Deliverable F: Prototype 1 & Customer Feedback

Ah Chuen, Kate; Ayed, Evanna; Eid, Ziad; Onusko, Belle; Watt, Kymani

Group 1

GNG1103 - B01

TA: Kaleb Mannion

University of Ottawa
Thursday, November 4th 2021

In this deliverable, we will be documenting the planning and construction of our first prototype and devising a test plan for the construction of our second prototype.

1. Analysis of the critical components or systems in our first prototype(Kate)
    1. The NTC Thermistor that we will be using is important because it will be able to detect if the temperature in the car is within a dangerous range. This is part of the first step in our alert process. A thermistor is a resistance thermometer which increases the resistance within the circuit as the temperature increases and decreases the resistance within the circuit as the temperature decreases. It is 'activated' when the temperature increases at a very high rate in a short period of time and since it is connected to the Arduino board, it will be able to send an output to it.
    2. The ESP32 Arduino Board that we will be using contains small and fast microcontroller boards and comes with inbuilt Wifi and Bluetooth features which will be useful for our project because we want our device to be able to send a Bluetooth output. Additionally, it is very small so it will allow us to create a discrete device that won't intrude on the family's car ride.
    3. We will use double AA batteries to power our Arduino system. These are essential for the function of our whole device because everything relies on the Arduino system. These are powerful and low cost at the Dollar Store. We will determine the proper amount that is needed to efficiently power our device.
    4. Wires are important because they will help us connect the important components that will produce the required inputs or outputs to our Arduino board.
    5. The codes that we have researched and compiled so far will be used to create our own code that will be able to use a suspicious temperature reading from the NTC Thermistor to produce the desired output that will notify the parents and/or bystanders. For our next prototype, we hope to have compiled enough code to connect the Arduino to an application on a cellular device.
2. Our prototyping test plan, analysis and results (All)
    1. Prototyping Test Plan (based on Deliverable E):
        i. In-person(Ziad, Kymani, Belle, Kate): Make the physical prototype out of materials found at home

ii. Virtual(Evanna): Research and compile some code that we can use when coding our Arduino board

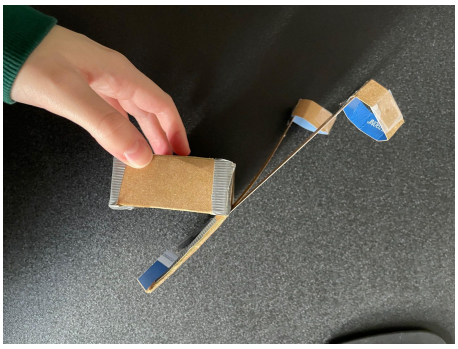
2. Prototype Analysis:

Component:	Observations:	Future plans:
Casing for arduino	- Our current prototype has an opening door at the back to change the batteries.	- We plan to move this door to the side, so that if it is opened by mistake, everything will not fall out.
Straps attaching to headrest	- We noticed the straps on this prototype appear a bit too short. - This prototype lacks the clasps that will allow us to attach and detach the straps to the headrest.	- We plan to make the straps longer, and to measure out the ideal length in a real car.
Coding	- We used tinkercad to test our our starting code - The first working draft of the code took the received input from the temperature sensor and converted it into celsius using equations. - Adjusting the delay between temperature readings allowed the sensors to more accurately sense the changes in temperature	- The plan for next week is to find a way to transmit the code to a cellular device - We plan on using the actual arduino and sensors to check how our code works in person

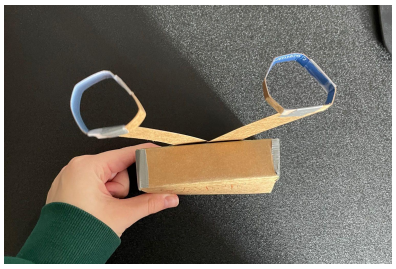
3. Results:

(Front View)

