Volume 4, Issue 8, August 2014 ISSN: 2277 128X

International Journal of Advanced Research in Computer Science and Software Engineering

Research Paper

Available online at: www.ijarcsse.com

Review of Various Image Contrast Enhancement Techniques

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Abstract: Image enhancement is a processing on an image in order to make it more appropriate for certain applications. It is used to improve the visual effects and the clarity of image or to make the original image more conducive for computer to process. In this paper we are going to review the different image contrast enhancement techniques. Image Enhancement techniques increase the contrast of image which is result produce better picture. There are many image contrast enhancement techniques like Linear Starching, Histogram Equalization, Adaptive Histogram Equalization, Convolution Mask Enhancement and Enhancement by Point Processing. This paper focuses on the comparative study of contrast enhancement techniques with special reference to local and global enhancement techniques. Also proposed solution is identified to apply to this enhancement technique. This novel method will use in many fields, such as medical image analysis, remote sensing, HDTV, hyper spectral image processing, industrial X-ray image processing, microscopic imaging etc.

Keywords: Image enhancement, histogram equalization, contrast enhancement.

I. INTRODUCTION

Image enhancement process consist of a collection of techniques that seek to improve the visual appearance of an image or to convert the image to a form better suited for analysis by a human or machine. Image enhancement means as the improvement of an image appearance by increasing dominance of some features or by decreasing ambiguity between different regions of the image. The objective of enhancement is to process an image so that the result is more suitable than the original image for a specific application. Image enhancement is one of the most interesting and visually appealing areas of image processing. Image enhancement is broadly divided into two categories: spatial domain methods and frequency domain methods. Spatial domain method refers to the image plane and approaches in this category are based on direct operation of pixels in an image. Frequency domain methods are based on adapting the Fourier transform of an image.

Image enhancement, which is one of the significant techniques in digital image processing, plays important roles in many fields, such as medical image analysis, remote sensing, high definition television (HDTV), hyper spectral image processing, industrial X-ray image processing, microscopic imaging etc. Image enhancement is a processing on image in order to make it more appropriate for certain applications. It is mainly utilized to improve the visual effects and the clarity of the image, or to make the original image more conducive for computer to process [1]. Generally, an image may have poor dynamic range or distortion due to the poor quality of the imaging devices or the adverse external conditions at the time of acquisition.

The contrast enhancement is one of the commonly used image enhancement methods. Many methods for image contrast enhancement have been proposed which can be broadly categorized into two methods: direct methods and indirect methods. Among the indirect methods, the histogram modification techniques have been widely utilized because of its simplicity and explicitness in which the histogram equalization (HE) is one of the most frequently used techniques. The fundamental principle of HE is to make the histogram of the enhanced image approximate to a uniform distribution so that the dynamic range of the image can be fully exploited. Contrast enhancement changing the pixels intensity of the input image to utilize maximum possible bins. Contrast enhancement is based on five techniques such as local, global, partial, bright and dark contrast.

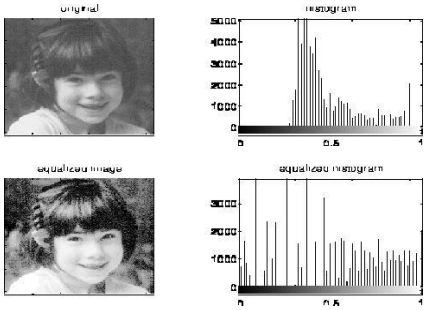

Fig.1: Showing the effect of Image Enhancement

II. 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. Adin Ramirez Rivera, Byungyong Ryu, and Oksam Chae, **"Content-Aware Dark Image Enhancement Through Channel Division", 2012[1]** proposed an algorithm which 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. They analyzed the contrast of the image in the boundary and textured regions, and group the information with common characteristics. These groups model the relations within the image, from which the transformation functions were extracted. The results were then adaptively mixed, by considering the human vision system characteristics, to boost the details in the image.

