Hot Car Emergency

Deliverable G: Prototype II & Client FeedBack

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Table of Contents

1. Introduction :

In this deliverable we will be introducing our second and improved prototype, discussing our plan to test it, and the feedback we got on our first prototype. In addition, we will be including our updated BOM with the materials for the final and completed prototype.

2. Prototype II:

The successor of Prototype 1 now known as Prototype 2 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]“

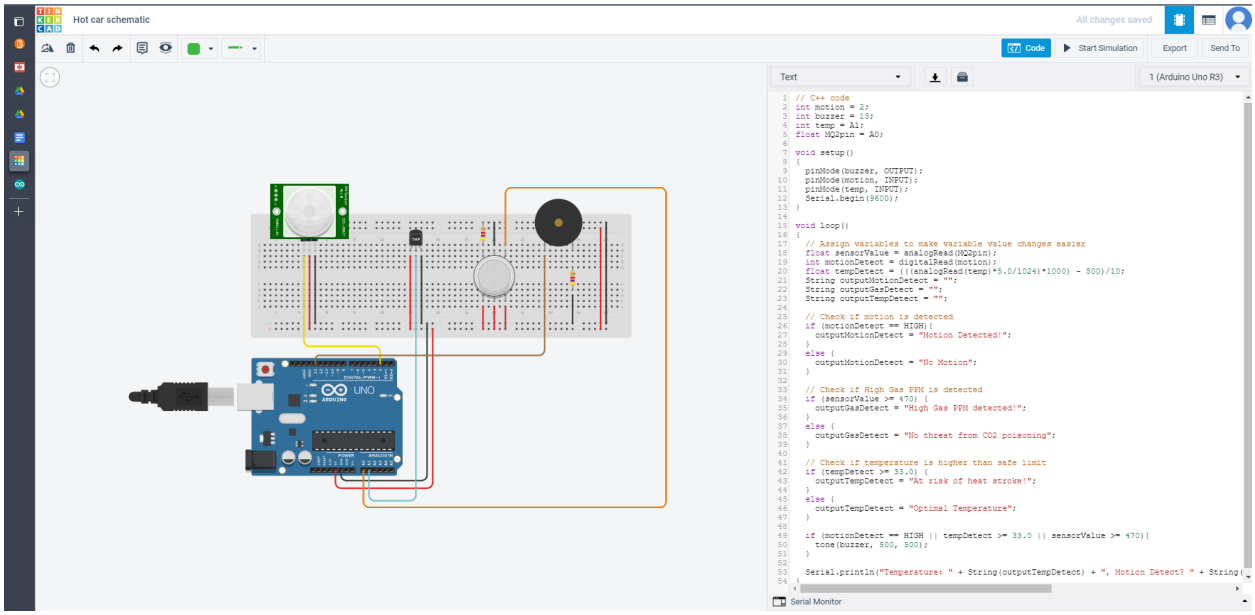
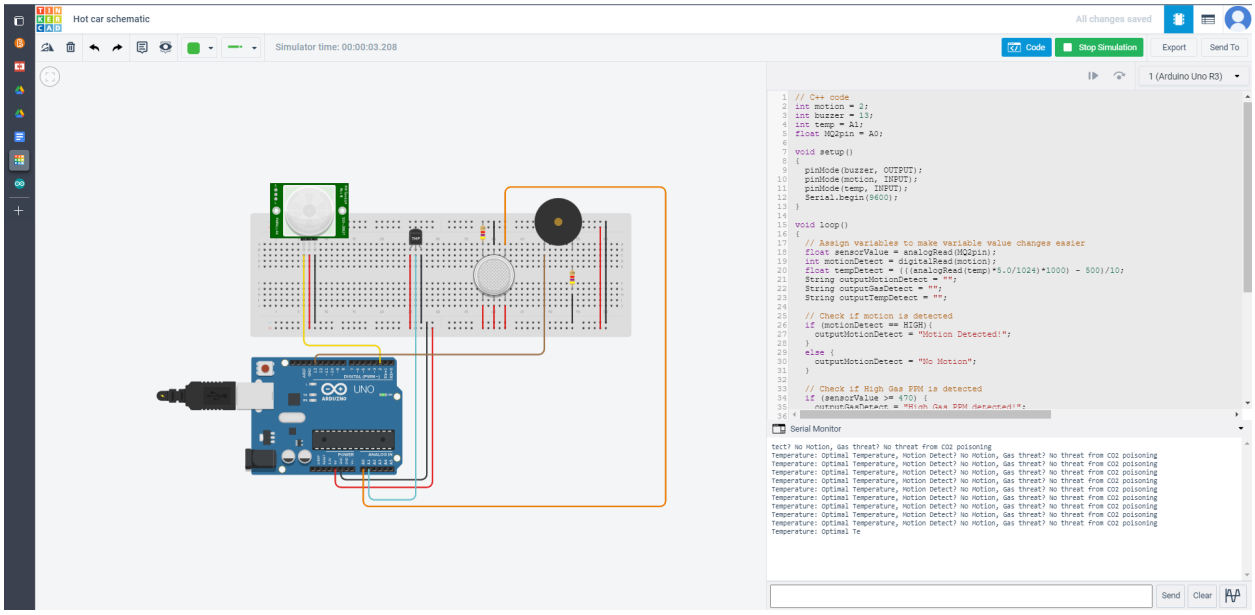
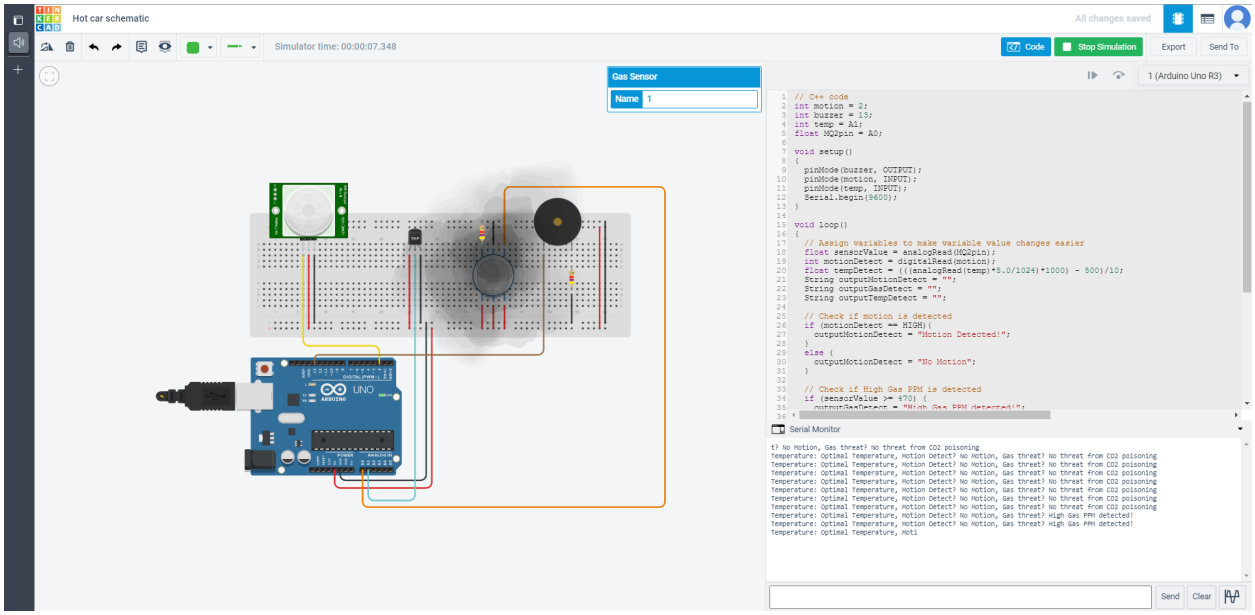


