**Deliverable G: Prototype II and Customer Feedback**

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*Abstract*

*The purpose of this deliverable is to document the second stage of prototyping, to allow for the planning and testing of the final product. This includes detailed images of the prototype, documenting the prototype test plan, analyzing the results from testing the prototype, and identifying the stopping criteria. Customer feedback will be gathered and considered to ensure the final product meets all the design requirements outlined in the detailed design.*

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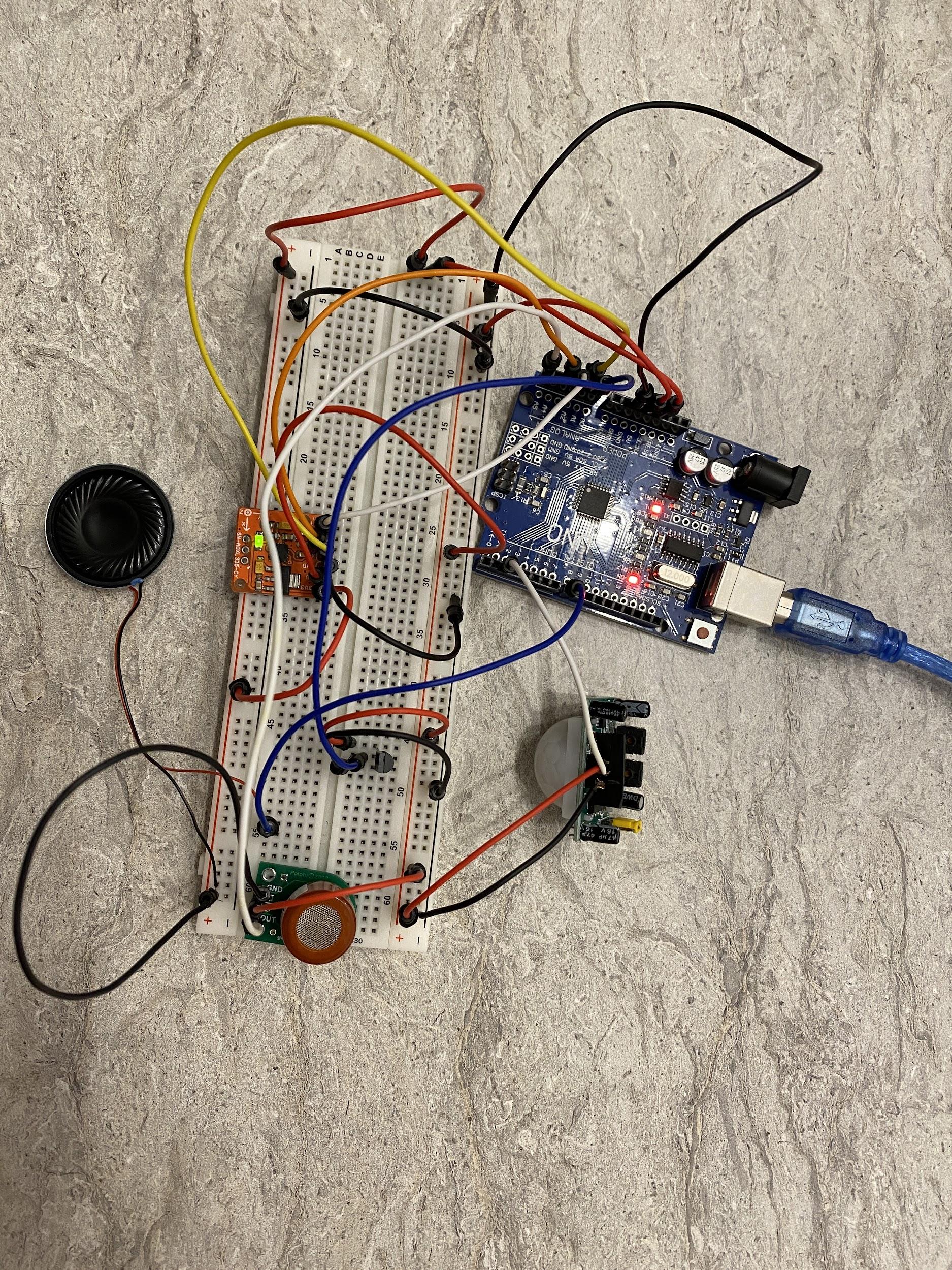
# Prototype II: Testing

