International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2017 IJSRCSEIT | Volume 2 | Issue 2 | ISSN : 2456-3307

Image Restoration Approaches for Image Quality Improvement

Deep Kumar
Software Engineer, Igniva Solutions Private Limited, Mohali, Punjab, India

ABSTRACT

Image restoration is the process of image quality enhancement so that noise and blurriness from the image can be removed. In the process of image restoration image has been subdivided into several parts so that image parts can be used for enhancement process using various image enhancement approaches and filters. After implementation of filters all the parts have been recombined so that image quality can be enhanced. In this paper various approaches that has been used for image restoration process has been reviewed. On the basis of these approaches quality of the image has been improved and used for further applications.

Keywords : FFT, Inverse Filter, RGB, YCBCR, and CMYK

I. INTRODUCTION

1.1 Digital Image Processing

An image may be defined as a two-dimensional function, f(x, y), where x and y are spatial (plane) coordinates, and the amplitude of at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point. When x, y, and the amplitude values off a real finite, discrete quantities, we call the image a digital image. The field of digital image processing refers to processing digital images by means of a digital computer. Pixel is the term most widely used to denote the elements of a digital image. Vision is the most advanced of our senses, so it is not surprising that images play the single most important role in human perception. The term gray level is used often to refer to the intensity of monochrome images. Color images are formed by a combination of individual images.

1.2 Fundamental Steps in Digital Image Processing: Digital image processing comprises various steps for performing different operations on digital images. The fundamental steps required for digital image processing are explained below.

1.2.1 Image acquisition

It is the first step of the digital image processing. In this phase of image processing the image is acquired for the pre-processing of the image. The pre-processing involves the conversion of color image to gray, scaling of the image and resize the image according to the dimensions that has to be used. The image acquisition is done by applying these methods to the image. The further processing can be done on the image after the completion of this step in digital image processing.

1.2.2 Image enhancement: Image enhancement is a particular area of digital image processing which deals with noisy or degraded images. Image enhancement basically deals to highlight certain important features of digital image. Different types of filters, operators and approaches had been used for enhancement of degrade images.

1.2.3 Color image processing: Color image processing is the branch of digital image processing with deals with the color pixels of digital image. Color pixel is the combination of three basic colors Red, Green and Blue. In digital image processing different model of the color images are available to transforms one color image into other model. These models are RGB, CMY, YCbCr.

1.2.4 Wavelets: Wavelets are that which mainly deals for representation of differentimages in different degrees of resolutions. Wavelet decomposes the image into different sub bands so that images can be different coefficients and values of the images can be visualize. Different types of wavelets that have been used for wavelet decomposition are Discrete Wavelet Transform (DWT), Discrete Cosine Transform (DCT) and Fast Fourier Transform (FFT).

1.2.5 Compression: Image Compression is the sub-topic of digital image processing which deals with reducing the size of the image that required storing the image on a storage media. This also reduces the bandwidth required for transmission of image over the internet. Image compression mainly used to reduces storage capacity. Image compression is of basically of two types, lossy image compression and lossless image compression.

1.2.6 Morphological processing: Morphological processing deals with different morphological operators used in digital image processing to perform various types of processing on image. Dilation, erosion, linearization and subtraction of background are different morphological operations used in digital image processing. Morphological operators are used to normalizing different images used in image processing.

1.2.7 Segmentation: Image segmentation is the process which deals to divide the image into continues parts. Image segmentation is used to compute the hidden features available in the digital image that can't be seen by visualizing the images. Segmentation is mainly used in the different recognition images and different medical images to extract hidden attributes of the image. A rugged segmentation procedure brings the process a long way toward successful solution of Imaging problems that require objects to be identified individually. In general, the more accurate the segmentation, the more likely recognition is to succeed.

1.2.8 Image restoration: Image restoration is a process that deals with improvement in the visualization of the digital image. This process utilizes various mathematical or probabilistic models to enhance the degraded images. Image restoration also deals with removal of noise from different regions of the image by applying filters and convolution theorems.

Image Restoration: Image restoration is not the only inverse problem that can be formulated as the minimization of a certain functional, or equivalently, as variation principles. Variation principles recently attracted the attention of many researchers in the area of image processing and low level computer vision some of the problems formulated using variation principles were edge detection determination of optical flow, and the shape from shading problem. The use of variation principles in visual surface interpolation, originally proposed by Grison in and is of particular interest here. In, the visual surface interpolation problem was formulated as the constrained minimization of a certain quadratic functional. A computational treatment of the resulting optimization problem was reported by Crimson.

