CST382-3 Digital Image Processing

Elements of Visual Perception

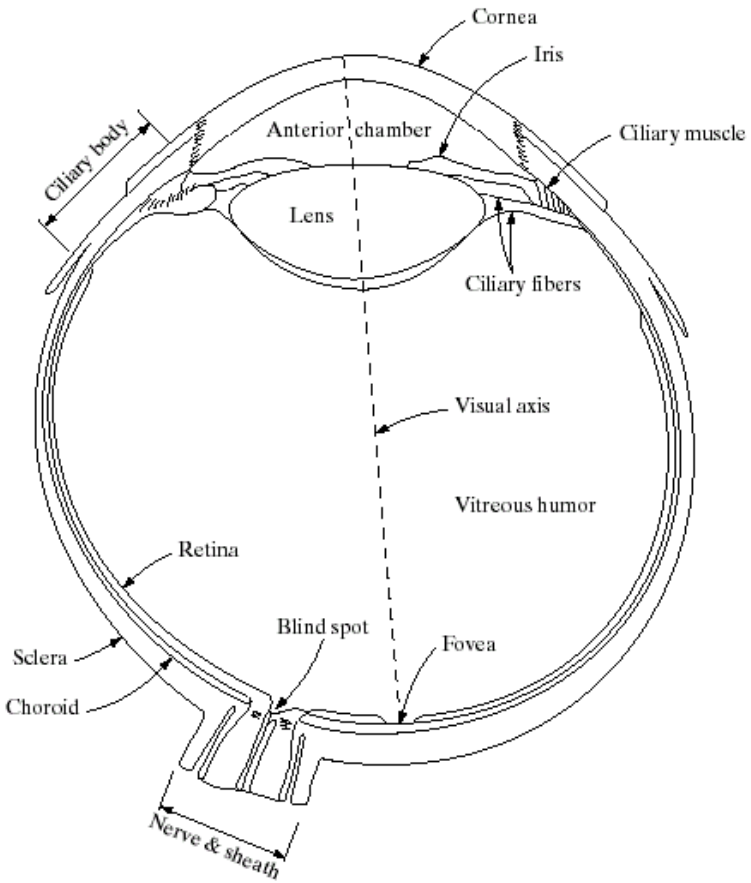


FIGURE 2.1
Simplified diagram of a cross section of the human eye.