B. Deepak Ghimire and Joonwhoan Lee ,**" Nonlinear Transfer Function-Based Local Approach for Color**

Image Enhancement,"2011[2] proposed a method in which the image enhancement was applied only on the V (luminance value) component of the HSV color image and H and S component were kept unchanged to prevent the degradation of color balance between HSV components. The V channel was enhanced in two steps. First the Component image was divided into smaller overlapping blocks and for each pixel inside the block the luminance enhancement was carried out using nonlinear transfer function. In the second step, each pixel was further enhanced for the adjustment of the image contrast depending upon the center pixel value and its neighborhood pixel values. Finally, original H and S component image and enhanced V component image were converted back to RGB image.

C. Sudharsan Parthasarathy, Praveen Sankaran, **"Fusion Based Multi Scale RETINEX with Color Restoration for Image Enhancement,"2012[3]** proposed that a fusion based approach on Multi Scale Retinex with Color Restoration (MSRCR) 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. One of the enhancement techniques that tries to achieve color constancy is Retinex. In Multi Scale Retinex (MSR), they average multiple SSR (Single Scale Retinex) images to obtain a net improved image.

D. S. Bronte, L. M. Bergasa, P. F. Alcantarilla, **"Fog Detection System Based on Computer Vision Techniques", [4]** proposed a real-time fog detection system using an on-board low cost b&w camera, for a driving application. This system was based on two clues: estimation of the visibility distance, which was calculated from the camera projection equations and the blurring due to the fog. Because of the water particles floating in the air, sky light gets diffuse and, focus on the road zone, which is one of the darkest zones on the image. The apparent effect is that some part of the sky introduces in the road. Also in foggy scenes, the border strength is reduced in the upper part of the image. These two sources of information were used to make the system more robust. The final purpose of this system was to develop an automatic vision-based diagnostic system for warning ADAS of possible wrong working conditions.

E. Zhang Chaofu, MA Li-ni, Jing Lu-na, "**Mixed Frequency domain and spatial of enhancement algorithm for infrared image", 2012 [5]** proposed a hybrid technique to enhance the image. It makes use of the Gauss filter processing to enhance image details in the frequency domain and smooth the contours of the image by the top-hat and bot-hat transforms in spatial domain. To enhance the infrared image, this algorithm did not enhanced only the details of the image, but the outline of the image had also been smooth.

F. A. Poljicak, L. Mandic, M. Strgar Kurecic, "**Improvement of the Watermark Detector Performance Using Image Enhancement Filters,"2012[6]** considered the influence of some image processing techniques on the watermark detection rate. Watermarking methods are still very sensitive to complex degradation attacks such are JPEG compression, or printscan process, so the detection rate of a watermark method decreases considerably after such attacks on a watermarked image. To improve the detection rate they reduced the degradation of the image by using unsharp, Laplacian or deconvolution filter. For the experiment dataset of 1000 images were watermarked and then compressed or printed and scanned. Degraded images were enhanced using unsharp, Laplacian and blind deconvolution filter. The watermark detection rate before and after enhancement was measured and compared.

G. Seung-Won Jung, Jae-Yun Jeong, and Sung-Jea Ko ,**" Sharpness Enhancement of Stereo Images Using Binocular Just-Noticeable Difference,"2012 [7]** proposed a new sharpness enhancement algorithm for stereo images.. They introduced a novel application of the BJND model for the sharpness enhancement of stereo images. An efficient solution for reducing the over enhancement problem in the sharpness enhancement of stereo images was proposed. The solution was found within an optimization framework with additional constraint terms to suppress the unnecessary increase in luminance values. In addition, the reliability of the BJND model was taken into account by estimating the accuracy of stereo matching.

H. Hong Zhang，Qian Zhao，Lu Li, Yue-cheng Li，Yu-hu you, "**Multi-scale Image Enhancement Based on Properties of Human Visual System,"2011[8]** utilized the LIP (logarithmic image processing) model and considered the characteristics of the human visual system (HVS) to propose a new multi-scale enhancement algorithm. Then a new measure of enhancement based on JND model (Just Noticeable Difference, JND) of human visual system was proposed and used as a tool for evaluating the performance of the enhancement technique.

