Nissan Leaf Driving Simulation

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Project Overview

The ME and ECE department requested that the Nissan Leaf residing in Lewis Hall be engineered to act as the input controller to a pre-existing driving simulation created by a previous capstone team. The goal was to use all OEM parts or sensors to capture data for steering, accelerating, braking, shifting, and auto-light control in real-time. All data is currently being consolidated to a single MCU that will eventually feed all signals into the simulation in a future capstone project.

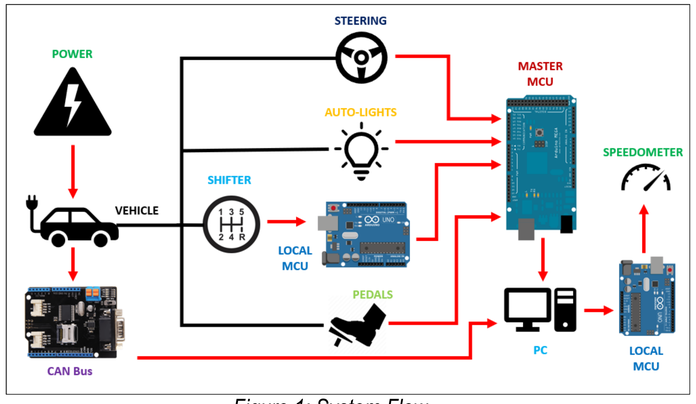

Figure 1: System Flow

System Constraints

- Real-time data transfer (100 milliseconds or less)
- Display simulation speed in vehicle in an aesthetically pleasing manner
- Detect steering angle with no greater than 1° of error
- Detect shifter positions: Park, Drive, Reverse, & Neutral
- Detect accelerator & brake pedal position
- Detect Low Beam, High Beam, Turn-signals, & Hazard lights
- Power all OEM components with 12 V DC power supply
- Read CAN Bus data at no less than 10 Hz

Solution

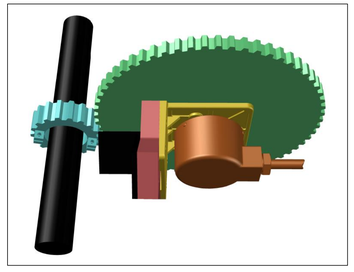

Figure 2: Steering Gear System

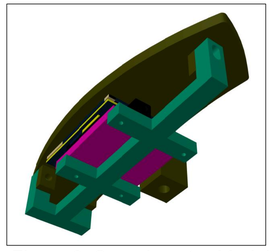

Figure 3: Speedometer Module

```
12:12:39.788 -> Shifter Info = D
12:12:39.788 ->
12:12:39.788 -> Steering Angle: 32.23
12:12:39.788 -> 1 Low beam detected!
12:12:39.788 -> Accelerator: 0.37
12:12:39.788 -> Brake: 0.02
12:12:39.788 ->
12:12:39.788 -> Steering Angle: 32.23
12:12:39.820 -> 1 Low beam detected!
12:12:39.820 -> Accelerator: 0.37
12:12:39.820 -> Brake: 0.02
12:12:39.820 ->
12:12:39.820 -> Steering Angle: 32.23
12:12:39.820 -> 1 Low beam detected!
12:12:39.820 -> Accelerator: 0.36
12:12:39.820 -> Brake: 0.02
12:12:39.820 ->
12:12:39.820 -> Shifter Info = D
12:12:39.820 ->
12:12:39.820 -> Steering Angle: 32.23
```

Figure 4: Sample Output

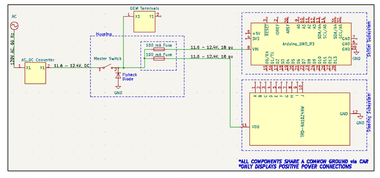

Figure 5: Power System Schematic

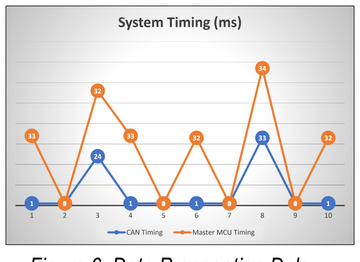

Figure 6: Data Propagation Delay

Outcomes

The team was able to successfully meet nearly all system design constraints with the given solution. Modifications were made to our design as necessary to account for calculation, instrumental, and system errors such as steering wheel rotation and common grounds for the MCUs. Currently, the system captures brake and accelerator pedal compression percentage, steering angle in each direction, auto-light signals, and shifter position in under 100 milliseconds. Simulator connection was a failure due to issues with the existing code and inability to bring the PC into the vehicle lab.

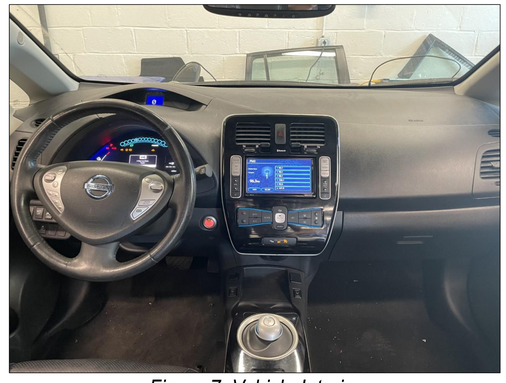

Figure 7: Vehicle Interior

Future Work

- Fix existing driving simulator software or create new software
- Feed collected data into Simulink physics engine
- Create systems for additional inputs: radio, windshield wipers, etc.
- Move simulator PC into Lewis Hall to connected to Master MCU
- Lift front wheels from the ground for easier steering
- Redundant brake sensor for error checking

Budget

TOTAL COST ➔ $684.18