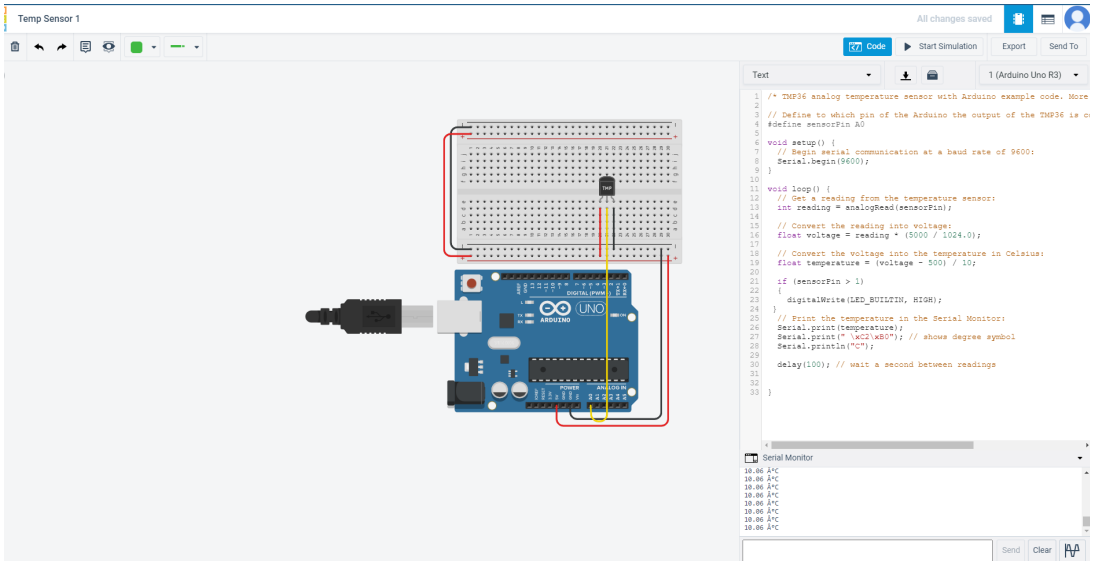
(Top-Back View)



(Side-Left View)



(Top View)



3. Documented prototyping test plan:

The initial idea was to use a thermal camera for our project, but the problem with that was the price as all thermal cameras are extremely expensive and difficult to code.

Now the idea is to use a temperature sensor (NTC Thermistor) since it's much more affordable and easier to use .

4. Feedback and comments from potential clients/users (Kate & Ziad)

Ziad and Kate met with some friends, family members and fellow uOttawa students to discuss the problem that this project is addressing and the solution concept that they came up with. Then, they asked for constructive feedback and comments on the current prototype that those future parents or current parents had. Here are the highlights of the comments we got:

<u>Current Parents:</u>

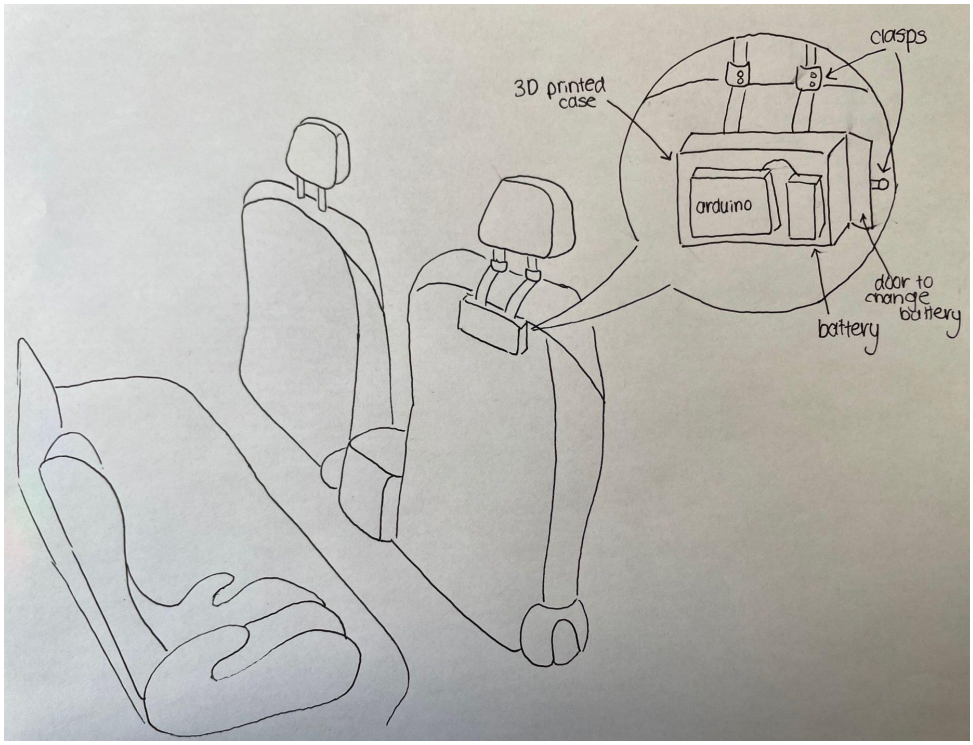
- "Maybe you shouldn't make the device rectangular in case the kid's head or arms hit it, or even the parent's when they help the baby in the car seat because " -Judith, Kate's older cousin Judith and mother of a 2 year old
    - We didn't consider this when we were designing our device. This is a valid concern so we will smooth the edges and corners of our device to make the future prototype smoother and safer.
- "How does the device attach to the car because I am only seeing 2 rings on the straps that don't have openings? It might be easier to make it a knotted shoe-lace design that can easily knot to the part of the car it's supposed to." -Michael, Kate's cousin and father of a 6 month old
    - We will reconvene and discuss if there is a more efficient way to connect the device to the car that will be simple enough for the parents to do and won't be easily undone

