Date :
Page No.

Section-5

Q1. Digital image processing :-

Ans:

- It refers to the processing of digital images by means of digital computer.
- It requires a computer and an image digitizer to process image.
- An image digitizer is used to convert image information into digital bits.
- The physical image is divided into horizontal lines of adjacent pixels.
- The number inserted into the digital image at each pixel location reflects the brightness of the image at the corresponding point.
- The conversion process is called digitization and a common form is illustrated by a figure.

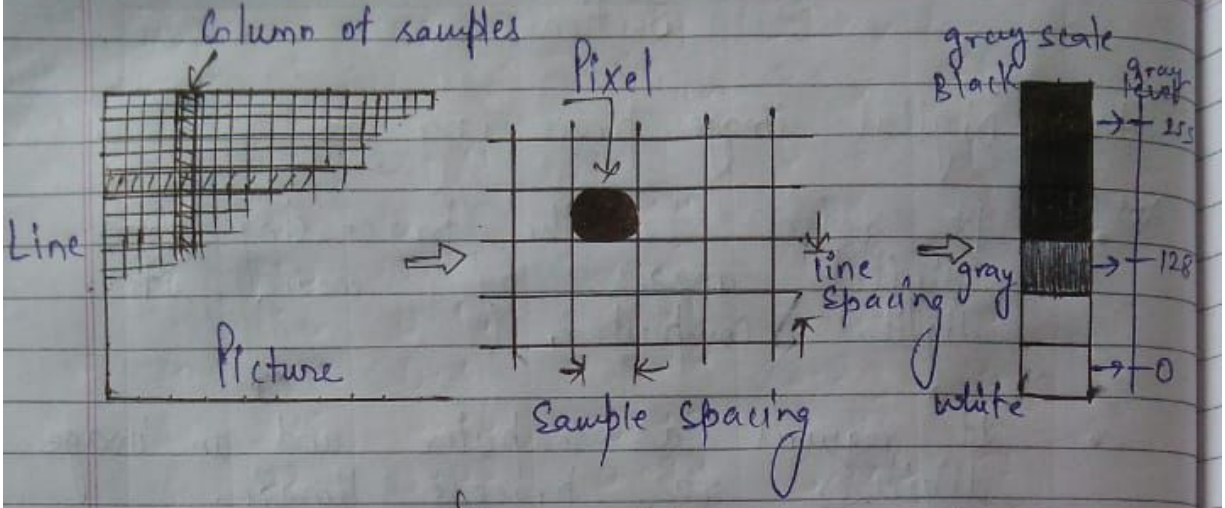


fig:- Digitizing an image

Applications of D.I :-

1) Gramma-ray imaging
2) X-ray imaging
3) Imaging in the ultraviolet band
4) Imaging in the visible and infrared band.

Date : / /
Page No.

Q.2 Histogram Equalization :-

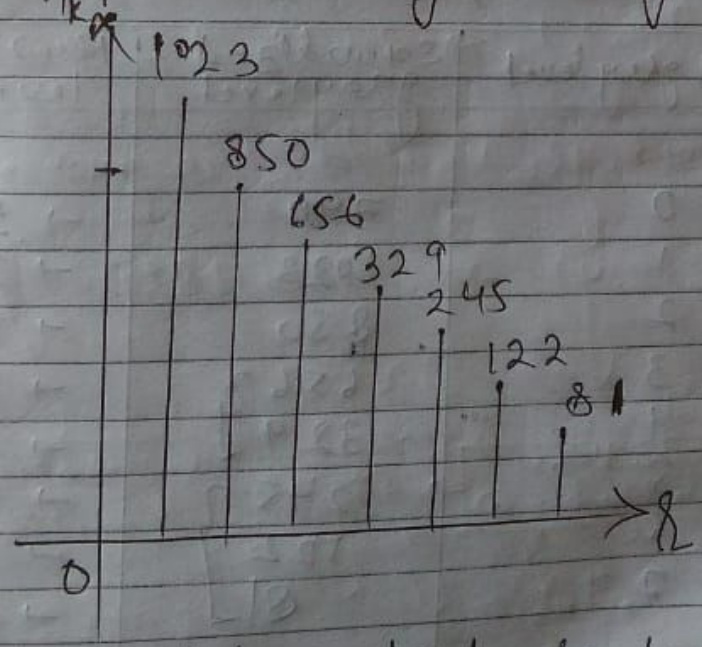
Ans. It is a Computer image processing technique used to improve contrast in images.

The method usually increases the global contrast of images when its usable data is represented by close contrast values.

Numerical -

Number of Grey level L=8

Now, plot the original histogram :



Original data histogram :-

Date : / /
Page No.

