International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 3, March - 2013

Image Enhancement Techniques: A Selected Review

Navneet Kaur
Student, UCoE
Punjabi University, Patiala

Er. Kanwalpreet Singh
Assistant Professor,UCoE
Punjabi University,Patiala

Abstract

Image enhancement is one of the primary aspects in computer vision. Image enhancement techniques have become widely available to provide a better transform representation for the most popular image processing systems. Image enhancement is one of the key issues in high quality pictures such as digital cameras. The main purpose of image enhancement is to bring out detail that is hidden in an image. This is the main reason that image enhancement is used in a huge number of applications with important challenges such as noise reduction, degradations, blurring etc. In this paper a number of image enhancement techniques have been defined from which researcher can get an idea for a modified efficient technique.

Keywords: Digital image processing*;* Image enhancement; Image restoration; Spatial and Frequency Domain.

1. Introduction

Image enhancement is basically improving the Interpretability or perception of information in images for human viewers and providing better input for other automated image processing techniques. There exist many techniques that can enhance a digital image without spoiling it. The enhancement methods can broadly be divided in to the following two categories:

1. Spatial Domain Methods
2. Frequency Domain Methods

In spatial domain techniques, we directly deal with the image pixels. The pixel values are manipulated to achieve desired enhancement. In frequency domain methods, the image is first transferred in to frequency domain. It means that, the Fourier Transform of the image is computed first. All the enhancement operations are performed on the Fourier transform of the image and then the Inverse Fourier transform is performed to get the resultant image.
Image enhancement is applied in every field where images are ought to be understood and analyzed. For example, medical image analysis, analysis of images from satellites etc. In this section we briefly describe the various image enhancement techniques.
Image enhancement is applied in every field where images are ought to be understood and analyzed. For example, medical image analysis, analysis of images from satellites etc. Image enhancement simply means, transforming an image *f* into image *g* using *T. (Where T* is the transformation. The values of pixels in images *f* and *g* are denoted by *r* and *s*, respectively. As said, the pixel values *r* and *s* are related by the expression,

$$s = T(r) \quad (1)$$

Where *T* is a transformation that maps a pixel value *r* into a pixel value *s*. The results of this transformation are mapped into the grey scale range as we are dealing here only with grey scale digital images. So, the results are mapped back into the range [0, L-1], where L=2k, k being the number of bits in the image being considered. So, for instance, for an 8-bit image the range of pixel values will be [0, 255].

This paper presents a literature review on some of the image Enhancement techniques like, Contrast Stretching, Histogram Equalization and its improvement versions, Homomorphic Filtering, Retinex, and Wavelet Multiscale Transform, Stochastic resonance, Fuzzy Gray Scale Enhancement Technique.

2. Literature Review

In this section, we are presenting the research work of some prominent authors in the same field and explaining a short description of various techniques used for Image Enhancement.

A. T.L. Tan, K.S. Sim and C.P. Tso **"Image enhancement using background brightness preserving**

histogram equalisation" 2011[1] proposed the Histogram equalisation technique that is widely used to enhance the image contrast but it tends to over-enhance the image background brightness. The brightness preserving bi-histogram equalisation (BBHE) was proposed to preserve the image brightness by decomposing the image into two based on the input mean. The sub-images are then independently equalised and combined into the output image.

B. Seyed Pooya Ehsani, Hojjat Seyed Mousavi, Babak.H. Khalaj **"Chromosome Image Contrast Enhancement Using Adaptive, Iterative Histogram Matching" 2011[2]** proposed an adaptive and iterative histogram matching (AIHM) algorithm for chromosome contrast enhancement especially in banding patterns. The reference histogram, with which the initial image needs to be matched, is created based on some processes on the initial image histogram.

C. Min Liu, Peizhong Liu **"Image Enhancement Algorithm for Video Based on Multi-Dimensional Biomimetic Informatics" 2012[3]** proposed an image enhancement algorithm of video analysis and the CI value is used as the evaluation function in this system, which can provide a reference to the degree of enhancement. The video image enhancement algorithm based on the point analysis method of multi-dimensional biomimetic informatics and it work well based on the point analysis method of multi-dimensional biomimetic informatics algorithm.

