Project Deliverable G

Prototype II and Customer Feedback

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Abstract

This deliverable is the improvements of the first prototype, which is based on the sketching and material list of the first prototype. Our last feedback and conclusion indicated that the power source should be improved in the future iterations. We had some problems with the last prototype, so the second prototype focused on the material assembly and the preparation of the coding part. We first used TinkerCad to design a prototype model and built a physical device using the materials we have received from the TA and shipments from Amazon. We have analyzed our prototype model and determined the parts where we need to enhance the design and to finalize the details.

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1. Introduction

In this deliverable, we are going to present our revised prototype, reflecting the feedback from the client during the meeting on November 10th. As we made a major design change during the last deliverable, we now have come up with a new detailed prototype plan. We have also revised our BOM list as some parts needed to be replaced. We have received most of the materials from the TA and the rest of the materials have been delivered. In this deliverable, we have built a physical model of our prototype and started working on the coding part using TinkerCad.

In this report, we have included our revised design plan as well as the prototype plan to successfully create a fully-functioning device that meets the client needs. The model that was created by TinkerCad and the coding used for the simulation are also attached.

2. Prototype II: Updates and Changes

There were no prototype plans in the last deliverable because we had a major design change, however, all circuitry other than the motion detectors and battery are complete. Since our method of detection is via motion, and alerting via sound, a prototype able to detect motion will and output sound will be developed in this deliverable. Motion detectors and the speaker are to be connected to the arduino board, then programme codes will be written for them. To test it, the speaker will sound if motion is detected, meaning the prototype passes the test. We will first test one installed detector by moving within a radius of 1 meter around it. Since this is the space within a car, the speaker should sound. If this is successful, a second detector would be installed, and the same test is to be conducted with the two detectors being separated by 1 meter. The speaker should sound even if only one detector detects motion. This is important for

large cars like minivans, where there will be blindspots at the front or back. Sensitivity of the detectors will be calibrated according to the motion tests. The distance of motion that triggers the sound indicates sensitivity calibrations. Testing could begin as soon as the required components and code are installed and written, starting November 10. Construction and tests will not take more than 3 days. This first prototype helps our team discover potential problems that will become the basis for future prototypes.

