Edge Detection

Processing example

(a) Original image

(b) Traditional Canny algorithm

(c) Improved Canny algorithm

Edge Detection

This step has 4 separate phases:

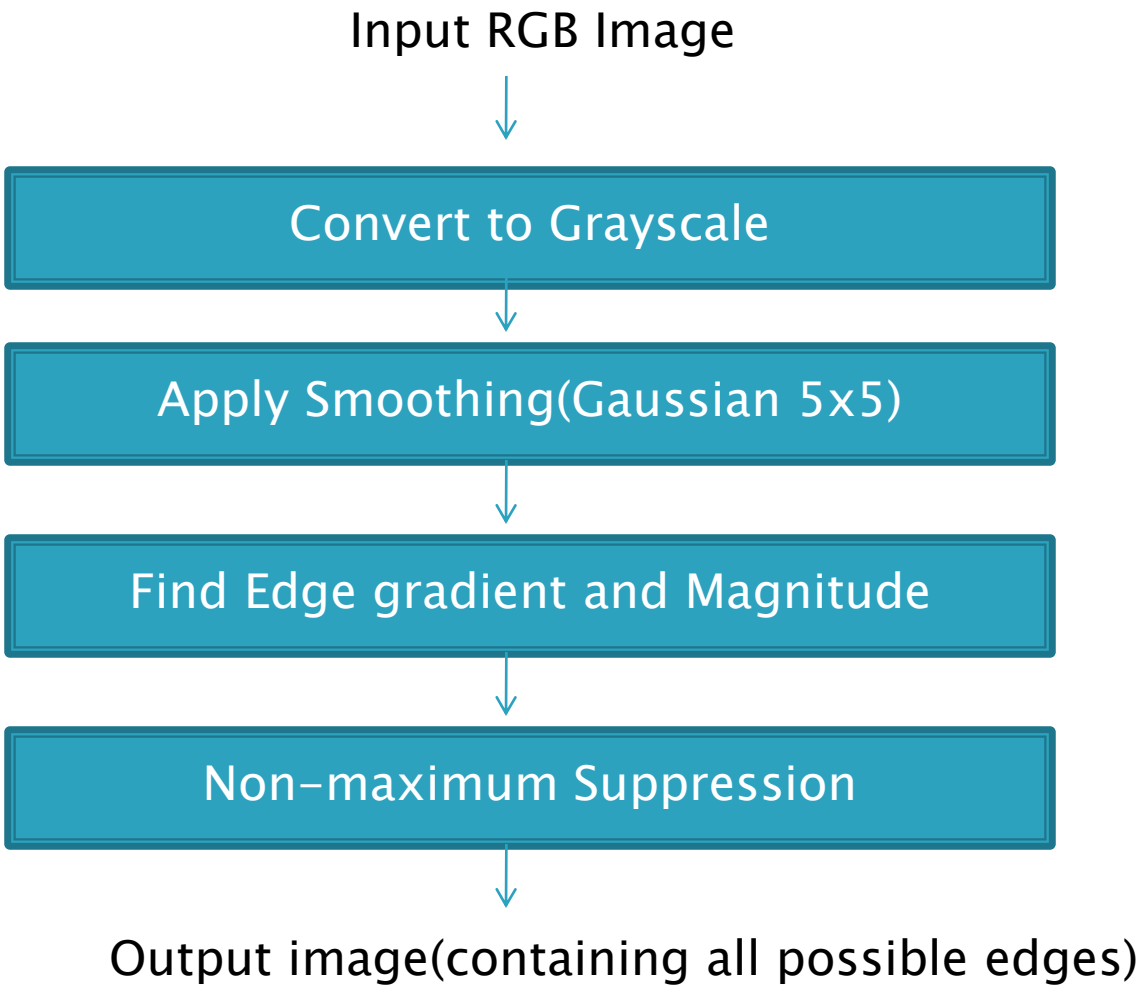
1.Smoothing: Blurring of the image to remove noise.