## GSM Module Testing

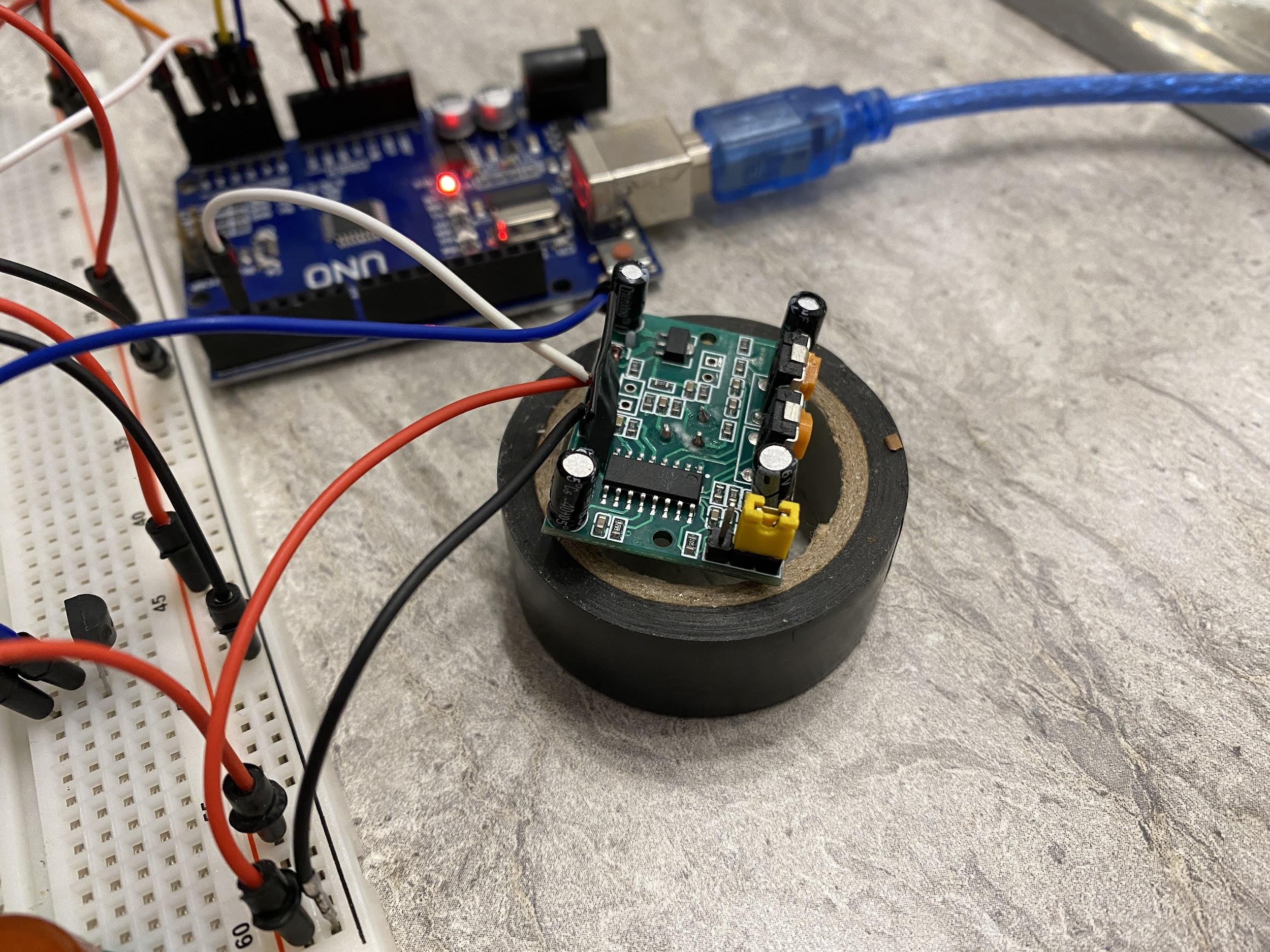
The detailed design had planned for the system to send text messages to the driver’s phone and call the authorities in an emergency in the vehicle. However, when testing the GSM module, we found out that there are no service providers in Canada that support GSM networks anymore. Therefore the system can’t deliver text messages to the driver’s phone or send out an emergency call to the authorities in case of emergency.

