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Image Enhancement Techniques- A Review

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Abstract: *This paper deal with image processing and its fundamental steps after that this paper has focused on the different image enhancement techniques. Image enhancement has found to be one of the most important vision applications because it has ability to enhance the visibility of images. Distinctive procedures have been proposed so far for improving the quality of the digital images. Image enhancement is one of the key issues in high quality pictures such as digital cameras. Since image clarity is easily affected by lighting, weather, or equipment that has been used to capture the image. These conditions lead to image may suffer from loss of information. The main purpose of image enhancement is to bring out detail that is hidden in an image or to increase contrast in a low contrast image. It provides a multitude of choices for improving the visual quality of images. Its object is to open up certain picture characteristics for investigation, conclusion and further use.*

Keywords- Digital Image Processing, Image Enhancement, Point Processing, Curvelet Transform

1. INTRODUCTION

Image processing is the form of signal processing in which image is given as input and output is become either an image or set of characteristics related to image. Image processing involves the processing of image such as altering, enhancement, compressing etc the existing image. **Image processing** is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too. [1]

Image Processing includes three steps:

1. Importing the image with optical scanner or by digital photography.
2. Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
3. Output is the last stage in which result can be altered image or report that is based on image analysis.

In imaging science, image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images referred to as imaging.

1.1 Steps of Digital Image Processing

There are some fundamental steps for digital image processing. The fundamental steps of image processing includes Image Acquisition, Image Enhancement, Image Restoration, Color Image Processing, Wavelets and Multi resolution Processing, Compression, Morphological Processing, Segmentation, Representation and Description, Object Recognition, Knowledge Bases. [2]

2. IMAGE ENHANCEMENT

2.1 Introduction:

Image enhancement refers to accentuation, or sharpening of image features such as edges, boundaries, or contrast to make a graphic display more useful for display and analysis. The enhancement process does not increase the inherent information content in the data. But it does increase the dynamic range of the chosen features so that they can be detected easily. Image enhancement is used to improve the quality of an image for visual perception of human beings. It is also used for low level vision applications. [3] Image enhancement is the mechanism to process the input image to make it more appropriate and clearly visible for the required application. Image enhancement improves the information content of the image and alters the visual impact of the image on the observer. [4] The objective of image enhancement is to modify attributes of an image to make it more suitable for a specific task. In the image enhancement process, one or more attributes of the image are modified and processed. The choice of attributes and the way they will be modified are specific to a given task. Enhancement is pre processing step in some computer vision applications to ease the vision task, for example to enhance the edges of an object to facilitate guidance of robotic gripper. Enhancement is also used as pre processing step in applications where human viewing of an image is required before further processing. Image enhancement is used for post processing generate a desirable image.

2.1 Types of Image Enhancement Techniques:

The aim of image enhancement is to improve the interpretability or perception of information in images for human viewers, or to provide `better' input for other automated image processing techniques. Image enhancement techniques can be divided into two broad categories:

1. Spatial domain techniques, which operate directly on pixels.

2. Frequency domain techniques, which operate on the Fourier transform of an image.

2.1 Spatial Domain Techniques

Spatial domain techniques directly deal with the image pixels. The pixel values are manipulated to achieve desired enhancement. Spatial techniques are particularly useful for directly altering the gray level values of individual pixels and hence the overall contrast of the entire image. But they usually enhance the whole image in a uniform manner which in many cases produces undesirable results. It is not possible to selectively enhance edges or other required information effectively. Techniques like histogram equalization are effective in many images. [5]

2.1.1 Grey Level Transformations in Spatial Domain

Various grey level transformations in spatial domain are point transformation, linear transformation, logarithmic transformation, power-low transformation and piece-wise transformation.

1. **Log Transformation Technique:**

Log transformation is one of the elementary image enhancement techniques of the spatial domain that can be

effectively used for contrast enhancements of dark images. The log transform is essentially a grey level transform which means that the grey levels of image pixels are altered. This transformation maps a narrow range of low grey level values in the input image to a wider range of output levels. [6]A general equation for log transformation is given by S=c log (1+r) Where, S is the output grey level, r is the input grey level and c is a constant. It is assumed that $r \geq 0$.

