University of Ottawa

GNG 1103[B]: Group 19

Deliverable F – Prototype I and Customer Feedback

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Abstract

In this deliverable we discuss our prototype I and the analysis of how prototype testing has gone. After the deliverable analysis is completed a bill of materials must be made and prototype II test plan is made.

1. Prototype I Test Plan

1.1. Why

1.1.1. Sensor Module

This module will include two different sensors. One for temperature, and one for detecting gas. It is very important for this module to be highly reliable and responsive. This module is required to detect dangerous environments.

1.1.2. Driver Seat Sensor

This sensor will determine whether there is a guardian present in the vehicle. It is critical that the system can detect whether someone is present consistently as alerting with someone present completely defeats the purpose of the product

1.1.3. Seat Belt Sensor

This sensor will determine whether there is a child present in the backseat of the vehicle. It is critical that we can detect whether there is a need for the system to be live because without a child present it can be extremely annoying to receive the notifications unnecessarily.

1.1.4. Buzzer Housing

This housing will be designed to secure the buzzer onto the vehicle. The housing must be able to allow sound to escape, while also protecting the buzzer from various environmental elements.

1.1.5. Arduino Container

The container will encase an Arduino Uno, as well as batteries to power the Arduino and 4 leds to show battery level. It is essential to be keep the arduino protected from the environment and also be accessible to replace batteries or charge them.

1.1.6. Application

The function of this application is to notify the car owner, or the car owner's family, in time when a timely situation occurs. It can avoid many situations that endanger the life of the child.

1.2. What

1.2.1. Sensor Module

The sensor module consists of two sensors, one for temperature and one for detecting dangerous gases. This module will house both sensors and must be placed inside the cabin of the vehicle. The data received from this module will be analyzed by code and the environment will be determined to be either safe or unsafe.

1.2.2. Driver Seat Sensor

The Sensor is essentially a switch that can detect when someone is sitting on the pad. It is two pieces of material with a conductive sheet on the inside of the top and bottom. When no one is on the pad the two conductive sheets do not touch, however, when someone sits on it the conductive sheets

will finish the circuit and sending a signal to the device. The test that will be conducted has two simple metrics, The sensor will return to a non finished circuit after it is sat on and when it is sat on a current will flow through it.

1.2.3. Seat Belt Sensor

The Sensor is a switch that can detect when a child is present in the vehicle. There is a buckle with a conductive rod going through the middle on the male end. this rod connects to the female buckle finishing the circuit. When no one is buckled in the two conductive pieces do not touch, however, when someone buckles the child is buckled in it will finish the circuit and sending a signal to the device. The test that will be conducted has one simple metrics; The sensor has a consistent current running through the system when buckled together.

1.2.4. Buzzer Housing

This housing will be 3D modelled and printed to protect the buzzer from damage. The housing will be black in colour and small, which means it will be hard to notice in vehicle. Sound will be allowed to escape from the housing without impacting the volume of the buzzer.

1.2.5. Arduino Container

This is a box that holds the Arduino Uno and batteries. It will be made of plastic, with Leds on the front of it to display battery life. There will be 2 ports on top for cord access. The lid will be removable, to service or replace the batteries. There will be screws around the top of the lid to hold it down and make sure it doesn't fall out if in case is tossed around.

1.2.6. Application

This application can be used for noticing the car owners. In order to build this application successfully it needs an Arduino Uno module, GSM module, SIM card, DHT module, and a few wires. Then use those wires to connect them together in order to make the DHT module works. After that, we can connect the whole system with our phone, and then it can send messages to our mobile phone when the temperature is too high or too low.

1.3. How / When

1.3.1. Sensor Module

The test will be conducted on Nov 4th and will consist of opinions of others and keeping track of what others have said about the component

1.3.2. Driver Seat Sensor

This will be tested with a simple circuit testing whether the displacement of the pad after being pushed is extremely similar or equal to before. The last part is connecting the circuit to the pad and determining whether a current will flow cleanly through the pad, tested with a light. This will be done on Wednesday Nov 4th.

1.3.3. Seat Belt Sensor

The testing of the connection of the circuit to the buckles and determining whether a current will flow cleanly through the buckle, tested with a light. This will be done on Wednesday Nov 4th.