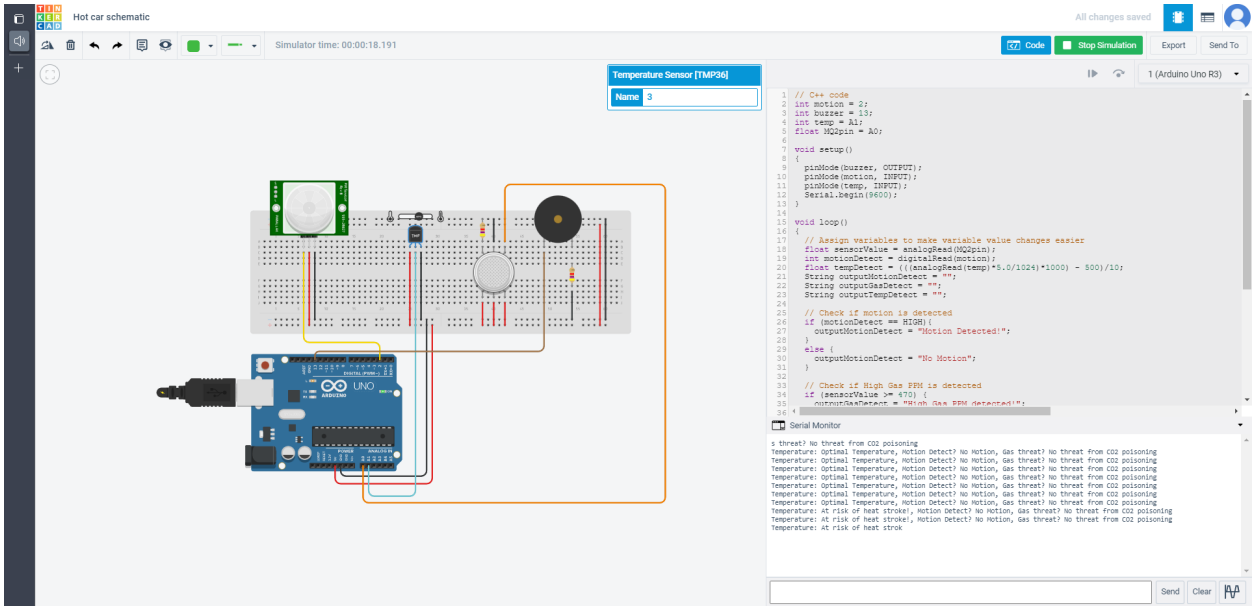
Figure 1: Inclusion of the motion sensor, temperature sensor and gas sensor with code in tinkercad