2. Power Low Transformation Technique

Power law transformation is another commonly used gray level transformation in the spatial domain. It is conceptually similar to alpha rooting in the frequency domain as this is done by raising the input grey level by some power. It is similar in operation to the log transforms in that power law transforms with fractional values of γ map a narrow range of dark input values into a wider range of output values thereby increasing the contrast. [6] The basic equation for power low transformation is $S= br^{\gamma}$

Where S is the output grey level, r is the input grey level, b is a scaling constant and γ is the power to which the input grey level is raised. One significant advantage of this transformation is that it is possible to control the transformation function by varying the parameter γ.

2.1.2 Histogram Processing

The histogram of a digital image with intensity levels in the range [0, L-1] is a discrete function and given by $h(r_k)=n^k$ where r_k is the k^{th} intensity level and n^k is the number of pixel having grey level $r_{k..}$ Histograms are frequently normalized by the total number of pixels in the image. Assume an M x N image, a normalized histogram.

$p(r_k)=n^k/MxN$ where $p(r_k)$ is probability of occurring k^{th} level.

2.1.3 Histogram Equalization

Histogram equalization is effective algorithm image enhancing technique. Histogram equalization is a technique for adjusting image intensities to enhance contrast. It is not necessary that contrast will always be increase in this. There may be some cases were histogram equalization can be worse. In that case the contrast is decreased. The histogram of an image represents the relative frequency of occurrence of grey levels within an image. [7] In

Histogram equalization we get the image that has equalized grey levels. By the equation, S=T(r) where 0<=r<=1

2.1.4 Histogram Matching

Histogram matching automatically determines a transformation function required to produce an output image with a uniform histogram. Matching of gray scale distribution of one image with another is possible [8].

2.2 Frequency domain techniques

Frequency domain techniques are based on the manipulation of the orthogonal transform of the image rather than the image itself. The orthogonal transform of

the image has two components magnitude and phase. The magnitude consists of the frequency content of the image. The phase is used to restore the image back to the spatial domain. In frequency domain technique the image is first transferred in to frequency domain by use of Fourier Transform. Enhancement operations are performed on the Fourier transform of the image and then to get the resultant image the Inverse Fourier transform is performed. These enhancement operations are performed to modify the image attributes such as brightness, contrast or distribution of the grey levels etc. In this pixel value of the output image will be modified according to the transformation function applied on the input values. Image

enhancement in frequency domain can be done as following equation, G (u, v) = H (u. v) F (u, v)

Where G (u, v) is enhanced image, F (u, v) is input image and H (u, v) is transfer function. [9] [10] The basic filters that can be used in frequency domain are low pass filters, high pass filters.

A. Low pass filter- Low pass filtering involves the elimination of the high frequency components from the image resulting in the sharp transitions reduction that are associated with noise. An idle low pass filter would retain all the low frequency components and eliminate all high frequency components but low pass filters suffer from two problems: blurring and ringing. These problems are basically caused by the shapes associated with the spatial domain filters.

B. High pass filter- These filters are basically used to make the image appear sharper. High pass filtering works in exactly the same way as low pass filters but uses the different convolution kernel and it emphasizes on the fine details of the image. While high pass filter can improve the image by sharpening overdoing of this filter can actually degrade the image quality.

3. LITERATURE SURVEY

Fan Yang et al. 2010, [11] proposed that the input image is convolved by a Gaussian filter with optimum parameters and then the original histogram is divided into different areas by the valley values of the image histogram and finally we use the proposed method to processes images. This method has excellent degree of simplicity and adaptability in comparison of others methods. In order to reduce the noise's interference and improve the quality of input image, in this work Fan Yang and Jin Wu propose to use Gaussian filter convolving the image firstly. Gaussian filter reduces the difference in brightness between adjacent elements. It also can reduce blocking effects.

