



Formula SAE Data Acquisition System

Sponsor: Vanderbilt Motorsports

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Background

- The Vanderbilt Motorsports Team wants to make data-informed design improvements for the Formula SAE competition
- Current vehicle telemetry is limited by unsynchronized data streams isolated across individual subsystems

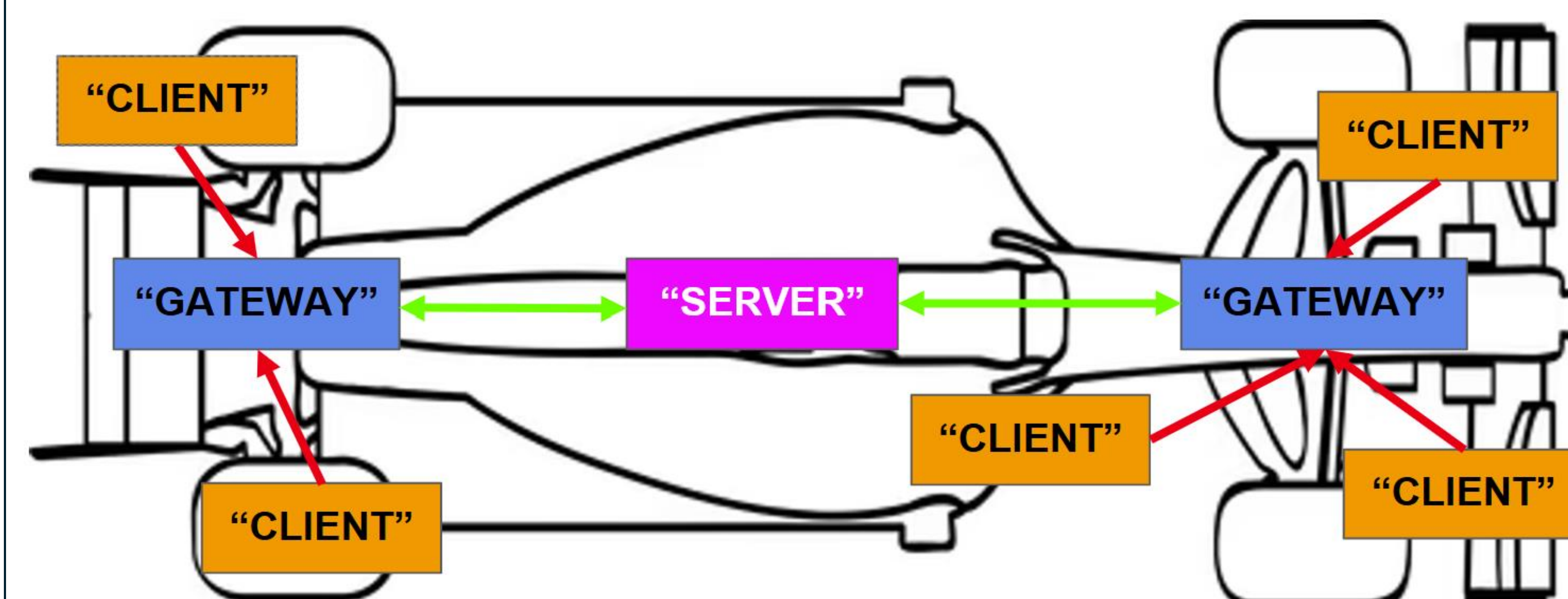


Design Goals

- Unify all disconnected data sources into a single data acquisition system
- Enable real-time data synchronization
- Provide custom sensor suite to support cooling system instrumentation
- Create accessible, scalable software framework to support future iterations

