Design Project User and Product Manual

Cool My Car

GNG 1103: Engineering Design

Submitted by:

Cool My Car, Group 8

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December 8, 2021
University of Ottawa

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1.0 INTRODUCTION

This User and Product Manual (UPM) provides the information necessary for owners of a CoolMyCar to effectively use the system and for prototype documentation.

The device is designed to reduce the thousands of preventable hot car deaths that happen every year, our team set out with that goal in mind and created the CoolMyCar. The following document will cover everything you need upon purchase of the CoolMyCar, the next section will give a basic overview, followed by the general set-up process, features, troubleshooting, and the product documentation. The purpose of this UPM is to make sure that every customer understands how to properly use the CoolMyCar system so we can do our part to keep everyone safe.

This product is intended for drivers, we are not responsible for injury or death, never leave your children or pets unattended regardless of the CoolMyCar system being installed on your vehicle.

2.0 OVERVIEW

Every year thousands of preventable deaths of children or pets left unattended in an overheating vehicle, these deaths however are completely preventable with the CoolMyCar system, if for any reason when installed properly into a vehicle, the system detects a child or pet in the vehicle the driver or anyone connected through the app will receive a notification before anything dangerous can occur.

Our product will not only monitor vehicle temperature and notify the user, it comes equipped with a fan to attempt to cool the vehicle before help arrives. Our product uses both weight and motion sensors to reliably detect and distinguish if what is left in the vehicle is in fact a child or pet and not luggage left on the seat to prevent any false alarms.

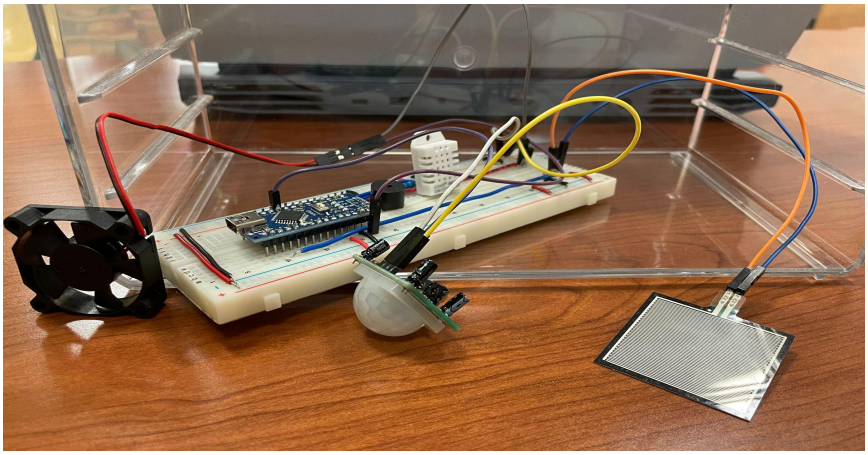


Figure 1: Final Prototype

As stated above our system comes equipped with 3 sensors, a fan, and a speaker to reliably detect a child or pet in the vehicle, monitor the internal temperature of the vehicle, a fan to cool the vehicle while help arrives, and a speaker to alert any possible people in the area.

Our system uses a microcontroller to interpret data gathered from the sensors, and using a wifi module to notify the user through SMS messaging on our app, the system is designed to be installed in a car and is not intended for use anywhere other than a car.

2.1 Cautions & Warnings

Caution read carefully: The CoolMyCar system and team is not responsible for possible injury or death while the system is installed. The CoolMyCar is not an excuse to leave children or pets unattended, it is designed to prevent accidental deaths in overheating vehicles.

3.0 GETTING STARTED

The device is comprised of:

- Arduino Nano
- Wifi module
- Temperature sensor
- Motion sensor
- Pressure sensor
- Speaker

The Arduino Nano is a physical programmable circuit board that will run all the necessary instructions to receive inputs and produce the necessary outputs to the connected sensors. The wifi module allows the Arduino board to connect to an external app, thus being able to send emergency alerts. The temperature sensor will monitor the conditions inside the vehicle, the motion and pressure sensors will detect if a child is unattended inside a vehicle and if necessary the speaker will alert the people in close proximity to the vehicle.

