Hot Car Emergency

Deliverable H: Prototype III & Client FeedBack

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November 21, 2021

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1. Introduction:

In this deliverable we will be presenting our third and final prototype, how we tested it to ensure its efficiency and finally the different feedback we have received from people around us to have an idea on what a potential customer would have to say and incorporated that into our final design.

2. Prototype III:

Prototype 3 will feature a gas sensor that will detect high amounts of carbon dioxide levels (measured in ppm). According to ASHRAE (American Society Heating, Refrigeration and Air Conditioning Engineers), “the comfort limit limit for CO2 concentration is 700 ppm over the ambient level, which is approximately 400 ppm, for a total of 1100 ppm (0.11%)” [1]. The casing and soldering the components is also included in the prototype 3 phase.

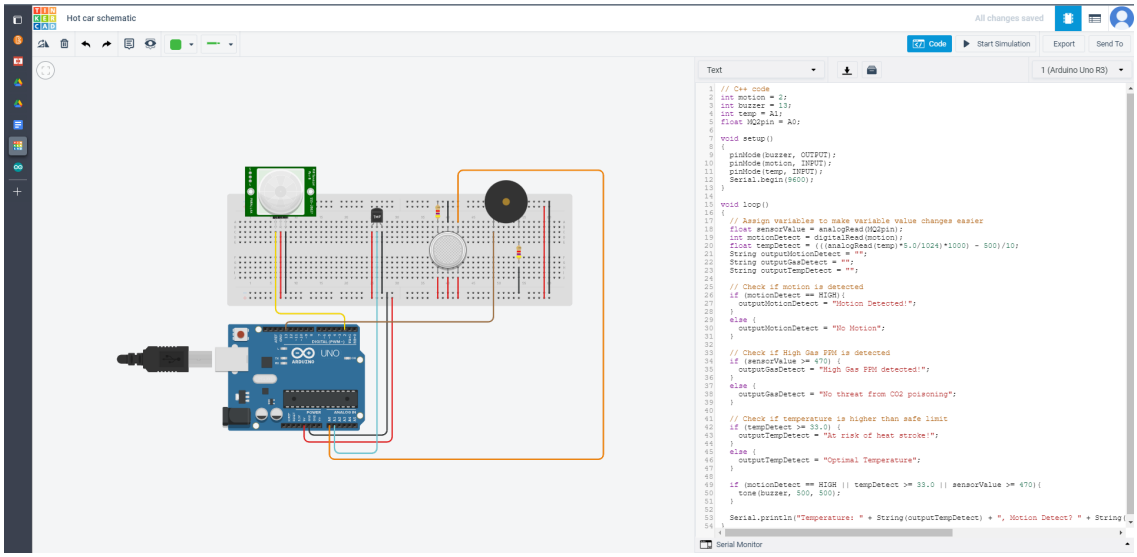
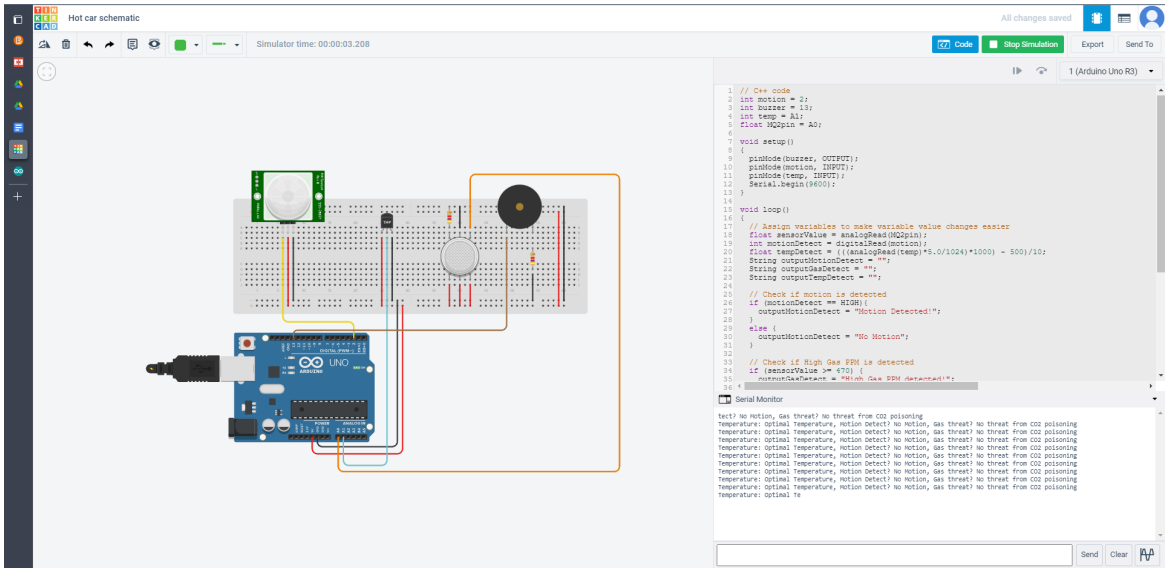
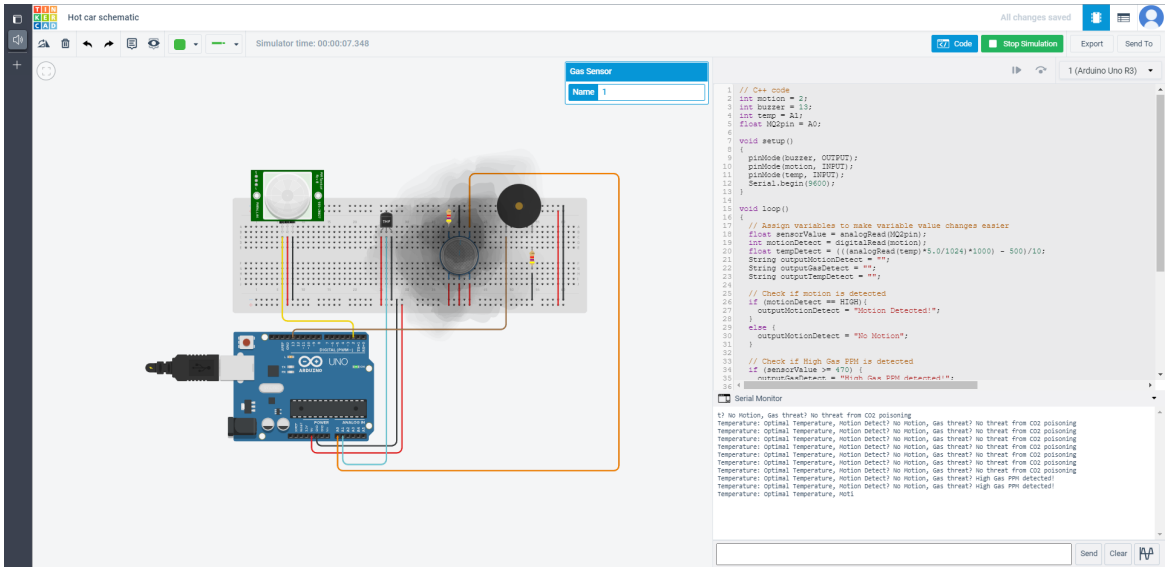