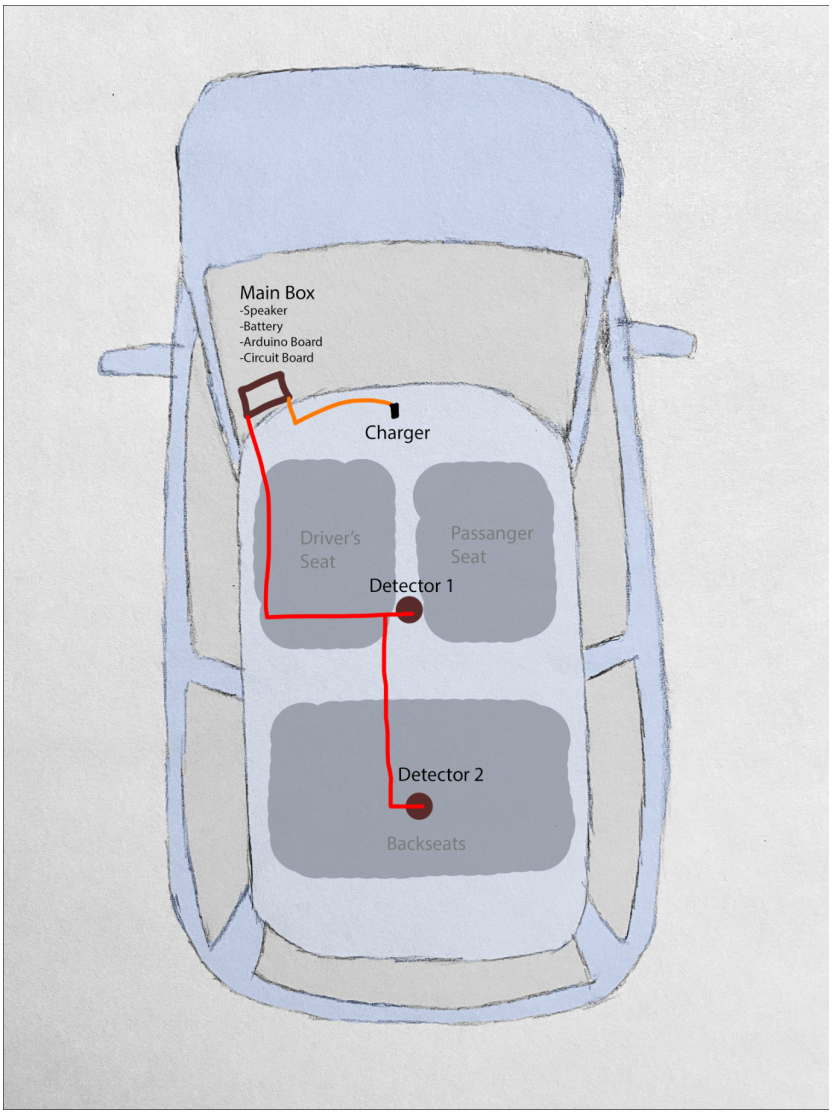

Figure 2-1. Revised Conceptual Design

2.1 Customer feedback

On November 10th, we presented our prototype to the customer and the professor. Since we had not built a physical model yet back then, we showed our design diagram and the TinkerCad design. We noticed that the professor and the client put much emphasis on the power source of the device as it is imperative to run the device even when the car engine is off. We explained that our device will be connected to a car charger so that it can run continuously. The client told us to make sure that the device is still functioning with the car charger. During our simulation of a physical device, we will make sure that the 3.8V battery and a car charger work as the energy source without error.

After consulting with my mother, she agrees with the general design, but has one concern; she asks “Does it keep beeping if I just sit in my car?” This is something we haven't thought of, and it was clear that we must include a killswitch to the main box.

Mohd said our design is good, and adding a visual aid like a blinking light will improve its effectiveness for alerting people nearby.

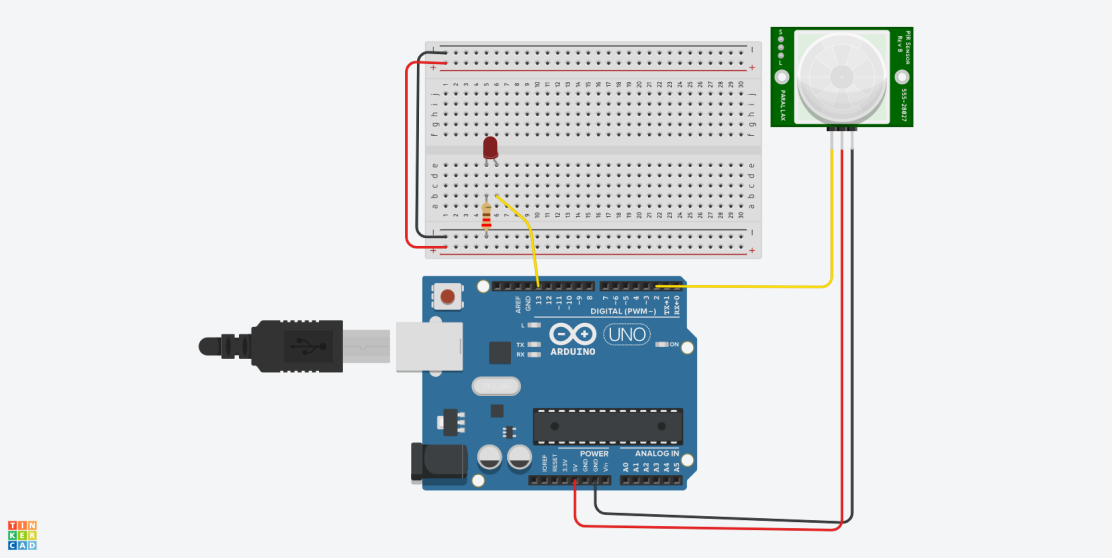

Figure 2-1-1.: Prototype Design with LED light

2.2 TinkerCad Simulation

We first decided to test with a simpler design to test the functionality and the coding. As can be seen in Figure 1, we first came up with a design that has a LED light and a motion detector. My sister gave us the feedback that the LED light is not strong enough to notify a driver or people passing by. Therefore, a light can be an additional source of an alerting system but should be accompanied by other devices.

