Honeycomb: User and Product Manual

GNG 1103B

Group 3

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Introduction:

Children in locked cars, especially in extreme temperatures, are in immediate danger if left alone. A product was needed to help these children by either removing them from the car or regulating the temperature in the car. Our solution is simple to install, easy to use, and can be integrated directly into any vehicle.

Designed for parents on the go and caretakers worried about their children's safety, the Honeycomb is a straight-forward solution to a situation that can quickly become life-threatening.

Our Solution:

The Honeycomb addresses the client's concerns and given design criteria while being reliable and uncomplicated. It is made up of a fan, sensors, an Arduino UNO, and a battery pack. It will sense when a child is in the vehicle and if the temperature is above 25°C, then activate a cooling system that regulates the temperature until it is manually reset by the caretaker and the child out of harm's way.

Target Specifications:

Table 1: The Best Specifications for Functional, Non-Functional, and Constraint groups

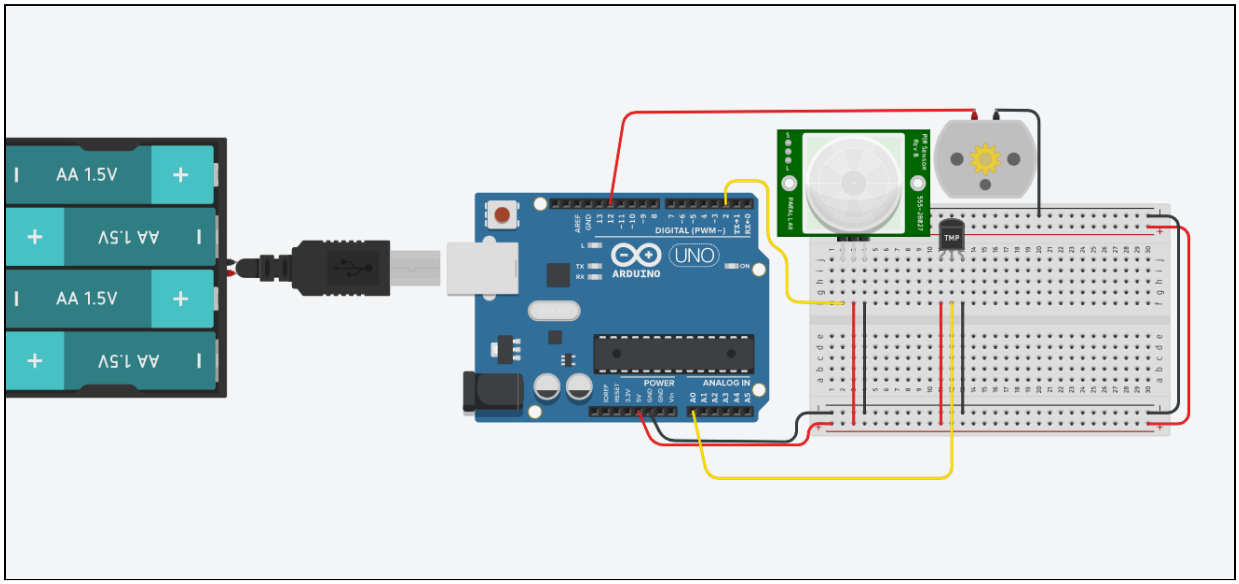
Necessary Specification	Required Value(s)	Verification
Child Alive and Unharmed	Mostly	Test
Stable Temp and Exiting Car	< 60 min	Test
Not integrated	Yes	Analysis
Identifies child through motion	Yes	Test
Compatible with all vehicles	Yes	Test
Triggers without formal interaction	Yes	Test
Constraints	**Required Value(s)**	**Verification**
Cost	50$	Feedback from PM
Size	Fits in car (relatively small)	Estimate
No/Lack of premade communication infrastructure	Still functions	Test/Analysis
Non-Functional Requirements	**Required Value(s)**	**Verification**
Aesthetics	Positive client feedback	Direct feedback from client
Reliability	75-99% efficiency	Test

