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Contrast Enhancement by Using Region Growing

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Abstract

Image Enhancement (IE) transforms images to provide better representation of the subtle details. This is an indispensable tool for researchers in a wide variety of fields including (but not limited to) medical imaging, art studies and atmospheric sciences. It is application specific an image enhancement technique is suitable for one problem might be inadequate for another. Principle objective of Image enhancement is to process an image so that result is more suitable than original image for specific application. In this research, Color correction will done by using the contrast enhancement .The proposed algorithm will neither requires a color calibration chart/object, nor explicitly compensates for the image as a whole. Instead correction of the image is done by region growing.

Keywords: *Contrast, Region Growing, SIFT (Scale Invariant Feature Transform).*

1. Introduction

Contrast is the difference in visual properties that makes an object (or its representation in an image) distinguishable from other objects and the background [1]. In the real world, the contrast is determined by the difference in the color and brightness of the object and other objects within the same field of view. In other words, it is the different between the darker and the lighter pixel of the image, if it is big the image will have high contrast and in the other case the image will have low contrast [1][2].The principal objective of enhancement is to process an image so that the result is more suitable than the original image for a specific application. Because it establishes at the outset that the techniques are oriented to the problem,a word specific is important.

Contrast enhancement techniques are used widely in image processing. Its objective of contrast enhancement is to increase the visibility of details that may be obscured by deficient global and local lightness [3]. The goal of color enhancement can be either to increase the colorfulnessand to increase the saturation. The lightness can give a perception of increased colorfulness, so in this case perceived saturation reduces for a given chroma. Onthe other hand, perceived saturation can be increased by increasing chroma or reducing lightness, or both. If chroma is increased moderately while slightly reducing the lightness, both saturation and colorfulness in an image can be enhanced. This method is also likely to avoid out-of-gamutor unrealizable colors[4].

1.1 Different types of methods are as:

1.1.1 Color Processing in LHS Space

In the early '80s, as color images and video media started getting increasingly commonplace, researchers soon realized that most of the enhancement techniques developed for monochrome images led to artifacts when applied to color images. In one of the earliest papers on color enhancement, Strickland, Kim and Mcdonnell [**Strickland 1986, Strickland 1987**] recognized that RGB color space did not correspond with the human color perception and so, image enhancement algorithms applied directly to RGB images could lead to color artifacts. They suggested performing enhancement operations in a color space whose dimension corresponded to luminance, hue and saturation. Authors also pointed out that enhancing luminance alone could lead to color artifacts in low luminance regions, and thus simultaneous saturation processing was required for proper enhancement. They presented the derivation of LHS coordinates from RGB. Although the nonlinear transformation between the two color spaces, some processed colors were at risk of being out-of-gamut when converted back to RGB.Strickland, Kim and Mcdonnell proposed to clip the RGB pixel vector at the color cube boundary to prevent color shift during the clipping operation.

1.1.2 Histogram Equalization

(HE) is a commonly used global contrast enhancement technique for both color and grayscale images. Histogram Equalization spreads out and flattens the histogram of the number of image pixels at each gray level value.Hence stretching the intensity values in the image over more of the available dynamic range of gray-levels and increasing the apparent contrast in the image. And this method is especially useful when an image is represented by close contrast values, like as images in which both the background and foreground are both bright, otherwise both are dark at the same time. Histogram Equalization is accomplished by linearizing the cumulative density function of the image intensity levels.

1.1.3 Contrast/Color Enhancement Method Based on the Chromaticity Diagram

In a different approach, Lucchese, Mitra and Mukherjee [**Lucchese 2001**] presented a two-stage method for color contrast enhancement based on xy chromaticity diagram. All colors with positive chroma values were maximally saturated through shifting to the borders of a given color gamut. In the next stage, the colors were desaturated toward a new white point by an appropriate color-mixing rule.