P. Rajavel 2010, [12] proposed to enhance image contrast while preserving image brightness. The image dependent brightness

preserving histogram equalization technique use the wrapping discrete curvelet transforms (WDCvT) and the histogram matching technique. This technique identifies region and separation. The curvelet transform is used to identify bright regions of an original image. It is also use for Histogram computation and matching.

Murli D.Vishwakarma 2011, [13] proposed that IPILN uses Gaussian filter, curvelet transform and perceptron network. Basically this technique involves three steps for contrast enhancement of the Image that are explained below.

1. Image Filtration: The Gaussian filter is used to obtain a row image from input image.

2. Image Transformation: Transformation is a process that is used to convert a signal from one domain to another without the loss of information.

3. Perceptron Network: To adjust the weight of input image, the concept of perceptron network is used. In perceptron network to adjust the weight, the learning factor is used which vary from 0 to 1.

Xiaoying Fang et al. 2012, [14] proposed a method to improve the enhancement result with image fusion method with evaluation on sharpness. As we know that Image enhancement can improve the perception of information. In this algorithm at first an image is taken from a real scene and then it should be divided into several regions according to the need for enhancement.

Adin Ramirez Rivera et al. 2013, [15] proposed a content-aware algorithm that enhances dark images, sharpens edges and details present in textured regions and give high degree of preservation to the smoothness of flat

regions. This algorithm produces an ad hoc transformation for each image, by adapting the mapping functions to each image characteristic to produce the maximum enhancement. They specially analyzed the contrast of the image in the boundary and textured regions, and then grouping of the information done with common characteristics. This algorithm Enhance the appearance of human faces, blue skies with or without clouds without introducing artifacts but it is unable to recover information from the shadowed or dark areas of images that had near-black intensities.

S.C.F. Lina et al. 2014, [16] proposed that the objective of this approach is increasing the image contrast while keeping the mean brightness of the output image unaltered as much as possible. First, a color channel stretching operation is performed allowing the full coverage of the permitted dynamic ranges in order to convey the richest set of color information to the viewer. Then, a histogram averaging process is carried out before it is used in the equalization operation. The purpose is to increase the information content that is obscured by the image capturing conditions. Finally, a histogram re-mapping process is conducted together with the HSI to RGB conversion stage to generate the output image. This method is able to release the need to separate the input image into sub-images and equalized independently. It also does not need to clip histograms to prevent artifacts. Instead, a histogram averaging strategy was adopted to produce the target distribution used in the histogram equalization process. Furthermore, an intensity re-mapping stage was included to

alleviate the generation of artifacts. Together with the color channel stretching pre-processing, the proposed approach is able to produce contrast enhanced images that are more desirable than current available methods in terms of brightness preservation, increased information content, object gradient sharpness and global contrast.

Literature Review

S. No.	Year	Author	Technique	Remarks
1	2010	Fan Yang	Multiple-Peak	This technique use Gaussian filter to reduce the noise interference & blocking effect.
2	2010	P. Rajavel	IDBPHE (Image-Dependent Brightness Preserving Histogram Equalization)	This technique identifies Region by wrapping discrete curvelet transform preserve high degree of brightness.
3	2011	Murli D.Vishwakarma	IPILN (Image Pixel Interdependency Linear Perceptron Network)	This technique use Gaussian filter, curvelet transform and perceptron network.

4	2012	Xiaoying Fang	Image Fusion	This technique use to enhance all regions of the image.
5	2013	Adin Ramirez Rivera	Content Aware	This technique use to Enhance the appearance of human faces and blue skies with or without clouds without introducing artifacts.
6	2014	S.C.F. Lina	AVHEQ(Averaging Histogram Equalization)	This technique is able to produce contrast enhanced images that are more desirable than current available methods in terms of brightness preservation, increased information content, object gradient sharpness and global contrast.

1. RESEARCH GAP

Image enhancement algorithms are very much popular, helpful and valuable for many image based applications. Below mentioned are the different research gaps accomplished from the literature survey.

