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SURVEY ON IMAGE RESTORATION TECHNIQUES

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Abstract: Image processing is one the hot research topic for the researchers. The image obtained from the different sensors or satellites are degraded and are not suitable for human perception or further process. The images are degraded by many parameters like noises in the environment or blurring of the image during image acquisition or during processing of the image. In order to improve the quality of the image so that the required objects can be easily accessible from the sensed images, the image restoration technique is used in the image processing. It improves the objectivity of the image and removes the noise and blurry content in the image. In this paper adaptive filter, median filter and lucy-richardson filter is used for image restoration process. Input image is converted to greyscale image and then noise is inserted in it. Further brightness and contrast is applied before performing image restoration using three filtering techniques.
Keywords: Image Processing, Restoration, Adaptive Filter, Median Filter, Lucy-Richardson Filter, Grayscale Image.

I. INTRODUCTION

Image restoration is the process of recovering an image that has been degraded by using a priori knowledge of the degradation phenomenon. Restoration techniques involve modeling of the degradation function and applying the inverse process to recover the original image. This process is processed in two domains: spatial domain and frequency domain.Due to imperfections in the image formation process and the imaging device, the observed image often represents the degraded version of the original image. The corrections of these imperfections are mandatory in many of the subsequent image processing and vision tasks. Different types of degradations exist in the nature which includes noise, blur, geometrical degradations, illuminations etc. In this thesis, an effort has been made on removing the blur and noise from degraded images. Due to enormous applications of image restoration, researchers have gained interest to work in this area. The research on image restoration started in 1950s with astronomical imaging when scientists of United States of America and Soviet Union were involved in producing images of the Earth and the solar system. The images were degraded versions of the original images due to substandard imaging environment, spinning and the tumbling of the space craft. To retrieve the meaningful information from the degraded images, image restoration techniques were used. It is not a surprise to see that digital image restoration is used in astronomical imaging even today. Ground based imaging systems were also subject to blurring due to change in refractive index of the atmosphere [9]. Image restoration also plays an important role in medical imaging. It has been used to remove film-grain noise in X-ray images, angiography images and additive noise in magnetic resonance images [10–14]. It has applications to quantitative auto radiography (QAR) in which image is obtained by exposing X-ray film to a radioactive specimen. Though image restoration has been successfully applied, but still has a scope for improvement in quality and resolution. Image restoration has also received attention in media where old movies and picture are corrected in order to obtain a good quality picture which includes removal of scratches from the deteriorated films. Another important application of image restoration is in the field of image and video coding. The techniques used to increase the coding efficiency and to reduce the bit rates of the coded images create blocking artifacts. Image restoration has been successfully used as a post processing step after decompression to eliminate the blocking artifact resulted due to coarse quantisation of transformed coefficients [15–19]. In addition, digital image restoration is used in many other applications. Printing applications use restoration techniques to ensure high-quality halftone reproductions of continuous image [20]. Defense applications may also require restoration such as a guided missile which takes distorted images due to the pressure difference around a camera mounted on the missile. Looking at its wide-spread application areas in almost every field, it finds an important place in this technological world. Thus, even though several suggestions have been made, the field of image restoration still remains an active field of research.

II. LITERATURE SURVEY

Jagdish H. Pujaret.Al. (2010) the technique of image processing has made its way into every aspect of today'stech-savvy society. Its applications encompass a wide ariety of specialized disciplines including medicalimaging, machine vision, remote sensing and astronomy. Personal images captured by various digitalcameras can easily be manipulated by a variety of dedicated image processing algorithms .Imagerestoration can be described as an important part of image processing technique. Image restoration hasproved to be an active field of research in the present days. The basic objective is to enhance the quality ofan image by removing defects and make it look pleasing. The drawback is that it cannot be applied to restore the elements which are at the oundaries. For this, we need to carry out certain edge detection techniques like SobelEdge Detection Technique and Canny Edge Detection Technique.
SiddarthSaxena et al (2011) Image restoration is the process of restoring or deblurring an image which has been undergone certain degradations. The main objective of the proposed method is to develop an image restoation system that works on the concept of feature matching. The proposed method is based on two steps. Firstly it segments both the input and blurred image and cluster those segments based on PSNR values. Secondly it retrieves segments having low PSNR values. The proposed method combines the segmentaion and fuzzy clustering with

deconvolutionmethod. This will increase the accuracy and efficiency of restoration system. This proposed method is better than other existing method for image restoration.

