Chapter 2
Importance of Image Processing

Importance and necessity of digital image processing stems from two principal application areas: the first being the Improvement of pictorial information for human interpretation and the second being the Processing of a scene data for an autonomous machine perception. Digital image processing has a broad range of applications such as remote sensing, image and data storage for transmission in business applications, medical imaging, acoustic imaging, Forensic sciences and industrial automation. Images acquired by satellites are useful in tracking of earth resources, geographical mapping, and prediction of agricultural crops, urban population, weather forecasting, flood and fire control. Space imaging applications include recognition and analyzation of objects contained in images obtained from deep space-probe missions. There are also medical applications such as processing of X-Rays, Ultrasonic scanning, Electron micrographs, Magnetic Resonance Imaging, Nuclear Magnetic Resonance Imaging, etc.

In addition to the above mentioned applications, digital image processing is now being used to solve a wide variety of problems. Though unrelated, these problems commonly require methods capable of enhancing information for human visual interpretation and analysis. The Image processing Procedures such as Image enhancement and restoration are used to process degraded or blurred images. Successful applications of image processing concepts are found in astronomy, defense, biology, medical and industrial applications. As per Medical Imaging is concerned most of the images may be used in the detection of tumors or for screening the patients. The current major area of application of digital image processing (DIP) techniques is in solving the problem of machine vision so as to attain good results.

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2.1 Image Enhancement

The principle objective of image enhancement technique is to process an image so that the resultant image is more suitable than the original for a particular application. Most of the enhancement techniques are very much problem oriented and hence enhancement for one application may turn out to be degradation for the other. Enhancement approaches may be classified especially into two broad categories.

1. Spatial domain enhancement techniques
2. Frequency domain enhancement techniques.

The former technique refers to process the image in the image plane (pixels) itself while the latter techniques are based on modifying the transform (Fourier or any other) of an image. In most of the general enhancement techniques for problems involve various combinations of methods from both the categories.

Some examples of enhancement operations are edge enhancement, pseudo-coloring, histogram equalization(HE), contrast stretching, noise filtering, un-sharp masking, sharpening, magnifying, etc. Usually the enhancement process does not increase the inherent information content present in the image but only tries to present it in a suitable manner for easy assessment. These image enhancement operations may be either local or global. Global operations work on the entire image at a time while local operations define spatial masks i.e., on small sub-images over which the operation is to be performed.

2.2 Image Segmentation

Image segmentation is the most sought after technique for extracting information from an image. This is generally considered as the first step in image analysis. The Segmentation process subdivides an image into its constituent parts or objects, such that level of subdivision depends on the problem to be solved. Segmentation is stopped when the Region of interest in a specific application has been isolated.

Generally one of the most difficult tasks in digital image processing is the autonomous segmentation method. This step determines the eventual success or failure of the image analysis. Effective segmentation very rarely fails to lead to a successful solution. The application of segmentation algorithms on monochrome images generally are based on one of the two basic and important properties of gray level values

1. Discontinuity
2. Similarity

In discontinuity, the simple approach is to partition an image is basically based on changes that occur abruptly in gray level. The principal areas of image processing

interest within this type of discontinuity are detection of isolated points, lines and edges in an image. The principal approaches in the second type are based on thresholding, region growing, splitting and merging. The concept of segmentation algorithms based on discontinuity or similarity of the gray level value of its pixels is applicable to both static and dynamic images.

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