Homework 7: Test Plan
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Course: ECE 411

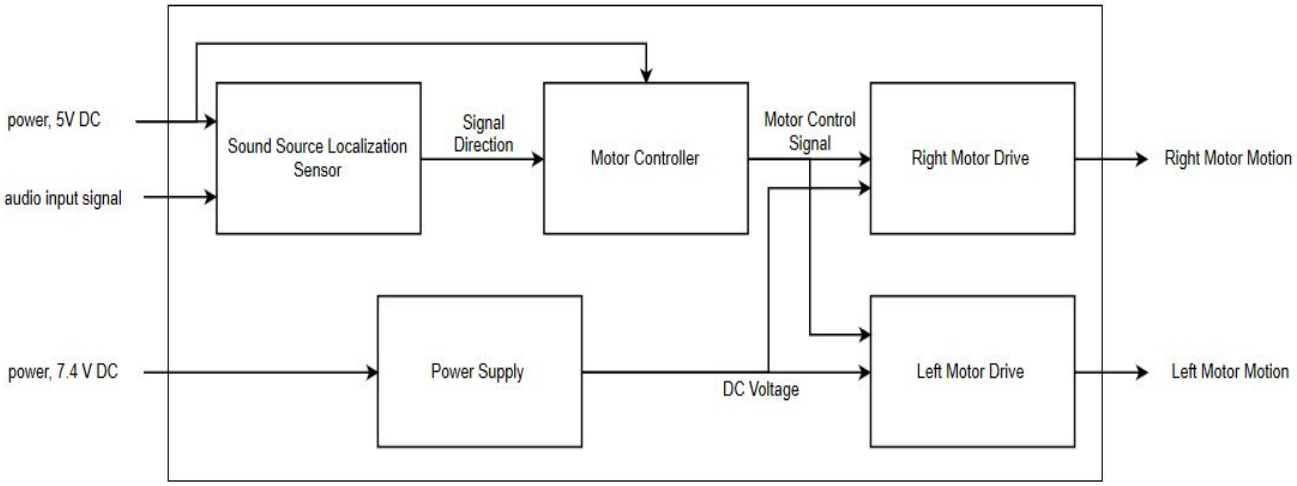
Test Plan for FearBot

FearBot's engineering requirements:

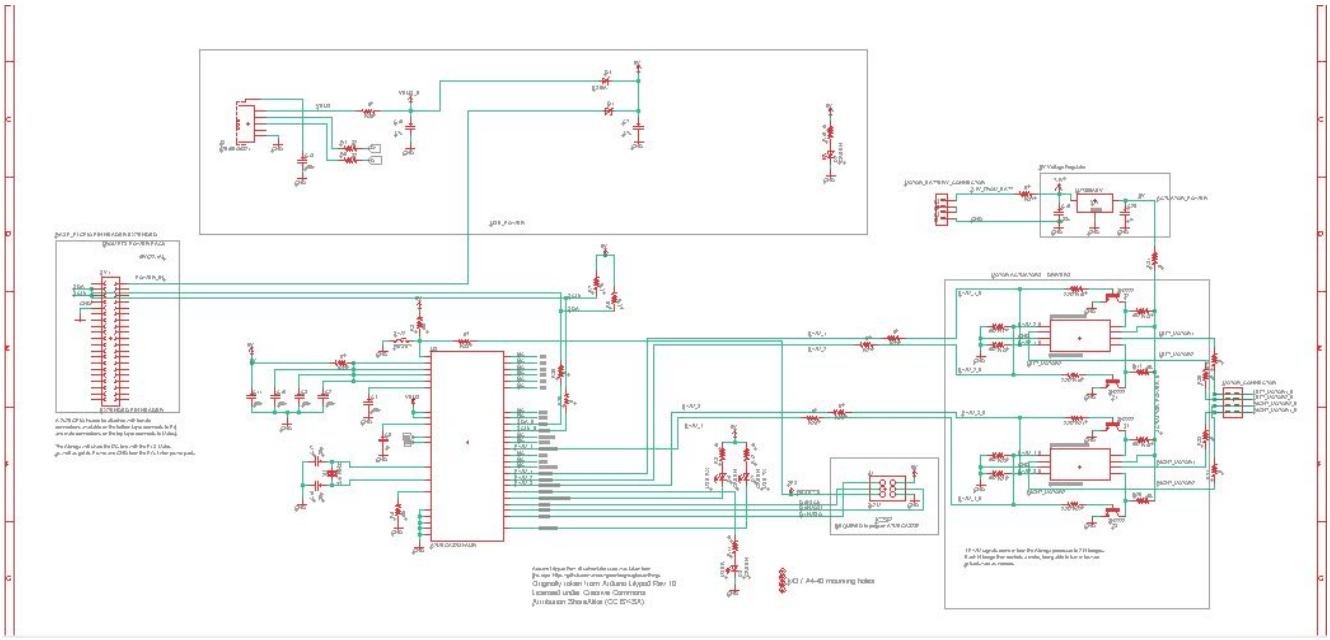
- FearBot must be able to sense sound from a distance of 10 ft or less, radially
- FearBot must turn itself nearly opposite (bot will align itself until the sound is between 70^0 to 110^0 behind it where 270^0 represents its front center) from the direction of the sensed sound and drive away from the source (can be at any speed).
- FearBot must sense, turn, and drive away all within 2 seconds from the act of a noise being made 10 ft away radially.