P. Sureka et al (2011) Image restoration is a technique which restore the degraded face images such as faxed images, scanned passport photos and printed images by removing noise in the image. The proposed restoration methodology consists of iterative method to restore the noisy images and that is compared with the high resolution counterparts. One of the possible improvements could be made is the use of super-resolution algorithm which helps to know about the prior on the spatial distribution of the image gradient.

A. M. Raid et al (2013) Image processing including noise suppression, feature extraction, edge detection, image segmentation, shape recognition, texture analysis, image restoration and reconstruction, image compression etc. uses mathematical morphology which is a method of nonlinear filters. Image processing techniques which deal with the shape (or morphology) of features in an image is described by Morphological image processing. 4 morphological operations (dilation, erosion, opening and closing) and 2 basic algorithms (boundary extraction and region filling) are implemented in matlab program.

Li-huiZou et al (2013) Motion blur is a common degradation which usually brings difficulties to subsequent image process and analysis of a machine vision system. An effective restoration scheme is proposed for high-overlapped image sequence with composite motion blurs which refer to the blurs caused during the exposure time by dual relative motions among the background of the scene, the moving objects and the scanning camera, resulting in additional local blurs in the global motion. Composite motion blur often occurs in many machine-vision-based application systems if existing multiple relative motions among the content of the scene, the background and the camera. In this paper, an efficient image restoration method for high-overlapped image sequence with composite motion blurs is proposed. It can greatly enhance the image quality by utilizing the high-overlapping ratios between neighboring frames properly and cooperating with space-variant PSF estimations.

Anil Gupta et al (2013) the major task in photography is motion blur. Taking clear photos under dim light using a hand-held camera is quite challenging. If the camera is set to a long exposure time, the image gets blurred due to camera shake. The Proposed Radon MAP algorithm is used for removing noise from photographs. This approach showed that (I) it is possible to estimate blur kernel projections by analyzing blurred edge profiles and that (ii) it can reconstruct a blur kernel from these projections using the inverse Radon transform. This method is conceptually simple and computationally attractive, but is applicable only to images with many edges in different orientations. The limitations of this proposed approach is that it works best for specific type of images rather than all types of images.

AnamikaMaurya et al (2014) 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. During image acquisition process degradation occurs. Image restoration is used to estimate the original image from the degraded data. Each technique has its own advantages and disadvantages. Research work is taking place on image fusion techniques using two algorithms, but there is scope for the improvement, If we can use more than two algorithms and more samples can be used results could have been better. The work will be carried out on MATLAB image processing tool box.

Wenyi Zhao et al (2014) have work on the task of deblurring, a form of image restoration, is to recover an image from its blurred version. The two techniques to improve the noise handling characteristics of a recently proposed variational framework for semi-blind image deblurring that is based on joint segmentation and deblurring. One technique uses a structure tensor as a robust edge-indicating function. The other uses non-local image averaging to suppress noise. We report promising results with these techniques for the case of a known blur kernel. The key idea is to achieve reliable segmentationunder significant noise and consequently better image restoration.

Er. Jyoti Rani et el (2014) The image restoration, different types of noises are introduced and different methods which are used to remove noise are described. In Medical images, noise particles are a particularly delicate and very difficult task. A tradeoff between noise reduction and the preservation of actual image features (without noise) has to be made in a way that enhances the diagnostically relevant image content. The paper, image restoration techniques has been implemented by using Various Parameters like Contour plots, Histogram equalization, MSE, PSNR, max difference, avg difference, normalized cross correlation, normalized absolute error, structure content as performance is measured.

Stefan Schulte et al. (2007) proposed a new algorithm for reducing any kind of impulse noise restoration technique called fuzzy impulse noise detection and reduction method. Using fuzzy gradient values for the noisy image, fuzzy set is formed. Based on the fuzzy set, the filtering process is carried out. In filtering process, the membership value from fuzzy set is used to implement the fuzzy averaging filter. The proposed method does not outperform the median based filter for random impulse noise but the detection method is used to provide the idea about the identification of impulse noise.. The proposed method works for locally instead of globally to better elimination of random impulse noise in the image. The fuzzy detection and reduction method is not better for color image restoration.

