Accelerating Autonomous Vehicles

MERCURY

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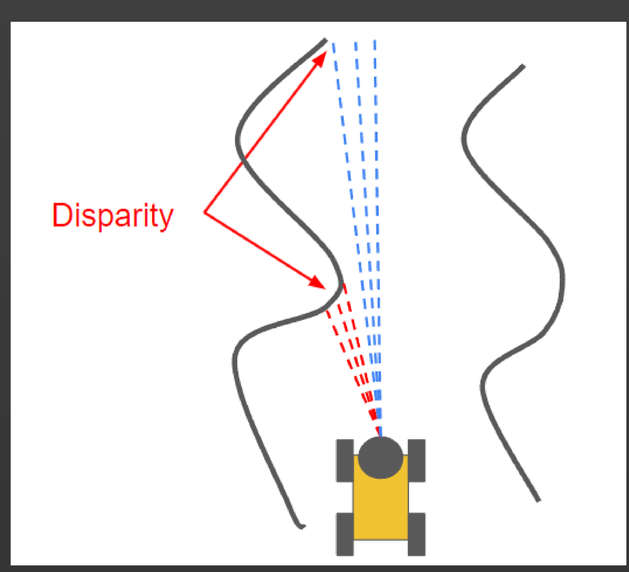
Overview

Our goal is to build an autonomous F1 car at 1/10th the scale. By restricting our model to the limitations of the F1Tenth platform, we successfully built a self-driving racing car that relies on the control of our algorithm. Using a LiDAR sensor and on-board computation, we implement a navigation algorithm and speed controller designed to run at a top speed of 6m/s in complex racetracks. We also organized a race to test our algorithm against other autonomous cars.

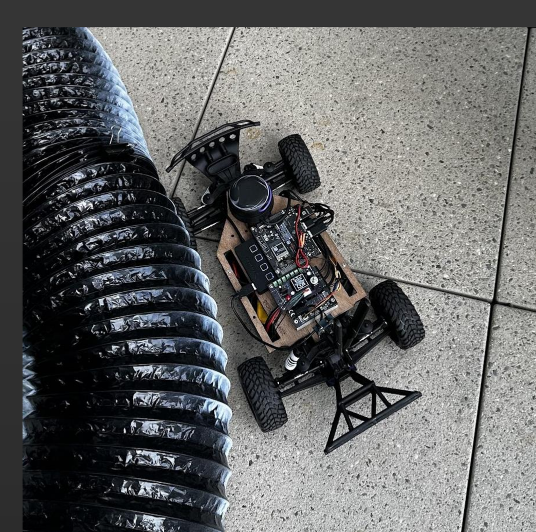
Navigation Algorithm



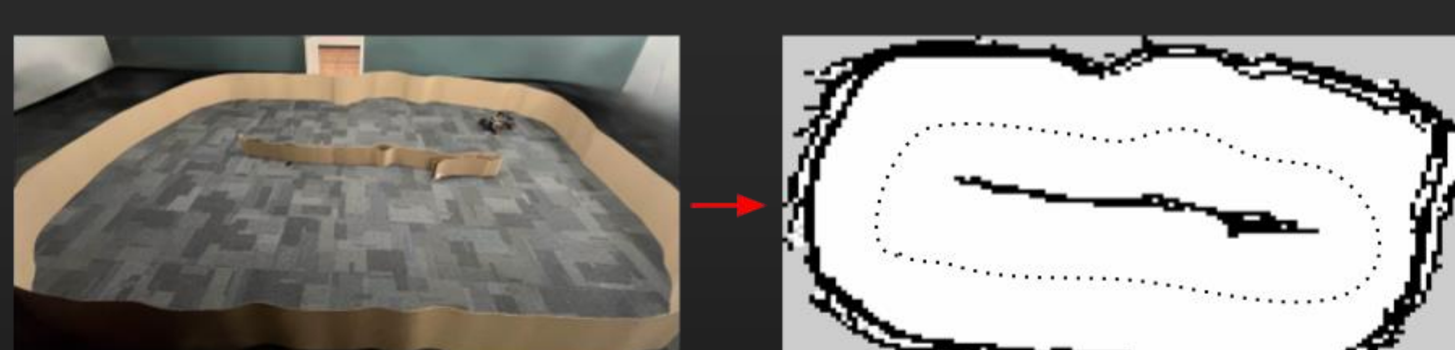
- Reactive based algorithm that uses real time LiDAR data
- Uses the closest and farthest average set of distances from the car to determine the car's turning angle