Documents used to test FearBot:

- Level 1 Block Diagram (and all of its modules) Document of FearBot
- Version 2.5 Schematic of FearBot



Level 1 Block Diagram of FearBot



Version 2.5 Schematic of FearBot

Testing approach

The Level 1 Block Diagram (and all of its modules) Document of FearBot shows that we need to test the modules:

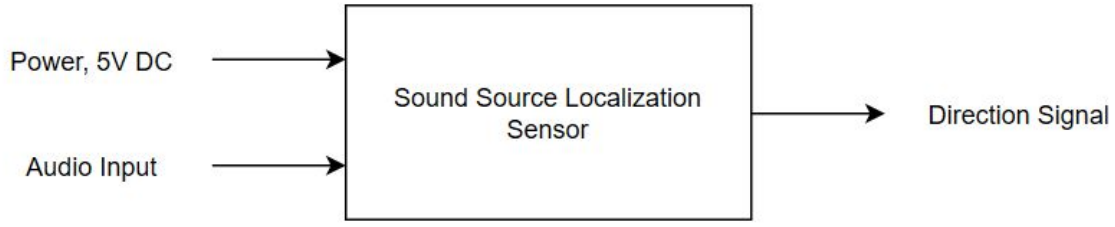
- Sound Source Localization Sensor
- Motor Controller
- Right Motor Drive
- Left Motor Drive
- Power Supply

individually, and then together one by one, until all of the modules are receiving the expected inputs and, in turn, producing the expected outputs. The inputs and outputs used to test the modules will be executed based off of the requirements for this MVP (ex. The input “audio signal” will be created from 10 ft or less).

Sound Source Localization Sensor will need to have the following tested:

- Sound data from the microphone array properly translated into angle corresponding with direction of source relative to the orientation of the MVP.
- Sound data that is outputted as the signal “Signal Direction” properly conveyed via I2C to the Motor Controller module
- Adequately powered with 5V DC from a battery pack

Referring to this part of the block diagram:



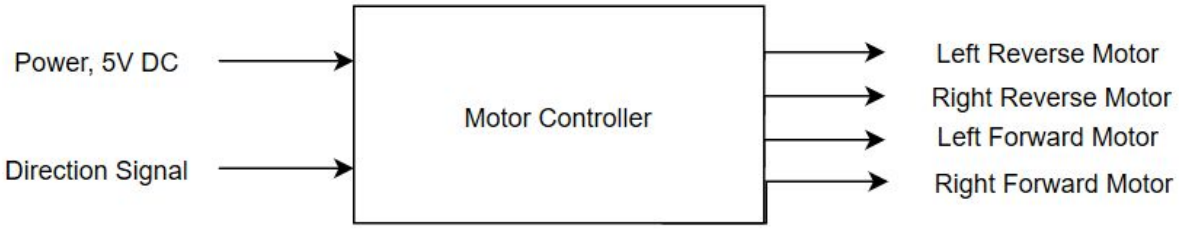
Level 1 Block Diagram: Sound Source Localization Sensor Module

Note: The Sound Source Localization Sensor consists of a Raspberry Pi and microphone array called a MATRIX Voice. In conjunction with software provided by the MATRIX developers, an open source software known as ODAS is being used for sound localization.

Motor Controller will need to have the following tested:

- Receives data from Sound Source Localization Sensor via I2C
- Interprets sound direction data and outputs appropriate PWM signals for the Left and Right Motor Drivers
- Is adequately powered with 5V DC from the shared battery pack as well as with a microUSB connection (these power sources can be applied at the same time or separately and the Motor Controller module should still have an appropriate voltage)

Referring to this part of the block diagram:



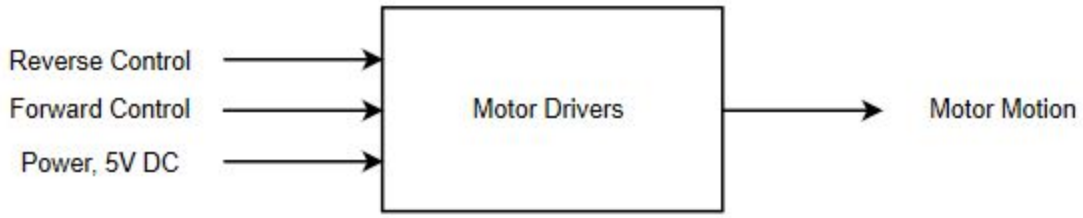
Level 1 Block Diagram: Motor Controller Module

Note: The Motor Controller's primary component is an ATMega42U4

Left and Right Motor Drivers will need to have the following tested:

- Can each receive forward and reverse PWM signals from the Motor Controller module, and drive their corresponding motors accordingly.
- Drivers each convey a 0-5V PWM signal to their corresponding motors.

Referring to this part of the block diagram:



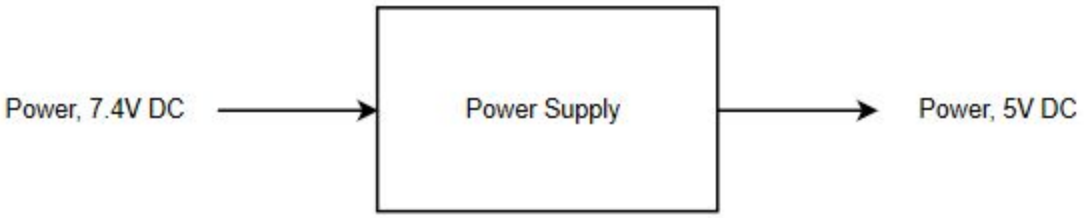
Level 1 Block Diagram: Left and Right Motor Drivers Module

Note: Each motor driver is made from an H-Bridge

Power Supply will need to have the following tested:

- Reliably outputs a 5V DC signal, given a 7.4V DC input

Referring to this part of the block diagram:



Level 1 Block Diagram: Power Supply Module

Note: The power supply is constructed from a basic 5V voltage regulator

Test Plan

1. Unit Test
    a. Determine voltage regulator outputs 5V given a 7.4V input
    b. Confirm H-Bridges drives each motor forward and backward given a 5V DC supply and PWM signal
    c. Test USB connection provides 5V power
    d. Confirm MATRIX Voice sound source localization properly determines the correct direction
    e. Test that Matrix-Voice/Raspberry Pi responds to sounds that are above its ignored threshold
    f. Test that ATMega32U4 accepts programs
    g. Isolated program tests
        i. Test that Raspberry Pi I2C C++ code transmits
        ii. Test that AtMega32u4 Arduino I2C code receives
        iii. Test that PWM pins when asserted in fact modulate.