The necessary software to detect if a child is left unattended in a hot vehicle is already preloaded in the Arduino.

Setup Walkthrough:

1. Connect the Arduino Nano with the batteries, as shown in the image below:

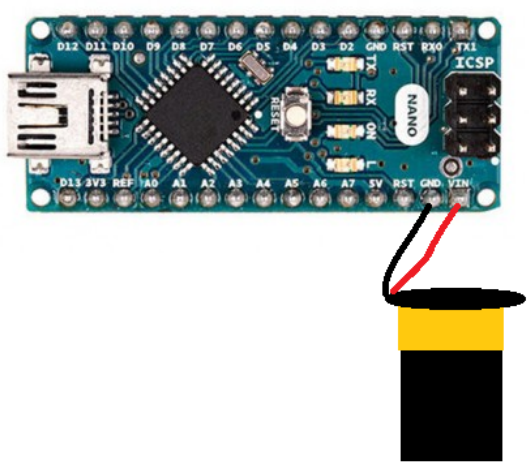


Figure 2: Arduino Nano connected to GND and VIN to battery supply

2. Now you should see a small LED blinking indicating that the system is ready to go.
3. Using the provided wires and adhesive pads install the motion and pressure sensors as shown in the diagram.

Figure 3: Motion Sensor above child seat and pressure sensor beneath child seat.

4. On the Cool My Car app select pair Arduino device through Wi-Fi.
5. Verify that the temperature readings shared on screen are accurate

Figure 4: Inside and Outside temperatures view in App

6. To test if the fan is working appropriately click on “regulate temp of car interior”

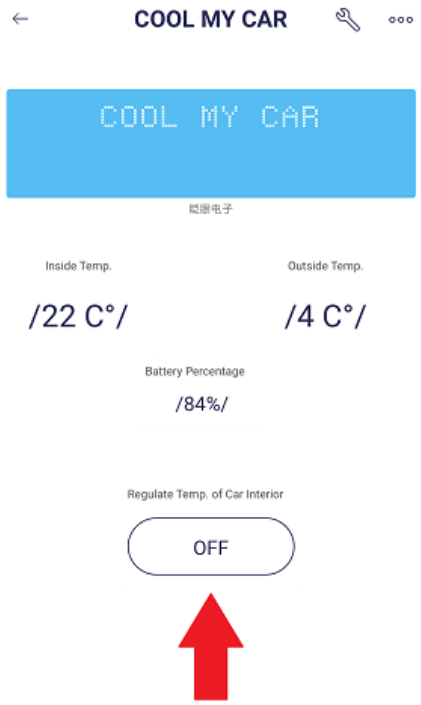


Figure 5: Button to regulate temperature inside vehicle

8. Now you have successfully installed and verified the functioning of the device.

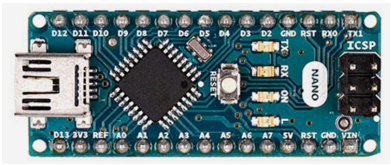
3.1 Set-up Considerations

Everytime the Arduino Nano is powered up it will start a sensor verification process to detect if all the sensors are connected and responding. This can take a few moments so the Arduino will not start working immediately, however, this process should not take longer than 1 minute.

In case an error with some sensor or component is encountered the error will be displayed through the app.

For the installation of this device no equipment is necessary, everything is included and no technical skill is needed to perform the installation. The user should be able to install this product in less than 30 minutes.

The wifi module is only able to broadcast a signal with a radius of less than 15 meters.

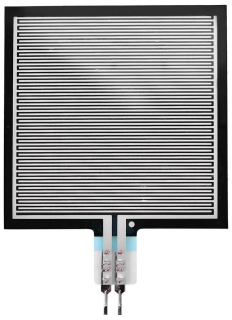


Arduino Nano (Board)

Wifi Module (Board)

Temperature Sensor (Input)

Motion Sensor (Input)



Pressure Sensor (Input)

Speaker (Output)

3.2 User Access Considerations

The product was developed having in mind the user group of parents between the ages of 25 - 45 that have access to smartphones. The app was designed with a minimalist approach to only display the most relevant information. The setup of the device was aimed to be fast and easy, and without any technical knowledge.

