Deliverable G: Prototype 2 & Customer Feedback

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

Group 1

GNG1103 - B01

TA: Kaleb Mannion

University of Ottawa
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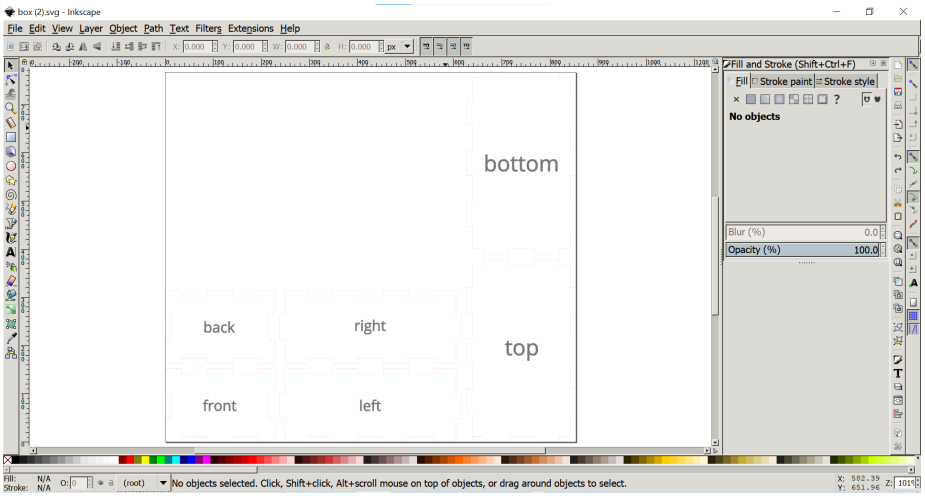
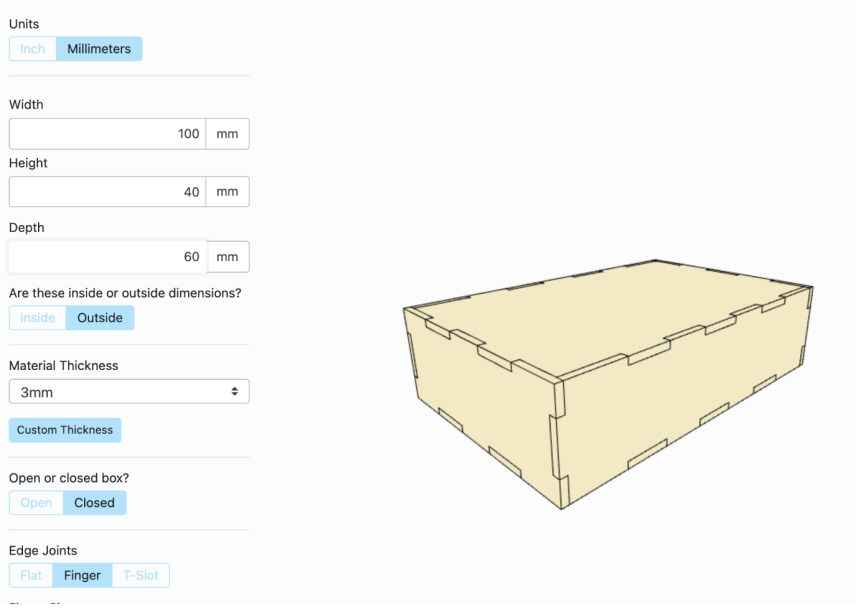
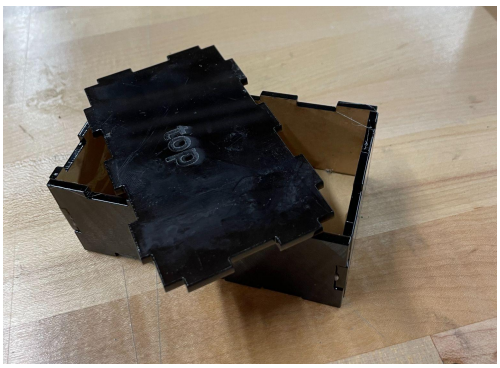
In this deliverable, we will be documenting the planning and construction of our second prototype, based on the feedback we received on our first prototype, and devising a test plan for the construction of our third prototype.

