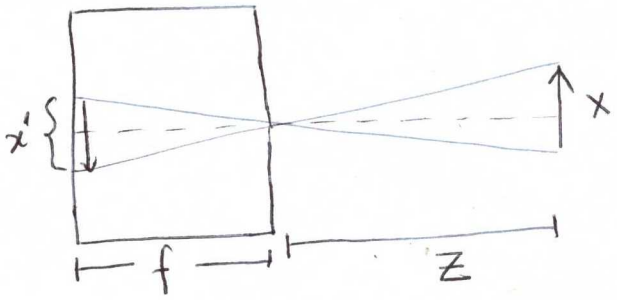
A1)



← Perspective Projection.

x' = size of the image sensor

f = focal length.

From similar triangles we get

$$\frac{x'}{f} = \frac{X}{Z} \quad - (i)$$

For digital camera

$$x' = 36 \; ; \; f = 50$$

$$\therefore \quad \frac{X}{Z} = \frac{36}{50} \quad - (ii)$$

For smartphone,

$$f = 4.$$

Substituting (ii) in (i) we get,

$$X = \frac{36}{50} \times 4$$

$$= 2.88 \text{ mm}$$

∴ size of the light-sensitive image sensor of smart phone is 2.88mm

Ratio of size of " " " " of digital camera & smart phone

$$= \frac{2.88 \times 2.88}{36 \times 36} = 64 \times 10^{-4}$$

≈ 0.0576.

→ Size of a sensor pixel element for the professional digital camera is $\frac{36 \times 36}{16000000}$ (size of image / No. of pixels)

$= 81 \times 10^{-6}$

for the smartphone camera.

$= \frac{2.88 \times 2.88}{16000000}$

$= 52 \times 10^{-8}$

→ Storage requirement for both of the cameras are:-

Square sensor = 16 MB

Each color channels occupy 1 Byte

Therefore for each pixel we require 3 Bytes of storage

∴ Total storage requirement = 48 MB

→ The disadvantages of smaller pixel size is that the images captured in low light will not be clear.

As the number of pixels increases, the memory requirement will also increase.

Professionals prefer large expensive cameras since we can have the captured image in 'RAW' format which can be processed further using specialized software.

A3) Histogram equalization is a transformation for contrast enhancements. It creates an image with equally distributed brightness levels over the whole brightness scale. We try to find a monotonic pixel brightness transformation such that the desired output histogram is uniform over the complete brightness scale.

For histogram equalization we calculate cumulative histogram, which is approximated by a sum in digital image. Moreover, we are finding a monotonous function for pixel transformation, therefore the resulting histogram after equalisation is not equalized ideally.

A2)

(i) 8-neighborhood for foreground & 4-nh for background

Image (a) → Total 2 (1 → fg & 1 - bg)

Image (b) → Total 3 (1 → fg & 2 → bg)

(ii) 4-nh for fg & 8-nh for bg

Image (a) → Total 26 (25 → fg & 1 → bg)

Image (b) → Total 12 (11 → fg & 1 → bg)

(iii) 8-nh for fg & bg

Image (a) → 2 (1 fg & 1 bg)

Image (b) → 2 (1 fg & 1 bg)

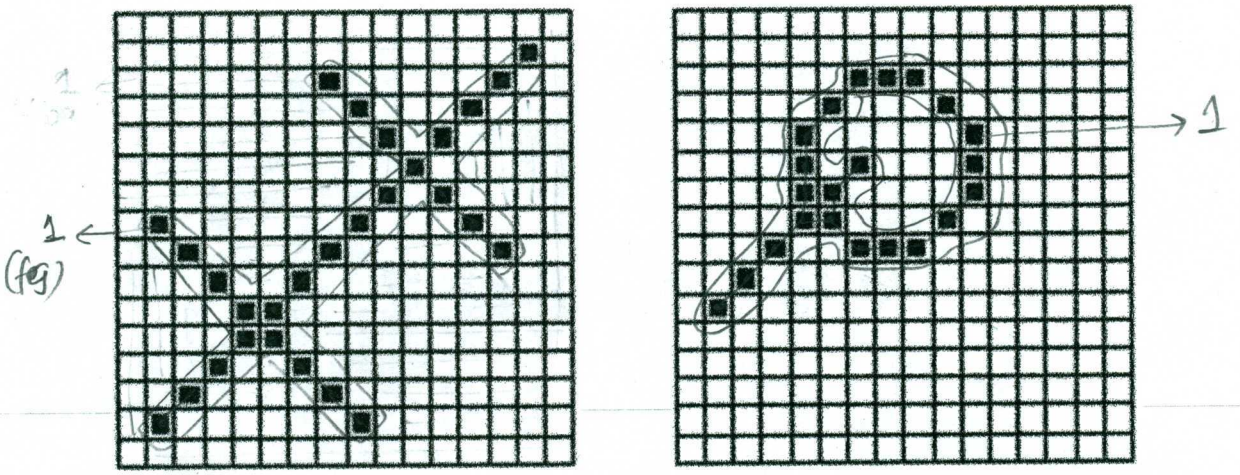
(iv) 4-nh for fg & bg

Image (a) → Total 26 (25 → fg & 1 → bg)