2. Finding gradient: The edges should be marked where the gradients of the image has large magnitudes.

3. Non-maximum suppression: Only local maxima should be marked as edges.

4. Thresholding: Potential edges are determined by thresholding.

Step 1 : Edge Detection



1.Smoothing

- Smoothing is done by using averaging masks.
- Every pixel is set a new calculated value.
- I used gaussian 5x5 mask for smoothing.

1/16*

1	2	1
2	4	2
1	2	1

$\frac{1}{115}$

2	4	5	4	2
4	9	12	9	4
5	12	15	12	5
4	9	12	9	4
2	4	5	4	2

Figure 3 Discrete approximation to Gaussian function with σ=1.4

Original Image

Using 3x3 kernel

Using 5x5 kernel

Blurred images

2.Finding Gradient magnitude and direction

- I used sobel masks for finding gradient magnitude and direction.

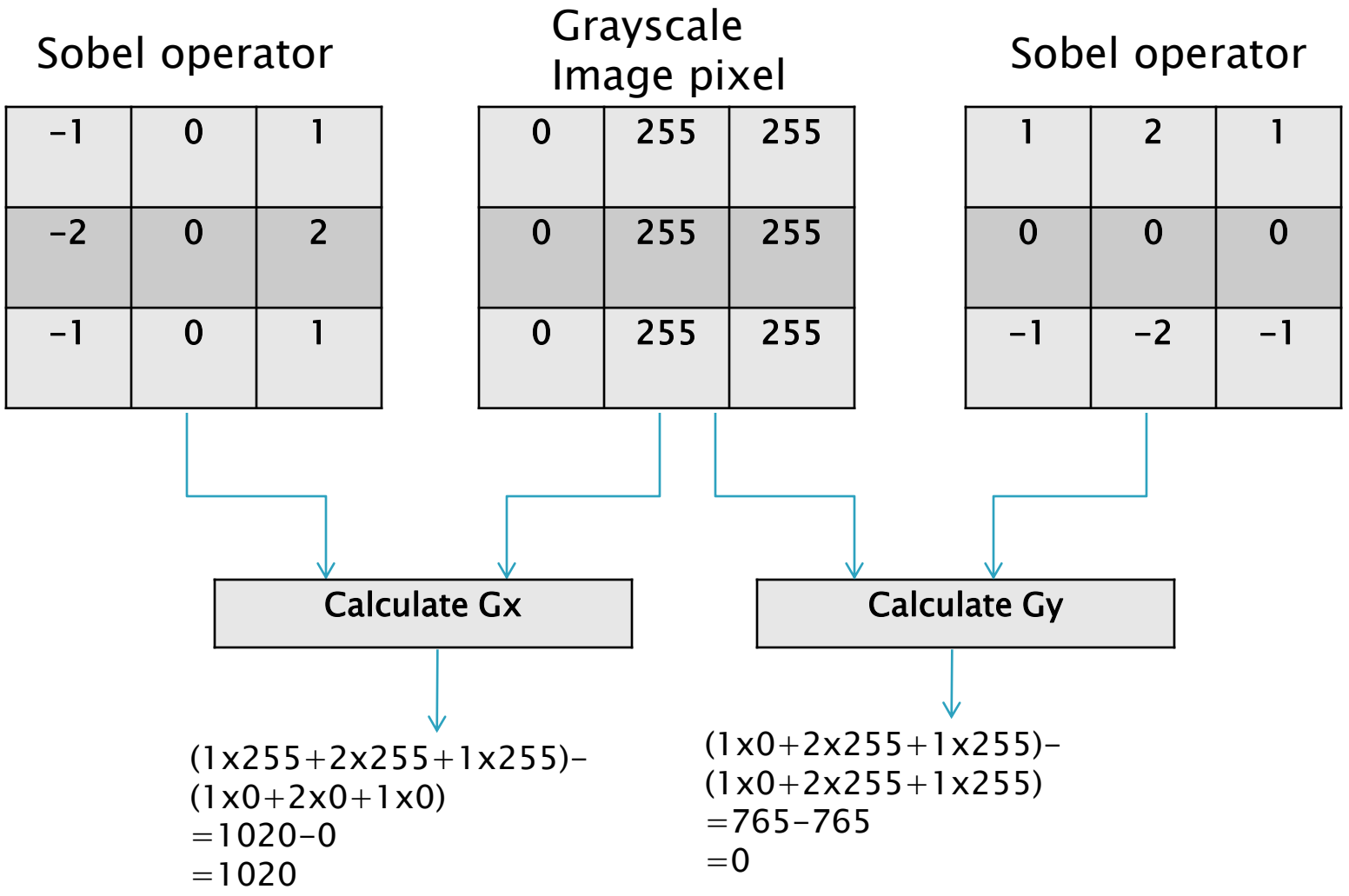
-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

