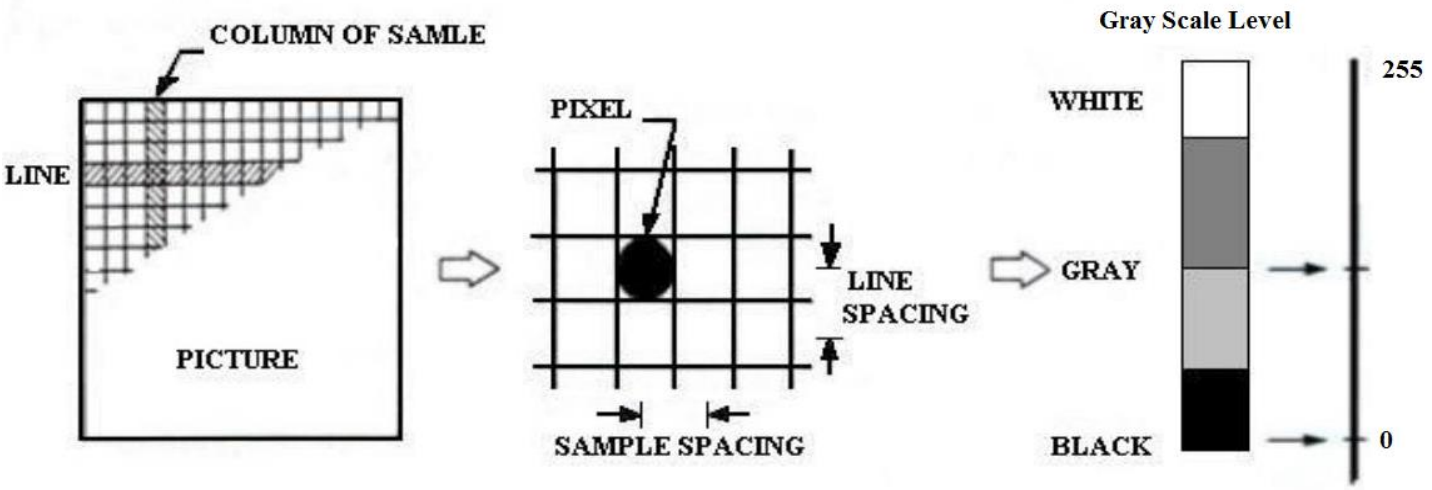
Lecture No: 3 Digital image processing

Digital images

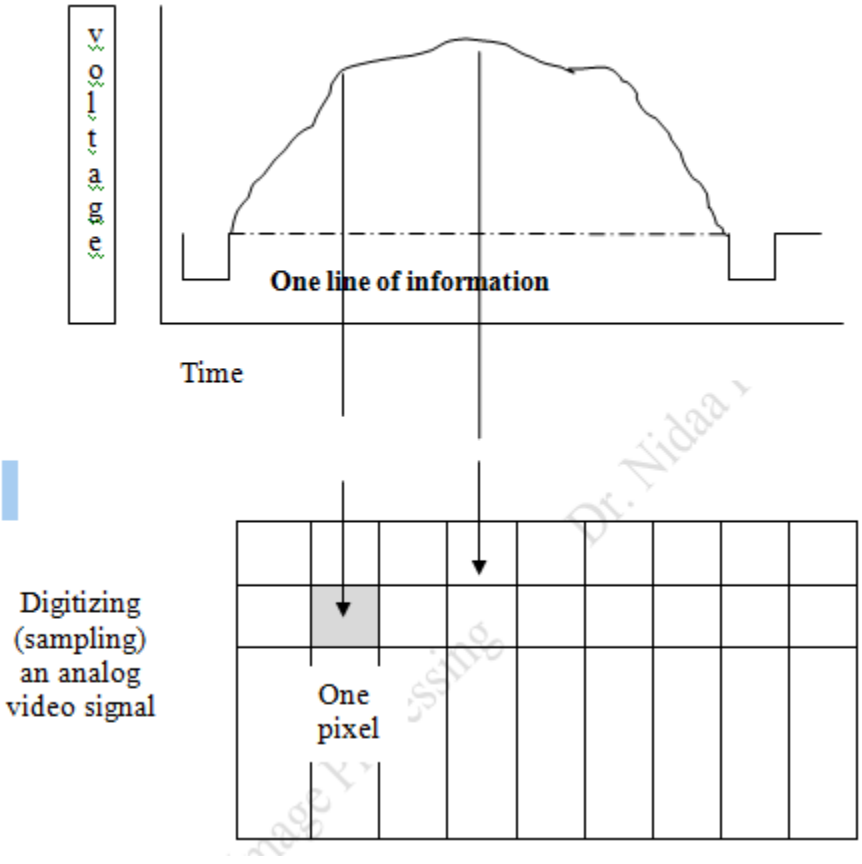
An image must be converted to numerical form before processing. This conversion process is called digitization, and a common form is illustrated in Figure. The image is divided into small regions called ***picture elements***, or ***pixel*** for short. The most common subdivision schema is the rectangular sampling grid shown in Figure. The image is divided into horizontal lines made up of adjacent pixels. Each pixel has a location or address (Line or row number and sample or column number) and an integer value called gray level. This array of digital data is now a candidate for computer processing.

