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Lect.3

Computer Imaging

Computer imaging is a fascinating and exciting area to be involved in today. The field of computer imaging separate into two primary categories:

Computer Vision and Image processing.

These two categories are not totally separate and distinct. Computer imagining can be separated into overlapping areas. Figure 1 below show that:

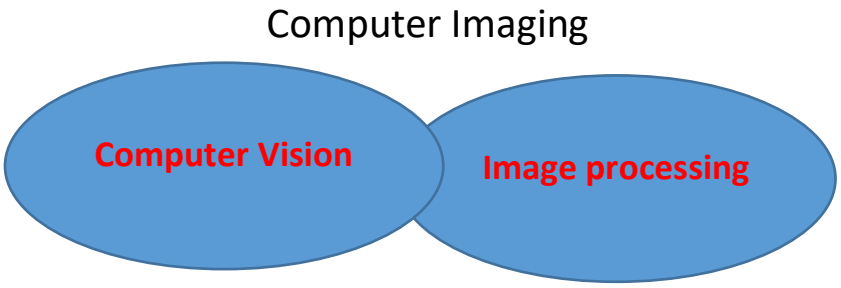

Figure (1): The overlapping between image processing and

1-Computer Vision:

Computer Vision is computer imaging, where the application does not involve a human being in the visual loop. In other word, the images are examined and acted upon by a computer. Computer vision systems used in many different areas within the medical community with only certainty being developed that the types of application will continue to grow.

2-Image Processing:

Image processing is computer imaging where the application involves a human being in the visual loop in other words the image is to be examined and acted upon by people the major to topics within the field of image processing include image restoration, image enhancement, and image compression.

There are no clear –cut bounders in the continuum from image processing at one end to computer vision at the other. Consider three types of computerized processes in these continuum:

1-Low-level processes: primitive operations ex: reduce noise, enhance contrast enhancement and sharpening.

2-Mid--level processes: segmentation (partitioning image as regions and objects).

3-High –level processes: recognizing objects.

Purpose of Image processing

The purpose of image processing is divided into 5 groups. They are:

Visualization - Observe the objects that are not visible.

Image sharpening and restoration - To create a better image.

Image retrieval - Seek for the image of interest.

Measurement of pattern – Measures various objects in an image.

Image Recognition – Distinguish the objects in an image.

Fundamental steps in Digital Image Processing:

It is convenient to subdivide different image processing algorithms into broad subclasses. There are different algorithms for different tasks and problems, and often we would like to distinguish the nature of the task at hand. In other words the steps to digital image processing as following and show that in figure 2.

1. Image Acquisition

This is the first step or process of the fundamental steps of digital image processing. Image acquisition could be as simple as being given an image that is already in digital form. Generally, the image acquisition stage involves preprocessing, such as scaling etc.

2. Image Enhancement

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, or simply to highlight certain features of interest in an image. Such as, changing brightness & contrast etc.

3. Image Restoration

Image restoration is an area that also deals with improving the appearance of an image. However, unlike enhancement, which is subjective, image restoration is objective, in the sense that restoration techniques tend to be based on mathematical or probabilistic models of image degradation.