Image (b) → Total 14 (11 → fg & 2 → bg)

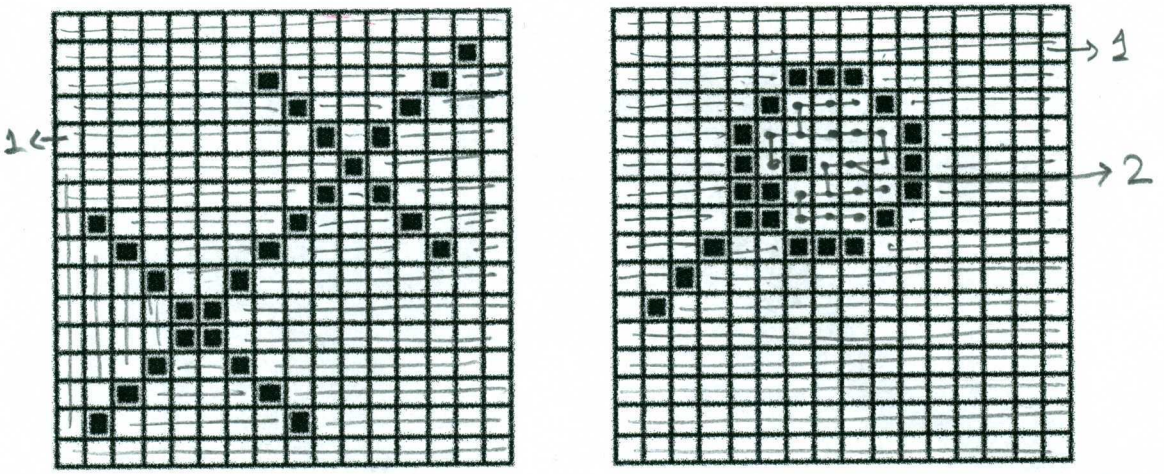
8 - neighborhood for foreground & 4-neighborhood for background

Foreground,



(a) (b)

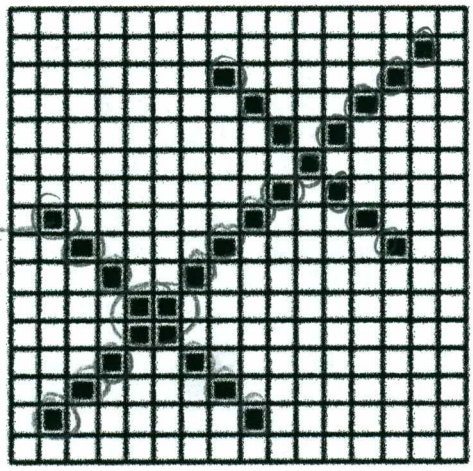
Background



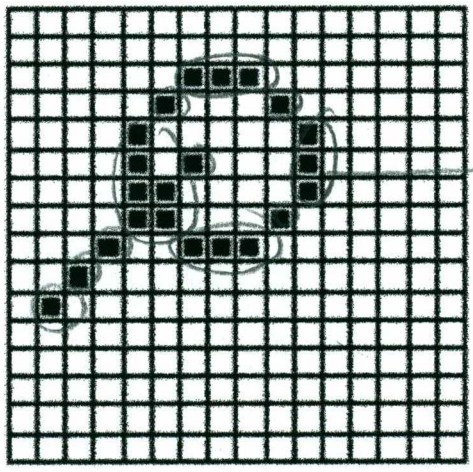
(a) (b)

4-neighborhood for foreground and background.