## Combined Sensor Testing

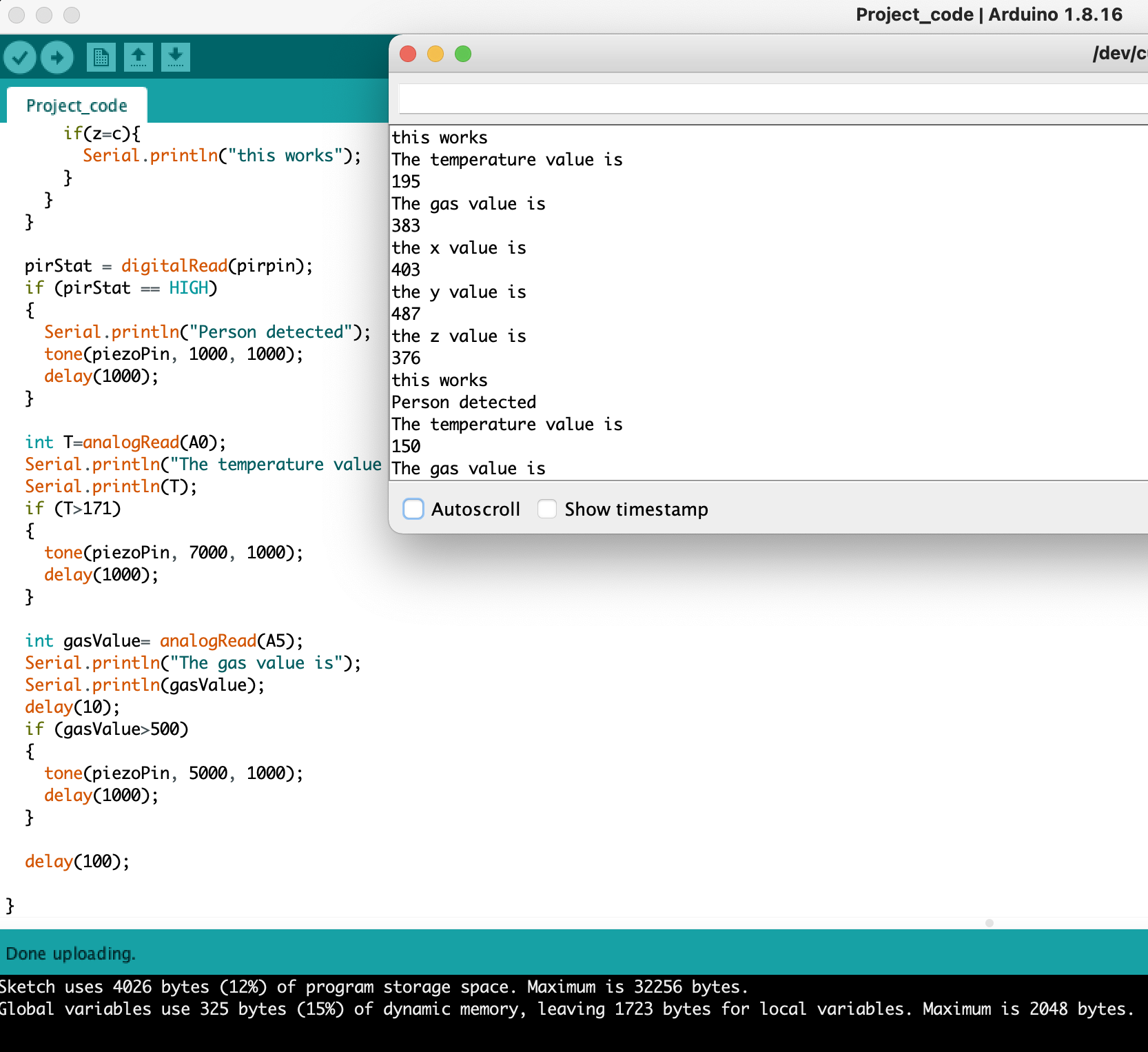
The sensors were all combined into one unified system, and the code was written to gather, and utilize the information that they provide. This all works. All of the sensors are providing reliable data, that is changing as one would predict with environmental changes. Whilst we haven’t fully tested the gas sensor it is clearly changing when subjected to a person's breath. The temperature sensor, while not giving the exact temperature, is consistently providing a measurement that can be corrected with simple operations. The motion sensor functions as desired and is very capable of detecting an occupant in the car. As of right now unique tones are being used to ensure that the operator can differentiate between different alerts, and once the app is created the system will be nearly fully functional. The accelerometer is functioning properly, but the code needs to be altered to ensure that the driver isn’t being alerted while the car is driving. All that remains in terms of sensors and testing is to ensure that the sensors are capable of gathering reliable data while they are in the case. The location of the system will also have to be tested as well.