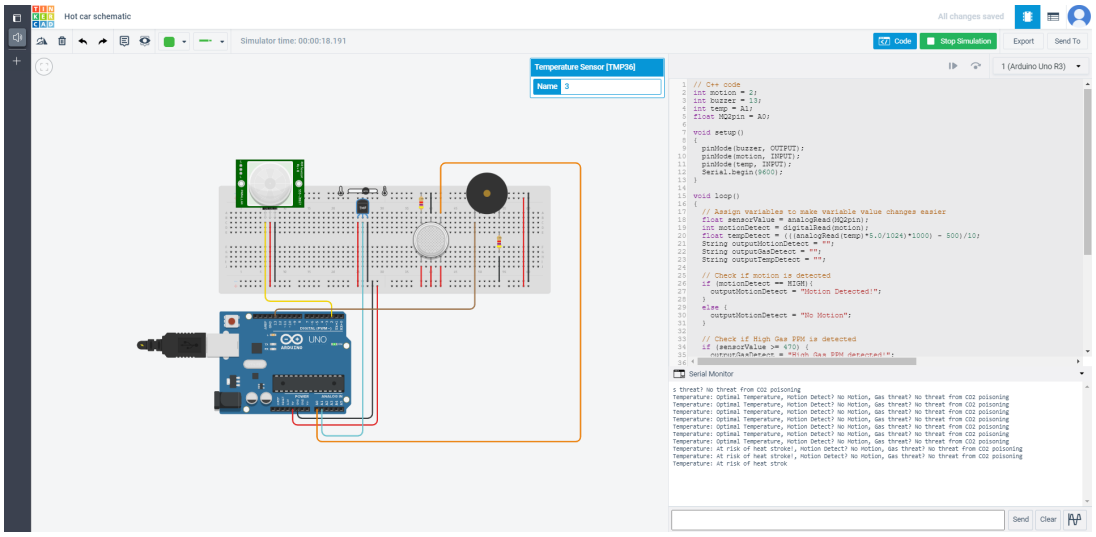
Figure 1: Inclusion of the motion sensor, temperature sensor and gas sensor with code in tinkercad



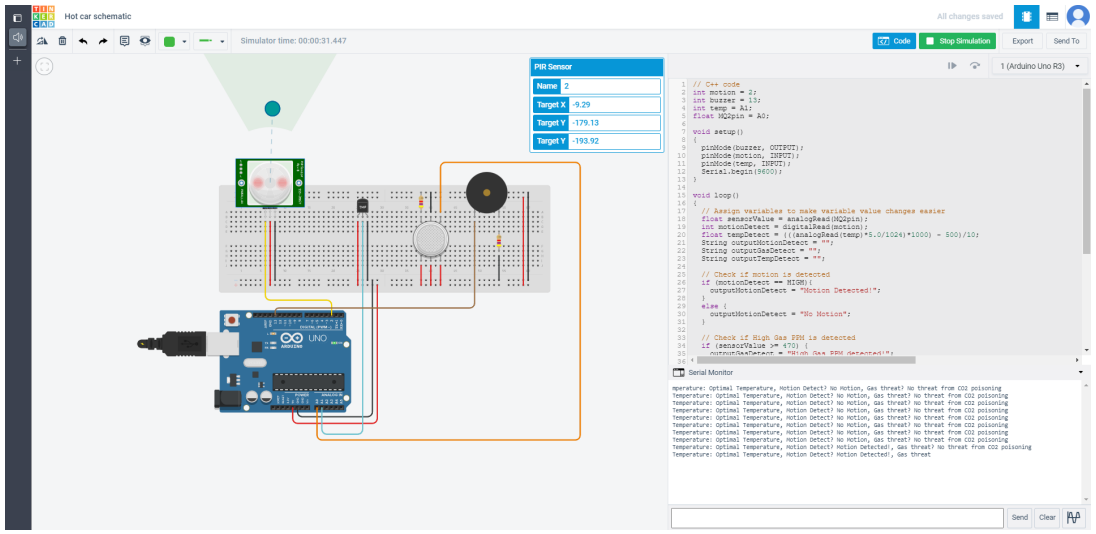
Simulation Case 1: all sensors are not triggered