<u>Future Parents:</u>

- "The idea is very good and practical, but I think it would be better to use proper material and not a cardboard box for the system" -Ariane B
    - We won't use cardboard because cardboard isn't 'kid-friendly' and would be very hard to clean food off of. The cardboard was simply for the prototype because it was a cheap and easy material to manipulate.
- "The straps for the prototype aren't adjustable and look a bit too short and we know

that all kids and all cars come in different sizes so I believe that it would be best if you manage to make the straps more adjustable and longer" - Luther L
    - The goal is to sell these internationally to all types of families with different size cars and babies so we will need to adjust our straps to accommodate our target clientele.
- "The parent can just put the device on the seat. Why do you need to connect in such a fancy way to the car" -Vaishnavi, Kate's friend and 1st year university student
    - We want to make sure that our device is able to stay consistent in its performance and we don't want it getting lost. Parents have enough worries and finding the device should not be one of them.

Updated design drawing:



Cost Estimation and Bill of Materials:				
Component	Description	Amount	Cost($)	Total Cost
Wires	Always in need of wires.	6	0.10	$0.60

The Arduino case- 3D printing filament	Plastic casing that covers the arduino, outer case will be 3D printed	1	2.50 (free for us)	$2.50
ESP32 - Arduino+	Containing the arduino board, breadboard,some wires and transistors.	1	10.94	$10.74
NTC Thermistor	Probes used to measure changes in temperature.	2	2.18	$4.36
Batteries	Used to power the system.	4	1.00	$4.00
Speaker	Used to notify bystanders.	1	10.00	$10.00
Snap fasteners (kit)	To secure straps to headrest, and close / open box	1	1.39	$1.39
Fabric for straps	Glued to outer casing to attach to headrest	1	4.95	$4.95
		Overall Cost :	$38.74	
		Allocated Budget:	$50.00	
		Money left (in case of emergency):	$11.26	

- Esp32 - Basically an arduino board with wifi/bluetooth capabilities. https://edu-makerlab2021.odoo.com/shop/product/esp32-111?search=esp#attr=233
- Ntc Thermistor - Probes that are used to measure surrounding temperatures https://edu-makerlab2021.odoo.com/shop/product/ntc-thermistor-138#attr=
- Batteries - Used to battery. https://edu-makerlab2021.odoo.com/shop/product/battery-90?category=5#attr=167
- Speaker - Used to emit sound to alert bystanders https://edu-makerlab2021.odoo.com/shop/product/speaker-59?category=19#attr=363
- Snap fasteners - to secure straps to headrest, and close / open box The Home Fusion Company 20 Sew on Snap Fasteners Fastenings 4 Assorted Sizes Metal Clothes Poppers
- Strap fabric Polypropylene Webbing Strapping Material, Flat Strap, 1 Inch W x 10/5 Yard, Black, UV Resistant Fabric, Web for Bags, Backpacks, Belts, Climbing Harnesses, Slings, Collars, (1" x 1 Yards