Cones & Rods

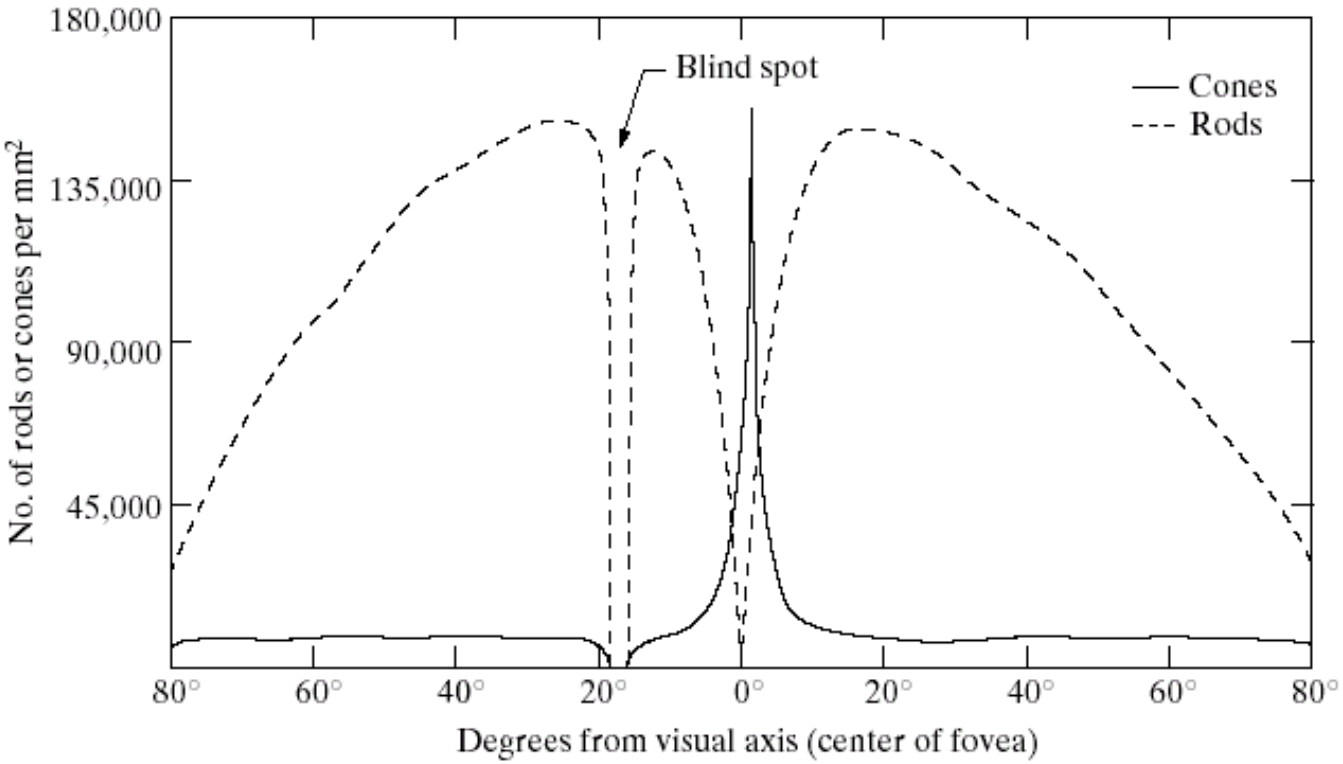


FIGURE 2.2
Distribution of rods and cones in the retina.

Image Formation

FIGURE 2.3
Graphical representation of the eye looking at a palm tree. Point *C* is the optical center of the lens.

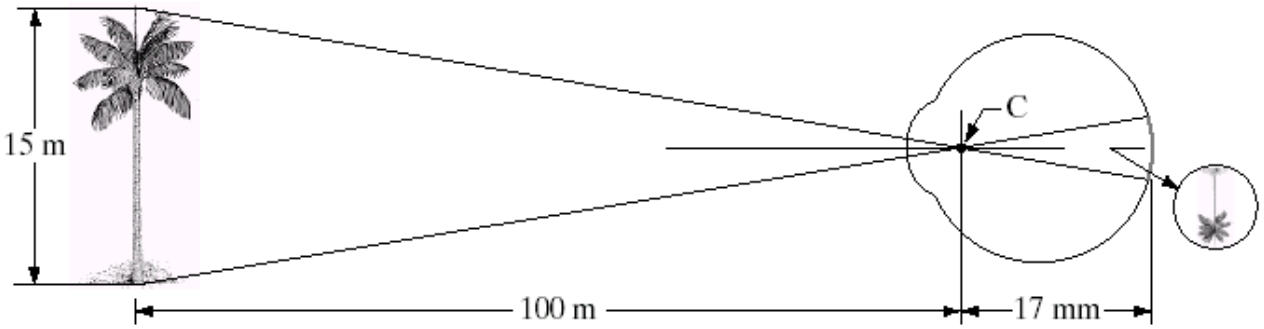


Image Sampling & Quantization

- To create a digital image, we need to convert continuous sensed data into digital form.
  - Sampling
  - Quantization

Image Representation

- To convert it to digital form, we have to sample the function in both coordinates and in amplitude.
- An image may be continuous with respect to the x- and y-coordinates and also in amplitude.

Image Representation

- Digitizing the coordinate values is called sampling.
- Digitizing the amplitude values is called quantization.