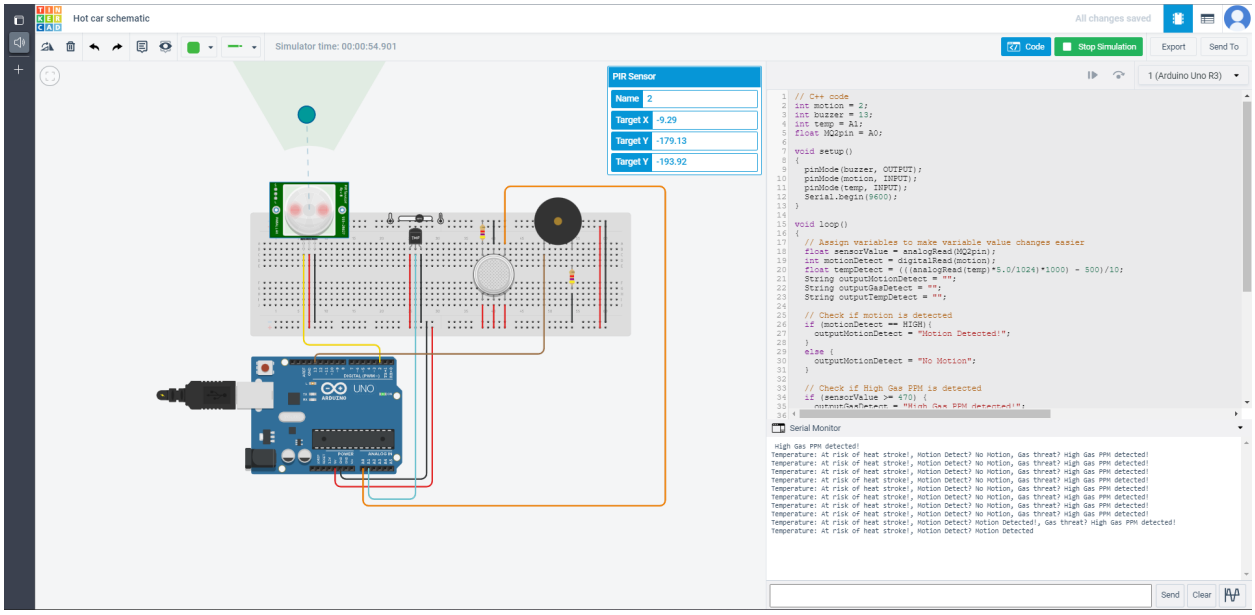
Simulation Case 2: Gas sensor detects high CO_2 PPM



Simulation Case 3: High Temperature is detected by the temperature sensor



Simulation Case 4: Motion sensor detects movement



PIR Sensor
Name: 2
Target X: -9.29
Target Y: -179.13
Target Y: -193.92

```
// C++ code
int motion = 2;
int buzzer = 13;
int temp = A1;
float MQ2pin = A0;

void setup()
{
  pinMode(buzzer, OUTPUT);
  pinMode(motion, INPUT);
  pinMode(temp, INPUT);
  Serial.begin(9600);
}

void loop()
{
  // Assign variables to make variable value changes easier
  float sensorValue = analogRead(MQ2pin);
  int motionDetect = digitalRead(motion);
  float tempDetect = (((analogRead(temp)*5.0/1024)*1000) - 500)/10;
  String outputMotionDetect = "";
  String outputGasDetect = "";
  String outputTempDetect = "";

  // Check if motion is detected
  if (motionDetect == HIGH){
    outputMotionDetect = "Motion Detected!";
  }
  else {
    outputMotionDetect = "No Motion";
  }

  // Check if High Gas PPM is detected
  if (sensorValue >= 470) {
    outputGasDetect = "High Gas PPM detected!";
```

```
 High Gas PPM detected!
Temperature: At risk of heat stroke!, Motion Detect? No Motion, Gas threat? High Gas PPM detected!
Temperature: At risk of heat stroke!, Motion Detect? No Motion, Gas threat? High Gas PPM detected!
Temperature: At risk of heat stroke!, Motion Detect? No Motion, Gas threat? High Gas PPM detected!
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Temperature: At risk of heat stroke!, Motion Detect? No Motion, Gas threat? High Gas PPM detected!
Temperature: At risk of heat stroke!, Motion Detect? Motion Detected!, Gas threat? High Gas PPM detected!
Temperature: At risk of heat stroke!, Motion Detect? Motion Detected
```