Ease of installation	Positive client/customer feedback	Direct feedback/Test

Digital Design:

Image 1: Arduino UNO Wiring Diagram

[Link to Wiring Diagram & Associated Code]



Product Design:

[Link to Product Case Design]

Image 2: Front View of the Product Case

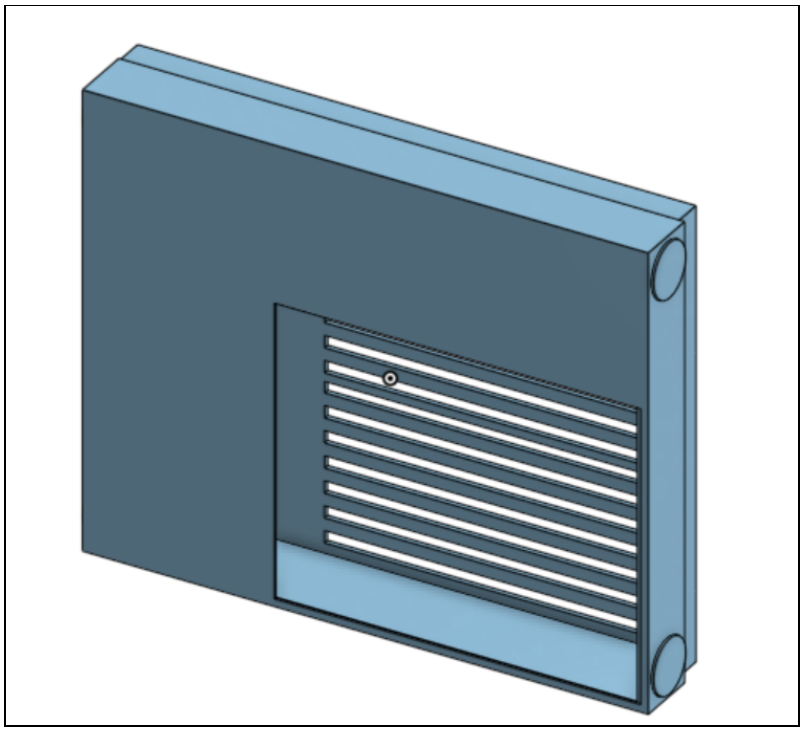


Image 3: Back View of the Product Case

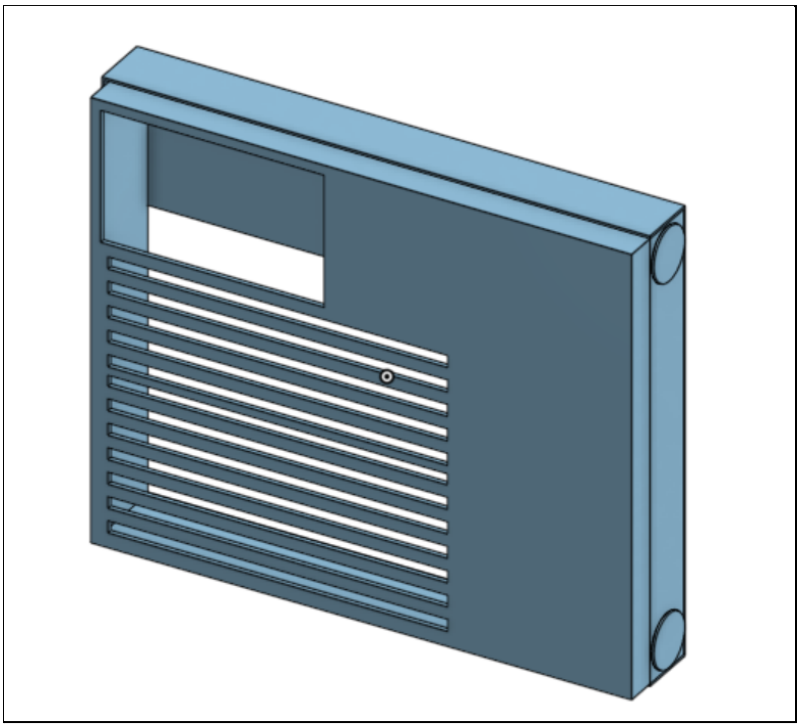


Image 4: Product Design

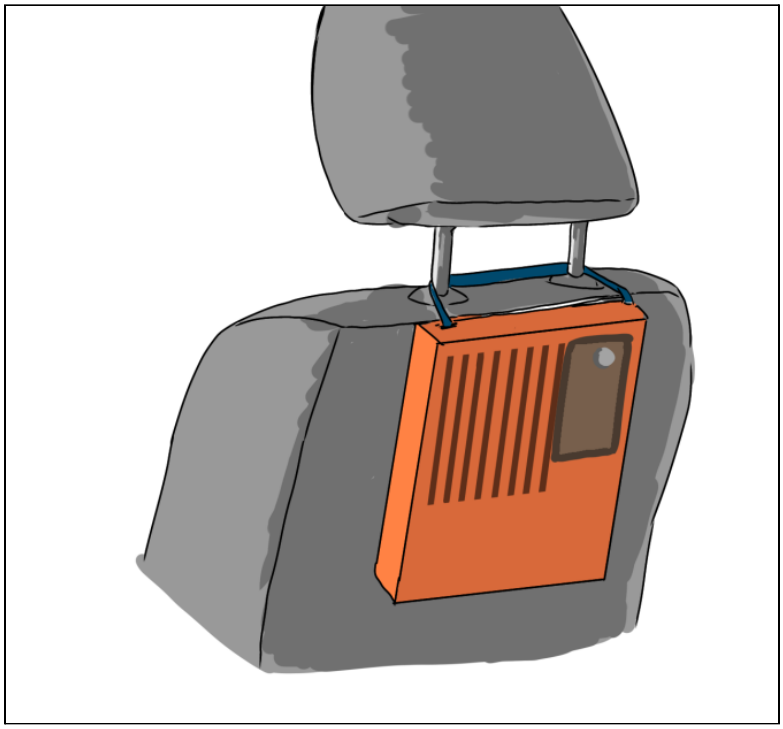
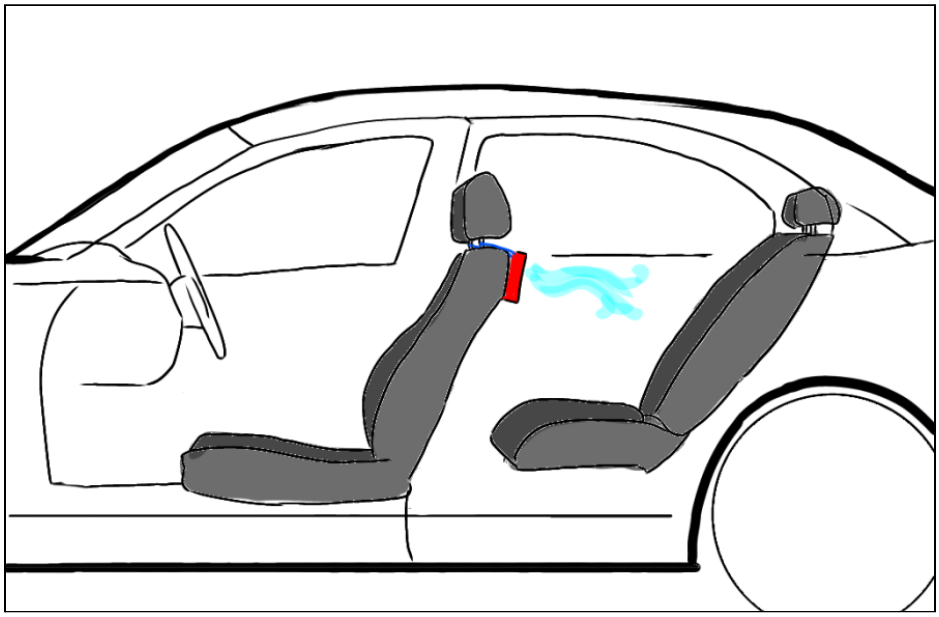