Image Representation

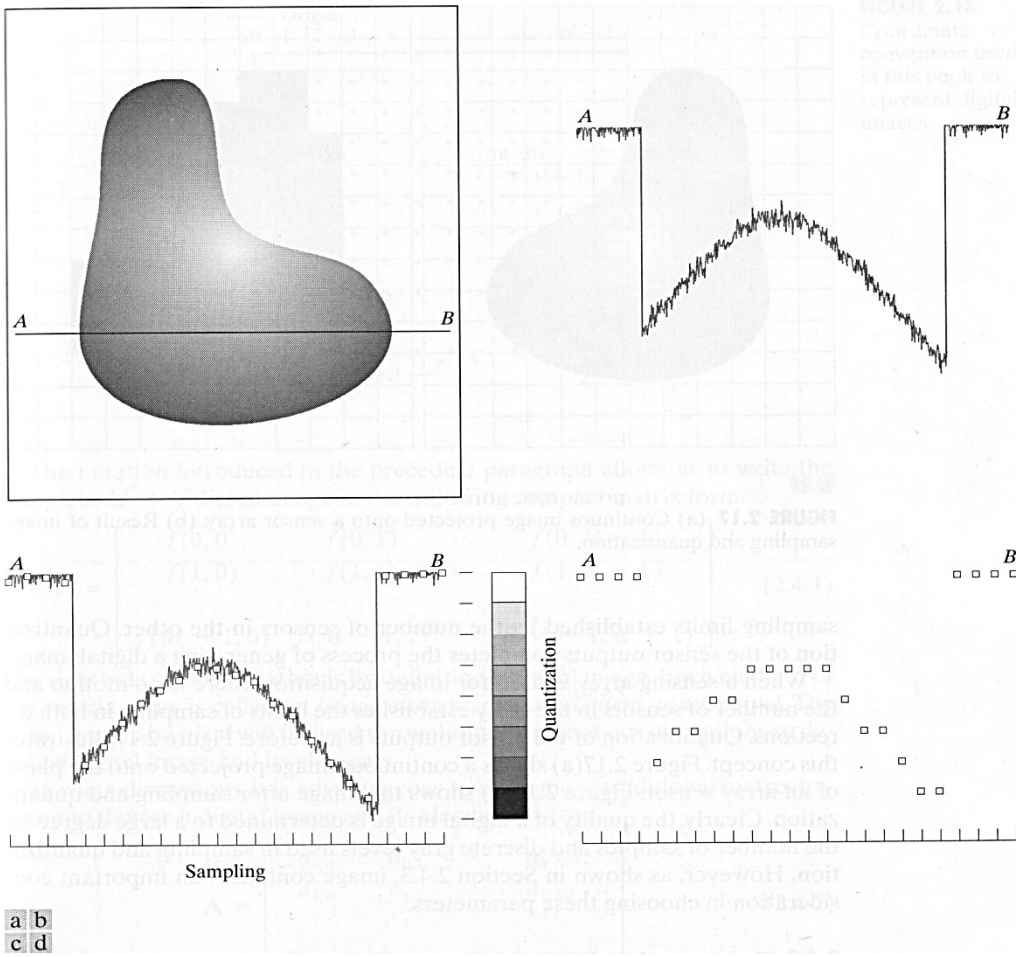