D. R.K. Jha, P.K. Biswas, B.N. Chatterji **"Contrast enhancement of dark images using stochastic resonance" 2012[4]** proposed a stochastic resonance based technique that are introduced for enhancement of very low-contrast images. In this technique an expression for optimum threshold has been derived. Gaussian noise of increasing standard deviation has been added iteratively to the low-contrast image until the quality of enhanced image reaches maximum.

E. Sudharsan Parthasarathy, Praveen Sankaran **"Fusion Based Multi Scale Retinex with Color Restoration for Image Enhancement" 2012[5]** proposed a fusion based approach on Multi Scale Retinex with Color Restoration (MSRCR) that would give better image enhancement. Lower dynamic range of a camera as compared to human visual system causes images taken to be extremely dependent on illuminant conditions. MSRCR algorithm enhances images taken under a wide range of nonlinear illumination conditions to the level that a user would have perceived it in real time.

F. Deepak Ghimire and Joonwhoan Lee **"Nonlinear Transfer Function-Based Local Approach for Color Image Enhancement" 2011[6]** proposed a method for enhancing the color images based on nonlinear transfer function and pixel neighbourhood by preserving details. In this method, the image enhancement is applied only on the V (luminance value) component of the HSV color image and H and S component are kept unchanged to prevent the degradation of color balance between HSV components. The V channel is enhanced in two steps. First the V component image is divided into smaller overlapping blocks and for each pixel inside the block the luminance enhancement is carried out using nonlinear transfer function. In the second step, each pixel is further enhanced for the adjustment of the image contrast depending upon the center pixel value and its neighbourhood pixel values. Finally, original H and S component image and enhanced V component image are converted back to RGB image.

G. Hong ZHANG，Qian ZHAO，Lu LI, Yue-cheng LI，Yu-hu YOU **"Muti-scale Image Enhancement Based on Properties of Human Visual System" 2011[7]** proposed a multi-scale enhancement algorithm in which they utilize LIP model and consider characteristics of the human visual system (HVS). Then a new measure of enhancement based on JND model (Just Noticeable Difference, JND) of human visual system is proposed and used as a tool for evaluating the performance of the enhancement technique.

H. Adin Ramirez Rivera, Byungyong Ryu, and Oksam Chae **"Content-Aware Dark Image Enhancement through Channel Division" 2012[8]** proposed a content-aware algorithm that enhances dark images, sharpens edges, reveals details in textured regions, and preserves the smoothness of flat regions. This algorithm produces an ad hoc transformation for each image, adapting the mapping functions to each image's characteristics to produce the maximum enhancement. We analyze the contrast of the image in the boundary and textured regions, and group the information with common characteristics.

I. Zhang Chaofu, MA Li-ni, Jing Lu-na **"Mixed Frequency domain and spatial of enhancement algorithm for infrared image" 2012[9]** proposed a hybrid algorithm to enhance the image. It uses Gauss filter processing to enhance image details in the frequencydomain and smooth the contours of the image by the top-hat and bot-hat transforms in spatial domain. Through the hybrid algorithm to enhanced the infrared image. Not only enhanced the infrared image of the details, but the outline of the image has also been smooth. Finally, the enhanced image is better than other algorithm of results.