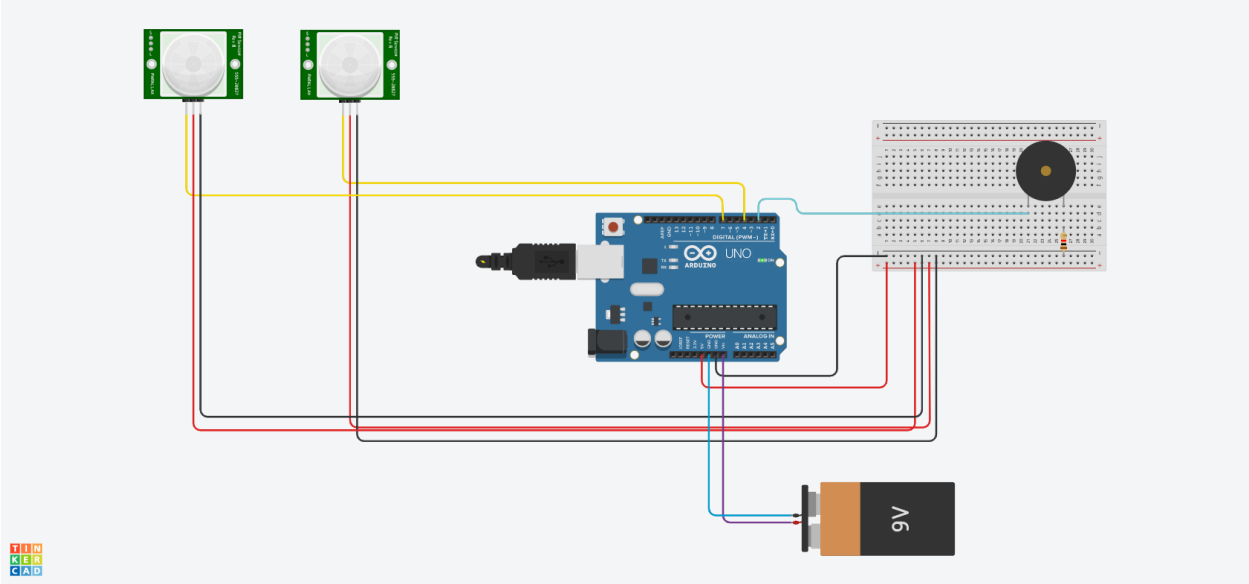

Figure 2-2-1.: Prototype II model created using TinkerCad

Note. A 9V battery was used instead of a 3.7V battery since there was not the same model on Tinkercad.

For the second design on TinkerCad, we set up the model as we have originally planned: two motion sensors and a speaker. Since the motion sensors will be installed one in the front and the other in the back, they should be separated by the breadboard and be connected using long jumper wires. Even though it is not shown in this design model, a car charger will be connected to the Arduino Uno and a 3.7V battery so that it is fully

functioning even after the car engine is off.

```
int state;
void setup()
{
pinMode(4, INPUT);
pinMode(7, INPUT);
pinMode(2, OUTPUT);
Serial.begin(9600);
}
void loop ()
{
  motiondetector1();
  motiondetector2();
}

void motiondetector1()
{
  if(digitalRead(4) == HIGH)
   {
     tone(2,700);
     delay(300);

    if (state==LOW)
   {
    Serial.println("Motion Detected");
    state=HIGH;
   }
   }
  else
   {
     noTone(2);
     if (state==HIGH)
  {
    Serial.println("Motion Stopped");
    state=LOW;
  }
   }
 }
```

Figure 2-2-2.: Coding part of Prototype II

```
38
39  void motiondetector2()
40  {
41    if(digitalRead(7) == HIGH)
42     {
43       tone(2,700);
44       delay(300);
45
46      if (state==LOW)
47     {
48      Serial.println("Motion Detected");
49      state=HIGH;
50     }
51     }
52    else
53     {
54       noTone(2);
55       if (state==HIGH)
56    {
57      Serial.println("Motion Stopped");
58      state=LOW;
59    }
60     }
61  }
```

Serial Monitor

Figure 2-2-3. Coding part of Prototype II

For the coding part, we took Arshiya Sharma's PIR sensor with buzzer model as a reference. Her model uses one motion sensor and one buzzer and we modified the design and coding to adhere to ours. we first declared the inputs and output using the void setup code. The motion detectors are inputs and they are connected to pin #4 and 7. The output is a speaker and is connected to pin #2. Then, we defined the loop functions. There are two loops since there are two inputs. We declared the void loops: the first one is "motiondetector1" and the second one is "motiondetector2." If either motion sensor detects "high" motion activity, the output (speaker) will sound at a volume of 700 and a delay of 300. Similarly, when the motion detectors senses a "low" level of motion activity, no sound will be played.