1.3.4. Buzzer Housing

The test will be conducted on Nov 4th and will consist of opinions of others and keeping track of what others have said about the component

1.3.5. Arduino Container

A prototype box was made from cardboard for size reference purposes. Everything fit properly so dimensions for the container are good. The battery Leds were tested in Tinker CAD using a potentiometer.

1.3.6. Application

The application will be test with a thermometer to check whether the DHT temperature measurement module can work or if it is accurate.

2. Key Concepts

2.1. Microcontrollers

Microcontrollers are small computers that store codes and executes those codes using outside hardware. They are key components to any complex circuit. The main microcontrollers used are the UNO R3 style controller.

3. Prototype I Components & Analysis

The components of this prototype are:

- Driver Seat Sensor
- Seat Belt Sensor
- Arduino Housing
- Circuit Diagram/simulation
- Sensor Housing
- Buzzer Housing

Along with each component that we have tested, there is also a general circuit that we have came up with. This circuit has a few components that have had to be omitted due to the lack of options with the software. It was done in Tinker CAD is kin to figure 1.

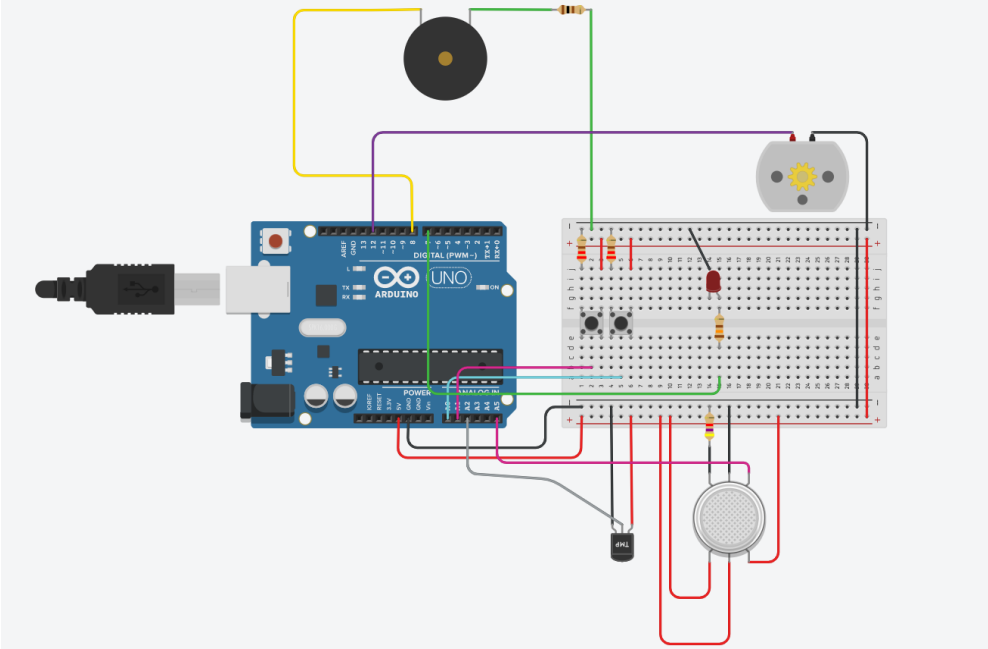

Figure 1: Tinker CAD Circuit

The circuit is missing the microphone sensor. The Button attached to A2 is the Seatbelt and The A1 is the Driver Pad. When the Seatbelt is pressed and the Driver Pad is not pressed the buzzer begins to go off with long intervals between buzzes. As the conditions progressively gat worse and worse the delay between buzzes becomes less and less. When the conditions become a dangerous level the DC motor begins to spin. Along with the Fan, the light (which represents the light strip) begins to blink.

The first component that was tested was the Driver Seat Sensor, this was done with very ideal outcomes. One of the first tests done with the Driver Seat Pad was the displacement of the pad after it is sat on. A differing mass was placed on the pad and the total displacement was measured through the distance between the two sheets before and after the contraption was sat on. This table shows the outcome of these tests.

Table 1: Driver Pad Displacement

Attempt #	Initial Distance (cm)	Final Distance (cm)	Displacement (cm)
1	3	3	0
2	3	2.9	0.1
3	2.9	2.9	0
4	2.9	2.9	0
5	2.9	2.9	0

This analysis clearly shows that overall, the displacement is negligible and the likely of it increasing overtime is low. With these in mind it is safe to say that this sensor will be reliable in maintaining an incomplete circuit when it is not compressed. The second round of testing is a very simple form of testing where a simple circuit is made. Figure 2 shows clearly that when the pad is not

being pressed there is no current being passed through. Figure 3 shows that when there is pressure being applied to the pad there is a current being passed through it.

