Memo

To: Professor Pisano

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Team: 10: Shazamboni

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Subject: First Prototype Test Report

1.0 Introduction

The first prototype testing for Team 10 was done on Tuesday, November 16, 2021. There were ultimately three tests that were planned and completed. The first test assessed the functionality of two ultrasonic sensors that will be used for the project. It was done by placing a flat object (i.e. a card) in front of each ultrasonic sensor. The object was moved so that the distance from each sensor varied. The measured distances from the sensors were then displayed on the monitor (in cm) while the actual distance was recorded by using a ruler.

The second test demonstrated the mobile application and its basic functionalities. The features that were shown were the ability to change to screens, buttons, and a joystick which displayed the angle and the distance of the joystick relative to the center.

The last test was done by showing that the smart car moved. Using the keyboard controls, the car was able to drive forwards, backwards, and steer. The camera was also able to move up, down, and side-to-side.

2.0 Equipment and Setup

2.1 Test I: Ultrasonic Sensor

The ultrasonic sensor used is model HC-SR04. Each sensor was configured into a breadboard along with 330 Ohm and 470 Ohm resistors. For this test, they were connected to the Raspberry Pi 2 Model B. Each sensor was connected to 4 pins on the Raspberry Pi: VCC, GRND, TRIG, and ECHO. The Pi was connected to the monitor to display the results of the measured distances. In terms of software, the python script used is on our Github named *ultrasonic_distance.py.* When conducting the tests for each sensor, a ruler was placed at the edge of the sensor. The equipment was properly set up according to the test plan.

2.2 Test II: ShazApp

The mobile application written in Dart using the Flutter framework is on our Github page. The simulation was run in IntelliJ and deployed to the Android device emulator. The application was up on the laptop and running before testing as the test plan stated.

2.3 Test III: Smart Car

The smart car used for testing came from the SunFounder Smart Video Car Kit V2.0. Along with a separate Raspberry Pi 4, the hardware includes two DC gear motors, Robot HATS, a PCA9685 PWM Driver, a Motor Driver Module, and two batteries. Prior to testing, it was already assembled by the team. Its software comes from the kit's Github repository. The code was used for testing purposes but will later be modified. After the car was assembled, the Raspberry Pi was connected to the monitor. The car was ready to be tested according to the test plan; however, the keyboard and mouse had to be connected from the previous Test I.

3.0 Measurements

3.1 Ultrasonic Sensor

The measurements recorded by the ultrasonic sensor and the actual distance measured by the ruler were recorded.

Object	**Expected Distance (Ruler) (cm)**	**Distance Calculated on Pi (cm)**	**Percent Error**
Ultrasonic Sensor #1	4	3.8	5.0%
	8	7.9	1.3%
	12	12.1	0.8%
Ultrasonic Sensor #2	4	4.1	2.5%
	8	8.0	0.0%
	12	11.9	0.8%

The hardware pinout as well as the usage and description are shown below.

Pi 2 Pin #	Usage/Description
18	Trigger/ Sends a sound wave for detection
24	Echo/Receives the sound wave back
2	Power/5V
6	GND/ The end of the loop

3.2 Shaz App

The objectives of the Shaz App were measured.

Description	Did it work? (y/n)
The simulator should be able to run successfully.	**Y**
The user should be able to switch between the two screens.	**Y**
The user should be able to move the joystick.	**Y**
Moving the joystick should display the degree and distance.	**Y**

3.3 Smart Car

The objectives of the smart car were measured.

Description	Did it work? (y/n)
The car can move forward.	**Y**
The car can move backward.	**Y**
The car can turn.	**Y**
The camera moves with the arrow keys.	**Y**

4.0 Conclusions

During our first prototype testing, we demonstrated the work we have completed thus far. First, our two ultrasonic sensors correctly determined distance up to a 5% margin of error. We will ultimately use the ultrasonic sensors to stop the ice resurfacer from impacting a wall or other objects. Next, the first iteration of our app was able to run all the basic options the user could pick from such as switching between two screens, moving a joystick, and displaying the degrees and distance which the zamboni moves. Future iterations will support live video streaming and Bluetooth/WiFi control. Finally, the smart car we built from the kit successfully moved in the directions we told it to move via keyboard and the kit's designed UI. In addition, the camera works via the arrow keys we clicked on. It will serve as a simple tool for us to further work on a prototype for control before we work on creating the actual zamboni. We will make modifications to the car so that we can understand how to connect the remote controls and the ultrasonic sensors together with our completed application.