3. Comparison of Different Techniques

Table1. Comparison between different images Enhancement techniques

S. No.	Paper Name	Author Name	Techniques used	Advantages	Limitations
1.	Image enhancement using background brightness preserving histogram equalisation	T.L. Tan, K.S. Sim and C.P. Tso	Histogram Equalisation	Maintain the background brightness.	Not much suitable for color images.
2.	Chromosome Image Contrast Enhancement Using Adaptive, Iterative Histogram Matching	Seyed Pooya Ehsani, Hojjat Seyed Mousavi, Babak.H.	Adaptive Iterative Histogram Matching	Best visualization effect on banding pattern.	Creates some unwanted blurring in edges and borders.
3.	Image Enhancement Algorithm for Video Based On Multi-Dimensional Biomimetic Informatics	Min Liu, Peizhong Liu	Multi-Dimensional Biomimetic Informatics	This technique can avoid complex mathematical Computations.	The enhancement effect is not so obvious on the border.
4.	Contrast enhancement of dark images using stochastic resonance	R.K. Jha, P.K. Biswas, B.N. Chatterji	Stochastic Resonance	There is no colour loss and spot in the enhanced image.	Technique used for very low-contrast images.
5.	Fusion Based Multi Scale RETINEX with Color Restoration for Image Enhancement	Sudharsan Parthasarathy, Praveen Sankaran	Retinex	Efficient for dynamic range coefficients	There will be gray level violation problem.
6.	Nonlinear Transfer Function-Based Local Approach for Color Image Enhancement	Deepak Ghimire and Joonwhoan Lee	Function-Based Local Approach	The original color of the enhanced image is not altered.	_____
7.	Content-Aware Dark Image Enhancement Through Channel Division	Adin Ramirez Rivera, Byungyong Ryu, and Oksam	Channel Division	preserves the smoothness of flat regions	Avoids over enhancement problems only with normal dynamic ranges.
8.	Mixed Frequency domain and spatial of enhancement algorithm for infrared image	Zhang Chaofu, MA Li-ni, Jing Lu-na	Mixed Frequency and Spatial domain enhancement algorithm	The target and background both are enhanced in Infrared image.	____

4. Conclusion

This paper presents a short description of various image enhancement techniques in order to make familiar with the enhancement of a blurred image, noise removal, setting the brightness, contrast and various other degradations in the image processing. Critical review concludes that modern techniques like retinex are much better than histogram equalization. These techniques are based on enhancement and can be used to evolve out a modified method of image enhancement in the world of constant evolution.

5. References

[1]. T.L. Tan, K.S. Sim and C.P. Tso "Image enhancement using background brightness preserving histogram equalisation" The Institution of Engineering and Technology , 21 November 2011 doi: 10.1049/el.2011.3421

[2]. Seyed Pooya Ehsani, Hojjat Seyed Mousavi, Babak.H. Khalaj "Chromosome Image Contrast Enhancement Using Adaptive, Iterative Histogram Matching" 978-1-4577-1535-8/11/ ©2011 IEEE

[3]. Min Liu, Peizhong Liu "Image Enhancement Algorithm for Video Based On Multi-Dimensional Biomimetic Informatics" 978-0-7695-4647-6/12 © 2012 IEEE DOI 10.1109/ ICCSEE.2012.244

[4]. R.K. Jha, P.K. Biswas, B.N. Chatterji "Contrast enhancement of dark images using stochastic resonance" IET Image Process., 2012, Vol. 6, Iss. 3, pp. 230–237; doi: 10.1049/iet-ipr.2010.0392

[5]. Sudharsan Parthasarathy, Praveen Sankaran "Fusion Based Multi Scale Retinex with Color Restoration for Image Enhancement" 978-1-4577-1583-9/ 12/ © 2012 IEEE

[6]. Deepak Ghimire and Joonwhoan Lee "Nonlinear Transfer Function-Based Local Approach for Color Image Enhancement" IEEE Transactions on Consumer Electronics, Vol. 57, No. 2, May 2011

[7]. Hong ZHANG，Qian ZHAO，Lu LI, Yue-cheng LI，Yu-hu YOU "Muti-scale Image Enhancement Based on Properties of Human Visual System" 978-1-4244-9306-7/11/ ©2011 IEEE

[8]. Adin Ramirez Rivera, Byungyong Ryu, and Oksam Chae "Content-Aware Dark Image Enhancement through Channel Division" IEEE Transactions on image processing, VOL. 21, NO. 9, SEPTEMBER 2012

[9]. Zhang Chaofu, MA Li-ni, Jing Lu-na "Mixed Frequency domain and spatial of enhancement algorithm for infrared image" 978-1-4673-0024-7/10/©2012 IEEE

[10]. Kim, Y.T.: 'Contrast enhancement using brightness preserving bi-histogram equalization', IEEE Trans. Consum.Electron, 1997, 43, (1), pp.1–8

[11]. Wang, Y., Chen, Q., and Zhang, B.: 'Image enhancement based on equal area dualistic sub-image histogram equalization method', IEEE Trans. Consum. Electron, 1999, 45, (1), pp. 68–75

[12]. Gonzalez, R.C., and Woods, R.E.: 'Digital image processing' (Prentice- Hall, 2008)

[13]. Pratt, W.K.: 'Digital image processing: PIKS scientific inside' (Wiley- Interscience, 2007)