1.1.4 Homomorphic Filtering

Homomorphic filtering is a frequency domain method for contrast enhancement. It has been used in a variety of applications like shadow identification [5], underwater image pre-preprocessing [6], [7], contrast enhancement for raised or indented characters [8], and seismic data processing [9]. Homomorphic filtering sharpens features in an image by enhancing high frequencies and sharpening object edges [10]. It also flattens lighting variations in an image, that bringing details out of shadows. It provides simultaneous dynamic range compression (reducing illumination variation) and contrast enhancement (increasing reflectance variation). The Homomorphic filtering can thus prove to be most effective on images that have large variations in lighting. Homomorphic filtering is based on a simple model of the imaging process, wherein images are formed from sensing light from an illumination source reflected from the surface of the objects being observed.

1.1.5 Fuzzy Logic

Fuzzy logic has been successfully applied to image enhancement and classification for many years [11], [12]. The foundation of fuzzy set theory was first established in 1965 by LotfiZadeh. The theory of fuzzy sets is a theory of graded concepts, theory in which everything is a matter of degree [13]. Unlike two-valued of fuzzy logic and boolean logic is based on degrees of membership and degrees of truth. The fuzzy logic not only recognizes true and false values but is also useful for propositions that can be represented with varying degrees of truth and falseness.

1.1.6 Single Scale Retinex

The idea of Retinex was proposed as a model of lightness and color perception of the human vision. The basic idea of Retinex algorithm is to separate illumination from the reflectance in a given image. It is an algorithm that improves the contrast, brightness and sharpness if an image. Different algorithms have been developed to implement the Retinex model and concept. Single-scale Retinex (SSR), Multi-scale Retinex (MSR) and Multi-scale Retinex with Color Restoration (MSRCR) have evolved since the idea of Retinex was first proposed [14]. The Retinex is an image enhancement algorithm that improves the contrast and sharpness of an image. The algorithm performs a non-linear spatial/spectral transform that provides simultaneous dynamic range compression and color constancy [14]. The Retinex is a member of the class of center surround functions where each output value of the function is determined by the corresponding input value (center) and its neighborhood (surround). For the retinex the center is defined as each pizel value and the surround is a Gaussian function.

2. Proposed Algorithm

Scale Invariant Feature Transform (SIFT) algorithm introduced by Lowe [15]. This algorithm is one of the most widely used one for image feature extraction. The SIFT extracts image features that are stable over image translation, rotation and scaling and somewhat invariant to changes in the illumination and camera viewpoint.Contrast enhancement techniques are used widely inimage processing. The objective of contrast enhancement is to increase the visibility of details that may be obscured by deficient global and local lightness. Main goal of color enhancement can be either to increasethe colorfulness, or to increase the saturation.Eight neighborhood pixels are considered for region growing. Eight-connected pixels are neighbors to every pixel that touches one of their edges or corners. All these pixels are connected diagonally, vertically,horizontally.

For each neighborhood

$$if\ T(i,j) < T(i-1,j-1) - \varepsilon \&\&(T(i-1,j-1) + \varepsilon)$$

then $T(i,j) = \sum_{k=-1}^{1} Mean(\ T(i-k,j-k)$

We assume that there is only color difference between the images. For convenience, the two images are respectively named as reference image and target image. Target image is the one to be corrected using the reference image. Our goal is to correct the target image so that it resembles the reference one in color appearance. The detailed explanation of the proposed algorithm is as follows.

1) Consider the right image (or left image) as reference image R and degrade the other one Left image (or right image) and consider as target image T.

2) Calculation of Sift key points on L and reference image R using Sift algorithm.

3) Compute the Matching points using SIFT matching algorithm.

4) Region growing on target image.

5) Detect holes and perform hole filling on target image.

$$If\ T(i,j) = o$$

$$Then\ T(i,j) = \left(\frac{\sum_{i=1}^{xs} . \sum_{j=1}^{ys} . \sum_{k=1}^{zs} T(i,j,k)}{(xs * ys * zs)}\right)$$

Where $[xs\ ys\ zs]$=$size(R)$

6) Enhancement in target image using reference image and target image.

