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A Review On: Removal of Impulse Noise from Corrupted Image

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***Abstract*— An images corrupted by impulse noise are often occurred in practice. That appear in digital images because of channel decoder damages, signals dyeing down in communication links, transfer in a communication channel, video sensor's noises and other factor. Before the adventure of computers and software such as Photoshop, mostly photo restoration was done by restoration experts such as museum art restorers. These were applied directly to the damaged photo and consisted mainly of air brushing over the damage. The objective of this review is to study various filtering technique which is used in image restoring process to reduce the blur, noises and provide the clarity to an image.**

***Keywords*— Image Restoring, CLAHE Filter, Hybrid Filter, Gaussian noise and Impulse noise**.

I. INTRODUCTION

Image Processing has many applications so it has a wide area. Since the early days ago painting and filling has been done by professional artist in art and photography. Making copies of their performance and results with semi-automatic digital techniques is currently an active area of research in this era [6]. Image processing means to deals with various actions to change an image. Images are produced to record or display useful information or details [4]. Due to flaws in the imaging and capturing process, however, the recorded image always represents a degraded version of the as it is natural scene. The undoing of these imperfections is critical to many of the successive image processing tasks. Essentially, it tries to perform an operation on an image which is the invert of the imperfections in the image formation system [7]. Image captured with today's cameras typically contain some degree of noise and blur. In dim-light situations, a photograph ruined due to blur. If the exposure time is reduced to remove blur due to motion in the scene or camera shake, intensity and colour noise may be increased beyond acceptable levels. The act of restoring an image to remove noise and blur is typically an under constrained problem [6]. Digital image processing (DIP) is a part of signal processing where processing of digital images using various types of computer algorithm. Digital Image Processing has numerous of applications which is studies and uses by researches of science and technology department. Some of fields that use Digital Image Processing include finger print, medical fields, photography [4].

Figure1: Example of Image Processing

Any image acquired by a device is susceptible of being degraded by the environment of acquisition and transmission. The restoration of images tries to minimize the effects of these degradations by using specific type filter. A great variety of techniques dedicated to carry out this task exist. The goal of de noising is to remove the noise while retaining as much as possible the important signal features [2]. Each of them depends on the types of the noise in images. During image acquisition, the photoelectric sensor induces the White Gaussian noise due to the thermal motion of the electron.

II. IMAGE RESTORING

Image Restoration refers to a group of methods or techniques that aim to remove or reduce the degradations that have occurred while the digital image was being obtained. Image Restoration is used to reduce degradation effects in the image. Filter designing technique in Image restoration used and improve the appearance of an image. The sources of image degradation includes harsh ambient illumination conditions, low quality imaging devices, image compression down sampling, out-of-focus acquisition, device or transmission noise motion blur- half-toning, dithering, and the presence of security watermarks on documents. Image Restoration is used to reduce degradation effects in the image. The sources of image degradation includes harsh ambient illumination conditions , low quality imaging devices ,image compression down sampling, out-of-focus acquisition, device or transmission noise motion blur, dithering, and the presence of security watermarks on documents [7].

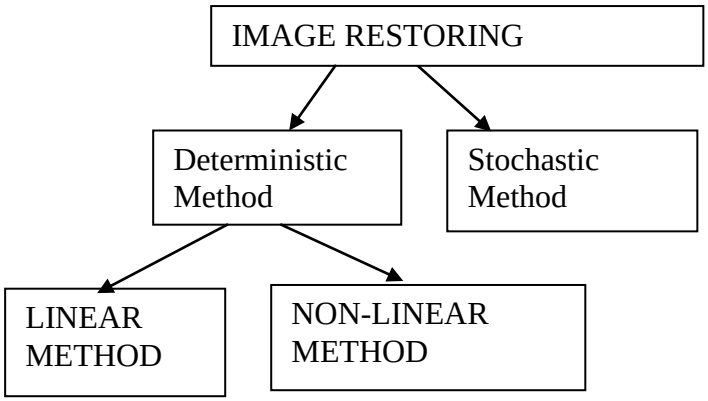

Figure 2: Image Restoring Method

III. DEGRADATION AND ITS CAUSES

Degradation and its causes are:-

- On the display mode degradation may occur.
- The degradation may occur when camera is in the acquisition mode, or
- During processing mode degradations may also takes place.
- Sensor noise causes degradation.
- Due to miss focus of the camera degradations may occur.
- Due to relative object-camera motion degradation arise.
- Random atmospheric turbulence create degradation.

