# Autonomous 1/10th-Scale Race Car for F1TENTH Competition

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SLAMing the Competition

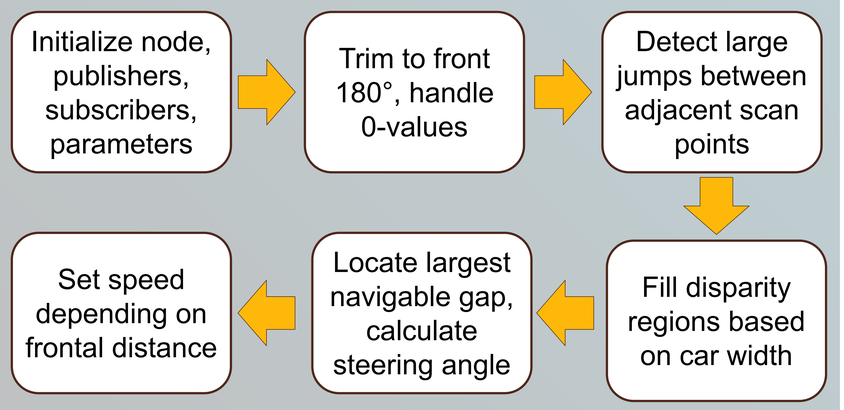
## Background

This project centers around developing a fully autonomous 1/10th-scale race car built for the 2024–2025 F1TENTH competition. Our team is one of four competing in the competition at UCSB. The competition emphasizes precision and efficiency, requiring teams to develop racing algorithms that can handle complex track layouts with limited intervention.

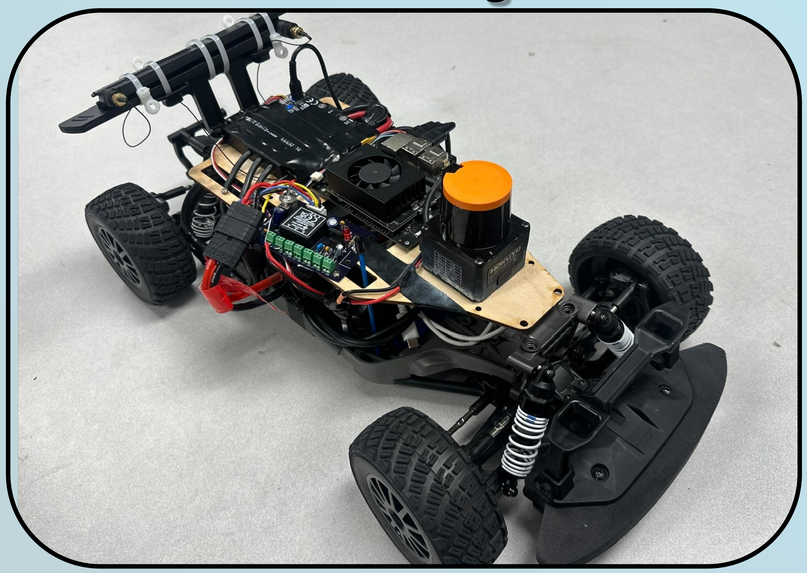
## Overview / Design Specs

Our vehicle is equipped with the NVIDIA Jetson Orin Nano for onboard computation, the VESC MK6 for precise motor control, and a LiDAR sensor to enable real-time environmental perception. Using Robot Operating System (ROS) as the middleware, we implemented modular systems for sensing, processing, and control. The core of our autonomy stack is the disparity extender algorithm, a LiDAR-based reactive method that enables the car to avoid obstacles and navigate safely through complex track environments. Our focus is on achieving consistent, high-speed lap times while maintaining robustness against sensor noise and environmental variation. Through iterative development and simulation testing, we aim to refine our system for both accuracy and adaptability.

