MICHIGAN STATE
UNIVERSITY

Project Plan Presentation

Remote Interface for Small-Scale Autonomous Race Cars

The Capstone Experience

Team Michigan State University CSE

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From Students…
…to Professionals

Project Sponsor Overview

Michigan State University – CSE Department

- MSU – PoliMOVE Accomplishments:
  - Won Indy Autonomous Challenge in 2024
  - First place at the IAC WeatherTech Raceway Laguna Seca event
  - Collab between MSU and Politecnico di Milano
- Sponsors of the Polimove-MSU team:
  - Michigan Office of Future Mobility and Electrification
  - DENSO North America Foundation
  - MSU Research Foundation

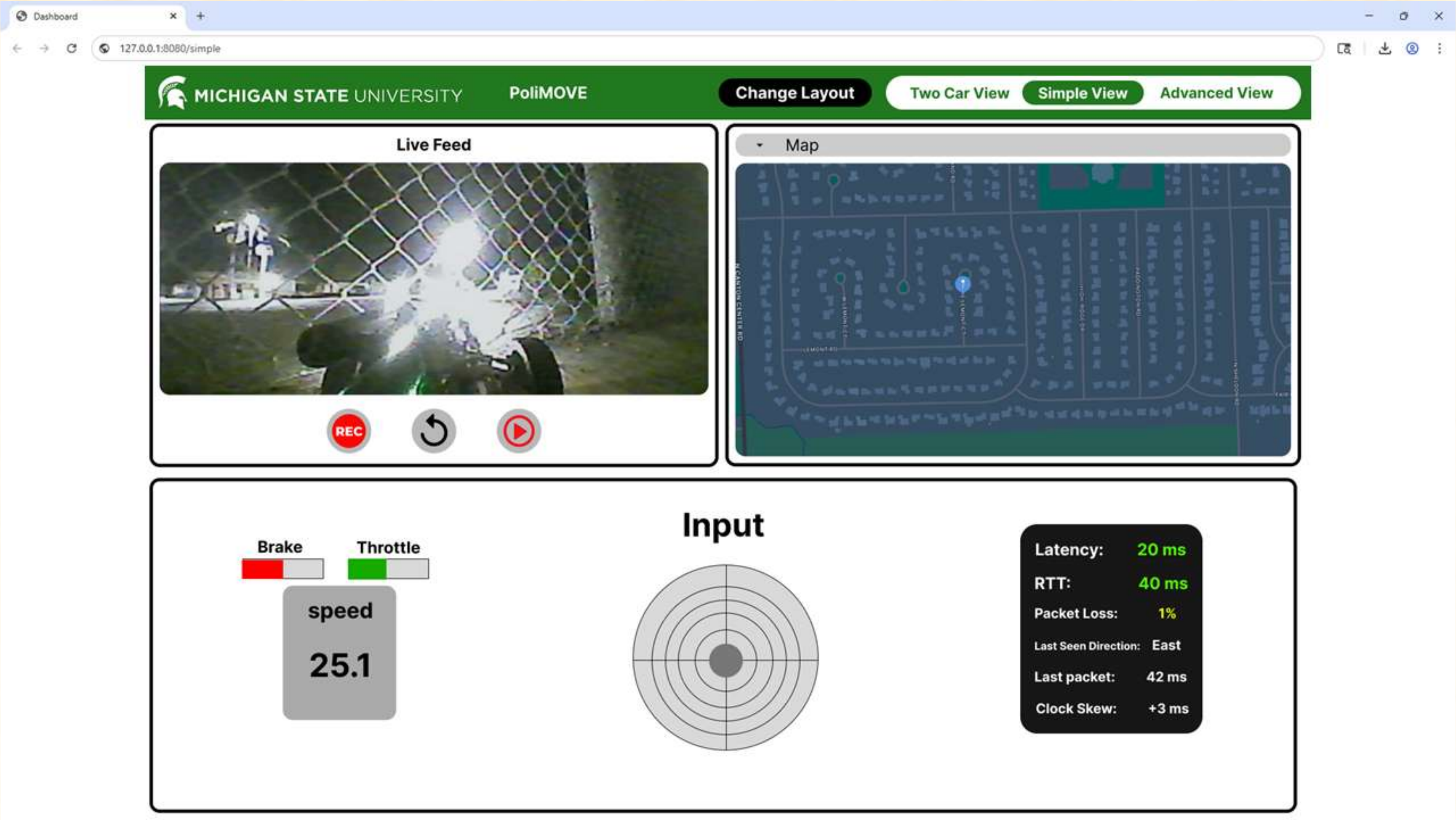
Project Functional Specifications

- **What is your problem?**
  - Indy Autonomous Challenge
  - High Stakes Testing
  - Crashing Full-Scale Car is Costly
  - Subpar Web UI
- **How do you fix the problem?**
  - Small-Scale to capture data
  - Less Cost when Crashing
  - Beautification of the UI
- **What else does it do?**
  - Access to GNSS data when offline
  - Ability for 2 cars to run at once
    - ROS Bags and Unique instances
  - Support Control through Front End UI

