SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

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 : Basic concepts in sampling and Quantization, Representing digital images, Neighbors of a pixel

17-08-2023

Basic concepts in sampling and Quantization, Representing digital images, Neighbors of a pixel/ 19EC513/ IMAGE PROCESSING AND COMPUTER VISION /Mr.S.HARIBABU/ECE/SNSCE

1

Basic concepts in sampling and quantization

➤ In Digital Image Processing, signals captured from the physical world need to be translated into digital form by "Digitization" Process. In order to become suitable for digital processing, an image function f(x,y) must be digitized both spatially and in amplitude. This digitization process involves two main processes called

1. Sampling: Digitizing the co-ordinate value is called sampling.

2. Quantization: Digitizing the amplitude value is called quantization

Typically, a frame grabber or digitizer is used to sample and quantize the analogue video signal.

Sampling

Since an analogue image is continuous not just in its co-ordinates (x axis), but also in its amplitude (y axis), so the part that deals with the digitizing of co-ordinates is known as sampling. In digitizing sampling is done on independent variable. In case of equation y = sin(x), it is done on x variable.

17-08-2023

Basic concepts in sampling and Quantization, Representing digital images, Neighbors of a pixel/ 19EC513/ IMAGE PROCESSING AND COMPUTER VISION /Mr.S.HARIBABU/ECE/SNSCE

2

Here is an example for image sampling and how it can be represented using a graph

The picture can't be displayed.

Basic concepts in sampling and Quantization, Representing digital images, Neighbors of a pixel/
19EC513/ IMAGE PROCESSING AND COMPUTER VISION /Mr.S.HARIBABU/ECE/SNSCE

- When looking at this image, we can see there are some random variations in the signal caused by noise.
- In sampling we reduce this noise by taking samples.
- It is obvious that more samples we take, the quality of the image would be more better, the noise would be more removed and same happens vice versa.
- However, if you take sampling on the x axis, the signal is not converted to digital format, unless you take sampling of the y-axis too which is known as quantization.

Sampling has a relationship with image pixels. The total number of pixels in an image can be calculated as Pixels = total no of rows * total no of columns.
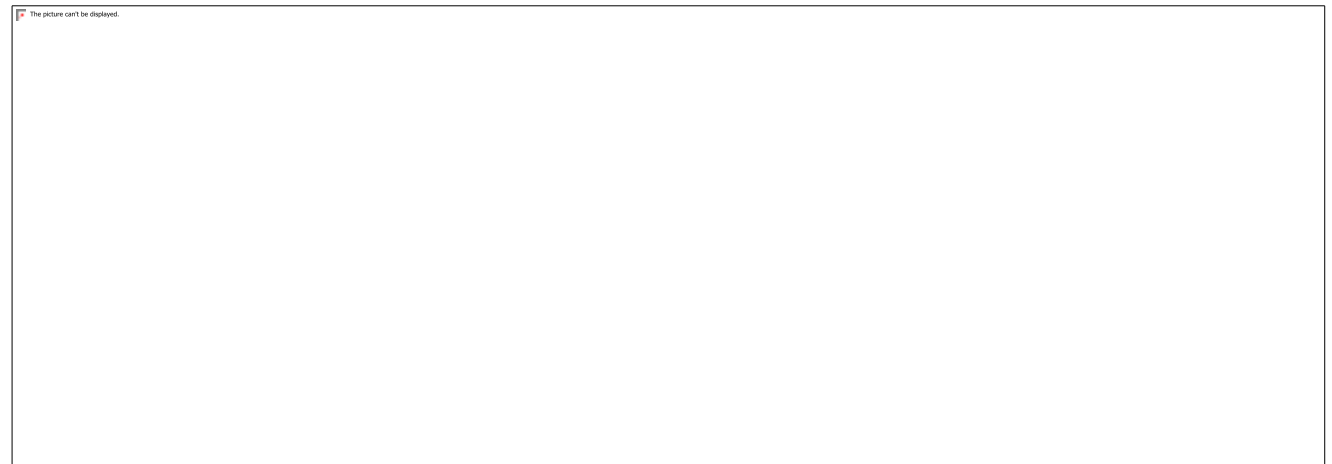
For example, let's say we have total of 36 pixels, that means we have a square image of 6X 6. As we know in sampling, that more samples eventually result in more pixels. So it means that of our continuous signal, we have taken 36 samples on x axis. That refers to 36 pixels of this image.
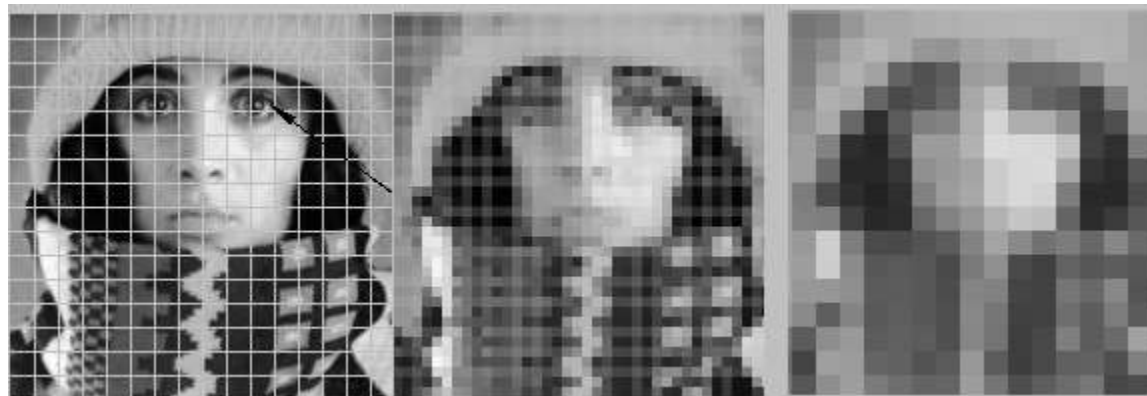Also the number sample is directly equal to the number of sensors on CCD array.

