Digital Image

- an image composed of picture elements, also known as pixels, each with finite,
- a two-dimensional function f (x, y)
  x and y are spatial coordinates
  The amplitude of f is called intensity or gray level at the point (x, y)
- An image stored in binary form and divided into a matrix of pixels. Each pixel consists of a digital value of one or more bits

Digital Image Processing?

- is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it.
- Digital image processing is the use of a digital computer to process digital images through an algorithm.

- process digital images by means of computer, it covers low-, mid-, and high-level processes

  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

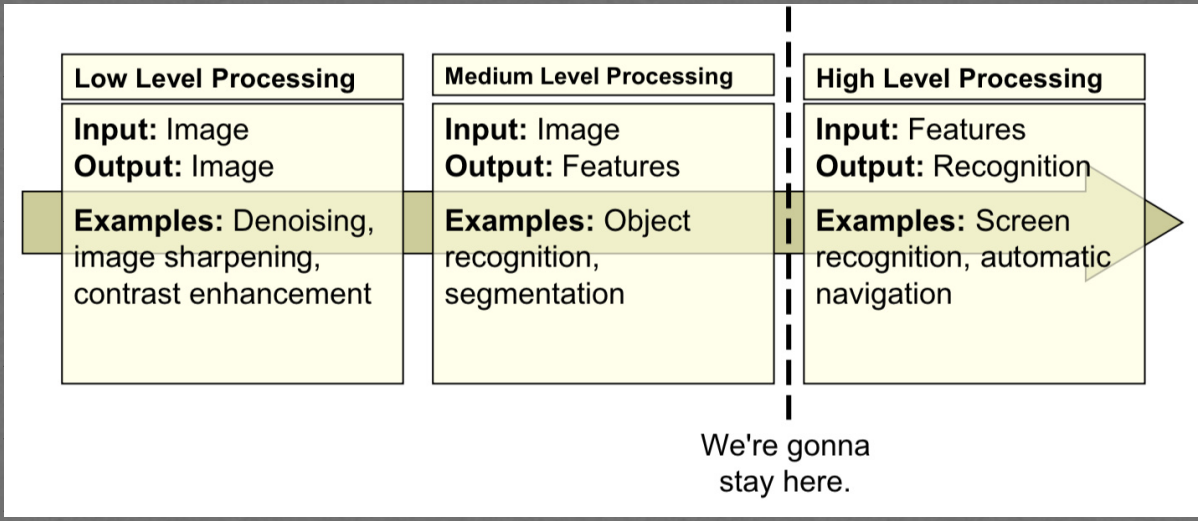
Pixel

- Components of a digital image

- The smallest addressable element in a raster image, or the smallest addressable element in an all points addressable display device; so it is the smallest controllable element of a picture represented on the screen.

Digital image processing focuses on two main tasks

- Improvement of image information for people's perception and interpretation
- Processing of image data for storage, transmission and good detection of machines



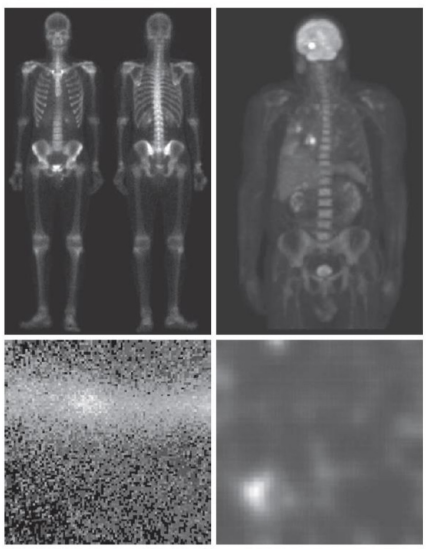
Sources for Images

- Electromagnetic (EM) energy spectrum
- Acoustic
- Ultrasonic
- Electronic
- Synthetic images produced by computer