Image 5: Product Placement



Physical Prototype Solution:

Image 6: Final Prototype

Materials Used:

- 1 x 3D- Printed Composite Structure
- 1 x 51 CFM DC Axial Cooling Fan
- 1 x 6-slot battery pack
- 1 x Arduino UNO
- 1 x TMP36-Analog Temperature Sensor
- 1 x RE200B series Motion, Pyroelectric, PIR (Passive Infrared) Sensor Evaluation Board
- 3 ft. Wires
- 6 x AA Batteries

Bill of Materials:

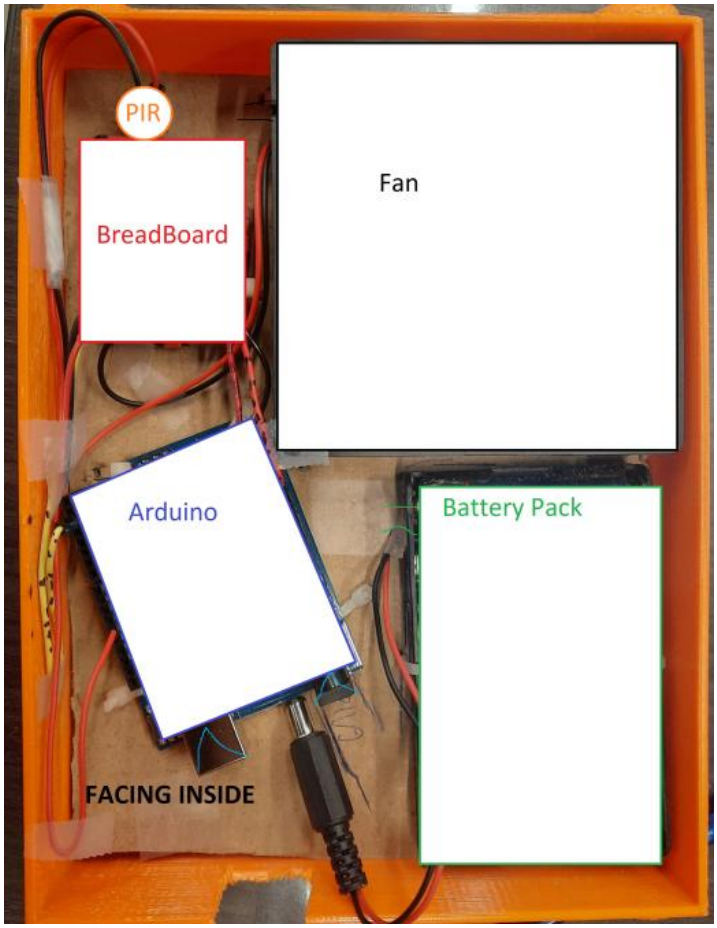
Link to BOM

Image 7: Bill of Materials

General Component Name	Specific Component Name	Scource	Price Per Unit ($)	Quanity	Total ($)
Misc Structual Component	N/A	N/A	5.00	1	5.00
Temperature Sensor	TMP36GT9Z	https://www.digikey.ca/en/products/detail/analog-devices-inc/TMP36GT9Z/820404	2.51	1	2.51
Fan	EE80251S2-1000U-999	https://www.digikey.ca/en/products/detail/sunon-fans/EE80251S2-1000U-999/619872(	4.34	1	4.34
Power Scorce (Battery)	Battery Holder + 4 Batteries	https://edu-makerlab2021.odoo.com/shop/product/aa-battery-holder-48#attr=47	5.00	1	5.00
Arduino Uno	Arduino Uno	https://edu-makerlab2021.odoo.com/shop/product/arduino-5#attr=5	20.00	1	20.00
LED Light	(DONATED BY TEAM MEMBER	https://www.futureelectronics.com/p/semiconductors--optoelectronics--leds/4304h5-vc	0.30	1	0.30
Wiring	5ft	https://edu-makerlab2021.odoo.com/shop/product/wire-5ft-45?search=wire#attr=213,2	2.50	1	2.50
PIR Sensor	N/A	https://edu-makerlab2021.odoo.com/shop/product/pir-sensor-46?page=3#attr=	3.00	1	3.00
Motor	108990003	https://www.digikey.ca/en/products/detail/seeed-technology-co-ltd/108990003/548779	6.59	1	6.59
				Prototype #	Total Protoype Cost
				3	49.24