## Autonomous Algorithm Flow



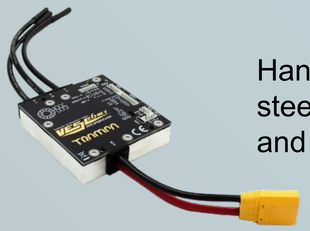

## Final Design



## Hardware / Key Components

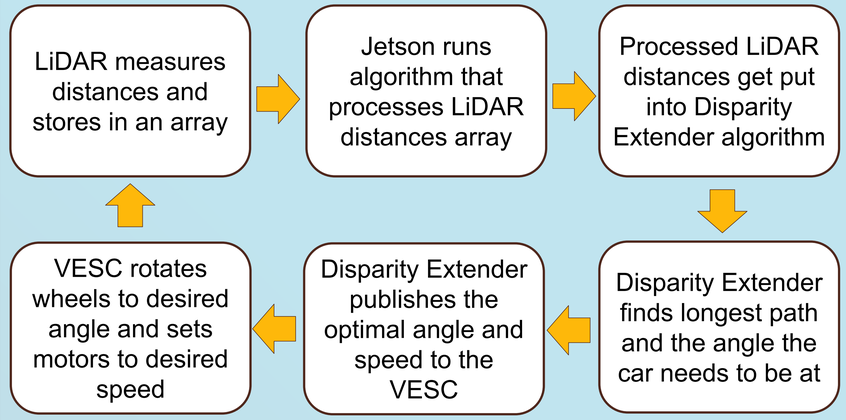
**NVIDIA Jetson Orin Nano**
Serves as the onboard computer responsible for processing LiDAR data, running our driving algorithms, and handling ROS 2 communication.


**Hokuyo UST-10LX**
This 2D LiDAR sensor provides a 270° field of view with a 40 Hz scan rate. It detects distances up to 10 meters and is critical for obstacle detection, gap-finding, and real-time navigation in our reactive driving algorithm.

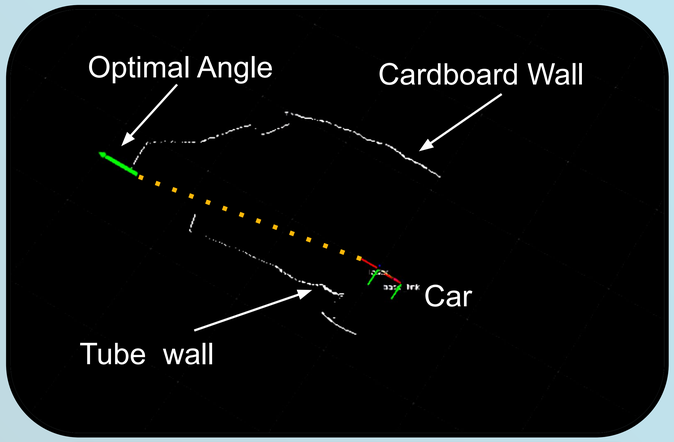


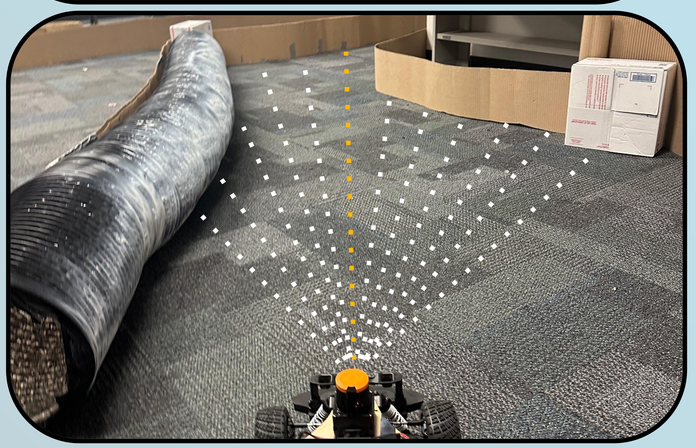
**VESC MK6**
Handles real-time control of the car's steering and throttle. It receives velocity and angle commands from the Jetson.

## Reactive Navigation Flow




## LiDAR Perception in Action



**Acknowledgements:**
Thank you to Professor João Hespanha and Ilan Ben-Yaacov for providing guidance throughout the research process. We are also grateful to Chris Cheney and Maddie Hesse for their continuous support and technical insight. Partial funding for the project came from the UCSB Office of Undergraduate Research and Creative Activities.

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