

Canny Edge Detection, Hough Transform, and Harris Corner Detection

1. Part A – Canny Edge Detection

Use `img_canny.png` to detect the edges of the objects in the image.

Tasks

- 1- Read the image and convert it to grayscale.
- 2- Apply Gaussian smoothing to reduce image noise.
- 3- Apply the Canny edge detector.
- 4- Display the original grayscale image and the resulting edge image.
- 5- Print a small binary matrix from the Canny result in the console. Use 0 for non-edge pixels and 1 for edge pixels.
- 6- Briefly explain how the threshold values influence the detected edges.

Suggested parameters: Gaussian kernel = 5×5 , Canny thresholds = 50 and 150.

2. Part B – Hough Transform

Use `img_Hough.png` to detect straight lines using the Hough transform.

Tasks

- 1- Read the image and convert it to grayscale.
- 2- Detect edges using the Canny method as a preprocessing step.
- 3- Apply the standard Hough line transform.
- 4- Draw the detected lines on a copy of the original image.
- 5- Display the edge image and the final image containing the detected lines.
- 6- Print a small binary edge matrix in the console.

- 7- Print the first few detected Hough parameters (rho and theta), when available.
- 8- Briefly explain the meaning of rho and theta.

Use a reasonable threshold for the Hough transform. The program may automatically adapt the threshold to the image size or use a clearly documented fixed value.

3. Part C – Harris Corner Detection

Use `img_harris.png` to identify important corner points.

Tasks

- 1- Read the image and convert it to grayscale.
- 2- Apply the Harris corner detector.
- 3- Normalize or threshold the Harris response.
- 4- Mark the detected corners on the original image.
- 5- Display the Harris response or the final image with detected corners.
- 6- Print a small matrix of the normalized Harris response in the console.
- 7- Explain why a large positive Harris response indicates a corner.

Suggested parameters: `blockSize = 2`, `apertureSize = 3`, and Harris parameter `k = 0.04`.