17-08-2023

Basic concepts in sampling and Quantization, Representing digital images, Neighbors of a pixel/ 19EC513/ IMAGE PROCESSING AND COMPUTER VISION /Mr.S.HARIBABU/ECE/SNSCE

4

Quantization

- Quantization is opposite to sampling because it is done on "y axis" while sampling is done on "x axis".
- Quantization is a process of transforming a real valued sampled image to one taking only a finite number of distinct values.
- Under quantization process the amplitude values of the image are digitized.
- In simple words, when you are quantizing an image, you are actually dividing a signal into quanta(partitions).
- Now let's see how quantization is done. In the image shown below, these vertically ranging values have been quantized into 5 different levels or partitions. Ranging from 0 black to 4 white. This level could vary according to the type of image you want.

No. of quantization levels = $k = 2^b$

The picture can't be displayed.

17-08-2023

Basic concepts in sampling and Quantization, Representing digital images, Neighbors of a pixel/ 19EC513/ IMAGE PROCESSING AND COMPUTER VISION /Mr.S.HARIBABU/ECE/SNSCE

5

- There is a relationship between Quantization with gray level resolution. The above quantized image represents 5 different levels of gray and that means the image formed from this signal, would only have 5 different colors. It would be a black and white image more or less with some colors of gray.
- When we want to improve the quality of image, we can increase the levels assign to the sampled image. If we increase this level to 256, it means we have a gray scale image. Whatever the level which we assign is called as the gray level. Most digital IP devices uses quantization into k equal intervals. If b-bits per pixel are used
- The number of quantization levels should be high enough for human perception of fine shading details in the image. The occurrence of false contours is the main problem in image which has been quantized with insufficient brightness levels. Here is an example for image quantization process.