Simulation Case 1: all sensors are not triggered



Simulation Case 2: Gas sensor detects high CO_2 PPM



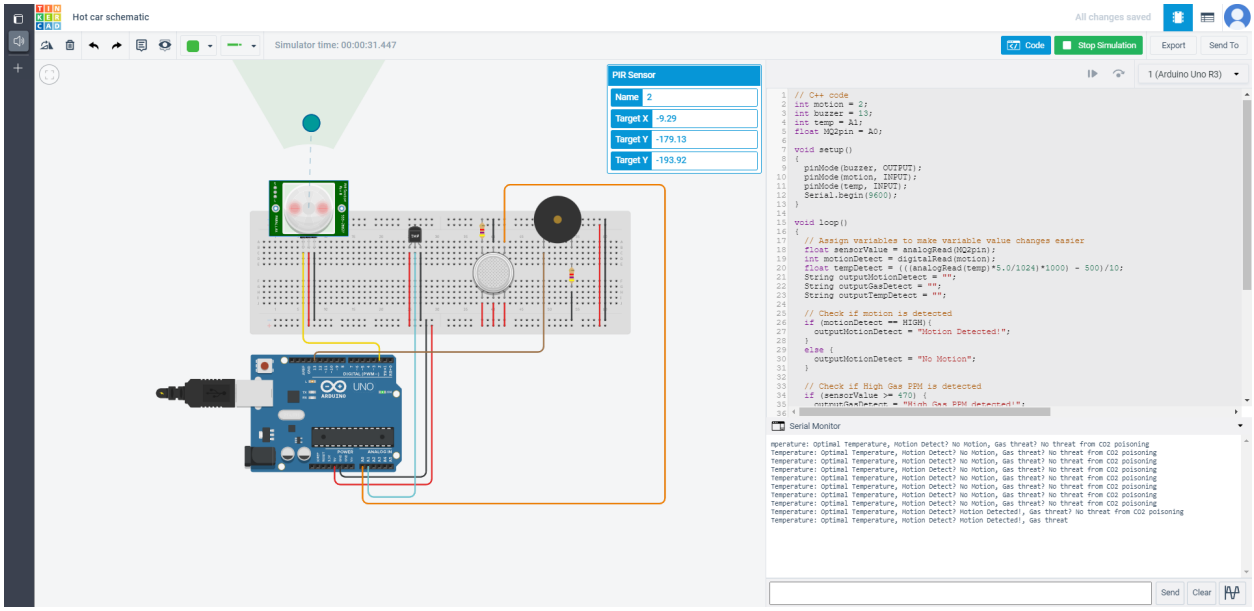
Temperature Sensor [TMP36]

