PROJECT SPECIFICATION

Path Planning by Satinderjit Singh

Compilation

CRITERIA

The code compiles correctly.

MEETS SPECIFICATIONS

Code must compile without errors with `cmake` and make.
Given that we've made `CMakeLists.txt` as general as possible, it's recommend that you do not change it unless you can guarantee that your changes will still compile on any platform.

RUBRIC SUPPORT

compilers with standard cmake and make command.

Valid Trajectories

CRITERIA

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

MEETS SPECIFICATIONS

The top right screen of the simulator shows the current/best miles driven without incident. Incidents include exceeding acceleration/jerk/speed, collision, and driving outside of the lanes. Each incident case is also listed below in more detail.

RUBRIC SUPPORT

The car is tested for 20 mins and it could drive about 15+ miles without any issue at around 46mph average speed.

CRITERIA

The car drives according to the speed limit.

MEETS SPECIFICATIONS

The car doesn't drive faster than the speed limit. Also the car isn't driving much slower than speed limit unless obstructed by traffic.

RUBRIC SUPPORT

The max velocity is set to 49.5 so it is always under 50mph limit even when we accelerate by 0.4 mph

```
331                 else if(ref_vel<49.5)
332                 {
333                   ref_vel += 0.400;
334                 }
```

CRITERIA

Max Acceleration and Jerk are not Exceeded.

MEETS SPECIFICATIONS

The car does not exceed a total acceleration of 10 m/s^2 and a jerk of 10 m/s^3.

RUBRIC SUPPORT

The max acceleration of 10m/s is not exceeded as we increase velocity by 0.4mph at any given time.

We start with 1.0mph from cold start.

```
200   double ref_vel = 1.0;
```

CRITERIA

Car does not have collisions.

MEETS SPECIFICATIONS

The car must not come into contact with any of the other cars on the road.

RUBRIC SUPPORT

The car checks if it is within 30m of car ahead of it. If yes it flags too_close

```
267                     if(check_car_s > car_s && check_car_s - car_s
< 30)
268                       too_close = true;
```

Once too_close is flagged it checks for cars on left lane and right lanes and changes lane if it safe to do, if not safe to lane change it keeps lane and slow down to follow car ahead of it.

```
310                 if(too_close && !leftcar_too_close && lane>0 &&
lane < max_lane && rightcar_front_max_clearance <
leftcar_front_max_clearance)
311                 {
312                   lane -= 1;
313                 }
314                 else if(too_close && !leftcar_too_close && lane>0
&& lane < max_lane && rightcar_front_max_clearance >
leftcar_front_max_clearance)
315                 {
316                   lane += 1;
317                 }
318
319                 else if(too_close && !leftcar_too_close && lane>0)
320                 {
321                   lane -= 1;
322                 }
323                 else if(too_close && !rightcar_too_close && lane <
max_lane)
324                 {
325                   lane += 1;
326                 }
327                 else if(too_close)
328                 {
329                   ref_vel -= 0.400;
330                 }
331                 else if(ref_vel<49.5)
332                 {
333                   ref_vel += 0.400;
334                 }
335
```

CRITERIA

The car stays in its lane, except for the time between changing lanes.

MEETS SPECIFICATIONS

The car doesn't spend more than a 3 second length out side the lane lanes during changing lanes, and every other time the car stays inside one of the 3 lanes on the right hand side of the road.

RUBRIC SUPPORT

The car stays in lane for most part other than when it is changing lanes when the car in-front is driving slower than speed limit.

CRITERIA
The car is able to change lanes

MEETS SPECIFICATIONS
The car is able to smoothly change lanes when it makes sense to do so, such as when behind a slower moving car and an adjacent lane is clear of other traffic.

RUBRIC SUPPORT
Car changes lanes whenever car infront is getting close and is driving slower than speed limit.
It checks for the cars in adjacent lane and checks where is has most clearance from front car so it can change lane which is moving faster

Reflection
CRITERIA
There is a reflection on how to generate paths.

MEETS SPECIFICATIONS
The code model for generating paths is described in detail. This can be part of the README or a separate doc labeled "Model Documentation".

RUBRIC SUPPORT
Using the spline method to generate the paths as described in Project Walkthrough video.

#1. Calculate the current car ’s’ and ‘d’.
#2. Calculate previous car ’s’ and ‘d’ which is tangent to current location and behind by distance travelled by car in 20millisecond.
#3. Calculate waypoints for 30m, 60m, 90m
#5 After we have these five points, we fit a spline through these points.
#6 We generate N number of points using following formula
N x 0.02 x velocity = Distance. Distance is fixed to 30m
#7 Once we have N, we generate x_point and gent y_point from spline.
#8 We did all calculation in car coordinate system to simply math. Once that is done we rotate and shift to map coordinates.
#9 the points are pushed in next_x_vals and next_y_vals