From above we can define **Digital Image** as a sampled, quantized function of two dimensions ***f(x,y)***,which has been generated by optical means, sampled in an equally spaced rectangular grid pattern , and quantized in equal intervals of gray levels.



Sampling : is a process of measuring the value of the image function *f(x,y)* at discrete ***intervals in space***. Each sample corresponds to a small square area of the image, known as a pixel. A digital image is a two-dimensional array of these pixels. Pixels are indexed by *x* and *y* coordinates, with *x* and *y taking integer values.*

In the figure below we see one line of a video signal being sampled (digitized) by instantaneously measuring the voltage of the signal at fixed intervals in time. The value of the voltage at each instant is converted into a number that is stored, corresponding to the brightness of the image at that point.



Digitizing (Sampling) an Analog Video Signal

Quantization

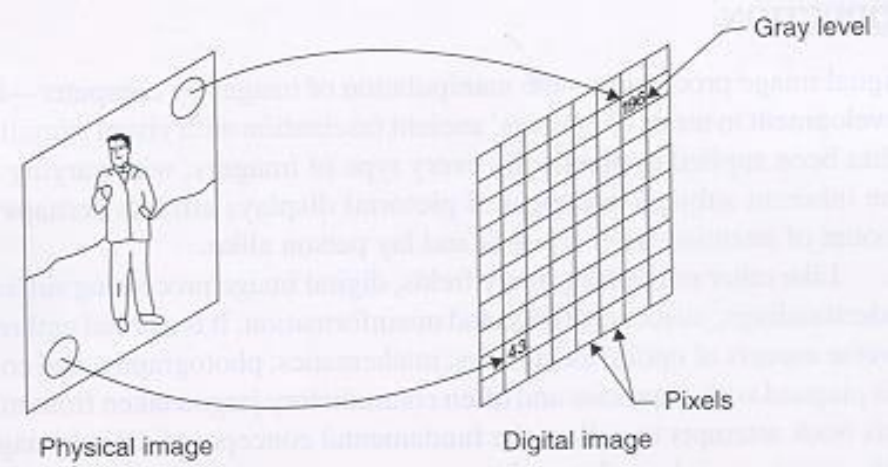
Quantization: is the representation of the brightness of each pixel by an integer value. Since digital computer process number, it is necessary to reduce the continuous measurement value to discrete units and represent them by integer number.

The digital image is 2D- array as:

$$\begin{pmatrix} I(0,0) & I(0,1) \ldots\ldots\ldots\ldots\ldots\ldots I(0,N-1) \\ I(1,0) & I(1,1) \ldots\ldots\ldots\ldots\ldots\ldots I(1,N-1) \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ I(N-1,0) & I(N-1,1) \ldots\ldots\ldots\ldots\ldots\ldots I(N-1,N-1) \end{pmatrix}$$

Image Representation

The digital image I (r, c) is represented as a two- dimensional array of data, where each pixel value corresponds to the brightness of the image at the point (r, c). in linear algebra terms , a two-dimensional array like our image model I(r, c) is referred to as a matrix , and one row (or column) is called a vector. And figure below show who the image represented as a matrix.



There are different types of images:

1- Binary image
2- Gray scale image
3- Color image