Kenny KalVin Toh et al. (2009) proposed a new noise adaptive fuzzy switching median filter for salt and pepper noise detection and removal. The fuzzy histogram is used to identify the pixel is corrupted by impulse noise or not. The noise free pixels are not disturbed or unchanged while implementing noise restoration process. The noise adaptive fuzzy switching median filter employs fuzzy reasoning mechanism to handle the uncertainty problems extracted as the local information introduced by the noise in the filtering process.

Mohsin Bilal et al. (2013) proposed evolutionary-based image restoration for space variant degradation problems. Pseudo convolution is an effective approach for restoring

space variant degradation problems. The restoration is formed as the minimization of constraint least square error. The proposed method implements genetic algorithm and particle swarm optimization as two evolutionary algorithms to obtain optimum solution for restoration with adaptive regularization. Increasing the image size introduces a new problem by expanding the search space exponentially. Thus, a hybrid meta-heuristic solution is further proposed for enhanced diversity for global convergence. For space invariant degradations, restoration improvements and computational complexities are dependent on the size of the image. In future, different sizes of image are to be analyzed.

TolgaTasdizen (2009) proposed principal neighbourhood dictionaries for non-local image denoising. The non-local image denoising algorithm uses Principal Component Analysis (PCA) to achieve high accuracy while reducing computational loads. Image neighbourhood vectors are projected onto the lower dimensional sub-space using Principal Component Analysis. The sub-space selection is done using Parallel Analysis (PA). The non-local image denoising scheme is implemented in the projected sub-space and also reduces the computational load by parallel computing of the sub-space. The limitation of the proposed method is the color image restoration not achieved with the single step. There is a separate restoration for the three channels.

Lei Zhang et al. (2010) proposed Principal Component Analysis and local pixel grouping mechanism for denoising Gaussian noise in the image. The edge preserving and structure preserving capabilities are obtained by modelling image pixels and their neighbours as vector variables whose training samples are selected using local pixel grouping concept. The image local features are preserved after coefficient shrinkage in the Principal Component Analysis domain to remove noise. The training sample selection procedure is necessary for optimally selecting the sample blocks.

Yue Wu et al. (2013) proposed a probabilistic non-local image denoising algorithm for restoring noise in the image. The main objective of the proposed algorithm is overcoming the defects of weight function used in classical non-local means algorithm. The proposed algorithm provides theoretical statistics of patch-wise difference for Gaussian noise to efficiently identify the noisy pixel in the patches. Along with that the probabilistic non- local means algorithm uses prior information to formulate probabilistic weight difference reflecting true similarities between the two noisy pixels.

Stefan Schulte et al. (2007) proposed a new fuzzy filter for the reduction of additive noise present in the image. There are two steps in the proposed filter. The first sub filter computes fuzzy distances between the color components of the central pixel and its neighbourhood. These distances determine in what degree each component should be corrected. The goal of the second sub filter is to correct the pixels where the color components differences are corrupted. The main advantage of the proposed filter is that it is simple for the denoising capability and the reconstruction capability of the destroyed color component differences. The proposed work has the limitation of applying other fuzzy filters and for other types of noises like speckle noise and stripping noise.

Samuel Morillas et al. (2009) proposed a fuzzy peer group-based method for mixed Gaussian and impulse noise removal. The fuzzy peer group is formed based on the novel fuzzy logic procedure. The peer group window concept for identifying noise in the image sub window is combined with the fuzzy concept to predict the uncertainty in the image pixel to compute whether the pixel is corrupted by noise or not. The fuzzy rule-based switching impulse noise filter is used to restore the noise in the fuzzy peer group window. In peer group formation, the customized fuzzy membership is introduced to proper identification of noisy pixel in the peer group window. The impulse and Gaussian noise are restored using fuzzy peer group averaging and vector median filter respectively.

Om Prakash Verma et al. (2009) proposed two new fuzzy filters for removing both impulse and Gaussian noises. The first sub filter detects the noisy pixel along with the amount of noise in it by utilizing three fuzzy membership functions. The corrupted pixels are then corrected using the median of the noise-free pixels. The second sub filter makes use of the relation between different color components of a pixel to remove the residual noise in the color image. For the removal of the Gaussian noise, an adaptive distance between color component pairs of the central pixel and the neighbourhood pixel is used to determine the weight of the latter. The weighted average of the weights of all the neighbourhood pixels helps to compute the correction term for the Gaussian filter. A cascade combination of the two fuzzy filters in which the output of the impulse filter is fed to the input of the Gaussian filter is shown to effectively eliminate the mixture of Gaussian and Impulse noises from color images.