3. Testing and Analysis

3.1. Experimental Model

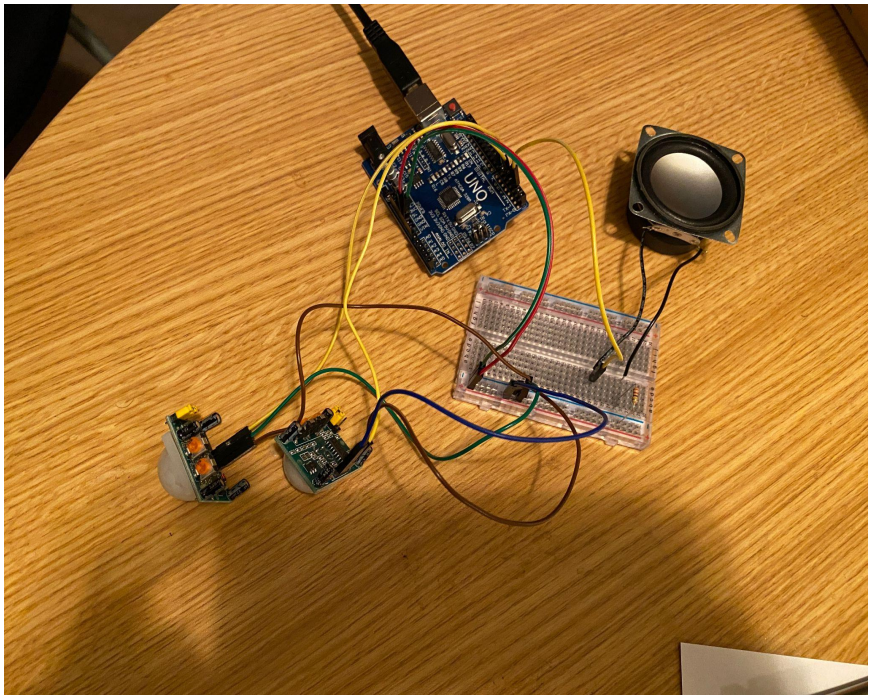

Figure 3-1-1.: Experimental Model

After developing a prototype design and running a simulation on TinkerCad, we built our first physical prototype. Two motion detectors and an alarm system were connected to the Arduino Uno and the coding was built using the Arduino app. We ran the simulation three times and noticed that the motion detectors are too sensitive. After discussing it with the TA, we will find a way to adjust the sensitivity of the motion sensors and modify the coding if we have