3.3 Accessing the System.

When accessing the system for the first time, the app will go through a welcome page and help the user step by step. This will allow the user to create a username and password, as well as, setting up the emergency contacts. The only part that the user will need to assemble from the hardware is connecting the battery to the device.

3.4 System Organization & Navigation

The app has a very simple design: a home page and a settings page. In the home page the user is able to see the temperature inside the vehicle, outside temperature, battery percentage, and a button to turn the fan on. In the settings page the user is able to manage his information, username, password, email, emergency contacts, and to deactivate the device.

3.5 Exiting the System

To deactivate the system completely the battery has to be unplugged from the Arduino Nano.

To turn the system off this can be done through the app by clicking “deactivate” in the settings.

4.0 USING THE SYSTEM

For the device to function properly, there is almost no interaction required. If you would like to add new emergency contacts or change existing ones, download the application on your mobile device. Once Cool My Car is properly installed in your vehicle, you can register your product in the app. From there, open the settings menu (the wrench icon in the top right corner) and either add a new contact, or modify existing contacts. On the home screen of the mobile app, you can also view the current ambient temperature, both inside and outside the vehicle. If you would like to turn the system on or off manually, you can do so from the home screen of the app.

The following subsection provides detailed, step-by-step instructions on how to use the various functions or features of Cool My Car.

4.1 Given Function/Feature

Managing Contacts

If you would like to add new contacts to be notified in case of an emergency, or manage existing contacts, you must first open the Cool My Car mobile application on your device. Once you are signed in and have your device properly connected to the product, you can tap on the wrench icon shown in the figure below to open the settings menu. Once inside the menu, you can enter the “Manage Contacts” section. You will be prompted to either add a new contact or to modify existing ones. Once you have made your selection, follow the instructions on the screen.

Figure 6. The location of the settings menu on the home screen.

Monitor Temperature

If you would like to monitor the current ambient temperature inside and outside the vehicle, simply open the Cool My Car mobile application. On the home screen, you can easily view the current temperature inside the car and outside, shown in the figure below.

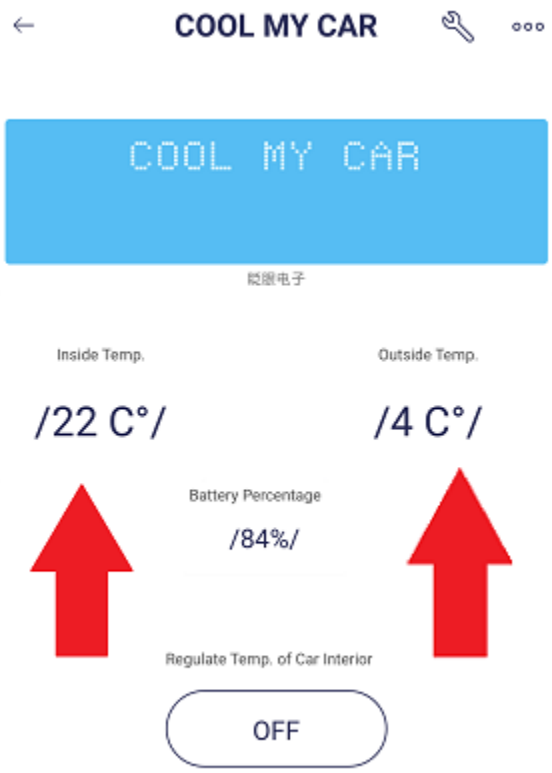


Figure 7. Location of the ambient temperature inside and outside the car.

Enable or Disable System

If you would like to manually turn on or turn off the temperature regulation system, you must first open the Cool My Car mobile application. Once you open the application and are on the home screen, you can press the ON/OFF button in the middle of the screen to activate or deactivate the system.

Figure 8. Location of the ON/OFF button for the temperature regulation system.

5.0 TROUBLESHOOTING AND SUPPORT

Possible recovery and error correction procedures include error conditions that may arise and actions that may need to be taken.

5.1 Error Messages or Behaviors

Errors will possibly arise for users when there are connection errors or set-up errors. The most common error message with CoolmyCar would be during the setup process when connecting the device to the app.

