Automated Driving Using External Perception

Individual Lab Report - ILR10

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Team E - Outersense

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Contents

1 Individual Progress

For this PR I worked on finishing the planning subsystem and covering up all the pending tasks from the previous PRs. The tasks that I focused on this PR was to make the planner system more robust, make 2 more cars and get things ready and set up for the FVD. The sections below talk about these, the challenges faced and other things I worked on during the last PR.

1.1 Making 2 more cars

One risk that we wanted to mitigate was if one of the car stops working. For this we are making 2 more cars. The 3D printed parts are ready and the components have been delivered. I then started working on changing the motor to a BLDC motor, then the spur gear to obtain a higher gear ratio to further educe the speed. Next I adjusted the ride height to the desired height. I followed this by replacing the battery and removing the ESC and transmitter that came with the car. I then attached the 3D printed parts by drilling into the chassis and placed the VESC the switch and the RPi at the required position. Lastly I attached the top part of the car where the Arucos are placed. The figure 1 shows the 2 new cars in action.

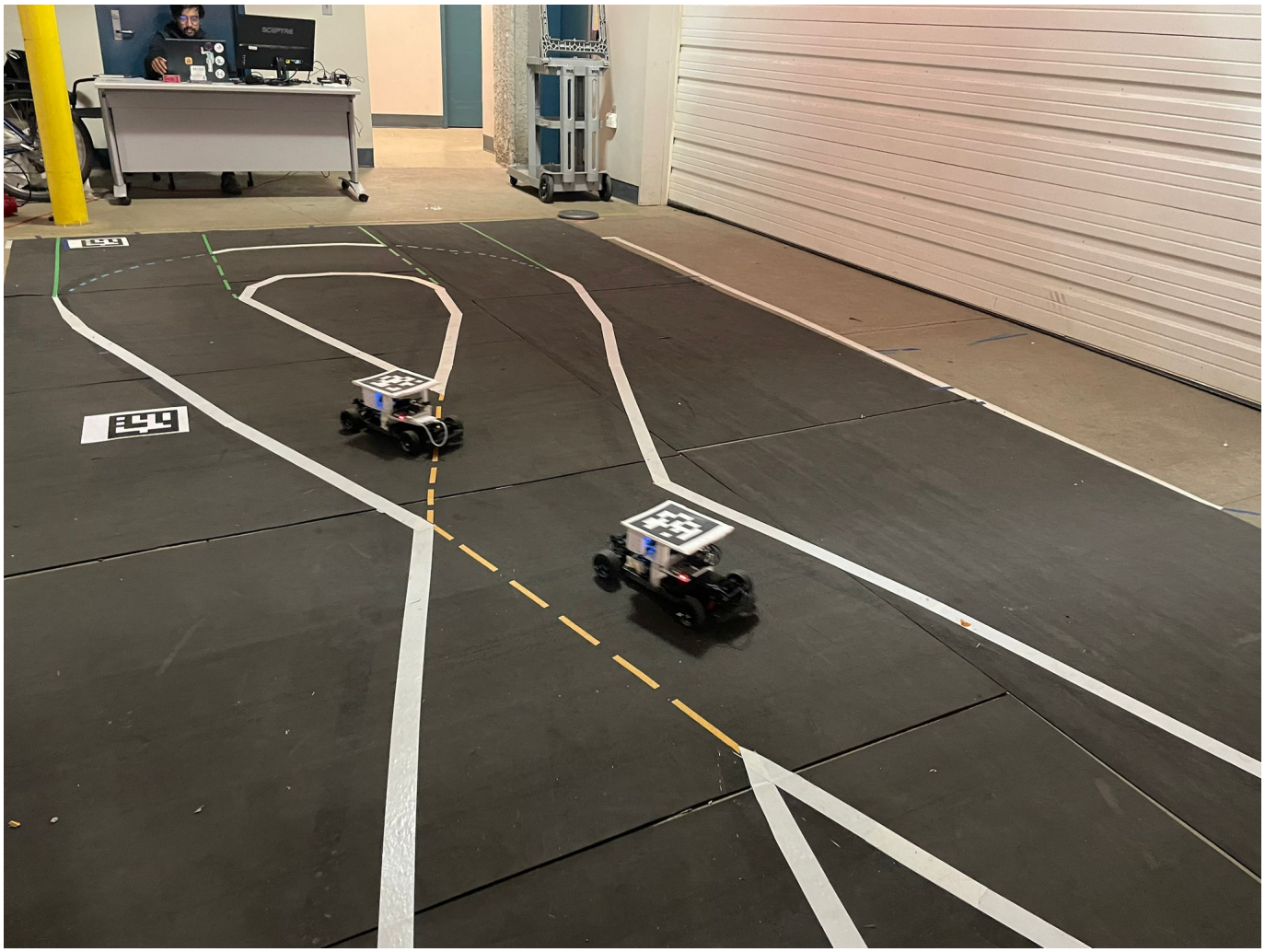

Figure 1: New cars on new track

The second stage in preparing for the FVD is to prepare the track. The Figure 1 here shows what the track will look like. The lanes are at 70cm and there are regions where the car will yield. We still have to make certain lane markings to prepare for the demo

1.2 Hybrid A* local planner

I have fixed the issues that the local planner had which I described in the previous ILR. This included the time to plan, the waypoints, map updation etc. The last part of the planner is obstacle avoidance. For this we had a lot of issues when the obstacle is flickering. For our FVD we want the vehicle to stop if there is any obstacle, for out Encore we want to avoid obstacles and plan around static obstacles and avoid colliding with dynamic obstacles. The planner has to handle all of this. For this first we segregate the obstacles into static and dynamic, the dynamic obstacles trigger the behavioral state machine and take us into cruise control mode. The intersection is another state that the planner handles for dynamic obstacles. We do not overtake dynamic obstacles under any circumstance. However if the dynamic obstacle stops or if there is any static obstacle on the road the car will plan a path around it. We will also be notifying the person monitoring the system that there is a obstacle and we are planning around it. For this we increase the look ahead distance of the goal. The Figure 2 here shows the wapoints the start and goal position for 2 cars and the paths. The black arrow and purple arrow are the goals of the 2 cars while the green arrow and red arrow are the current position of the car.

