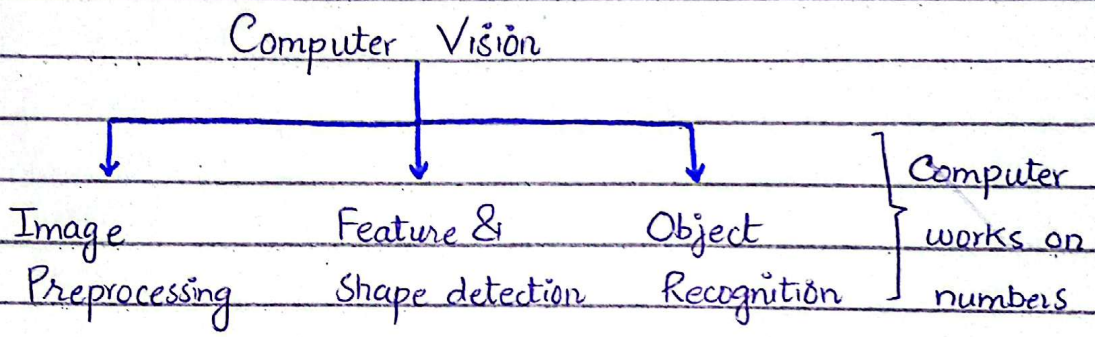
⇒ Image Preprocessing:

1) Gray Scale Conversion:

Gray scale conversion ⟶ Luminance method

$$X = 0.289R + 0.5870G + 0.1140B \qquad (0\text{-}255)$$



2) $R+B+G/3$ ⁂ Gray scale ⟹ Edge Detection Imp

* Computationally less expensive ECG image (color doesn't matters)

2) Image Resizing:

$$\begin{bmatrix} 2 & 4 & -6 \\ 3 & 2 & 1 \end{bmatrix} \rightsquigarrow 4\times4 \rightsquigarrow \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

⇒ Check the closest pixel and fill value

$$\begin{bmatrix} 2 & 4 & 4 & 6 \\ 2 & 4 & 6 & 6 \\ 3 & 2 & 2 & 1 \\ 3 & 2 & 1 & 1 \end{bmatrix}$$

⇒ Take the average of nearest pixel for compression.

⇒ Research papers ⇝ diff format

3) Image Rotation:

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

$(x, y) = (3, 2)$, angle $= \theta = 90°$

$$x' = x\cos\theta - y\sin\theta$$
$$y' = x\sin\theta + y\cos\theta$$
$$x = +2, \quad y = 3$$

$x', y' \Rightarrow$ angles after rotation

$$x' = 3\cos 90 - 2\sin 90$$
$$y' = 3\sin 90 + 2\cos 90$$

* Use for data augmentation.

4) Negative Image:

bright $\longrightarrow$ dark

dark $\longrightarrow$ light

$I_{(neg)} = 255 - I_{(orig)}$

$R = 0, \; G = 25, \; B = 30$

$255 - 0 = 255$

$255 - 25 = 230$

$255 - 30 = 225$

* Medical Images
* Kidney, Lungs etc.

5) Binary Conversion:

$$I_{bin}(x,y) = \begin{cases} 255 & \text{if } I(x,y) > T \\ 0 & \text{if } I(x,y) < T \end{cases}$$

* Edge & shape detection
Adaptive thresholding ⇒ T (based on image)

6) Bit planee Slicing:

(0-255) gray scale
↳ 8 bit

* works on the individual pixel of image.

8- planes

$$\begin{bmatrix} 2 & 4 \\ 4 & 2 \end{bmatrix} \Rightarrow \left[\begin{array}{cc} 00000010 & 00000100 \\ 00000100 & 00000010 \end{array}\right]$$

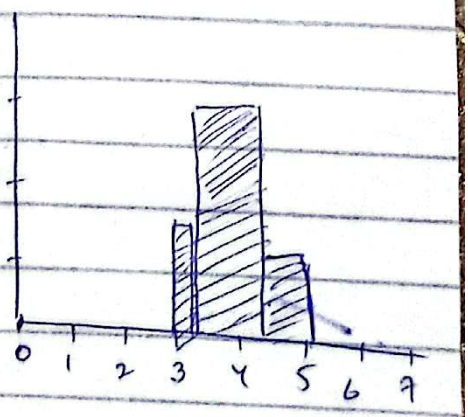
0- plane 1- plane

$$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \quad \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

* Edge Detection, feature extraction, compression.