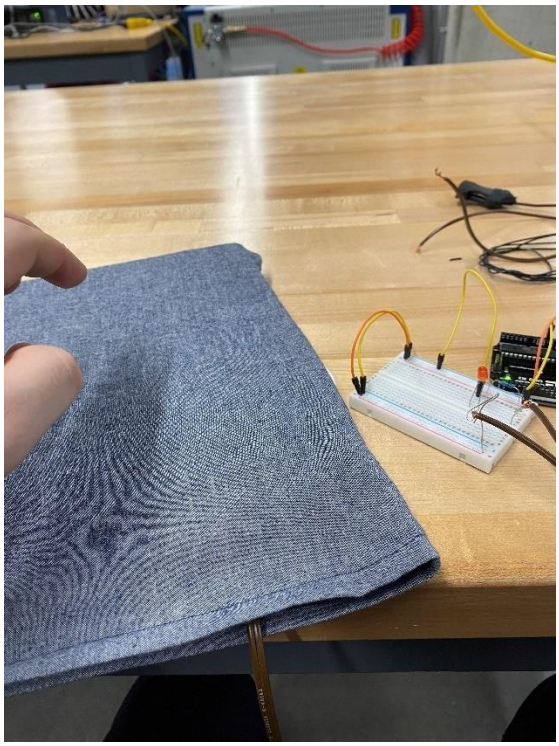

Figure 2: Driver Pad decompressed

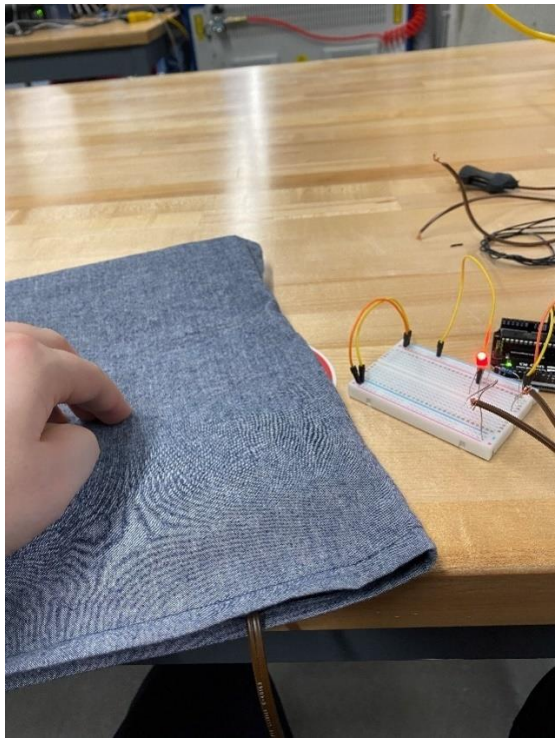

Figure 3: Driver Pad compression

The driver seat is so crucial because it is the switch that determines the whether the system will be live or not. This will remove the need for the system to be active while the guardian is present. This will remove annoyance. Realistically the Driver Seat sensor is in a high-level stage and has exceeded testing expectations. Similarly, the Seat Belt Sensor is also performing very strongly.

The Seat Belt Sensor is critical as it directly relates to the goal of our product. The goal is saving/helping a child trapped inside a vehicle during dangerous situations. The test for this component of our prototype also has a very simple testing method. The testing method is if it will achieve a circuit when the buckle is clicked in. As shown in both figures 2 and 3 there is clearly no circuit being sent through the buckle while it is not clicked, however, when it is clicked together the light turns on, showing a completed circuit. Figure 4 is showing the completed circuit and Figure 5 is the uncompleted circuit.