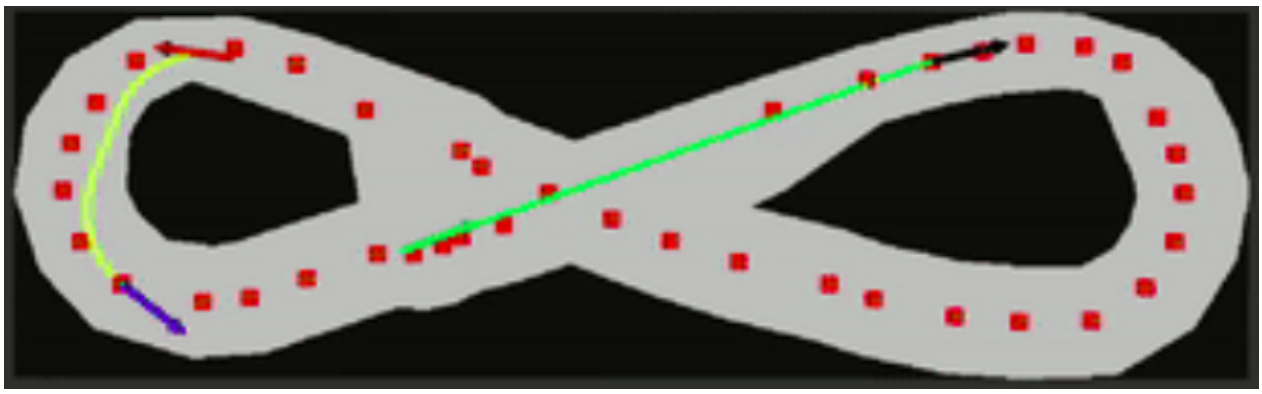

Figure 2: Planning for 2 cars

2 Challenges

2.1 Huge latency

This is a surprising challenge that we have right now. The system works well most of the times and then suddenly stops working and just goes haywire. We were able to debug that this happens when multiple visualizers are running on different systems. When Rviz is open on 3 laptops and is subscribing to various topics at that time there is a huge latency in the network. We still are not able to justify the delay as the data is still just in mbs and the router should be able to handle it with ease. The latency goes up to 1 second and that messes up the entire system. The messages build up and the latency keeps adding till the system crashes and then restarts. For now we are

unsubscribing all the debugging topics from our RQT graph and are trying not to publish Rviz when not necessary.

2.2 Obstacle flickers

During the testing of the system, we continued with the same process that we always did. However, we were trying to run the Rc cars in a figure of 8 like how it would run during the FVD. What we observed was that on introducing an obstacle the perception system detected it but there was a flicker. This flicker is a huge problem for the planning system. The planner can plan a path in the dt time that the obstacle is missing and the car can start moving forward till when the obstacle is detected again and the car stops. If this keeps happening the car inches forward till it hits the obstacle thereby blocking it and then continues to move forward. This is a huge problem that we are trying to fix. We are first trying to latch on to the obstacle as detected by the perception system. Next we are trying to maintain a safety buffer which is greater than 2 times the car length so that even if the car moves there is a lot of time for it to stop. Third is the possibility of latching on to the obstacle in the map for a t time thereby adding the obstacle on time but removing it after a t time has passed.

3 Team Work

This section talks about the work the team members have been doing in the project.

- **Jash Shah**: Jash and I were together on the planning system. He helped me in understanding how to implement the planner on ROS. He is currently working on making the obstacle detection more robust by latching on to the obstacles.
- **Shreyas Jha**: Shreyas integrated the VESC IMU package into the RC car's software. He is further fused odometry from the car and IMU reading with the perception to get a reliable pose of the object even when the car is stationary. He is still tuning and tweaking the values to make the state estimate smooth.
- **Ronit Hire**: Ronit worked on the perception system. He has been working on multi car detection and tracking. The tracking of the vehicle is a huge challenge as the tracker gives an ID to each object and if the tracker is reinitialised the ID changes.He is also helping the other systems and debugging the latency issues that we are observing in our system.
- **Atharv Pulapaka**: Atharv has been working on the control of multiple RC car. He has also been working on making the presentation for the FVD. He tested the cruise control for 2 RC cars. Further he modified the existing follower to follow the path provided by the planner and tuning the MPC for the changes.

4 Plans

The task of eliminating Aruco based detection and tracking and performing data association is still on going. Ronit is owing this piece. we are working towards the final code freezes and checks before we can be ready for the FVD. We will also be working on the presentation and preparing for the demonstration in the next few days. We had some issues in the dry run the other day, we have found the issue to be latency but have not found a solution to that problem as I write this ILR.

- **My Plans**: I am going to work on getting the track, the infrastructure and the cameras ready for the FVD. I will then check up on the cars and ensure they are ready from the mechanical side. Further, I will be testing and checking on the planning subsystem everyday leading to the FVD. We still have a few issues with the map that we hope we can either avoid or overcome during our demonstration. Lastly, I will be working on the presentation and getting ready for the demo.