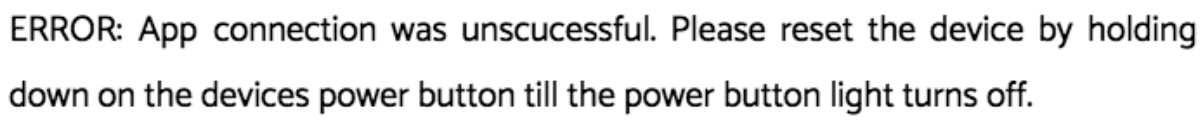


Figure 9: Connection Error

If this message pops up, follow the given instructions, wait five minutes, then turn the device on again and follow the connection steps again. If the message still pops up, refer to the *5.3 Support* section.

Another possible error message would be during the set-up phase when mounting the motion sensor.

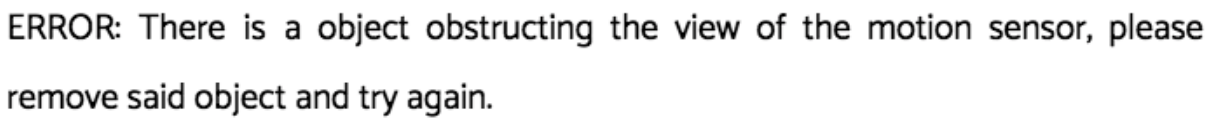


Figure 10: Motion Sensor Error

For the device to accurately sense motion, the motion sensor should be placed one meter away from a car seat as well as having nothing obstructing the view: ie. no headrest pillows, storage solutions, TV's etc. If the motion sensor error message pops up, follow the given instructions and try again; if there are further complications, please refer to section *5.3 Support*.

5.2 Maintenance

Regular app updating should be done to keep the app running appropriately and allow users to have minimal complications: the updating would include possible bug fixes as well as possible new functions or features.

It is recommended to test the device every three-to-six months to ensure there are no possible complications with the sensors or cooling system.

5.3 Support

For any comments or concerns, users can get emergency assistance and system support through the help page on the Cool my Car's website CoolmyCar.com; where frequently asked questions are answered. For further support, the user can email the following staff members: (a) Kaitlynn Sampel (ksamp081@uottawa.ca) for any app complications; (b) Kobe Belanger (kbela090@uottawa.ca) for any cooling system issues; (c) Benjamin McConnell (bmcco081@uottawa.ca) for any connection issues; (d) Steven Wilson (swils129@upttawa.ca) for any sensor issues; or (e) Hans Rao Ladkoo (for any general questions.

If there are any identified issues with the systems, or any security incident handling issues, please contact Cool my Car's general email coolmycar@gmail.com or call 1-800-266-5227 where a team member, if requested, will provide a response and proceed with caution for further assistance.

Hours of operation are as followed (Holiday hours may differ) :

- Monday-Friday → 6:00am - 10:00pm EST
- Saturday → 7:00 - 9:00pm EST
- Sunday → 8:00am - 6:00pm EST

6.0 PRODUCT DOCUMENTATION

6.1 Subsystem 1 of Prototype

6.1.1 BOM (Bill of Materials)

The table below lists the price of all materials needed to build the prototype.

Description	Price	Link
Temperature sensor module	$9,99	https://edu-makerlab2021.odoo.com/shop/product/humidity-temperature-sensor-23?search=temperature#attr=187
Speaker	$2,50	https://edu-makerlab2021.odoo.com/shop/product/buzzer-10#attr=248
Motion sensor	$5,45	https://edu-makerlab2021.odoo.com/shop/product/pir-sensor-4

