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A Study on Different Image Enhancement Approaches

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Abstract

One of the major aspect as well as requirement of image processing is image enhancement. Image enhancement is required when we have an improper image in terms of brightness, contrast, blur, noise etc. In such case we need to perform some filtration process to enhance the quality of image. The present work is focused on the image enhancement in case of noising. In this work we have mainly worked with Gaussian noise. In this present work, image denoising using adaptive median filter is defined. The work is based on the adaptive implementation of filter. It means at first the analysis will be performed to identify the major areas where the image is having the noise. Based on the analysis the median filter will be implemented in selected area.

Keywords: *Image Enhancement, Gaussian, Sharpening, De-noising.*

I INTRODUCTION

Image noise is the one of the critical factor that affects the image quality under the effects of brightness and color information. This distortion occurs because of the scan problem or the some sensor grain problem while performing the image scan or camera based photo capturing. The noise can be generated because of the film grain or because of some unavoidable shot taken using the photon detector. This kind of capturing process also having the distortion because of obscure object. This kind of image distortion also having the image pixel change in terms of unwanted fluctuations. The noise not only decreases the image clarity but also affect the recognition rate in image recognition application. The noise reduction is the effective concept that is been used as the major preprocessing activity that is used in most of the image processing applications. These applications use different denoising operations at the earlier stage to remove the image noise. Different kind of image distortions in an image in terms of noise is shown in figure 1. One of the most common noise type is the Gaussian noise. Generally the image noise is divided in two main categories called additive noise and multiplicative noise

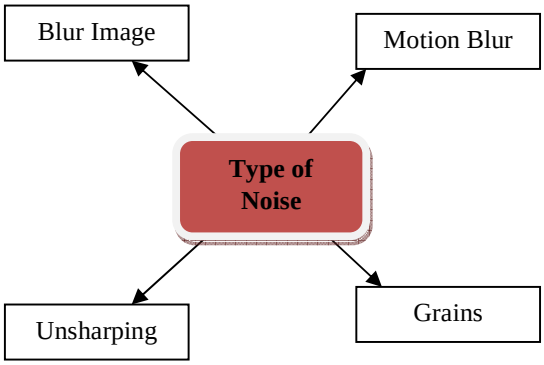

Figure 1 : Different Types of Noise

The image pixel intensity and density variation is the factor of the noise. The change in the image pixel values under the brightness vector is considered as the noise over the image. These variation includes the variation analysis so that the significant improvement to the image will be considered. The higher the variation in the image, lower the image quality will be. There are number of significant object images where the noise is detected very easily such as the medical images. In such environment, the smaller noise can change the meaning of image objects. Sometimes, the grain noise in such image can be detected as the tumor area. Because of this the noise reduction or the elimination in the images is required to achieve the better and accurate results. There are number of approaches that are used to enhance the image quality and to remove the noise over the image. Some of the important such approaches are discussed here under.

A) Image sharpening

Sharpening is the actually the image enhancement approach used to sharpen the image features and to adjust the image contrast. This approach is used in the images having the unequal brightness or the images captured in dim light or in dark light. The feature

extraction and the repairing in such images is done using image sharpening.
The convolution filter is used to repair the image in such problem. The kernel array for the image sharpening operation is given as under

$$\begin{bmatrix} -1/9 & -1/9 & -1/9 \\ -1/9 & 1 & -1/9 \\ -1/9 & -1/9 & -1/9 \end{bmatrix}$$

Figure 2 : Kernel of Image Sharpening

Sharpening is the transformation technique that actually work on the image features such as edges of the image. The image extraction and the processing on it actually improve the visual effect of the image. The sharp images is more eye caching.

B) Image Restoration

Image Retouching, Image Restoration, Image editing, is the bridge between the creative needs of the photography and practical needs of printing. Good image editing emphasizes the content of an image while maintaining its creativity. Profit By Outsourcing specializes in image editing, restoration, and retouching for various industries like: Travel, Hotel, Real Estate, Consumer Electronics. Image restoration is also called image impainting that actually removes the patches or the physical distortion over the image and improves the image quality. The detection of the missing area over the image and its removal also comes under the impainting methods. The distortion removal is also done under the image restoration.

