Test Plan

Team #1: The Community
Project: A.B.E.D

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(Rev 1.3)

12/07/2020

1.0 INTRODUCTION

1.1 This Document

It provides information in regards to the project's test plan and test cases. Also, it provides a high-level overview of the product.

1.2 Recording of results

4.3.1: Ultrasonic Sensor module – Test 1		
Distance Measured (cm)	**Actual Distance (cm)**	**Error %**
24	25	4
10	11	9
30	32	6
25	25	0
14	15	6
21	20	5

4.3.1: Ultrasonic Sensor module - Test 2		
Distance Measured (cm)	**Actual Distance (cm)**	**Error %**
6.5	10	35
17.5	20	13
26	30	13

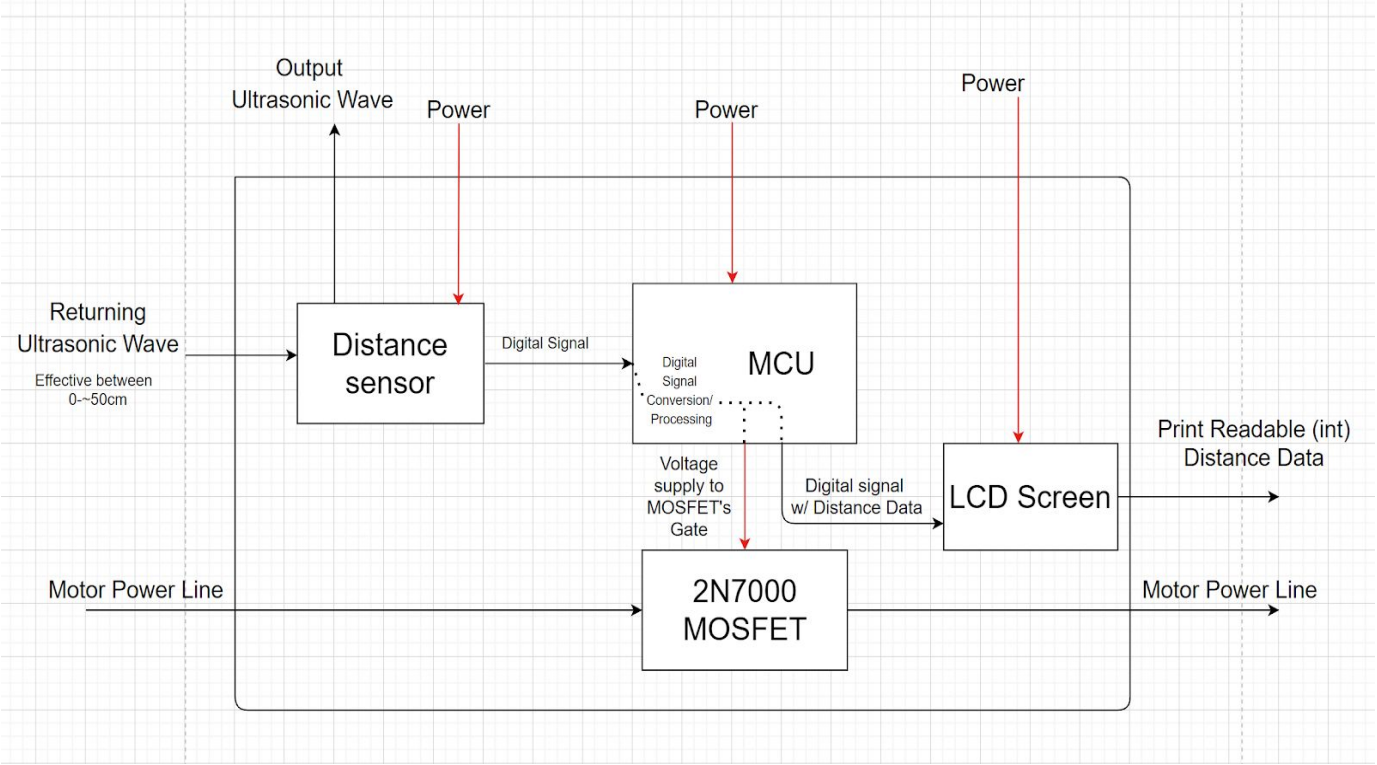
4.3.2: MOSFET 2N7000 Unit Test		
Applied voltage to the gate (V)	**Gate voltage measured (V)**	**LED attached to Drain (On/Off)**
5	4.94	On
0	0	Off

