Project Deliverable J

Project Presentation

University of Ottawa

GNG 1103

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1. Final Presentation Script

In this presentation, we are going to present our solution to the hot car emergency and outline each step in the design thinking process. We are first going to explain five important steps in each designing process. First of all, a design process is to create or to plan engineering design by first understanding real problems and empathizing customer's needs while ensuring safety and functionality using engineering knowledge and creativity. To optimize the product quality and customer's satisfaction, we need to follow five steps of the design process, which are empathizing, defining, ideating, prototyping and testing.

Design thinking process consists of five main steps which are empathize, define, ideate, prototype and test. During the first meeting and interview, our client emphasized that children dying in locked cars due to heat strokes and carbon monoxide poisoning is not only a persistent problem in his country, UAE, but also a world-wide concern of parents and guardians. According to NSC Injury facts, on average, 38 children under the age of 15 die each year in the US from heat stroke after being left in a vehicle (NSC, 2021). Although some children were intentionally left by their parents, most deaths were due to “Forgotten Baby Syndrome,” which refers to parents who accidentally leave their child in a locked car. The 80% of temperature increase will occur in the first 30 minutes (NSC, 2021) so it is imperative to get children out of the car as soon as possible. Therefore, there is a need to design a simple and easily-accessible device to notify parents and guardians without making any physical or software modification.

In the defining part, we analyzed the given information and tried to define the problem as well as its constraints in a short and specific way. These were defined based on the information we gathered while doing benchmarking on four different products. Table 1,2 and 3 are the result of our defining step.

Six main interpreted needs were listed. For each need, we have defined specific design criteria, which can be applied to more than one needs. Table 1 shows the needs from the most important to the least, along with their design criteria. Since the child/pet detection and notification system are of the utmost importance, we have carefully chosen the design criteria which involves motion, CO2 and temperature monitoring systems. While ensuring compatibility and universality as design priorities, we have also included aesthetics, two-way audio system and speaker as design criteria to entertain and calm children.

Table 1: Client Needs and Their Design Criteria

#	Need	Design Criteria
1	Child detection and Notification system	Alerting system (push notification), Motion detection, CO2 detection, Temperature monitoring
2	Compatibility with any vehicle	WIFI or Bluetooth system, width and length, backup battery, weight
3	Easy to install without engineering background	Quick set-up time
4	Durability of material in extreme weather conditions	Type of material, stability, operating conditions, product life
5	Reasonable sale cost	Cost
6	Entertain and calm children	Aesthetics, two-way audio system, Speaker

Table 2 : Comparison of Importance Given by each Plug-in after Benchmarking

Device / Specifications	Importance/Weight	Laxihub M1	KINGMELL BABI	Rbicor	Elepho eClip
Company		LAXIHUB	Kingmell	Rbicor	Elepho
Alerting system (push notification)	5	2	3	3	3
Motion detection	4	2	2	2	0
Wifi/bluetooth	4	1	2	3	3
CO2 detection	4	0	0	0	0
Temp. monitor	4	0	0	0	3
Size	2	3	1	2	2
Weight	3	3	1	1	3
Cost	2	3	2	2	3
Type of material	2	1	3	2	2

Set-up time	3	3	3	3	3
Backup battery	2	0	3	0	0
Product life	2	1	2	2	2
Speaker	2	2	0	2	0
Aesthetics	1	2	2	2	2
Total points		60	67	69	77

This step (product score) is marking each specification we found, and calculating the total mark to find the best product as reference of our own design.

After our processing of Design Criteria and Benchmarking. We summarized our estimation of each Design specification based on Functional Requirements, Constraints, and Non-Functional Requirements.

