Path Planning Project README

Udacity Self Driving Car Nanodegree

Description

The two main components for this project were using a spline to generate a path for the car and creating a Finite State Machine to control when the car should change lanes. This document will explain my implementation of both in detail.

Path Generation

The simulator is activating by pushing it a list of points at 0.02 second intervals. To generate these points, a header file that implements a spline is used. The first two points in the spline are the car's previous and current position. The second three points are generated from the XY position of the car in the target lane at 1, 1.5, and 2 seconds in the future.

Fitting the spline to the five points establishes the equation the desired path of the car. Now, the spline can be used to calculate however many new points are needed to add onto the previous path. We know the change in time that each new point in the path represents, so we can maintain some variable for the desired speed for the car, and then it's simple dimensional algebra to calculate the change in distance for each point, thus setting the speed of the car.

Finite State Machine

The Finite State Machine (or FSM) starts off in the Drive state, which is the state we are in when there is no car in the same lane within 60 meters of the target car. In this state, the car will steadily accelerate up to the speed limit and not change lanes.

The next state is the Prepare To Change Lanes state. This state is entered when there is a car within 60 meters of the target car. The left lane is checked first, then the right lane. A lane is determined to be suitable for a lane change if it exists and meets three criteria: There must be at least 50 meters available in front of the car, there must be at least 15 meters behind the car, and there must be at least 10 meters more distance in the new lane than the current lane. If a suitable lane is found, the car will enter the Change Lanes state. If no suitable lane is found, the car will follow at a safe (approximately 40 meter) distance.

In the Change Lanes State, the car maintains its velocity and moves to the lane that was previously determined to be suitable for the car. This is accomplished by simply moving the last three points of the spline into the desired lane. Then, the path generation algorithm takes care of the gradual lane change over the course of the next 1 second. Once the car is in the desired lane, the FSM returns to the Drive state.