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CS549-E24-E01
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Week 5 Assignment

Objective:

The objective is to harness edge extraction and line detection techniques to identify the vanishing point that will guide the vehicle's path. This involves formulating the problem as $At = b$, constructing the normal equations, and solving for the unknown variables using a least squares approach, without utilizing any pre-existing Python or OpenCV least-square solution methods.

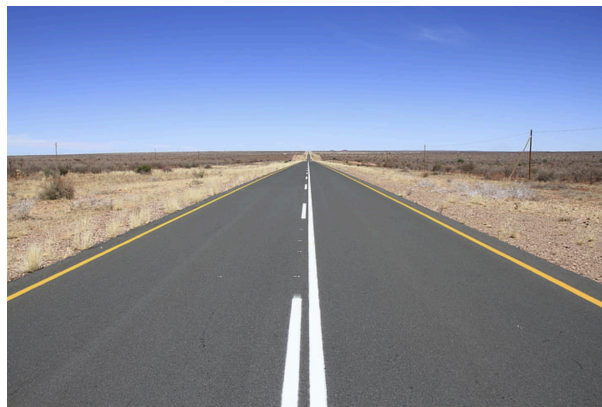


Figure 1. Input Image

Code Description:

The process began by loading the image `texas.png` using the OpenCV library. The image was then converted to grayscale to simplify the processing steps. To reduce noise and smoothen the image, Gaussian blur was applied, which is essential for enhancing the accuracy of edge detection. The Canny edge detection algorithm was used to extract edges from the blurred grayscale image, helping in identifying the prominent edges in the image.

The Hough Transform method was employed to detect lines from the edges identified by the Canny algorithm. This step provided the parameters of the detected lines in polar coordinates. The problem was formulated by creating a matrix \mathbf{A} and a vector \mathbf{b} from the detected lines. The least squares solution was then used to solve for the vanishing point, represented as (u, v) .

The identified vanishing point was marked with a red circle on the image. Additionally, the detected lines were plotted within the image bounds to visualize their intersection at the vanishing point.

Results:

The resulting image successfully demonstrates the detection and marking of the vanishing point on a Texas road. The red lines represent the detected edges of the road and other elements, converging towards

a single point known as the vanishing point. This vanishing point, marked with a red circle, is an important reference for an autonomous vehicle to maintain a straight path while navigating the road.

The detected vanishing point is accurately positioned at the convergence of the detected lines, validating the effectiveness of the least squares solution method. Also, the use of red lines to represent the detected edges and the red circle to mark the vanishing point provides clear visual confirmation of the vanishing point detection. Lastly, the detected lines are correctly plotted within the image bounds, ensuring that the visualization is clean and interpretable.

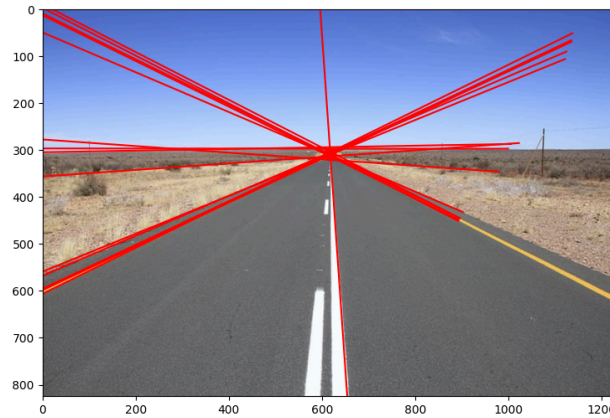


Figure 2. Vanishing Point w/ Red Circle

