SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE NAME : 19EC513 – IMAGE PROCESSING AND COMPUTER VISION

III YEAR / V SEMESTER

Unit I- DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS

Topic : Adjacency, Connectivity, Regions and Boundaries, Distance Measures and image fomation

Neighbors of a Pixel

A pixel p at coordinates has four horizontal and vertical neighbors whose coordinates are given by
(x + 1, y), (x - 1, y), (x, y + 1), (x, y - 1)

The four diagonal neighbors of p have coordinates
(x + 1, y + 1), (x + 1, y - 1), (x - 1, y + 1), (x - 1, y - 1)

Adjacency, Connectivity, Regions, and Boundaries

For example, in the adjacency of pixels with a range of possible intensity values 0 to 255, set V could be any subset of these 256 values. We consider three types of adjacency:

(a) 4-adjacency. Two pixels p and q with values from V are 4-adjacent if q is in the set N4(p)
(b) 8-adjacency. Two pixels p and q with values from V are 8-adjacent if q is in the set N8(p)
(c) m-adjacency (mixed adjacency). Two pixels p and q with values from V are m-adjacent if
(i) q is in N4(p) or
(ii) q is in ND(p)and the set N4(p) n N4(q)has no pixels whose values are from V.

a b c
d e f

FIGURE 2.25 (a) An arrangement of pixels. (b) Pixels that are 8-adjacent (adjacency is shown by dashed lines; note the ambiguity). (c) *m*-adjacency. (d) Two regions (of 1s) that are adjacent if 8-adjecency is used. (e) The circled point is part of the boundary of the 1-valued pixels only if 8-adjacency between the region and background is used. (f) The inner boundary of the 1-valued region does not form a closed path, but its outer boundary does.

Distance measure

For pixels p, q, and z, with coordinates (x, y), (s, t), and (v, w), respectively, D is a *distance function* or *metric* if

(a) $D(p, q) \geq 0 \quad (D(p, q) = 0 \quad \text{iff} \quad p = q)$,
(b) $D(p, q) = D(q, p)$, and
(c) $D(p, z) \leq D(p, q) + D(q, z)$.

The *Euclidean distance* between p and q is defined as

$$D_e(p, q) = \left[(x - s)^2 + (y - t)^2\right]^{\frac{1}{2}} \qquad (2.5\text{-}1)$$

For this distance measure, the pixels having a distance less than or equal to some value r from (x, y) are the points contained in a disk of radius r centered at (x, y).

The D_4 *distance* (called the *city-block distance*) between p and q is defined as

$$D_4(p, q) = |x - s| + |y - t| \qquad (2.5\text{-}2)$$

In this case, the pixels having a D_4 distance from (x, y) less than or equal to some value r form a diamond centered at (x, y). For example, the pixels with D_4 distance ≤ 2 from (x, y) (the center point) form the following contours of constant distance:

$$\begin{array}{ccccc} & & 2 & & \\ & 2 & 1 & 2 & \\ 2 & 1 & 0 & 1 & 2 \\ & 2 & 1 & 2 & \\ & & 2 & & \end{array}$$

The pixels with $D_4 = 1$ are the 4-neighbors of (x, y).

The D_8 *distance* (called the *chessboard distance*) between p and q is defined as

$$D_8(p, q) = \max(|x - s|, |y - t|) \quad (2.5\text{-}3)$$

In this case, the pixels with D_8 distance from (x, y) less than or equal to some value r form a square centered at (x, y). For example, the pixels with D_8 distance ≤ 2 from (x, y) (the center point) form the following contours of constant distance:

2	2	2	2	2
2	1	1	1	2
2	1	0	1	2
2	1	1	1	2
2	2	2	2	2

The pixels with $D_8 = 1$ are the 8-neighbors of (x, y).

A simple image formation mode.

of an image with the help of 2D Sampling and Quantization techniques that is done by the capturing devices like cameras. In general, we see a 2D view of the 3D world.