7) Histogram Equalization:

4	4	4	4	4
3	4	5	4	3
3	5	5	5	3
3	4	5	4	3
4	4	4	4	4



* Sum = frequency sum * nk = pixel frequency

Gray level	0	1	2	3	4	5	6	7
Frequency	0	0	0	6	14	5	0	0

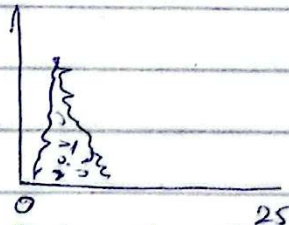
* CPF = comulativ freq

Highest Gray value = 5

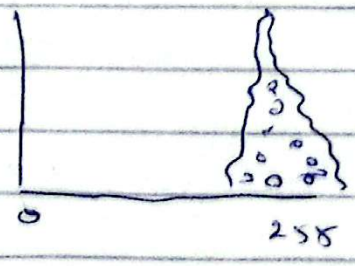
$2^3 = 8 =$ 3 bits [0 - 7]

Gray level	no of pixel (freq nk)	nk/sum	CPF
0	0	0	0
1	0	0	0
2	0	0	0
3	6	6/35 = 0.24	0.24
4	14	14/25 = 0.56	0.8
5	5	5/25 = 0.2	1.0
6	0	0	1.0
7	0	0	1.0

CPF*7 ~~SK~~	final value
0	0
0	0
0	0
1.68	2
5.6	6
7	7
7	7
7	7

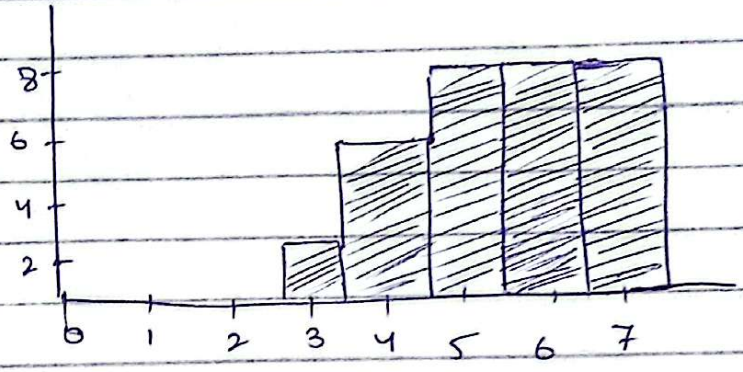


=> redistribution of pictures pixel



=> Balancing the very bright and dark pictures.

Gray level	0	1	2	3	4	5	6	7
Frequency	0	0	0	2	6	7	7	7



8) Constrast Streching :

$$I_{new} = \frac{(I_{old} - I_{min})}{(I_{max} - I_{min})} \times (N_{max} - N_{min}) + N_{min}$$

Image (50-200) current range

50	150	150
100	100	100
150	150	200

→ New Range (0-255)

$I_{old} = 50$

$$I_{new} = \frac{(50-50)}{(200-50)} \times (255-0) + 0 \Rightarrow 0$$

$50 \Rightarrow 0$

$I_{old} = 100$

$$I_{new} = \frac{(100-50)}{(200-50)} \times (255-0) + 0$$

$100 \Rightarrow 85$

* Normalization ⇒ Intensity change

⇒ darker ⇒ darker , brighter ⇒ brighter
* Mapping within the spacific range.

⑨ **Blurring:**
Lower the edge intensity.
⇒ average of pixels value.

