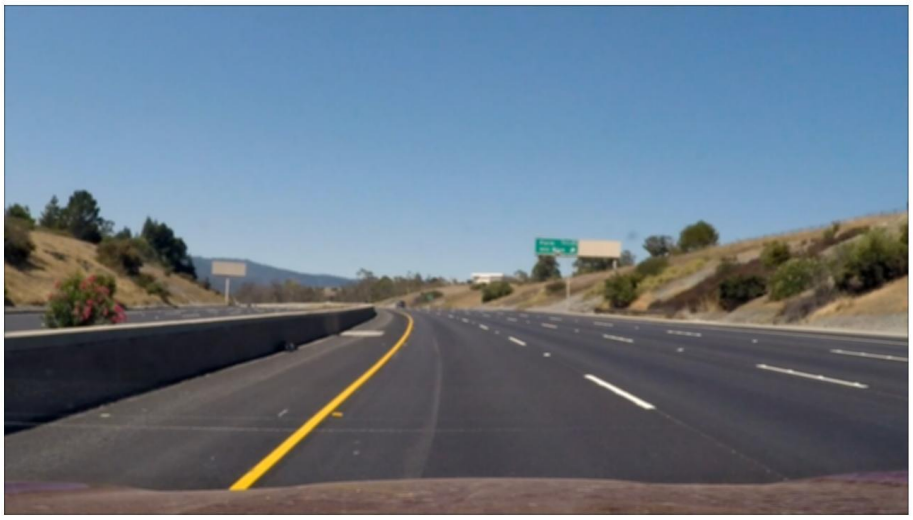
The following steps were involved in the lane detection exercise:

1. **Gaussian Filter** – We start off by applying a Gaussian filter to smoothen the edges in the image. This allows for easier line detection instead of having sharper ridges in the lanes we are trying to detect



2. **Edge Detection** – The idea for detecting the edges was referenced from the Lane Departure Warning System[1] which uses a correlation filter to identify the lines using the gradients that vary from -1 to 1. This edge detection was used as it performed much

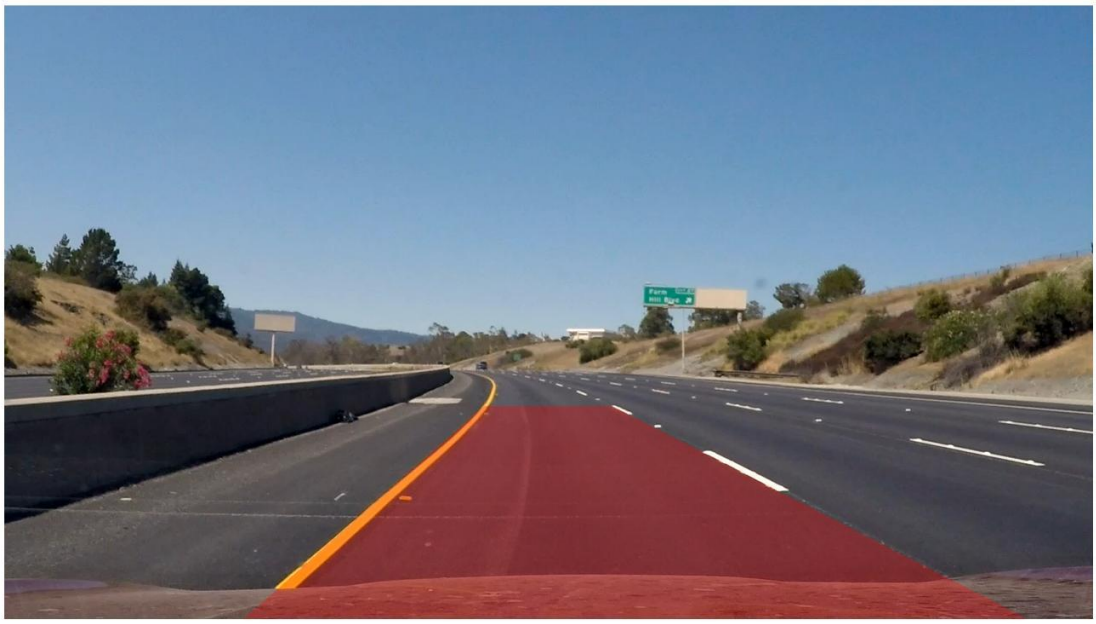
[1] https://www.mathworks.com/help/vision/examples/lane-departure-warning-system.html

better when compared to the 'Canny' or 'Sobel' detectors as the correlation filter only outputs one line for each of the paint blacks that form the lanes.

3. **Masking the image**- The next step was to mask the right size of the image such that the top half of the image and the sides were ignored as our region of interest always lies in the bottom half of the frame. The shape of the mask is a trapezoid and the result of applying it can be seen below.

4. **Hough transform**-This was followed by performing the Hough transform for the masked image. We found the Hough lines by first finding the Hough peaks for the required theta and rho values. A lot of trial and error was performed to identify the best set of parameters for the picture.
5. **Separating lines** – The slope of each of the detected Hough lines is calculated so that the type of lanes can be separated into lines that belong to the left side of the lane, lines that belong to the right side of the lane or lines that are not part of the lane.

6. **Regression** – All the starting and ending points of the Hough lines that belong to left and right side are stored. We then perform the regression to fit these points as one line and fit a polynomial for both the left and right sides of the lane. This forms the lane required to be followed. Since the lane curves sometimes, a second degree polynomial is fitted with three known points. The points used for fitting this curve are the starting points, ending points and the vanishing point for the two lines in the image. The vanishing point



is merely the theoretical point of intersection of the left and right line. A red mask is then applied for the area between the left and right line and a yellow border is provided for the lines itself. This completes the task of lane detection.

7. **<u>Identifying the turn</u>**- The next step for predicting any potential turns is performed by analyzing the location of the vanishing point. The deviation of the vanishing point to either the left or right of the center with a certain threshold allows us to predict in which way the road curves in the future.

EXTRA CREDIT

The same technique was followed for the extra credit challenge video.

There were a few difficulties observed due to the variation in the road colors in the images. So a few added thresholding parameters were added to obtain the yellow and white lines before filtering the image to determine the edges.

NOTE: Out of the 480 images in the challenge video provided, the detection was performed for 260 apart from a few skipped frames where detecting the yellow lines was very difficult no matter the thresholding due to the signs in the floor.