- Gamma-ray imaging: nuclear medicine and astronomical observations

Gamma ray is electromagnetic radiation of the shortest wavelength and highest energy

Gama-Ray Imaging



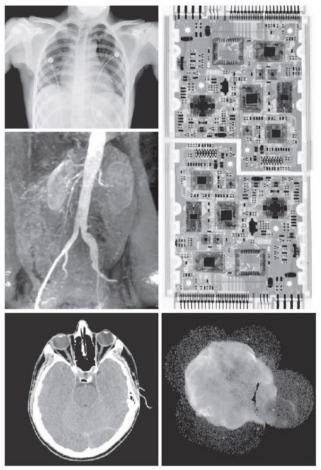
a b
c d

FIGURE 1.6
Examples of gamma-ray imaging. (a) Bone scan. (b) PET image. (c) Cygnus Loop. (d) Gamma radiation (bright spot) from a reactor valve. (Images courtesy of (a) G.E. Medical Systems, (b) Dr. Michael E. Casey, CTI PET Systems, (c) NASA, (d) Professors Zhong He and David K. Wehe, University of Michigan.)

- X-rays: medical diagnostics, industry, and astronomy, etc.

X-rays are a form of electromagnetic radiation, similar to visible light. Unlike light, however, x-rays have higher energy and can pass through most objects, including the body. Medical x-rays are used to generate images of tissues and structures inside the body.

X-Ray Imaging



a b c d e **FIGURE 1.7** Examples of X-ray imaging. (a) Chest X-ray. (b) Aortic angiogram. (c) Head CT. (d) Circuit boards. (e) Cygnus Loop. (Images courtesy of (a) and (c) Dr. David R. Pickens, Dept. of Radiology & Radiological Sciences, Vanderbilt University Medical Center; (b) Dr. Thomas R. Gest, Division of Anatomical Sciences, University of Michigan Medical School; (d) Mr. Joseph E. Pascente, Lixi, Inc.; and (e) NASA.)

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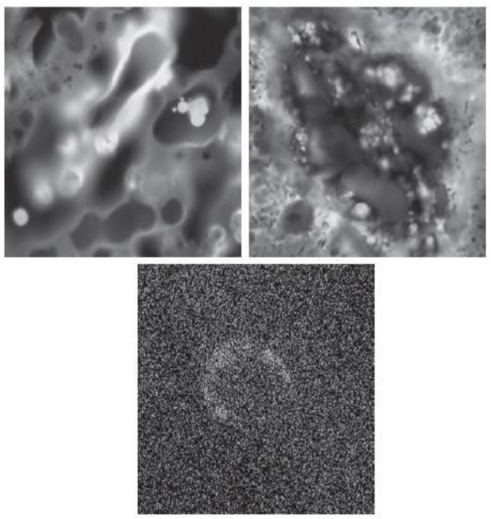
Ultraviolet Imaging.

Ultraviolet is a form of electromagnetic radiation with wavelength from 10 nm to 400 nm, shorter than that of visible light, but longer than X-rays. UV radiation is present in sunlight, and constitutes about 10% of the total electromagnetic radiation output from the Sun.

Ultraviolet Imaging



a b c

FIGURE 1.8 Examples of ultraviolet imaging. (a) Normal corn. (b) Smut corn. (c) Cygnus Loop. (Images courtesy of (a) and (b) Dr. Michael W. Davidson, Florida State University, (c) NASA.)