Foreground



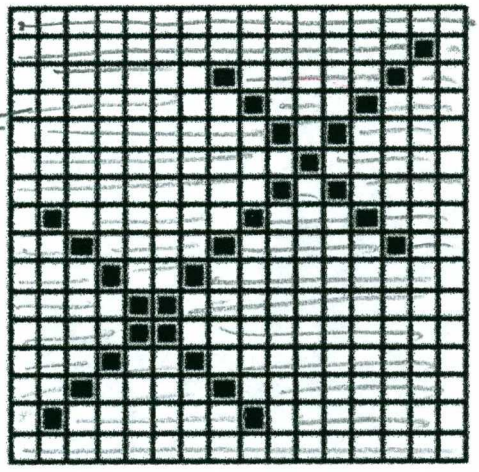
Total 25



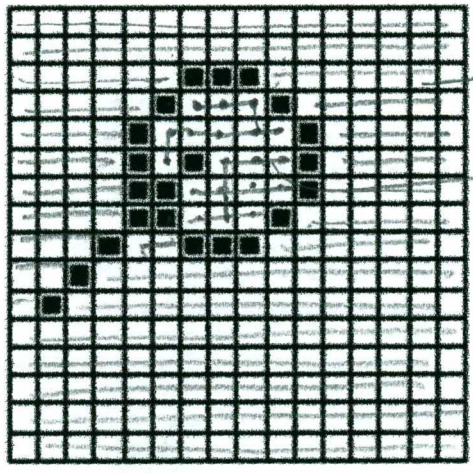
Total 11.

(a) (b)

Background



1



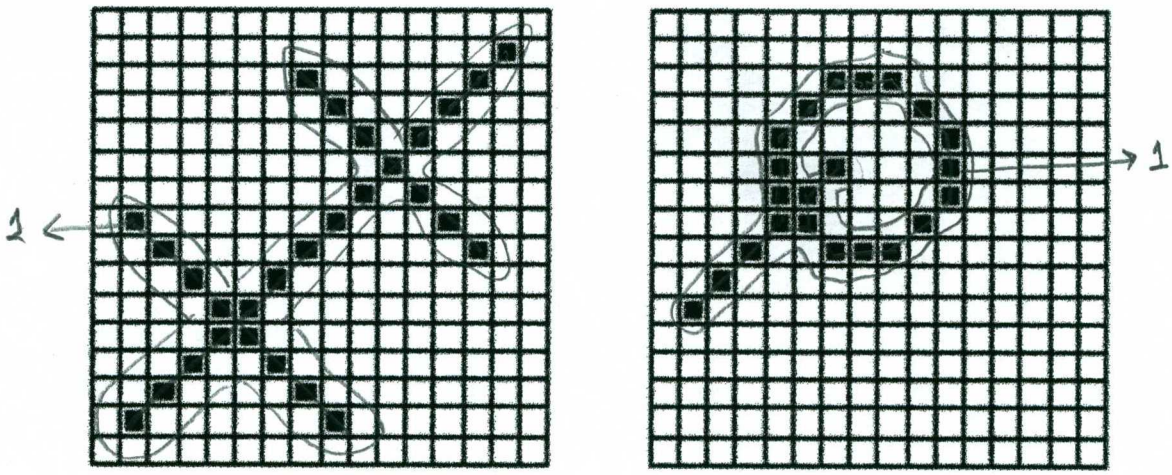
1

2

(a) (b)

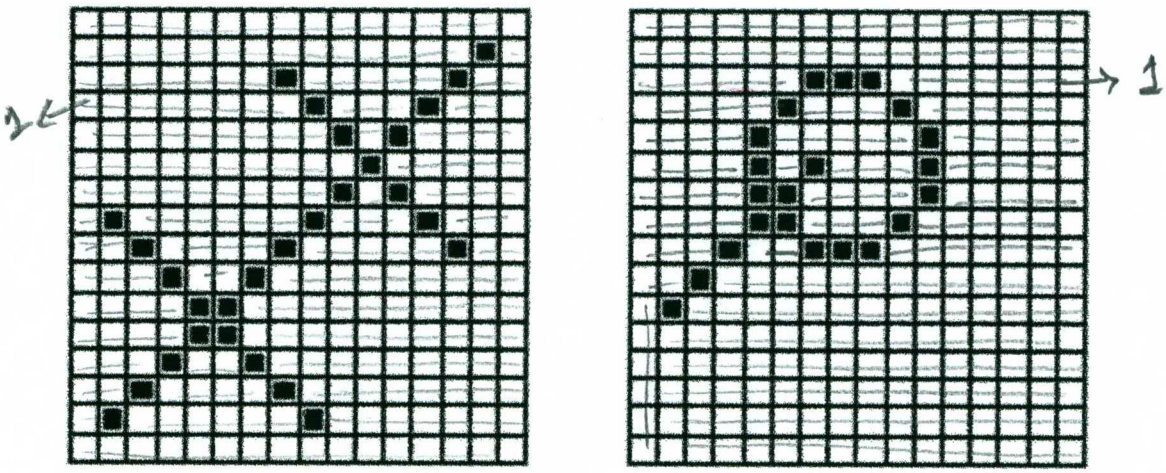
8-neighborhood for foreground and background