Mostly existing image restoration methods we assume that the degradation process can be described by a mathematical model [9].

IV. IMAGE RESTORING FILTERING TECHNIQUE

1. Median Filtering- Median filtering is a very important and widely used techniques of filtering and best known for its excellent noise reduction ability from the images.

2. Adaptive Filtering- An adaptive filter that uses the grey and colour space for removal impulsive noise in images. All processing is based on the grey and colourful space. It provide the best noise suppression results and better preserve thin lines, edges , image details and yield. The image quality compared to other filters.

3. Linear Filtering- Linear filter we can easily remove the noise from the image with the help in filter function. This filter can be implemented on salt and pepper and Gaussian noise.

4. Weiner Filtering- Wiener filter incorporates both the degradation function and statistical characteristics of noise into the restoration process.

5. Histogram Equalization- This technique also used to restore the image. An image produces contract intensities that are not well distributed during histogram representation.

6. Contrast Limited-Adaptive Histogram Equalization (CLAHE)- CLAHE is work on small regions in the image that is called tiles rather than the entire image. Each tile's contrast is enhanced so histogram of the output region approximately matches the histogram specified by distributed parameter.

7. Decision Based Filter- Decision Based Filter addresses the limitations of median filter in which only median values are used for the replacement of the corrupted pixels. The new algorithm first detects the impulse noise in the image. In the image corrupted and uncorrupted pixels are detected by checking the pixel element value against the maximum and minimum values in the window selected areas.

V. APPLICATION OF IMAGE RESTORATION

- The first application of digital image restoration in the engineering community in the area of astronomical imaging. Observations of the Earth and the planets motion blur so slow camera shutter relative speeds to rapid spacecraft motion. Poisson noise, Gaussian noise etc. is often used in such type of space problem.
- In the area of medical imaging, image restoration has played a very pivotal role. Restoration has been used for mammograms, filtering of Poisson distributed X-rays and digital angiographic images, and Magnetic resonance Imaging MRI.
- Used to restore aging and deteriorated films. The motion picture restoration is often associated with digital techniques are used to eliminate scratches and dust from old movies and colorize black and white films.
- Video or image coding is expending area or application of digital image restoration it improve coding efficiency and bit rate of coded image.

VI. RELATED WORK

The various approaches and filtering technique used to restore an image are described below:

A. Image restoring scheme for degraded face image

Viola and Jones face detection algorithm which is to localize the spatial extent of the face and determine its boundary study by the P. Sureka, G. Sobiyaraj, R. Suganya . Both original and degraded images they applied geometric normalization in their next step. It holds two processes namely automatic eye detection and affine transformation that matches the images in the database and constructs the canonical faces. Low pass filtering is done using Wiener filter which reduces the noise in the image and the invariant wavelet transform reduces artefacts.

B. Design of Hybrid Filter for De noising Images

This process is provided by J. Najeer Ahamed in 2009, the proposed design of hybrid filter utilizes the concept of neuron fuzzy network and spatial domain filtering. This method incorporates improved adaptive wiener filter and adaptive median filter to reduce white Gaussian noise and impulse noise respectively. Selection of filters depends upon the performance of the impulse noise detection process. The edge detector is capable of extracting edges from filtered images which has been blurred due to different filtering actions. Natural and synthetic images optimization of neuron fuzzy network training with its internal parameters is collectively accomplished. And data accomplished by the edge detector and noise filter with the corrupted image together form the training data set. Offers excellent line, edge, detail, and texture preservation performance is the distinctive feature of the proposed operator over other operators while, effectively removing noise from the input image at the same time.

C. Image Restoration by Matching Gradient Distributions

To reconstruct a clean image from a degraded image, or maximizes a posterior probability or restoration of blurry or noisy image is commonly performed with a MAP estimator. With a sparse gradient image a MAP estimator prior used, reconstructs piecewise smooth images and typically removes textures that are important for visual realism. Author present an alternative de convolution method called iterative distribution reweighting (IDR) which imposes a global constraint on gradients so that are constructed image should have a gradient distribution similar to a reference distribution. Reference distribution not only varies from one point to another in natural images, but also depending on texture with in an image. A reference distribution directly from an input image estimated by the author.

