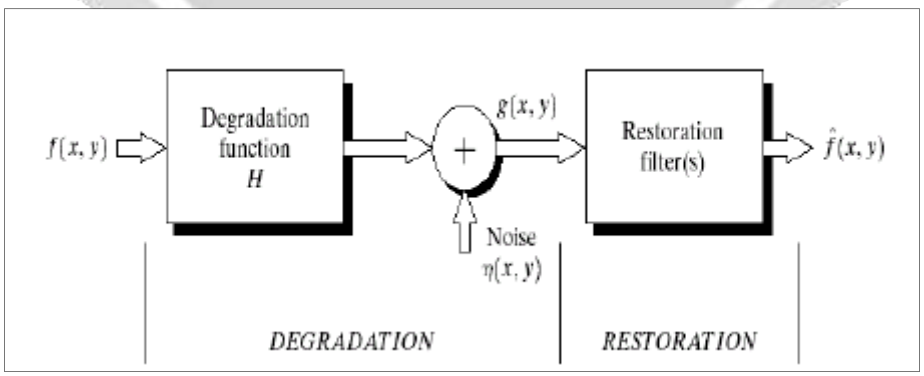

Fig- 2. Shows the degradation/restoration model

This Fig2 shows the original image f(x, y). The noise n(x, y) operates on input image and a degraded image g(x,y) is produced. The main aim of restoration process is to remove the degradation from the image and obtain the twin image f (x, y) of the original image. We want the output to be as same as possible to the original image. The Mathematical equation of Fig.2 is represented as follows, where h(x, y) is the function that causes distortion and n(x, y) is the noise. The symbol * represents convolution.

$$g(x, y) = h(x ,y) * f(x, y) + n(x, y)$$

In the spatial space, we are intrigued by the parameters that characterize the spatial qualities of noise, and whether the noise is related with the picture/image.

3. NOISE Model.

The noise arises in an image due to various factors such as, while transmitting the images from one place to another or while image acquisition process. The other factors are sensor temperature, atmospheric problem, low/high light levels. These factors cause addition of various kinds of noises in the image. The types of noises are discussed below:

A. Gaussian Noise: The Gaussian noise is also called normal noise and is occur most frequently. The Gaussian noise has random distributions of amplitudes over time. The probability density function of Gaussian noise [1] is given by :

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

Where z represents intensity and σ is the standard deviation.
Gaussian noise arises in an image due to factors such as poor illumination/or high temperature and by electronic circuit noise. Gaussian noise is modeled by random values added to the image. It is caused by random disturbances or fluctuations in the signal.

B. Rayleigh Noise: The Rayleigh noise is basically found in range imaging. Range imaging is a collection of techniques which produces 2D images. Sometimes, the Rayleigh noise gets generated in 2D images. The probability density function of Rayleigh noise[1] is given by:

$$p(z) = \frac{2}{b}(z-a)e^{\frac{(z-a)^2}{b}} \quad z \geq a$$

[1]

$$=0 \quad z<0$$

Where, $z = a + \sqrt{\pi b/4}$

The Rayleigh density can be useful in approximating skewed histograms. The Rayleigh noise can also be found in Magnetic Resonance Imaging (MRI) which consists of medical images of human body.

C. Erlang (gamma) Noise: This type of noise affects Laser imaging. The Laser images are used to get 3D images with the help of laser. The images are captured by sensors which are mounted on laser. The PDF for Gamma noise [1] is:

$$p(z) = \frac{a^b z^{b-1}}{(b-1)!}(z-a)e^{-az} \quad Z \geq 0$$

$$= \quad 0 \quad z < 0$$

Where, a > 0 and b is a positive integer. The mean and variance of gamma density is given by: z = b/a

D. Exponential Noise: The Exponential noise occurs most frequently in LASER imaging which is a process of capturing 3D images. Exponential noise sometimes affects these 3D images too. The PDF of Exponential noise [1] is:

$$p(z) = ae^{-az}$$

Where, a>0. The mean and variance of this PDF is given by z=1/a

E. Uniform Noise: The Uniform noise is caused by quantizing the pixels of a sensed image to a number of discrete levels. It is also called quantization noise. The PDF expression for Uniform noise [1] is given by :

$$p(z) = \frac{1}{b-a} \qquad a \leq z < b$$

$$= 0 \qquad \text{otherwise}$$

The mean and variance of uniform noise is given by z=a + b/2

Uniform noise is not encountered in real world imaging systems, but helps in providing a comparison with Gaussian noise.

F. Impulse Noise (Salt and Pepper Noise): The salt noise means scattering of white dots in the image and Pepper noise is scattering of black dots in the image. Impulse noise occurs when faulty switching takes place during imaging. The PDF of Impulse noise [1] is given by :

$$p(z) = p_a \qquad z = a$$

$$= p_b \qquad z = b$$

The intensity of b appears as a white dot in the image, if b>a. Alternatively, the intensity of an appears as a black dot or dark dot if a>b. If either Pa=0 or Pb=0, then impulse noise is known as Unipolar. If neither Pa nor Pb is zero, then the values of Impulse noise are as similar to salt and pepper values which are randomly distributed in the image

4. Types of blur

In digital image various types of blur effects exist:

1. Average Blur :

The Average blur is one of several tools you can use to remove noise and specks in an image. We can use this tool when noise is present over the entire image. Average blurring can be distributed in horizontal and vertical direction and can be finding by circular averaging of radius R which is evaluated as

$$R = \sqrt[2]{g^2 + f^2}$$

Where g is the horizontal size blurring direction and f is vertical blurring size direction and R is the radius size of the circular average blurring [4].

2. Gaussian Blur

The Gaussian Blur effect is a filter that blends a specific number of pixels incrementally, following a bell-shaped curve [6]. Blurring is dense in the center and feathers at the edge. Apply Gaussian Blur filter to an image when we want more control over the blur effect [5].

3. Motion Blur

It occurs when there is relative motion between the object and the camera during exposure. The many type of motion blur can be distinguished all of which are due to relative motion between the recording device and the scene. This can be in the form of translation, a rotation, a sudden change of scale, or some combinations of these. The Motion Blur effect is a filter that makes the image appear to be moving by adding blur in a specific direction. The motion can be controlled by angle or direction (0 to 360 degrees or –90 to +90) and/or by distance or intensity in pixels (0 to 999) based on the software used [4].

4. Atmospheric Blur

It occurs due to random variations in the reflective index of the medium between the object and the imaging system and it occurs in the imaging of astronomical objects.

5. Out of focus blur

When a camera images a 3-D scene onto a 2-D imaging plane, some parts of the scene are in focus while other parts are not. If the aperture of the camera is circular, the image of any point source is a small disk, known as the circle of confusion (COC). The degree of defocus (diameter of the COC) depends on the focal length and the aperture number of the lens, and the distance between camera and object. An accurate model not only describes the diameter of the COC, but also intensity distribution within the COC.

5. CONCLUSION

In this paper we described different types of noise which is available in image. We also give brief description of blurring technique. The main aim of paper is that to give idea about different noise and blur of image.it is very helpful to beginner of research work. We introduce basic about image processing and specially reconstruction of image. We introduce about different noise which are degraded the image. In most of the image motion blur and Gaussian noise are available. There are so many algorithm and filters to remove it.

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