University of Al-Hamdaniya
Computer Science Department
Digital image processing

Digital Image Processing
An Introduction

Lec-1

By

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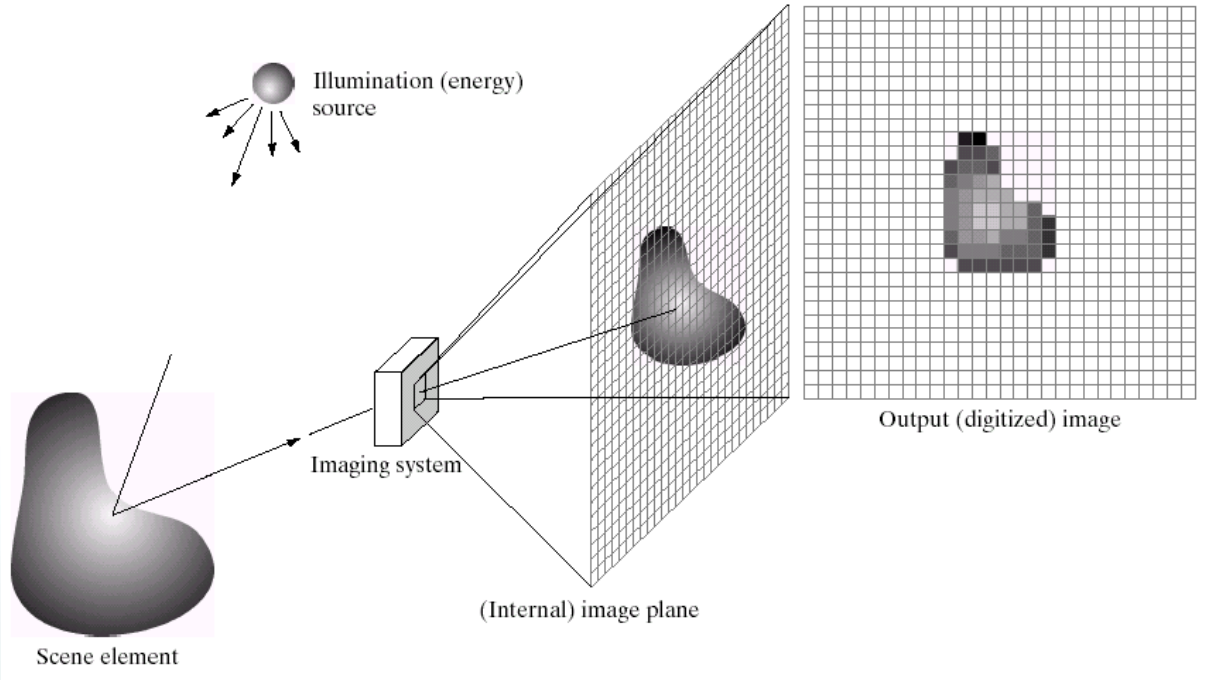
What is a Digital Image?

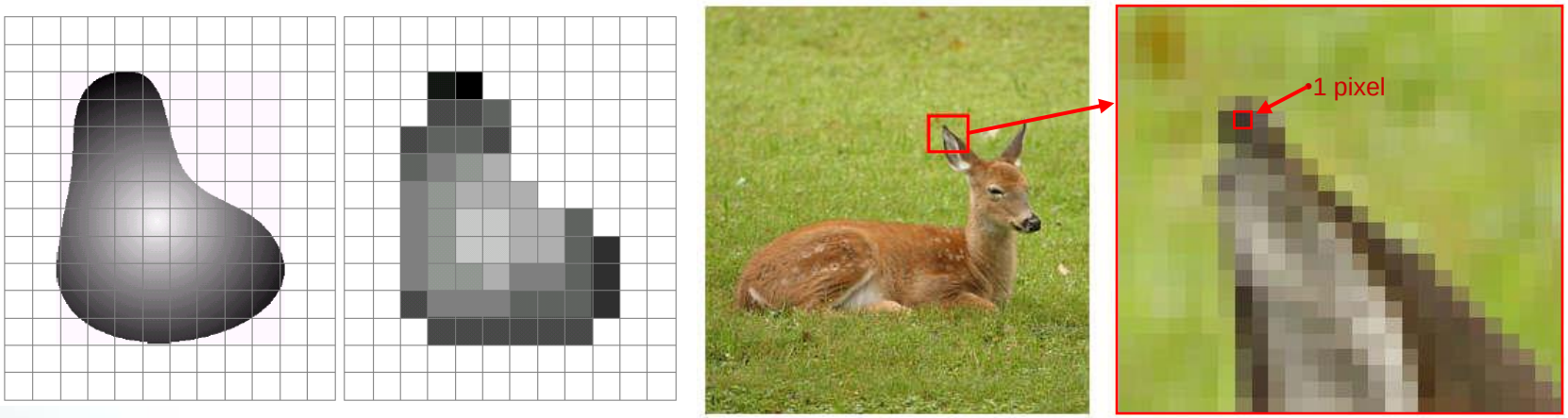
An Image is a 2D function, $f(x,y)$, x and y are *spatial* (plane) coordinates. Amplitude f is called *intensity* or *gray level* of the image**.**