Hardware Diagram:

Image 8: Hardware Diagram



Building Procedure:

1. Download the 3D-printed case design, and print with the file provided as advised.
2. Using a thin sheet of 6” by 8” cardboard as a structural plate, affix a battery pack, Arduino UNO, and breadboard facing “inward” as shown in the Hardware Diagram. To affix an item, drill a hole relative to screw slots in the respective components. Drill another hole adjacent to each of these holes. Next, use a cable-tie or a piece of cord to create a loop from which the product can be hung.
3. After affixing each part, cut a 3.5” diameter hole into the cardboard centred around the fan’s position as shown in the Hardware Diagram. Cut another hole roughly 0.5” in diameter to slot the PIR sensor into. Then affix the fan and PIR facing “outward”.
4. Download the Arduino UNO Wiring Design and code provided. Program the code onto the Arduino.
5. Place the sheet of cardboard and components facing downward (upwards side towards the grill) into the base of the case, as shown on the Hardware Diagram. When placed inside the bottom of the 3D-printed case, the cardboard should be large enough to fit snugly. If too large, adjust the size of the cardboard using a pair of scissors. If too small, affix with adhesive such as tape or glue
6. Once firmly placed, begin wiring the components to the breadboard and Arduino UNO according to the code and individual specifications of parts, provided in the Wiring

Diagram. Ensure that the PIR sensor is running through a resistor and that the temperature sensor is slotted into the breadboard.

7. When the wiring is secured, insert the batteries and plug the power port into the Arduino. The product should now be fully operational.
8. Affix the back cover and reset button.
9. Add and adjust the mounting cable as needed. Hang over the back of the driver's or passenger's seat facing the baby seat.

Code:

The Honeycomb system runs on a simple loop written in the programming language C. It loops through two functions every ten seconds. These two functions are both 'read' functions of the sensors used; a PIR motion sensor and a temperature sensor. The digital 'read' function of the PIR sensor returns a status of HIGH or LOW while the TMP36 returns a float value calculation based on the analog 'read' function. The system then checks to see if the PIR value = HIGH and if the temperature is over 25°C (or 0°C if in Demo mode). If both these conditions are met the system will then the fan will turn on for five hours or until the system is reset by the user. The code is as below:

```
int sensorPin = A0;
int pirPin = 2;
int pirStat = LOW;
int val=0;
int motor1pin=12;
 int motor2pin=13;
 int x;
float temparray[10] = {0,0,0,0,0,0,0,0,0,0};
float tempav = 0.0;
int y = 0;
void setup()
{
Serial.begin(9600);
pinMode(pirPin, INPUT);
pinMode(motor1pin, OUTPUT);
pinMode(motor2pin, OUTPUT);
}
void loop()
 {
int reading = analogRead(sensorPin);
float voltage = reading * 4.5/1024;
float temperatureC = (voltage *100) - 44 ;
Serial.print(temperatureC);
Serial.println(" degrees C");
Serial.println(analogRead(sensorPin));
Serial.println(digitalRead(pirPin));
y = y + 1; Serial.println(y%10); temparray[(y%10)] = temperatureC; tempav =
(temparray[0]+temparray[1]+temparray[2]+temparray[3]+temparray[4]+temparray[5]+temparray[6]+temparray[7]+temparray[8]+temparray[9])/10; Serial.print(tempav); Serial.println(" average degrees C");
Serial.println(temparray[9]);
val=digitalRead(pirPin);
if(val==HIGH)
{
Serial.println("PIR sensor activated");
if(pirStat==LOW) { pirStat=HIGH; }
 }
else { Serial.println("PIR sensor not active");
if(pirStat==HIGH)
 {
pirStat=LOW; }
 }
if(val==HIGH&&tempav>=0)
{
digitalWrite(motor1pin, HIGH);
delay(100000);
digitalWrite(motor1pin, LOW);
}
delay(1000); }
```