Simulation Case 5: All sensors are tripped

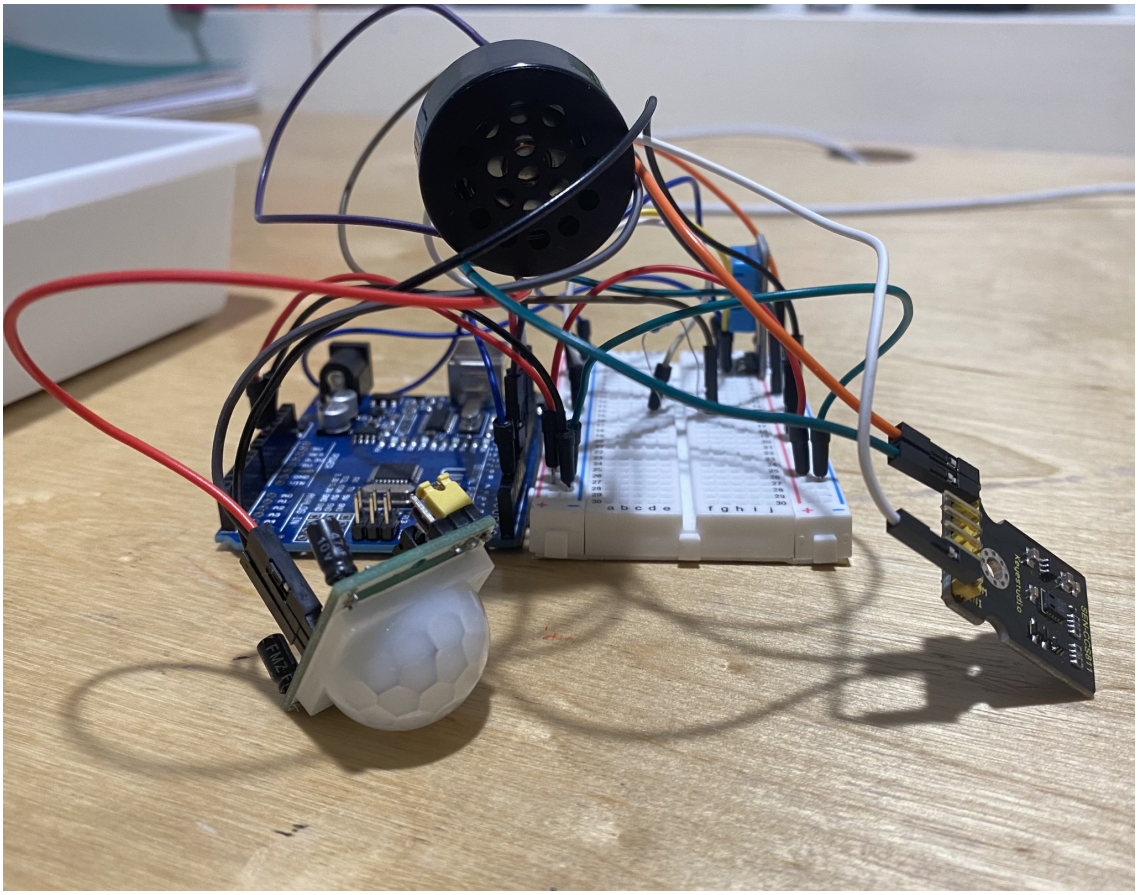

Figure 2: Wiring of the components controlled by the Arduino Uno to the breadboard

3. Prototype testing plan:

3.1. What?

We are going to be testing the functionality of our final prototype as a whole in a myriad of different situations. We will test whether the case we have designed for it is fitting and whether it conflicts with any of the components. Additionally, we will be checking whether the case hinders any part of the functionality. Our main aim is to check whether this prototype is correctly visualizing the idea we as a group came up with to tackle this issue and whether we have satisfied most, if not all, of our client's needs.