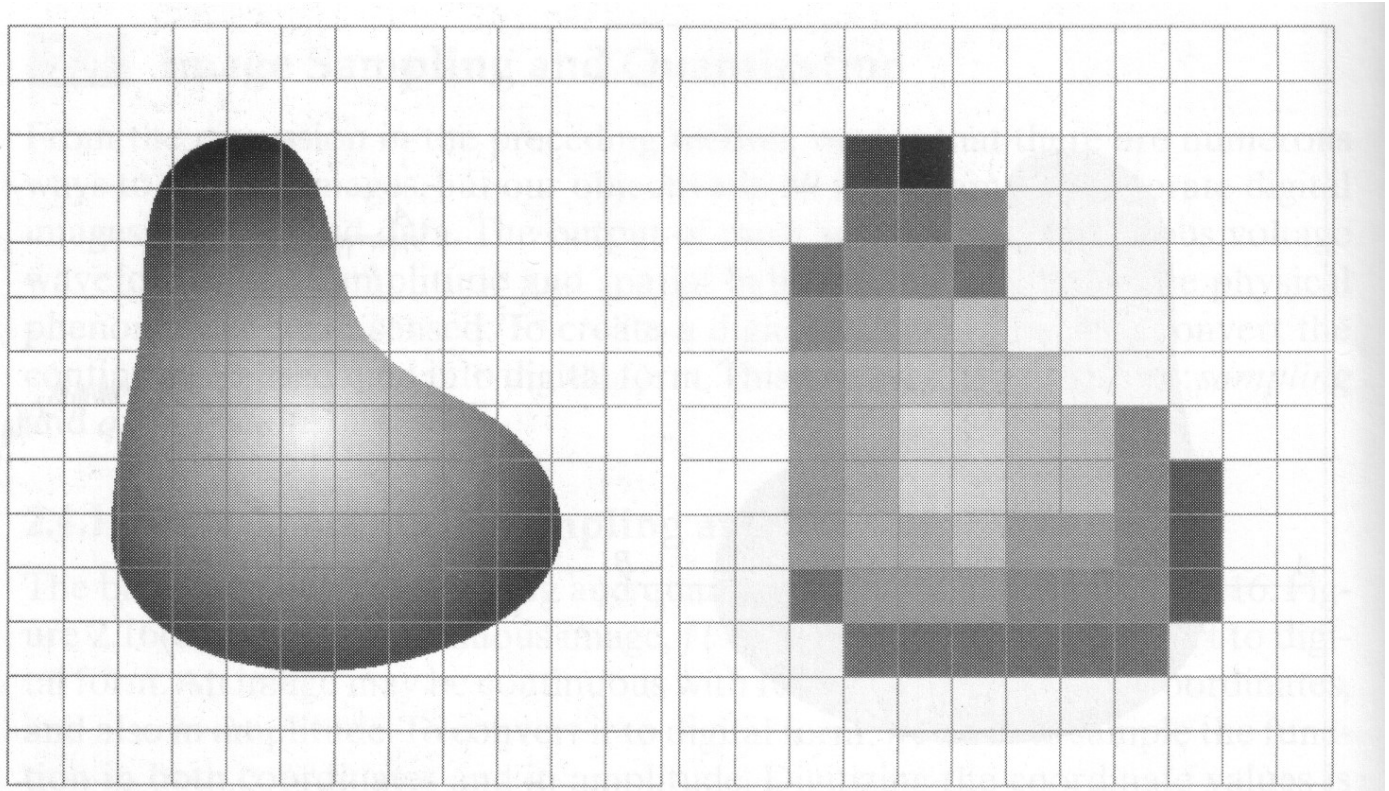