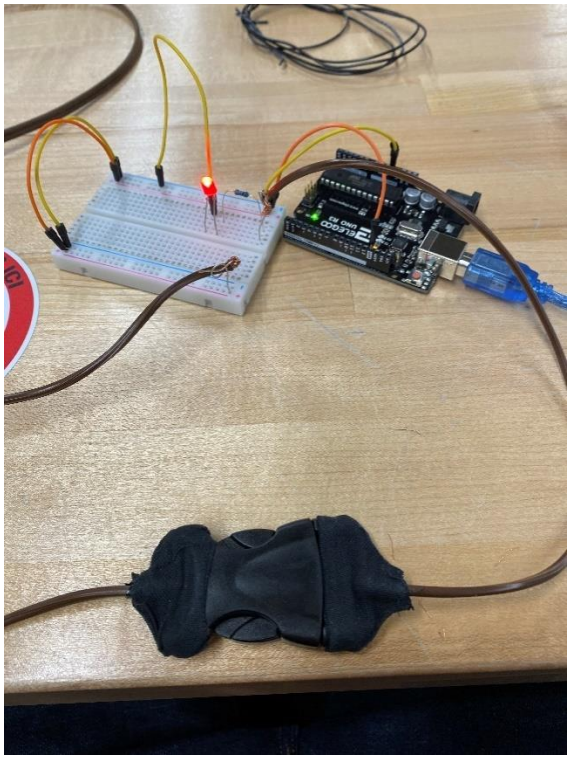

Figure 4: Clipped Buckle Sensor

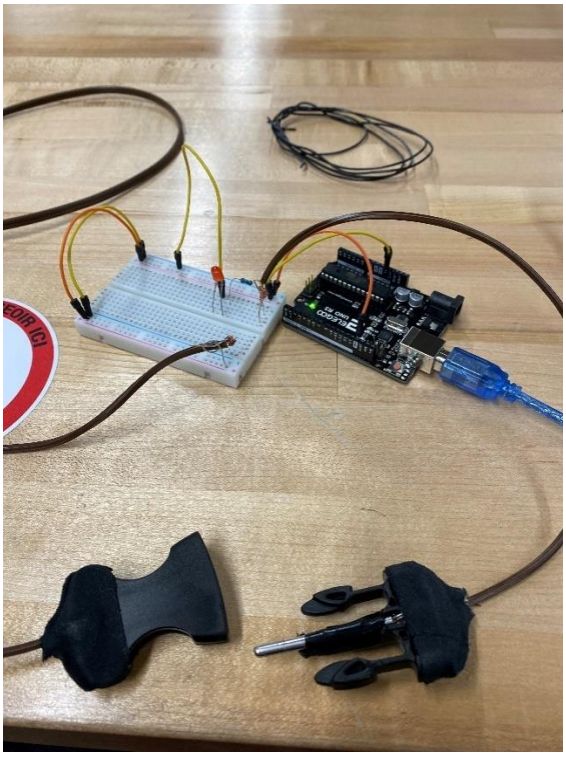

Figure 5: Unclipped Buckle Sensor

The Seat Belt sensor is just as crucial to the system's success, as without this sensor it would be difficult to tell whether a child is present in the vehicle to begin with. This is the proverbial on switch for the system and without it there is difficulty to determine presence of a child.

Figure 6: Arduino Container Top View

Figure 7: Arduino Container Side View

It is also important the Arduino is protected from the environment and be safe to make the product last. The prototype container was made from cardboard, and everything fits as it should. The container

was shown to the group members and a few friends to get their feedback, and most of their feedback was that it looks great.