Anisha&Wilscy (2011) proposed Impulse Noise Removal from Medical Images Using Fuzzy Genetic Algorithm (FGA). The proposed technique uses Fuzzy Genetic Algorithm to find the optimal composite filters for removing all types of impulse noise from medical images. A fuzzy rule base is used to adaptively change the crossover probability of the Genetic Algorithm used to determine the optimal composite filters for removing different levels of impulse noise from medical images without using deep knowledge about noise factors. The proposed technique is used for reducing noise in the satellite images.

III. PROBLEM FORMULATION

3.1 Objectives

- To carry out extensive literature survey related to the Image restoration.
- To exhaustively compare and evaluate the performance of the existing techniques related to image restoration.
- To evaluate the performance of these technique by using MATLAB.

3.2 Methodology

The methodology that will be adopted to carry out this research work is as follows:

- To develop a clear understanding of the relevant

topics through an exhaustive literature survey.
- Critical evaluation of the already published research work.
- Proposing and investigating ideas and solutions for improved performance.
- To carry out the performance analysis of the investigated system using simulation tool.
- Develop a comparative study and propose an improved solution

3.2.1 Adaptive Filtering

Adaptive filter is a computational device that attempts to model the relationship between two signals in real time in an iterative manner. Adaptive filters are often realized either as a set of program instructions running on an arithmetical processing device such as a microprocessor or DSP chip, or as a set of logic operations implemented in a field-programmable gate array (FPGA) or in a semicustom or custom VLSI integrated circuit. An adaptive filter is one which can automatically design itself and can detect system variation in time.

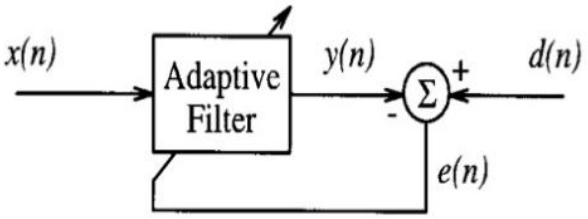

Figure 3.1 Adaptive Filtering

Here, x(n) is input digital signal
y(n) is output digital signal
d(n) is desired response
e(n) is error signal

3.2.2 Median Filtering

Median filtering is a nonlinear method used to remove noise from images. It is widely used as it is very effective at removing noise while preserving edges. It is particularly effective at removing 'salt and pepper' type noise. The median filter works by moving through the image pixel by pixel, replacing each value with the median value of neighboring pixels. The pattern of neighbors is called the "window", which slides, pixel by pixel over the entire image 2 pixels, over the entire image. The median is calculated by first sorting all the pixel values from the window into numerical order, and then replacing the pixel being considered with the middle (median) pixel value.

3.2.3 Lucy-Richardson Filtering

Another type of non-blind image restoration technique adopted in this study based on Lucy-Richardson method which possesses iterative procedure. This algorithm maximizes probability of restored image when convolved with PSF. If h_i is the observed value at pixel position 'i' then, it can be given as:

$$h_i = \sum \quad d_{ir} a_r$$

where, d_{ir} is the PSF, the segment of light coming from true position 'r' that is observed at position 'i', a_r is the blurred image pixel value at position 'i'. Mathematical representation of the iterative process to calculate a_r is given as:

$$a_r^{(t+1)} = a_r^{(t)} \sum \quad \frac{h_i}{b_i} d_{ir}$$

where, $d_{ir}$is PSF and $b_i = \sum \quad r d_{ir} a_r$

IV. CONCLUSION AND FUTURE SCOPE

Image restoration deems to reconstruct or recover a degraded image. The information loss due to image acquisition and transmission is restored under some constraints which are suitable for natural images and medical images. The lost information is recovered or restored with the prior information about natural images and medical images that leads to achieve more visual realism.This study presents adaptive filtering, median filtering and lucy-richardson filtering for image restoration to enhance the quality of an image. In this study input image is first converted to the grayscale image and then noise is inserted in it. Further, brightness and contrast is added to the noisy image and the restoration of image is done using adaptive filtering, median filtering and lucy-richardson filtering. MATLAB tool is used to perform filtering and simulation results show results using three different type of filtering. In future, soft computing along with artificial intelligence techniques may be used to further enhance the quality of an image.

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