1. Here is the **prototype** that we have developed to achieve the objectives that we set up in our last deliverable. This prototype will be the case that the Arduino board, batteries and wires required for our device's function will be in. We first made a digital prototype on Makercase and Inkscape and then printed the 10cm x 6cm x 4cm acrylic case in the laser cutting machine at the campus' Maker Lab. The laser cutting process was fairly quick which will be beneficial when the client is mass producing the device.







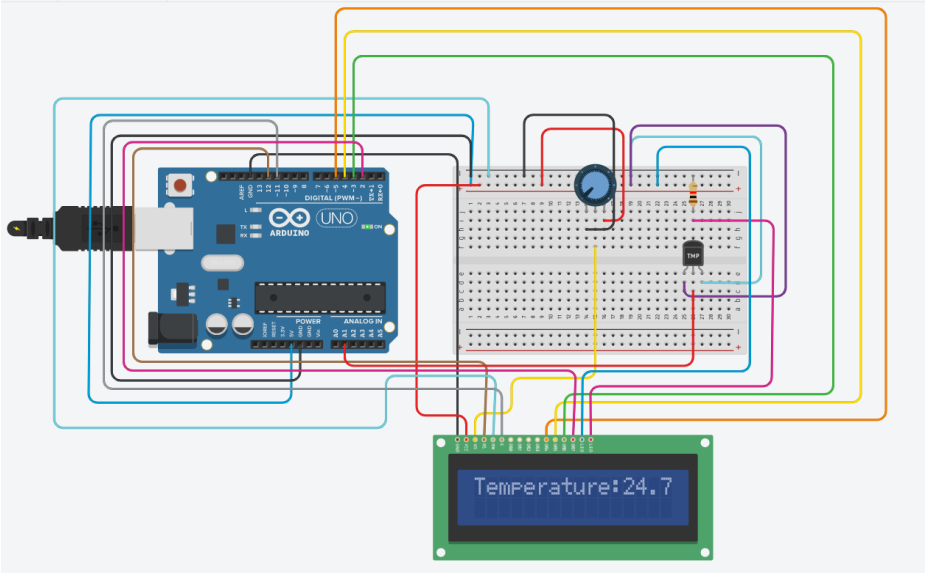
The following link is for the virtual circuit that we built on Tinkercad of the hardware that will be in this box:
https://www.tinkercad.com/things/gq5RUTNA27w-copy-of-temperature-sensor-display-with-lcd-in-arduino/editel?sharecode=qvcSwXFhrJ8E5N4I1usfjwY-ynNYQhIniefTWjJ3wAE

The code for the arduino:

```
#include<LiquidCrystal.h>
LiquidCrystal lcd(12,11,5,4,3,2);
float value;
int tmp = A1;
void setup(){
        pinMode(tmp,INPUT);
}

void loop(){
        value = analogRead(tmp)*0.004882814;
        value = (value - 0.5) * 100.0;
        lcd.setCursor(0,1);
        lcd.print("Temperature:");
        lcd.print(value);
        delay(1000);
        lcd.clear();

}
```



(The thermistor detects the temperature and is coded to display it on the LCD screen)

We hope that we will be able to build this virtual circuit in person for our next prototype.

3.a) & 6) Prototyping test plan:

Thurs. Nov. 11 2021	Deliverable G due (Prototype 2)
	- Prototype 2 created
	  - In-person:
	  - Kymani & Ziad: Help Evanna make the existing codes more specific to our project, test the new codes on the Arduino board and manipulate them - 5 days
	  - Belle & Kate: Work on refining the outside aesthetic of the project - 5 days
	  - Virtual:
	  - Evanna is in charge of the coding aspect of the project. It is up to her to delegate the tasks to Ziad and Kymani - 5 days
	- Testing:
	  - Testing the code to make sure that the sensor can detect a certain range and that the device can release a sound(don't have to be connected yet)
	  - Have a teammate breathe rapidly and see if the sensor detects it
	  - Have a teammates breathe very slowly and see if the sensor detects it
	  - Code the Arduino board to produce a noise and listen