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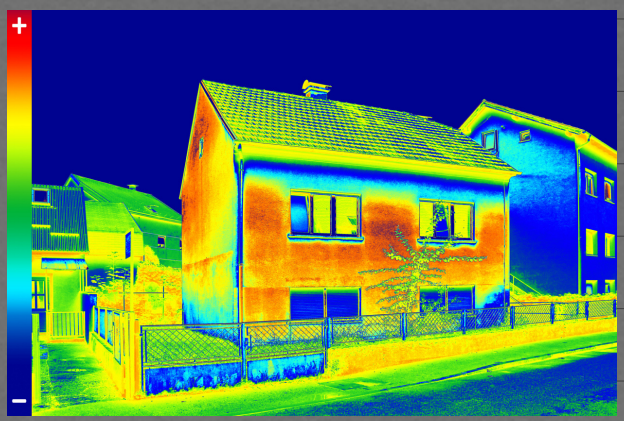
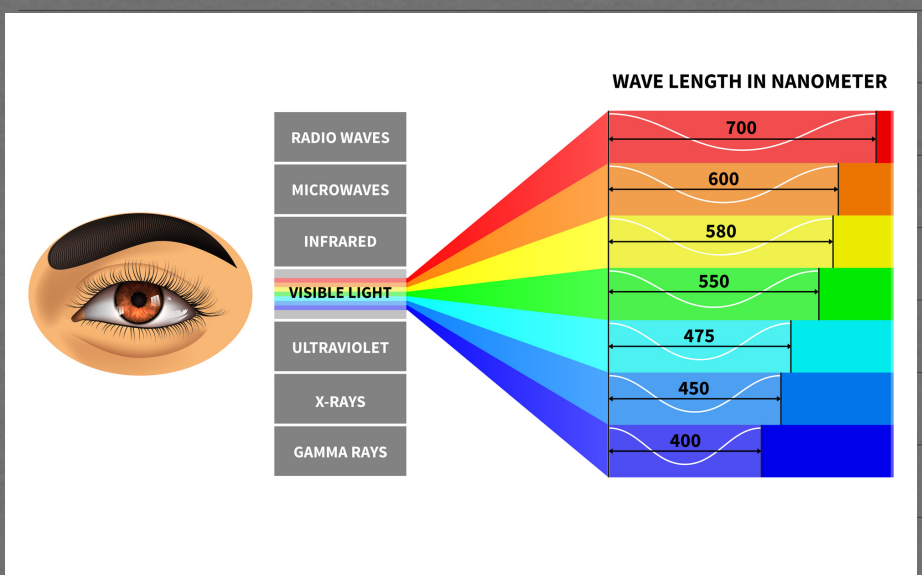
Infrared Imaging

Infrared (IR) imaging technology is used to measure the temperature of an object.

