Midterm Exam

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1 Question 1

Following are the steps to equilize the histogram of an image using **Normal** and **Contrast Limited Advanced Histogram Equilazation**.

a) Histogram Equilization

1. Counted total number of pixels of every intensity from (0-255) present in the grayscaled images.

2. Stored the pixels present in particular groups.

3. Calculated **cdf** of every intensity from (0-255).

4. Changed the intensity of the stored pixels for every group from (0-255) with **cdf[i]*i**.

b) Contrast Limited Advanced Histogram Equilazation

1. Divided the image in 8x8 parts.

2. For every part, counted total number of pixels of every intensity from (0-255) present in the grayscaled images.

3. Stored the pixels present in particular groups.

4. Calculated **pdf** of every intensity from (0-255).

5. Clipped every bucket of each intensity with a predifined value. Distributed the extra values collected equally in every intensity buckets.

5. Calculated new **cdf** and changed the intensity of the stored pixels for every group from (0-255) with **cdf[i]*i**.

Out of the two approaches **Contrast Limited Advanced Histogram Equilazation** is **better**. It performs histogram equilization on seperate blocks hence avoiding oversaturation of certain parts of the image.

Figure 1: Original Image.

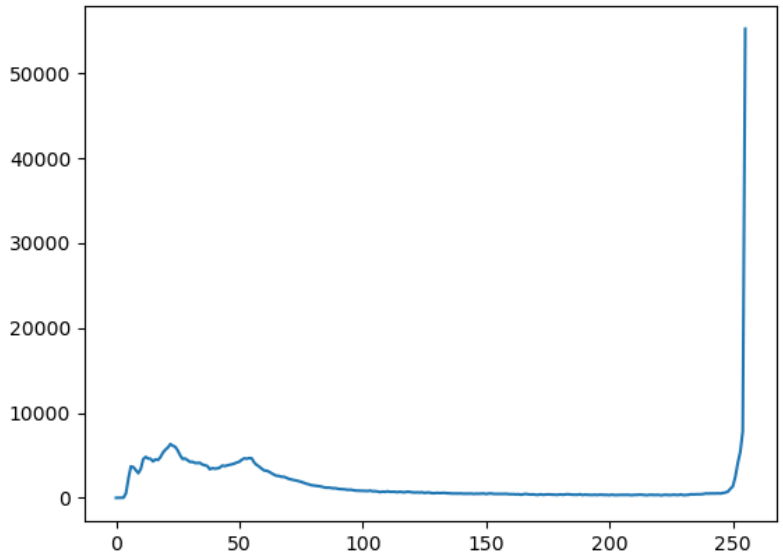

Figure 2: Histogram of original grayscaled image.

Figure 3: Normal Histogram Equilization.

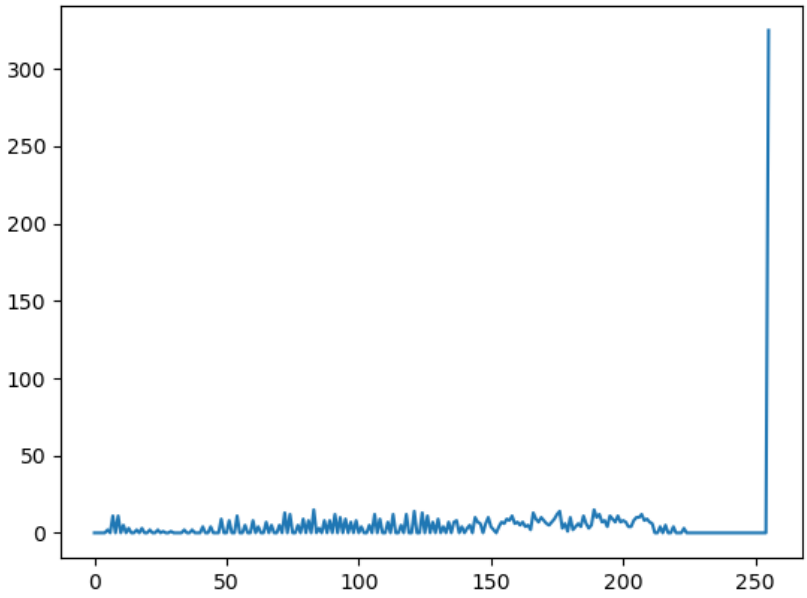

Figure 4: Normal Histogram Equilization.

Figure 5: Contrast Limited Advanced Histogram Equilazation.