Gradient magnitude=sqrt((Gx)*(Gx)+(Gy)*(Gy))
Direction=atan(Gy/Gx)



Applying Sobel operator

Calculation of Gradient Magnitude and Direction

Gradient magnitude

$$G=\sqrt{Gx^2+Gy^2}$$

$$=\text{sqrt}(1020^2+0^2)$$
$$=1020$$

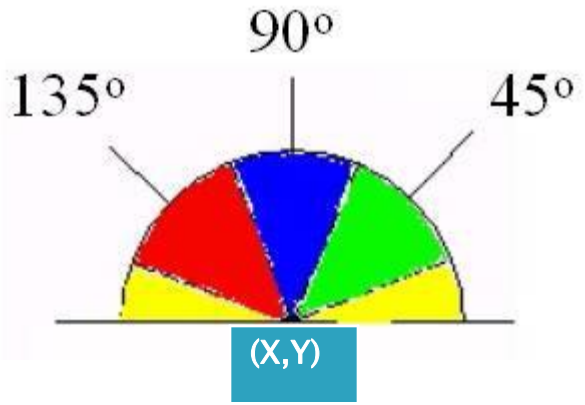
Gradient direction,

$$\text{Theta}=\tan^{-1}(Gy/Gx)$$
$$=\tan^{-1}(0/1020)$$
$$=0^\circ$$

Selecting Gradient direction:

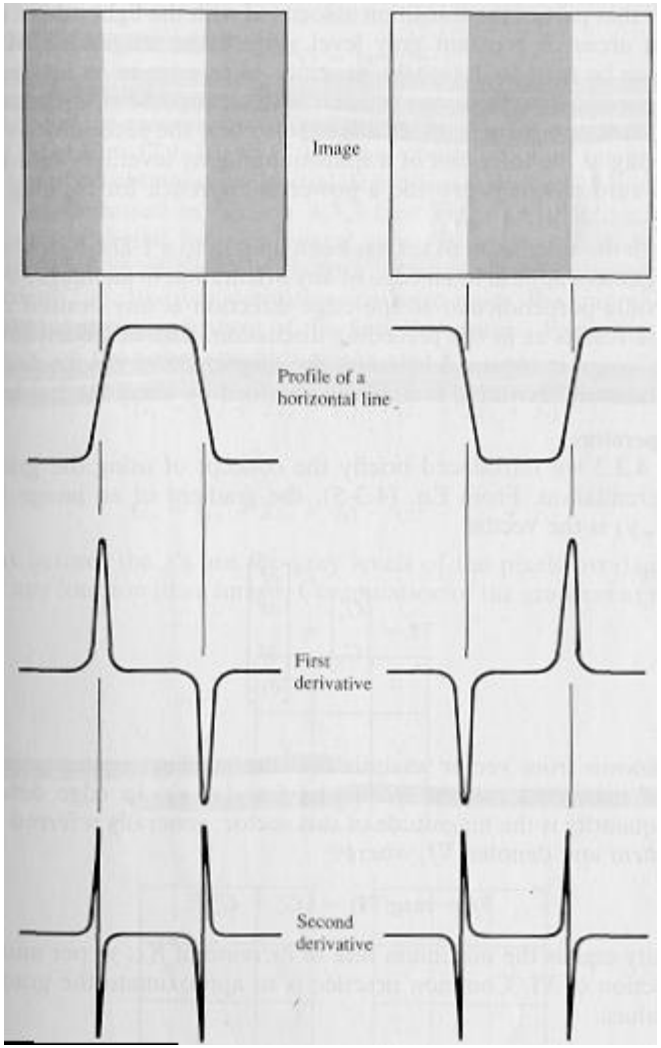
We are interested in horizontal,vertical or diagonal edges.
So From a pixel (x,y), there are four possible directions- 0,45,90 and 135 degree. So direction is assigned to each pixel (x,y) From our calculated direction as following table

