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An Overview of Image Processing and its Techniques

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Abstract: Image processing is one of the rapidly growing fields at present due to the increased advancements in the digital silicon chips, computers and digital signal processing. It is a technique used to enhance the raw images from various sources for different applications. The sources could be cameras or sensors or scanners etc.Image processing is generally classified as analog and digital version of it; digital image processing(DIP) is mostly used. The various steps involved in DIP include with image acquisition, Image enhancement, image segmentation, feature extraction, image classification etc. The present paper gives a brief introduction on image processing and a detailed overview of techniques used in it.
Keywords: Feature extraction, Image acquisition, image classification, image enhancement, imagesegmentation, image restoration.

Introduction

The Image processing can be defined as the class of signal processing in which input is an image on which we perform some operations to get an enhanced version of it or to extract some characteristics of it. It is one of the rapidly growing research areas. To start the research in this field one must understand what the need of image processing is. There are two main application areas, because of which the importance and necessity of image processing is rapidly increasing i.e. enhancement of pictorial information and advancement in human-machine interfaces. It can be broadly classified as analog and digital image processing. Due to its wide range of applications the digital image processing has dominated over its analog counterpart. By definition, analog image processing is done on analog signals, i.e the images are altered by electrical means by varying the electrical signal e.g. television image. Whereas,the digital image processing involves techniques in which images are manipulated by using computers. Application areas include image and data storage, remote sensing, medical imaging, industrial automation etc. This paper focused more on digital image processing.

A. An Image

An image can be viewed as a two dimensional function, f(x,y), where xand y represent the spatial coordinates and f indicates the amplitude values. In other words an image can be defined as a two dimensional array. Every element in digital image is called as a picture element or pixel in general. The images can be categorized into binary image, gray scale image, 8 bit format, 16 bit format depending on the applications. The following section will describe briefly how different operations are performed on any image again depending on various applications.

Different Phases of Digital Image Processing

The following are the different phases of digital image processing.Each subsection will provide the basic idea of applying different techniques in this field.

A. Image Acquisition

The method of acquiring image from different sources and then transforming those raw images into an array of numerical data is called as the image acquisition process. And this process depends on what type of hardware system we have to acquire image. For example, a camera consists of a sensor which measures the reflected energy. Most of the sensors used are made up of charge coupled device (CCD). Some of them use CMOS technology.

B. Image Enhancement

The method of providing better representation of an input image is called as the image enhancement process. Many images for example medical images, satellite images etc., they suffer from poor contrast and noise. Hence to get useful information out of these images it becomes necessary to enhance and remove the noise content. Also the process of enhancement differs from one field to another. Basically image enhancement can be done in either spatial domain or in frequency domain. Spatial domain techniques

directly deal with the image pixels whereas frequency domain techniques use orthogonal transform of the image rather than considering image itself.

Some of the spatial domain techniques are logarithmic transforms, power law transforms, histogram equalization. All these techniques usually enhance the entire image in a uniform manner. And this might undesirable result in some cases since using these techniques it is not possible to enhance edges or to select other required information. The most commonly used spatial domain technique is the histogram equalization. Figure 1. shows an example of image enhancement by histogram equalization.

Figure 1.Example of image enhancement using histogram equalization

C. Image Restoration

Sometimes images get degraded by during the process of acquisition and the process of recovering such degraded image is called image restoration. It improves the appearance and quality of the image. We can see the degraded image as the image obtained by convolving the original image with degraded function and additive noise. Therefore to restore the image we need to de-convolve the degraded image. Most commonly used method for image restoration includes inverse filter, Wiener filter, constrained least square filter method etc.One obvious question that will now arise is the difference between image enhancement and restoration. Image enhancement only manipulates the degraded image and it couldn't be precisely represented by mathematical functions whereas in case of restorationspecific featuresare extracted from the imperfect image.Figure 2.Shows an example of image restoration using wiener filter method.

Figure 2.Example of image restoration using Wiener filter

D. Color Image Processing

Color is a powerful component which simplifies the object identification and extraction. Color image processing is divided into two categories i.e full color and pseudo color processing.in case of full color processing, the images are acquired with a full color sensor whereas in pseudo color processing color is assigned to a particular monochrome intensity.

E. Image Compression

Image compression plays a very important role in the effective storage and transmission of the images. The main aim of image compression is to decrease the redundancy in the image data to record or send only few number of samples. In any digital image which is basicallyan array of pixels,these pixels are correlated with their neighboring pixels and hence contain redundant bits. With the help of compression algorithms such redundant bits can be removed from image so that the image size is reduced. There can be two types of compression algorithm possible i.e. Lossy and Lossless.

In the lossless compression, the compressed image is the exact replica of the original image. Some of the most commonly used losslesscompression algorithms are Run Length Encoding (RLE), Entropy encoding, Predictive Coding.
RLE algorithm replaces a sequence of identical symbols by a pair containing the symbol and the run length. Entropy encoding creates and assigns a unique prefix code to each of the unique symbol occurring in the input and then compresses the data by replacing every fixed length input symbol with the corresponding variable length prefix free codeword. Predictive coding encodes only new information in each pixel. The new information is the difference the actual and the predicted value of the pixel.