3.2. Testing

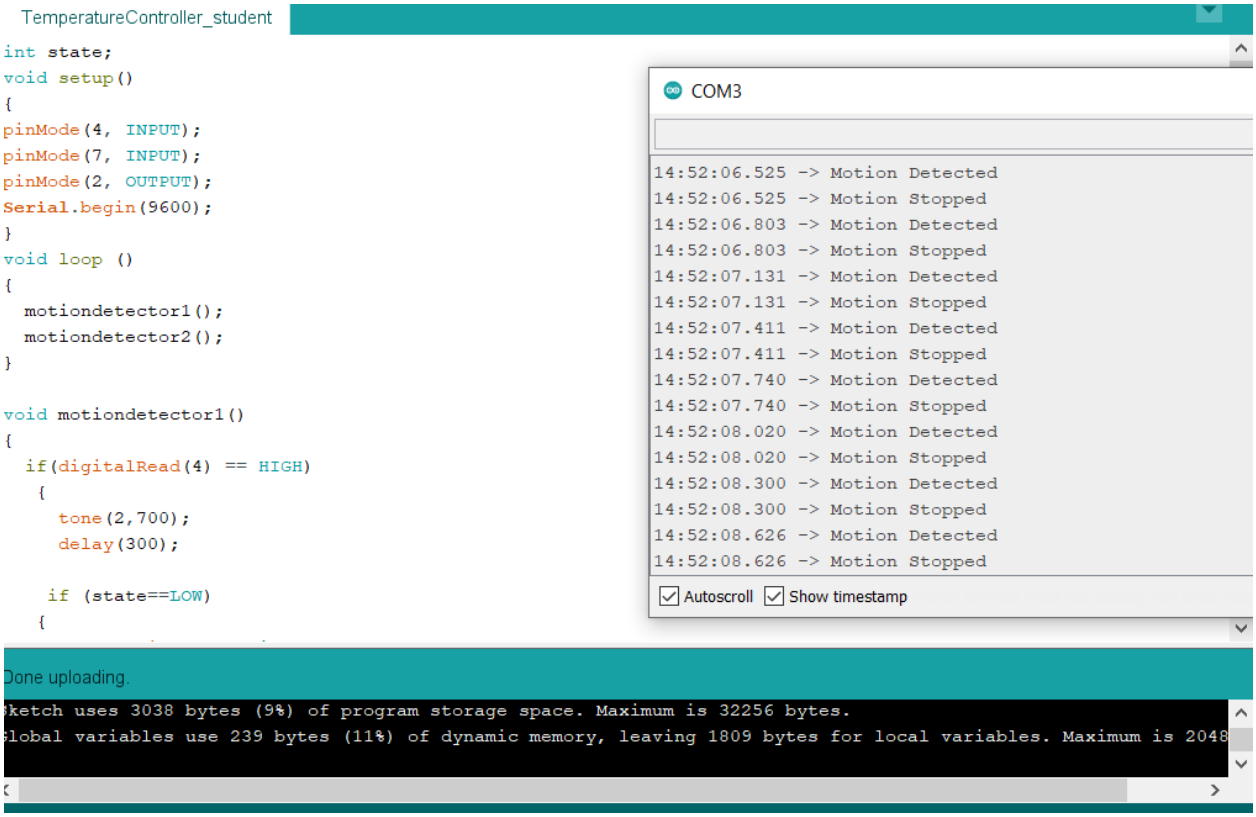

Figure 3-2-1.:Simulation Monitor

We tested the code after the material was assembled. The code works for the two motion sensors with the audio system. The tone of the speaker is 2,700, and the volume of delay is 300.

3.3. Analytical

After the material assembling and code testing. We are facing the problem with the motion sensor, it is too sensitive to detect, when we run the code, the motion sensor keeps detecting the motion and activating the speaker. We will discuss that problem with TA in the next zoom meeting and figure it out.

4. Target Specification and Design Details

4.1. Target Specification

The target of our design is to notify the people in the car or the driver to prevent the "Hot Car" issue. When the car engine is turned off, our device is activated, our motion sensor starts scanning the front and back seats to check if someone is left in the car. And if so, the motion sensor will activate the speaker to alarm the driver or the passenger.

4.2. Design Detail

Firstly, our device will connect with the car charge to ensure the power supply, which is connected by Arduino cable USB Type A-B. And the case will be stabled in the middle of the right-top side of the car, therefore one motion sensor is pointing to the front passenger seat and another one is pointing to the back seats, which can scan the entire car, and the speaker will also be placed in the case. There will be grooves inside the case to ensure the device's stability, and we will use velcro to stabilize the case. The speaker will also be placed in the case.

4.3. BOM Chart

Name	Links	Unit Price	Tax	Total per item	Quanity	Total before tax	shipping	Total after shipping
Motion sensor	link	$10.99	$2.08	$10.99	2	$21.98	0	$24.07
Speaker	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Car charger	link	$15.29	$2.53	$15.29	1	$15.29	0	$17.82
Electrical Wire	link	$9.98	$2.70	$9.98	2	$19.96	0	$22.66
Arduino Board	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
breadboard	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Jumper wires	From GNG lab	$0.00	$0.00	$0.00	20	$0.00	0	$0.00
Resistors	From GNG lab	$0.00	$0.00	$0.00	15	$0.00	0	$0.00
Battery	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Male to Male header pin	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Arduino Cable USB Type A-B	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Protoboard	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Total		$36.26	$7.31	$36.26		$57.23		$64.54

Figure 4-3-1.: BOM Chart

This is the revised BOM Chart of our device, and the total cost is $64.54. We have added Male to Male header pin, Arduino Cable USB Type A-B and a Protoboard. We have ordered and received three materials from Amazon.