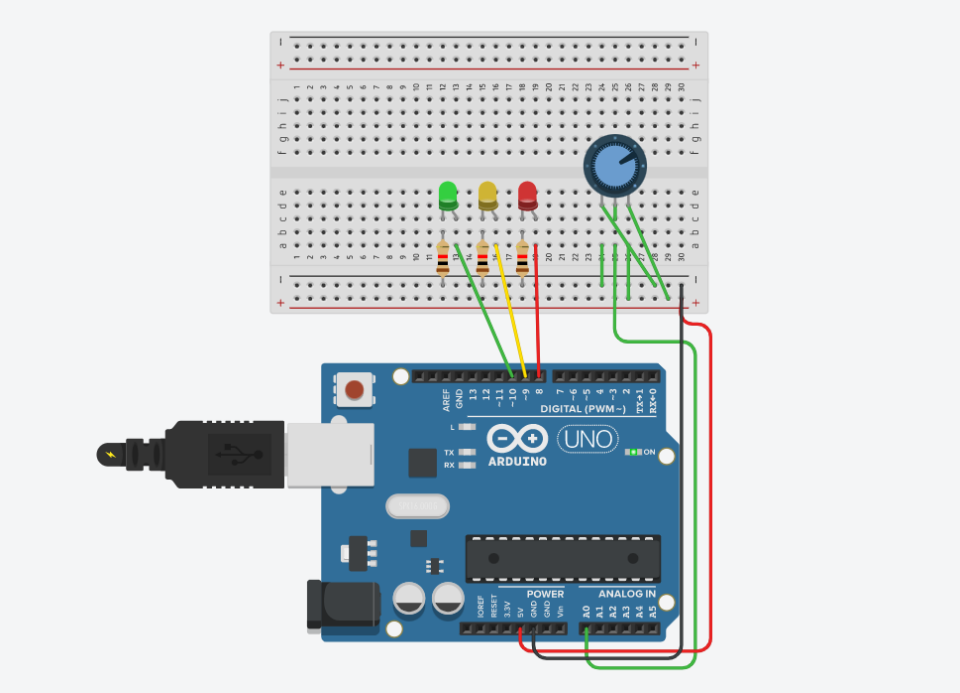

Figure 8: Tinker CAD Circuit (Battery Full)

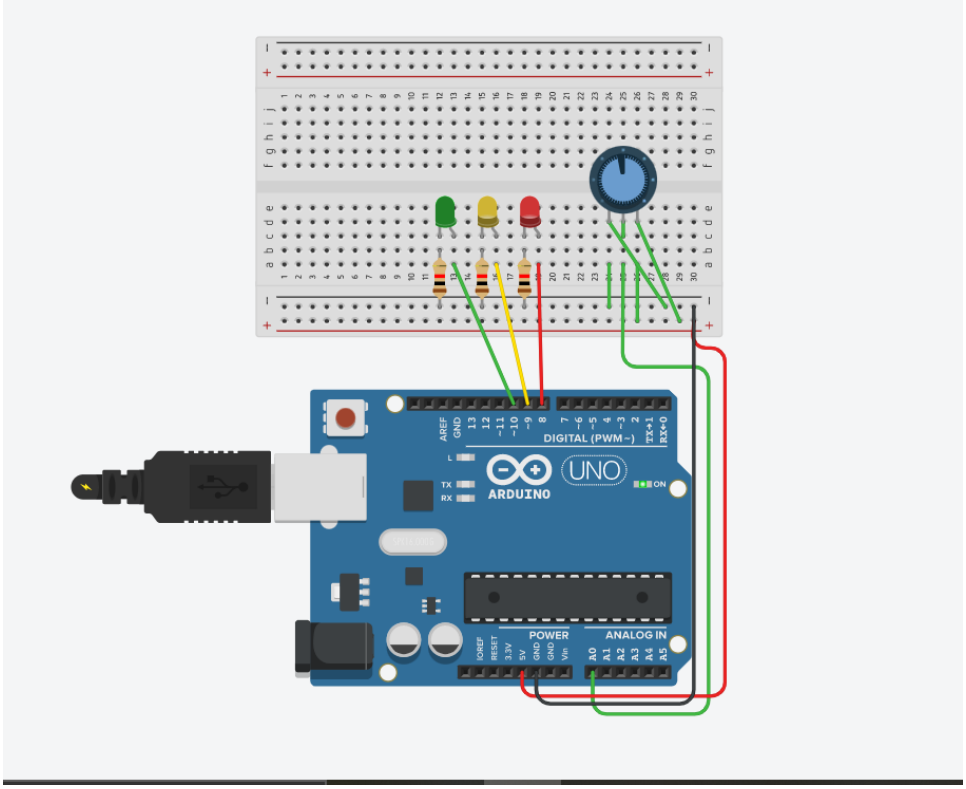

Figure 9: Tinker CAD Circuit (Battery Half)