In multiple peak technique limitation that use of peak & valley point of histogram to separate image into sub images limits its performance for image in which peak & valleys are nearby. The IDBPHE technique is unable to recover information from the shadowed or dark areas of images that had near-black intensities. In the

IPILN method the process of calculating the pixel difference some values are rejected which could be important data. Content aware method is unable to recover information from the shadowed or dark areas of images that had near-black intensities. The Image fusion method evaluates local statistical feature sharpness.

1. CONCLUSION

The Image enhancement plays important role in image processing. In this paper I have been taken survey on various techniques of image enhancement. Some of the image enhancement does not provide better results in multiple light sources. Most of the techniques are useful for altering the gray level values of individual pixels and hence the overall contrast of the entire image. But they usually enhance the whole image in a uniform manner which in many cases produces undesirable results. We can compare results of above discussed techniques and then choose a better technique for specific task.

REFERENCES

[1] [Online]. Available: http://www.engineersgarage.com/articles/image-processing-tutorial-applications.

[2] [Online]. Available: http://tanmayonrun.blogspot.in/2011/10/describe-fundamental-steps-of-digital.html.

[3] S. Kushwaha and D. R. K. Singh, "Study and Analysis of Various Image Enhancement Method using MATLAB," *International Journal of Computer Science* , vol. 3, no. 1.

[4] S. Bharal, "A SURVEY ON VARIOUS UNDERWATER IMAGE ENHANCEMENT TECHNIQUES," *International Journal of Computer Application (2250-1797)* , vol. 5, no. 4, 2015.

[5] S. O.Mundhada and P. V. K. Shandilya, "Image Enhancement and Its Various Techniques," *International Journal of Advanced Research in Computer Science and Software Engineering,* vol. 2, no. 4, 2012.

[6] S. O.Mundhada and P. V. K. Shandilya, "Spatial and Transformation Domain Techniques for Image Enhancement," *International Journal of Engineering Science and Innovative Technology (IJESIT),* vol. 1, no. 2, 2012.

[7] D. K. A. and R. K. I. , "A Survey on Various Image Enhancement Algorithms for Naturalness Preservation," *International Journal of Computer Science and Information Technologies,* vol. 6, no. 3, 2015.

[8] J. Y. im, L. Kim and S. H. Hwang, "An advanced Contrast Enhancement Using Partially Overlapped Sub –Block Histogram Equalization," *IEEE Transactions on Circuits and Systems for Videc Technology,* vol. 11, no. 4.

[9] S. Bedi and R. Khandelwal, "Various Image Enhancement Techniques- A Critical Review," *International Journal of Advanced Research in Computer and Communication Engineering,* vol. 2, no. 3, 2013.

[10] D. K. Pandey and P. R. Nema, "Selective Review on Various Images Enhancement Techniques," *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering,* vol. 2, no. 6, 2013.

[11] F. Yang and J. Wu, "An Improved Image Contrast Enhancement in Multiple-Peak Images Based on Histogram Equalization," *IEEE International Conference on Computer Design and Applications,* 2010.

[12] P. Rajavel, "Image Dependent Brightness Preserving Histogram Equalization," *IEEE Transactions on Consumer Electronics,* vol. 56, no. 2, 2010.

[13] M. D. Vishwakarma, "Image Pixel Interdependency Linear Perceptron Network," *IJARCS,* vol. 2, no. 4, 2011.

[14] X. Fang, J. Liu, W. Gu and Y. Tang, "A Method to Improve the Image Enhancement Result based on Image Fusion," 2012.

[15] A. R. Rivera, B. Ryu and O. Chae, "Content Aware Dark Image Enhancement through Channel Divison," *IEEE Transactions on Image Processing,* vol. 21, no. 9, 2013.

[16] S. Lin, C. Wong, M. Rahman, G. Jiang, S. Liu, N. Kwok, H. Shi, Y.-H. Yu and T. Wu, "Imageenhancementusingtheaveraginghistogramequalization (AVHEQ) approach for contrast improvement and brightness preservation," *Computers & Electrical Engineering,* pp. 1-15, 2015.