

Digital Image Processing

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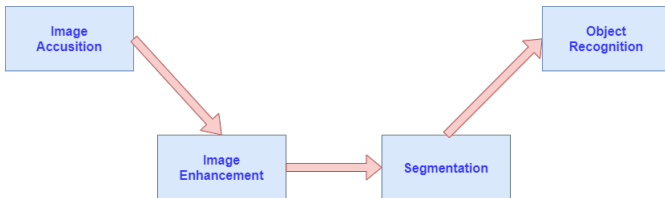
August 9, 2021

What is Digital Image Processing?

- Digital Image
 - a two-dimensional function
 - x and y are spatial coordinates
 - The amplitude of f is called intensity or gray level at the point (x, y)
 - Components are called pixels.
- Digital Image Processing
 - process digital images by means of computer
 - low-level: inputs and outputs are images
 - mid-level: outputs are attributes extracted from input images
 - high-level: an ensemble of recognition of individual objects

Components

Figure: Components of Image Processing



Process of Image Acquisition

The Image Acquisition is purely Hardware Dependent Process, in which reflected light energy from the object being imaged is converted into electrons and spread over the internal sensor chip which is like a 2-D array of cells is cell is called photosite and contain amount of charges which is further converted to digital form using Analog to Digital Converter.

Now this digital image can be used for enhancement, restoration, segmentation and other manipulations

Image Acquisition

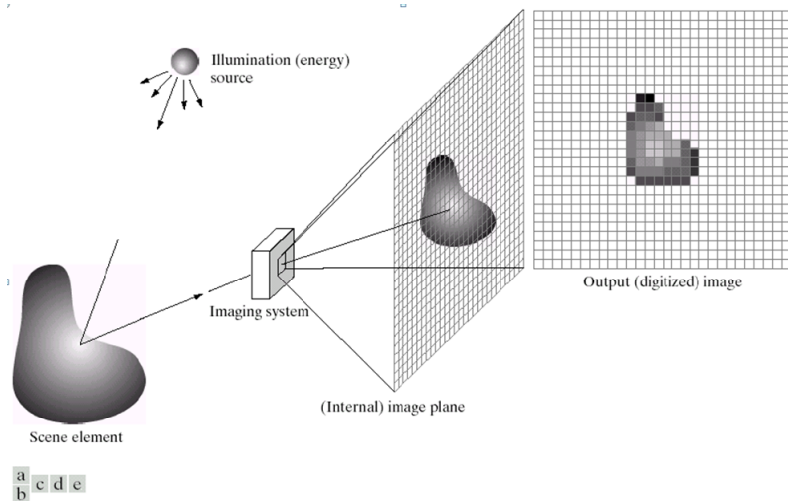
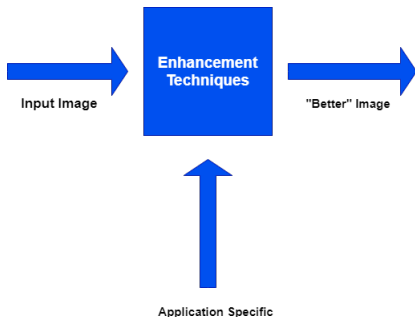


FIGURE : An example of the digital image acquisition process. (a) Energy (“illumination”) source. (b) An element of a scene. (c) Imaging system. (d) Projection of the scene onto the image plane. (e) Digitized image.

Image Enhancement

- **Image Enhancement process** consists of collection of techniques that seek to improve the visual appearance of the image or to convert the image to a form better suited for analysis.
- **The principle idea** of image enhancement is to modify the attributes of an image to make it more suitable for



Enhancement Techniques

The image enhancement techniques can be divide into two main categories:

- Spatial Domain Techniques

These techniques are performed to the image plane itself and they are based on direct manipulation of pixels in an image.

The operation can be formulated as $g(x, y) = T[f(x, y)]$, where g is the output, f is the input and T is some operation on f defined over some neighborhood of (x, y) .
e.g., **Contrast Enhancement, Sharpening.**

Enhancement Techniques

The image enhancement techniques can be divide into two main categories:

- Frequency Domain Techniques

In this techniques the image is first transferred into frequency domain using Fourier Transform. Then the Enhancement operations are performed on Fourier transform of the image and then the Inverse Fourier Transform is calculated to get the resultant image.

$$f(x, y) \rightarrow F(u, v) \rightarrow G(u, v) = H(u, v)F(u, v), G(u, v) \rightarrow g(x, y)$$

e.g. **Lowpass, Highpass filtering.**

Segmentation

Object Recognition