Project Design Specifications

- Web-based application for monitoring and interacting with racecars
- Provides basic vehicle control through the interface
- Displays live video feed of the cars in real time
- Shows key data, including:
    - LiDAR
    - GNSS data with charts and maps
    - IMU data with charts
    - Brake and Throttle inputs
    - Steering angle, speed and runtime
- Includes a playback feature to record and replay previous sessions

Screen Mockup: Simple View



speed

25.1

Latency: 20 ms

RTT: 40 ms

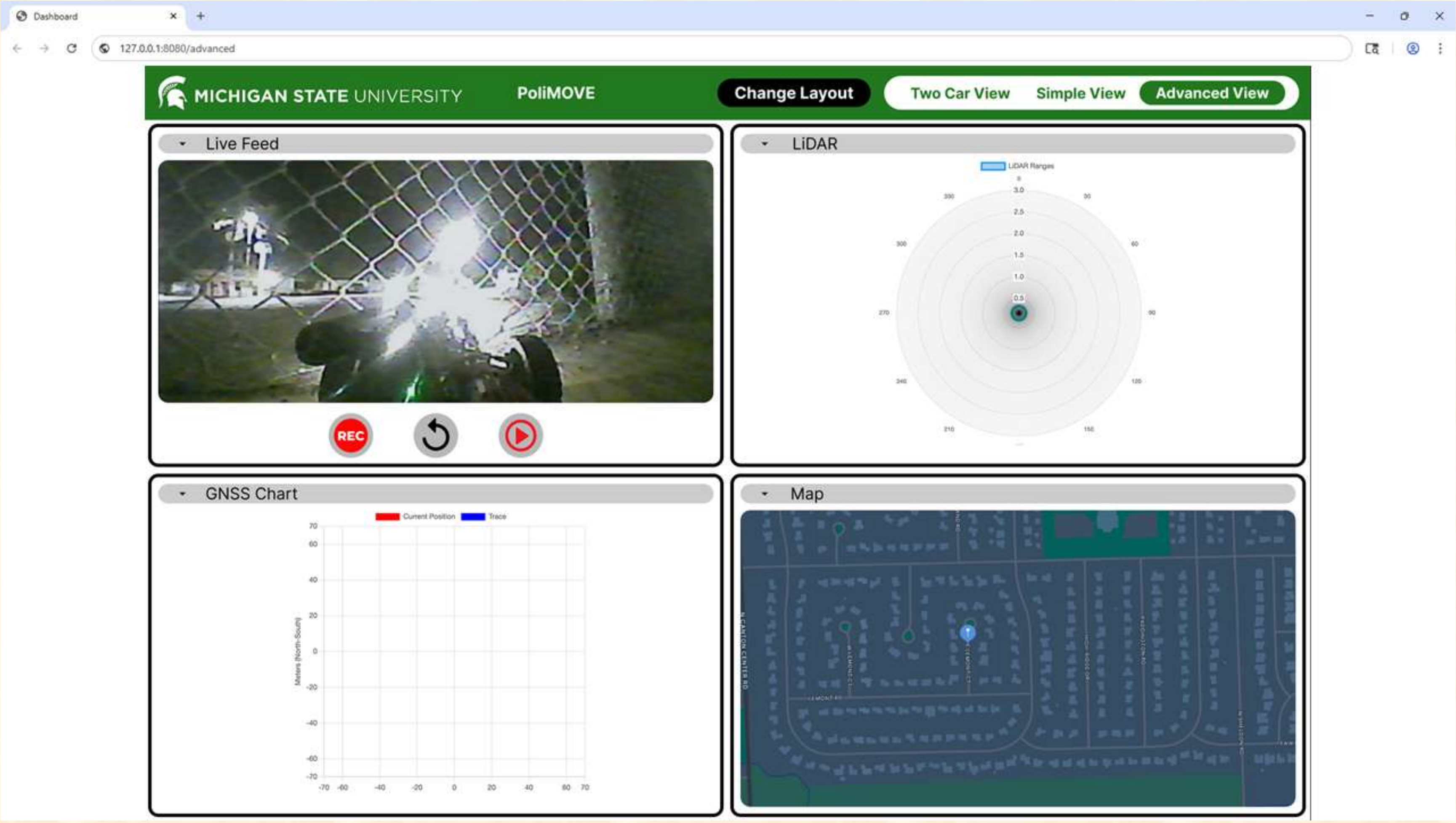