2.0 REFERENCE DOCUMENTS

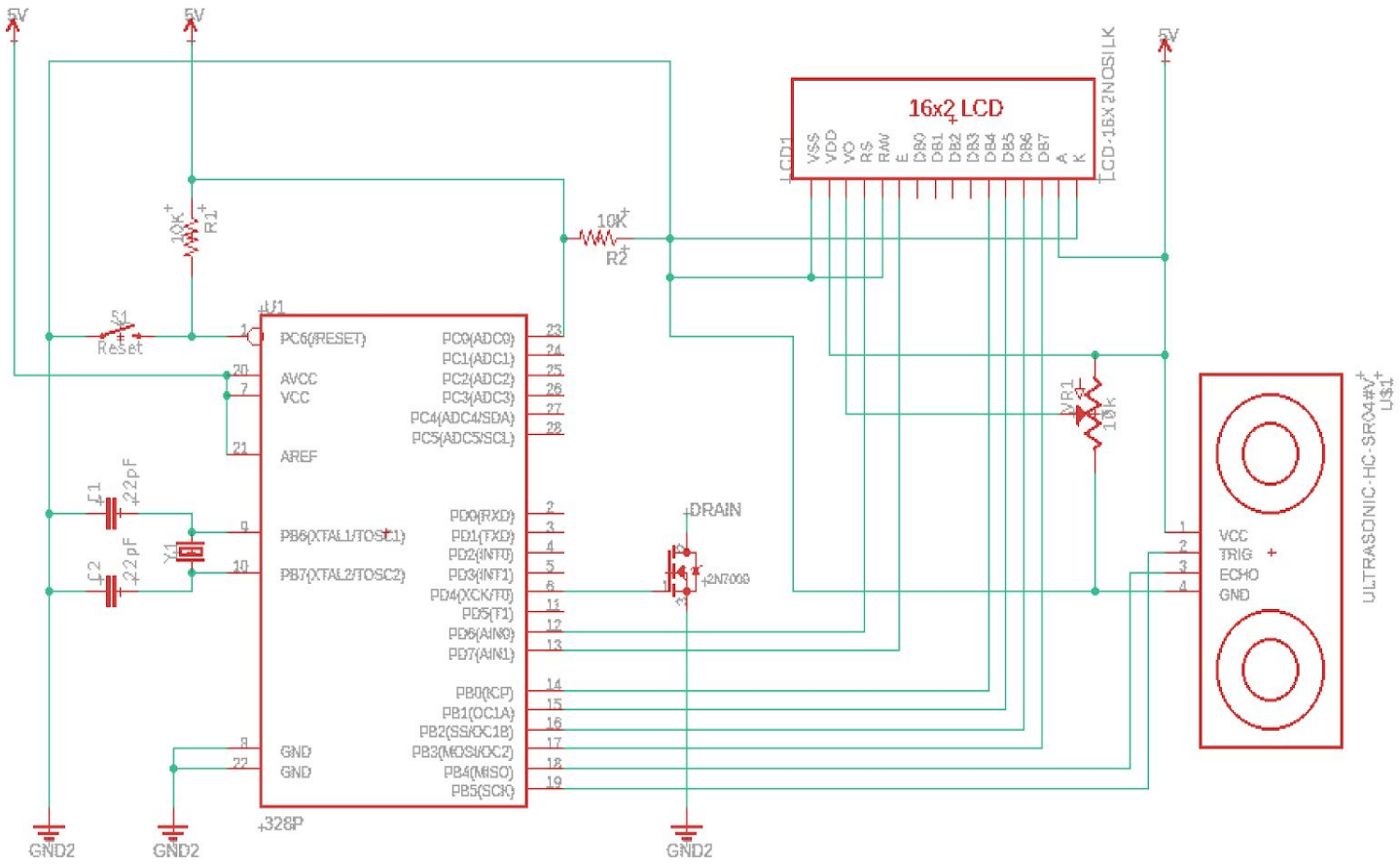
2.1 Design Documentation

- ABED design specifications
  - Will be as small as possible
  - Will be made in 2 weeks
  - Needs to be durable
  - Should use the minimum amount of materials possible
  - Waste kept to a minimum
  - Should have a readout of currently detected object distance
  - Must have the ability to detect a human-sized object reliably
  - Must be able to stop electromotive vehicle reliably in a safe distance

- ABED block diagram



➢ ABED wiring diagram



2.2 Resources

- ➢ One individual familiar with C/C++ and python programming
- ➢ One individual familiar with Arduino IDE
- ➢ One individual who knows how to work with a multimeter
- ➢ Arduino IDE
- ➢ 2N7000 MOSFET
- ➢ 5V power supply
- ➢ Arduino 1602 LCD
- ➢ Atmega328P Microcontroller
- ➢ HC-SR04 Arduino ultrasonic sensor
- ➢ Breadboard
- ➢ 2K-ohm resistor
- ➢ LED
- ➢ Female/male jumpers

3.0 PRETEST PREPARATION

3.1 Test equipment

- ➢ Measuring stick/tape
- ➢ Laptop/PC
- ➢ Masking tape
- ➢ Any type of Fluke Multimeter

3.2. Test Setup and Calibration

- Setup the test environment and ensure that all tools and equipment used for the test are reliable sources of measurements and data such that the resulting tests conducted are both accurate and meaningful.

4.0 SYSTEM TESTS

4.1 Functional checks

4.1.1 Ultrasonic sensor
4.1.2 LCD Display
4.1.3 MOSFET
4.1.4 Microcontroller

4.2 STRESS TESTING

- Such stress tests are crucial for understanding the boundaries and limitations of our components, modules, sub-systems, and project as a whole; Thus allowing us to use such data in current or future debugging/reworking situations.

4.2.1 Pulling more than 1A from Microcontroller GPIO #6 pin and observing shutdown signal behavior.

4.2.2 Testing boundaries of the HC-SR04 ultrasonic sensor by pushing the limits of range both on the near and far side.

4.3 UNIT/MODULE TESTING

4.3.1 HC - SR04 (ultrasonic sensor): Conduct module test to establish that the HC-SR04 performs its ultrasonic distance reading functionality to the desired and target specification(s); should be able to reliably measure the obstacle distance in the 5-10cm range while being accurate enough to work in an emergency system (within 5-10% error margin)