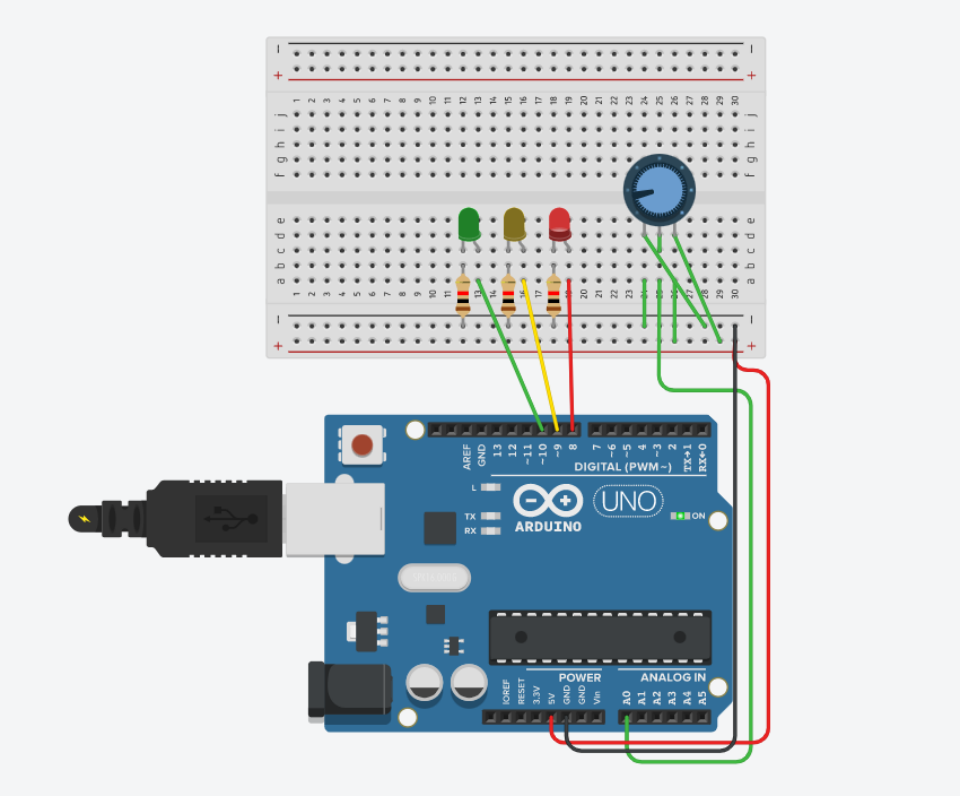

Figure 10: Tinker CAD Circuit (Battery Low)

The Arduino case will also display battery life from Leds. A Tinker CAD circuit was made for the testing of the battery level display. When all 4 Leds are on, green, yellow and red, the battery is full. As the battery level starts to drop, which was tested by a 250-ohm potentiometer, the green led gets dimmer, and when the battery level is at 50% the green led turns completely off. From 50% to 10% the yellow Led gets dimmer and turns off. The red led is when the battery level is under 10%, and when it's off the battery is dead.

For the notification system we need to use Arduino module, GSM module, temperature sensor and SIM card. And the whole system will be similar to add the pictures together. (Because I didn't find the GSM module in tinkercad) In this system the temperature sensor is used to test the environment and the GSM module is used for placing the SIM card.

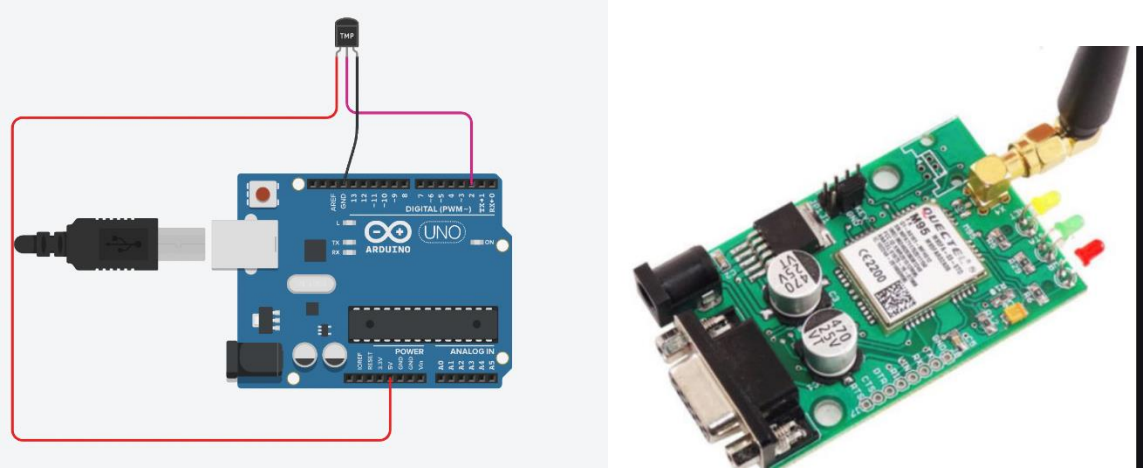

Figure 11: Application system

4. Customer Feedback

During our meeting, we were given the opportunity to present our designs and receive feedback from the customer. During the meeting, it was brought to our attention by the client that an SMS system would not be the desired alert system as many people do not check messages regularly. The client also mentioned that we could incorporate a new module into our design which could break or open windows in case of unsafe conditions. Feedback received from the client was limited as the meeting time was short, and time for discussion was minimal.

