



AUBREY BAKER & SARAH TIPOFF

Vehicular Child Reminder

2018-2019

Engineering Design and Development
Career and Technological Education Center



AUBREY BAKER & SARAH TIPOFF

VEHICULAR CHILD REMINDER PREVENTS CHILD MORTALITIES

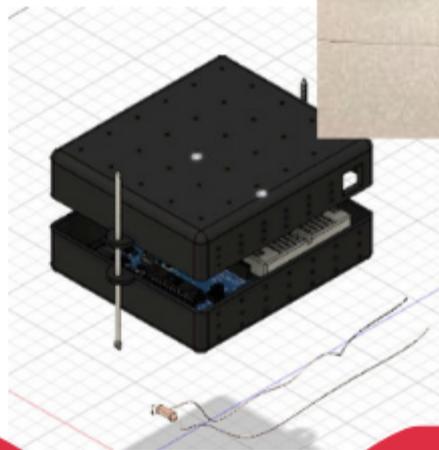
From 1998-2015, 636 children have died from vehicular heatstroke.



WE HELP YOUR CHILDREN.

PORTABLE ALARMING

Since 1998, there have been 705 documented deaths in children that were caused by vehicular heatstroke. Out of those that died, 54% of the mortalities were caused by the child being forgotten in the car.



The Vehicular Child Reminder serves as an alarm that will notify a parent and/or guardian that is driving a car with a small child in the back seat. When the child's harness buckle is clicked together and the driver's side door is open, an alarm will sound until the door is shut. An alarm sound and a LED light will flash on a continuous loop. This will allow for the driver to be reminded immediately rather than a delayed time so that the kid can get removed from the car without having the risk of enduring heatstroke.

PROBLEM STATEMENT

Since 1998, there have been 705 documented deaths in children that were caused by vehicular heatstroke. Out of those that died, 54% of the mortalities were caused by the child being forgotten in the car. However, some parents are not aware of the drastic temperature changes that can occur when the vehicle is turned off. The state of Texas ranks number one in child hot car deaths across the United States.

EXPERTS

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Vehicular Heatstroke

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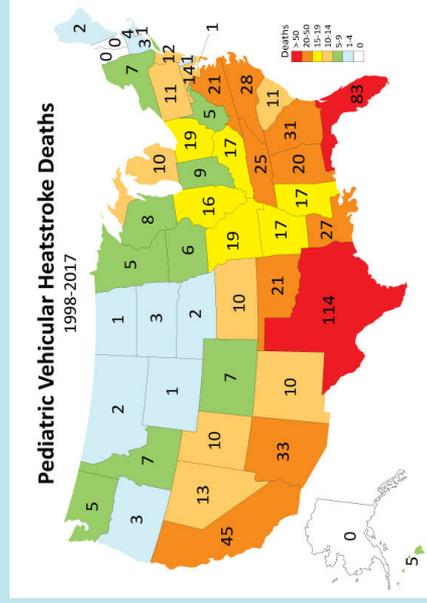
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ASSOCIATIONS & ORGANIZATIONS

National Safety Council

1121 Spring Lake Dr, Itasca, IL 60143-3201
(800) 621-7615

National Highway Traffic Safety Administration

200 New Jersey Ave, SE Washington, DC 20590
(888) 327-4236

Pediatric Center of Round Rock

7700 Cat Hollow Dr, #104 Round Rock, TX 78681
(512) 733-5437

Safe Kids Worldwide

1255 23rd St, NW, Suite 400, Washington, DC 20037-1151
(202) 662-0600

KidsAndCars.org

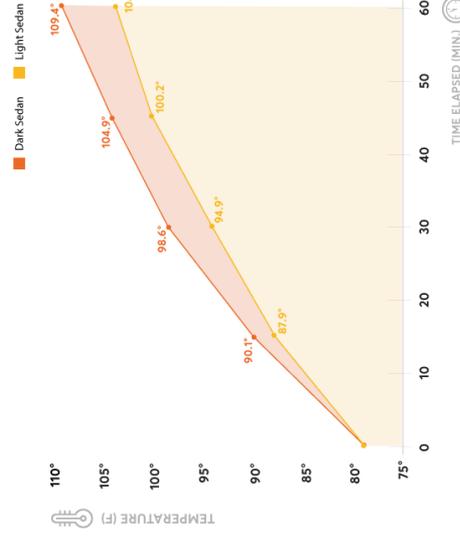
email@KidsAndCars.org
(913) 732-2782

Automotive Safety Council

737 Mallibu Dr, Lexington, KY 40502
(859) 269-4240

Vehicle Temperature Rise in 1 Hour

Even in a lightly colored vehicle, temperatures become dangerous for kids within just one hour.



Vehicle temperature measured on a partly cloudy day, with air temperature averaging 78.4° F.

BASIC FACTS & KNOWLEDGE

Heatstroke happens when the body temperature :exceeds 104°F

Heatstroke is the leading cause of non-crash related fatalities for children 14 and younger:

- 1998-2015, 636 children died from heatstroke
- 53% child "forgotten" by caregiver
- 29% child playing in unattended vehicle
- 17% child intentionally left in vehicle by adult
- 1% unknown cases

The inside of a car can reach up to 125° with the windows cracked
The average number of U.S. child vehicular heatstroke deaths is 37 per year



JUSTIFICATION ARTICLES

CHILD VEHICULAR HEAT STROKE FACT SHEET

This article identifies the contributing factors that cause vehicular heatstroke. It then goes on to analyze the data found when dealing with the science, deaths, and preventative measures that deal with vehicular heatstroke.

FEASIBILITY STUDY OF VEHICULAR HEATSTROKE AVOIDANCE SYSTEM FOR CHILDREN

Vehicular heatstroke is a serious problem where preventative measures can be taken to avoid the detrimental effects. It also provides details about how the vehicle can reach such extreme temperatures within minutes.

HEATSTROKE DEATHS OF CHILDREN IN VEHICLES

The ages, environment type, and circumstances that are mostly related to vehicular heatstroke deaths are confirmed.

A WARNING TO PARENTS ABOUT VEHICULAR HEATSTROKE

The information within this resource addresses the symptoms associated with heatstroke and how to prevent it from happening.

NEVER LEAVE YOUR CHILD ALONE IN THE CAR!

Facts about hyperthermia deaths in children and how to implement more safety in regards to this issue is provided.

KIDS IN HOT CARS HEAT STROKE FACT SHEET

Extensive depth on the data of the causes and outcomes of vehicular heat stroke is expressed in the document.

Justification Articles

Source:

Jali, H. M., Ismail, A., Izzuddin, A. T., Sulaima, F. M., & Mokhtar, S. M. (2015). Feasibility Study of Vehicular Heatstroke Avoidance System for Children. *The International Journal Of Engineering And Science*, 4(11), 14-18. Retrieved October 9, 2018, from https://www.researchgate.net/profile/Mohd_Jali/publication/286002022_Feasibility_Study_of_Vehicular_Heatstroke_Avoidance_System_for_Children/links/5665426a08ae418a786dc97f/Feasibility-Study-of-Vehicular-Heatstroke-Avoidance-System-for-Children.pdf.