A digital image is a representation of a two-dimensional image as a finite set of digital values, called picture elements or pixels



Pixel values typically represent gray levels, colours, heights, opacities etc

Remember *digitization* implies that a digital image is an *approximation* of a real scene



Common image formats include:

- 1 sample per point (B&W or Grayscale)
- 3 samples per point (Red, Green, and Blue)
- 4 samples per point (Red, Green, Blue, and “Alpha”, a.k.a. Opacity)



For most of this course we will focus on grey-scale images

Common Image types

1. Binary Image (B&W)

Black and White contains only two levels (0,1). 1 bit per pixel.

Binary Image

2. Gray scale image

Gray image represent by black and white shades of gray without apparent color or combination of levels for example: (8-bit)gray image means total (2^8) levels form black to white **0 = black** and **255 = White.**

Gray scale image

3. RGB Image (Red, Green, and Blue)

RGB (Red, Green, and Blue) refers to a system for representing the colors to be used on a computer display. Red, Green, and Blue can be combined in various proportions to obtain any color in the visible spectrum. For every color channel: red (R), green (G), and blue (B) each matrix element contains an 8-bit value, refers to the amount of red, green, or blue at that point in a [0-255] scale.

RGB Red(R) Green(G) Blue(B)

- The figure is an example of digital image that you are now viewing on your computer screen. But actually , this image is nothing but a two dimensional array of numbers ranging between 0 and 255.

- Each number represents the value of the function f(x,y) at any point. In this case the value 128 , 230 ,123 each represents an individual pixel value. The dimensions of the picture is actually the dimensions of this two dimensional array.

128	230	123
232	123	321
123	77	89
80	255	255

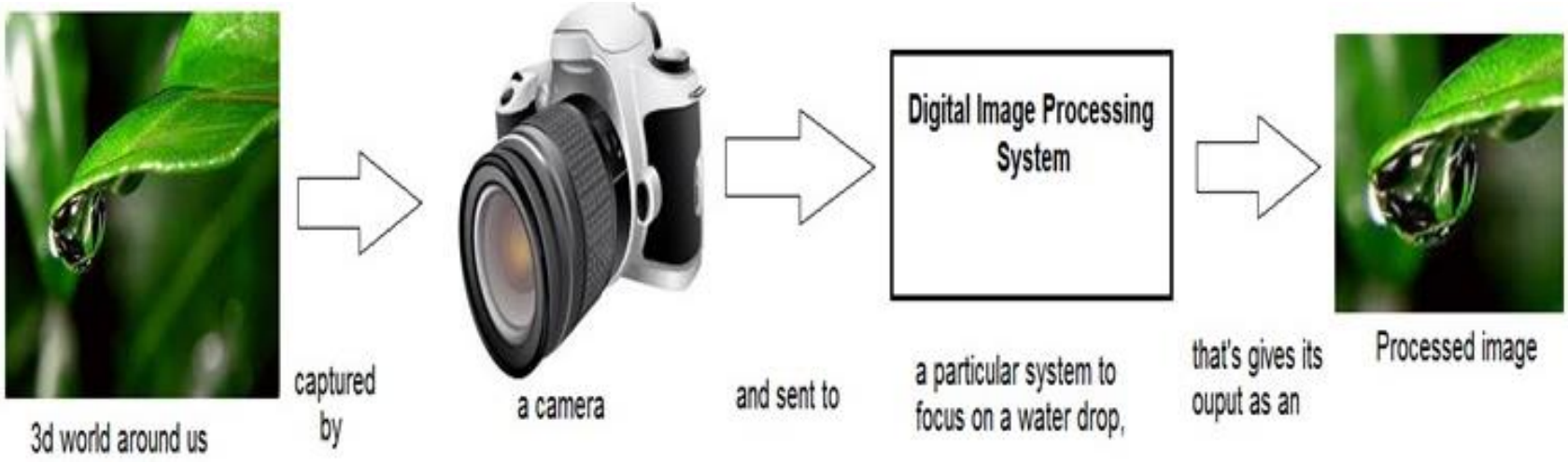
What is Digital Image Processing?

Digital Image Processing : Processing a given *input image* to obtain a desired *output image*.

Digital image processing focuses on **two major tasks**

- Improvement of pictorial information for human interpretation
- Processing of image data for storage, transmission and representation for autonomous machine perception.

How it works



In the above figure , an image has been captured by a camera and has been sent to a digital system to remove all the other details , and just focus on the water drop by zooming it in such a way that the quality of the image remains the same.