Design Solution

"Nervous System" Architecture



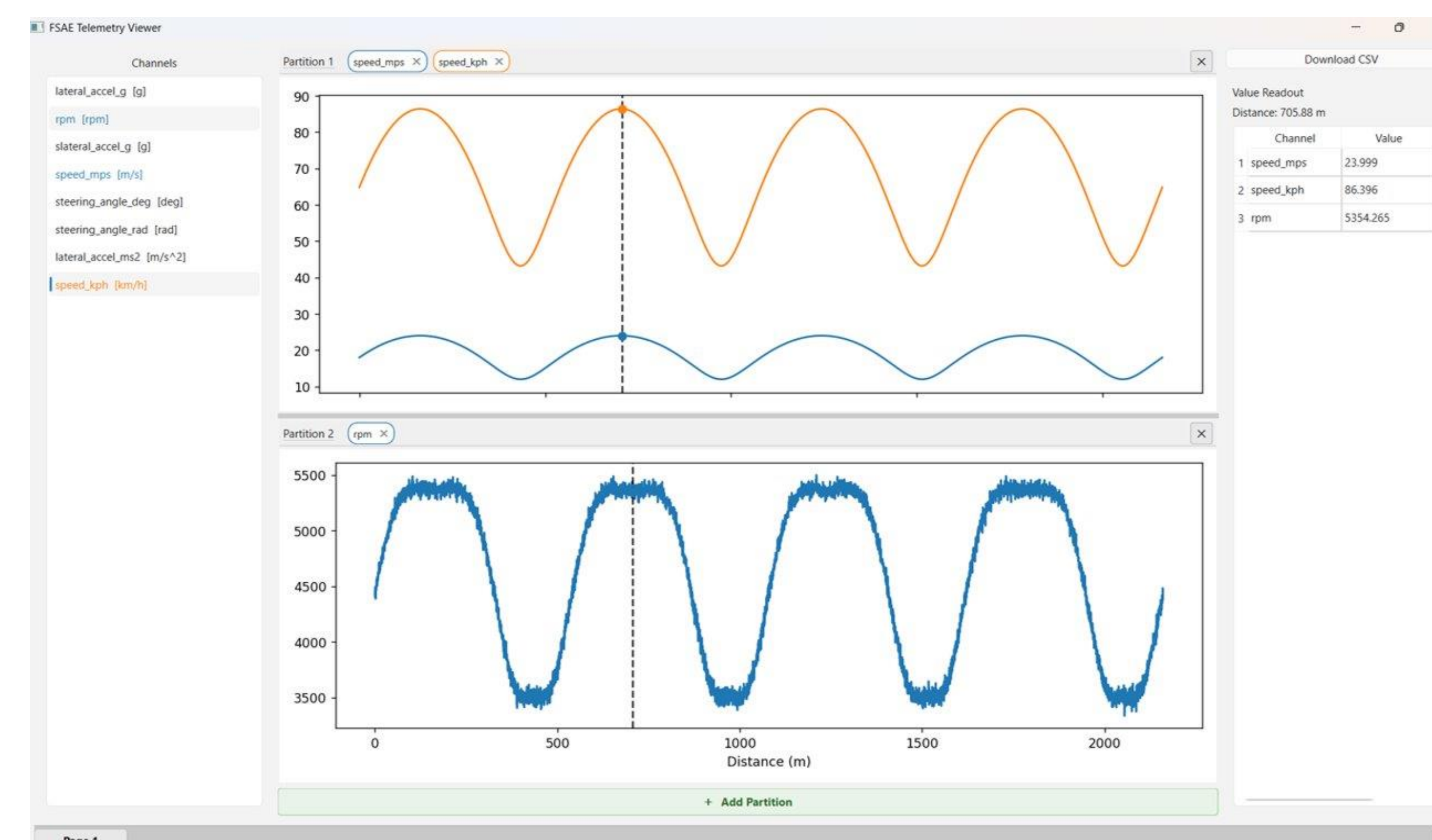
→ Short Distances (SPI, I2C)

→ Long Distances (CAN)

- Combined radiator cooling sensors with RaceBox Mini to correlate vehicle dynamics with GPS telemetry
- Designed custom gateway PCB to ensure stable power distribution and bridge sensor data to main CAN bus
- Scalable model for multi-protocol sensor integration

