

Project Writeup

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1. Camera Calibration

- The chessboard images were loaded, converted to grayscale and the corners were found using `findChessboardCorners`.
- Two arrays were created **objpoints** and **imagepoints** which had the corners in object (board) coordinates and the image (camera world coordinates).
- The found corners were then used as arguments in the `calibrateCamera` function to compute the distortion coefficients and the camera matrix.
- The found chessboard corners are shown on the image using `drawChessboardCorners` function.
- The distortion matrix, the distortion co-efficients, the rotation and translation vectors were calculated using the `cv2.calibrateCamera` function.
- The camera matrix and the distortion coefficients were pickled and saved into a file.

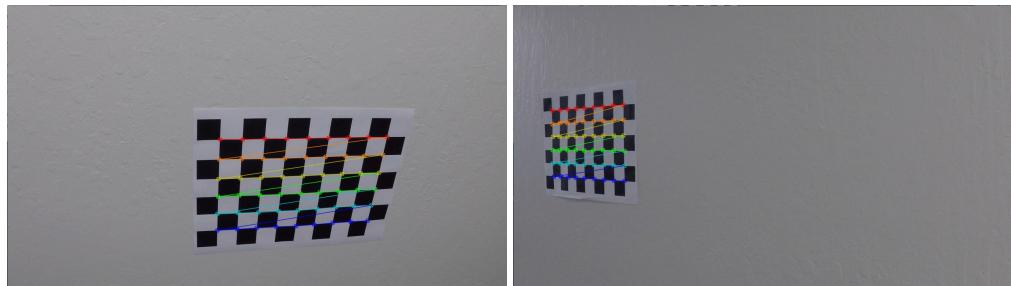


Figure 1: chessboard images pose 1 and 2

- 16 such chess board images were taken and used for calibration and the distortion coefficients and the camera matrix was computed from them.

2. Image Processing Pipeline

- The images were initially undistorted using the coefficients found during camera calibration.
- Then a perspective transform was defined such that the images were rotated and centered in a way that the region of interest was centered.
- The transformation matrix was obtained using the `cv2.warpPerspective` function in openCV.

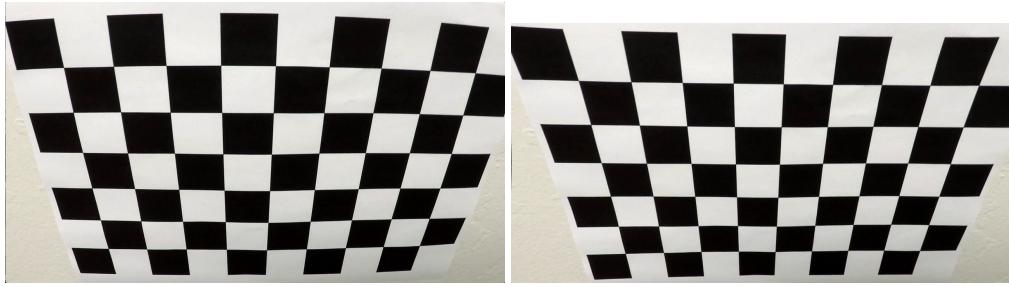


Figure 2: Distorted image (left) , After Undistortion (Right)



Figure 3: Distorted image (left) , After Undistortion (Right)

- Once the images were warped, a binary threshold was applied.
- A variety of thresholds were applied and finally it was shown (Jeremy Shannon) that the HLS l channel and the LAB b channel were really good thresholds to extract the region of interest.
- Then as shown in the udacity classroom, the sliding window fit / or the extrapolation fit was used to identify the lane lines.
- The extrapolate polyfit uses the positional information of the lane lines from the previous image and begins the search from the same region in the next image.
- Keeping track of this lane data across these images was possible due to the line class, where the **l_line & r_line** instances were used to keep track of the left and right hand lanes.
- The detected lane lines were then drawn back on the original image.
- The radius of curvature was measured as suggested and drawn back on the original image.



Figure 4: Input Test Images

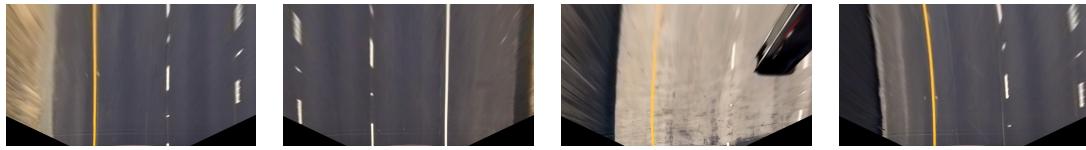


Figure 5: Undistorted and perspective transformed Images

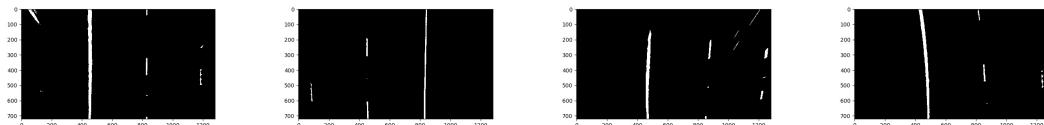


Figure 6: Thresholded binary image

3. Code References

Topic	Line
Undistortion	33
Line Class	38
Threshold	146
Sliding Window	184
Radius of Curvature	334

Table 1: Code references

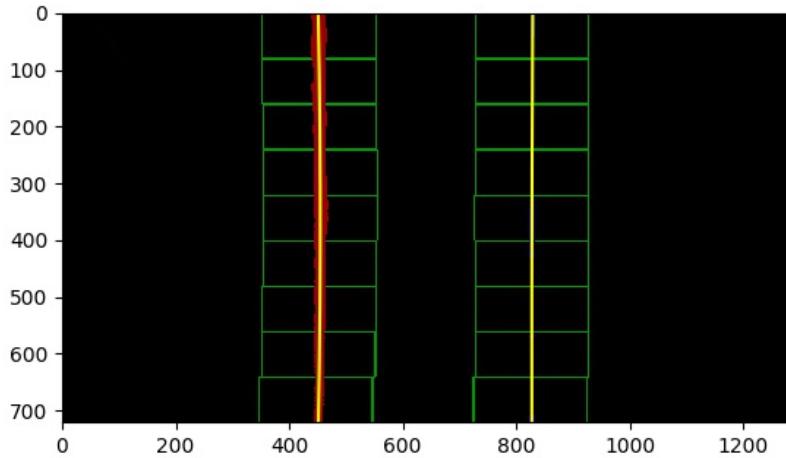


Figure 7: Initial sliding window fit to find lane lines

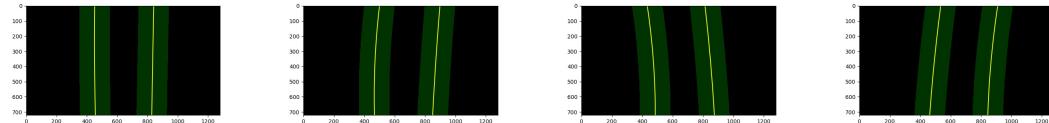


Figure 8: Extrapolated search using the information from sliding window fit in the previous figure



Figure 9: The detected lane lines drawn back on the original image using the `cv2.fillPoly` function



Figure 10: The measured radius of curvature written back on each image