Test Writer: Navid Karami-chamgordani						
Test Case Name:	Ultrasonic Sensor Unit Test/Physical Matrix Test				**Test ID#:**	UltraSonic-UT-01
Description:	Check the sensor functionality to ensure it functions properly before & after installing it.				**Type**	black box (toggling inputs and comparing them to the expected outputs)
Tester Information:	Adam & Navid					
Name of Tester:	Adam				**Date:**	12/04/20
Hardware:	4.3.1: HC - SR04 (ultrasonic sensor)				**Time:**	12 PM
Setup:	Setup a measuring tape track for comparison of the digital reading from the sensor to its actual environment. Run the constant measurement loop program to continuously read distance measurements and repeatedly print them to the console log; with this program running in place, arrange various obstacles at every 5cm increment and compare the accuracy of the sensor readings to the expected obstacle distance					
Test	**Action**	**Expected Result**	**Pass**	**Fail**	**N/A**	**Comments**
1	Write a program that constantly measures the distance using the sensor and compare it to the physical measuring tape dist.	Program should be statically tested to verify accuracy of the sensor's readings; (for a successful system is comprised of properly functioning subsystems)	X			The reported distance was accurate but with some minor exceptions, for example at the 25cm obstacle, the program showed 24 cm. The error is deemed to be in acceptable range
2	Write a program that constantly measures the distance using the sensor. Measure a 30 cm long floor connected to a wall. Measure and place three markings each 10 cm apart. Compare the measured distance and the actual distance.	Program and sensor provide accurate measurements while vibration is involved due to robocar movements.	X			The actual distance compared to the reported distance from the ultrasonic sensor was within acceptable bounds of ~1cm as long as the obstacle and the car were on level ground. (uneven ground results in measuring distance above or below obstacle)