Summary:

This article discusses the feasibility of current systems to prevent vehicular heatstroke accidents. It begins by introducing the problem, analyzing which parts of the car heat up the most, why children are more susceptible to heatstroke, and explains some of the general statistics behind vehicular heatstroke accidents. According to the text, an overwhelming majority of child vehicular heatstroke deaths was the result of loving, responsible parents that unknowingly left their child in the car. Next, the article breaks down the pseudocode behind most systems used to prevent vehicular heatstroke accidents and analyzing the effectiveness of the current systems. Its system initializes with the engine off and it will automatically delay one minute to ensure that there's time for the parent to get the child out of the vehicle. The sound and motion sensors will be engaged to detect any live forms. If the vehicle is clear then the system will send a text message to the driver or first person, and if the system is at reset then it will temporarily disengage the sensors. If this doesn't occur then the system will send a text message to the next person, and the sensors will continue to engage will the system is reset. The sensor used for this system are PIR sensors, which is a passive infrared sensor, and sound sensors. The PIR sensors measure infrared light radiating from objects in its view, which is about 12 feet. As found in the results, the PIR sensors could sense movement within 180 degrees and detects people up to 30 feet away. If the sensor detects a child in the vehicle, the LED that acts as a warning light will turn ON and automatically OFF when the sensor detects no movement. The article concludes by stating through their research and data, that the current method of sound and movement detection is effective in detecting if a child was left behind in a vehicle and what should be done in the future to improve the system.

Critique:

This article provides validity, but also provides need for further research. This article again proves that there is a problem with vehicular heatstroke accidents and that an effective solution needs to be developed. This article however provides need for further research due to the methods they found to be the most effective in detecting if a child has been left behind, sound and motion. In my original research what seemed to be the most effective method was temperature and a sensor to detect if the car was turned on. I think the methods discussed in this article are effective, but have to be more expensive at the very least. This adds the unique aspect of what method should be used to detect if a child was left behind, or if it would be the best to combine the two methods of sound and temperature which at this point has not been done yet.

Justification Articles

Source:

Null, J. (2013, July 15). *Heatstroke Deaths of Children in Vehicles* [PDF]. San Francisco: San Francisco State University.

Summary:

This text goes into depth over the statistics surrounding vehicular heatstroke accidents. The article begins by looking at the statistics of how many deaths there have been since 1998 and what were the causes of these. It found that 52% of kids were forgotten by the caregiver or what we typically think of being the causes of these accidents, but the other 48% being from children playing which makes up 29% of the incidents, being left intentionally in the vehicle which makes up 18% of the incidents, or unknown causes which only makes up 2% of the incidents. The article then shifts and looks at the ages of the victims, with age and percent of accidents being inversely proportional and the geographical locations of these accidents, with Texas having by far the most. Finally the article concludes by looking at the science behind why a vehicle heats so quickly and by stating general safety recommendations.

Critique:

The article provides insight to the problem of vehicular heatstroke by providing a plethora of statistics and even the science behind why a car heats up so fast, debunking methods like leaving the window cracked. This article adds a myriad of unique aspects to my overall research such as the causes behind vehicular heatstroke accidents with only 52% actually occurring through the stereotypical leaving a child in a car accidentally. Also learning about the science behind how a car heats up so fast stresses the importance of the interior color, with darker areas of a car sometimes reaching up to 180 degrees. Also this highlights the importance of this issue by proving that Texas has had by far the most vehicular heatstroke and the amount of vehicular heat stroke accidents grows each year.

Justification Articles

Source:

A Warning to Parents About Vehicular Heat Stroke. (2016, June 11). Retrieved from <https://www.pediatriccenterofroundrock.com/a-warning-to-parents-about-vehicular-heat-stroke/>

Pediatric Center of Round Rock

Summary:

First and foremost, heat stroke deaths are the leading cause of non-crash-related auto fatalities for children ages 14 and under. On average, 37 children die each year, and more than half of them are under two years old. Most heat stroke deaths occur during the summer, but deaths are also happen in other weather conditions including the cold. Children are more susceptible to heat stroke because their bodies heat up three to five time faster than adults. Cars can heat up very quickly, and a vehicle's interior temperature rises at the same rate with the windows open or closed. Signs of heat stroke include shock, collapse, temperature over 104 degrees Fahrenheit, fainting, seizures, and not being able to walk. Heat illness symptoms include weakness, dizziness, nausea, feeling faint, headache, and an increased body temperature. To sum up, never leave children unattended in a vehicle, even with the windows open, lock the car to prevent children from hiding and playing in it, look before you lock the car, and call 911 if you see a child trapped in a car.

Critique:

The information presented in this article provides insight on the causes of child vehicular heat stroke to best know how to approach a solution to the problem. Since the main cause of this problem is forgetfulness, then the solution can be some sort of reminder to the parent or guardian either with software, mechanical, or electrical qualities. Also, since the victims of this problem aren't typically able to communicate at their age, their needs to be a body heat sensor to detect if someone is still in the car. Something brought up in the article, is that it's important to keep the car locked while not in use because kids could find their way inside but not be able to get themselves out. This definitely contributes to the causes of our problem, so this suggests that there should be some alterations to the cars locking and unlocking system for small children.

Justification Articles

Source:

Willingham, A. (2018, July 20). More than 36 kids die in hot cars every year and July is usually the deadliest month. Retrieved from <https://www.cnn.com/2018/07/03/health/hot-car-deaths-child-charts-graphs-trnd/index.html>

Summary:

Instances where kids have died in a hot car include children being forgotten in a car, accidentally locking themselves in a car or trunk, or a child being intentionally left in a car. The Department of Meteorology & Climate Science at San Jose State University has been collecting data on these incidents since 1998, and the highest number of deaths per year was 49 deaths in 2010. 2015 had the lowest number of deaths with 24, but 2017 was an unusually deadly year with 42 deaths. Even though it's obvious that states with higher temperatures are typically where most deaths by vehicular heat stroke happen, there have been instances in nearly every state. Texas had the most deaths from 1998 to 2015 with 100, Florida was second with 72, and California was third with 44. The hottest months inevitably bring higher hypothermia rates. As of July 20, 2018, 26 children have already lost their lives this year due to hot cars. 87% of vehicular heat stroke victims are 3 or younger. The young age of most victims is expected because they're typically in rear-facing safety seats and can't effectively communicate or unbuckle themselves. Only 19 states have actual laws that make it illegal to leave children alone in a car in the first place. Since situations of deaths are almost always accidental, these laws don't necessarily contribute to the prevention of hot car deaths. With "Good Samaritan" laws, 19 states offer some legal protection to people who reasonably intervene when they see a child in a hot car. Children are more at risk of this occurrence due to their biology. Children's body temperatures rise 3-5 times faster than adults, the temperature of a car can get to 20 degrees within 10 minutes, and heat stroke can occur in the shade, with the windows down, and even at temperatures as low as 57 degrees.

