Deliverable C - Design Criteria

GNG 1103 - Engineering Design

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Course Coordinator: Dr. Muslim Majeed

Group 8: Hans Rao Ladkoo, Benjamin McConnell, Kobe Belanger, Steven Wilson, Kaitlynn Sampel

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1.0 Introduction

This deliverable outlines our plan to create a working system to prevent the deaths of children and pets locked in hot cars. The system is based on Mansour Kharoub's needs, our research, and interpreted needs statements from deliverable B. In this deliverable, the design criteria is outlined to show all of the constraints on our system and functional/non-functional requirements. A technical benchmarking investigation is utilized to gain a better understanding of the project, additionally, we compare to other products currently available in the market. In doing so we find the best fit for our client and can meet all of his needs.

2.0 Design Specifications: Functional, Non-functional, and Constraints

Based on the information gathered from our client interview we were able to identify specific design needs that our product must have. Additionally, we used that information to research products in the market that could satisfy some/all needs that our client has.

The device detects when a child or pet is present.
- Weight of child for sensors
- Pets and children may not remain in the same spot (don't trigger weight sensors)
- Motion (won't trigger motion sensor if asleep/unconscious)
- Body heat

The device knows when the child or pet is left unattended.
- Door sensors
- Sensors for owner/parent detection
- Inactivity sensor (driver/parent unconscious)
- Proximity to owner's smartphone

The device alerts the owner/parent when the child or pet is left unattended.
- SMS message
- App notification
- Automated phone call
- Door chime
- Instrument cluster/heads up display/media centre notification or reminder

The device keeps the child or pet safe while waiting for help.
- Controlled climate
- Filtered/clean air to the cabin
- Reassuring/calming the child

The device alerts others of the issue when the issue is not attended in a certain time.
- Prevent excessive damage to the vehicle
- Speaker or alarm system outside of the vehicle
- Instructions

The device is not expensive.
- No unnecessary features

- Simple yet effective design

The device is convenient.

- Slim design to fit under the seat or behind the front seat
- Durable to avoid kicking or accidental crushing
- Easy to move and secure in place (in case of removing or folding seats)
- Requires little or no maintenance
- Device is lightweight

3.0 Technical Benchmarking

A variety of products were researched in order to find potential solutions that met our client's needs, although there was not one product that satisfied most needs we were still able to find valuable information. The products researched were primarily for a) keeping the car cool and b) notifying the owner of a vehicle if a was child is left unattended.

The products were evaluated on a scale of 1-4 to quantify how close they are to meeting the specification, where 1 (red) is the lowest, 2 (orange), 3 (yellow), and 4 (green) is the highest.

Table 1. Technical Benchmarking

Product Name	Sense A Life	AutoKool Solar Powered Ventilation	Driver's Little Helper Sensor System	Car Windshield Sun Shade
Company	Sense A Life Team	Koolatron	Driver's Little Helper	EcoNour
Functionality	The device alerts parents to remove their child from the car. In case of no response, emergency contacts are notified.	A window-mounted solar-powered fan extracts hot air and draws cool air from the outside.	A sensor goes under the seat where the child sits and detects movement.	Sunshield protects against UV rays that increase car temperature.
Sensor	Geolocation	N/A	Sensor detects movement	N/A
Power	Long-lasting Lithium-Ion batteries	Solar-powered	Battery	No power
Price	$100 (USD)	$55.99 (CAD)	$54.54 (USD)	$15.99 (USD)
Weight	N/A	1 lb	2 ounces	4.8 ounces
Material	Durable ABS Case	Weatherproof material	N/A	Polyester

Table 2. Weighed Technical Benchmarking

Product Name	Importance (weight)	Sense A Life	AutoKool Solar Powered Ventilation	Driver's Little Helper Sensor System	Car Windshield Sun Shade
Company		Sense A Life Team	Koolatron	Driver's Little Helper	EcoNour
Functionality	5	2	4	3	1
Sensor	3	3	1	4	1
Power	4	4	2	3	4
Price	4	1	3	2	4
Weight	2	1	2	4	3
Material	3	4	3	1	2
Total		15	15	17	15

4.0 Target Specifications

The target specifications were based on the benchmarked data and the information gathered from our client. The tables below show the specific functional requirements, constraints, and non-functional requirements our final product should have.

Table 3. Functional Requirements

	Design Specifications	Relation (+, < or >)	Value	Units	Verification Method
	Functional Requirements				
1	Detects when a child or pet is present	=	yes	N/A	Test
2	Detects if child or pet is unattended	=	yes	N/A	Test
3	The device alerts the owner if a child or pet is left unattended	>	10	min	Test
4	The device keeps the child or pet safe while waiting for help	<	28	Celcius	Test
5	The device alerts people in close proximity	<	30	meters	Test

Table 4. Constraints

	Design Specifications	Relation (+, < or >)	Value	Units	Verification Method
	Constraints				
1	The device is not expensive	<	150	Dollars	Estimate
2	The device is compact	<	14x 17 x 28	inch	Analysis
3	The device is easy to install	<	1	hour	Test
4	Operating conditions	=	15 to 40	Celcius	Test
5	Weight	<	40	lbs	Analysis

Table. 5 Non-Functional Requirements

	Design Specifications	Relation (+, < or >)	Value	Units	Verification Method
	Non-functional Requirements				
1	Reliability	=	Yes	N/A	Test
2	UV Resistance	=	Yes	N/A	Test
3	Aesthetics	=	Yes	N/A	Test
4	Discrete	=	Yes	N/A	Test
5	Product life	>	5	years	Test

5.0 Reflection

During the client meeting, we were explicitly told that as long as the kid is unattended and left in the car, regardless of whether the temperature is dangerously high or not, the device has to alert the owner and the passers-by. Hence the system should detect when the child is present and unattended. Also, if a minimum of ten minutes has elapsed and the child is still unattended, the system will alert the owner and passers-by. The client said we need to get passers-by involved, thus the device needs to alert the passers-by as well, in the vicinity. Hence a radius of 30 m has been chosen because it is a close-range distance. We were also informed that the child should be kept safe while help is on the way. A safe temperature range of less than 28℃ has been chosen. (Above 28℃, it starts getting too hot) As a result of these client specifications, the above five functional requirements were chosen.

During the client meeting, we were told that the prototype should be affordable. Hence $150 has been chosen as the cost. As in deliverable B, installation time is not a critical factor and a max installation time of one hour has been chosen. The device should be able to sense high temperatures for it to be functional and the highest temperature of 40 ℃ has been chosen after research because this is among the highest temperatures recorded in most countries. A broad temperature range of 15℃ to 40℃ has been chosen to account for temperatures that are considered safe for the child and those that are dangerous. A size of 14 x 17 x 28 inches and a weight of fewer than 40 lbs has been deemed as most appropriate for the device, after accounting for the fact that the device should not take up too much space nor be too heavy.

6.0 Conclusion

This deliverable has introduced our client to our design specifications for a device that tells guardians that their child or pet is left unattended in a car. Although there are not many options on the market, there are some devices that are comparable to the client's needs. These devices include the following: (a) Sense A Life which scaled a 15 on the Technical Benchmarking scale; (b) AutoKool Solar Powered Ventilation which scored a 15; (c) Driver's Little Helper Sensor System which scored a 17; and (d) Car Windshield Sun Shade, which scored a 15. From this data, it is concluded that Driver's Little Helper is the optimal option for reference when creating a new device.

References

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