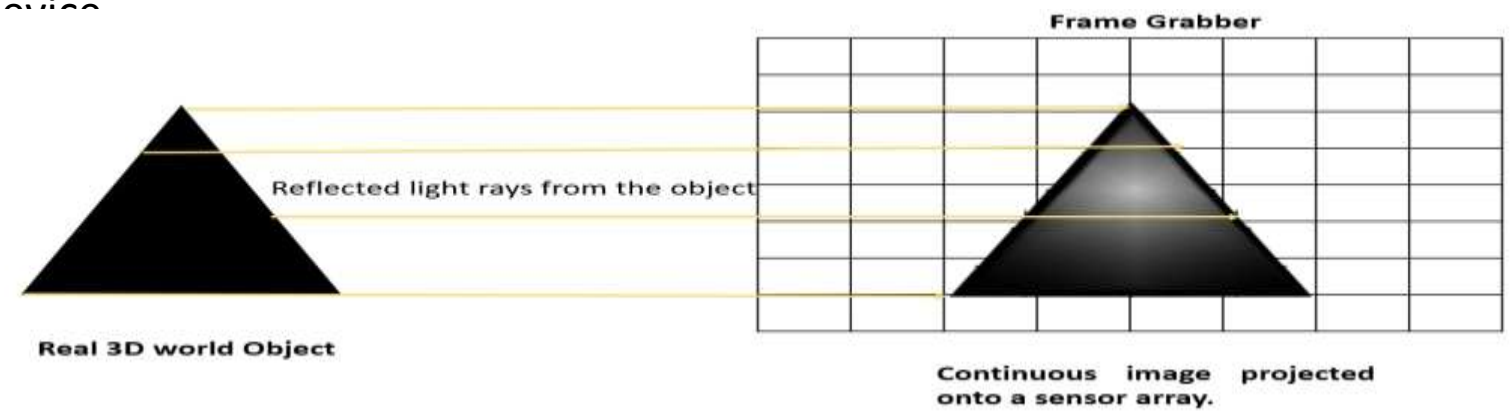
In the same way, the formation of the analog image took place. It is basically a conversion of the 3D world that is our analog image to a 2D world that is our Digital image.

Generally, a frame grabber or a digitizer is used for sampling and quantizing the analog signals.

Imaging:

The mapping of a 3D world object into a 2D digital image plane is called *imaging.* In order to do so, each point on the 3D object must correspond to the image plane. We all know that light reflects from every object that we see thus enabling us to capture all those light-reflecting points in our image plane.

Various factors determine the quality of the image like spatial factors or the lens of the capturing device.



Color and Pixelation:

In digital imaging, a frame grabber is placed at the image plane which is like a sensor.

It aims to focus the light on it and the continuous image is pixelated via the reflected light by the 3D object. The light that is focused on the sensor generates an electronic signal.

Each pixel that is formed may be colored or grey depending on the intensity of the sampling and quantization of the light that is reflected and the electronic signal that is generated via them.

All these pixels form a digital image. The density of these pixels determines the image quality. The more the density the more the clear and high-resolution image we will get.