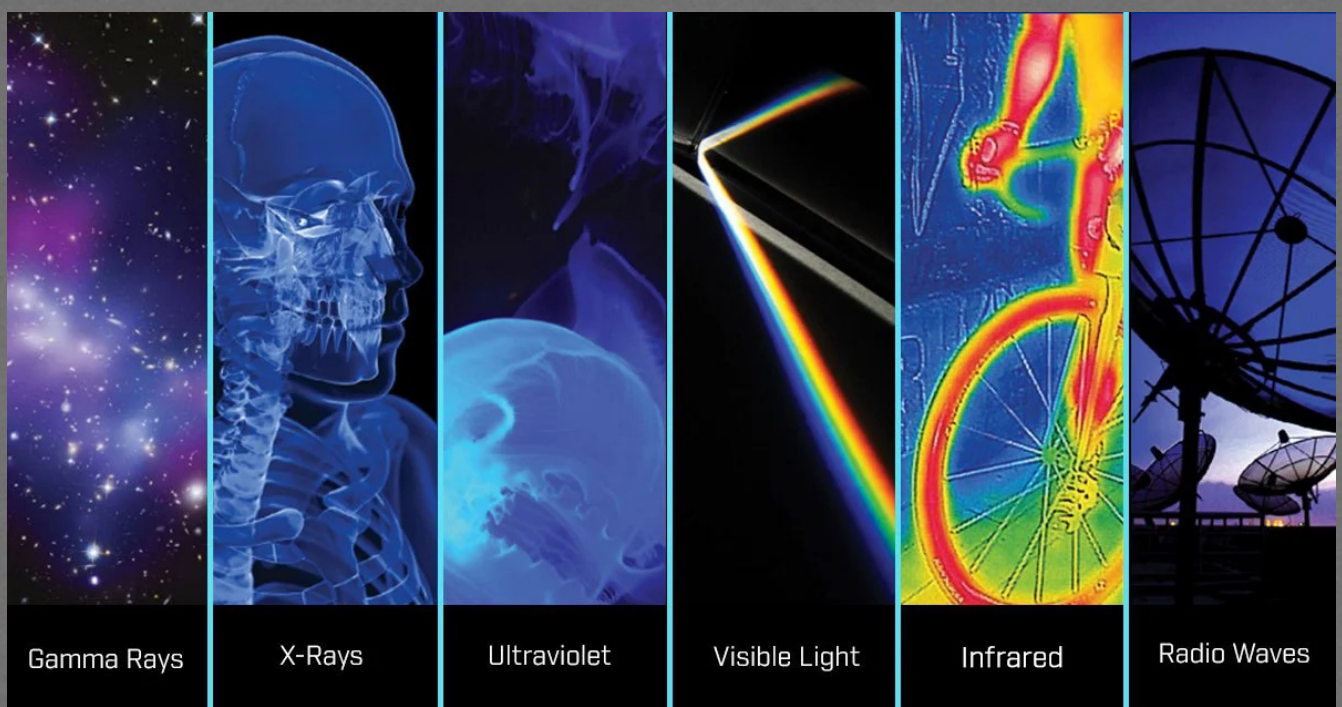


visible light

The visible spectrum is the portion of the electromagnetic spectrum that is visible to the human eye. Electromagnetic radiation in this range of wavelengths is called visible light or simply light. A typical human eye will respond to wavelengths from about 380 to about 750 nanometers.



All Rays types



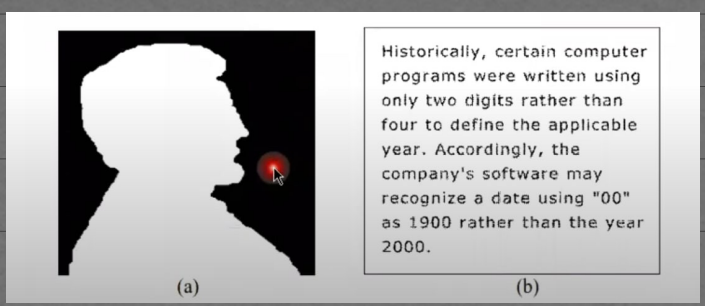
Fundamental tasks in Digital image processing

- **Image enhancement:** To improve the quality of image.
- **Image restoration**: To restore or recover original image from a degraded version.
- **Image compression**: Reducing the storage size required to store or transmit an image.
- **Image segmentation**: Is concerned with procedures that partition an image into parts or objects
- **Image Recognition**: recognizing en object from en image such as the car plate number, face detection and recognition

Type of Digital images

Binary images

A Binary image is referred to as a 1-bit image because it takes only 1 binary digital
(black = 0 and white = 1)

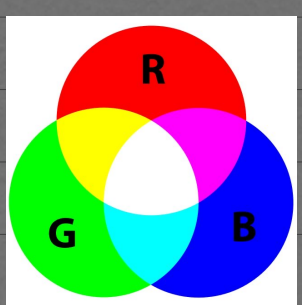


Grey - scale images

Grey - scale images are referred to as monochrome (one-color)images. It is 8-bit / pixel data, which allows us to have 256different

Color images

Typical color images are represented as red, green, and blue (RGB). It is 28-bit / pixel.



The Function $f(x,y)$ is the product of 2 components

[1] $i(x,y)$ The amount of source illumination incident on the scence.

[2] $r(x,y)$ The amount of illumination refl-

ected by the objects in the scene.

So $\boxed{F(x,y) = I(x,y) * r(x,y)}$