In Lossy compression, the compressed image is not same as that of the input image. There is some amountof loss in the image. Some of thelossy compression algorithms are Transform encoding, Vector quantization, Fractal Coding.
Transform encoding is used for natural data like audio signals or photographic image. In this case the knowledge of the application is used tochoose information to discard. The remaining information is then compressed. Vector Quantization develops a dictionary of fixed size vectors. In this case the given image is partitioned into non overlapping blocks which are called as image vectors. For each of thse image vectors the closest matching in the dictionary is found its index in the dictionary is used as the encoding of the original image. Fractal coding decomposes the image into segments. Each segment is looked up in a fractals.

F. Morphological Processing

When performing operations like thresholding there is a chance that images get distorted due to noise. The aim of the morphological operations is to remove the imperfections in the images which may affect the shape and texture of the image. These operations are most commonly defined for binary images, they can also be applied for gray scale images.

G. Image segmentation

It is a process that subdivides an image into its constituent parts.To what extent this sub divisions carried out depends on the problem being solved. It should stop when the objects of interest in an application have been isolated. Image segmentation can be classified into two categories i.e. Local segmentation and global segmentation. Local segmentation is concerned with specific part or region of the image whereas the global segmentation concerned with segmenting the whole image. There are several techniques for segmentation and each one has its own importance. All the techniques can be approached in two ways i.e. region based or egde based approaches. Some of the most commonly used segmentation techniques are as shown in Figure 3.
All the techniques are categorized into three classes as Structural segmentation , stochastic segmentation and Hybrid techniques.Structural techniques rely on the information of the structure of required portion of the image. Stochastic technique works on the discrete pixel values of the image instead of the structural information of the region. And the hybrid techniques use the concept of both discrete pixel and structural information together.

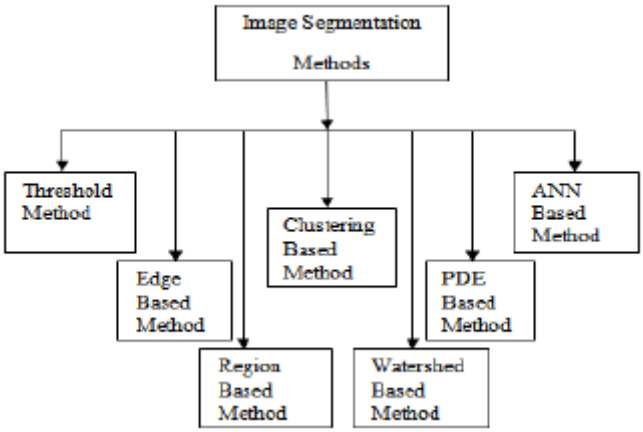

Figure 2.Image segmentation techniques

H. Object Detection and Recognition

Object detection and recognition in image processing is concerned with determining the identity of an object in an image. It is basically a web based application which mainly used to detect the multiple objects from various types of images. It does recognize the images after performing the detection.

Conclusion

This paper presents an overview of various stages of image processing techniques. It provides the brief idea about the various algorithms that can be efficiently applied for image processing depending on the application.

References

[1]. YunBo Rao and Leiting Chen, "An efficient contourlet transform-based algorithm for video enhancement", Journal ofzInformation Hiding andMultimedia Signal Processing, vol. 2, no. 3, pp. 282-293, 2011.

[2]. T. Singh, "Novel Restoration Process for Degraded Image," in 2014 Fifth International Conference on Signal and Image Processing, 2014, pp. 81–86.

[3]. A. Thakur and A. Iqbae, "Comparison efficacy of restoration method for Space Variant Motion Blurred Images using kalman & wiener filter," 2016.

[4]. R. Kaur and E. N. Singh, "Image Restoration - A Survey," *IOSR J. Comput. Eng.*, vol. 16, no. 4, pp. 107–111, 2014.

[5]. D. Sugimura, T. Mikami, H. Yamashita, and T. Hamamoto, "Enhancing Color Images of Extremely Low Light Scenes Based on RGB/NIR Images Acquisition With Different Exposure Times", IEEE TRANSACTIONS ON IMAGE PROCESSING,VOL. 24, NO. 11, Nov. 2015.

[6]. Agrawal A, Raskar R. ,"Optimal single image capture for motion deblurring", Proceedings of IEEE Conference on Computer Vision and Pattern Recognition; 2009. p. 2560–7.

[7]. Arun R, Madhu S, Nair R, Vrinthavani, Tatavarti R., "An alpha rooting based hybrid technique for image enhancement", Engineering Letters. 2011; 19(3):159.

[8]. Gonzalez R., "Image restoration and reconstruction in Digital Image Processing", 3rd Ed. India: Pearson Prentice Hall; 2011. p. 322–30.

[9]. Digital Image Processing - Chellappa, 2nd Edition, IEEE Computer Society Press, 1992.