Packet Loss: 1%

Last Seen Direction: East

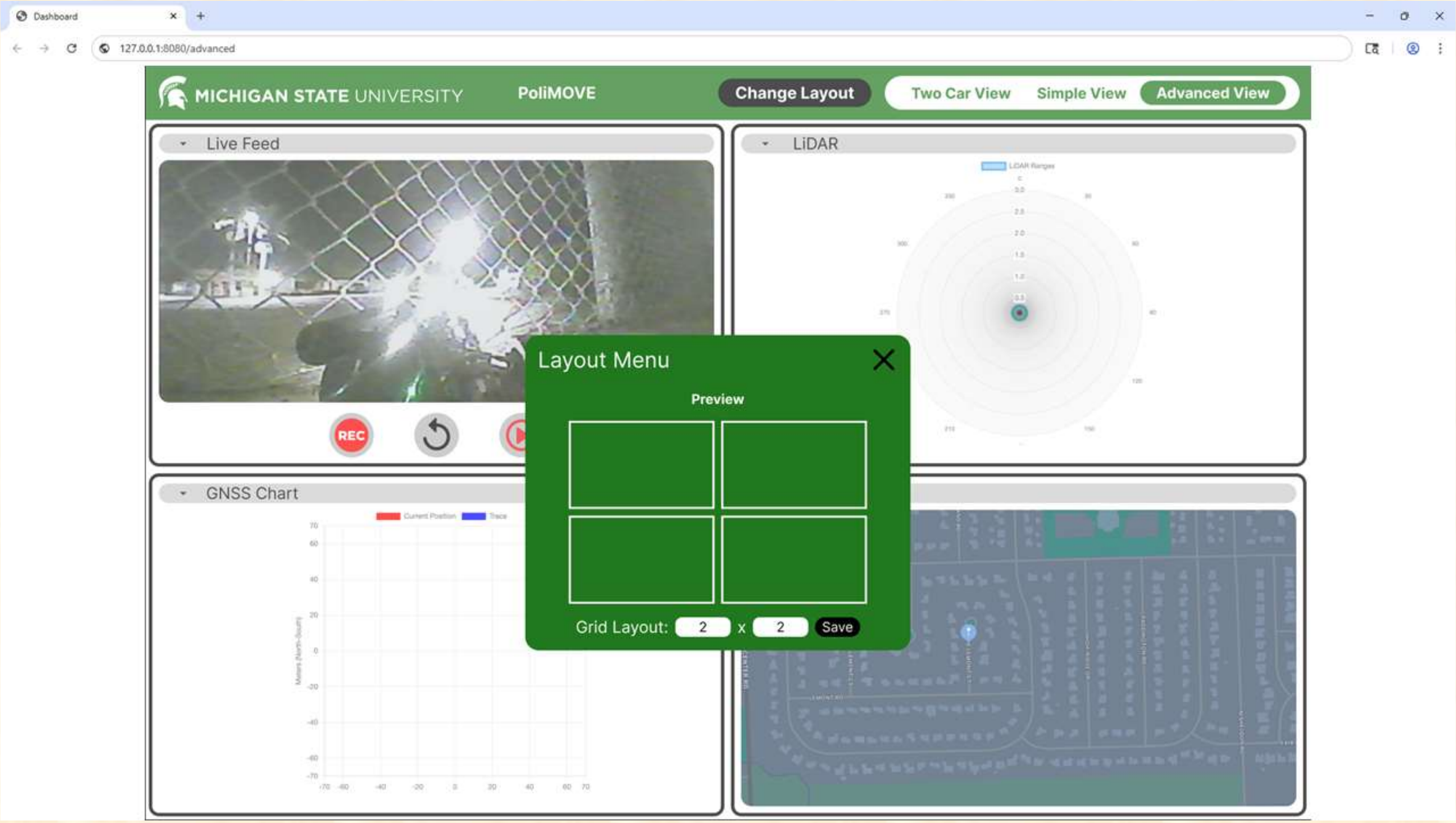
Last packet: 42 ms

Clock Skew: +3 ms

Screen Mockup: Advanced View

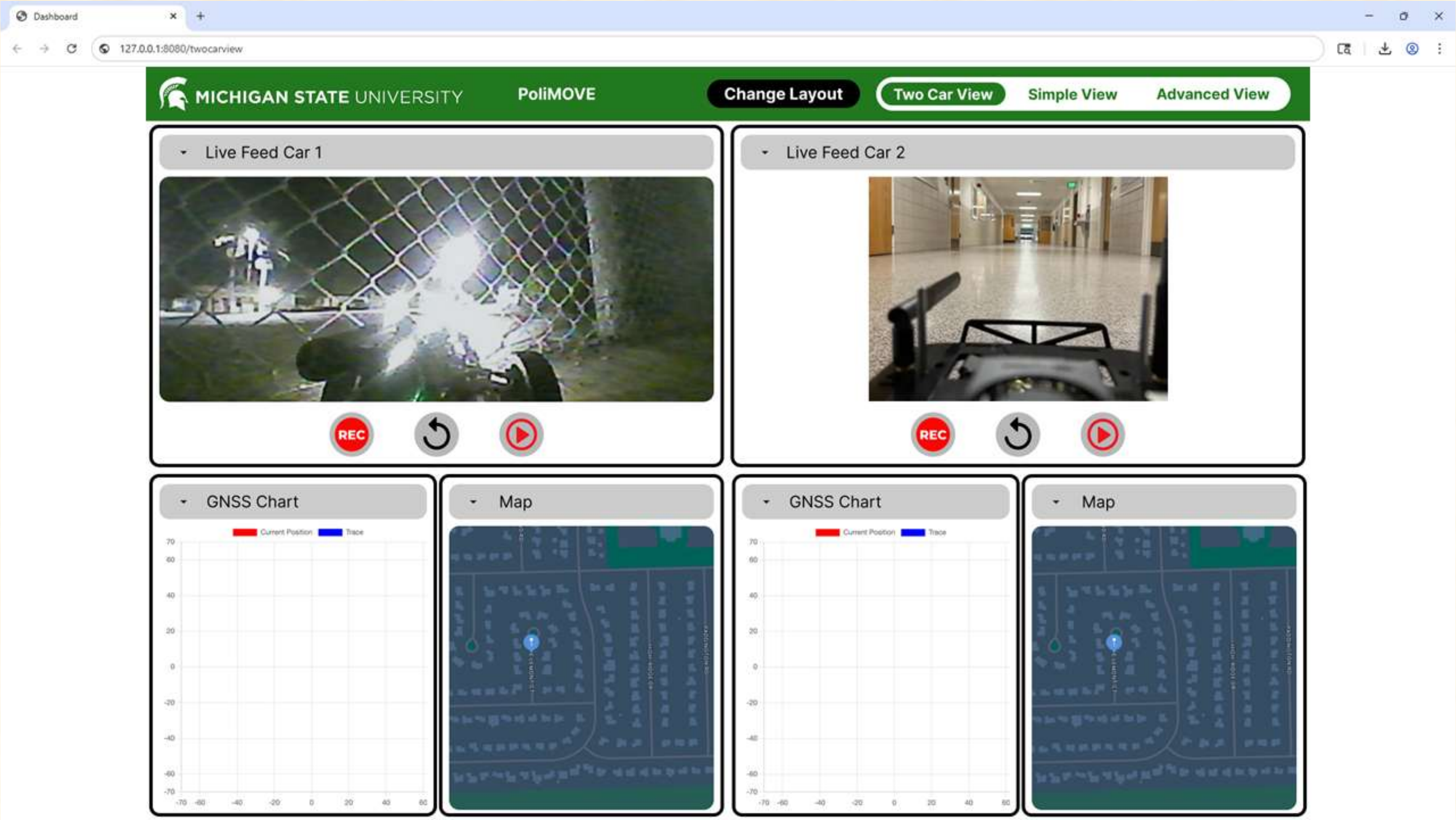


Screen Mockup: Change Layout Menu



Grid Layout: 2 x 2

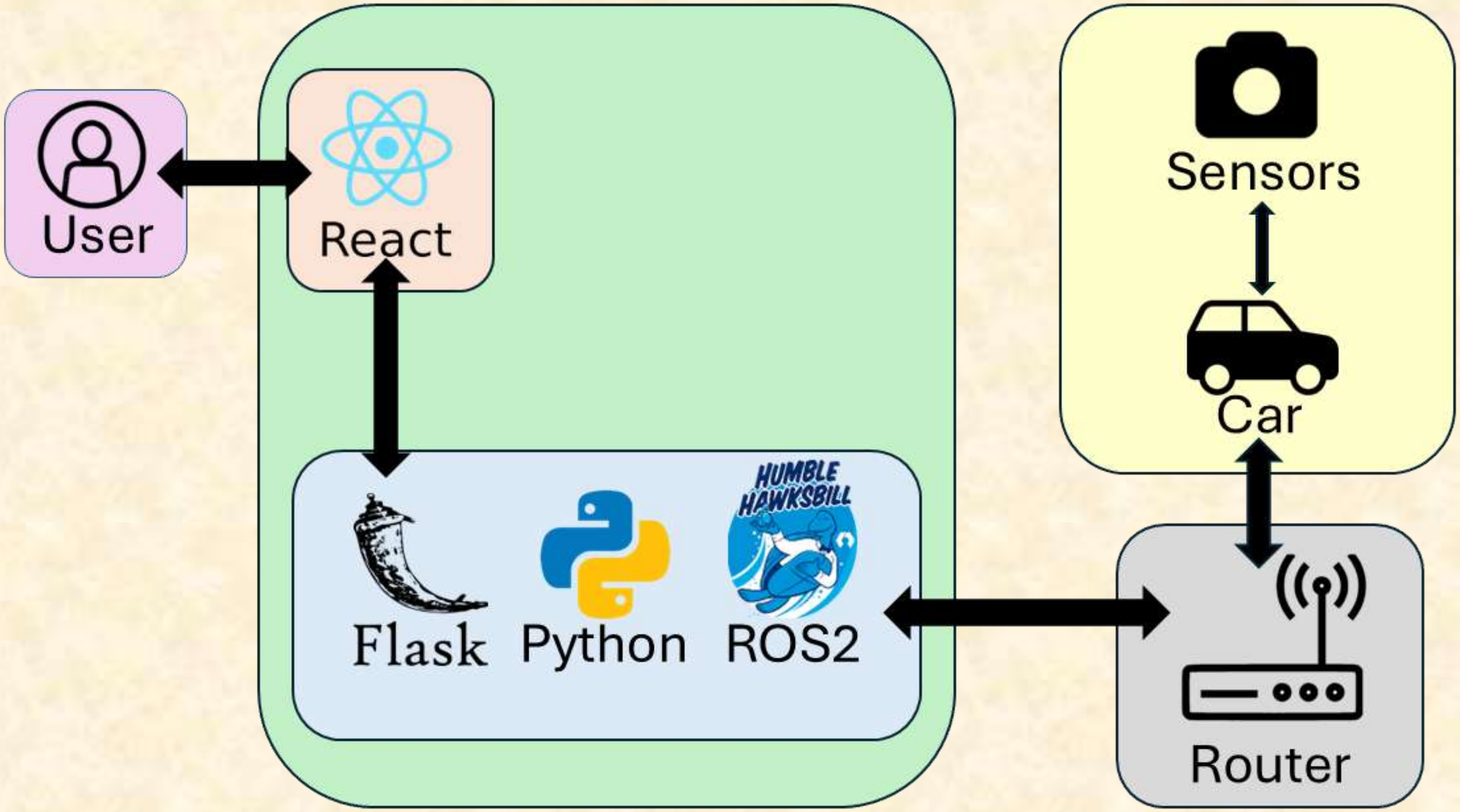
Screen Mockup: Two Car View



Project Technical Specifications

- Easy-to-use and appealing web application
- View sensor data collected by the car in an intuitive fashion
- Ability to drive the car in multiple ways, via controller, steering wheel, and touchscreen
- Ability to cache maps to use while car is offline
- Use application with two cars at the same time
    - One car plays back data, the other is driven

Project System Architecture



Project System Components

- Hardware Platforms
  - Small Remote Operated Car
  - Laptop
  - Wi-Fi Router
- Software Platforms / Technologies
  - Python
  - React
  - Flask
  - Robot Operating System 2 (ROS2)
  - Docker

Project Risks

- Risk 1 - Using and Navigating Cached Maps
  - Description: Accessing map data offline
  - Mitigation: Store map data locally
- Risk 2 - Running 2 cars at once
  - Description: Need to figure out how to run 2 cars at once
  - Mitigation: Communicate with both cars in 2 separate instances
- Risk 3 – Creating an Interactive UI for K-12 use
  - Description: Creating a front end controller for children to use
  - Mitigation: Use web sockets so that front end can communicate with the back end ROS2 subscribers
- Risk 4 – Working with hardware
  - Description: Team has limited experience in robotics/hardware
  - Mitigation: Work hard to become proficient with hardware

Questions?

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