3. Results

PSNR, is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. The PSNR is usually expressed in terms of the logarithmic decibel scale;due to many signals have a very wide dynamic range. PSNR is most commonly used to measure the quality of reconstruction of lossy compression codecs (e.g., for image compression). The signal in this case is the original data, and noise is the error introduced by compression. Whereas comparing compression codecs, the PSNR is an approximation to human perception of reconstruction quality. Though a higher PSNR generally indicates that the reconstruction is of higher quality, any how it may not. And one has to be extremely careful with the range of validity of this metric; it is only conclusively valid when it is used to compare results from the same codec (or codec type) and same content.

PSNR(Peak signal to noise ratio) is used to analyze the visual quality of the enhanced image in comparison to the original image. Change in PSNR shows that quality of image increases after applying proposed algorithm.

Input Pair	**PSNR of original Image and Target image**	**PSNR between Enhanced Image and Target Image**
Pair 1	20.2193	24.7073
Pair 2	19.9169	26.2036

Here the PSNR is improved by 4.7 and 6.3 approx.Hence the quality of image gets enhanced.Here the original and the enhanced images are shown.

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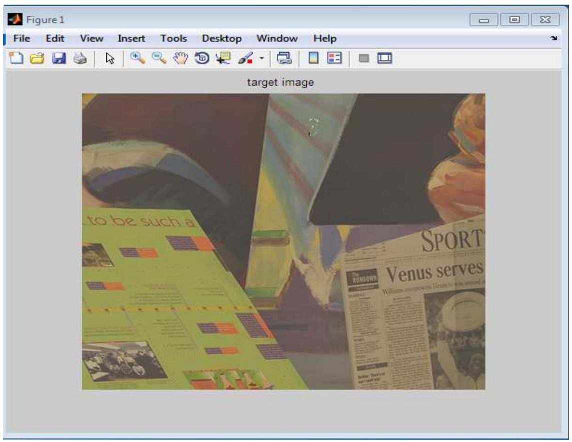

Figure 1: Target Image

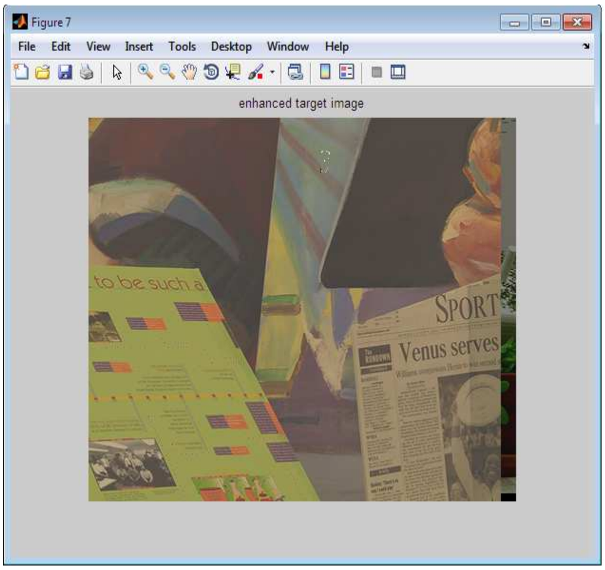

Figure2: Enhanced Target Image

4. Conclusion

Image enhancement algorithms offer a wide variety of approachesfor modifying images to achieve visually acceptable images. Choice of such techniques is a function of the specific task, imagecontent, viewing conditions and observer characteristics.The aim is to improve the visual appearance of the image, or to provide a "better" transform representation for future automatedimage processing, like analysis, detection, segmentation andrecognition. Moreover, it helps analyses background information thatis essential to understand object behaviour without requiringexpensive human visual inspection. For carrying out image enhancementunderstanding under low quality image is a challenging problembecause of these reasons. Due to low contrast, we cannot clearlyextract objects from the dark background. Most colour based methodswill fail on this matter if the colour of the objects and that of thebackground are similar.In this research the proposed algorithm can neither requires a color calibration chart/object, nor explicitly compensates for the image as a whole.

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