Table 3 : Design Specifications

#	Design specifications	Relation	Value	Unit	Verification Method
Functional Requirements					
1	Alert system	=	Yes	NA	Test
2	Motion detection	=	Yes	NA	Test
3	Mobile connectivity	=	Yes	NA	Test
4	CO2 detection	=	400-10000	ppm	Test
5	Temperature monitoring	=	400 - 10000	ppm	Test
Constraints					
6	Cost	≤	50	$	Analyze
7	Weight	≤	1500	gm	Estimate
8	Length	≤	30	cm	Estimate
9	Width	≤	20	cm	Estimate
10	Operating Conditions (Temperature)	=	-40 to 60	℃	Test

Non-Functional Requirements					
11	Quick Installation Time	>	5	minutes	Test
12	Durability	=	Yes	N/A	Test
13	Aesthetics	=	Yes	N/A	Test
14	Product life	>	5	years	Test
15	Speaker/Audio system	=	Yes	N/A	Test

The next step is “ideate.” We created a concept design and sketch of the solution in the ideate step. Each member presented lots of different ideas and we iterated based on the user feedback. There were various conceptual subsystem design concepts presented by each member.

Table 4. Conceptual Ideas of Subsystem

Idea #	Subsystem Ideas	Final conceptual design	What we actually used
1	Motion detection with motion sensors		Finalized
2	Temperature monitoring system with temperature sensor		
3	Two-way audio system	Selected	
4	Child-specific pressure cushion that connects with Bluetooth		
5	CO2 concentration detector	Selected	
6	Voice reminder device connected with car system		
7	CO2 and humidity sensor		
8	Alarm system	Selected	Finalized
9	Three-device array with pressure sensor		
10	Co2-activated glass cutting device		
11	Photo sensor for car charger		Finalized
12	Entertainment system for children		

We initially planned to use a CO2 sensor with some entertainment unit for kids trapped in the car. However, after the meeting with the TA, we realized that the motion detector will be way more cost-effective and highly effective than the CO2 sensor. Therefore, we changed major parts of our design. As seen in Table 4, we can observe the huge shift in our conceptual design. This greatly delayed our whole process, which caused more problems in the prototype step.

In the following "prototype" step, we came up with the detailed project plan and started to build a tangible device. For each prototype, we set specific goals and we created different types of prototypes that meet different purposes.

Table 5. Project Plan for Three Prototypes

Task	Assigned	Duration	Due date
Prototype plans	Everyone	7 days	October 21, 2021
Revise the plan based on the client feedback	Everyone	7 days	October 25, 2021
Modifying the design-Zoom meeting with Mohd	Fred and Don	1 day	October 27, 2021
Revising Deliverable E	Everyone	3 days	November 3, 2021
Buying materials	Fred and Don	1 day	November 3, 2021
Prototype I	Everyone	7 days	November 3, 2021
Revise Prototype I & Deliverable F	Everyone	2 days	November 4, 201
Prototype II	Everyone	7 days	November 9, 2021
Revise Prototype II, risk assessment & Deliverable G	Everyone	5 days	November 11, 2021
Prototype III	Everyone	7 days	November 15, 2021
Revise Prototype III & Deliverable H	Everyone	7 days	November 25, 2021
Final design presentation & Deliverable I	Everyone	7 days	December 1, 2021
Final presentation & Deliverable J	Everyone	3 days	To be announced
User and Product Manual & Deliverable K	Everyone	7 days	December 8, 2021