3.2. Why?

As the problem we are trying to solve with our product is vital and can cause serious harm, the functionality of our product in any possible case must be guaranteed and therefore, we have to test it in a myriad of situations at different stages to be able to guarantee that to our client and any potential customers. We tested it at different stages to identify any issues or defects beforehand and to identify anything that needed to be added and adjusted the preceding prototype accordingly. For this specific prototype (the third one) we are looking to see how all the parts work together and that none of the components conflict with one another. In addition, we are testing it to make sure that the motion sensor will still work with the case we have designed and that it does not affect it's sensing range and that the speaker is still loud enough to be heard.

3.3. How?

We will start by simply setting our prototype on a stand and testing different scenarios with the temperature and motion. Then gradually we will add some obstacles and try to replicate how it would go in a car. We will set it inside a box and see if the speaker will still be loud enough to be heard. We will adjust out code so that our system is triggered at a lower temperature for the sake of testing these different scenarios in a safe environment and will adjust it back once we are done if all the results are as expected.

3.4. Stopping Criteria

After testing our final prototype, we came to the conclusion that everything was working together nicely and that the motion sensor was triggered when the dangerous temperature we set was reached and the buzzer was activated to alert passengers of the dangerous temperature, or alert others of the child in these dangerous conditions. We had some holes in our casing to allow

the buzzing sound to be heard which came out to be beneficial and did not dim the sound of the buzzer.

4. Updated BOM:

#	Product	Price (CAD)	Links
1	Arduino	20	https://edu-makerlab2021.odoo.com/shop/product/arduino-5?search=arduino#attr=5
2	Temperature sensor	3.4	https://edu-makerlab2021.odoo.com/shop/product/humidity-temperature-sensor-23?search=temperature#attr=188
3	CO_2 Sensor	12.5	https://edu-makerlab2021.odoo.com/shop/product/air-quality-sensor-134?search=carbon+dioxide#attr=
4	Motion Sensor	3	https://edu-makerlab2021.odoo.com/shop/product/pir-sensor-46?category=6#attr=
5	PCB	0.5	https://edu-makerlab2021.odoo.com/shop/product/protoboard-51?search=pcb#attr=53
6	Wires	0.2	https://edu-makerlab2021.odoo.com/shop/product/jumper-wires-44?search=wires#attr=44
7	Velcro	0.22	https://edu-makerlab2021.odoo.com/shop/product/velcro-119#attr=
8	Battery Holder	1	https://edu-makerlab2021.odoo.com/shop/product/aa-battery-holder-48?search=battery#attr=49
9	Speaker	2.5	https://edu-makerlab2021.odoo.com/shop/product/speaker-59?search=speaker#attr=64

10	220Ω resistor	0.04	https://edu-makerlab2021.odoo.com/shop/product/resistor-6?search=+resistor#attr=11
11	Acrylic panels	16	https://makerstore.ca/shop/ols/products/acrylic-12-inch-x-24-inch/v/M002-24-X-1-4-BLC
12	Male Headers	N/A	Unknown

5. Client Feedback:

After developing and testing prototype III, we have gone ahead and presented it to potential clients and students around campus to obtain any feedback with regards to functionality and useability. The feedback we received for prototype III is that people were curious about how loud our product will be, therefore, we decided to make the opening at the top of the case for the motion sensor bigger in order to ensure that the case will not block the sound and those walking by the car will still be able to hear the alarm.

6. Conclusion:

To sum up, in this deliverable we have presented the idea for our third and final prototype including any finish touches we will be working to add before presenting it to the judges. We went through our testing plan and what results we got, since this is our final prototype we have compared the results to the ones of the previous testing plans to see how well along our product was coming. During the testing we discovered that some extra material was required and therefore an updated BOM was included with the updated budget. Additionally, we asked around to see what potential customers would think of our product to get an idea of how to improve it before presenting it to the judges and included that feedback. These are the steps we took in order to reach our third and final prototype.

7. Wrike Link:

https://www.wrike.com/workspace.htm?acc=4975842#path=folder&id=758826332&c=timeline3&vid=47240201&a=4975842&so=10&bso=10&sd=0&st=nt-1