Limitations:

- Limited by LiDAR scan frequency
- Missed Lidar scans are interpreted as infinite distance



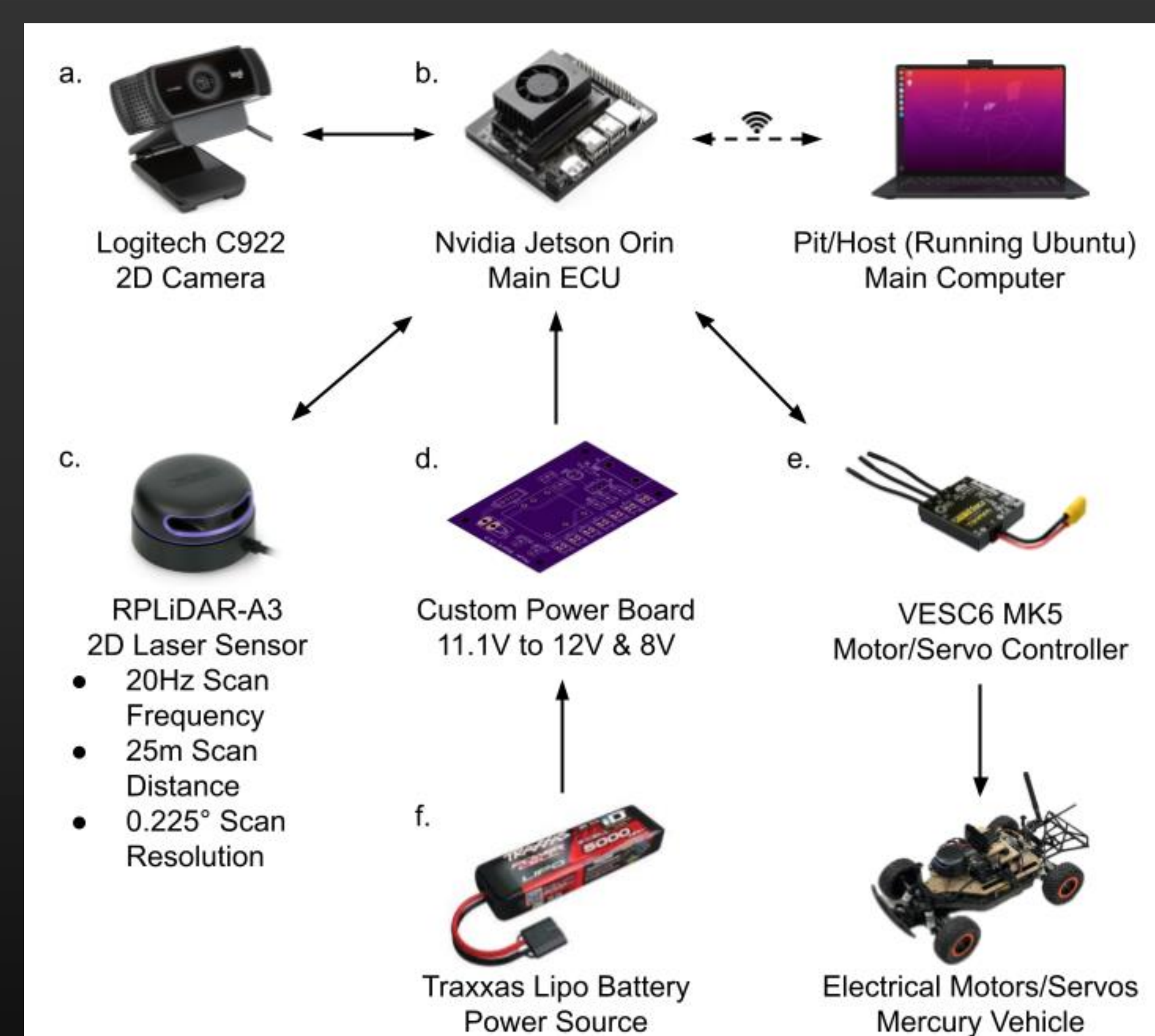
SLAM Speed Controller



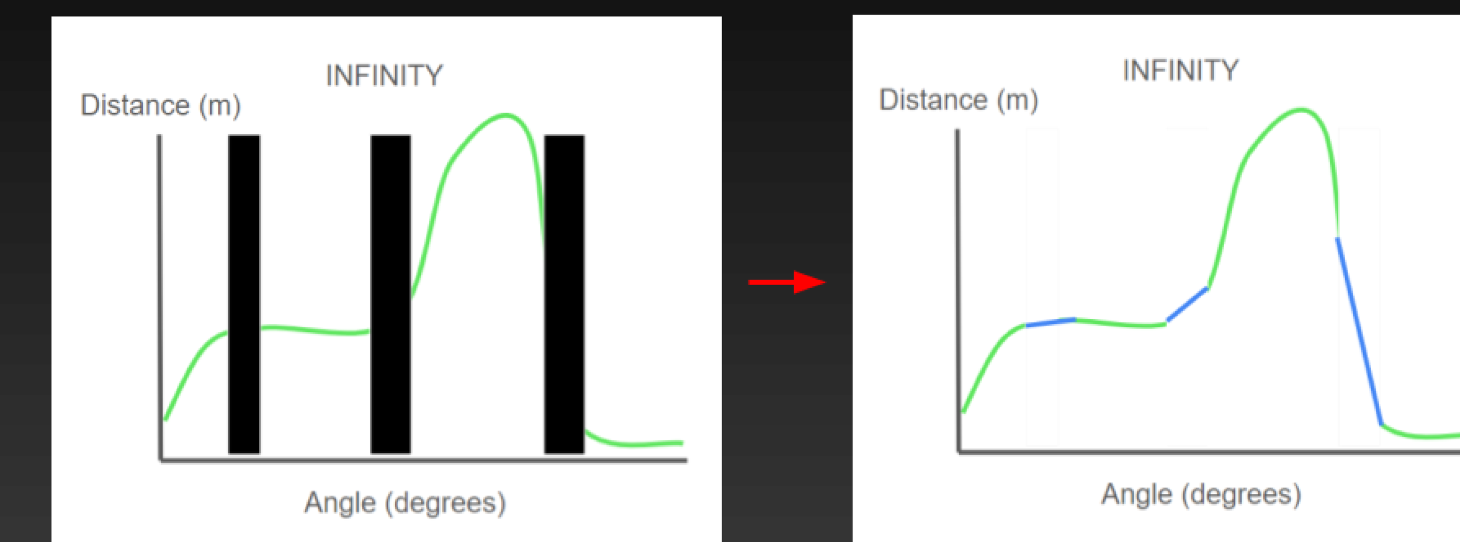
- Utilizes Simultaneous Localization and Mapping (SLAM) and to determine track curvature
- Faster speeds at shallow turns
- Slower speeds at sharp turns
- Reduces lap time by 16.7% compared to lidar based speed controller

Final Product

Hardware



Infinity Interpolation



- A filter system designed to help reinterpret absorbed or reflected LiDAR scans
- Linearly interprets faulty data

Material	Black HVAC Tube	White HVAC Tube	Corrogated Cardboard	Smooth Cardboard
Infinity %	88.2	13.2	21.4	1.1

- LiDAR has the highest percentage of scans on flat, brightly colored objects
- Black HVAC tubing absorbs majority LiDAR scans

Racing Event

Team Name	Key Component	Best Lap Time	Top Speed
UCSB Mercury	LiDAR	12.3s	6m/s
UCSD Triton AI	Depth Camera	21.0s	3m/s

- Organized a time trial event with Triton Ai at UCSD
- First ever UCSB representation for f1tenth autonomous racing
- Stress tested vehicle and optimized lap time on full sized track
- Got involved with the f1tenth racing community and was exposed to a wide range of algorithms

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