



Due Date: 23:59 pm on Saturday, March 19th, 2022

Circle by Using Hough Transform

In this assignment, you will get familiar with edge detection methods and Hough Transform. First of all, you will extract and obtain the edge points from an image simply by using an edge detection method. Then, you will use these edge points to detect circles by giving the map including edge points as an input for the Hough Transform (See Figure 1). As a dataset, you will use a subset of [1].

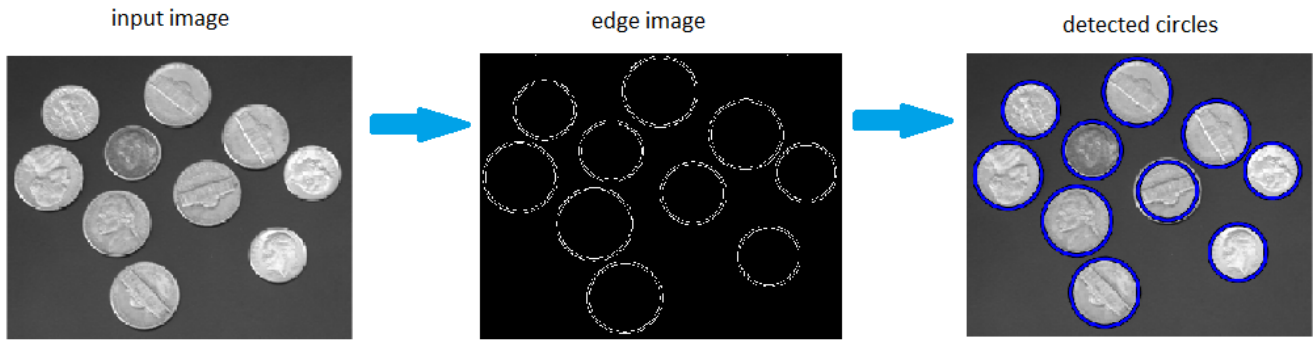


Figure 1: Hough Transform

Edge Detection and Hough Transform

Edge Detection: We can define edges as a sudden changes of brightness values in the image pixels. These sudden level of transition determines how the candidate pixel groups have potential to construct an edge. Generally several different edge detection methods are utilized to extract horizontal, vertical and diagonal edge information by constructing an edge map of an image (See Figure 2). Edge detection is a critical process because of that most of the shape information is intrinsically encoded in edges.

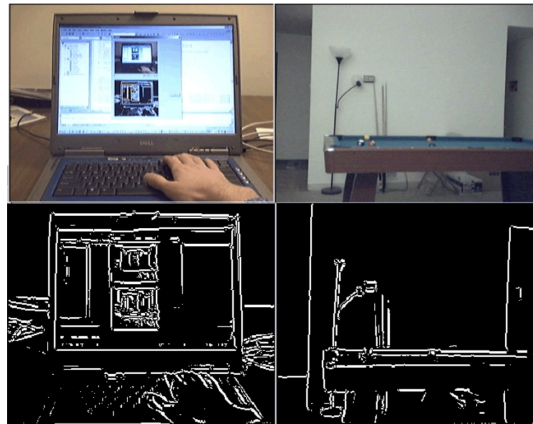


Figure 2: Example images and their corresponding edge images obtained by an edge detection methods

Hough Transform: Hough Transform is a voting method which developed to solve these issues:

1. Detection of a potential line object with respect to the given points
2. Determining the count of the potential line objects
3. Assigning the given points to the one of the potential line objects detected.

Hough Transform proposes to save vote for each potential line on which each edge point exists and search for the lines gotten.

Dataset

Dataset [1] consists of sample images including circular objects. For each image, there is also a txt file provided for ground-truth information showing where the circular objects are placed on the image (See Figure 3).



Figure 3: Sample images and the ground truth bounding rings from the dataset

The Implementation Details

1. Firstly you are expected to use an edge detection method to obtain an edge map of the input image. *you may use the available functions from the libraries for obtaining the edge map. You may use; Sobel Edge detector, Laplacian Edge detector, Canny Edge detector etc.*
2. Then you are expected to utilize Hough Circle Transform on obtained edge map to detect possible rings within the image. **You must implement your own Hough Transform method.**

3. You should also plot your detected rings on the original image and segmentation map of the corresponding input image to measure visually how good your method's performance is.
4. You should pay attention to code readability such as comments, function/variable names and your code quality:
1) no hard-coding 2) no repeated code 3) cleanly separate and organize your code 4) use consistent style, indentation
5. Your code should read all images from a folder named "dataset" and write results to the console.
6. Your code should also calculate the relevant Intersection Over Union (IOU) value.
7. You should use Python 3 for the assignment.

The Report

You are also expected to write a report about your results visually (by plotting your detected rings on the corresponding original image) and quantitatively by calculating the Intersection over Union (IoU) score for each corresponding image:

$$IOU = \frac{Area\ of\ Overlap}{Area\ of\ Intersection} \quad (1)$$

What should you write in the report?

- Explain which edge detector you have chosen and why and explain how you set the parameters of edge detection algorithm. Show edge detection results for 10 images at the document with relevant code snippet you have written.
- Explain all steps of Hough transform with visual examples and code snippets you have written.
- Put 10 samples of your detected rings as in Figure 3 and write IOU scores of each.
- Calculate the average IOU score for all images and write on your report and comment on your results.
- Show at least 5 images that your method fails to detect license plates correctly and explain possible reasons for it.
- You should write your report in L^AT_EX
- You should give visual results by using a table structure.

What to Hand In

Your submission format will be:

- README.txt (*give a text file containing the details about your implementation, how to run your code, the organization of your code, functions etc.*)
- code/ (*directory containing all your code*)
- report.pdf

Archive this folder as **b<studentNumber>.zip** and submit to <https://submit.cs.hacettepe.edu.tr>.

Grading

The assignment will be graded out of 100:

- CODE: 0 (no implementation), 15 (a partial solution– only edge detection), 30 (a partially correct solution - edge detection and partially correct Hough Transform), 50 (a correct solution) and REPORT: 50.

Academic Integrity

All work on assignments must be done individually unless stated otherwise. You are encouraged to discuss with your classmates about the given assignments, but these discussions should be carried out in an abstract way. That is, discussions related to a particular solution to a specific problem (either in actual code or in the pseudocode) will not be tolerated. In short, turning in someone else's work, in whole or in part, as your own will be considered as a violation of academic integrity. Please note that the former condition also holds for the material found on the web as everything on the web has been written by someone else.

References

[1] <https://github.com/zikai1/CircleDetection/blob/master/datasetMY.zip>