Fig 3.1 Generating a digital image (a) Continuous image. (b) A scan line from A to B in the continuous image. (c) Sampling & quantisation. (d) Digital scan line.

Sampling

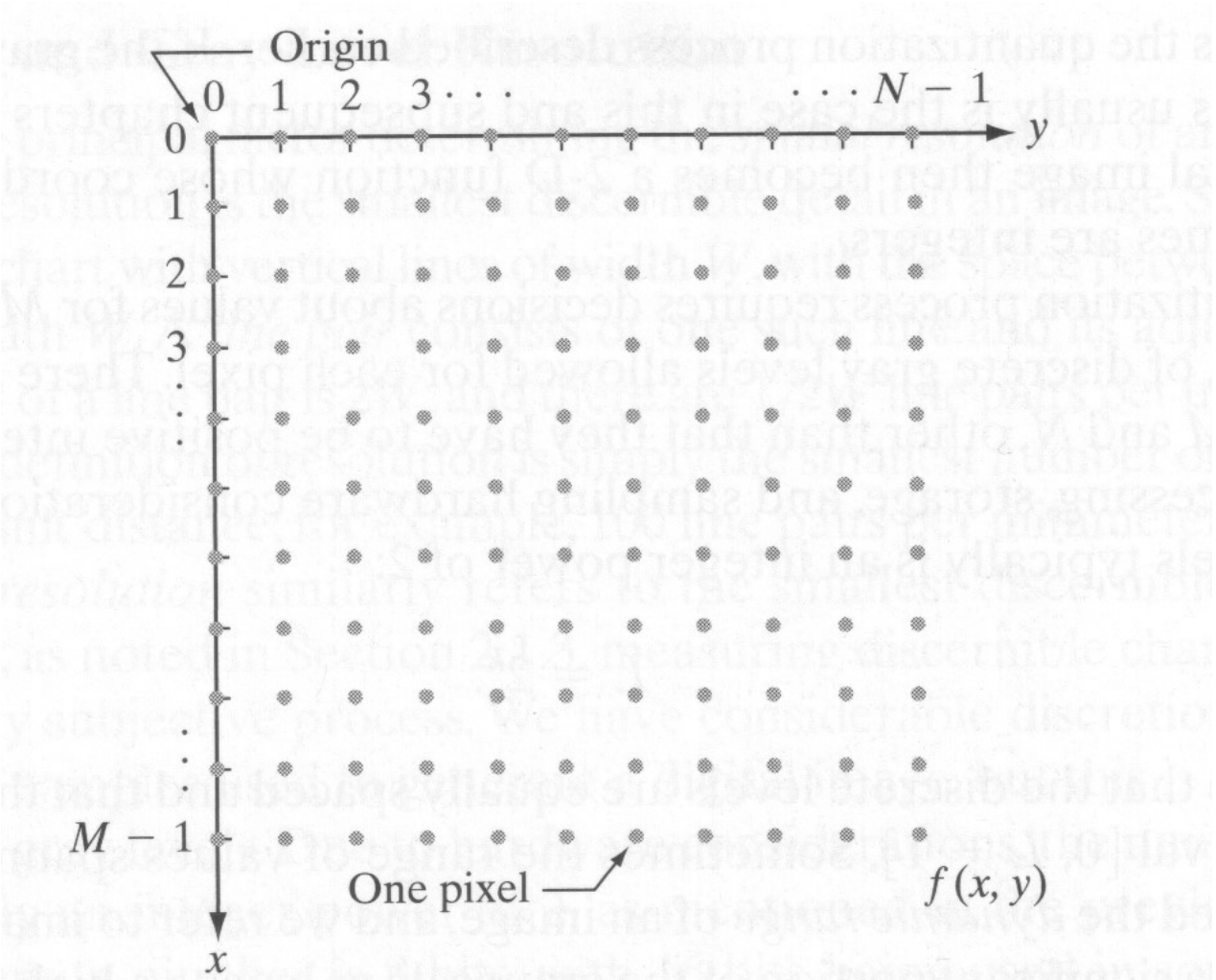


a b

Sampling

- The result of sampling and quantization is a **matrix of real numbers**
- The values of the coordinates at the origin are (x,y) = (0,0).
- The next coordinate values along the first row are (x,y) = (0,1).
- The notation (0,1) is used to signify the 2nd sample along the 1st row.

Sampling



Digital Image

$$f(x,y) = \begin{bmatrix} f(0,0) & f(0,1) & \cdots & f(0,N-1) \\ f(1,0) & f(1,1) & \cdots & f(1,N-1) \\ \vdots & \vdots & & \vdots \\ f(M-1,0) & f(M-1,1) & \cdots & f(M-1,N-1) \end{bmatrix}.$$

Digitized Image and Size

- The number of bits required to store a digitized image is

$$b = M \times N \times k$$

- Where M & N are the number of rows and columns, respectively.
- The number of gray levels is an integer power of 2:
- $L = 2^k$ where k =1,2,…24
- It is common practice to refer to the image as a “k-bit image”