The role of quadratic functional based on rotationally symmetric differential operators was studied by Brady and Horn in. Terzopoulospresented the study of several analytical and computational aspects regarding the application of variation principles in visual surface interpolation.

II. REVIEW OF LITERATURE

Nicolaos B. Karayianniset al [1]"Regularization Theory in Image Restoration-The Stabilizing Functional Approach", this paper presents several aspects of the application of regularization theory in image restoration. This is accomplished by extending the applicability of the stabilizing functional approach to 2-D ill-posed inverse problems. Image restoration is formulated as the constrained minimization of a stabilizing functional. The choice of a par- ticular quadratic functional to be minimized is related to the a priori knowledge regarding the original object through a formulation of image restoration as a maximum a posteriori estimation problem. This formulation is based on image representation by certainstochastic partial

differential equation image models. The analytical study and computational treatment of the resulting optimization problem are subsequently presented. As a result, a variety of regularizing filters and iterative regularizing algorithms are proposed. A relationship between the regularized solutions proposed and optimal Wiener estimation is also identified. The filters and algorithms proposed are evaluated through several experimental results.

Gajanand Gupta et al [2] "Algorithm for Image Processing Using Improved Median Filter and Comparison of Mean, Median and Improved Median Filter", animproved median filter algorithm is implemented for the de-noising of highly corrupted images and edge preservation. Mean, Median and improved mean filteris used for the noise detection.Fundamental of image processing, image degradation and restoration processes are illustrated. The picturesare corrupted with different noise density and reconstructed. The noise is Gaussian and impulse (salt-and pepper) noise. An algorithm is designed to calculate the PSNR and MSE. The result is discussed for Mean, Median and improved Median filter with different noise density.

AnamikaMaurya, RajinderTiwari et al [3]"A Novel MethodofImage Restoration by using different Types of Filtering Techniques" Imagerestoration is an important issue in high level image processingwhich 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. Aim of this research paperis to provide a concise overview of most useful restoration models .Different types of image restoration techniques like wienerfilter, inverse filter, regularized filter, Richardson –Lucy algorithm, neural network approach ,wavelet based approach,blind deconvolution are described and strength and weakness of each approach are identified.

Herng-HuaChanget al [4] "Brain MR Image Restoration Using an Automatic Trilateral Filter With GPU-Based Acceleration", Noise reduction in brain magnetic resonance (MR) images has been a challenging and demanding task. This study develops a new trilateral filter that aims to achieve robust and efficient image restoration. Methods: Extended from the bilateral filter, the proposed algorithm contains one additional intensity similarity funct-ion, which compensates for the unique characteristics of noise in brain MR images. An entropy function adaptive to intensity variations is introduced to regulate the contributions of the weighting components. To hasten the computation, parallel computing based on the graphics processing unit (GPU) strategy is explored with emphasis on memory allocations and thread distributions. To automate the filtration, image texture feature analysis associated with machine learning is investigated. Among the 98 candidate features, the sequential forward floating selection scheme is employed to acquire the optimal texture features for regularization. Subsequently, a two-stage classifier that consists of support vector machines and artificial neural networks is established to predict the filter parameters for automation. Results: A speedup gain of 757 was reached to process an entire MR image volume of 256 × 256 × 256 pixels, which completed within 0.5 s. Automatic restoration results revealed high accuracy with an ensemble average relative error of 0.53 ± 0.85% in terms of the peak signal-to-noise ratio.

Jos Bratti;Joel Gayaet al [5] "Understading Image Restoration Convolutional Neural Networks with Network Inversion" Convolutional Neural Networks (CNNs) have achieved state-of-the-art performance in many image restoration applications. The knowledge of how these models work, however, is still limited. While there have been many attempts at better understanding the inner working of CNNs, they have mostly been applied to classification networks. Because of this, most existing CNN visualization techniques may be inadequate to the study of image restoration architectures. In the paper, we present network inversion, a new method developed specifically to help in the understanding of image restoration Convolutional Neural Networks. We apply our method to underwater image

restoration and dehazing CNNs, showing how it can help in the understanding and improvement of these models.