4.3.2 MOSFET 2N7000: Generate test to examine the reliability and consistency of our 2N7000 MOSFET such that it is reliable in its duty to regulate the flow of charge to the motors; This will be achieved by sending the high and low logic level signals to the MOSFET and recording it's actual voltage levels to ensure it's within an acceptable range for reliable connecting/disconnecting of the drain and source. This will ensure that the braking occurs only

when required and not randomly due to faulty voltage levels supplied to the base (and to avoid falling into metastability)

Test Writer: Navid Karami-chamgordani						
Test Case Name:		4.3.2: MOSFET 2N7000 Unit Test			**Test ID#:**	MOSFET-UT-01
Description:		Check the MOSFET functionality to ensure it functions properly before adding it to the ABED system.			**Type**	black box
Tester Information		Adam & Navid				
Name of Tester		Adam			**Date:**	12/05/20
Hardware		2N7000 MOSFET			**Time:**	2 PM
Setup		Place LED, 2K-ohm resistor, and MOSFET on breadboard. Apply 5V to breadboard's positive rail. Connect power supply ground to the breadboard's negative rail. Connect the LED cathode to MOSFET Drain. Connect the LED anode to one leg of a 2K resistor and connect the other leg of the resistor to 5V rail. Connect the MOSFET source to the ground rail of the breadboard. Apply 5V to the MOSFET's gate.				
Step	**Action**	**Expected Result**	**Pass**	**Fail**	**N/A**	**Comments**
1	Applying 5V to MOSFET gate and observing LED behavior connected to MOSFET Drain	MOSFET gate functioning properly by controlling current flow from source to drain	X			Gate voltage was 4.94 V and the LED turned on, indicating the current was flowing from source to drain.
2	Applying 0V to MOSFET gate (or connecting the gate to GND) and observing LED behavior connected to MOSFET Drain	MOSFET gate functioning properly by controlling current flow from source to drain	X			Gate voltage was 0 V and the LED turned off, indicating the current was not flowing from source to drain.

4.4 INTEGRATION TESTING

- At this point, our individual subsystems/subcomponents have undergone their specific unit tests to ensure each cog in the machine works individually and they have now been integrated into the larger subcomponents of the entire system. This consists of the integration of the HC-SR04, LCD screen, and MOSFET to the MCU but without the integration to the entire robot car as a whole; we will test that the major modules of the overall system operate/cooperate correctly together before incorporating any further specifics

4.4.1 The first integration test will consist of passing signals from the HC-SR04 sensor to the MCU to be handled in the software, and if needed, to make a change to the logic output level on the MOSFET

4.4.1.1 This test will be the heart of our system since it is what will ultimately be what controls the breaks of the low-speed vehicle

4.4.2 Consequent integration testing will consist of the relay of the HC-SR04's digital signal to the MCU, it's processing of the signal into readable data, and then the output of said data on the LCD screen. This will be an all inclusive test that tests the validity of the program by allowing the tester to check that the data being used in the decision matrix is being handled correctly internally

4.4.3 The final, and critical, integration test will be that of the MCU - MOSFET - Motor integration; This is imperative because it is this connection that turns data points into the life-saving product that ABED strives to be. This integration test will ensure that upon a change in the output logic signal from the MCU to the MOSFET the motors indeed to lose power/charge and result in a stopped vehicle

4.5 ACCEPTANCE TESTING

4.5.1 Team 'The Community' will conduct a panel meeting to discuss the implementation of the current design and perform a strict comparison between its findings and the original requirements specified for the design. In doing so, The Community will be able to assess how well ABED abides by the constraints and restrictions placed on the project; After the conclusion of the acceptance testing (i.e. meticulously comparing each and every traceable piece to the applicable constraints) ABED will be either deemed "acceptable" or not.