Memo

Team: Team 09
Date: 3/2/23
Subject: Second Prototype Testing Plan

Required Materials

Hardware:

- Breadboards for controllers, steering, and misc, and their respective connections
- PID controller with backup “watchdog” controller
- Relay boards
- DAC boards
- DC-DC converter
- Polycase enclosure
- 3D printed fittings for the enclosure
- Screws to attach backup parts to the printed fittings

Software

- Simulink Scripts
    - PID implementation on controller
- C code scripts for auxiliary, main, and watchdog controllers
    - ESP-IDF libraries
    - Configurations for UART and I2C communication

Setup

Test Bed:

The test bed is set up in a purposefully “exploded” view to demonstrate the separate functionality of each part. We have created a means of simulating the input a car would be experiencing as inputs to the controller. We have also implemented a redundancy scheme, where the controller, relay boards, and other pieces of hardware are duplicated in case one set fails. The controller has the PID controller code downloaded onto it.

The test bed is split into two parts, where the main controller and its relevant components are placed on the left side (including the PID and the watchdog controllers and relay modules), while the right side contains the auxiliary controller and inputs from the steering and throttle signals through potentiometers (unable to use our rotary sensor due to previous malfunction and backlog lead times for new parts).

Enclosure:

The enclosure is purchased and shown for display purposes next to the test bed. Inside the enclosure are removable fittings, left un-bonded to the floor of the case for now for demonstration purposes, and also because it needs to be machined and prepared for the final product.

Pre-testing setup procedure

Test Bed:

Wire the auxiliary controller together with one of the ESP32-S3s, connected to two potentiometers for steering and throttle inputs and a relay module. The main controllers will consist of two ESP32-S3s connected to two relay modules and the MCP4725 DAC breakout board. Connect the auxiliary and main controllers using UART pins. Compile and upload the respective C-code for the appropriate controllers from the user's source code to the microcontrollers. *Aux_controller.c* goes to the auxiliary controller, *main_controller.c* corresponds to the main controller, and *watchdog.c* will be for the watchdog controller.

Enable power to the test bed, verify that everything is working correctly. In order, enable each of the controllers within the test bed by pushing software code into the chips and verify that they are working correctly/no compilation issues.

Enclosure:

Open the lid of the enclosure and reveal the inside with included components.

Testing Procedure

Test Bed:

Input voltage into the test bed system, where the controllers and relay modules are turned on one by one. Show multimeter output from the test bed. Use controls to vary the inputs to the board and how they affect the output, as well as the possibility of triggering the watchdog when input signals are larger than desired design limits.

Enclosure:

Disassemble the enclosure and explain what each part is for, and talk about how the whole device will fit together.

Measurable Criteria

Test Bed:

- Test bed responds to manual input from steering and throttle and transmits signals via UART towards the main controller.
- Steering input fed through the PID controller and throttle signals go through the speed emulator logic within the main controller.
- All components work correctly with the proper voltage outputs/readings.
- The test bed does not overload or trigger the watchdog controller unexpectedly.

Enclosure:

- Components all fit in the box and are correctly sized
- Components are simple to fit together and easy to remove and add
- Team is able to demonstrate how everything will fit and flow together, as well as address future work needed