Volume 2, Issue 4, April 2012 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Image Enhancement and Its Various Techniques

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Abstract- **Image enhancement is the task of applying certain alterations to an input image like as to obtain a more visually pleasing image. The alteration usually requires interpretation and feedback from a human evaluator of the output resulting image. Image enhancement is to improve the image quality so that the resultant image is better than the original image for a specific application or set of objectives. Enhancement techniques such as alpha rooting operate on the transform domain. The transform domain enables operation on the frequency content of the image, and therefore high frequency content such as edges and other subtle information can easily be enhanced. However, these techniques bring about tonal changes in the images and can also generate unwanted artifacts in many cases, as it is not possible to enhance all parts of the image in balanced manner.**

***Keywords*— Image Enhancement, spatial domain techniques, frequency domain techniques**

I. INTRODUCTION

Digital image processing is an area characterized by need for extensive experimental work to establish the viability of proposed solutions to a given problem. Image processing technology is used by planetary scientists to enhance images of mars, venus or other planets. One of part of the image processing is the image enhancement. Image Enhancement is the improvement of digital image quality, without knowledge about the source of degradation. Image Enhancement is the technique to improve the interpretability or perception of information in images for human viewers [1]. It is to improve the image quality so that the resultant image is better than the original image for a specific application. 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. Whenever an image is converted from one form to other such as digitizing the image some form of degradation occurs at output.

Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured [2]. Enhancement may be used to restore an image that has suffered some kind of deterioration due to the optics, electronics and/or environment or to enhance certain features of an image. The objective of image enhancement is dependent on the application context, and the criteria for enhancement are often subjective or too complex to be easily converted to useful objective measures, image enhancement algorithms tend to be simple, qualitative, and ad hoc. In addition, in any given application, an image enhancement algorithm that performs well for one class of images may not perform as well for other classes [3]. Spatial domain techniques like the logarithmic transforms, power law transforms, histogram equalization, are based on the direct manipulation of the pixels in the image plane, while the transform domain techniques are based on the manipulation of the orthogonal transform of the image rather than the image itself [4].

II. RELATED WORK

Image enhancement process consists 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. The principal objective of image enhancement is to modify attributes of an image to make it more suitable for a given task and a specific observer. During this process, one or more attributes of the image are modified. Digital Image enhancement techniques provide a multitude of choices for improving the visual quality of images. Appropriate choice of such techniques is greatly influenced by the imaging modality, task at hand and viewing conditions [6].A familiar example of enhancement is shown in Fig.1 in which when we increase the contrast of an image and filter it to remove the noise "it looks better."It is important to keep in mind that enhancement is a very subjective area of image processing. Improvement in quality of these degraded images can be achieved by using application of enhancement techniques [2].

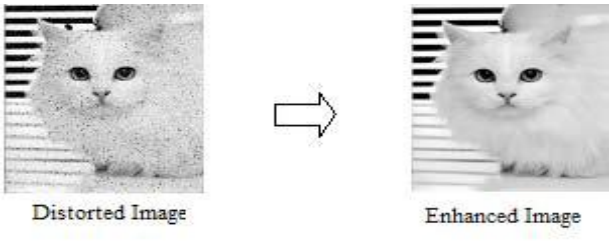

Fig.1: Image enhancement

The work done by various researchers for Image Enhancement are discussed as follows

Madhu [4] suggested that the Adaptive histogram equalization produced a better result, but the image is still not free from washed out appearance. The sharpness is poor and the background information as well as the plane is still fogged and poor in contrast. Alpha rooting rendered the entire image in a dark tone. Even the outline of the clouds which was visible in case of histogram equalization is lost.

Agaian [7] suggested that the common no transform-based enhancement technique is global histogram equalization, which attempts to alter the spatial histogram of an image to closely match a uniform distribution. Histogram equalization suffers from the problem of being poorly suited for retaining local detail due to its global treatment of the image. It is also common that the equalization will over enhance the image, resulting in an undesired loss of visual data, of quality, and of intensity scale.

Tang [9] suggested global histogram equalization, which adjusts the intensity histogram to approximate uniform distribution. The global histogram equalization is that the global image properties may not be appropriately applied in a local context. In fact, global histogram modification treats all regions of the image equally and, thus, often yields poor local performance in terms of detail preservation. Therefore, several local image enhancement algorithms have been introduced to improve enhancement.

III. IMAGE ENHANCEMENT TECHNIQUES

Image enhancement techniques can be divided into two broad categories:-

3.1 Spatial Domain Techniques:

Spatial domain techniques directly deal with the image pixels. The pixel values are manipulated to achieve desired enhancement. Spatial domain techniques like the logarithmic transforms, power law transforms, histogram equalization, are based on the direct manipulation of the pixels in the image. 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 [4]. It is not possible to selectively enhance edges or other required information effectively. Techniques like histogram equalization are effective in many images.

3.1. 1 Point Operation

Point operations, or image processing operations are applied to individual pixels only. The point operation is represented by

$$g(m,n)= T[f(m,n)]$$

Where f(m,n) is the input image, g(m,n) is the processed image, and T is the operator defining the modification process which operates on one pixel.

3.1.2 Mask Operation

In mask operation, each pixel is modified according to values in a small neighbourhood.

3.1.3. Global Operation

In global operation, all pixel values in the image are taken into consideration for performing operation.

3.2 Frequency Domain Techniques

Frequency domain techniques are based on the manipulation of the orthogonal transform of the image rather than the image itself. Frequency domain techniques are suited for processing the image according to the frequency content [1]. The principle behind the frequency domain methods of image enhancement consists of computing a 2-D discrete unitary transform of the image, for instance the 2-D DFT, manipulating the transform coefficients by an operator M, and then performing the inverse transform. 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 [4]. The usual orthogonal transforms are discrete cosine transform, discrete Fourier transform, Hartley Transform etc.The transform domain enables operation on the frequency content of the image, and therefore high frequency content such as edges and other subtle information can easily be enhanced.

IV. APPLICATIONS

Image enhancement is used for enhancing a quality of images. The applications of image enhancement are Aerial imaging, Satellite imaging, Medical imaging, Digital camera application, Remote sensing.

V. CONCLUSION

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. There are various techniques available which produce highly balanced and visually appealing results for a diversity of images with different qualities of contrast and edge information and it will produce satisfactory result.

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