I. Rajib Kumar Jha, Rajlaxmi Chouhan, P. K. Biswas,**" Noise-induced Contrast Enhancement of Dark Images using Non-dynamic Stochastic Resonance," 2012 [9]** proposed a nonlinear non-dynamic stochastic resonance-based technique for enhancement of dark and low contrast images. A low contrast image was treated as a subthreshold signal and noise-enhanced signal processing was applied to improve its contrast. The proposed technique uniquely utilized the addition of external noise to neutralize the effect of internal noise (due to insufficient illumination) of a low contrast image. Random noise was added repeatedly to an image and was successively hard-thresholded followed by overall averaging. By varying the noise intensities, noise induced resonance was obtained at a particular optimum noise intensity. Performance of the proposed technique had been investigated for four types of noise distributions - gaussian, uniform, poisson and gamma. Quantitative evaluation of their performances had been done in terms of contrast enhancement factor, color enhancement and perceptual quality measure.

J. Khairunnisa Hasikin, Nor Ashidi Mat Isa, **"Enhancement of the low contrast image using fuzzy set theory," 2012[10]** proposed a fuzzy grayscale enhancement technique for low contrast image. This technique was proposed by maximizing fuzzy measures contained in the image. The membership function was then modified to enhance the image by using power-law transformation and saturation operator.

K. Mussarat Yasmin, Muhammad Sharif, Saleha Masood, Mudassar Raza and Sajjad Mohsin ,**" Brain Image Enhancement - A Survey,"2011 [11]** The basic purpose of enhancement operation is to analyze the brain images precisely in order to effectively diagnose and examine the diseases and problems. Brain imaging provides a way to investigate and determine brain related diseases in an efficient and effective manner. The basic objective of this study was to evaluate and discuss different techniques and approaches proposed in order to handle different brain imaging types. The paper provided a short overview of different methods presented in the prospect of brain image enhancement.

L. Xiaoying Fang, Jingao Liu, Wenquan Gu, Yiwen Tang ,**" A Method to Improve the Image Enhancement Result based on Image Fusion,"2011 [12]** proposed a method to improve the enhancement result with image fusion method with evaluation on sharpness. Several different evaluation methods and fusion policies were discussed and compared.

III. COMPARISON OF DIFFERENT TECHNIQUES

Comparison of observations given in all references is discussed here.

Methods	Advantages	Disadvantages
Adaptive Histogram Equalization	It contains low contrast and dark regions.	Won't work effectively.
Histogram Equalization	It is a most effective technique for gray-scale images.	But the color images it is a difficult task to work.
Décor relation Stretch	It is originated in the world satellite and aerial mapping.	It is a much complicated process then the other described site.
Image Adjust	It is used to adjust the image intensity at easily.	Not able to find the original image.
Image Noise	It is used to reduce the noise from an image easily.	While the dispensable image in low light.

IV. FUTURE SCOPE

Classical image enhancement techniques cannot adapt to the varying characteristics of images. The application of a global transform or a fixed operator to an entire image often yields poor results in at least some parts of the given image [13]. Morrow [14] has proposed a region based technique for improvement of results. Keeping in view, the shortcomings of the pre-build techniques, a modified algorithm is proposed based upon the adaptive region growing technique. This region growing technique involves the implementation of 8-connected approach and concept of seed selection.

V. CONCLUSION

Image contrast enhancement plays an important role in image enhancement. In this paper, the different image contrast enhancement techniques are analyzed. The mixture of global and local contrast enhancement techniques is superior to other techniques because these techniques improve the visual effects and clarity of the image with preserving its brightness. This is proposed system, implementation work is going on. The major goal of image contrast enhancement is to produce images without severe side effects at the same time maintain input mean brightness.

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