		6?page=3#attr=
Pressure sensor	$11,00	https://www.amazon.ca/Pressure-RP-S40-ST-Accuracy-Pressuring-Intelligent/dp/B098XLHBXN?pd_rd_w=yWCSQ&pf_rd_p=b3be4e7b-d30a-475a-9f41-93061344bf4d&pf_rd_r=1KSPFSGJ7YJ1NYT7PYE0&pd_rd_r=ebe2c000-c803-4d93-a4d8-16547f547fc6&pd_rd_wg=dgdpx&pd_rd_i=B098XLHBXN&psc=1&ref_=pd_bap_d_rp_1_t
Computer fan (Already have)	$4,49	https://www.amazon.ca/gp/product/B07SRRWHVN/ref=ppx_yo_dt_b_asin_title_o01_s00?ie=UTF8&th=1
Arduino NANO	$8,00	https://edu-makerlab2021.odoo.com/shop/product/pir-sensor-46?page=3#attr=
Electrical components (wires, resistors, capacitors, breadboards, etc…)		http://inventory_mlab.makerepo.com/
Wifi Module	$9,99	https://www.amazon.ca/gp/product/B07PR9T5R5/ref=ppx_yo_dt_b_asin_title_o00_s00?ie=UTF8&th=1
total	$51.42	
Arduino IDE	Open Source	
"DHT.h" Library	Open Source	Downloadable from IDE
Blynk Library	Open Source	Blynk Repo
WiFi Library	Open Source	Downloadable from IDE

Table 2: Prototype Testing

6.1.2 Equipment list

Basic electronic tools:

- Breadboard
- Jumper wires
- Pliers
- Soldering iron

Components:

- Arduino Nano
- Wifi module
- Temperature sensor
- Motion sensor
- Pressure sensor
- Speaker

6.1.3 Instructions

Follow the schematics from the circuit below to connect the pressure, motion, and temperature sensors to the Arduino.