Installation and Intended Use:

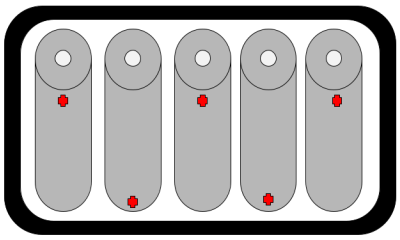
As seen in Image 4 and 5, the Honeycomb is to be installed on the back of either the passenger's or driver's seat, facing towards the baby seat. Secured to the headrest and tilted in

the direction of the child, it will sense when the temperature is 25°C and start the fan which will cool the environment and thus the child until it is manually reset by an adult.

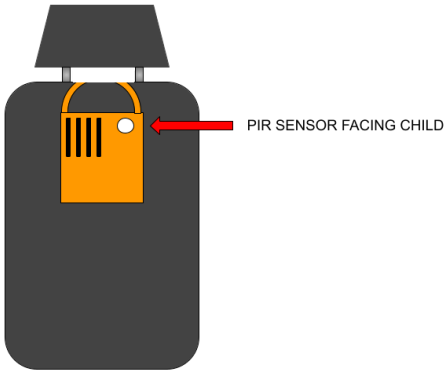
How to Operate the Honeycomb:

The Honeycomb is a very simple device to operate. It is a plug-and-place device, and thus only needs the batteries added and to be hung in the desired location (recommended in front of the child's seat). The system will automatically start sensing for movement and temperature. If the system does trigger at an undesired time, simply hit the reset button and the Honeycomb will begin scanning again.

Step 1: Insert batteries.



Step 2: Hang the Honeycomb device in the desired location.



Your system is all set for use! Make sure to change the batteries regularly!

Safety Warnings:

The current prototype is not a final for-sale product, and must be further developed before it is ready to be sold commercially. The Honeycomb is not 100% reliable and we do not encourage leaving a child unattended in a car with the current version of the product. Ensure that any hair, loose garments, or things that may get caught are kept away from the fan. When replacing the batteries, unplug the battery pack. Only reset the Honeycomb using the external reset button, and do not attempt to take it apart. Install out of reach from the child. If the product is overheating, reset it or unplug the batteries for a short time to allow it to cool.

Potential Hang-Ups and Troubleshooting:

How to reset the Honeycomb when something goes wrong?

Simply either press the reset button on the arduino(preferred method), or you can remove the batteries and replug them back in.

My Honeycomb won't turn on?

The most likely source of loss of power is dead batteries. Ensure all batteries are AA and placed in the correct order (positive/negative) and have some life left in them.

My Honeycomb is going off at random times?

Your best bet is to reset the system via the arduino reset button. If the issue persists contact technical support.

How do I replace the batteries of my Honeycomb?

Simply remove the old ones and place new AA batteries in the correct order as shown in Step 1 of the Operation

Why use the Honeycomb instead of other available products?

The Honeycomb is cheaper, more robust and a simple solution to your hot-vehicle problems!

Maintenance/Repair Information:

The Honeycomb's batteries must be replaced depending on use, but is advised to do so every 3 months to prolong product lifespan. Before doing so, ensure to unplug the battery pack and allow the product to cool, then lay it flat and open the back cover. If the cord suspending the Honeycomb is to break, it can be replaced with any similar bungee cord or hardware-grade rope to the user's discretion. Any further maintenance or repair can be directed toward Honeycomb Customer Service. Do not attempt any additional upgrades or repair without company guidance.

Conclusion:

The Honeycomb device takes the weight off parents' shoulders worldwide by eliminating the risk of this potentially dangerous problem. For situations that can quickly become life-threatening, it is a high quality, straight-forward robust solution that will ease any caretaker's mind.