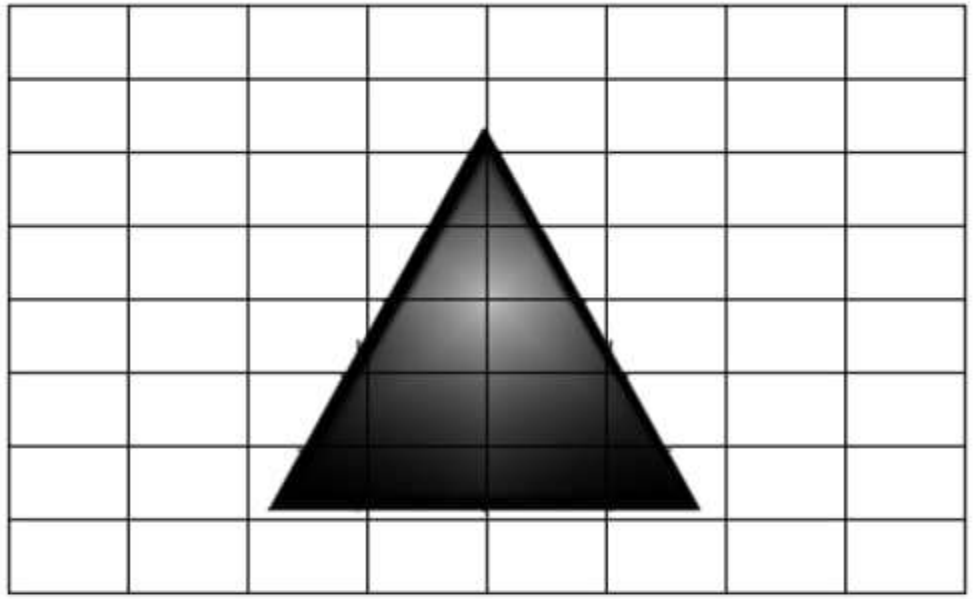
Forming a Digital Image:

In order to form or create an image that is digital in nature, we need to have a continuous conversion of data into a digital form. Thus, we require two main steps to do so:

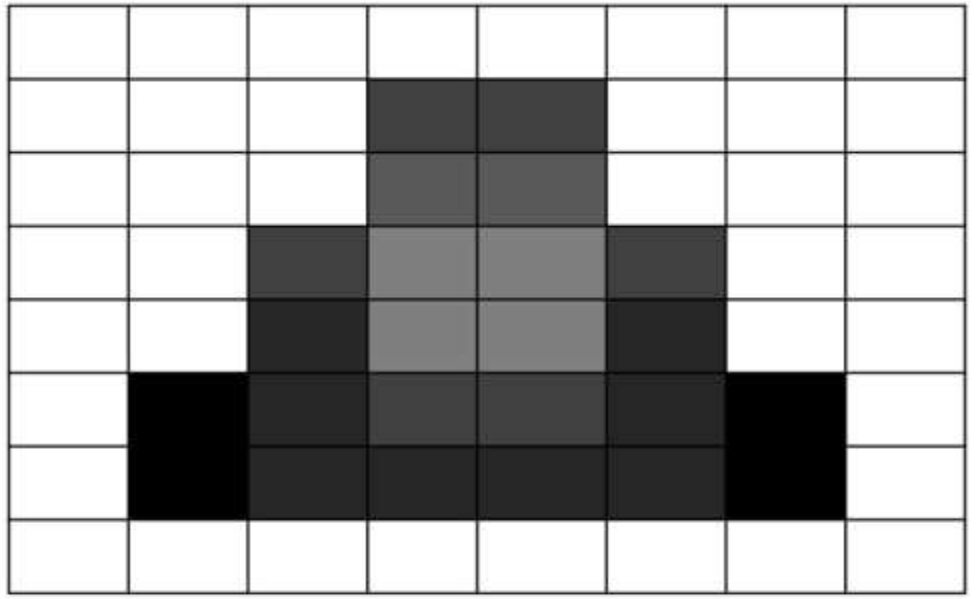
•**Sampling (2D):** Sampling is a spatial resolution of the digital image. And the rate of sampling determines the quality of the digitized image. The magnitude of the sampled image is determined as a value in image processing. It is related to the coordinates values of the image.

•**Quantization:** Quantization is the number of grey levels in the digital image. The transition of the continuous values from the image function to its digital equivalent is called quantization. It is related to the intensity values of the image.

The normal human being acquires a high level of quantization levels to get the fine shading details of the image. The more quantization levels will result in the more clear image.



Continuous image projected onto a sensor array.



Result of image sampling and quantization.

Any Query????

Thank you……