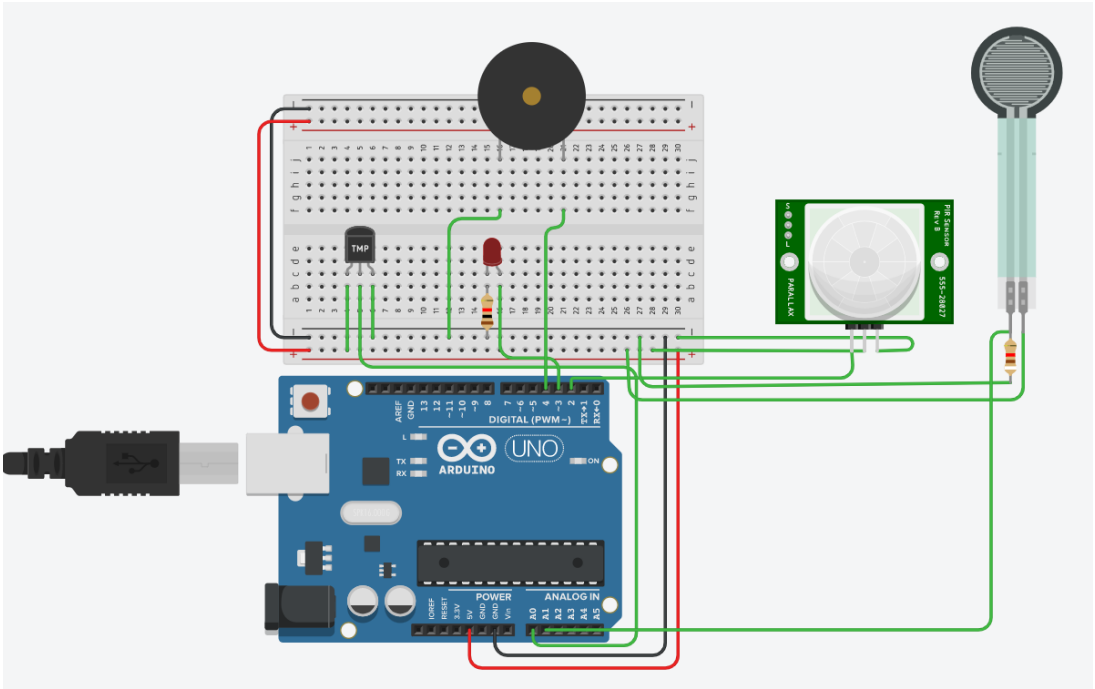


Figure 11: Prototype Wiring Schematics

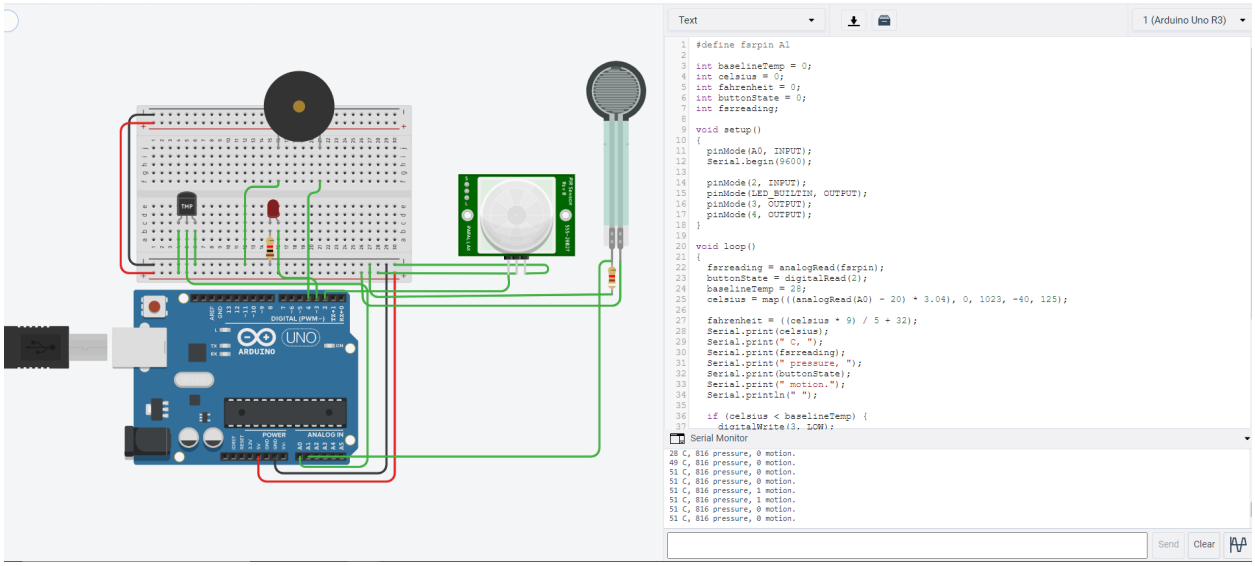


Figure 12: Prototype Wiring Schematics with Code

Upload the code from the TinkerCAD file to have the basic functioning of the sensors.

Tinkercad File:

https://www.tinkercad.com/things/6eF4Pfuoq7d-gng-1103-prototype-1/editel?sharecode=zIFKd_A8VlBRRtI9demXVjfSOs4tQDoNG52V3xbMmaw

```
#define fsrpin A1

int baselineTemp = 0;
int celsius = 0;
int fahrenheit = 0;
int buttonState = 0;
int fsrreading;

void setup()
{
  pinMode(A0, INPUT);
  Serial.begin(9600);

  pinMode(2, INPUT);
  pinMode(LED_BUILTIN, OUTPUT);
  pinMode(3, OUTPUT);
  pinMode(4, OUTPUT);
}

void loop()
{
  fsrreading = analogRead(fsrpin);
  buttonState = digitalRead(2);
  baselineTemp = 28;
  celsius = map(((analogRead(A0) - 20) * 3.04), 0, 1023, -40, 125);

  fahrenheit = ((celsius * 9) / 5 + 32);
  Serial.print(celsius);
  Serial.print(" C, ");
  Serial.print(fsrreading);
  Serial.print(" pressure, ");
  Serial.print(buttonState);
  Serial.print(" motion.");
  Serial.println(" ");

  if (celsius < baselineTemp) {
    digitalWrite(3, LOW);
    digitalWrite(4, LOW);
  }
  if (celsius >= baselineTemp && buttonState == HIGH && fsrreading > 800) {
    digitalWrite(3, HIGH);
    digitalWrite(4, LOW);
  }
  if (celsius >= baselineTemp + 7 && buttonState == HIGH && fsrreading > 800) {
    digitalWrite(3, HIGH);
    digitalWrite(4, HIGH);
  }
```

