Advanced Lane Detection

Calibrating the video

Normally, images taken from a camera introduce a warping to the image, due to nature of the lens. optical distortion is caused by the optical design of lenses (and is therefore often called “lens distortion”), perspective distortion is caused by the position of the camera relative to the subject or by the position of the subject within the image frame. This distortion can be undone, by comparing it to a reference image with straight lines, like a chess board. We use cv2.findchessboardcorners to obtain corner points in the distorted image, and since we know where the corner points should be for an undistorted chess board, we can get the transformation required to un warp the image.

Figure 1:Distorted vs undistorted

Pipeline:

1. ### Calibrate the camera:

   Using the above method, undistort the image obtained from the camera

2. Apply required filters

Our objective is to filter the unwarped image, such that only the lanes are visible. To achieve this, we can use a number of techniques. For example, we can take one channel of the image, such as the red color channel, and experiment with various thresholds (i.e. compare the pixel value with some numbers to filter out pixels not in range of those numbers). If we set the thresholds to 100-150, then only those pixels in the R channel whose value is within 100-150 will remain. We can also experiment by converting the image to other types, such as HLS image, and use thresholding. Finally, we can use sobel filter in the x direction to try to obtain all the vertical lines in the video. Finally, when we are satisfied with the individual images, we can combine them to form a composite filtered image. It is acceptable if there is some noise, as we will deal with it in future steps.

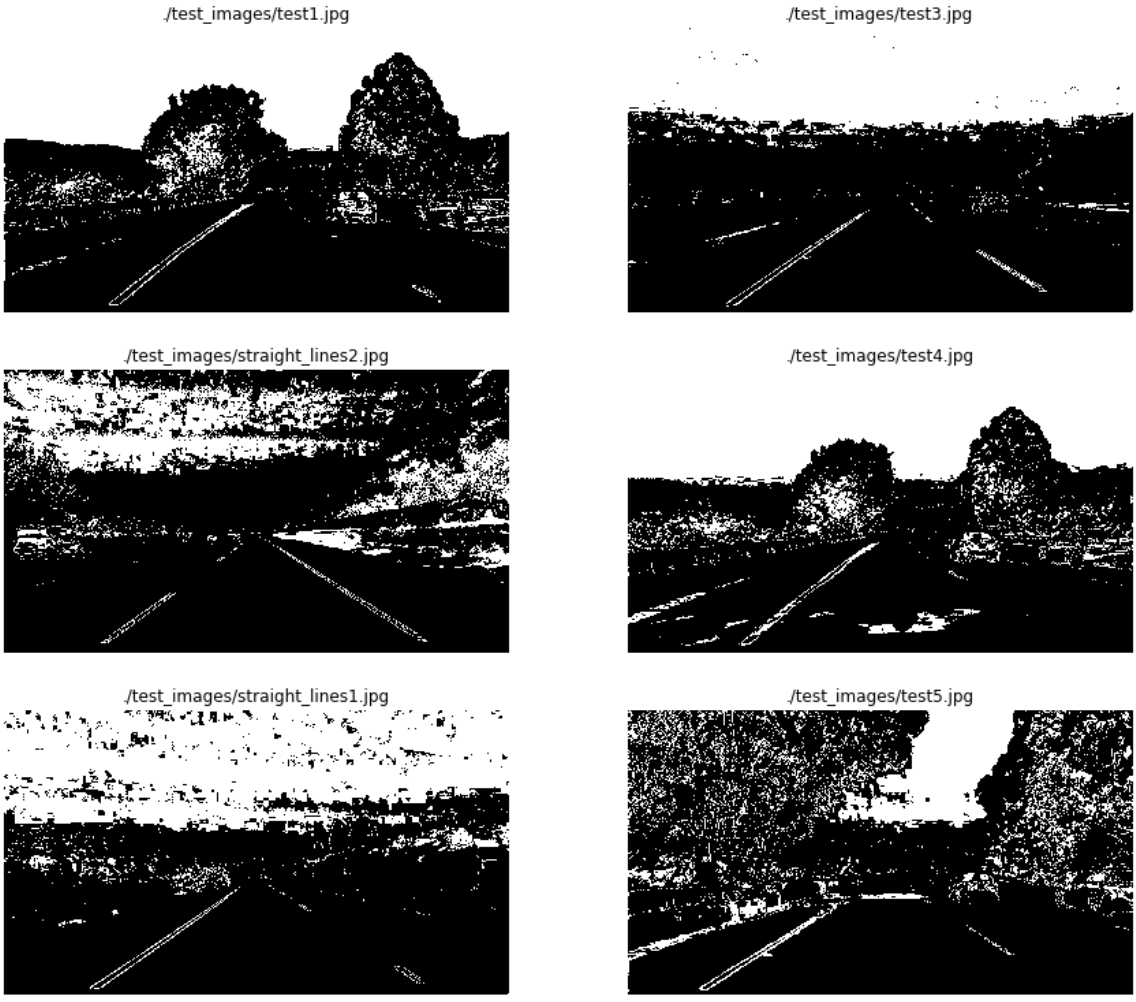


Figure 2 Filtered images, showing the detected lanes

3.Perspective Transform

We obtain a top down image using perspective transform. To do this, we obtain 4 points in the original image, and estimate where they will land in the top down image. We can use known points to do this. Using these 4 points, we obtain a matrix that can be used to transform the whole image to top down view. This view also removes everything other than the lane from view.