Critique:

I find the last fact of the summary extremely compelling because most people would think that the temperature of a car would still be under control within certain

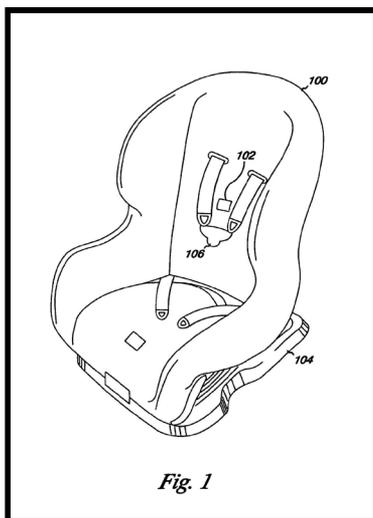
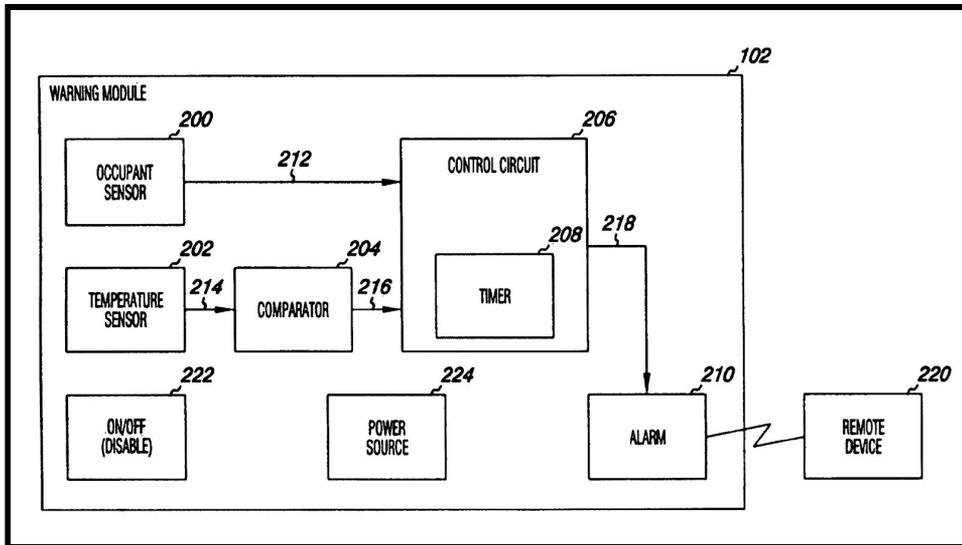
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circumstances, but those circumstances can be deceiving to the reality that a car will still be able to reach high temperatures within the enclosed space. This article does an exceptional job conveying facts of not just certain regions or states but the country as a whole. Vehicular Heatstroke has become a well-known problem within our country, and it can be easily avoided with the right solution. The number one cause of this problem is people's forgetfulness, so a reminder that comes from the car itself or with an app on people's phone could be a potential solution. Also, people get distracted so easily by their phone or their own thoughts, so a way to make sure they're not distracted when getting out of the car is important.

Patent Search

Patent Number: US6922147B1

Images/Sketches:



Patent Summary:

This patent is for a car seat that has a force sensor and temperature sensor to detect if a child has been left in the car seat. If the car seat determines that a child has been left

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behind, then an alarm will go off through the car seat. The benefits of this car seat is that it has what is believed to be the most efficient way of detecting if a child has been left behind-- a force sensor and temperature sensor. The alarm system is also built into a car seat which is an advantage to this design.

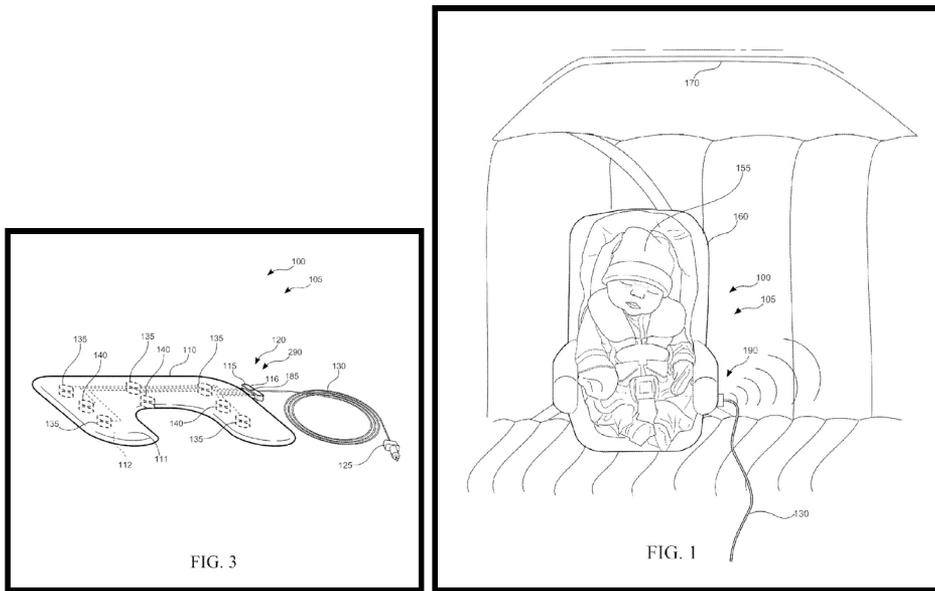
Patent Critique:

The patented idea is an attempt to solve the issue I'm tackling, but is a little outdated. Some good attributes are the force sensor and temperature sensor system used to determine if a child was left behind. However, the alert system and car seat design itself is extremely outdated. Since this patent was published in 2001, mobile phones were not a big innovation at the time. This means that the design relies on the use of an audible alarm through a remote alarm. Obviously it is ineffective to have a separate device to carry around when phones exist now. Another thing to consider is that the car seat is front facing while the newest and safest car seats are typically rear facing. The unique aspect this patent adds is the temperature and force sensor combination used to detect if a child has been left behind.

Patent Search

Patent Number: US9569948B1

Images/Sketches:



Patent Summary:

This patent is for a device that can be placed under a car seat and be synced with the car itself. It uses a combination of a weight sensor and a temperature sensor along with information from the car, like if the ignition is off to trigger the car's anti-theft alarms if it determines a child was left in the car. The main benefits are that this invention can be placed under any car seat. It also uses the car itself as the medium for the alarm.

Patent Critique:

The presented idea is a unique attempt to solve the problem, but it may be a little unreliable and too tech-savvy. According to the results of similar inventions, having the force or weight sensor not being an actual part of the car seat is unreliable and may not be able to accurately determine if the seat is occupied as well as a sensor that's built

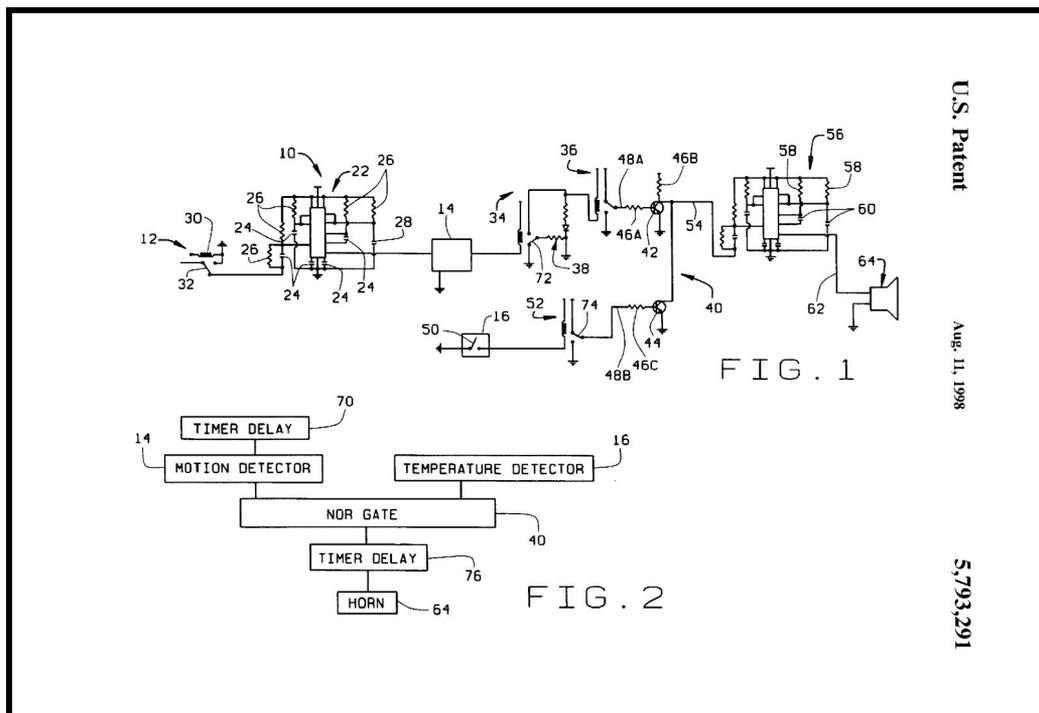
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into the car seat. A really cool attribute of this design is how it uses the car's built in alarm system, but that could damage the child's ears. Looking at the patent there seems to be a lot of reliance on the car itself. Thus if someone has an older car, this device may not work. The unique aspect this patent adds is the use of the car's anti-theft system as an alarm.

