Udacity Self Driving Car - Term 3 - Project 1

Path Planning Project

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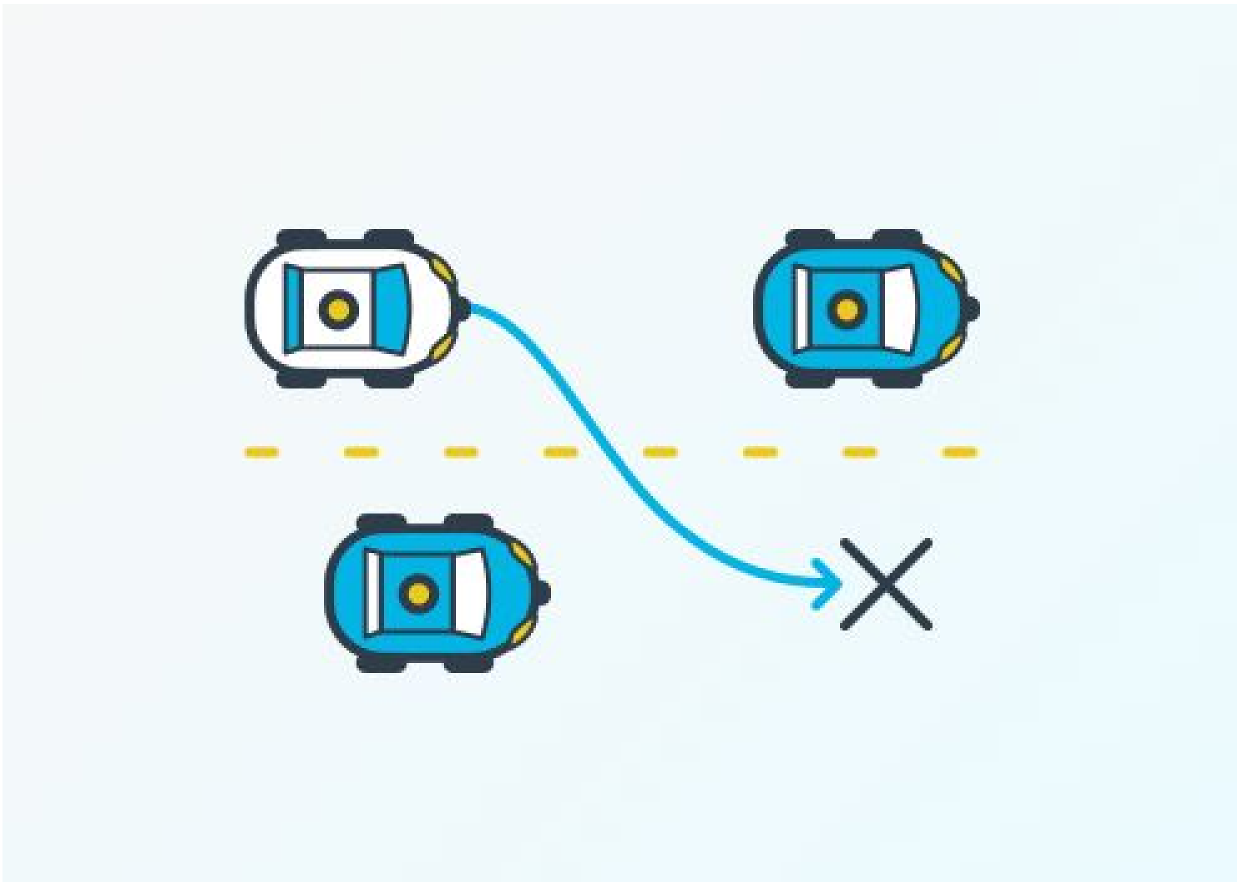


Introduction

The purpose of this project is to create a path planner that navigates the car smoothly and safely. Udacity has provided a series of simulated sensor fusion data that is referenced by the car navigation algorithm. The car is programmed to maintain a speed within the legal limits (50 MPH) while changing the speed and lane when necessary. More details is provided in the rubrics but at a minimum the car must do the following:

1) The car is able to drive at least 4.32 miles without incident..

