Lab → Monday → {5:30 - 7:30}

M.S → 20%

E-S → 35%

Lab → 20%

Mini Proj → 20%

class int. → 5%

← Advanced Image Processing →

Signals → 1. Continuous
2. Discrete.
3. Digital → Amplitude is broken into levels & values are assigned to nearest level.

⇒ Sampling process → Converting Continuous signals to discrete time signal.

⇒ Quantization → Converting Discrete to Digital time signal

{Note → if Quantization levels are less, then info. will lost which will result into more distortion.}

→ Processing continuous time signal is not easy, as sample size becomes ∞. {that's why sampling is needed}.

→ To reduce the memory size storing the levels, quantization is used as no. of levels are more in discrete.

⇒ Image is a Signal.

25/01/2022

$\boxed{\text{Energy}(E) = h\nu}$ → freq.

h → Plank's const. $= \{6.62 \times 10^{-34}\}$

&

$\boxed{\lambda = \frac{c}{\nu}}$

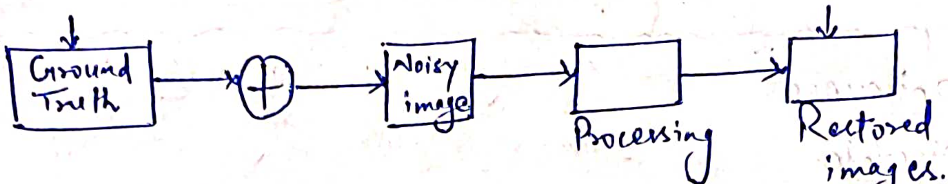
λ → wavelength

The EM spectrum →

Key stages in Digital Image Processing →

Image Quality assesment Metrics →

1. Reference based.
2. Blind / No-reference based.



errors → 1. Root mean squared error (RMSE). } → should be minimized,

2. PSNR (Psignal to Noise Ratio).

3. SSIM (structural similarity ~~index~~ matrix) } → should be maximized,

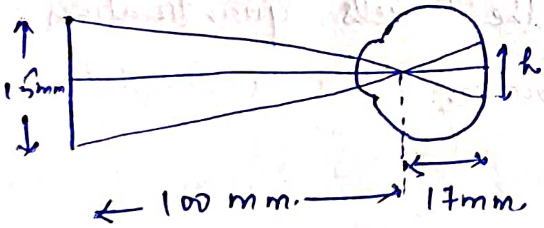
$\boxed{(0-1)}$

Human Eye → Diameter of Lens ⇒ $\boxed{20mm}$

1.5 mm × 1.5mm. ⇒ 150,000 element/mm²

⇒ 2.25 * 150,000

⇒ {337500 element.}



⇒ $\boxed{\frac{15}{100} = \frac{h}{17}}$

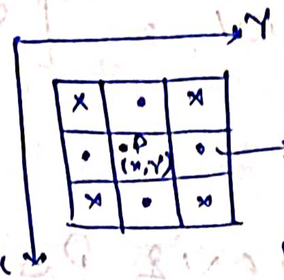
→ Weber Ratio →

1/02/2022

04/02/2022

Pixels in image →

→ 'p' is center pixel.



→ This is our dir.n assumptions.

↳ These are 4 neighbours of P.

$\boxed{N_4(p)}$

$N_D(p)$ → This will give info. of digonal neighbours

⇒ union will give all 8 neighbours.

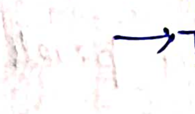
→ $\boxed{N_8(p) = N_4(p) \cup N_D(p)}$

1. → Each neighour is at unit distance from 'p'.
2. → If 'p' is a boundry pixel, there will be less neighbours.
3. → 3 type of neighbourhood →
   (i). $N_4(p)$.
   (ii). $N_D(p)$.
   (iii). $N_8(p)$.

→ **Connectivity →**

i.) Establishing image boundry.

(ii). Defining image components | regions.



if $f(x, y) > Th$

⇒ $(x, y) \in$ object.

else.

$(x, y) \in$ background.

→ ~~The~~ Two pixels are connected if they are adjacent in some sense. →

(i). They are neighbours (N_4, N_8, N_D) and →

(ii) P, q, such that $q \in N_4(P)$, ⇒ $\boxed{I(P) = I(q)}$

* let V be the set of grey levels used to define ~~connecting~~ connectivity for 2 pts. $I(P), I(q) \rightarrow$

$I(P) \in V$; $I(q) \in V$; [8-bit : $\boxed{0-255}$]

3 types of Connectivity $\rightarrow$

(i). 4- connectivity $\Rightarrow$ $I(P), I(q) \in V$ & $P \in N_4(q)$

(ii) 8 - " $\Rightarrow$ $I(P), I(q) \in V$ & $P \in N_8(q)$

(iii). M - " (Mixed - conn.) $\Rightarrow$

(a). $I(P), I(q) \in V$

(b). $q \in N_4(P)$

(or)

(c). $q \in N_D(P)$ (and) $N_4(P) \cap N_4(q) = \phi$

Ex $\rightarrow$ $V = \{1\}$.