Patent Search

Patent Number: US9845050B1

Images/Sketches:



Patent Summary:

A motion sensor is used to determine if an individual is left behind in the car. Not only is a motion sensor included with this proposed invention, but a NOR gate and temperature detecting element as well. The NOR gate is a Boolean operator that will go through a series of true and false statements and if the temperature detecting element identifies that the temperature is above a certain degree, then the alarm system will sound when motion is detected. This patent is supposed to be placed in a car to prevent heat stroke from occurring in an individual left in a car. The benefits of this device are that it has a temperature detector that will confirm the dangerous temperatures. It is also built into the car which has an advantage for consumers so they don't have to install it themselves.

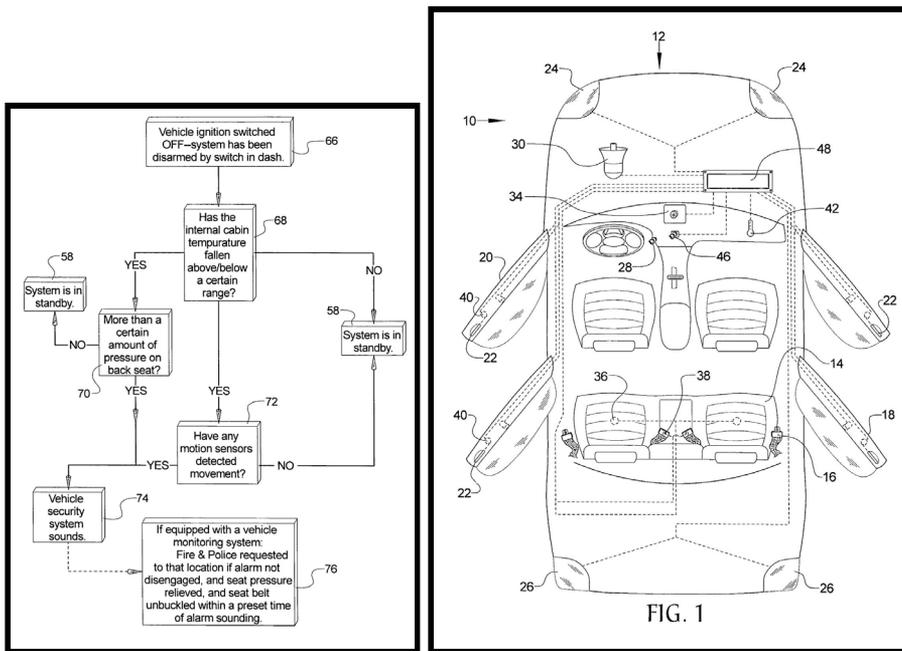
Patent Critique:

The idea has a clear way to solve the issue of vehicular heat stroke. However, a problem is presented when the child is asleep. The child will be stationary with little to no movement. This means that when motion is not detected, the Boolean operator will not be triggered to set off the alarm. Since this patent was published in 1996, technology was not the same at all. It doesn't include any of the new technology advances such as smartphones. The only way that someone can know if there's a child in the car is through the audio alarm. This is ineffective because the person that's trying to be alarmed would have to be in the same vicinity to a limited radius.

Patent Search

Patent Number: US7170401B1

Images/Sketches:



Patent Summary:

This patent stands out from other devices proposed in which there is a force sensor on the back seat of the car; others implement a force sensor within a car seat. This will allow for an alarm to be set off if there's a child, animal, or other individual trapped inside of the car. It uses a combination of a force sensor, motion sensor, and a temperature sensor. If the ignition is detected to be turned off, then a series of boolean statements will be asked to the system. First, temperature is detected to be either within or out of a certain range. Then, if either motion or certain amount of force is detected the alarm will sound. The main benefits of this design are that the force sensor is implemented into the back seat of the car.

Patent Critique:

One of the major critiques of this design is that the force sensor is within the backseat of the car. This presents a problem when the owner of the vehicle wants to put other things in the back of the car when there's not enough space in the trunk of the car. This position of force sensor is not completely accurate because it cannot guarantee that the seat is being occupied by a living being. Another drawback to this design is that it uses the car's system for all of its operations. This means that if someone owns an outdated car that cannot support the system then they will not be able to use the device.

Similar Products

Product Name: Kars4kids Safety App

Images/Sketches:



Description of the Product:

With the Kars4Kids Safety app, the alarm goes off when you and your phone leave the car so that you'll never forget a baby in the backseat. The app relies on Bluetooth technology; the vehicle used will need to be equipped with Bluetooth for the app to function properly. The app syncs with the vehicle's Bluetooth to sound an alert when you leave the car, reminding you to take the child. The app can be customized with a certain photo or ringtone. You can choose the times that you need the alert, and you have the option to turn the alert on each time you travel. The three options for the alert settings is always on, time frame, and notification only. If it's always on, you will get an alert every time you turn off your engine. There is no need for any input on the driver's part each trip and the app will go off even with a change of routine. With a specific time frame, you can set time blocks during which the app is automatically turned off. The

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alert will be triggered when the engine is turned off during scheduled times, and you can add multiple start and end times. If it's set up as notification only, the default alert setting is off. Each time you phone pairs with you car, an unobtrusive notification will appear in the notification bar of you phone, giving you the choice to turn the alert on. If the notification is not opened then it will disappear when the car is turned off.

Kars4Kids. (2014). Kars4Kids Safety App - Never Forget Your Kid in the Car. Retrieved from <https://www.kars4kids.org/safety-app/#features>

Why does this product solution fall short?:

Although this product has a great concept, the functionality of some features isn't practical. It is claimed that the volume of the app is the volume of the media playing in your car. This means that for people that keep the media volume off or very low then it's not as effective. Also, even though every car may have Bluetooth in the future, it's very inconvenient for cars that don't have Bluetooth implemented in the software. In addition, people have complained in reviews that there aren't very clear instructions on how the app works with the Bluetooth and volume. In another scenario, on a certain function, the app doesn't allow you to answer calls while driving, the malfunction occurs when the user wasn't able to answer calls when they were in a store (not driving). Overall, the app needs thorough revisions to ensure efficiency and a longer duration of use.