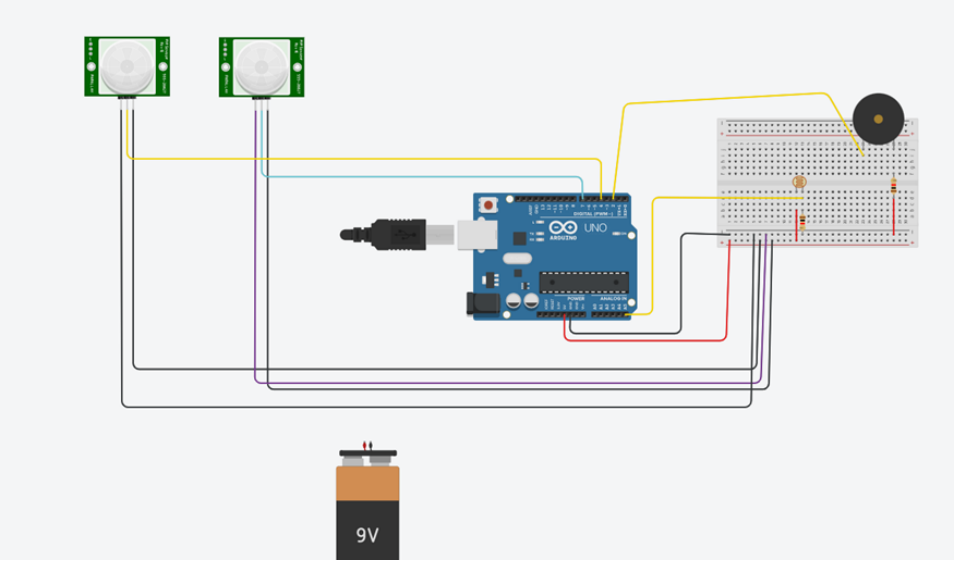

Figure 1. Design created using TinkerCad

We first created a simulation design on TinkerCad and figured out the list of materials that we needed to get. Based on the information we found from TinkerCad, we made the list of materials and their cost chart as seen in Table 6.

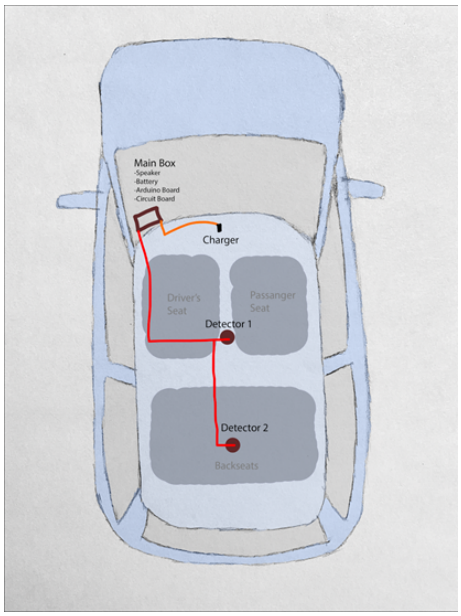

Figure 2. Finalized conceptual design

As aforementioned, we decided not to use a CO2 level detector since it will not be a universal solution in any car environment. Instead, we decided to use two motion sensors that will be attached in the front and back, with one speaker that will notify the driver that there is a child or a pet in the car.

Table 6. List of Materials and their costs

Name	Links	Unit Price	Tax	Total per item	Quanity	Total before tax	shipping	Total after shipping
Motion sensor	link	$10.99	$2.08	$10.99	2	$21.98	0	$24.07
Speaker	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Car charger	link	$15.29	$2.53	$15.29	1	$15.29	0	$17.82
Electrical Wire	link	$9.98	$2.70	$9.98	2	$19.96	0	$22.66
Arduino Board	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
breadboard	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Jumper wires	From GNG lab	$0.00	$0.00	$0.00	20	$0.00	0	$0.00
Resistors	From GNG lab	$0.00	$0.00	$0.00	15	$0.00	0	$0.00
Battery	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Male to Male header pin	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Arduino Cable USB Type A-B	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Protoboard	From GNG lab	$0.00	$0.00	$0.00	1	$0.00	0	$0.00
Total		$36.26	$7.31	$36.26		$57.23		$64.54

Unfortunately, due to the big change in the design, the plan didn't go as we initially set. We had to order different parts from Amazon, which often delayed our prototype processing.

