Lab Instructions - session 7

Hough Transforms

Part 1. Hough Line Transform

Detect lines in an image using the function cv2.HoughLines
File: **hough_line.py**

```
def draw_line(Img, rho, theta):
   """draws a line in an image 'Img' given 'rho' and 'theta'"""
   a = np.cos(theta)
   b = np.sin(theta)
   x0 = a * rho
   y0 = b * rho
   x1 = int(x0 + 1000 * (-b))
   y1 = int(y0 + 1000 * a)
   x2 = int(x0 - 1000 * (-b))
   y2 = int(y0 - 1000 * a)

   cv2.line(Img, (x1, y1), (x2, y2), (0, 0, 255), 1)


Img = cv2.imread('highway.jpg')

G = cv2.cvtColor(Img, cv2.COLOR_BGR2GRAY)  # -> grayscale

E = cv2.Canny(G, 100, 200)  # find the edges

min_votes = 160  # minimum votes to be considered a line
distance_resolution = 1  # 1 pixel: resolution of the parameter "rho" (distance to origin)
angle_resolution = np.pi / 180  # pi/180 radians: resolution (bin size) of the parameter "theta"
L = cv2.HoughLines(E, distance_resolution, angle_resolution, min_votes)

# draw the lines
for [[rho, theta]] in L:
   draw_line(Img, rho, theta)

cv2.imshow("E", E)
cv2.imshow("Img", Img)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

Increase Min_Votes -> Less lines detected, but lines with higher votes remain

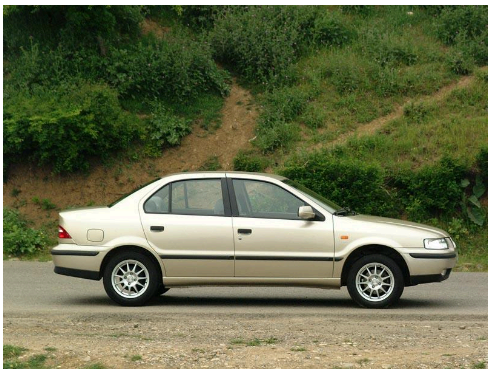
- What happens by increasing or decreasing the parameter **`min_votes`**? Why?
- What is the effect of increasing and decreasing the **`distance_resolution`** and **`angle_resolution`** parameters? Explain.

Increasing distance_res ->
Lines close together merged into a single line
More robust to noise, small variations in distance ignored
It does not mean some pixels will be ignored, but the distance to the line is rounded to the nearest multiple of rho

Increasing angle_res (smallest angle distinguished) ->
lines with slightly different angles merged into a single line
more robust to noise, small variations in angle ignored

Part 2: Hough Circle Transform

The goal is to detect the wheels of the car in the picture using `cv2.HoughCircles`



File: **hough_circle.py**

```python
import numpy as np
import cv2

I = cv2.imread('samand.jpg')

G = cv2.cvtColor(I,cv2.COLOR_BGR2GRAY) # -> Grayscale
G = cv2.GaussianBlur(G, (3,3), 0);     # Gaussian blur

canny_high_threshold = 200
min_votes = 100 # minimum no. of votes to be considered as a circle
min_centre_distance = 40 # minimum distance between the centers of detected circles
resolution = 1 # resolution of parameters (centre, radius) relative to image resolution
circles = cv2.HoughCircles(G,cv2.HOUGH_GRADIENT,
                           resolution,min_centre_distance,
                           param1=canny_high_threshold,
                           param2=min_votes,minRadius=0,maxRadius=100)

for c in circles[0,:]:
    x = c[0] # x coordinate of the centre
    y = c[1] # y coordinate of the centre
    r = c[2]  # radius

    # draw the circle
    cv2.circle(I,(x,y), r, (0,255,0),2)

    # draw the circle center
    cv2.circle(I,(x,y),2,(0,0,255),2)

cv2.imshow("I",I)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

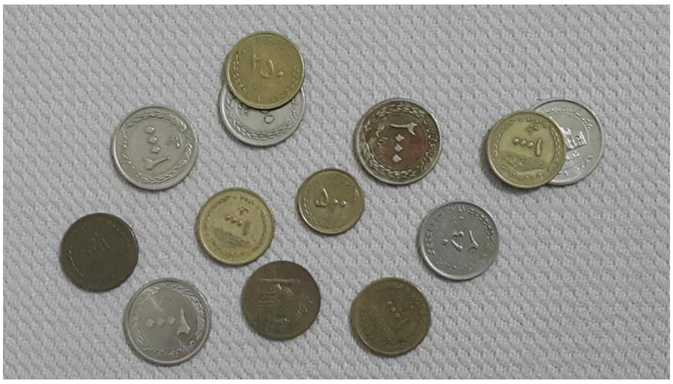
- Change the parameters of `cv2.HoughCircles` and see how each of them affect detection.

Increase res -> More precise detection (smaller circles can be detected too)

Increase min_centre_dist -> reduce number of false circles detected but may miss true circles too

Today’s task: count the coins

You need to count the number of coins in the next image:



Write a piece of code to perform this task using a hough circle transform. Change the file **task1.py** to perform the task. Play with the parameters until you get the desired results.

File: **task1.py**

```
import numpy as np
import cv2

I = cv2.imread('coins.jpg')
G = cv2.cvtColor(I,cv2.COLOR_BGR2GRAY)
G = cv2.GaussianBlur(G, (5,5), 0);

canny_high_threshold = 160
min_votes = 30 # minimum no. of votes to be considered as a circle
min_centre_distance = 40

circles = np.array([[10,10]])

for c in circles[0,:]:
    x = 100
    y = 100
    r = 40
    cv2.circle(I,(x,y), r, (0,255,0),2)
print(circles.shape)
n = 100
font = cv2.FONT_HERSHEY_SIMPLEX
cv2.putText(I,'There are %d coins!'%n,(400,40), font, 1,(255,0,0),2)

cv2.imshow("I",I)
cv2.waitKey(0)
```

- What happens by changing different parameters?
- The Hough transform can even detect the partially occluded coins. Why is this the case?

Because of voting, edges of occluded circles can contribute to votes making partially occluded circles pass the min number of votes.

References

- OpenCV-Python Tutorials - Hough Line Transform
- OpenCV-Python Tutorials - Hough Circle Transform