Kars4Kids Safety - Apps on Google Play. (n.d.). Retrieved from <https://play.google.com/store/apps/details?id=com.vb.kidsnkars&showAllReviews=true>

Similar Products

Product Name: Evenflo Advanced Embrace DLX Infant Car Seat with SensorSafe

Images/Sketches:



Description of the Product:

This is one of the few car seats on the market with a built-in sensor, and it's designed for babies up to 12 months (35 lbs). The shoulder harness clip is similar to the ChildMinder, but the Evenflo comes with a wireless receiver that plugs into the car's on-board diagnostic port. By plugging it in there, the SensorSafe knows when the engine has been cut, at which point a series of sounds, through a smart chest clip and wireless receiver, will remind you that your child is in the backseat. The gentle chimes remind the driver when the chest clip is unbuckled during transit. Also, the receiver reminds the driver that the baby is still in the back after arriving at the destination. In addition, this technology is compatible with 2008 or newer gas/diesel equipped vehicles purchased in the U.S. or Canada.

8 Life-Saving Gadgets That Remind Parents There's a Baby in the Back Seat. (2018, July 13). Retrieved from <https://www.fatherly.com/gear/best-car-seat-alarms/>

Why does this product solution fall short?:

One of the restrictions of this product is that it can only support babies up to 12 months (35 lbs), but the problem of vehicular heatstroke can also occur to toddlers. Although a majority of these tragic situations is because of a baby sleeping or not making noise in the backseat, there is the case of toddlers getting accidentally locked in a car. The end solution should not just focus on the car seat, but it should have a system in the car that detects the older kids. It is also said that the reminder alarm as “a series of gentle tones” which is inconvenient for people who have poor or no hearing. There has to be some sort of vibration or light in order for it to be truly effective with every person’s circumstances.

Evenflo Advanced Embrace DLX Infant Car Seat with Sensorsafe, (Peridot). (n.d.).

Retrieved November 13, 2013, from

[https://www.amazon.com/Evenflo-Advanced-Embrace-Sensorsafe-Peridot/dp/B013F443MS/ref=as_at/?creativeASIN=B013F443MS&imprToken=j.Y7hcRMDDe1ro7ivnGncrw&slotNum=1&ie=UTF8&qid=1519154444&sr=8-2&keywords=Evenflo Advanced Embrace DLX Infant Car Seat with SensorSafe&dpID=5104VdwSYvL&preST=_SY300_QL70_&dpSrc=srch&linkCode=w50&tag=fatherlycom-20&linkId=6b5d2c4cdceca8fcaae7971cf0f9e2b0](https://www.amazon.com/Evenflo-Advanced-Embrace-Sensorsafe-Peridot/dp/B013F443MS/ref=as_at/?creativeASIN=B013F443MS&imprToken=j.Y7hcRMDDe1ro7ivnGncrw&slotNum=1&ie=UTF8&qid=1519154444&sr=8-2&keywords=Evenflo+Advanced+Embrace+DLX+Infant+Car+Seat+with+SensorSafe&dpID=5104VdwSYvL&preST=_SY300_QL70_&dpSrc=srch&linkCode=w50&tag=fatherlycom-20&linkId=6b5d2c4cdceca8fcaae7971cf0f9e2b0)

Similar Products

Product Name: ChildMinder SoftClip

Images/Sketches:



Description of the Product:

The ChildMinder SoftClip is an alert system that utilizes the basic idea of distance to set off the alarm. It has two components that work together in order to alarm the parent or guardian if they have left their child in the car without realizing it. The ChildMinder SoftClip is a digital shoulder harness clip that is supposed to be replaced with the given clips on the child's car seat. It syncs to either a smartphone app or a key fob mechanism that will sound an alarm once it is detected to be a certain distance away from the child/car. In order for the alarm to be triggered, the receiver (smartphone app or key fob) has to be more than 15 feet away from the transmitter. From being spill-proof to crash-tested, this device one of the most durable in the market.

Why does this product solution fall short?:

This product is faulty in which the implementation of the concept is poorly carried out. The device's alarm sequence is not continuous as it is imperative to be able to get the child out of the car as soon as possible. The device is also very unreliable with its ability to detect when the key fob is more than 15 feet away from the car. This presents a major problem when parents become oblivious to the fact that they left their child in the car and are completely unaware of it when the device does not sound.

Baby Alert International. (n.d.). Retrieved November 11, 2018, from <http://www.babyalert.info/design/index.html>

Similar Products

Product Name: 2018 GMC Acadia

Images/Sketches:



Description of the Product:

The GMC Acadia implements software in their cars. This software operates much like the alert system when the headlights or trunk is open. There was an attempt to pass legislation requiring all automakers to put this technology in their vehicles. However, the Hot Cars Act of 2017 was not passed.

Why does this product solution fall short?:

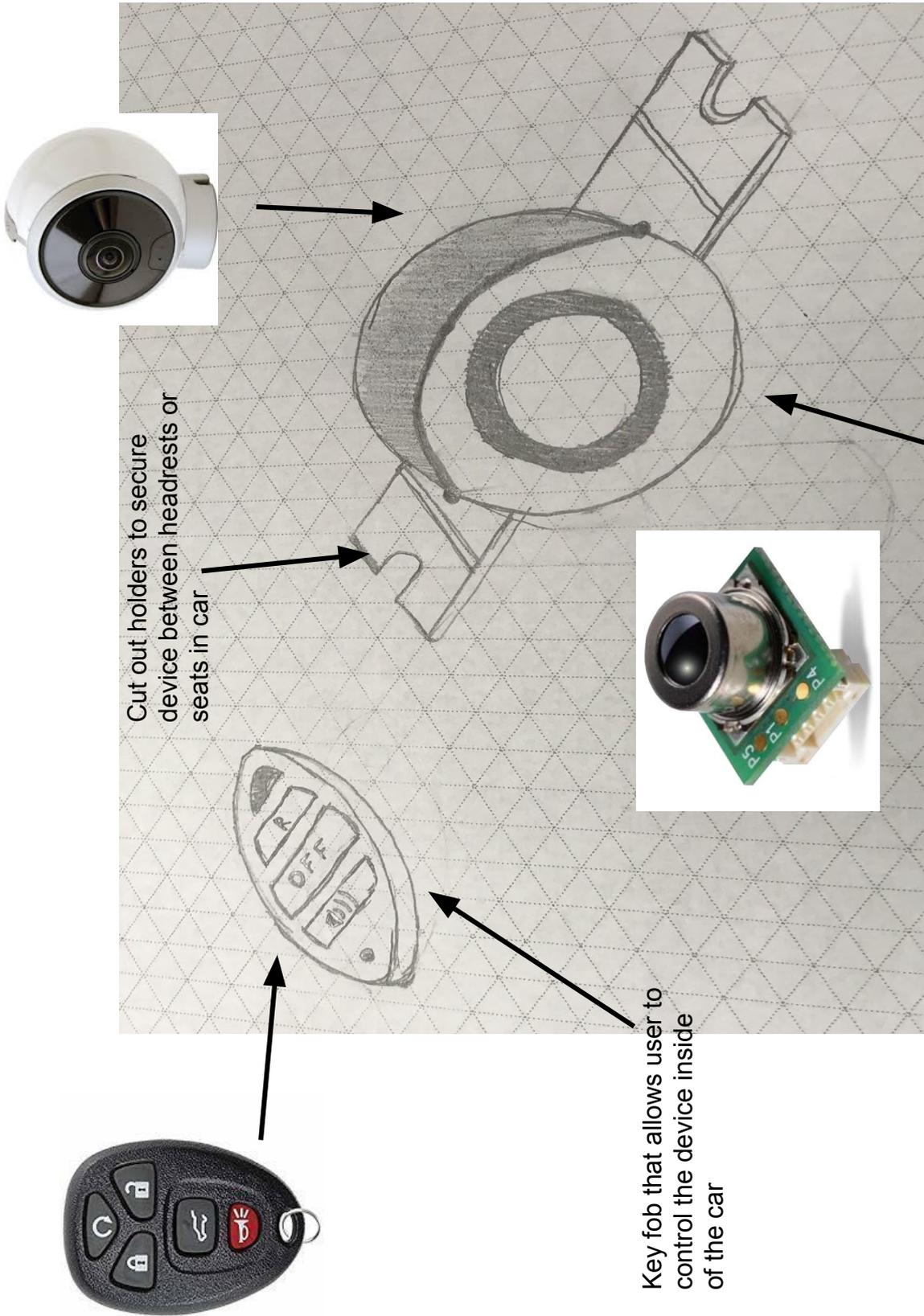
Since the act was not passed, the 2018 Acadias, Terrains, Yukons, Canyons, and Sierras have a standard feature in their vehicles. Instead of it alarming the driver that there is person occupying the rear seat, it will only alarm if the car door has been opened and closed up to ten minutes before the vehicle is started. When the car has established that the car door was opened and closed prior to turning on the ignition,