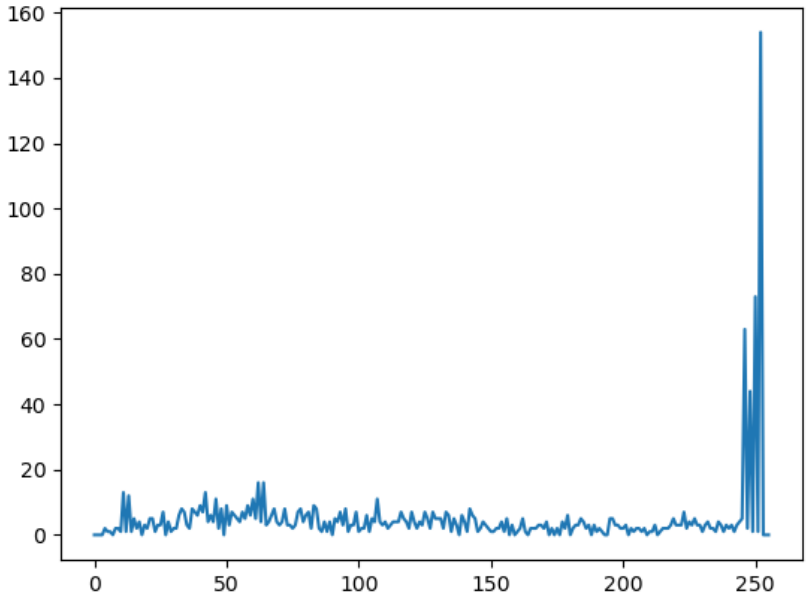

Figure 6: CLAHE histogram

2 Question 2

Following are the steps to detect lanes in given images.

1. Coverted the copies of the given images in grayscale.
2. Considered a trapezium part of the image containing two lanes.

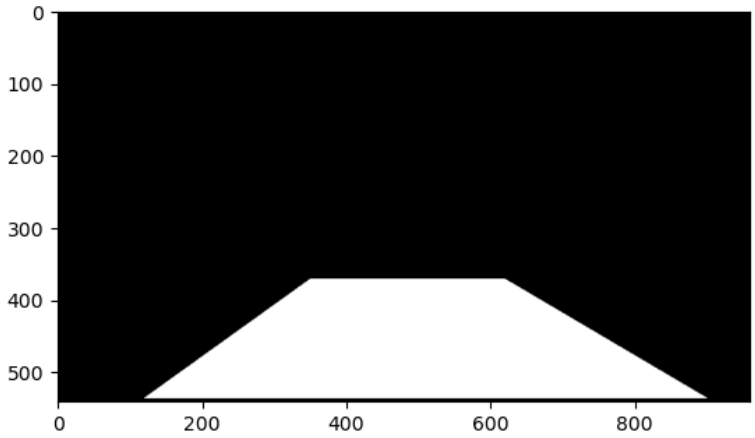

Figure 7: Stencil to extract lane image.

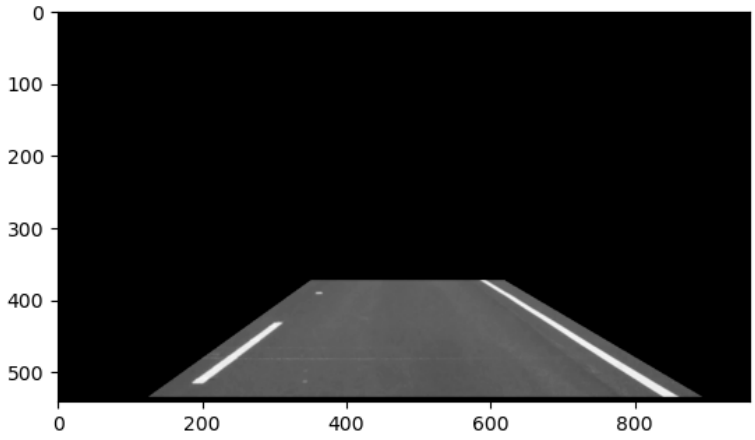

Figure 8: Extracted Lane image.

3. Detected lanes using Hough lines.

4. Rejected similar lineson the same lane.

5. Differentiated the lanes by coloring them with green and red.

Figure 9: Lane Detection.

3 Question 3

Following are the steps to find the radius of curvature of the detected lanes.

