Medial Axis Detection

Computer Vision Assignment - 1

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AIM : Medial axis detection of Moving Objects

Your task of this assignment was to highlight the medial axis of the moving object in
the video clips given using OpenCV's inbuilt operations. Each frame was extracted from the video and following procedure was followed :

- Background Subtraction
- Cleaning of Image
- Identification of Edges and Lines
- Processing on Lines Extracted
- Medical Axis Identification

Background Subtraction

Background subtraction is the process of separating out foreground objects from the background in a sequence of video frames.

OpenCV Function Used : GaussianBlur, createBackgroundSubtractorKNN, cvtColor

Steps followed:
1. Convert Frame to grayscale using cv2Color Function
2. Apply Gaussian Blur
3. Apply BackgroundSubtractor to get binary image

Cleaning of Image

The thus obtained background subtracted image may contain noise, imperfections etc. which should be cleaned to get a better picture of the moving object in the foreground.

OpenCV Function Used : dilate, erode, morphologyEx, createStructuringElement

Steps followed:
1. Morphological image processing techniques are used in the order
    a. Dilate (Kernel 3x1) ->
    b. Dilate (Kernel 10x1) x2 ->
    c. Erode (Kernel 10x1)

Binary Image After
Background Subtraction and Cleaning Operations

Identification of Edges and Lines

The thus obtained background subtracted image may contain noise, imperfections etc. which should be cleaned to get a better picture of the moving object in the foreground.

**OpenCV Function Used : canny, HoughLines, HoughLinesP**

Steps followed:
1. Edges are detected from the binary image using Canny function
2. HoughLines function on Edge Binary Image returns an array of lines represented by rho,theta
3. HoughLinesP function returns line segments, which are part of Hough Lines by progressive probabilistic method. These line segments are used to estimate the length of the medical axis.
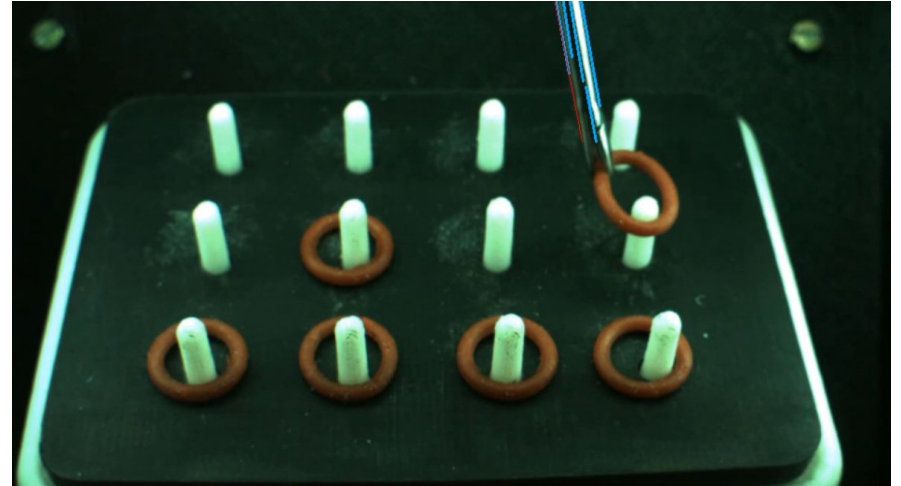
Edges From Canny Operation

Hough Line Transform
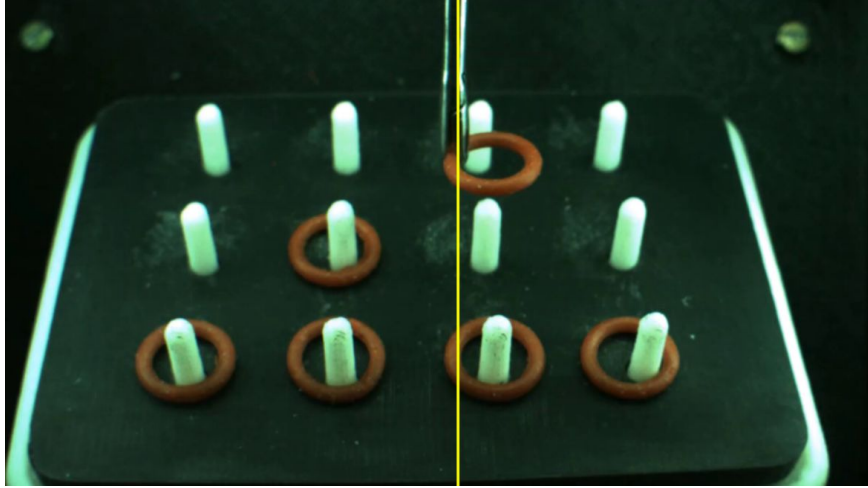
Hough Lines from cv2.HoughLines

