An Analytical Analysis of Integrated Non-Linear Image Enhancement with Dynamic Restoration

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Abstract

This paper has proposed a new integrated image enhancement algorithm by integrating non linear image enhancement technique with dynamic restoration. Image processing plays a vital role in visualization application. It improves the visibility of poor images. Different techniques have been proposed so far. To improve image quality image enhancement can selectively enhance and restrain some information about image. It is a method which decreases image noise, eliminate artifacts, and maintain details. Its purpose is to amplify certain image features for analysis, diagnosis and display. The overall objective of this paper is to find the limitation of the existing image enhancement techniques and propose an analytical model to provide the solution for the same.
Keywords: Image enhancement, human visual perception, Visibility.

1. Introduction

In vision processing, the process of improving the quality [1] of a digitally stored image by manipulating the image with certain methods. Advanced image enhancement techniques also supports many filters for altering images in various ways. Programs specialized for image enhancement are sometimes called image digital image filters.

Image enhancement techniques acting as an important part in image processing. Person click image from common environment with elevated dynamic range include both dark and bright regions. Due to go beyond in dynamic range of human eyes sensing, those image are not easy to distinguish by human eyes. Image enhancement is a general approach to get better quality of those images in terms of human visual observation. There are two methods for image enhancement one is spatial domain and second is transform domain methods. In spatial domain method [5] an image is enhance by straight dealing with the intensity value in an image. In transform domain enhancement method it transforms the image intensity data into a specific domain by using different techniques like DFT, DCT, etc. Figure 1 is showing the poor visible input image. It is clearly shown in the image that it will not give much information to observers and, it may contain poor results for further processing.

Figure 1. Input image [11]

Figure 2 is showing the enhanced image. It is clearly shown in the figure that all the objects are enhanced and image is now providing quite more information to the observers.

Figure 2. Enhanced Images [11]

Transform domain enhancement method engage mapping the image intensity data into a given transform domain by using transforms such as the 2-D

discrete cosine transform (DCT). The main idea for using this technique is to improve the image quality by manipulating the transform coefficients. The main drawbacks of the transform-based image enhancement techniques are: they establish assured artifacts, they cannot concurrently enhance all pixels of the image properly and it is very hard to computerize the image enhancement procedure [5]. Color image enhancement plays a vital role in Digital Image Processing. The reason of image enhancement is to get better details of an image and highlight the helpful information. If a person takes an image by using a digital camera or mobile phone, in sunlight or dark room that image cannot be a good image. As a result of that image, it cannot be proper visualize for human eyes. [8]. An image enhancement technique is generally used for the upgrading of the quality of a vague image. Among many image enhancement approaches, the nonlinear image enhancement (NIE) method has a simple structure and can obtain a good processing effect [9].

2. Image Enhancement Techniques

2.1 Image enhancement using HSV color space

The color images are always represented in RGB color space. HSV space is nearer to human observation, the (H) refers to the spectral composition of color, saturation (S) defines the clarity of colors and (V) refers the brightness of a color or just the luminance value of the color [5], [8]. The following equations are shows the conversion of RGB values into HSV values.

$$H = \begin{cases} H_1, & if\ B \le G, \\ 360 - H_1, & if\ B > G \end{cases} \quad (1)$$

where,

$$H1 = \cos^{-1}\left\{ \frac{0.5[(R-G)+(R-G)]}{\sqrt{(R-G)^2+(R-B)(G-B)}} \right\} \quad (2)$$

$$S = \frac{\max(R,G,B) - \min(R,G,B)}{\max(R,G,B)} \quad (3)$$

$$V = \frac{\max(R,G,B)}{255} \quad (4)$$

The basic range of (H) hue in equation is from 0 to 360 whereas saturation and values varies from 0 to 1. The Image enhancement process includes remove artifacts, advanced color correction, filter adding and reduction, image replacement, augmentation and creation [11].

2.2 Histogram Equalization

Histogram equalization is a common method for enhancing the appearance of images. Histogram equalization is a method in image processing of contrast adjustment using the image's histogram. This process typically increases the universal contrast of many images, mainly when the usable data of the image is represented by close contrast values. Every level should hold the same number of pixel values [1].