5. Updated BOM

Owing to the limited budget, we need to spend money prudently and cautiously. Thus, we have listed a potential costs table below.

Part#	Part Name	Description	Cost ($)
1	Humidity/Temperature sensor (DHT22)	Link	9.99$
2	Gas Sensor (MQ-6)	Link	6.50$
3	Microphone amplifier (3.7W ClassD)	Link	8.00$
4	Buzzer (Active)	Link	2.00$
5	Auxiliary Fan	Link	6.00$
6	Elegoo - Micro control.	N/A	0.00$
7	9V connection cord	Link	1.30$
8	Velcro	Link	0.11$
9	9V Battery	Link	0.00$
10	LEDs x 4	Link	1.20$
11	5V LED strips	Link	5.00$
12	Thunkable	Link	0.00$
13	Laser Cutting	N/A	0.00$
14	3-D printing	N/A	0.00$
15	Wiring x2	Link	5.00$*

16	Double sided adhesive	N/A	0.00$
18	Wood	N/A (Leftovers)	0.00$
19	Filaments	N/A (Leftovers)	0.00$
20	Zipties x4	Link	2.36$
21	Resistors x5	Link	0.50$
Total			**48.40$**

5.1. Equipment List

Part	Description
Protoboard	Wiring block used to centralize circuits
Multimeter	Use to measure electronic components of the system
3-D printer	This machine will be used to make the case for the sensor and possibly other things
Laser Cutter	This is a machine that will be used to cut out the pieces for our cases to the Arduino
Soldering/solder	Used to connect wiring between sensors and
Jumperwires	Used to make non permanent connections during the prototyping stage
ThinkerCad	Used to virtually create circuits before physical production begins
DHT lib	Library for the DHT 22 sensor
MQ-6 lib	Library for the MQ-6 sensor
Class D lib	Library for Class D microphone Amplifier

6. Planning for Prototype II

6.1. Why

6.1.1. Physical circuit/code

For sensing change in temperature and air.

6.1.2. Sensor Housing

To keep the sensors protected and accurate

6.1.3. Driver Seat Sensor

To make sure if there is a guardian in the vehicle.

6.1.4. Seat Belt Sensor

To determine if there are children in the back seat of the vehicle.

6.1.5. Application (Notifications)

There is no GMS module in Tinkercad and no suitable module can be found to replace it.

6.1.6. Arduino Container

Finally, we should add those controller inside the box.

6.2. What

6.2.1. Physical circuit/code

Controls the environment with given parameters, and with the help of the other components. Motherboard of the whole system.

6.2.2. Sensor Housing

To contain the sensors in safe location.

6.2.3. Driver Seat Sensor

Connect the circuit with the pad.

6.2.4. Seat Belt Sensor

Connect the circuit with the buckle.

6.2.5. Application (Notifications)

Find the GSM module successfully and use it to finish creating the whole notification system.

6.2.6. Arduino Container

Try to put some system or module into this container and make sure they are work.

6.3. When/How

6.3.1. Physical circuit/code

Check if the circuit is giving correct outputs, by varying the temperature and air based on the set parameters and testing with the other sensors to make sure it's in sync.

6.3.2. Sensor Housing

Check if the sensors fit in properly, and are able to read their values accurately.

6.3.3. Driver Seat Sensor

Use a small light to detect whether the current can effectively pass through the circuit after the circuit is connected to the pad.

6.3.4. Seat Belt Sensor

Use a light to test the connection between the circuit and the buckle and determine whether the current can flow through the buckle smoothly.

6.3.5. Application (Notifications)

To look up some alternatives online or try to find and use the GSM module in reality.

6.3.6. Arduino Container

Check if all dimensions fit properly, and is able to house an Arduino UNO and a 9V battery properly. Make sure the battery display Leds function as desired.

7. Wrike URL

https://www.wrike.com/workspace.htm?acc=4975842&wr=20#path=folder&id=758826352&vid=47240218