*Figure 1: Fully assembled sensors*

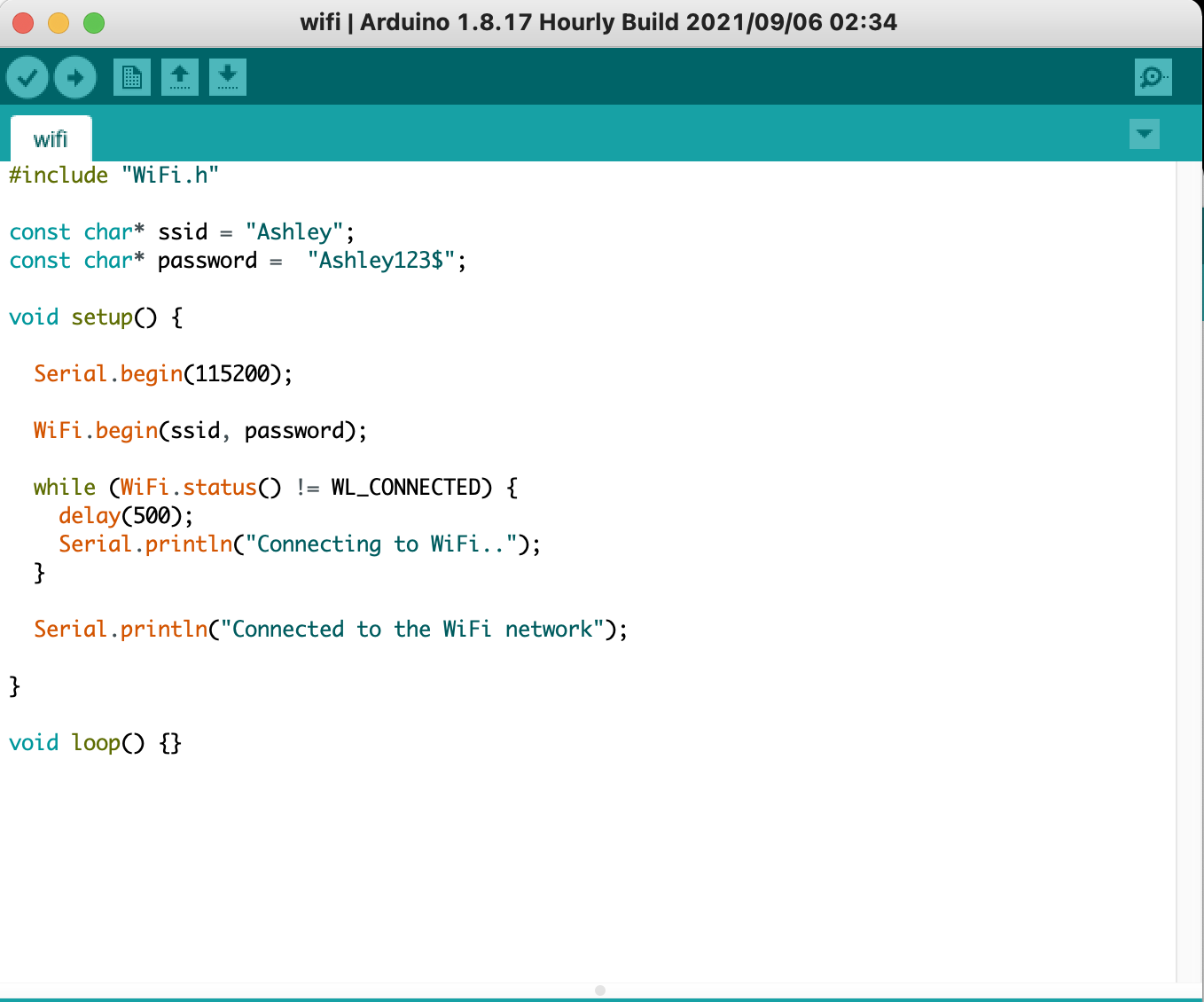


*Figure 2: Motion sensor being tested*

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*Figure 3: code functioning, with data printed to the serial monitor*

## Bluetooth/Wifi Connection Testing



*Figure 4: Wifi connection code in the Arduino IDE*



*Figure 5: Serial monitor with the connection status*

Individual testing of the Bluetooth low energy component was conducted, and the results were successful. The device could connect to a wifi network; however, this component has not been integrated into the system yet. The combination of the systems relies on developing the application, which is the goal of Prototype III. Further testing of the BLE component will be conducted as soon as the coding for the application is developed,