In this paper, the comparative analysis of some image enhancement approaches is defined. In this section, the exploration to the image noising and the type of denoising approaches is defined. In section II, the work related to the image restoration is discussed. In section III, the comparative study of three main image enhancement approaches is defined. In section IV, the conclusion of the work is presented.

2. LITERATURE SURVEY

Lot of work is already done in the area of image processing and image restoration. Some of the work already done in this area is discussed here under.

Rakesh Kumar has defined a wavelet based neighbor pixel analysis approach for image denoising. Author has defined a adaptive pixel analysis approach using adaptive thresholding. In this work, a computational analysis approach has defined to perform the analysis and later on the Gaussian distribution is implemented to repair the image[1]. Another work on image denoising using the soft computing technique was defined by G. Vijaya. Author has defined the interactive algorithm to perform the denoising and image segmentation. The segmentation process was about to perform the processing on color images using the fuzzy approach. Author used the multiple approaches for image segmentation such as C Means clustering, Fuzzy Clustering and the convolution networks[2].
Ce Liu has defined the automatic detection of noise and its removal over the single image. The paper has presented a unified framework to perform the noise estimation over the image and to perform the noise reduction. Author has implemented piece wise segmented model to perform the image denoising. Author has defined a noise level identification function to identify the noise problem in the image and based on which the filtration over the noise is performed[3]. S. suryanarayna defined the impulse noise detection approach. Author defined convolutional filter to identify the pixel area under the defined matrix and based on the estimation. The weight assignment is done to the particular areas. Once the weights are assigned, the next work was to remove the noise based on the corruption level. A threshold based median filter is implemented on this image area to repair and filter the image[4]. Another work on image denoising was done by Rashmikant. Author has defined the fractional coding based sub band analysis approach for the detection of the approximation value. Author has presented the transformation invariant approach for the encoding of image so that the image is noise free[5].
S. Grace Chang has defined an adaptive wavelet thresholding based approach for the denoising and image compression. Author defined the soft thresholding improved wavelet approach for image repairing. Author used the Bayesian framework at the later stage to analyze the wavelet coefficient and based which the

Gaussian distribution is implemented to repair the image. Author has defined a simple and closed form for image repairing so that the sub band based image analysis will be performed and the adaptive repairing results will be obtained[6]. X.T. Wang has presented a directional analysis based wavelet approach for image restoration. Author used the direction lifting analysis as the estimation approach and later on wavelet based decomposition is implemented to repair the image. Author has defined the pixel pattern analysis approach for the image noise distribution analysis and later on each sub band was handled separately to perform the noise reduction. The work has used the adaptive filter to repair the image[7].

Florian Luisier has defined a orthonormal wavelet based thresholding to repair the image. Author has defined a statistical approach to repair the image. This statistical method is based on the wavelet coefficients and the parameterized method is implemented to reduce the pixel weights. Once the pixel weights are defined, the repairing of image is performed[8]. Taeg Sang Cho has used the gradient distribution based approach for image restoration. Author defined the iterative matching to perform the reweighting of the global constraint and based on this reweighting the reconstruction of image is performed[9]. Yogesh Bahendwar has defined the denoising on the MRI images. Author defined the medical image analysis approach for the DWT based transformation and the peak to signal ratio is to perform the noise reduction and repairing of image[10].

3. PROPOSED WORK

Image enhancement is a useful technique in image processing that permits the improvement of the visual appearance of the image or provides a transformed image that enables other image processing tasks (image segmentation, for example).Methods in image enhancement are generally classified into spatial methods and frequency domain ones. The present work is focused on the spatial methods, and in particular, to the use of morphological image transformations. The application of mathematical morphology to image processing and analysis has initiated a new approach for solving a number of problems in the related field. This approach is based on set theoretic concepts of shape. In morphology objects present in an image are treated as sets. The identification of objects and object features through their shape makes mathematical morphology become an obvious approach for various machine vision and recognition processes. Quite often a recorded image suffers from a common degradation like poor contrast. The range of intensity i.e. the difference between the highest and lowest intensity values in an image gives a measure of its contrast. The first work dealing with contrast theory was carried out by Meyer and Serra. There are standard techniques like histogram stretching, histogram equalization for improving the poor contrast of the degraded image. During the histogram equalization process, grey level intensities are reordered within the image to obtain a uniform distributed histogram. However, the main disadvantage of histogram equalization is that the global properties of the image cannot be properly applied in a local context, frequently producing a poor performance in detail preservation. The basic flow of the image enhancement algorithms is shown in figure 3