D. Removal of High Density Impulse Noise Using Cloud Model Filter

The fact that makes image de noising a difficult task is uncertainties in the impulse noise. The most knowledge is removing uncertainty and erratic error, unfortunately it is like to impulse noise. The mathematic implements for handling uncertainty mostly are probability theory and fuzzy mathematics. The randomness and fuzziness are the two most important features among the uncertainties. Author use a detail-preserving filter based on the Cloud Model (CM) to remove several impulse noise. Cloud model integrate the concept of randomness and fuzziness. And it is a conversion model, between qualitative and quantitative description. In normal cloud generator algorithm normal random number overcomes the insufficiency of common generating random numbers. Random numbers which is produce can be predictable and replicated, and present a random sequence as a whole. Identifies the pixels corrupted by impulse noise by detector, normal cloud generator. Then, the identified noise pixels are replaced by a fuzzy mean estimation of the processed noise free pixels within the detection window. Cloud model filter makes a great improvement in image de noising when compared with traditional switching especially, at high density noise level.

E. A Novel Method of Image Restoration by using Different Types of Filtering Techniques.

Image restoration is an important issue in high level image processing which deals with recovering of an original and sharp image using a degradation and restoration model. Degradation occurs during image acquisition process. Image restoration is used to estimate the original image from the degraded data. Aim of this research paper is to provide a concise overview of most useful restoration models .Different types of image restoration techniques like wiener filter, inverse filter, regularized filter, Richardson –Lucy algorithm, neural network approach ,wavelet based approach ,blind de convolution are described and strength and weakness of each approach are identified.

F. Probabilistic Recovery Filling-in Technique for Image Restoration

Image Restoration means to restore a degraded/distorted image to its original content and quality. Many restoration methods are available and implemented for recovery of the corrupted images. Filling-in of missing information is a very important technique in image processing. Some blocks of image are lost when transmission of an image done then instead of using common retransmission query protocols should be use. Reconstruction of the lost data using correlation between the lost block and its neighbours has been used. Filling missing block with the information propagating from the surrounding pixels is the basic idea of the author. To find the corrupted and missing pixels and the probability of recovery on particular pixel is proposed by "Probabilistic Recovery Filling Technique''. If probability of recovery of pixel is < 60 % in corrupted pixel then matching of pixel will be done from surrounding. Otherwise recovery probability of corrupted pixel is >60%, then matching of the pixel will be done with the remaining part of pixel and for completely missing pixels find the missing block from the surrounding that is good option in this.

VII. SUMMARY OF FILTERING TECHNIQUE

Summary of Various Filtering Methods

In the following Table, contains all image restoration technique methods that are explained previously.

METHOD	BASED ON	FEATURES
Wiener Filter and Viola and Jones face detection algorithm	Face Detection	Automatic eye detection and affine transformation processes hold by this method that matches the images in the database and constructs the canonical faces. Low pass filtering is done using Wiener filter which reduces the noise in the image and the invariant wavelet transform reduces artefacts.
Hybrid filter used	Improved wiener filter	It improved adaptive wiener filter and adaptive median filter and reduce white Gaussian noise and impulse noise respectively.
Using cloud model filter	Remove impulse noise from an image	Integrate the concept of randomness and fuzziness. Normal cloud generator algorithm overcomes the insufficiency of generation of random numbers. Random numbers produces which can be predictable and replicated.
Using matching gradient distribution	Based on MAP estimator	Iterative distribution reweighting (IDR) imposes a global constraint on gradients so that image reconstructed and have a gradient distribution which is similar to a reference distribution.
Wiener filter, inverse filter, regularized filter, Richardson – Lucy algorithm, neural network approach wavelet based approach	Provide a concise overview of most useful restoration models	various blurring and de blurring techniques studied
Probabilistic filling technique	Finding missing block from an image.	Probability of recovery of pixel is < 60 % then matching of the pixel from surrounding will be done. If recovery probability of corrupted pixel is >60%, then matching of the pixel will be done with the remaining part of that particular pixel.

VIII. CONCLUSION

Any image acquired by a device is susceptible of being degraded by the environment of acquisition and transmission. The restoration of images tries to minimize the effects of these degradations by means of a filter. By filtering we mean the processing of the image in order to remove or reduce a particular unwanted component for example-noise, or to increase or fetch a particular set of features, such as edges. Improved adaptive wiener filter used to reduce white Gaussian noise. To reduce impulse noise adaptive median filter is used. The ideal low-pass filter suppresses noise and high-frequency information providing a smoothing effect to the image and High-pass filtering is used for image sharpening and extraction of high-frequency information such as edges.

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