Name: 3

```
// 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!";
```

```
s threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: At risk of heat stroke!, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: At risk of heat stroke!, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: At risk of heat strok
```

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



PIR Sensor

Name: 2

Target X: -9.29

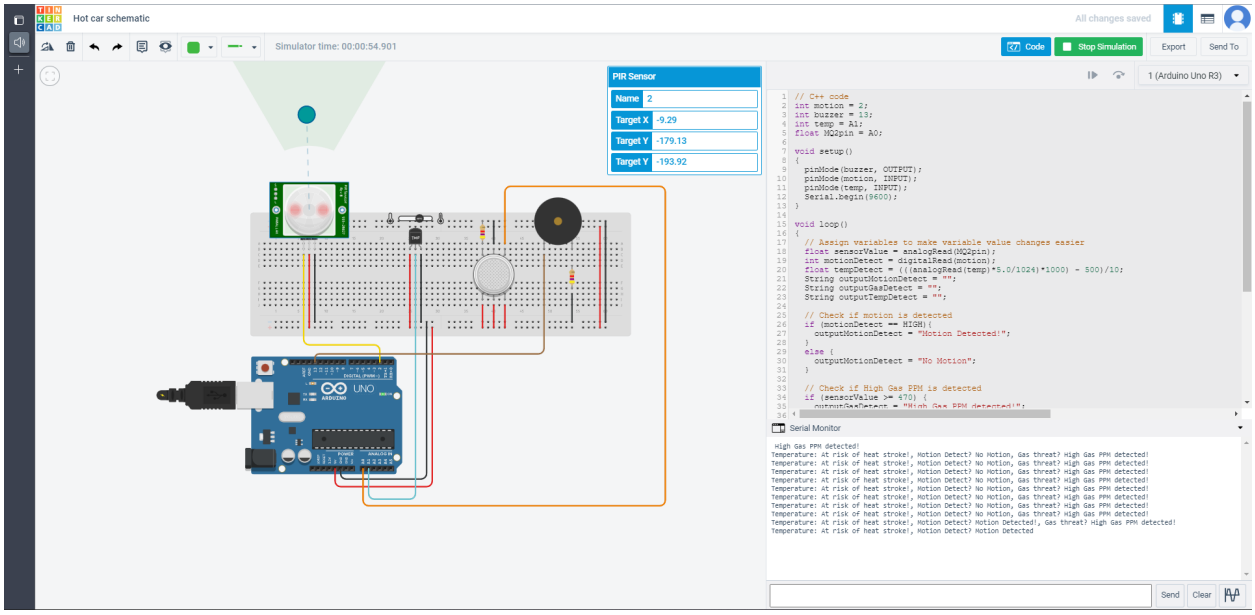
Target Y: -179.13

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!";
```

```
mperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? No Motion, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? Motion Detected!, Gas threat? No threat from CO2 poisoning
Temperature: Optimal Temperature, Motion Detect? Motion Detected!, Gas threat
```

Simulation Case 4: Motion sensor detects movement



Simulation Case 5: All sensors are tripped

3. Prototype testing plan:

3.1. Prototype II

3.1.1. What?

We will be testing our second prototype which is our first prototype (temperature sensor, PIR sensor, and speaker) along with a CO2 sensor. Our first two prototypes will focus mainly on the functionality of our product. We will iterate with these prototypes until we reach a fully functional and reliable product.

3.1.2. Why?

We are testing this to make sure that there are no complications in our product and that it meets our client's needs.If any problems arise we can solve them ahead of time and understand what is causing them before adding all the components to our final prototype. Additionally we will present this to our client to show him how our product is comin along therefore, we need to make sure it is functioning properly to correctly visualize to him our construction process.

3.1.3. How?

Similarly to how we tested our first prototype, we will be testing our second prototype by first writing the code that includes all of the sensors on tinker cad to make sure we have everything

connected properly. We will then write the code so that whenever the CO2 levels rise above the safe levels. Unfortunately we would not be able to replicate this situation in real life but we will adjust the code to fit the arduino and will do the pepper research to make sure it will function properly. If possible we will look into trying to duplicate a dangerous situation and see the response.

3.1.4. Stopping Criteria

Once the CO2 levels are above 1100 ppm the speaker will be activated regardless of whether the temperature is too high or the car is stopped as this is too dangerous for humans and can lead to suffocation.

3.2. Prototype III

3.2.1. What?

Our third and final prototype will be based on the final look and whether the casing we have will be compatible with our product in all situations. It will focus on the aesthetic and final look making sure it nicely wraps up our prototype and enhances it. Additionally we will finally be adding the 9V battery and setting the code for the system to be activated once the system is being charged by the discharge of the battery meaning the engine has stopped running.

3.2.2. Why?

We are testing this to make sure that there are no complications in our product and that it meets our client's needs.If any problems arise we can solve them ahead of time and understand what is causing them before adding all the components to our final prototype. Additionally we will present this to our client to show him how our product is comin along therefore, we need to make sure it is functioning properly to correctly visualize to him our construction process.

3.2.3. How?

We will start by getting the dimensions for our whole prototype after soldering and laser cutting our box from colorless acrylic to make sure it does not disrupt the motion sensor or the speaker. Additionally, we will test to see if the whole system is light

enough to be supported by our components on the roof of a car by attaching it to the inside of a box or something similar. Next, we will attach the battery and write a code that will be able to differentiate whether the arduino is being powered by the charging or discharging of the battery so it can activate the motion sensor. We will try our best to try and test this out physically and attempt it multiple times until we get it working.

3.2.4. Stopping Criteria

We should see that the motion sensor is working perfectly in the case we laser cutted with no problem and that the case fits all our components and arranges them neatly. Our case should not be too heavy or big that we cannot attach it to the roof of a car. Additionally, once we attach the battery if motion is sensed and the arduino is being powered by the discharge of the battery it should activate the speaker with a MAX of 2-3 minutes delay.

4. Client FeedBack:

After meeting with the client, we have established that there are no issues with our current prototype and that we should continue with what we have. We will continue to enhance the immediate response as requested in the first meeting and continue to further enhance our code in order to ensure that it will work in addition to our current solution. We are planning to have our CO2 sensor done by the end of this prototype in the immediate response for our final prototype.

5. 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	CO2	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	1	https://edu-makerlab2021.odoo.com/shop/product/battery-90?search=battery#attr=278
9	Battery Holder	1	https://edu-makerlab2021.odoo.com/shop/product/aa-battery-holder-48?search=battery#attr=49
10	Speaker	2.5	https://edu-makerlab2021.odoo.com/shop/product/speaker-59?search=speaker#attr=64
11	220 ohm resistor	0.04	https://edu-makerlab2021.odoo.com/shop/product/resistor-6?search=+resistor#attr=11
12	Acrylic panels	16	https://makerstore.ca/shop/ols/products/acrylic-12-inch-x-24-inch/v/M002-24-X-1-4-BLC

6. Conclusion :

After our client meeting and prototype II and III planning, we have come up with our upgraded prototype I and alternative (prototype II and III). We have gone over what they will be, how they will work, why we are performing these tests and the different values we have obtained from our test (ie. delay time). We have made our upgraded bill of materials which is simply the acrylic for the case of the arduino and have listened to our clients feedback and will implement it into our next prototype.

7. Bibliography

[1]https://www.sae.org/news/2017/04/co2-buildup-in-vehicle-cabins-becoming-a-safety-issue

8. Wrike Link

https://www.wrike.com/open.htm?id=776833452