5. Test Plan

To successfully complete all the prototypes and to create a final device, we have come up with a detailed test plan. Our goal is to finalize the details of coding and design parts by November 16th. Since two presentations are scheduled on November 25th and December 1st, our plan is to finish the testing by November 23rd. After the final prototype is built, we are going to define a stopping criteria which will allow us to end the testing phase. Then, we will run the simulation at least four times to check that it runs without error. We are going to get feedback from our family, friends and the TA and will reflect them by November 24th.

Table 5-1.: Test Plan Chart

Test ID	Test Objective	Description of Prototype used and of Basic Test method	Description of Results to be recorded and how these results will be used	Duration (Days)	Start Date
1	Motion Sensor	Prototyped in tinkercad, tested using simulation mode, proven with physical model	Should initiate sound for speaker	2	Nov 12
2	Speaker	Prototyped in tinkercad, tested using simulation mode, proven with physical model	Sound should play when initiated by detector	2	Nov 12
3	Motion Sensor	Motion sensor sensitivity adjustment	Motion sensor needs to be less sensitive	2	Nov 13
4	Prototype II assembly	Building of a physical prototype II	Building and testing the coding	3	Nov 13

5	Powering speaker and sensor with battery	Connecting it to a 3.7 V battery to a device	The battery will play a significant role in running a device when the car engine is off	2	Nov 13
6	LED light	Discussing whether to include a LED light as an additional source of an alerting system	We will discuss it with the TA and figure out if it would be helpful to install the LED light. If it is, we are going to add an additional coding to the existing one	1	Nov 15
7	Differentiate between battery power and car power	We need to figure out if there is a code that will start our device when the car engine turns off	The coding will be used to run the device even after the car engine is off. Also, the battery will provide power for the device.	3	Nov 15
8	Kill switch	Checking if the kill switch works on the Arduino Uno	The drivers should be able to turn off the device when it's not used	2	Nov 15
9	Coding	Validating the coding and simulation	The finalized coding will be used to run the device. The details such as the volume of the alarm and the sensitivity need to be adjusted.	3	Nov 15
10	Case	Building of an Arduino Uno case using laser cutting. Arranging an appointment to use a laser cutter	A case should be big enough to hold arduino uno, speaker and a motion sensor	4	Nov 16
11	Aesthetics	Checking the physical appearance of the device	Finalizing the aesthetic designs	1	Nov 17
12	Assembly	Assembling all parts in the case we built	We should check if all the device fits in a case perfectly	1	Nov 19

13	Installation	Installing the final device in the car using magnetic tape	We need to check if the magnetic tape is strong enough to hold the device	1	Nov 20
14	Analyzing	Analyzing the critical subsystems	This step is essential in reducing the risk and uncertainty and also important for system integration. Ex) motion sensitivity, alerting system verification	2	Nov 20
15	Stopping criteria	Discussing a stopping criteria which will allow us to end the testing	We will determine what criteria should be defined for us to stop the testing. For example, the simulation should run four consecutive times without any errors while fulfilling the details we have determined	1	Nov 22
16	Simulation	Simulating the final device at least four times	After each simulation, we are going to record any unusual activities	2	Nov 22
17	Feedback	Getting feedback from our family and friends and modifying the details. We also contact the TA to check the details	The feedback will be used to finalize the details of our final solution..	2	Nov 22
18	Reflecting the feedback	We check if there is any parts we need to modify	We reflect the feedback on our prototype and make minor changes and finalize the details	2	Nov 23

6. Testing Results and Analysis

Although this is our first official prototype, we tested both critical components of the design, the motion sensors and speaker. With this complete, we can integrate a battery and charger for our next prototype. The completion of this prototype unveils new challenges as well. For example, how the sensors will know whether it's being powered by a battery or by the car. In the future, these challenges will become the basis for our prototypes.

7. Conclusion

In conclusion, the material assembling and the coding part of our group project are finished. We know that we are running late than other groups, and we still have the problem with the device and casing part, but the problems will be solved after the zoom meeting with TA. The time is running off, and we will hurry up and finish the project before the due time.

8. Reference

1. Sharma, Arshiya. “PIR Sensor with buzzer- for motion detection(burglar alarm).” *TinkerCad*, https://www.tinkercad.com/things/aYbFDGd1A4p-copy-of-pir-sensor-with-buzzer-for-motion-detectionburglar-alarm.