0	1	1
0	1	0
0	0	1

4- Connectivity.

0	1	1
0	1	0
0	0	1

8- connectivity.

0	1	1
0	1	0
0	0	1

M- connectivity.

$\Rightarrow$ Adjacency $\rightarrow$ p, q

1. 4- adjacency
2. 8- adjacency
3. M- "

Path $\rightarrow$ A path $P(x, y)$ to $q(s, t)$ is a sequence of distinct pixels

$(x_0, y_0), (x_1, y_1), \ldots\ldots, (x_n, y_n)$

where $(x_0, y_0) = (x, y)$, $(x_n, y_n) = (s, t)$

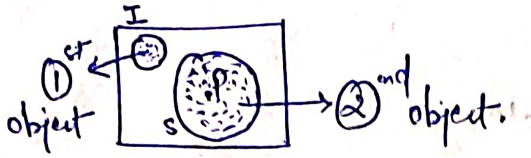
(x_i, y_i) is adjacent to (x_{i-1}, y_{i-1}).

length of path $= n$ $[1 \leq i \leq n]$

Connected Component → Let $S \subseteq I$ and $P, q \in S$

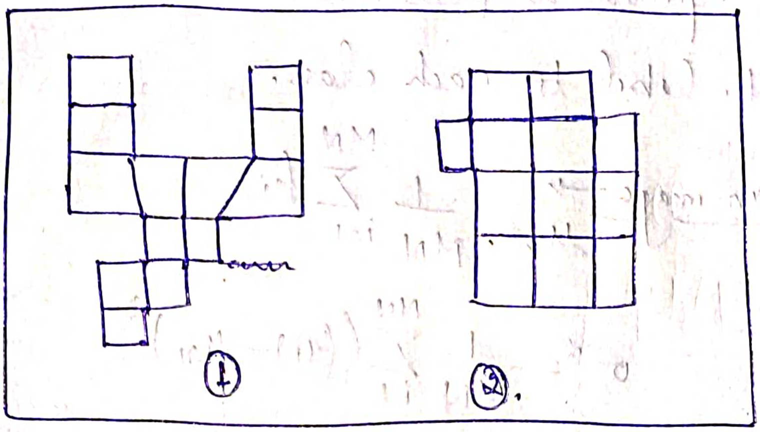
P is connected to q in S if there is a path from 'P' to 'q' consisting entirely of pixels in S.

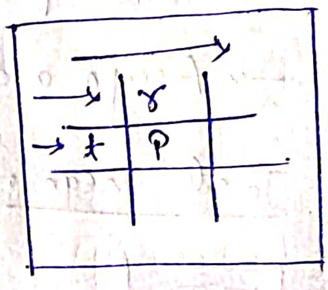
For any $P \in S$, the set of pixels in S that are connected to 'p' is called connected components of S.



Connected component Labelling →
1) →
2) ⇒ Area
3) ⇒ Boundary.

Algorithm →





1. → Scan an image from left to right and top to bottom.
2. → Assume 4 connectivity.
3. → P be the target pixel at any step in the ______ process.
4. → $I(P)$ = pixel value at position 'p'.
   $L(P)$ = label assigned to pixel location P.

Steps → (i). If $I(P) == 0$, move to next position.

(ii). if $I(P) == 1$, $I(r) == 0$
$I(t) == 0$

Then assign a new label to P.

(iii). if $I(P)==1$; $I(r)==1$, $I(t)==0$ — Assign the label of 'r' to 'P'. | $I(r)==0$, $I(t)==1$ — Assign the label of 't' to 'P'.

(iv). if $I(P)==1$; $I(r)==1$
$I(t)==1$

if $L(r)==L(t)$ then $L(P)=L(r)$
else assign $L(P)=L(r)$ with a note.

→ At the end, all the pixels with value(1) are labeled.
→ some labels are equivalent.
→ in 2nd pass, equivalent pairs will be formed equivalent class.
→ Assign a diff. label to each class.

To calc mean of an image → $\mu_x = \frac{1}{MN}\sum_{i=1}^{MN} f(i)$

image (N, M)

$$\sigma^2 = \frac{1}{MN}\sum_{i=1}^{MN}\left(f(i)-\mu_x\right)^2$$

form Groups.

08/02/2022

Distance Measures →