6. Prototyping test plan :

a. Purpose of the Test/Objectives:
   i. Determine if the prototype functions properly
   ii. Receive feedback from the client on if the prototype satisfies the needs of the client, and how the prototype can be improved.

iii. Making sure that the materials used are safe around kids and compatible.
iv. Making sure that the hardware and the software pair well together and is coded well so that a concerning detection from the hardware is immediately followed by a response from the software.

b. Stopping Criteria:
   i. We will end testing once our prototype has proven itself to be practical and functioning. We want our device to be stored properly in the car where it can measure the temperature of the car and make sure it does not break.
   ii. We want our sensors to be functioning correctly and to pair well with our alert notification software and to be easy and reliable.

Codes for the temperature sensor that can be used in our project:

These codes will be used to help write out our own code for our temperature sensor. Later on we will search for code for our phone alert.

1) The first code:

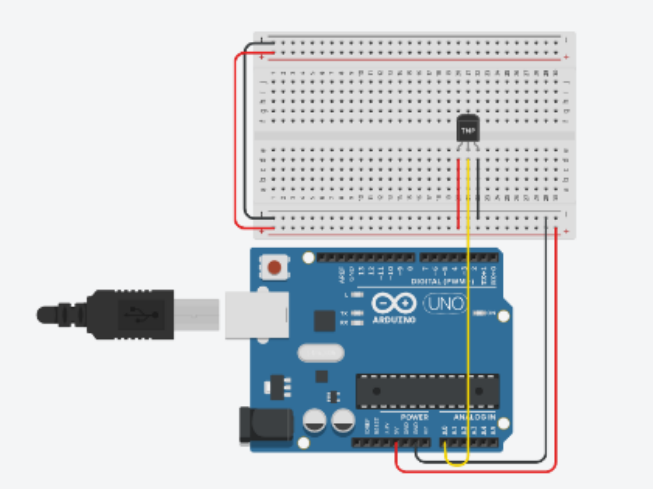
```
float temp;
int tempPin = 0;

void setup() {
   Serial.begin(9600);
}

void loop() {
   temp = analogRead(tempPin);
   // read analog voltage from sensor and save to variable temp
   temp = temp * 0.48828125;
   // convert the analog volt to its temperature equivalent
   Serial.print("TEMPERATURE = ");
   Serial.print(temp); // display temperature value
   Serial.print("*C");
   Serial.println();
   delay(1000); // update sensor reading each one second
}
```

2) The second code:

```
//TMP36 Pin Variables
int sensorPin = 0; //the analog pin the TMP36's Vout (sense) pin is connected to
                        //the resolution is 10 mV / degree centigrade with a
                        //500 mV offset to allow for negative temperatures

/*
 * setup() - this function runs once when you turn your Arduino on
 * We initialize the serial connection with the computer
 */
void setup()
{
  Serial.begin(9600);  //Start the serial connection with the computer
                       //to view the result open the serial monitor
```

```
}

void loop()                     // run over and over again
{
 //getting the voltage reading from the temperature sensor
 int reading = analogRead(sensorPin);

 // converting that reading to voltage, for 3.3v arduino use 3.3
 float voltage = reading * 5.0;
 voltage /= 1024.0;

 // print out the voltage
 Serial.print(voltage); Serial.println(" volts");

 // now print out the temperature
 float temperatureC = (voltage - 0.5) * 100 ;  //converting from 10 mv per degree wit 500 mV offset
                                               //to degrees ((voltage - 500mV) times 100)
 Serial.print(temperatureC); Serial.println(" degrees C");

 // now convert to Fahrenheit
 float temperatureF = (temperatureC * 9.0 / 5.0) + 32.0;
 Serial.print(temperatureF); Serial.println(" degrees F");

 delay(1000);                                  //waiting a second
}
```