2. Integration Tests
    a. Test H-Bridge as in Test 1b, but with the 5V H-bridge supply provided by the voltage regulator
    b. Run H-Bridge with PWM signal from ATMega32U4
    c. Confirm MATRIX Voice functions with motor controller board sharing I2C and power pins
    d. Test that Matrix-Voice/Raspberry Pi C++ code properly isolates angles as integers
    e. Test that AtMega32u4 properly responds to incoming I2C values by asserting PWM pins high
    f. Test that I2C C++ code still works when integrated into Matrix Voice code
    g. Test that a sufficiently loud sounds transmit accurate angles across I2C bus and AtMega begins driving appropriate PWM signals.
    h. Test that appropriate PWM signals when asserted together enact a LEFT turn, RIGHT turn and FORWARD motions on motors.

3. Functional Tests
    a. Determine FearBot senses the direction of a sound

    b. Confirm Fearbot reacts to the sound
4. Acceptance Test
    a. Test if FearBot is able to sense sound from a distance of 10ft and less
    b. Test if FearBot turns itself nearly opposite (as mentioned in requirements) from the direction of the sensed sound and drives away from the source (can be at any speed).
    c. Test if FearBot senses, turns, and drives away within 2 seconds from the act of a noise being made.

Test Case Description

Test Writer: Mike Hall						
Test Case Name		Voltage Regulator Output			**Test ID**	**1a**
Description		Ensuring proper functionality of L7805ABV voltage regulator under normal conditions, and with 10kHz crosstalk from PWM signal.				
Tester Information						
Name of Tester					**Date**	
Hardware Version					**Time**	
Setup		Solder motor power headers, voltage regulator, capacitors C15 and C20, and resistor R37 to board. Resistor R31 should **not** be soldered to the board. An oscilloscope probe should be connected to the voltage regulator output pin.				
Step	**Action**	**Expected Result**	**Pass**	**Fail**	**N/A**	**Comments**
1	Apply 7.4V DC to motor battery connector pin 4	Voltage regulator output is 5V +/- 0.2V				
2	Apply 15V DC to motor battery connector pin 4	Voltage regulator output is 5V +/- 0.2V				
3	Apply 7.2V - 7.6V 10kHz square wave to motor battery connector pin 4	Voltage regulator output is 5V +/- 0.2V				
Overall Result						

Test Writer: Colton Bruce							
Test Case Name		Confirm MATRIX Voice functions, with motor controller board as an interceptor				**Test ID**	**2c**
Description		The MATRIX Voice must be connected to the Raspberry Pi through the motor control board, with all required data pins still accessible. This test will confirm this by ensuring sound source localization occurs when all boards are connected.					
Tester Information							
Name of Tester						**Date**	
Hardware Version						**Time**	
Setup		Fully build a motor control board as given in reference material					
Step	**Action**	**Expected Result**	**Pass**	**Fail**	**N/A**	**Comments**	
1	Connect Raspberry Pi to motor control board through bottom 2x20 female headers						
2	Connect MATRIX Voice to motor control board through top 2x20 male headers						
3	Power devices by connecting Raspberry Pi to 5V source.	LEDs on all board will turn on					
4	SSH into Raspberry Pi	Can run commands on Raspberry Pi					

5	Enter ODAS Bin directory using command “cd ~/odas/bin”					
6	Run ODAS using command “./matrix-odas &”					
7	Run ODAS sound localization demo using command “./odaslive -vc ../config/matrix-demo/ matrix_voice.cfg”	The lights on the MATRIX Voice will light up in the direction of a detected sound.				
Overall Result						