Figure 13: Code

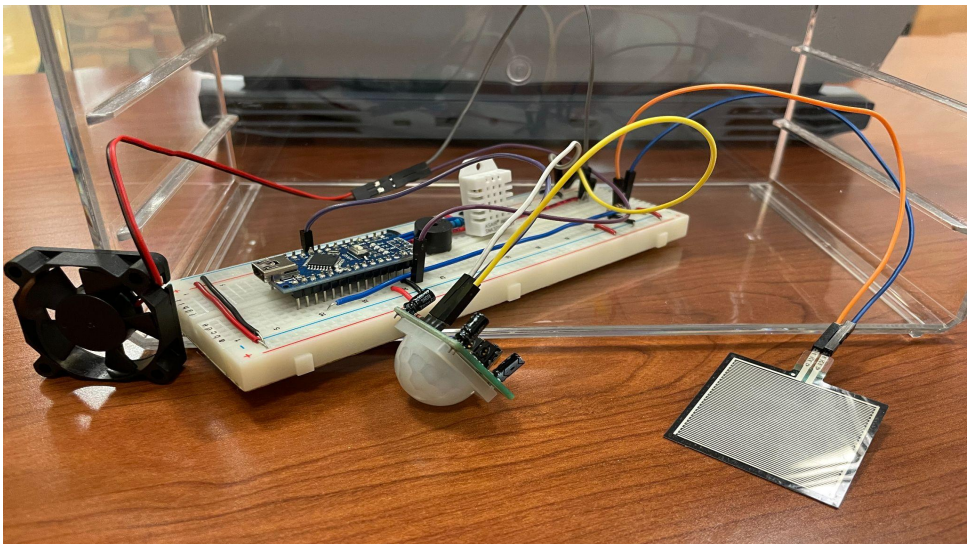


Figure 14: Final Prototype

6.2 Testing & Validation

The figure below shows tests being performed on the prototype to check whether all sensors are working properly.

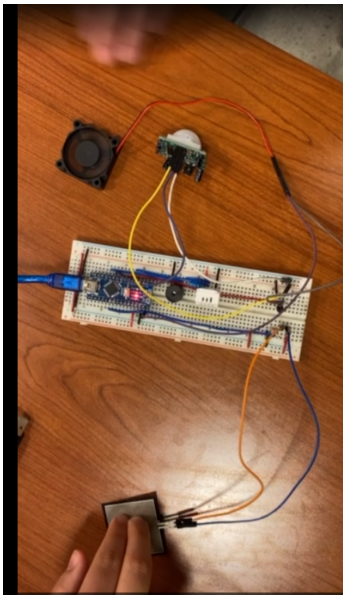


Figure 15: Final Prototype Testing

The table below details all the tests performed on the prototype, the results obtained, whether these results were expected or not and lastly their significance.

Test	Result	Was the result expected?	Significance
Does the pressure sensor detect properly?	Yes	yes	The pressure sensor will work for our application
Does the alarm turn on when the right sensors are activated?	Yes	yes	The system works properly
Does the fan turn on/off according to the sensor inputs?	Partially	No	The fan works at a very basic level, sometimes a slight nudge is needed.
Does the new speaker function in the same way as the previous one?	Yes	yes	The new speaker will work.

Table 3: Prototype Testing

7.0 CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

The prototype works as intended and is mostly aligned with the client's needs and expectations. All sensors work properly and components such as the fan still work, albeit at basic level. There was a need to build a device that prevents a forgotten child from choking in a car by alerting passers by and the guardian, while keeping him safe inside. Our device does just that in the following process: The device's pressure sensor and motion sensor detect the presence of the child. As a result, the alarm triggers to alert passers by and the device sends an emergency text to the guardian, through the app. Furthermore, any surge in temperature is picked up by the temperature sensor and consequently, the fan activates the cooling process to keep the child safe before help arrives. This prototype sets the ground for future more advanced prototypes whereby the budget is not restricted and other components can be added.

If we had more time to work on the project, we would have carried out more tests on the prototype and try to figure out why certain components such as the fan, in our prototype, are not working optimally. We could also have considered adding an infrared sensor to determine movement more accurately by measuring heat given off by the child. However it's coding is more complex and would require more time to figure out.

8.0 APPENDICES

8.1 APPENDIX I: Design Files

MakerRepo: https://makerepo.com/swils129/944.cool-my-car-b8

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
Deliverables A - J	https://makerepo.com/swils129/944.cool-my-car-b8	Nov. 11, 2021