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then it will chime a sound and a visual message that reads “Rear Seat Reminder, Look in Rear Seat” once the ignition is turned off. This makes the invention less effective as it does not detect an actual person. Another downfall to this is that the notice is placed in an ineffective spot. The information shows up in the middle of the dashboard but nowhere else, such as the monitor in between the two captain chairs.

8 Life-Saving Gadgets That Remind Parents There's a Baby in the Back Seat. (2018, July 13). Retrieved November 13, 2018, from <https://www.fatherly.com/gear/best-car-seat-alarms/>

Concept Sketches & Product Concept



Cut out holders to secure device between headrests or seats in car

Key fob that allows user to control the device inside of the car

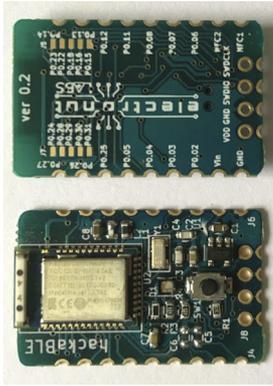
Thermal sensor identifies when child's temperature exceeds specific temperature that can result in heatstroke

Concept Sketches & Product Concept

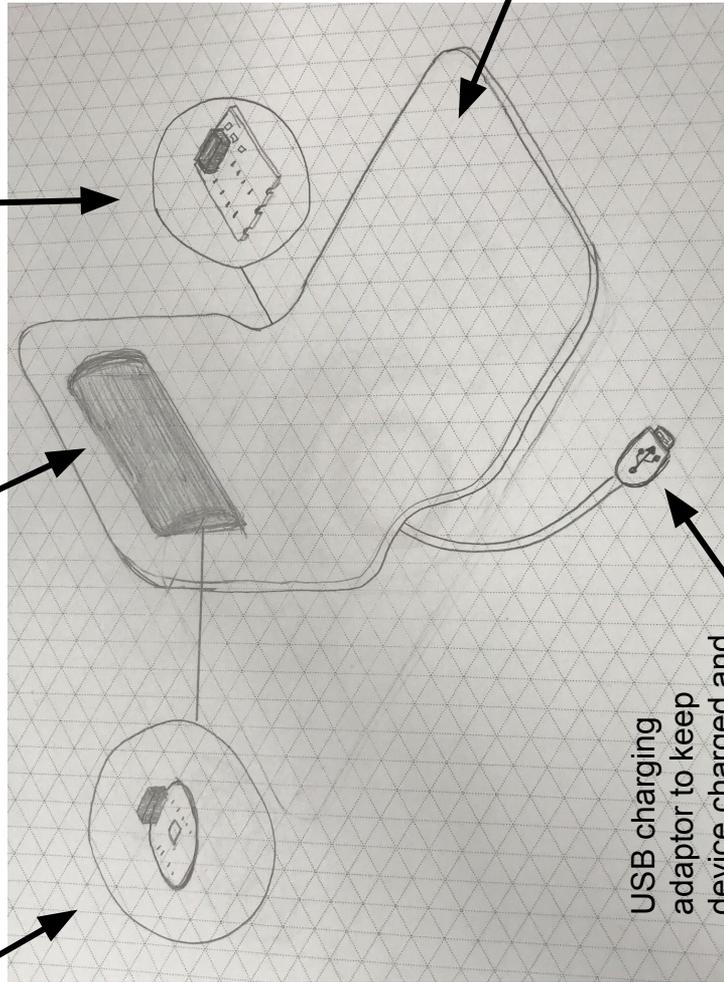


Heart rate monitor

Headrest identifies the heart rate IF thermal sensor identifies an exceeded temperature