	to hear if it does - Testing the outer design of the project to make sure it is waterproof, sturdy, 'kid-proof' and comfortable - Pour water on device - Spill food on device and attempt to wipe it off - Place a teammate's arm against the sensor and gently apply pressure
Tues. Nov. 23 2021	Client Meeting - Team shows the client the prototype that was built for Deliverable G that is a semi-functioning version of the final device - 15 min (All) - Client gives his feedback on what he likes/doesn't like, what can be improved/what should stay - 10 min - Team takes notes and reconvenes after the meeting to talk about the changes that will be made and what will be kept for Prototype 3 - 1 hour (All)
Thurs. Nov. 25 2021	Deliverable H due (Prototype 3) - Prototype 3 created - In-person: - Kymani & Ziad: Help Evanna make the finishing touches to the existing code and test the new codes on the Arduino board - 5 days - Belle & Kate: Work on refining the outside aesthetic of the project and can help with coding if needed - 5 days - Testing: - Testing the code to make sure that the sensor can detect a certain range and that when it does, it releases a sound - Have a teammate breathe very rapidly and very slowly and listen for a noise output - Testing the outer design of the project to make sure it is waterproof, sturdy, 'kid-proof' and comfortable
Tues. Nov. 30 2021	Client Meeting - Team shows the client the prototype that was built for Deliverable H that is a fully-functioning version of the final device - 15 min (All) - Client gives his feedback on what he likes/doesn't like, what can be improved/what should stay - 10 min - Team takes notes and reconvenes after the meeting to talk about the changes that will be made and what will be kept for the final device - 1 hour (All)

3.b) **Prototype analysis:**

Component:	Observations:	Future plans:

Acrylic case	- The black coloured acrylic would absorb too much heat. This would make our temperature sensor inaccurate.	- For our next prototype, we will also cut two holes in the back of the box, so that our straps can loop through to create a stronger bond.
Straps & clasps	- These are currently missing from our prototype, as we are still waiting for them to arrive.	- They will secure the case to the headrest. - They will also be placed on our case door (as shown in design drawing).
Sensors	- We currently do not have a way to detect the presence of a child.	- We will purchase a PIR sensor to detect a person in the car.

4. **Feedback:**

Comments:	Possible solutions:

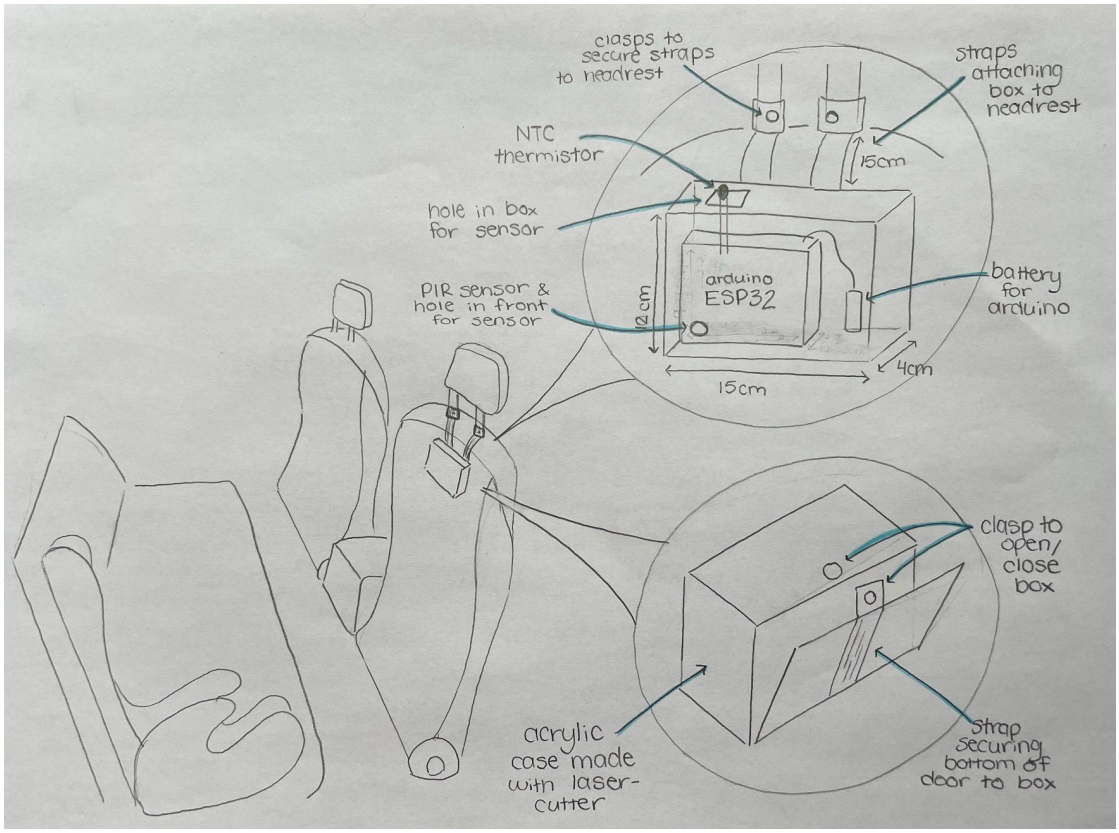
- The client stated that rechargeable batteries for our device would be more efficient and ideal. This way, busy parents will not have to buy new batteries on a regular basis, manually change them or remember to charge them which increases their likelihood of parents using the device and increasing the success of the device.	- Solar-powered batteries:
	  - Too expensive for budget
	- Lower-end rechargeable batteries:
	  - Require another power source to charge them