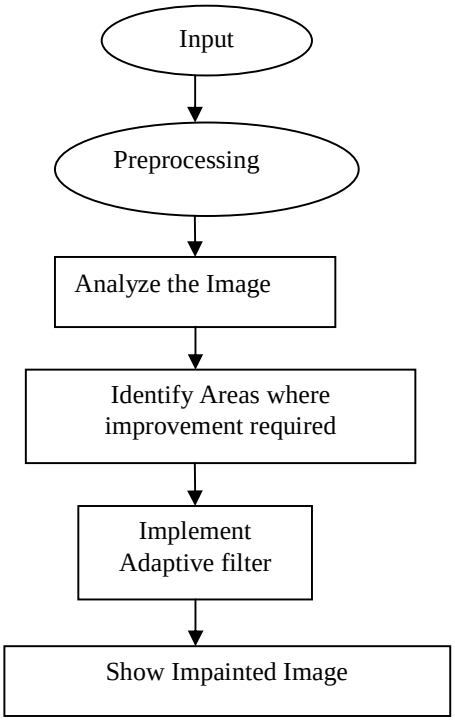

Figure 3 : Flow of Image Enhancement Approaches

In this section three main image denoising approaches are discussed

A) Median Filter

Median filter is a three dimensional generalization of median filter used for images, which was discussed in chapter 3. This filter utilizes spatial as well as temporal information available about the neighborhood of current pixel.

Let a current pixel be I (i, j , t)={ $Z_{i,j} = (z_{i,j}^{(1)}, z_{i,j}^{(2)}, z_{i,j}^{(3)})$}, where (i, j) and t indicate the spatial and temporal location in the image I, respectively. Consider a 3D sliding window 3×3×3 around I(i, j, t). This window consists of pixels I(i', j', t'), where |i-i'|≤1, |j-j'|≤1 and |t-t'|≤1 [16]. Such a sliding window is applied to compute the filtered value I'(i ,j, t) in the image. This 3-D sliding window W of size 3×3×3 has 27 pixels available for processing.

Then, for 3× 3×3 median filter, the filtering window is

$$W = [\, I_{i-1,j-1,}\, I_{i-1,j,}\, I_{i-1,j+1,}\, I_{i,j-1,}\, I_{i,j,}\, I_{i,j+1,}\, I_{i+1,j-1,}\, I_{i+1,j,}\, I_{i+1,j+1}] \quad (1)$$

Where **I** is the Image corrupted by noise and (i, j) are the spatial coordinates in t^{th} frame of digital Image **I**. The output of Image median filter is given by:

$$Z_{i,j} = (z_{i,j}^{(1)}, z_{i,j}^{(2)}, z_{i,j}^{(3)})$$

Where $z_{i,j}^{(k)} = \text{median}\,(W^{(k)})$ (2)

Median is computed individually for each IMAGE channel considering 27 values of 3-D sliding window for a single IMAGE channel.

The corresponding filtering windows of all three frames are combined for spatio-temporal filtering. This results in better quality of frames, as more noise-free pixels are available for use in filtering. Performance of this filter is better than median filter applied on single frame using spatial filtering.

B) Vector Median Filter

Vector median filter is three dimensional generalization of vector median filter. VMF of 27 pixels of 3-D sliding window W, as mentioned in section 5.1 is taken.

Let f be the intensity function for image I. filtering criteria for vector median filter is same as that of vector median filter [5] i.e.

$$L_i = \sum_{j=1}^{n} ||fi - fj||, \;\; i = 1\ to\ n \quad (3)$$

Here n=27.