Hidden bluetooth eligible breadboard to send information to smartphone app



USB charging adaptor to keep device charged and easily transportable

Thermal sensor pad cut out to fit into a carseat



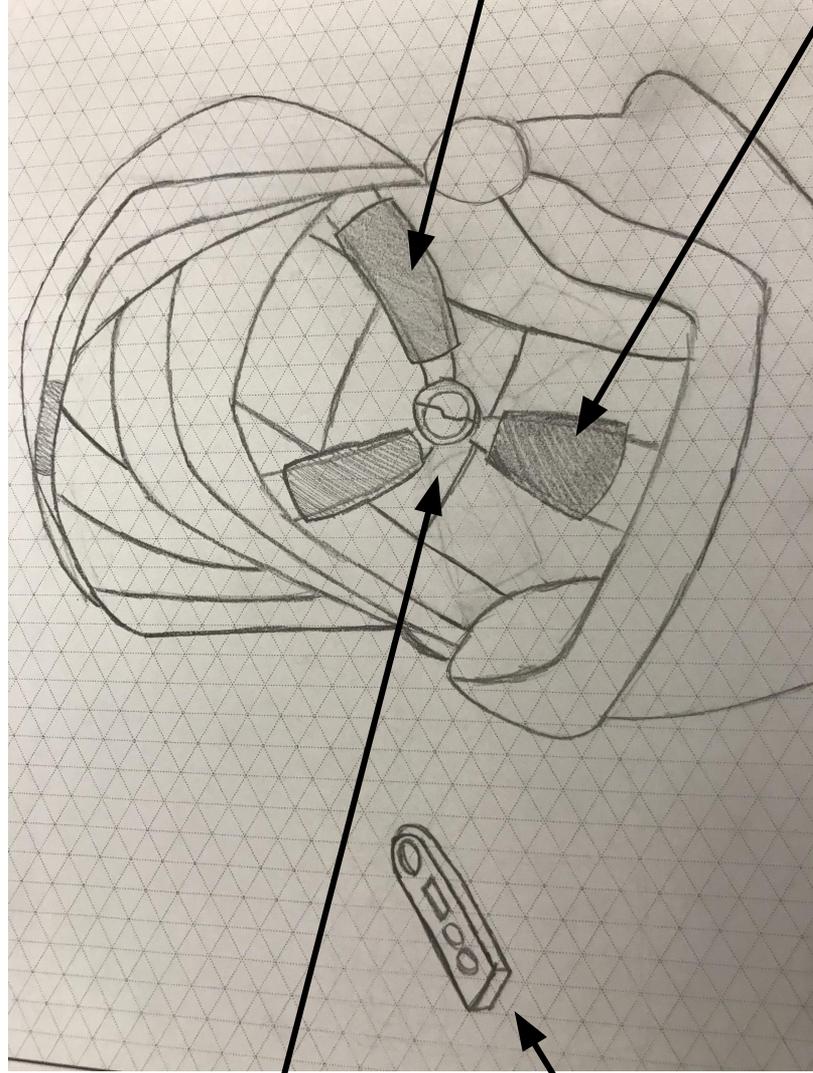
Concept Sketches & Product Concept



Proximity Sensor



Temperature Sensor



Temperature sensors within will detect the child's temperature

Velcro, removable pads

Clicked seat belt and sensed temperature are required to activate the alarm

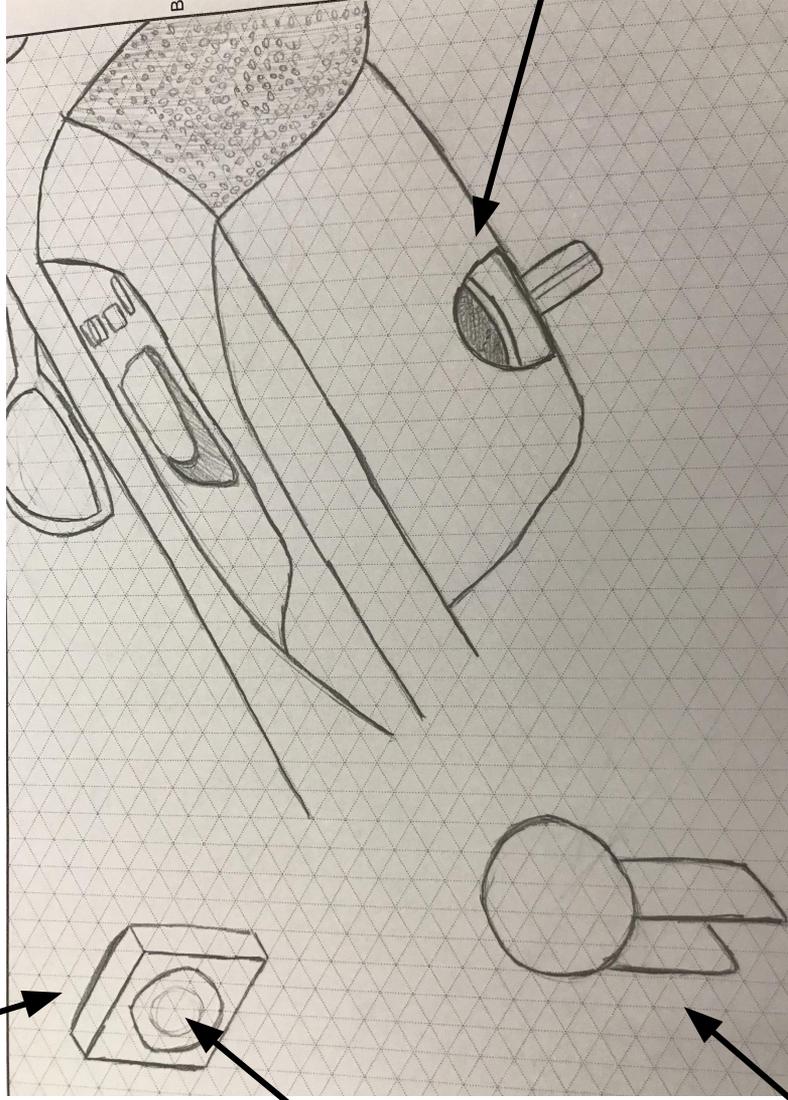
Clicking of the seat belt will help activate the alarm

Key fob with alarm, distance sensor, and a speaker

Concept Sketches & Product Concept



Motion Sensor



Inside of a car door

Speaker

Sticker or pin to place in car wherever the parent will remember to press it once the baby is in the car

Button for turning motion sensor On/Off

Green light will turn on when on and transparent when off

Motion sensor device is a removable clip

If motion sensor is on, once the car door open then the device will emit a series of three noises

Attack Path

Problem Statement:

Since 1998, there have been 705 documented deaths in children that were caused by vehicular heatstroke. Out of those that died, 54% of the mortalities were caused by the child being "forgotten" in the car. However, some parents are not aware of the drastic temperature changes that occur when the vehicle is turned off. The state of Texas ranks number one in child hot car deaths across the United States.

Technical Problem Justification:

With the current products that are available for purchase, many of them are found to be ineffective. This means that they either malfunction or do not do the task that they need to. Parents and guardians are unsatisfied with many of the published solutions because the alarms are not loud enough or the mechanism does not even detect the child.

<https://www.kars4kids.org/safety-app/#features>

<https://www.fatherly.com/gear/best-car-seat-alarms/>

Legal Issue Justification:

When a parent or guardian "forgets" their child in the vehicle and the child suffers from heatstroke, the parent is then charged for violating laws. In some states it is against the law to leave a child of 12 years or younger unattended in the car with a supervisor.

When a child dies as a result of being left in the car, then the parent is confronted by law enforcement.

<https://www.wklaw.com/charges-for-leaving-your-child-in-a-car/>

<https://www.usatoday.com/story/news/nation-now/2018/05/24/hot-car-child-death-heatstroke-nashville/641733002/>

Health & Safety Justification:

PLTW | Engineering

There have been over 636 child deaths over the past 20 years due to vehicular heatstroke. This means that there is about 32 deaths each year. In some instances, parents or guardians are found to have accidentally left their child in the car ending in unforeseen results. Many parents believe that they will never forget their child in the car and do not realize the detrimental effects that a rapid increase in temperature can cause on an individual stuck in an enclosed and turned off vehicle.

<https://www.noheatstroke.org>

Target Market

Total Available Market:

The automotive safety system in 2017 was estimated \$82.8 billion and is projected to be \$169.46 billion by 2025.

Definable: The target market must have specific characteristics identifying what the potential customers have in common:

Our target market includes parents of small children, especially babies and toddlers, due to the fact that vehicular heatstroke is more likely to occur to those groups. It is also important that consumers are car owners since the product will function in or with the vehicle.

Meaningful: Target market characteristics must meaningfully relate to the decision to purchase:

The purpose of our problem and solution will appeal to our target market because parents are always looking for ways to ensure their child's safety in any circumstance. Since there have been incidents of heat-caused deaths of children in the US, parents will be more likely to invest in a product that will help to completely eliminate, if not prevent, this problem from ever happening to their own child. The same problem is applicable to pets. Additionally, if parents are comfortable with the way that the technology works then they won't feel as intimidated by the product set up and usage.

Sizable: The target market must be large enough to profitably sustain your business:

In the US there's a total of 82.83 million families, and as of 2017 there are more than 19 million children of ages 0-4 in the US. Also, there are 276.1 million registered vehicles in the US as of 2018. Within the child car seat industry, including combination and convertible car seats, infant car seats, and booster car seats, the market revenue is expected to reach 6.5 billion US dollars by 2022. The global baby car seat market is expected to grow at a CAGR of close to 6% from 2017-2018. Additionally, the

PLTW | Engineering

automotive safety system market is estimated to be USD 82.80 billion in 2017 and is projected to reach 169.46 billion by 2025. It had a CAGR of 9.36%.