Resolution

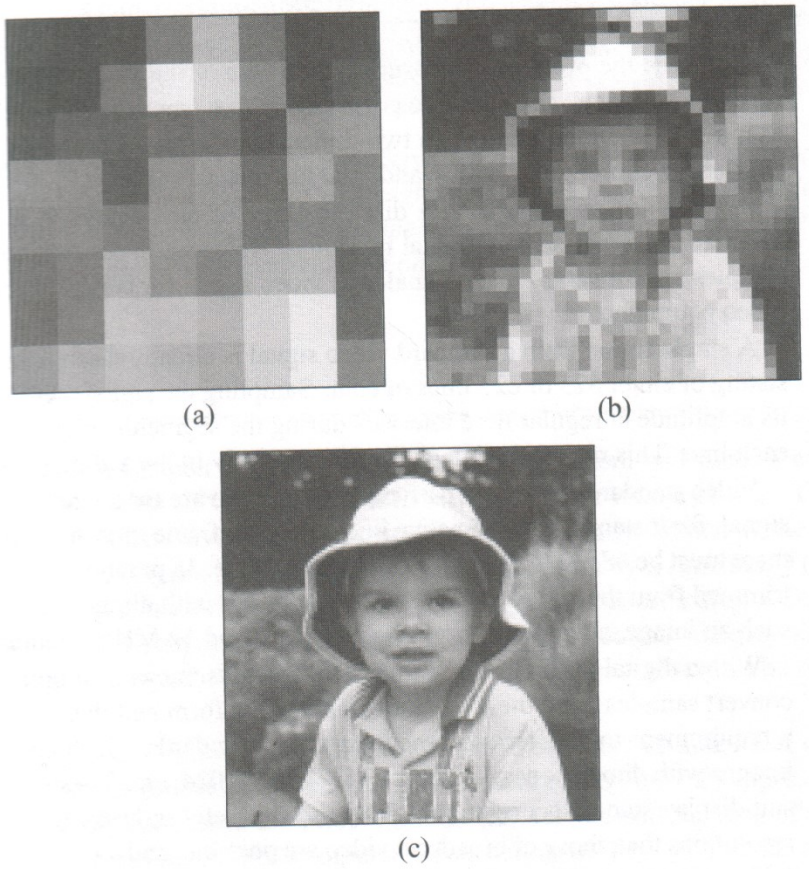


Fig. 3.6 Effect of resolution on image interpretation (a) 8x8 image. (b) 32x32 image (c) 256x256 image

Effect of Quantization

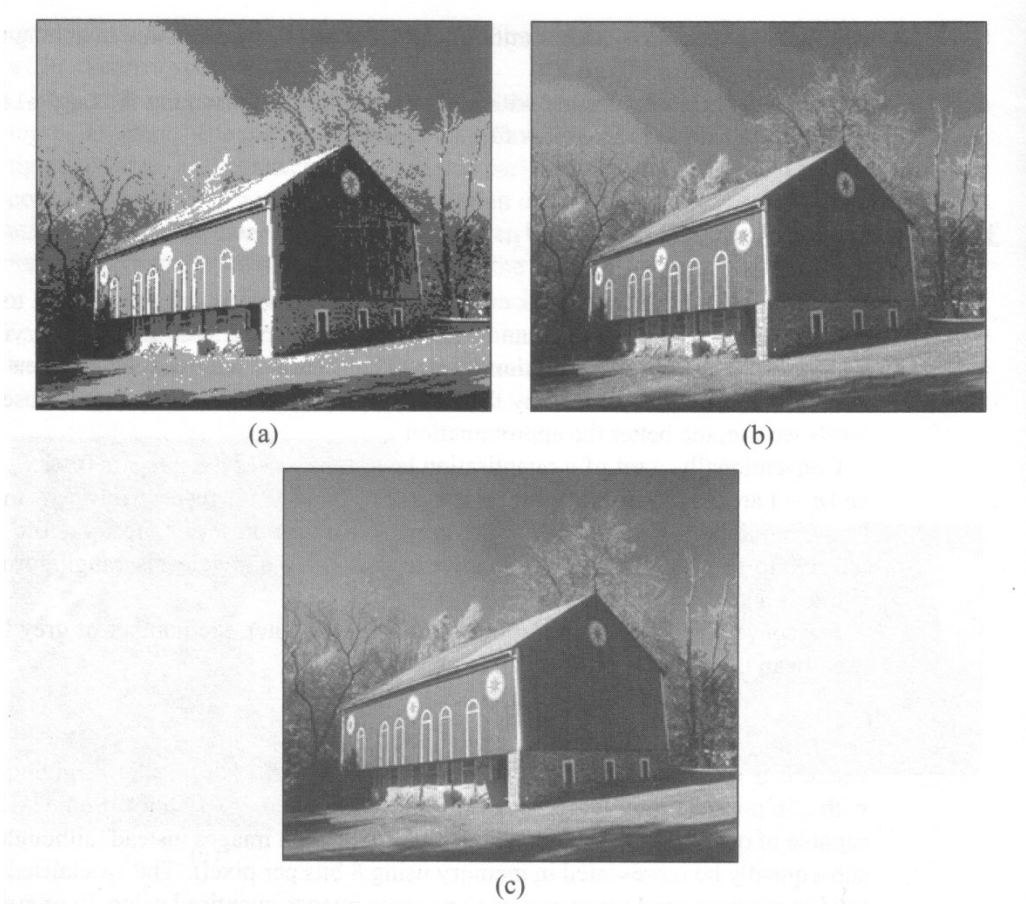
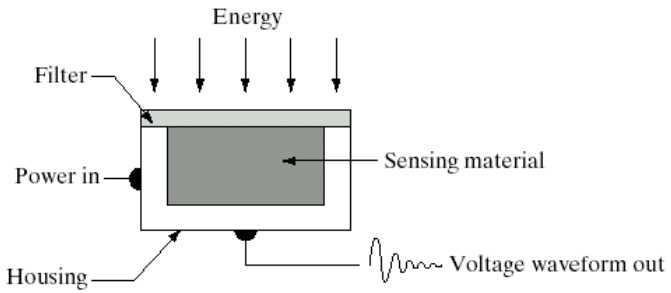