The Vector $\mathbf{f}_i$ for which $L_i \leq L_j \;\forall$ i=1 to n, is the output of Vector median filter. The filtering window consists of pixels from previous and next frames present at the same spatial locations as the pixels in filtering window of current frame. With the advantage of three dimensional filtering VVMF have better performance as compared to VMF.
The three dimensional filtering helps the vector approaches much more in high noise environment because enough number of noise-free pixels can be obtained through neighboring frames.

B) Vector Directional Filter

Vector directional filter is three dimensional generalization of vector directional filter. VDF of 27 pixels of 3-D sliding window **W** is taken for computing the output of vector directional filter. Let **f** be the intensity function for image **I**.
Filtering criteria for vector directional filter is same as that of vector directional filter i.e.

$$d_j = \sum_{i=1}^{n} D(x, .xj) \quad (4)$$

The output is given by the pixel which minimizes α_i within the filtering window. It differs from VDF in method of obtaining the neighborhood as it belongs to the class of spatio-temporal filters. VVDF have better performance as compared to VDF. The three dimensional filtering helps Vector directional filter (VDF) focuses on minimizing the accumulated sum of angles subtended by all other pixels in filtering window. It is clear that this filter is only of use when preserving only chromaticity of the image is important. VVDF more in high noise environment because enough number of noise-free pixels can be obtained through neighboring frames because it is very less probable that same pixel will be corrupt in neighboring frame.

4. CONCLUSION

In this paper, the study of different image restoration and image enhancement approaches is defined. The presented work has explored the need of image restoration and defined the comparative study of three main approaches called median filter, vector median filter and vector directional filter.

References

[1] Rakesh Kumar, "Improved Image Denoising Technique Using Neighboring Wavelet Coefficients of Optimal Wavelet with Adaptive Thresholding", International Journal of Computer Theory and Engineering , Vol. 4, No. 3, pp. 395-400,2012.

[2] G. Vijaya, "Image Denoising Based On Soft Computing Techniques", *International Journal of Research and Reviews in Applied Sciences,Vol.7,Issue1,pp. 32*- 37,2011.

[3] Ce Liu, "Automatic Estimation and Removal of Noise from a Single Image", IEEE Transactions On Pattern Analysis And Machine Intelligence, 2006.

[4] S Suryanarayana, "Novel Impulse Detection Technique for Image Denoising", Journal of Theoretical and Applied Information Technology, pp. 102-106, 2005 - 2009 JATIT.

[5] Rashmikant A Madaliya, " Image denoising using fractal coding technique in wavelet Domain", International Journal of advancement in electronics and computer engineering (IJAECE), Volume 1, Issue1, pp.18-23, 2012.

[6] S.Grace Chang, "Adaptive Wavelet Thresholding for Image Denoising and Compression", IEEE Transactions On Image Processing, VOL. 9, NO. 9, pp. 1532-1546, 2000.

[7] X.T. Wang, "Robust adaptive directional lifting wavelet transform for image denoising", The Institution of Engineering and Technology Image Process, Vol. 5, Issue 3, pp. 249–260,2008.

[8] Florian Luisier, "A New SURE Approach to Image Denoising: Inter-scale Ortho-normal Wavelet Thresholding", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 16, NO. 3, pp. 593-606, 2007.

[9] Taeg Sang Cho, "Image restoration by matching gradient distributions", IEEE Transactions On Pattern Analysis And Machine Intelligence, pp. 1-13, 2011.

[10] Yogesh Bahendwar, "A Modified Algorithm For Denoising MRI Images Of Lungs Using Discrete Wavelet Transform", National Conference on Innovative Paradigms in Engineering & Technology (NCIPET-2012),International Journal of Computer Applications, pp. 29-32,2012.

[11] Yu-Wing Tai, "Simultaneous Image Denoising and Compression by Multi-scale 2D Tensor Voting". Vision and Graphics Group, The Hong Kong University of Science and Technology, 2011.

[12] Lei Zhang, "PCA-Based Spatially Adaptive Denoising of CFA Images for Single-Sensor Digital Cameras", IEEE Transactions On Image Processing, VOL. 18, NO. 4, pp. 797-812, 2009.

[13] A. Buades, "Image Denoising Methods: A New Nonlocal Principle", Society for Industrial and Applied Mathematics, Vol. 52, No. 1, pp. 113–147, 2010.