2.3 Contrast Enhancement

The main use of contrast enhancement is to accomplish the image brightness. Contrast enhancement firstly divide the value component image in HSV image space into lesser overlapping blocks and find the shape of the nonlinear transfer function for every pixel. In contrast enhancement process, for each pixel the amount of enhancement is depending upon the midpoint pixel itself and its neighboring pixel values [6]. A neighboring pixel-dependent contrast enhancement method is used to achieve enough contrast, even elevated than original image [2].

After conducting the literature survey it has been found that the transform-based image enhancement introduces some inconsistencies like:-

- Transform-based image enhancement cannot enhance all parts of the image simultaneously and it is hard to automate the image enhancement process.
- The main drawback of transform based image enhancement is that, after enhancement the image detail are degraded.

3. Problem formulation

In order to reduce the problems of the limitations of the exiting techniques a new hybrid non linear image enhancement technique is proposed. Proposed technique will integrate non-linear enhancement technique with image restoration. The proposed algorithm is seems to be significant as the transform-based image enhancement methods results in certain artifacts on the output enhanced image, so restoration technique will reduce these artifacts. The proposed algorithm will use HSV plane to enhance the image, as it is known H and S component need no modification for enhancement so alteration will be done on V (intensity) only.

The proposed method comprises three processes, i.e. adaptive intensity enhancement, contrast enhancement and color restoration. Adaptive intensity enhancement utilizes a particularly designed nonlinear transfer function which is proficient of reducing the intensity of light regions and at the same time enhancing the intensity of gloomy regions. Contrast enhancement tunes the intensity of each pixels magnitude based on its nearby pixels. Finally, color restoration process based on the chromatic information of the input image frame is applied to convert the enhanced intensity image back to a color image.

4. Proposed Technique

The main objective of algorithm which will provide better results than existing algorithms to enhance the images. Dynamic image restoration using adaptive gamma correction and also adaptive smoothing technique will be integrated to the non linear enhancement method to provide more accurate results. By doing this we can hope that the detailed variance and background variance will be increased and decreased respectively. However dynamic restoration may come up with some potential overheads so we will try to reduce them. Figure 3 is showing the various steps to achieve the objectives.

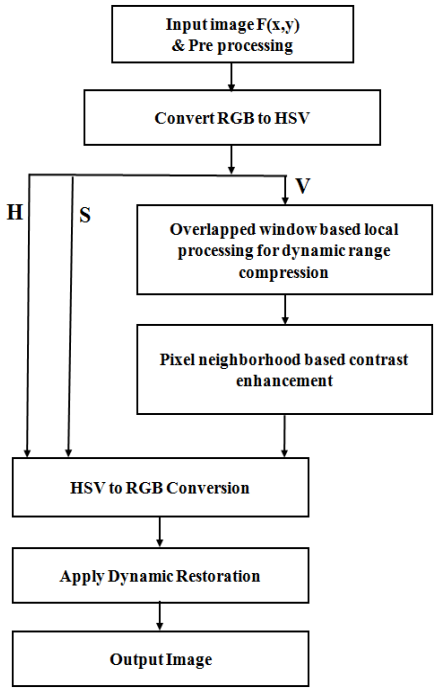

Figure 3. Proposed Algorithm

Step 1: In step 1 image is passed to the system and some pre-processing operations are applied on it.
Step 2: In step 2 image is converted in HSV plane.
Step 3: As H and S component stay constant but V is the only factors which need some alteration while enhancing the images.
Step 4: Now overlapped window based local processing for dynamic range compression will be applied on V component.
Step 5: Now pixel neighborhood based contrast enhancement is applied on the image.
Step 6: Now re-convert given image to HSV to RGB again.
Step 7: Now apply dynamic restoration algorithm.
Step 8: Get output image.

5. Discussion

The image enhancements techniques play a significant role in digital image processing. It is shown in this paper that the nonlinear image enhancement can be used to improve the quality of a blurred image by using the concept of the light source refinement. This work has proposed an integrated enhancement algorithm to improve the detailed variance in images. The proposed solution is seems to be efficient as integrated result will provide better results.

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