3) The third code:



```
/* LM35 analog temperature sensor with Arduino
example code. More info: https://www.makerguides.com
*/

// Define to which pin of the Arduino the output of
the LM35 is connected:
#define sensorPin A0

void setup() {
  // Begin serial communication at a baud rate of
9600:
  Serial.begin(9600);
}

void loop() {
  // Get a reading from the temperature sensor:
  int reading = analogRead(sensorPin);

  // Convert the reading into voltage:
  float voltage = reading * (5000 / 1024.0);

  // Convert the voltage into the temperature in degree Celsius:
  float temperature = voltage / 10;

  // Print the temperature in the Serial Monitor:
  Serial.print(temperature);
  Serial.print(" \xC2\xB0"); // shows degree symbol
  Serial.println("C");

  delay(1000); // wait a second between readings
}
```

Building the first prototype was a memorable and very educational experience and we're looking forward to building our second prototype based on the client and public feedback that we received. We can't wait to create the best product for our client.

```
#include<LiquidCrystal.h>



LiquidCrystal lcd(12,11,5,4,3,2);

const int con=75;

#define sensor A1           //sensor input pin

#define buzzer 7            //buzzer pin




void setup()

{

 pinMode(buzzer,OUTPUT);      //configure pin 7 as output

 analogWrite(9,con);          //adjust lcd contrast
```

```
 Serial.begin(9600);          //start serial communication

 lcd.begin(16,2);

 lcd.setCursor(0,0);

 lcd.print("    Digital     ");

 lcd.setCursor(0,1);

 lcd.print("  Thermometer   ");  //Desiplay starting message

 delay(4000);

 lcd.clear();                        //clear lcd



}



void loop()
```

```
{
```

```
    float reading=analogRead(sensor);      //read the value of sensor
```

```
    float temperature=reading*(5/1023.0)*100;   //convert the reading into
celsius scale
```

```
    delay(1000);
```

```
   Serial.print(temperature);
```

```
   lcd.clear();
```

```
   lcd.setCursor(2,0);
```

```
   lcd.print("Temperature");
```

```
   lcd.setCursor(2,1);

   lcd.print("in C =");

   lcd.print(temperature);    //print the temperature









   delay(10000);              //delay of 10 seconds

   if(temperature>=30){       //check if temperature>30

      lcd.clear();

      lcd.setCursor(2,0);

      lcd.print("Warning");

      lcd.setCursor(0,1);

      lcd.print("Temp High");     //display warning message
```

```
      digitalWrite(buzzer,HIGH); //turn on the buzzer




    }

    if(temperature<=20){     //check if temperature<20

      lcd.clear();

      lcd.setCursor(4,0);

      lcd.print("Warning");

      lcd.setCursor(3,1);

      lcd.print("Temp Low");    //display warning message

      digitalWrite(buzzer,HIGH); // //turn on the buzzer

      }

}
```

Join Zoom Meeting

https://uottawa-ca.zoom.us/j/91767788635?pwd=dUJRMjgvRDlUSUtTUnI0ZklkQlRaUT09

Meeting ID: 917 6778 8635

```
// include the library code:
#include <LiquidCrystal.h>

const int con=75;
#define sensorPin A0          //sensor input pin


// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

void setup()
{
```

```
  analogWrite(9,con);         //adjust lcd contrast
  Serial.begin(9600);         //start serial communication
  lcd.begin(16,2);
  lcd.setCursor(0,0);
  lcd.print("    Digital    ");
  lcd.setCursor(0,1);
  lcd.print("  Thermometer   ");  //Desiplay starting message
  delay(4000);
  lcd.clear();                  //clear lcd
  // Begin serial communication at a baud rate of 9600:
  Serial.begin(9600);
}



void loop() {
```

```
// Get a reading from the temperature sensor:

int reading = analogRead(sensorPin);



// Convert the reading into voltage:

float voltage = reading * (5000 / 1024.0);



// Convert the voltage into the temperature in degree Celsius:

float temperature = voltage / 10;



  Serial.print(temperature);

  lcd.clear();

  lcd.setCursor(2,0);

  lcd.print("Temperature");

  lcd.setCursor(2,1);

  lcd.print("in C =");

  lcd.print(temperature);   //print the temperature
```

```
  delay(1000);


}
```

Join Zoom Meeting

https://uottawa-ca.zoom.us/j/94815339076?pwd=a05YeTFiWXJLQ2lBMkZ6ZWMxNStzQT09

Meeting ID: 948 1533 9076

Passcode: M93pUH