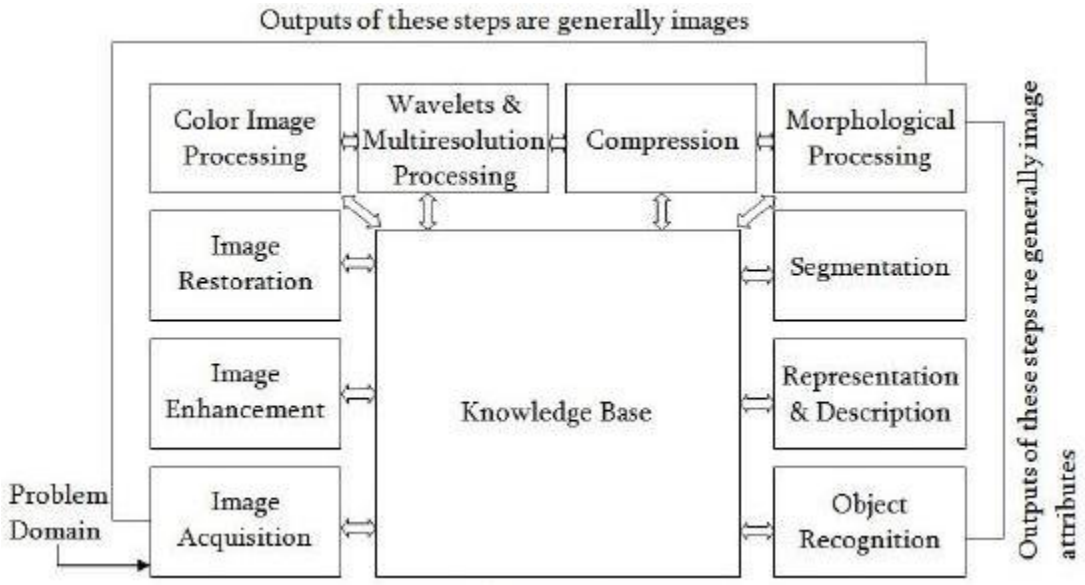

Figure (2). The fundamental steps to digital image processing.

4. Color Image Processing

Color image processing is an area that has been gaining its importance because of the significant increase in the use of digital images over the Internet. This may include color modeling and processing in a digital domain etc.

5. Wavelets and Multiresolution Processing

Wavelets are the foundation for representing images in various degrees of resolution. Images subdivision successively into smaller regions for data compression and for pyramidal representation.

6. Compression

Compression deals with techniques for reducing the storage required to save an image or the bandwidth to transmit it. Particularly in the uses of internet it is very much necessary to compress data.

7. Morphological Processing

Morphological processing deals with tools for extracting image components that are useful in the representation and description of shape.

8. Segmentation

Segmentation procedures partition an image into its constituent parts or objects. In general, autonomous segmentation is one of the most difficult tasks in digital image processing. A rugged segmentation procedure brings the process a long way toward successful solution of imaging problems that require objects to be identified individually.

9. Representation and Description

Representation and description almost always follow the output of a segmentation stage, which usually is raw pixel data, constituting either the boundary of a region or all the points in the region itself. Choosing a representation is only part of the solution for transforming raw data into a form suitable for subsequent computer processing. Description deals with extracting attributes that result in some quantitative information of interest or are basic for differentiating one class of objects from another.

10. Object recognition

Recognition is the process that assigns a label, such as, “vehicle” to an object based on its descriptors.

11. Knowledge Base:

Knowledge may be as simple as detailing regions of an image where the information of interest is known to be located, thus limiting the search that has to be conducted in seeking that information. The knowledge base also can be quite complex, such as an interrelated list of all major possible defects in a materials inspection problem or an image database containing high-resolution satellite images of a region in connection with change-detection applications.

Some applications of digital image processing:

Image processing has an enormous range of applications; almost every area of science and technology can make use of image processing methods. Here is a short list just to give some indication of the range of image processing applications.

1-Medicine:

Inspection and interpretation of images obtained from X-rays, MRI or CAT scans, analysis of cell images, of chromosome karyotypes.

2- Agriculture:

Satellite/aerial views of land, for example to determine how much land is being used for different purposes, or to investigate the suitability of different regions for different crops, inspection of fruit and vegetables—distinguishing good and fresh produce from old.

3- Industry:

Automatic inspection of items on a production line, inspection of paper samples.

4- Law enforcement:

Fingerprint analysis, sharpening or de-blurring of speed-camera images.

References:

1- Gonzales R.C. and Woods P., Digital Image Processing, Addison- Wesley,4th edition, 2018

2-Alasdair McAndrew, An Introduction to Digital Image Processing with Matlab Notes for SCM2511 Image Processing.