Fig.3.7 Effect of quantization on image interpretation.
(a) 4 levels. (b) 16 levels. (c) 256 levels

Image Sensing Acquisition

a
b
c

FIGURE 2.12
(a) Single imaging sensor.
(b) Line sensor.
(c) Array sensor.



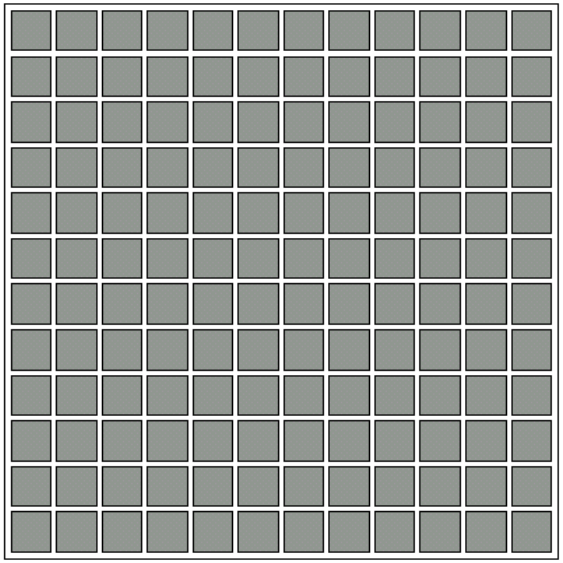
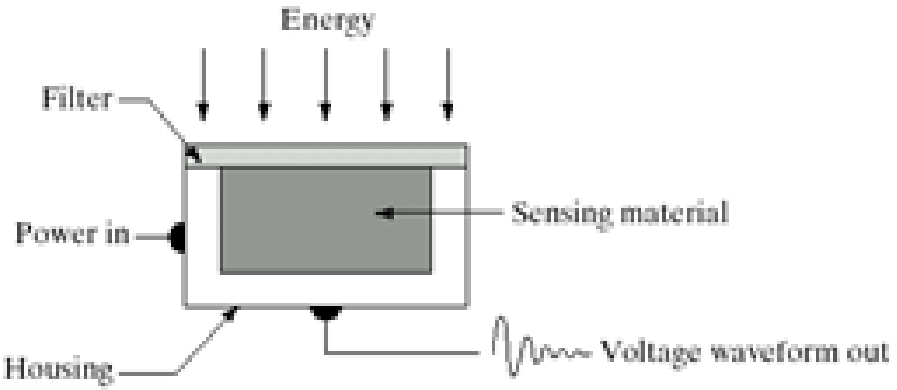