2) The car drives according to the speed limit.
3) Max Acceleration and Jerk are not Exceeded.
4) Car does not have collisions.
5) The car stays in its lane, except for the time between changing lanes.
6) The car is able to change lanes

Credit

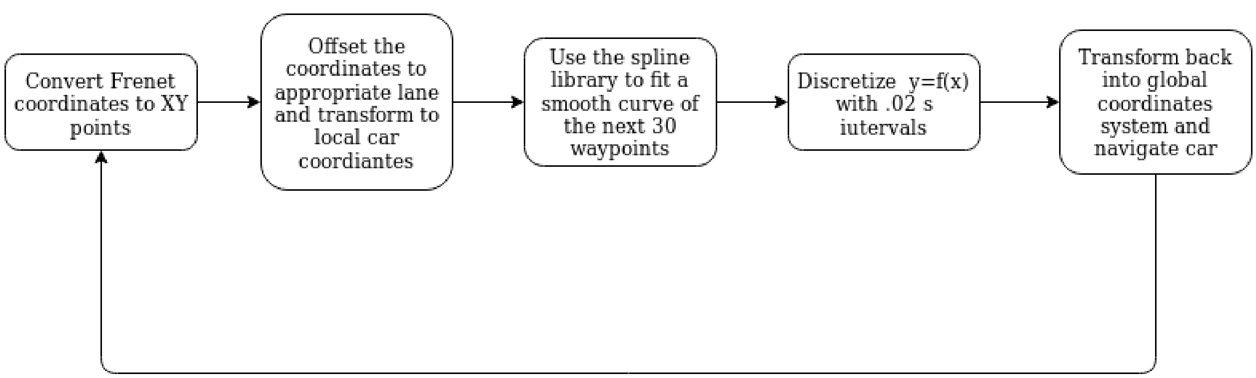
Portion of the code is taken from the Q&A section from the project (Path Planning Project: Card 6).

Car Workflow

The car is programmed with different sections to respond to different scenarios. The car is programmed to respond to three main actions. The first action is is to move within the waypoints comfortably and smoothly to give a comfortable ride. Second, the speed of the car must to appropriately maintained. Lastly, the navigation must determine whether to stay or change lanes.

Waypoints and Smoothness

The car is programmed to follow the way points provided by the simulator. However, to give comfort for the rider, the next 30 waypoints projected to the car coordinate systems are passed to a spline fit function. Afterwards. the car location is discretize to 0.02 s intervals. Finally, the algorithm projects back into the global coordinates to navigate the car.

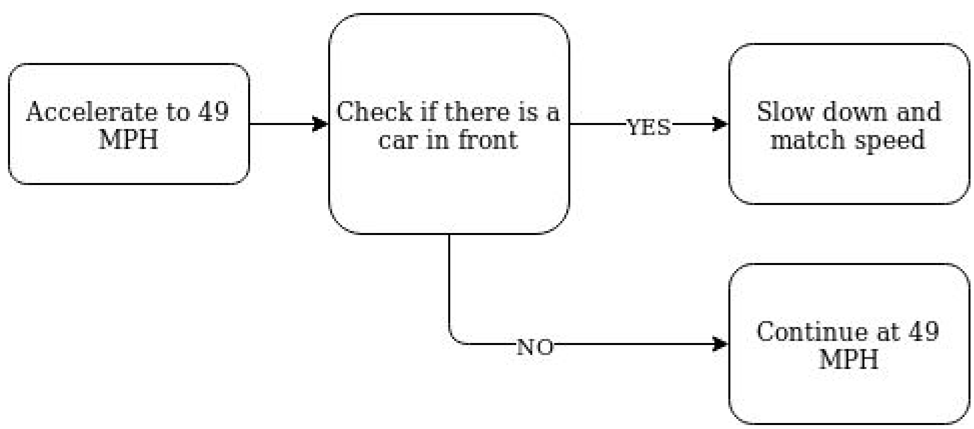


Car Speed

The speed of the car is important because the car needs to maintain a speed below the speed limit and maintain an appropriate speed to prevent any collision with the surrounding cars. Also, the car cannot accelerate or decelerate beyond the requirements or else the rider would experience discomfort.

The car is designed to maintain a speed of 49 MPH unless otherwise instructed to do so. If the car is below this designated speed, the car will accelerate within the defined maximum acceleration until it hits 49 MPH.

The car uses the sensor fusion data provided by the simulator to check all the cars within the vicinity. The algorithm cycles through all the cars and determines if any of them are in front and within the same lane. If there is a car within our lane, the main car will adjust it speeds to match the car in front to prevent collision. The car speed process is the following:



Lane Change

The car must determine whether it is logical and appropriate to change lanes when necessary. In order to do this, the car must account for all the cars within the vicinity using the sensor fusion data provided by the simulator. The car has three choices that can be chosen. These three choices are change lane to the left, stay within the current lane, or change lane into the right.

To determine which is the best choice, the algorithm keeps track of three different cost functions, one for each choice. The cost function changes for different scenarios. For instance, the cost function for “changing to left lane” will be extremely high if the car is already in the most far left lane. The car actively monitors the cost function and determines which out of the three is the lowest cost and makes the appropriate decision. The process of the lane change is the following: