Computer Vision and Graphics

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Assignment -1

1. Implementation of canny edge detector
2. Implementation of Hough line transform

1. Implementation of Canny edge detector

Edge is a discontinuity in intensity or color of the image, in simlper words sudden change in intensity from one pixel to another pixel.
To detect the edges of the image we need to make sure, there should be less noise. Here we lose some data hence one should make sure structural properties of image are preserved.
Canny edge detector is edge detector that gives edge detected image without noise.
To obtain canny image, here are the steps to follow

a. Read a image in gray scale
b. Pass the image to Gaussian filter which smoothens the image.

Fig.1 Original Image

Fig.2 Gaussian Image

c. Now this smoothened image is convolved with sobel filter's kernel. Sobel filter is used for edge detection in x-axis and y-axis.
The size of the kernel of sobel filter is 3 x 3.

X – Direction Kernel

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

Y – Direction Kernel

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

Fig.3 Sobel in x-axis

Fig.4 Sobel in y-axis

d. The image obtained after passing to sobel filter is passed to Laplacian filter which is an edge detector used to compute the second derivatives of an image
The kernel for laplacian filter is

$$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

This kernel is convolved with output image of sobel filter.

Fig.5 Result of Laplacian

Fig.6 Result of Laplacian after passing through sobel filter in y-axis

Fig.7 Result of Laplacian after passing through sobel filter in x-axis

e. And lastly hysteresis is performed by taking two threshold values namely high threshold and low threshold.
   - If the pixel value is greater than high threshold, then it is assigned to 255
   - If the pixel value is less than low threshold, then it is assigned to 0
   - If the pixel value is between the two thresholds then neighboring pixel values are compared to high threshold. If any of the neighboring pixel value is greater than high threshold, the previous pixel that has value between two thresholds is assigned to 255

     The resulting image is called Canny Image which detects edge with no noise.

Fig.8 Canny Image

2. Hough Transform

Hough transform is used to detect the lines, circles, or other any structure that can be represented by the parametric equations.

In my code, I'm detecting lines of the image or find locations of lines in the image.

There are steps to follow to implement hough transform.

a. First step is that, all the edge detected points are to be collected. This can be done by taking a edge detected image. All the coordinate values of edge detected points in the image are defined in polar form using parametric equation.

   Parametric equation of line is

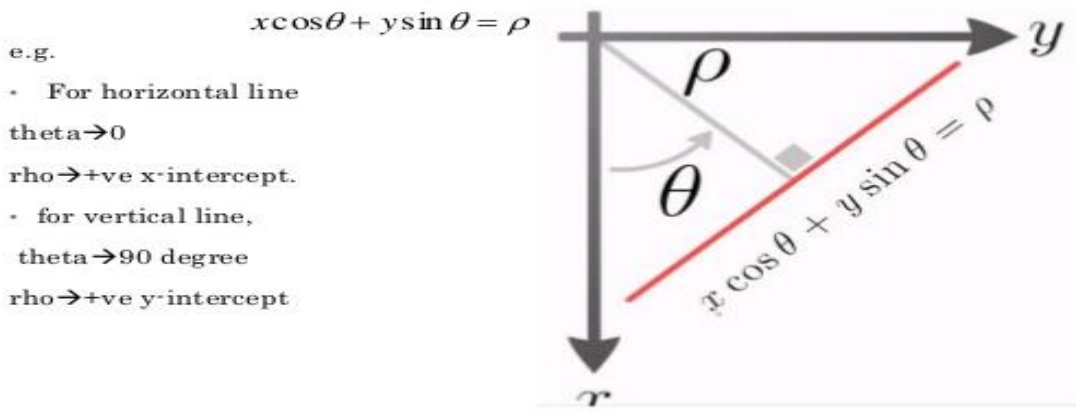

Fig.9 Theta and rho in x and y place

Here,

theta is angle between the x-axis and perpendicular distance between origin and the line.

Rho is and perpendicular distance between origin and the line.

b. For each point obtain the values of rho and theta using parametric equation of line.

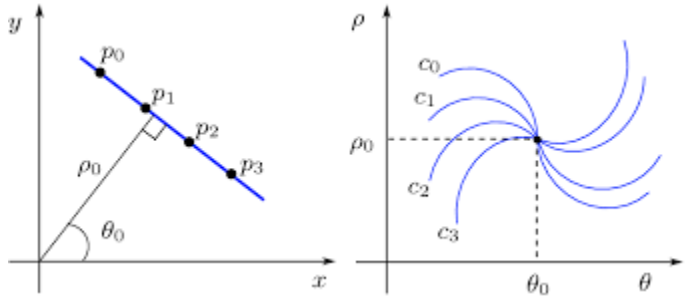

Fig.10 Corresponding lines and curves in different planes

The points in x and y plane is curve in theta and rho plane and the point of intersection in rho and theta plane is a line in x and y plane.

c. Now (xi,yi) lines are converted to ($\theta i, \rho$i) curves and score at ($\theta i, \rho$i) is incremented in score matrix.
d. By taking threshold and comparing with each score, number of lines are reduced.
e. These curves those score is greater than threshold are converted back to slope and intercept plane and is drawn on the image.

f.

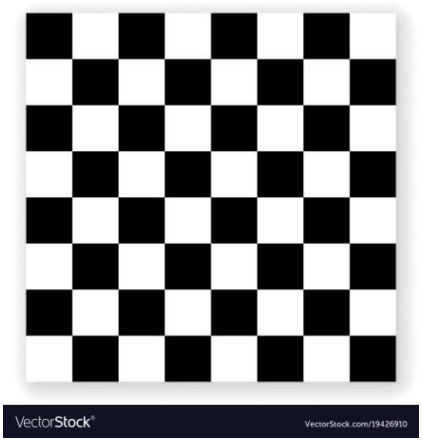

Fig.11 Original Image

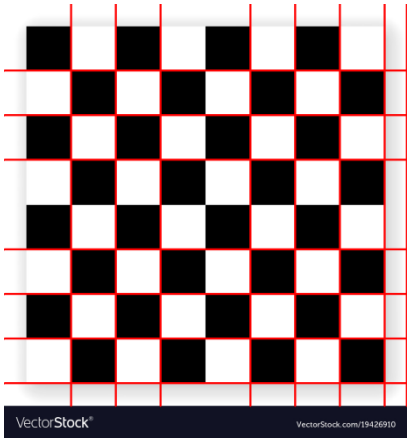

Fig.12 Line detected image