III. APPROACHES USED

Inverse Filter: Image restoration using generalized inverse filterIf we know or can create a good model of the blurring function that corrupted an image, the quickest and easiest way to restore that is by inverse filtering. Unfortunately, since the inverse filter is a form of high pass filer, inverse filtering responds very badly to any noise that is present in the image because noise tends to be high frequency. In this section,author explore a method of inverse filtering called a thresholding method

Wiener Filter: Image restoration using generalized wiener filter the inverse filtering is a restoration technique for deconvolution. However, inverse filtering is very sensitive to additive noise as explained in the previous section Because Wiener can removes the additive noise and inverts the blurring simultaneously, it is usually used instead of inverse filter in these cases. The Wiener filtering is optimal in terms of the mean square error. In other words, it minimizes the overall mean square error in the process of inverse filtering and noise smoothing. The approach is based on a stochastic framework.

Noise Detector: The Adaptive Noise Detector is used to detect the type of noise such as Gaussian noise, salt and paper and so on, if exists in the current image. Similar to [5] it calculates the Distance vector D from image histogram array.Histogram of image describes the intensity value of pixels that occur in an image. Various boundary thresholds are set, according to the maxima values found in D. Depending on location of maxima values nature of the noise is detected, whether it is impulse, uniform, or Gaussian. Once the noise has been find out, the NT Indicator is set as an input to the second stage of the system. The corrupted pixels are then mapped to a binary matrix with the same dimensions as the image. An example shown in following fig. gives the difference between edges and salt and paper noise in image.

IV. CONCLUSION

Image restoration is the process that implies that image has been subdivided into different parts and all the parts have been preprocessed and together combined for getting enhanced image. In the process of image enhancement various approaches and filters have been implemented on the image so that quality of the image can be improved. In this paper various approaches that are inverse filter, Wiener filter and noise detection based approaches have been used. On the basis of these approaches image quality has been improved so that content of the images can be easily identified.

V. REFERENCES

[1]. Nicolaos B. Karayiannis "Regularization Theory in Image Restoration-The Stabilizing Functional Approach", IEEE Transactions On Acoustics. Speech, And Signal Processing. Vol 38. No 7. July 1990.

[2]. Gajanand Gupta "Algorithm for Image Processing Using Improved Median Filter and Comparison of Mean, Median and Improved Median Filter", International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-1, Issue-5, November 2011.

[3]. AnamikaMaurya, RajinderTiwari "A Novel Method of Image Restoration by using Different Types of Filtering Techniques", International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 3, Issue 4, July 2014..

[4]. Herng-Hua Chang "Brain MR Image Restoration Using an Automatic Trilateral Filter With GPU-Based Acceleration", IEEE Transactions on Biomedical Engineering, IEEE Transactions on Biomedical Engineering (Volume: 65, Issue: 2, Feb. 2018).

[5]. Jos Bratti;Joel Gaya "Understading Image Restoration Convolutional Neural Networks with Network Inversion" , Machine Learning and Applications (ICMLA), 2017.

[6]. XiaoyanXu, "Image Denoising in Wavelet Domain", School of Engineering, University of Guelph,E-mail: xux@uoguelph. Carl Taswell , " Experiments in

[7]. Wavelet Shrinkage Denoising"C. Taswell (ctaswell@toolsmiths.com), Computational Toolsmiths, POB 18925, Stanford, CA 94309-8925.

[8]. Yi Wan and Robert D. Nowak ," Wavelet-Based Statistical Model For Image Restoration " , Rice University ,Department of Electrical Engineering,

[9]. 6100 South Main Street, Houston, TX 77005, USA.

[10]. Javier Portilla and Eero P. Simoncelli ," Image Denoising Via Adjustment of Wavelete Coefficient Magnitude Correlation", Center for Neural Science, and Courant Institute of Mathematical Sciences New York University, NY 10003, E-mail: fjavier,eerog@cns.nyu.edu.

[11]. Jae S. Lim, " Image Restoration by Short Space Spectral Subtraction", IEEE Transactions on Acoustics, Speech, and Signal Processing, Vol. ASSP-28, No. 2, April, 1980.

[12]. A. Buades, B. Coll, And J. M. Morel, "A review of Image Denoising Algorithms with a New One", Multiscale Model. Simul. 2005 Society for Industrial and Applied Mathematics, Vol. 4, No. 2, pp. 490-530.