① RL
② EX-AI
③ Multimodel AI
④ Quantum AI
⑤ Cyber Security

⑩ **Sharpening:**
Edge detection
(Intensity change)

⇒ **Blurring:**

⇒ Median filter:

3x3 filter ⇒

10	200	30
40	50	60
255	80	90

[10, 30, 40, 50, 60, 80, 90, 200, 205]

200	30	0
50	60	0
80	90	0

10

padding

0 30 50 60 80 90 200

$$\begin{bmatrix} 10 & 0 & 0 \\ 40 & 0 & 0 \\ 255 & 0 & 0 \end{bmatrix} \quad 0 \quad 10 \quad 40 \quad 255$$

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 10 & 200 \\ 0 & 40 & 50 \end{bmatrix} \quad \begin{bmatrix} 0 & 40 & 50 \\ 0 & 255 & 80 \\ 0 & 80 & 30 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 200 & 30 \\ 0 & 50 & 60 \end{bmatrix}$$

$$\begin{bmatrix} 40 & 50 & 60 \\ 255 & 80 & 90 \\ 0 & 0 & 0 \end{bmatrix}$$

* Average Blurring:

3x3 Kernel image

$$\frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} \quad \begin{bmatrix} 10 & 20 & 30 \\ 40 & 50 & 60 \\ 70 & 80 & 90 \end{bmatrix}$$

$$= \frac{1}{9}\left[10+20+30+40+50+60+70+80+90\right] = \frac{450}{9}$$

⇒ Gaussian Blurring:

$$G(x,y) = \frac{1}{2\pi\delta^2} e^{-x^2+y^2/2\delta^2}$$

(x, y) = Coordinates in Filter

δ = Factor controlling the blurring.

* Decide Kernel size
* Compute values within Kernel using Gaussian function.

$$\begin{bmatrix} (-1,1) & (0,1) & (1,1) \\ (-1,0) & (0,0) & (1,0) \\ (-1,-1) & (0,-1) & (1,-1) \end{bmatrix}$$

y +ive

x -ive

x +ive

(0,0)

y -ive

For $X=0, Y=0$

$\delta = 1$

$$G(0,0) = \frac{1}{2\pi(1)^2} e^{-((0)^2+(0)^2)/2(1)}$$

$$= \frac{e^0}{2\pi} = 0.204$$

$$\begin{bmatrix} 0.0751 & 0.1238 & 0.0751 \\ 0.1238 & \boxed{0.2042} & 0.1238 \\ 0.0751 & 0.1238 & 0.071 \end{bmatrix} \times \begin{bmatrix} 100 & 120 & 130 \\ 80 & \boxed{90} & 110 \\ 70 & 60 & 50 \end{bmatrix}$$

weights, Gaussian — original Image

* Morphilogical Analysis:

0 → 1

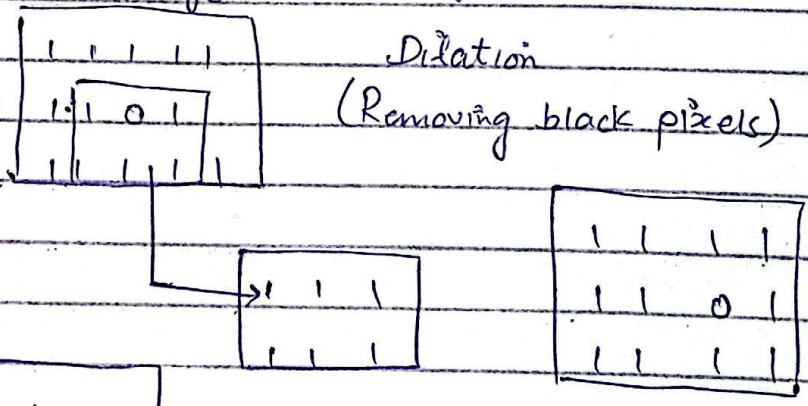
black — white

Morphilogical Analysis

Erosion (Removing white pixels)

image

Dilation (Removing black pixels)



2×3

Kernel

{ Brightness ⇒ Erosion
Darkness ⇒ Dilation }

image

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

Kernel

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

= X = X = X = X = X = X =