F1Tenth Autonomous Car

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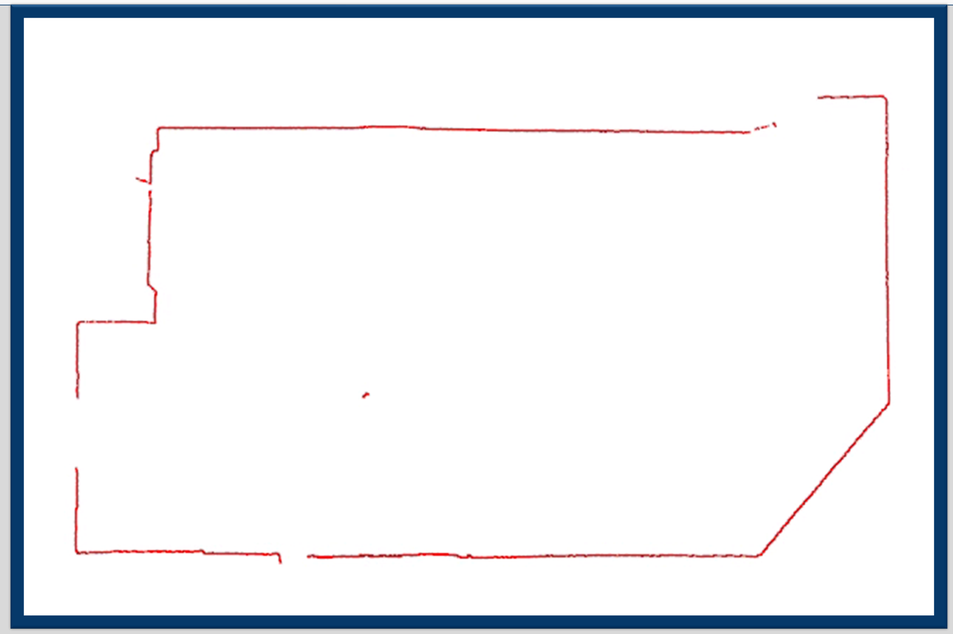
Introduction

Hello! We are the F1Tenth Senior Design Team. We decided for our project that we would build an autonomous RC car capable of racing in the official F1Tenth competitions. The car uses LiDAR to map out the race area and then proceed to use an internal algorithm to determine where to drive. The car will be able to stop and avoid obstacles as well as map and drive down paths all by itself with no input from the user. This project is additionally an extension of a project from last year's senior design group.

Development Process

1.Analyze the state of last year’s car to see where they succeeded and failed.
2.Research official documentation and algorithms from the f1tenth organization.
3.Add individual components to the car for independent operation.
4.Modify the current system to work with the new hardware attachments.
5.Develop the autonomous algorithm and interface it with the LiDAR.



Materials and Methods

Nvidia Jetson Nano - This is a high-speed microcontroller with 128 cuda cores for high-speed ram storage. This will take in our sensor inputs and control the steering and speed based upon said inputs.

VESC MK VI - This is responsible for taking in inputs from the Nvidia Jetson Nano and outputting power to the wheels as well as steering the front wheels. This has two separate outputs, the first being a 17.45V AC output to the Brushless DC Motor that drives the car. The second output will be a pwm signal to the steering servo, it has a 2ms timeframe and is between 858-1670µs.

RPLidarS2 - This is our new Lidar unit. It will map out the racetrack prior to the race and create parameters for our car to operate within. It has a 13mm resolution and a 1-megabit baud rate for data transfer. It takes 3200 scans a second and uses a high-speed driver for passing outputs along.

Wall Following Algorithm - This algorithm allows us to follow the mapped-out walls of our racetrack. By taking in the Lidar inputs, we can convert the data into the different angles during our approach and proceed through the track in a timely but safe manner.

Design Scope

•Battery powered car that can supply 50 Watts that will last 30 minutes.
•Self-driving/self-steering/autonomous after mapping the track manually.
•Car will use an algorithm to autonomously travel the fastest route (shortest distance).
•Will use a microcontroller for car control.
•Will use sensors to detect walls and other cars for obstacle avoidance.
•Will you use a DC motor.

Conclusion

By first restoring the car and learning more about the hardware, we were able to start integrating new hardware and programs into the system. By implementing the new hardware on to the car and refining our algorithm we were able to successfully create an autonomous F1Tenth racecar.