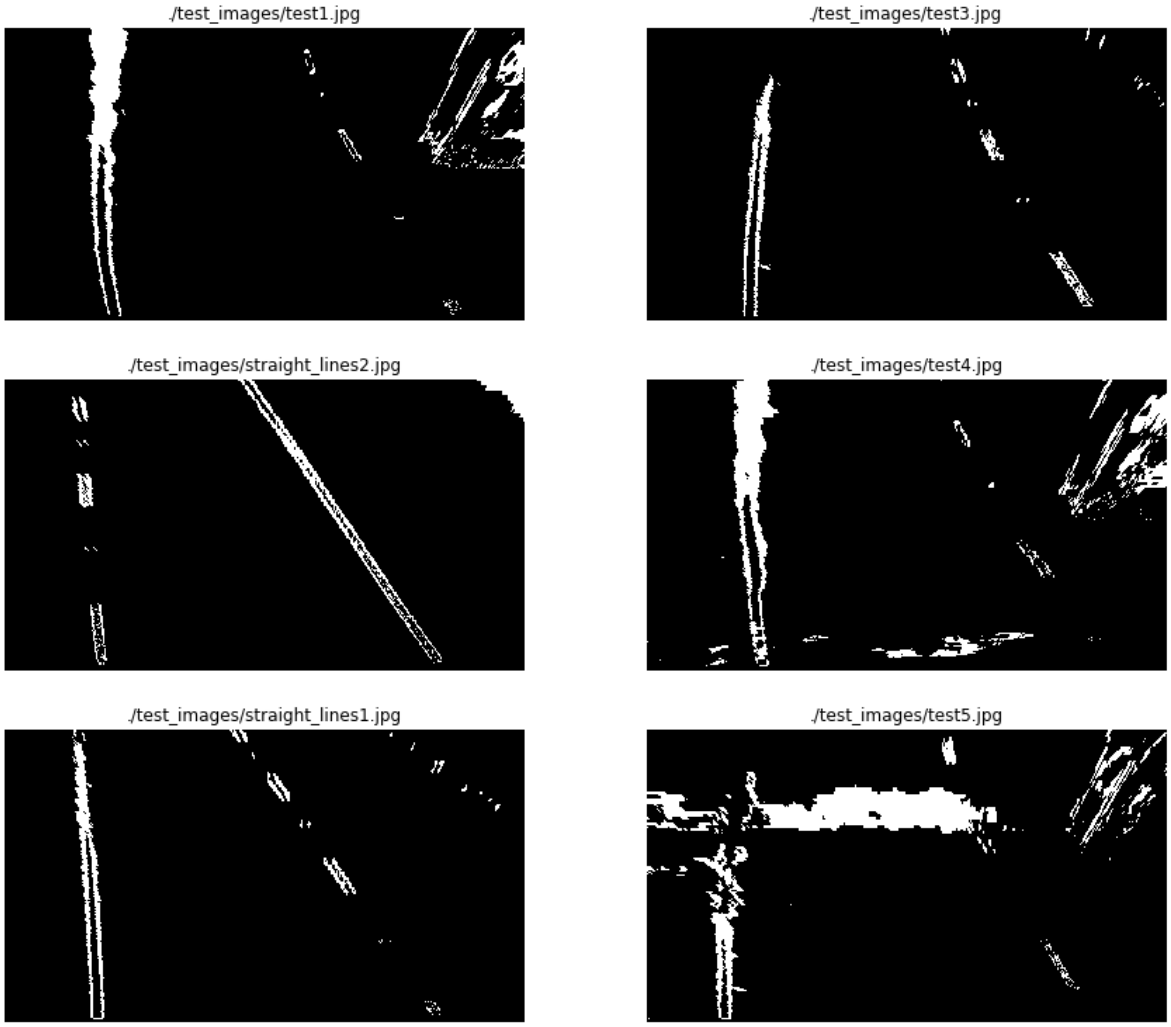


Figure 3:Top down view

4.Lane finding and curve fitting

Once we have a top down image, we take a histogram of the image along x axis. The idea is that the two lanes will lie on either side of the mid point of the histogram. The block on the left of the mid point is highly likely to be the left lane, and same for the right lane. But we do not do this for the entire image. Instead we divide the image into horizontal windows, and perform this histogram technique on each horizontal window. Thus, each window has a left lane candidate, and right lane candidate. Finally, we join all these candidate points using a polynomial.