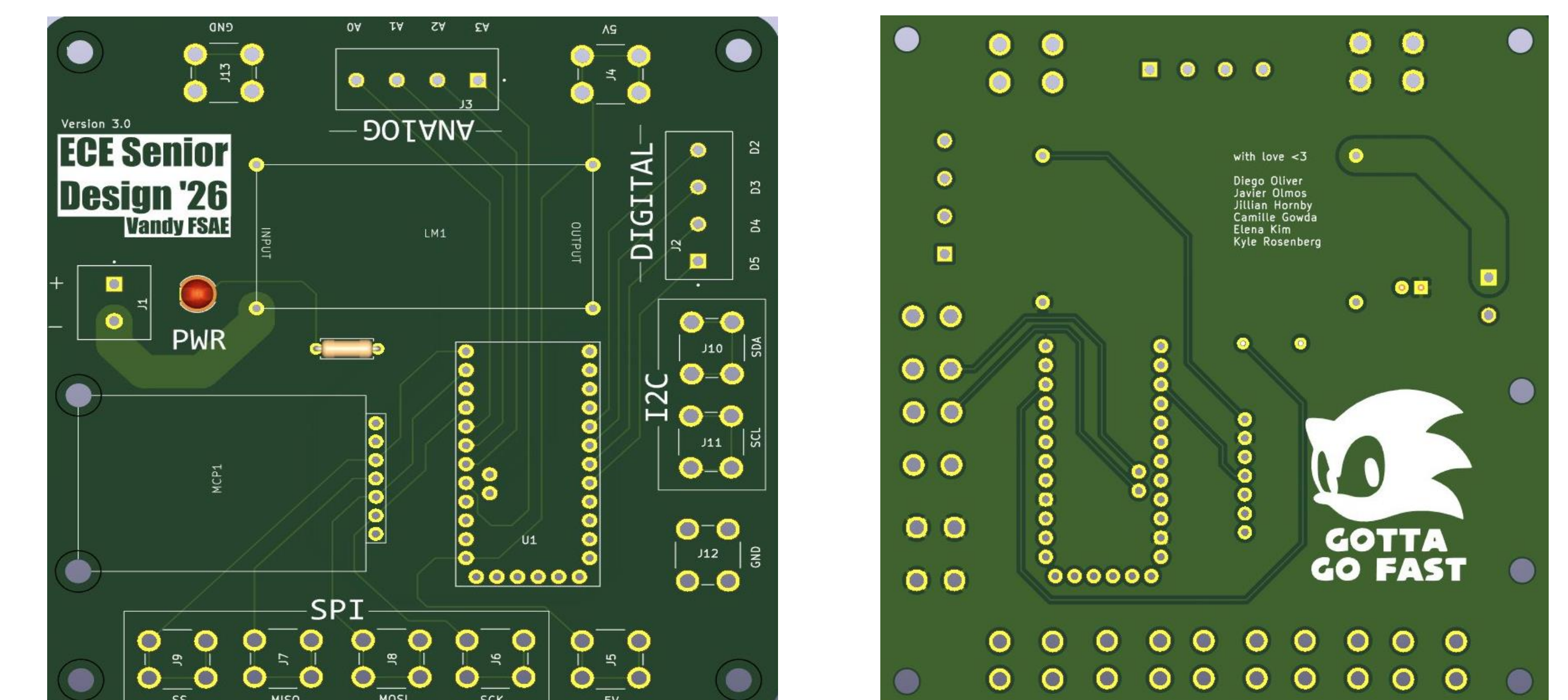
- Central Server (Raspberry Pi): Central processing hub that orchestrates network timing to ensure collision-free communication.
- Gateways (Custom PCB): Robust communication bridge between the central server and local clients.
- Client Nodes (Sensors): Hardware that interacts with the physical environment to continuously monitor conditions like temperature and pressure.
- Communication Pathway (CAN Bus): Primary physical wiring connecting the system that ensures reliable data delivery, even in noisy environments.

Data Visualization Dashboard



- Python-based data logging and visualization framework
- Interactive plotting of logged vehicle data to analyze performance metrics
- User-friendly, scalable interface designed to integrate future sensor node expansions seamlessly

Gateway PCB Design



Outcomes

- Successfully integrated independent sensors into a synchronized multi-source data system
- Enabled evaluation of cooling subsystem performance
- Provided scalable platform for future vehicle development