Foreground



(a) (b)

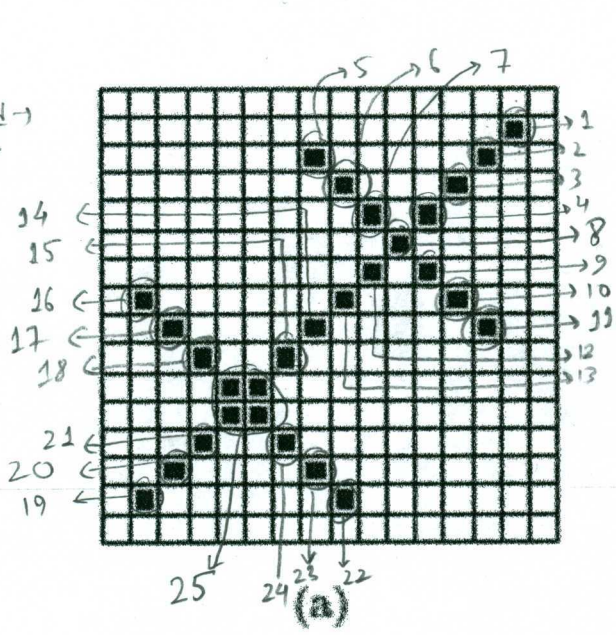
Background



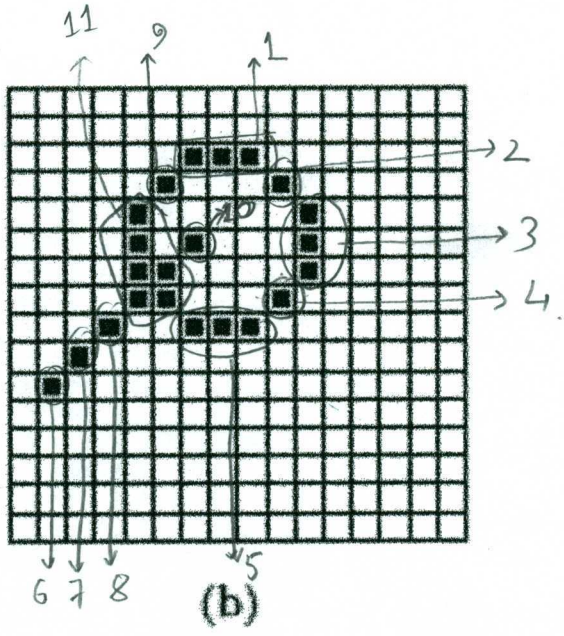
(a) (b)

4-neighborhood for foreground & 8-neighborhood for background

Foregoound→

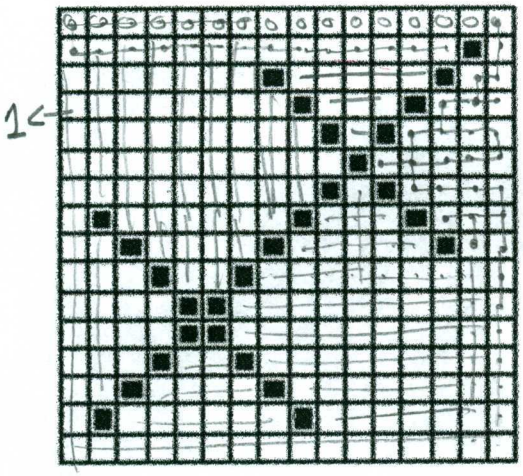


(a)

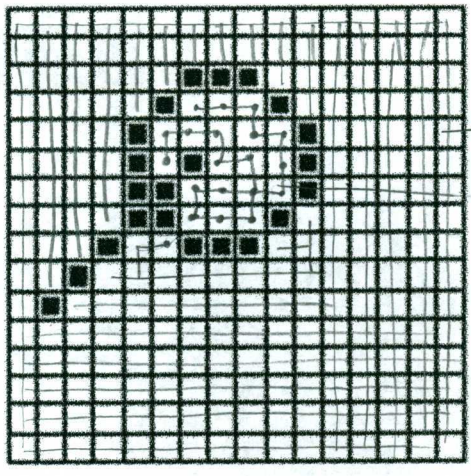


(b)

Background→



(a)



(b)