Image Acquisition – Single Sensor



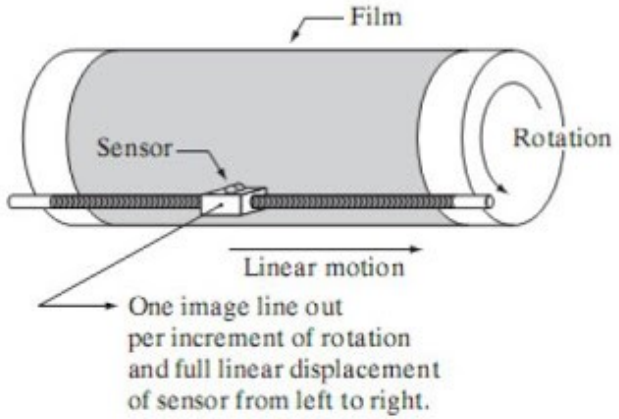
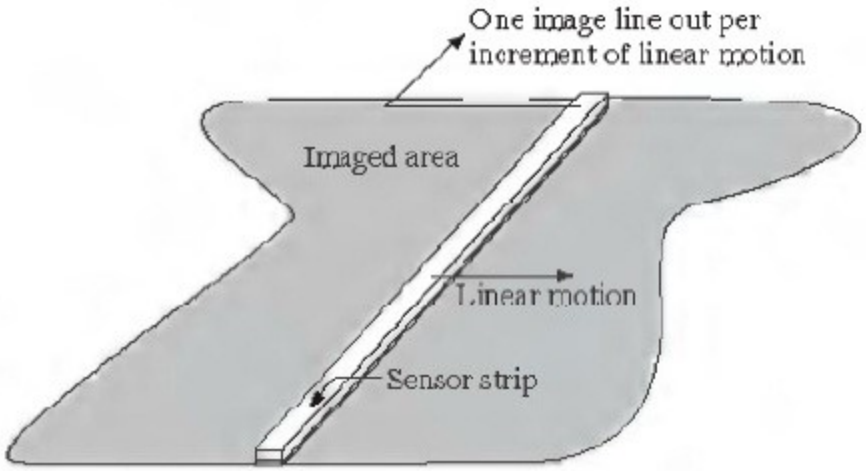


Image Sensing – Linear Sensor Strip



Circular Sensor Strip

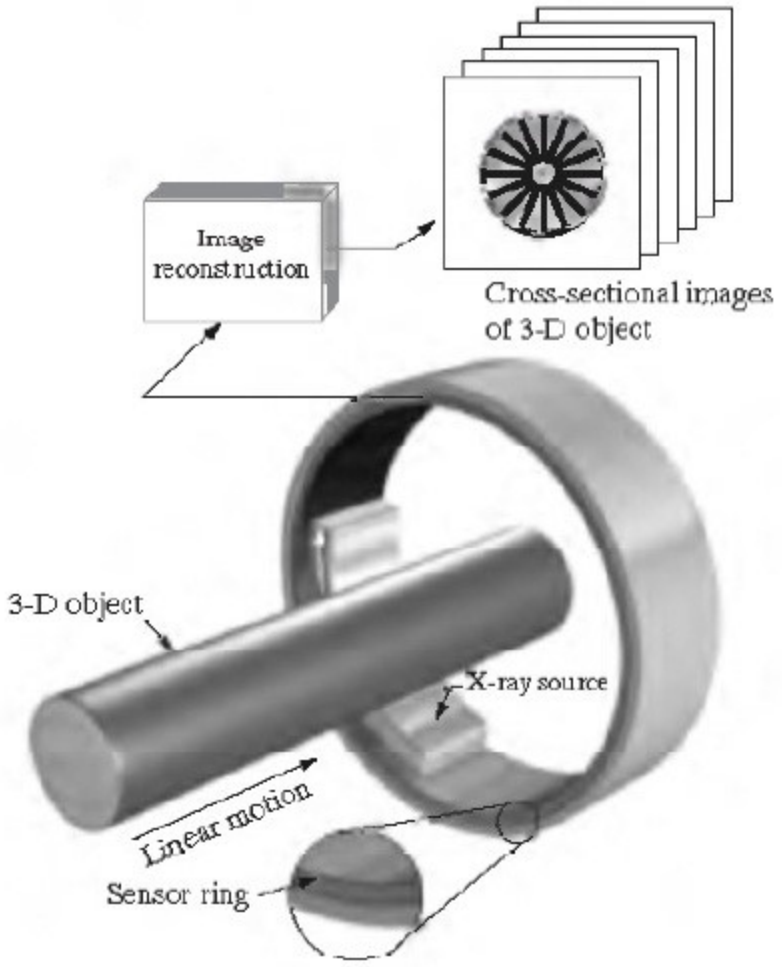


Image Acquisition – Array Sensor