- The acrylic box that we laser cut is black and we received some feedback from a friend that the black colour may affect the thermistor's temperature reading because the box will absorb more heat than the actual car.	- We will make the box with a material that is a lighter colour
- The acrylic box's top can easily be lost as it isn't connected to the rest of the box.	- We will make modifications to our box's design to create a mechanism that will connect the top to the rest of the box while allowing it to open and close

- 1 sensor may not be enough to be sure that the alert is accurate	- We will add a second sensor who's reading will verify the validity of the first sensor's alert
	  - PIR motion sensor
	  - Heart rate/respiration sensor

	- CO_2 sensor
- The straps won't be as solid if they are simply attached to the outside of the box than if they are secured to the box's overall design	- We can add holes to the back on the box's virtual prototype that will let the straps go in to be secured

Updated design drawing:



With our updated design drawing, we have established specific measurements for our design. However, we must wait to finalize the measurements of the hole in the box for the temperature sensor. Also, our strap length has been extended so that our case may sit better when hanging from the seat. We have also decided to have our case open at the front, instead of the side. This will give the parent more room to reach inside and replace or recharge a battery when needed. In our last drawing, the opening was on the side. Finally, we have also added a PIR sensor to our design. This will also be contained inside our box, and an additional hole will be added to the front of the box to allow the sensor to detect the presence of a child or animal.

Updated BOM: (addition of PIR sensor)

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	0.83	$1.66
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
PIR sensor	Inside case, to detect motion of child	1	4.68	$4.68
		Overall Cost :	$41.74	
		Allocated Budget:	$50.00	
		Money left (in case of emergency):	$8.26	

1. Esp32 - Basically an arduino board with wifi/bluetooth capabilities. https://edu-makerlab2021.odoo.com/shop/product/esp32-111?search=esp#attr=233
2. Ntc Thermistor - Probes that are used to measure surrounding temperatures https://www.digikey.ca/en/products/detail/murata-electronics/NXRT15XV103FA1B040/3900395
3. Batteries - Used to battery. https://edu-makerlab2021.odoo.com/shop/product/battery-90?category=5#attr=167
4. Speaker - Used to emit sound to alert bystanders https://edu-makerlab2021.odoo.com/shop/product/speaker-59?category=19#attr=363
5. 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
6. 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

7. PIR sensor - sense the presence of a child to activate system
   https://edu-makerlab2021.odoo.com/shop/product/pir-sensor-46#attr=
   https://www.digikey.ca/en/products/detail/IRA-S410ST01/490-12572-ND/5797463

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