Figure 2-1. Arduino Uno Case

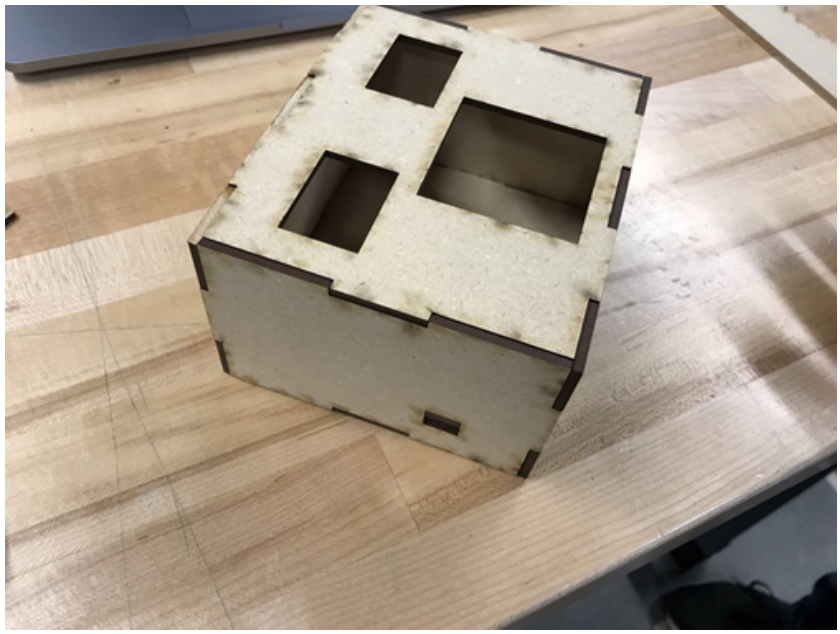

Figure 2-2. Arduino Uno Case

During the prototype phase, we also created a laser-cut box for Arduino Uno, two motion sensors and a speaker.

Figure 3. Completed device

Our design consists of three major parts: motion detecting sensors, audio notification system and a photo sensor that will help activate the device once the car engine turns off. The key advantage of our model is the fail-proof way of activating the device regardless of the deactivation of the car engine. During the last meeting with the client, he expressed his concern about providing power to the device. Since there was no coding solution for the system to determine whether the device is car-powered or battery-powered, we decided to use a light-activated switch circuit; when the car engine turns off, the LED light will also be off, which then triggers the circuit and turns on our detection system. On top of that, when the car engine turns off and the motion sensor detects a child or a pet in the car, the audio system will automatically play the alarm "ALERT, there is a baby or a pet in the car." This will make sure that the driver checks their backseat before they leave the car. Also, even if the driver still leaves a child in the car, the alarm will keep playing so that pedestrians passing by the car can help the child. Our device is designed so that it can save a child's life in the shortests yet in a fail-proof way. It is also an affordable solution for all the potential customers. This light and easy-to-install device will help parents and guardians avoid unfortunate accidents in the future.

After completing the prototype phase, the next part is the test step. We test and get feedback from our client. For example, during the prototype step, the client asked many questions about "how to power the device when the car engine is off". Therefore, in the following prototype, my group focused on the back-up battery and car charging part of the device. In the testing phase, we set the "finishing criteria" to successfully complete the testing and simulations. This step was repeated four times so that the device runs without errors. Not following these steps could cause serious consequences. For example, during the prototype step, my group did not really differentiate different stages and purposes for each prototype. Therefore, when we moved to the next prototype, there was always an unsolved problem such as finding the exact measurement of the device to create a container for the Arduino Uno. Setting different goals for each prototype is very important because it allows us to focus on that particular goal in order to move to the next and more detailed prototype. You need to successfully finish each step to move on to the next step. Therefore, reviewing and getting feedback are imperative to design a successful device.

In conclusion, we have collaborated and created a solution for the hot car emergency using five steps of the design thinking process. Based on the defined design criteria, we initially decided to use a CO2 sensor and audio notification system but later

switched to the motion sensor which could offer a more universal and accessible solution. On top of that, by adding a photo sensor that could activate or deactivate the Arduino Uno based on the light on the car charger, we have created a device that could always function even when the car engine is off. There was room for improvement in the overall performance of our group. We could have prioritized our tasks better and actively used Wrike to stay on track. At the end of each step in the design thinking, we could have verified and reviewed each step and shared feedback so that we all knew that we were ready to move on to the following step. Moreover, we could have designed the physical appearance of our device a little more sophisticated and aesthetic. From this course and this specific project, we have learned the importance of each design thinking process and learned how to apply them in creating a real tangible solution to the hot car emergency.

2. Reference

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