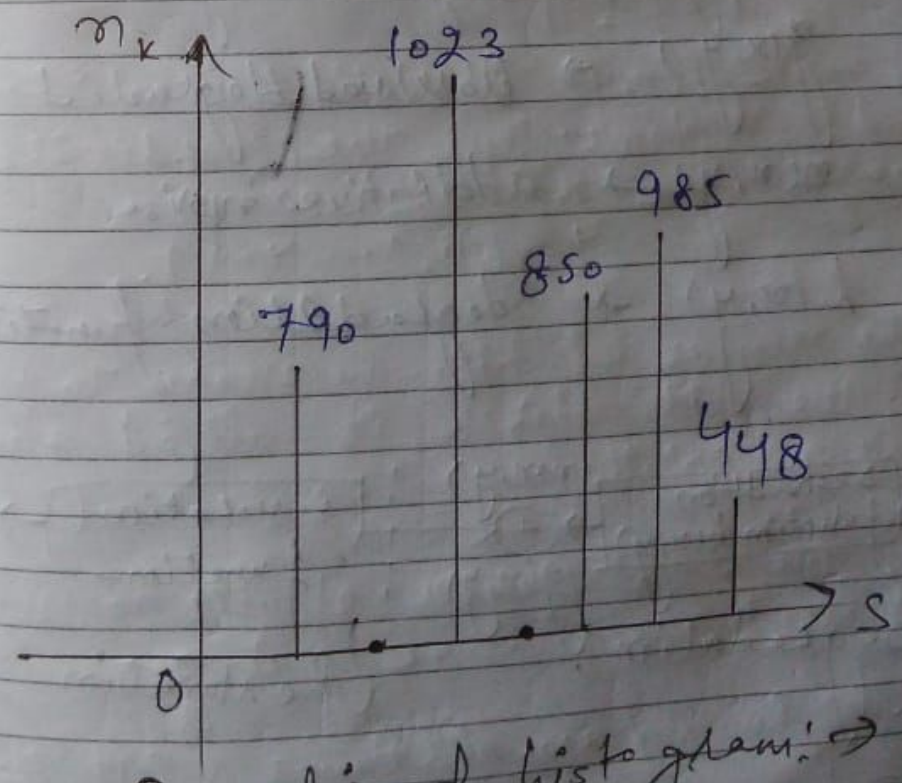
Gray level	n_k	PDF $p_x(x_k) = \frac{n_k}{n}$	CDF $S_k = \sum p_x(x_k)$	$(L-1) \times S_k$ $7 \times S_k$	Rounding off
0	790	0.91	0.19	1.33	1
1	1023	0.25	0.44	3.08	3
2	850	0.21	0.65	4.55	5
3	656	0.16	0.81	5.67	6
4	329	0.08	0.89	6.23	6
5	245	0.06	0.95	6.65	7
6	122	0.03	0.98	6.86	7
7	81	0.02	1	7	7
	N=4096				

We take 1st, 2nd and the last column

Old gray level	Equalized gray level	New gray level
0	790	→ 1
1	1023	→ 3
2	850	→ 5
3	656	→ 6
4	329	→ 6
5	245	→ 7
6	122	→ 7
7	81	→ 7

We notice that the new gray levels have pixels only at 1, 3, 5, 6, 7. there are no pixels in gray level 0, 2 and 4.

Equalized gray level	Number of pixels
0	0
1	790
2	0
3	1023
4	0
5	850
6	656+329=985
7	245+122+81= 448



Equalized histogram: ⇒

Date : / /
Page No.

Q.3 Image Restoration :→

→ Image Restoration can be defined as the process of removal or reduction of degradation in an image through linear or non-linear filtering.

→ The ultimate goal in restoration is to improve an image.

→ Restoration is an objective process.

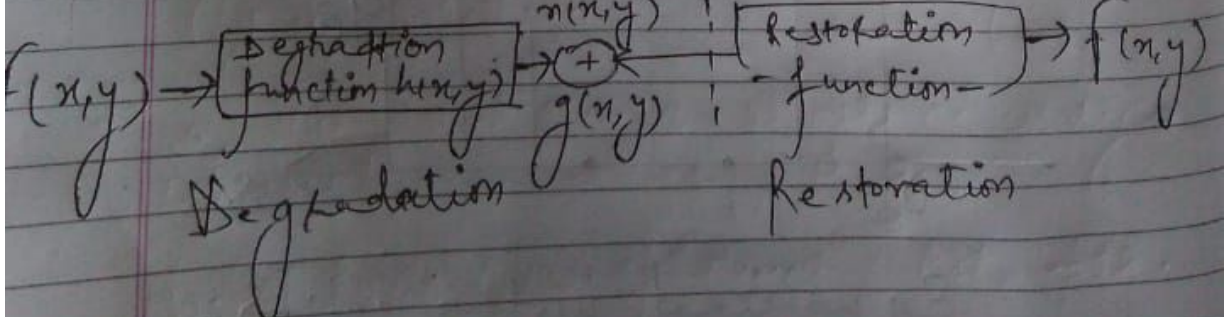
Degradation Model :→

$f(x,y)$ → Original image

$g(x,y)$ → Observed degraded

$n(x,y)$ → addictive noise

$h(x,y)$ → degradation function.



In degradation block linear image model

$$g(x,y) = \int_{-\infty}^{+\infty}\int f(k,l)\cdot h(x-k, y-l)\, dk\, dl + n(x,y)$$

$$g(x,y) = f(x,y) * h(x,y) + n(x,y)$$

Hence, to remove degration function we need to apply inverse filtering to degraded image.

$$g(x,y) = \sum_k \sum_l h(x-k, y-l) f(k,l) + n(x,y)$$

Two area of restoration :->

→ Quantum limiting imaging in X-ray

→ CT (computed Tomography in health care areas.

Date: / /
Page No.

Q.5 Digital image representation ?

→ An image can be defined as a signal that varies over the special coordinate (x, y).

→ mathematical written as f(x, y)

equation -

$$f(x,y) = \begin{bmatrix} f(0,0) & f(0,1) & f(0,2) & \cdots & f(0,Y-1) \\ f(1,0) & f(1,1) & f(1,2) & \cdots & f(1,Y-1) \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ f(X-1,0) & f(X-1,1) & f(X-1,2) & & f(X-1,Y-1) \end{bmatrix}$$

→ The image f(x,y) is divided into X rows and Y columns. Thus, the coordinate range are $x = (0, 1 \ldots X-1)$

$y = (0, 1 \ldots Y-1)$.

→ The number of bits necessary to represent by the bit depth is called gamut or palette.

→ So, the total Number of bits necessary to represent the image is

No. of Rows X No. of Columns X Bit depth.