# Updated Bills of Materials

| Item | Quantity | Cost | Taxes | Shipping | Total | Link |
| --- | --- | --- | --- | --- | --- | --- |
| Arduino Uno | 1 | 17.00 | N/A | N/A | 17.00 | [[1]](https://makerstore.ca/shop/ols/products/arduino-uno-r3) |
| Motion Sensor (HC-SR501) | 1 | 11.99 | N/A | N/A | N/A | [[2]](https://www.amazon.ca/gp/product/B086XCTTP6/ref=ppx_yo_dt_b_asin_title_o02_s00?ie=UTF8&psc=1) |
| ESP32-BLE | 1 | 16.90 | N/A | N/A | N/A | [[3]](https://www.amazon.ca/gp/product/B07P1L7839/ref=ppx_yo_dt_b_asin_title_o02_s00?ie=UTF8&psc=1) |
| Various Capacitors | 1 | 11.68 | N/A | N/A | 54.36 | [[4]](https://www.amazon.ca/gp/product/B00W1COWV8/ref=ppx_yo_dt_b_asin_title_o02_s00?ie=UTF8&psc=1) |
| Carbon monoxide gas sensor (MQ-7) | 1 | 8.76 | 2.69 | 9.21 | 20.66 | [[5]](https://www.robotshop.com/ca/en/carbon-monoxide-sensor-mq7.html) |
| Accelerometer (Cytron ADXL335) | 1 | 11.86 | N/A | N/A | N/A | [[6]](https://www.robotshop.com/ca/en/cytron-adxl335-3-axis-accelerometer.html) |
| Temperature Sensor (TMP-36 | 1 | 1.92 | 3.44 | N/A | 26.43 | [[7]](https://www.robotshop.com/ca/en/temperature-sensor-tmp36.html) |
| 8Ohm speakers | 1 | 9.26 | N/A | N/A | 20.90 | [[8]](https://www.amazon.ca/gp/product/B07BFTYY6L/ref=ppx_yo_dt_b_asin_title_o01_s01?ie=UTF8&psc=1) |
| Resistors (10k,15k,27k,470k)Ohm | 4 | 0.65 | 3.29 | 13.85 | 25.27 | [[9]](https://www.pcboard.ca/index.php?route=account/order/info&order_id=2798) |
| Pololu Carrier for MQ Gas sensors | 1 | 1.95 | 0.30 | 7.69 | 9.93 | [[10]](https://www.pishop.ca/product/pololu-carrier-for-mq-gas-sensors-bare-pcb-only/) |

(Taxes and shipping costs grouped by order)

**Total Estimated Cost with taxes and shipping = $174.55**

# Updated Equipment List

* Thunkable (Software for app creation):
  + Thunkable will be the primary software used for creating the app, UI and images will be created with it in addition to photoshop.
* Soldering Iron and Solder:
  + Will be used to modify the connections and lengthen portions of wires if needed.
* Wiring:
  + It is used to connect required parts and lengthen required wires if necessary.
* Fastening Material (Tape, Zipties,):
* Arduino IDE:
  + The Arduino IDE will be used to set up code for the Arduino, it will outline steps to be followed in specific situations, and will tell the Arduino what sensors must be monitored and what to do at specific values.
* Breadboard:
  + Will be used to create the initial circuits for testing the prototype.
* CP210x USB to UART Bridge VCP driver:
  + Is used to connect the Bluetooth low energy component to the Arduino IDE

# Prototype III: Test Plan

# Procedure

1. 3D print the case to hold the system.
2. Design the visual components of the application.
3. Develop the code for the application.
4. Integrate the app with the system of sensors.
5. Test the installation process.
6. Test the sensors in a vehicle.

## Stopping Criteria

Testing will be finalized once the system can successfully detect motion in a vehicle and send notification and the sensor readings to the driver’s device via mobile application. Refinements will be made to the system until the prototype has a high degree of fidelity.

# Customer Feedback

Since the client did not provide any feedback after our 2nd presentation, we have asked potential clients for feedback instead.

## Battery

There has been no testing of a battery solution up until now. One client found this concerning and would like to see testing done before the final prototype. Our proposed battery and power solution is to have a small standby battery to ensure that the device will have sufficient battery when the car is shut off. We will charge the battery using the car when it is running. The battery will ideally power the system for an hour at a time, ensuring that it will never run out in normal circumstances.

## Initial alert

Some clients were confused about how the driver would initially be alerted when parking the car. This would be done using the speaker attached to the system. A unique sound would be used to ensure that the driver both hears and understands the purpose of the alert. Additionally, if the alert fails the system will send a Bluetooth notification to the driver’s phone.

## Fastening to a car

Concern was brought up about the technique to attach the system to the car, if it would be permanent and if it would be universal. Our goal is to create many options to ensure the greatest success in different cars, and the most compatibility. Our testing is planned to start with the next prototype, once the case for the system has been made.

# Conclusion

We have documented and completed the second stage of prototyping. Feedback about the prototype was gathered from the client and potential users to help direct the final stage of prototyping. A plan for the development and testing of the final product has been created, which will include developing the application, testing the notification system, and testing the installation process.