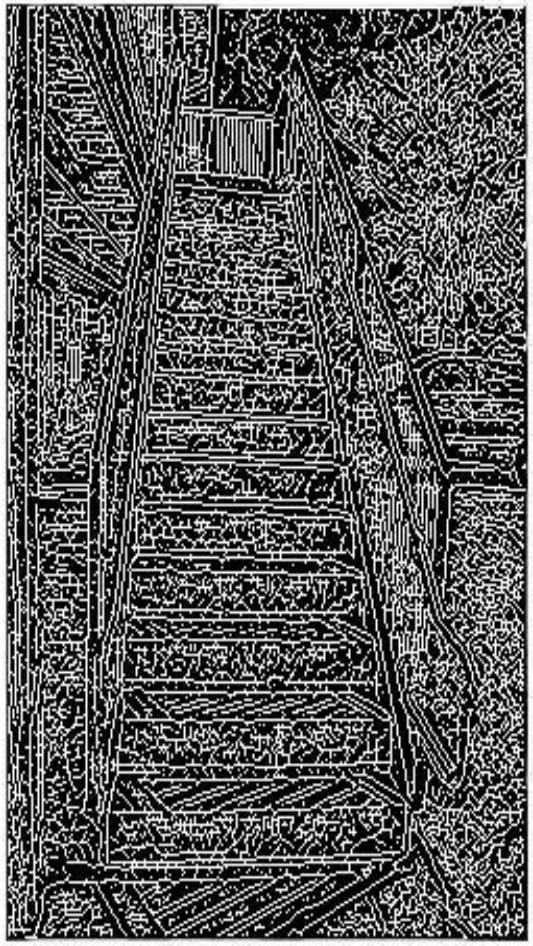
Calculated Direction	Assigned Direction
0°-22.5° (Yellow)	0°
22.5°-67.5° (Green)	45°
67.5°-112.5° (Blue)	90°
112.5°-157.5° (Red)	135°
157.5°-180° (Yellow)	0°



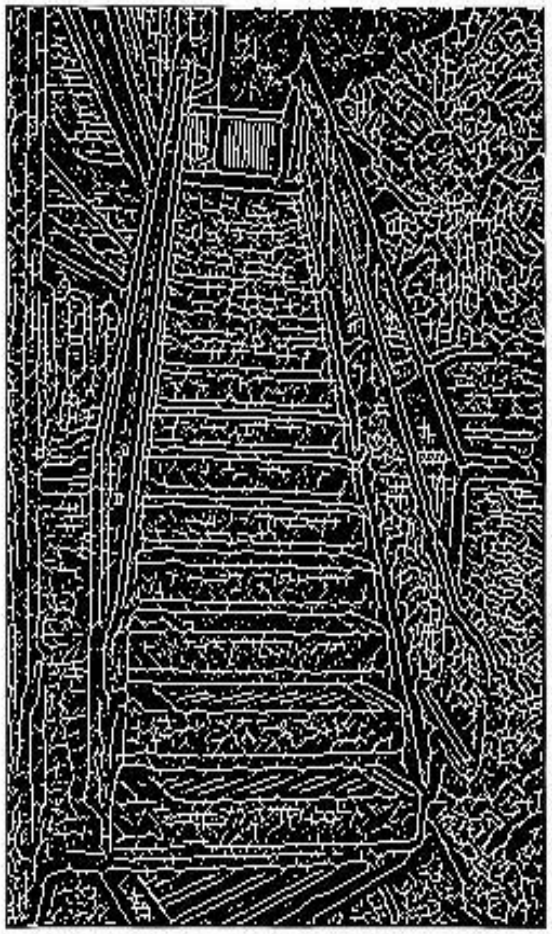
3.Non Maximum Supression

- Not all point should be kept as edge pixel, only those which are at a local maxima.
- All non maximum points should be removed.