Hough Line Segments from cv2.HoughLinesP
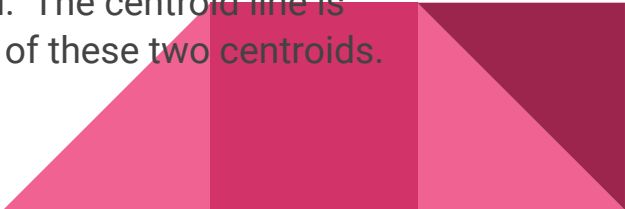
Processing on Lines Extracted

Θ Filter:

Theta filter function creates a histogram of all the Θ values from the lines obtained from cv2.HoughLines function. The range of the bin with the highest count is selected and the lines with their corresponding theta values in this range are selected for the next ρ filter.

ρ Filter:

This function again creates a histogram of ρ values from the Θ filtered lines and selects two bins with the highest count.

Estimation of Medial Line:

For each bin, the centroid of the lines in (ρ,Θ) space is calculated. The centroid line is considered to be a representative of the bin. Medial Line is the center of these two centroids.

Processing on Lines Extracted

Segment Filter:

     Segment Filter filters all the line Segments obtained from progressive Probabilistic Hough Transform which are deviated from the Medial Axis Line.

Length Estimation:

     The Y-coordinates of the line segments after segment filter are averaged to obtain the minimum and maximum Y-coordinates. The Medial Axis Line Segment is the Medial Axis Line with the selected Y-coordinates as end-points.

Medial Axis Identification
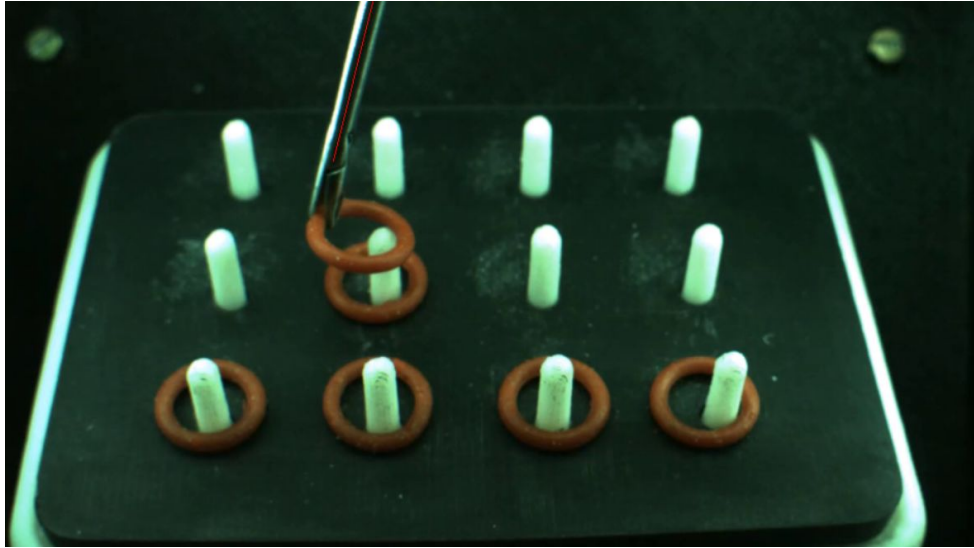
The red line is the medial axis of the moving object. Link To The Video Folder:
https://drive.google.com/drive/folders/1AG3qh1_6daCK-7FmZG81GvU5fawSi2ot?usp=sharing