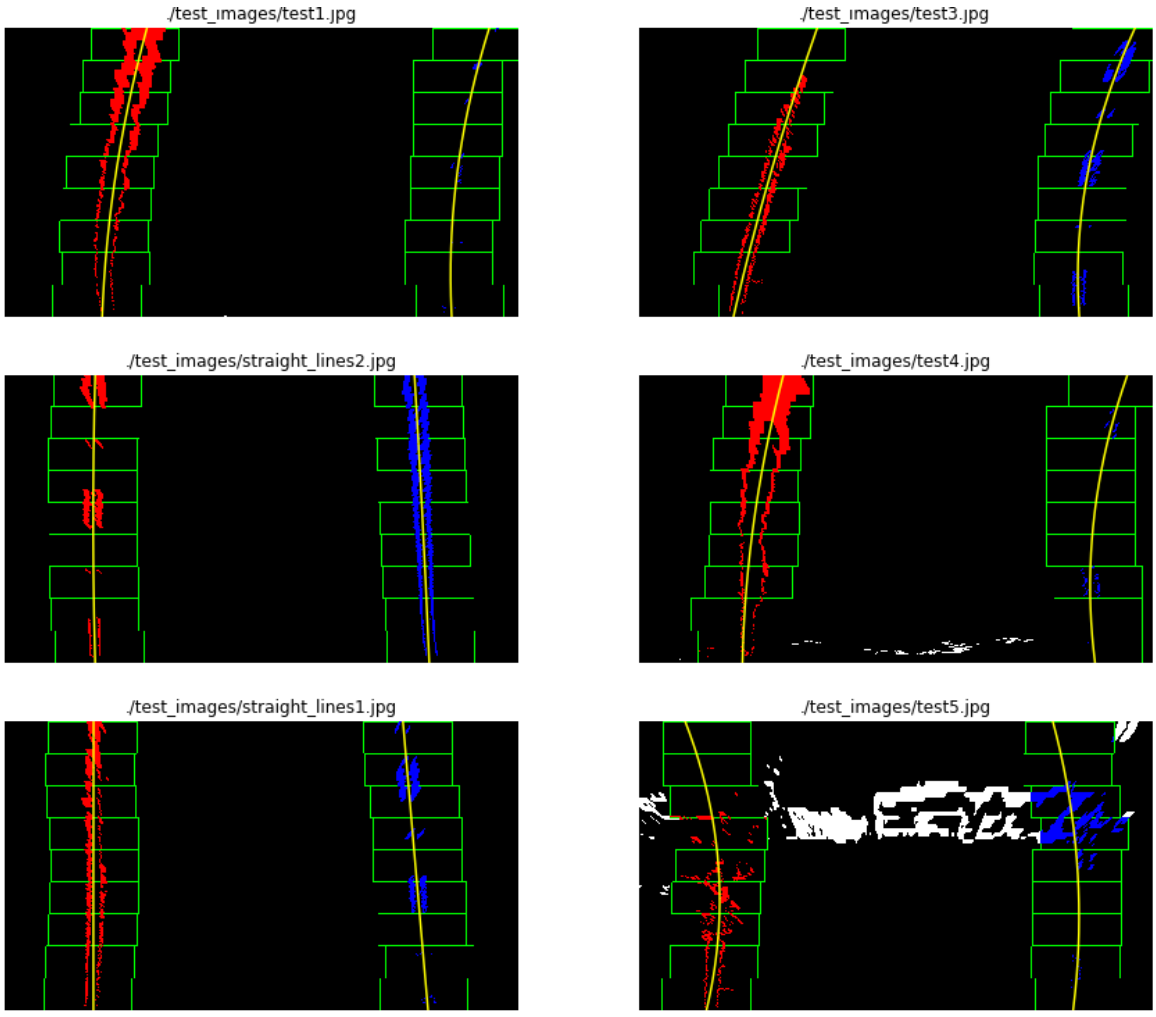


Figure 4:Finding the curve of the lane

5.Final processing

The polynomial obtained is evaluated and a list of Y coordinates are calculated. Then these points are remapped on the original image using inverse of the perspective transform matrix.

./test_images/test1.jpg

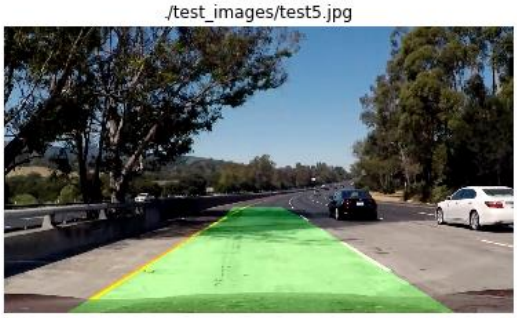
./test_images/test3.jpg

./test_images/straight_lines2.jpg

./test_images/test4.jpg

./test_images/straight_lines1.jpg

./test_images/test5.jpg



Discussion:

- We can make the filtering more efficient by using more channels, filters.
- Use a higher fps video recording device to get more frames.