1. Converted the copies of the given images in grayscale.

2. Considered a trapezium part of the image containing two lanes.

3. Warped the part to get a frame containing the lanes

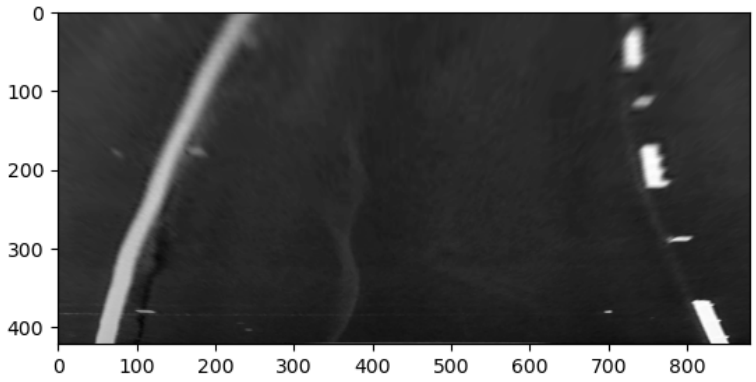

Figure 10: Warped Image

4. The warped image was then thresholded.

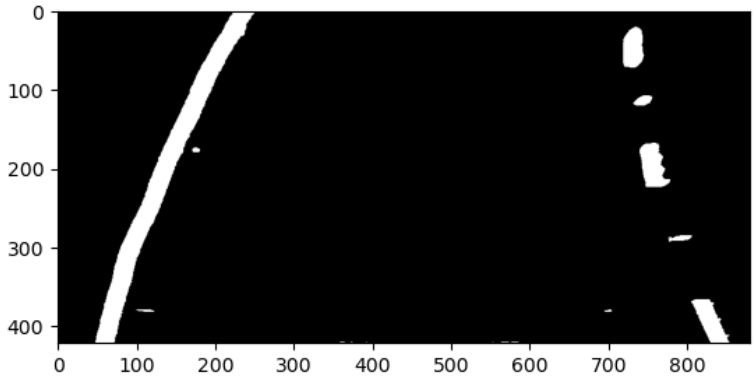

Figure 11: Thresholded Warped Image

5. Implemented the sliding window approach to detect multiple points on the lanes which will then be used to detect the curvature of the lanes.

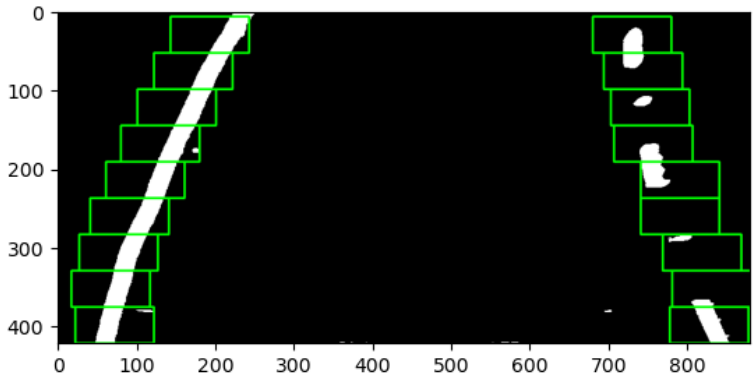

Figure 12: Lane Detection.

6. Based on the curvature of the lane, indicated the vehicle to turn right, left or moving straight is found.

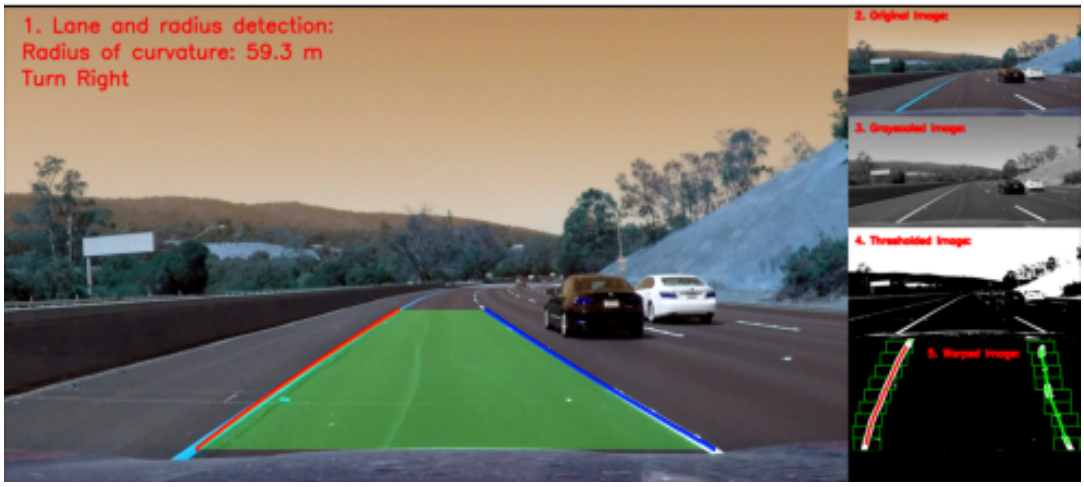

Figure 13: Final Frame

Following is the brief explaination of **Sliding Window approach** uesd in lane detection.

a) Sliding Window Approach

i. Found histogram of white pixels along the x-axis in the warped and thresholded image.

ii. Divided the array having the number of white pixels for every column in x-axis in two parts.

iii. Found x position in both parts of the array.

iv. Considered two rectangular block around the two x coordinates found.

v. The block size is considered as 1/9*height of the image height.

vi. The first blocks are considered at the bottom of the image. Thus shifting the blocks upwards and considered 9 blocks per side per image frame.

vii. In every block, found the mean of the x-coordinates of the white coordinates present as the new white coordinate present.

viii. The steps from v to viii is repeated for every frame.

b) Understanding of Homography The homography is performed by calculating the Homography matrix. The homography matrix can be computed as the eigen vector corresponding to the least eigen value The A matrix consists of atleast 4 points from the image space and corresponding world space. In the given frames, 4 points corresponding to the image are selected and homography transformation is performed based on those 4 points.

c) Understanding of Hough lines The hough lines are found by projecting the points in r, theta space. For each point, a wave appears in that space. Intersection of the waves of multiple points indicate that the points lie on the same line.

d) How likely will the pipeline generalize The pipeline is generalized to the scenarios faced in the given videos. If any other issue occurs, then it may face issues.