Using 3x3 kernel



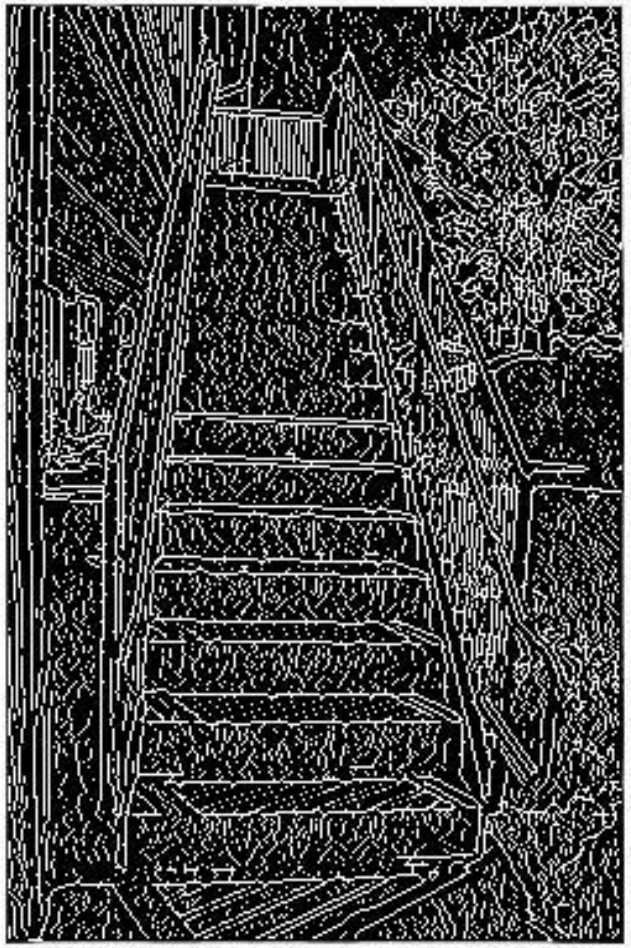
Using 5x5 kernel

After non maximum suppression

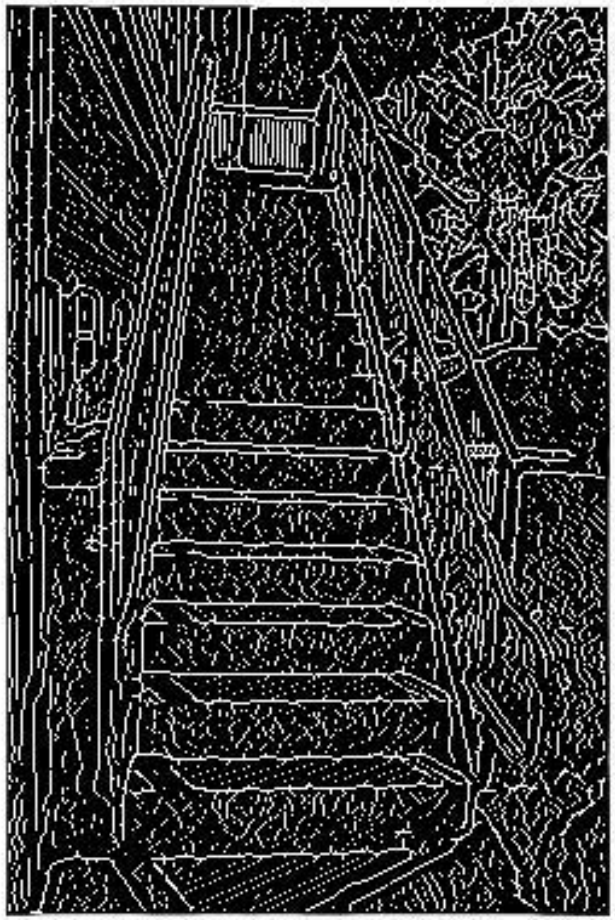
4.**Thresholding**

- There may exist some false edges still because of noise or color variation.

- To remove these, the edges weaker than a certain value (threshold value)is removed.



Using 3x3 kernel



Using 5x5 kernel

Applying Threshold value

Thank you