Image Processing Types:

- **Analog image processing**

  Analog image processing is done on analog signals. It includes processing on two dimensional analog signals. In this type of processing, the images are manipulated by electrical means by varying the electrical signal. The common example include is the television image.

- **Digital image processing**

  The digital image processing deals with developing a digital system that performs operations on an digital image.

  Digital image processing has dominated over analog image processing with the passage of time due its wider range of applications.

The continuum from image processing to computer vision can be broken up into low-, mid- and high-level processes

•**Low Level Process**	•**Mid Level Process**	•**High Level Process**
•**Input:** Image **Output:** Image •**Examples:** Noise removal, image sharpening	•**Input:** Image **Output:** Attributes •**Examples:** Object recognition, segmentation	•**Input:** Attributes **Output:** Understanding •**Examples:** Scene understanding, autonomous navigation

•In this course we will stop here

History of Digital Image Processing

Early 1920s: One of the first applications of digital imaging was in the news-paper industry

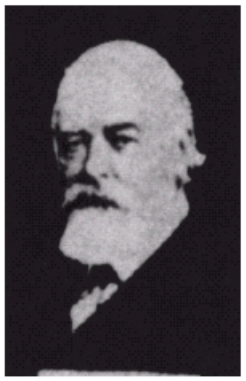
- The Bartlane cable picture transmission service
- Images were transferred by submarine cable between London and New York
- Pictures were coded for cable transfer and reconstructed at the receiving end on a telegraph printer

•Early digital image

History of DIP (cont…)

Mid to late 1920s: Improvements to the Bartlane system resulted in higher quality images

- New reproduction processes based on photographic techniques
- Increased number of tones in reproduced images



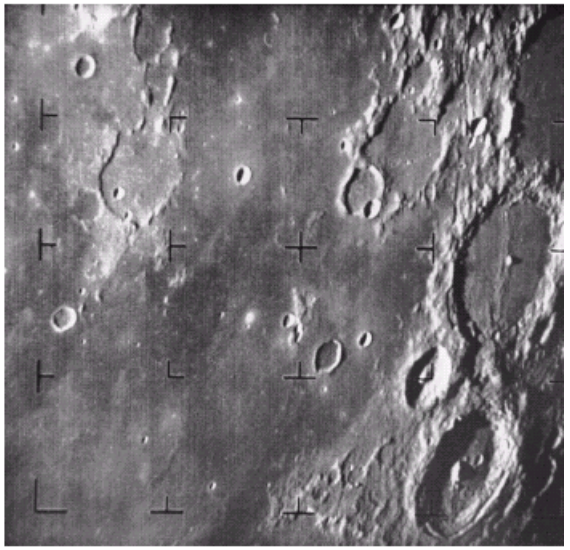
•Improved digital image

•Early 15 tone digital image

History of DIP (cont…)

1960s: Improvements in computing technology and the onset of the space race led to a surge of work in digital image processing

- **1964:** Computers used to improve the quality of images of the moon taken by the *Ranger 7* probe
- Such techniques were used in other space missions including the Apollo landings

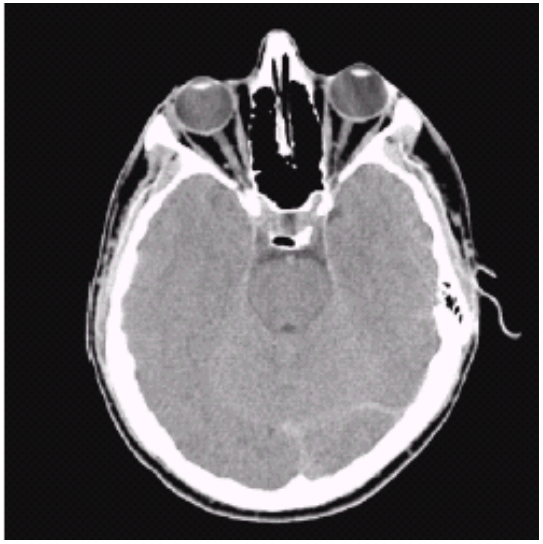


•A picture of the moon taken by the Ranger 7 probe minutes before landing

History of DIP (cont…)

1970s: Digital image processing begins to be used in medical applications

- **1979:** Sir Godfrey N. Hounsfield & Prof. Allan M Cormack share the Nobel Prize in medicine for the invention of tomography, the technology behind Computerised Axial Tomography (CAT) scans



•Typical head slice CAT image

History of DIP (cont…)

1980s - Today: The use of digital image processing techniques has exploded and they are now used for all kinds of tasks in all kinds of areas

- Image enhancement/restoration
- Artistic effects
- Medical visualisation
- Industrial inspection
- Law enforcement
- Human computer interfaces

End Of Lecture