Basic concepts in sampling and Quantization, Representing digital images, Neighbors of a pixel/ 19EC513/ IMAGE PROCESSING AND COMPUTER VISION /Mr.S.HARIBABU/ECE/SNSCE
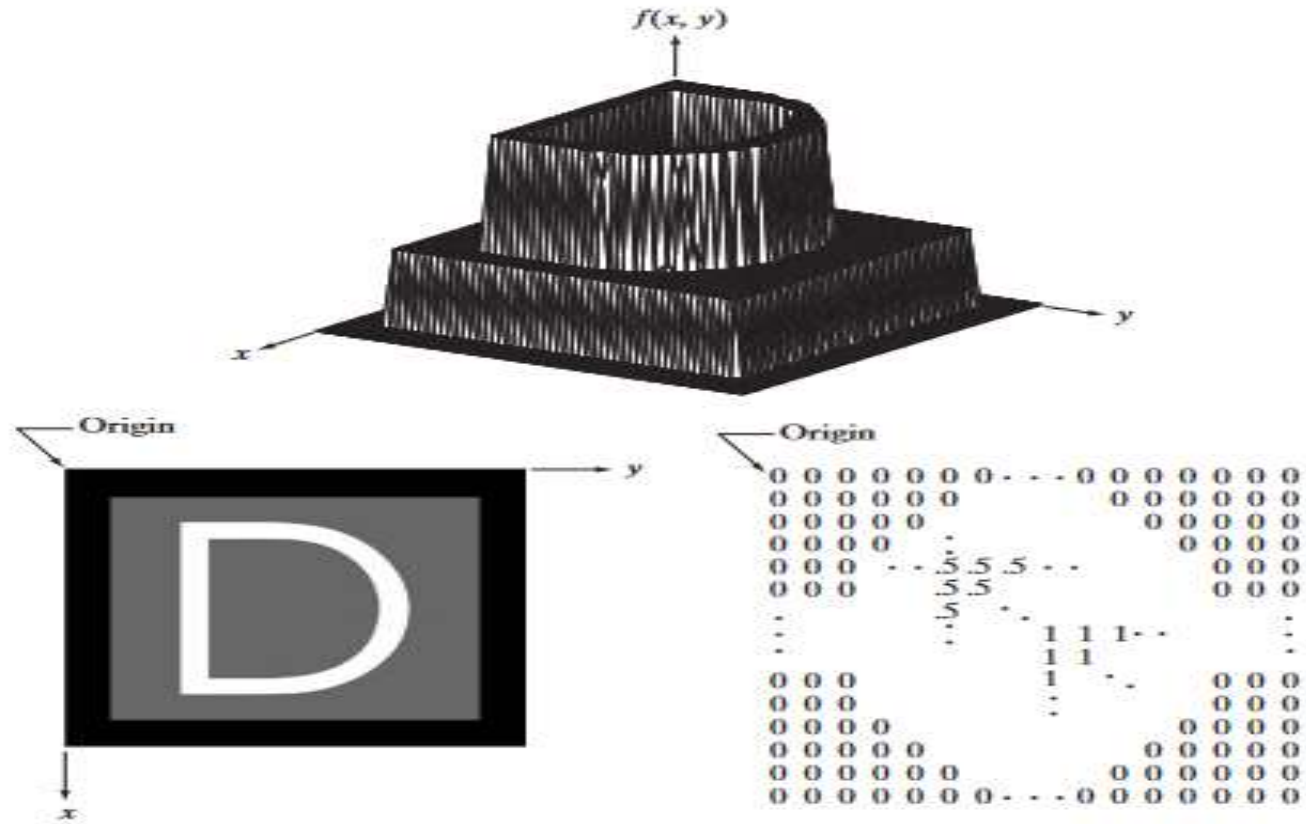
a
b c

FIGURE 2.18
(a) Image plotted as a surface.
(b) Image displayed as a visual intensity array.
(c) Image shown as a 2-D numerical array (0, .5, and 1 represent black, gray, and white, respectively).

$$f(x, y) = \begin{bmatrix} f(0,0) & f(0,1) & \cdots & f(0, N-1) \\ f(1,0) & f(1,1) & \cdots & f(1, N-1) \\ \vdots & \vdots & & \vdots \\ f(M-1,0) & f(M-1,1) & \cdots & f(M-1, N-1) \end{bmatrix} \quad (2.4\text{-}1)$$

Basic concepts in sampling and Quantization, Representing digital images, Neighbors of a pixel/
19EC513/ IMAGE PROCESSING AND COMPUTER VISION /Mr.S.HARIBABU/ECE/SNSCE

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)

Basic concepts in sampling and Quantization, Representing digital images, Neighbors of a pixel/
19EC513/ IMAGE PROCESSING AND COMPUTER VISION /Mr.S.HARIBABU/ECE/SNSCE

8

Any Query????

Thank you……

Basic concepts in sampling and Quantization, Representing digital images, Neighbors of a pixel/
19EC513/ IMAGE PROCESSING AND COMPUTER VISION /Mr.S.HARIBABU/ECE/SNSCE