Reachable: Both the definition and the size must lead to affordable and effective ways to market to your potential customers:

Since the problem of vehicular heatstroke has become more prominent with the increasing combination of car usage and cell phone/life distractions, incidents of child vehicular heat stroke occurring have become well known through the media, specifically TV news channels. This market isn't as competitive as others because vehicular heatstroke is still a growing issue. This means that our product would be competing with other popular products. However, the market for automotive safety systems is extremely competitive with vehicle companies such as GMC, Chevy, and Volkswagen. Also, there aren't many of these products that are widely advertised or sold in stores. Media advertisement through news coverage, physical ads at daycares and car dealerships, or having our product for sale in retail stores will all be effective ways to market to potential customers.

<https://www.statista.com/statistics/183790/number-of-families-in-the-us-by-number-of-children/>

<https://www.businesswire.com/news/home/20170328005365/en/Global-Baby-Car-Seat-Market-2017-2021-Market>

<https://www.statista.com/topics/1484/families/>

Survey and Results

Vehicular Heatstroke

Since 1998, there have been 705 documented deaths in children that were caused by vehicular heatstroke. Out of those that died, 54% of the mortalities were caused by the child being “forgotten” in the car. However, some parents are not aware of the drastic temperature changes that can occur when the vehicle is turned off. The state of Texas ranks number one in child hot car deaths across the United States.

* Required

1. Gender *

Mark only one oval.

- Female
- Male
- Prefer not to say
- Other: _____

2. Are you a parent? *

Mark only one oval.

- Yes
- No *Stop filling out this form.*

Untitled Section

3. What age group are you in? *

Mark only one oval.

- 18-24
- 25-30
- 31-39
- 40-49
- 50+

4. How many small children are in your immediate family *

Mark only one oval.

- 0
- 1
- 2
- 3
- 4 or more

5. What is the age of your youngest child?
Mark only one oval.

- 0-1 years old
- 2-3 years old
- 4-5 years old
- Older than 5 years old

6. How many times a day is your child in a car? *

Mark only one oval.

- 0
- 1
- 2
- 3 or more

7. Does your child sit in a car seat? *

Mark only one oval.

- Yes
- No

8. How often is your child sleeping when you arrive at a destination?(on a scale of 1 to 5) *

Mark only one oval.

	1	2	3	4	5	
Not often	<input type="radio"/>	Very often				

9. Are you aware of any products that prevents your child from overheating in a car? *

Mark only one oval.

- Yes
- No

10. If yes, provide a list of the products below. (If no, put n/a) *

11. **Have you used any of the products to keep your child from overheating in a car? (If no, put n/a) ***

12. **What features did you like? (If no, put n/a) ***

13. **What features did you dislike? (If no, put n/a) ***

14. **How comfortable do you feel with software technology? ***

Mark only one oval.

- Not comfortable at all
- Kind of familiar
- Very familiar

15. **What features are most important when it comes to child safety? (Check all that apply) ***

Check all that apply.

- Convenience
- Accessabiity
- Easy to operate
- Easy to install safety mechanism

16. **If a monitoring device that included an alarm function were created, how would you like to be notified in an emergency? ***

Mark only one oval.

- inside of your car
- notification on your phone
- alarm on key fob
- Other: _____

17. **How much would you invest in a product that will ensure the safety of your child from overheating in a car? ***

Mark only one oval.

- \$1-\$50
- \$51-\$100
- \$101-\$200
- \$201-\$300
- \$301 or more

Powered by



Survey Results

QUESTIONS

RESPONSES

172

172 responses



SUMMARY

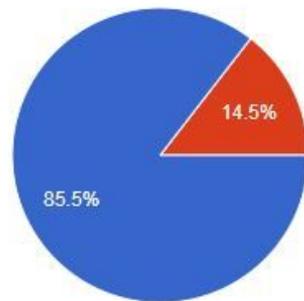
INDIVIDUAL

Accepting responses



Gender

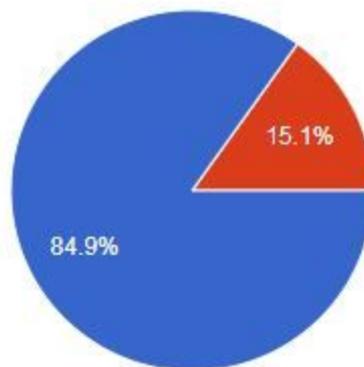
172 responses



- Female
- Male
- Prefer not to say

Are you a parent?

172 responses

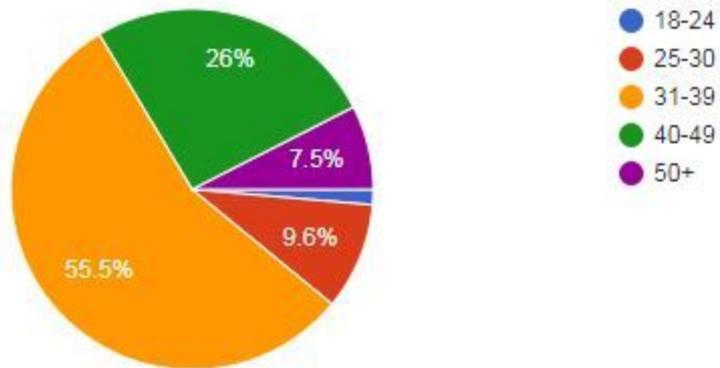


- Yes
- No

Survey Results

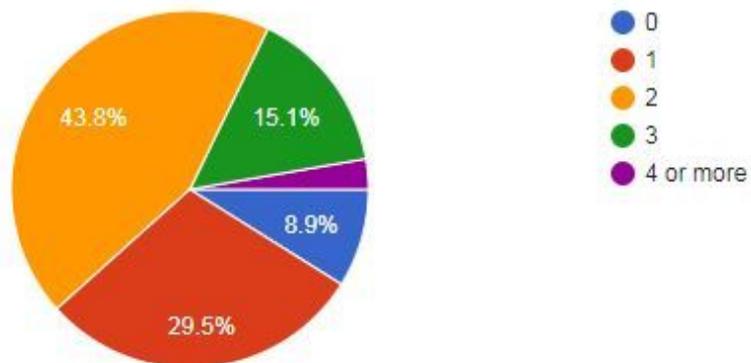
What age group are you in?

146 responses



How many small children are in your immediate family

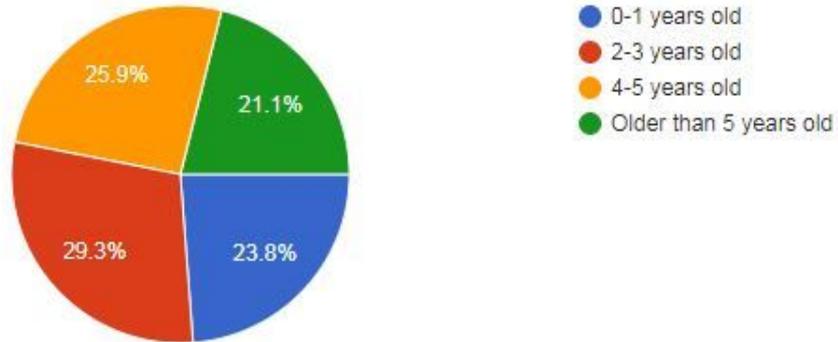
146 responses



Survey Results

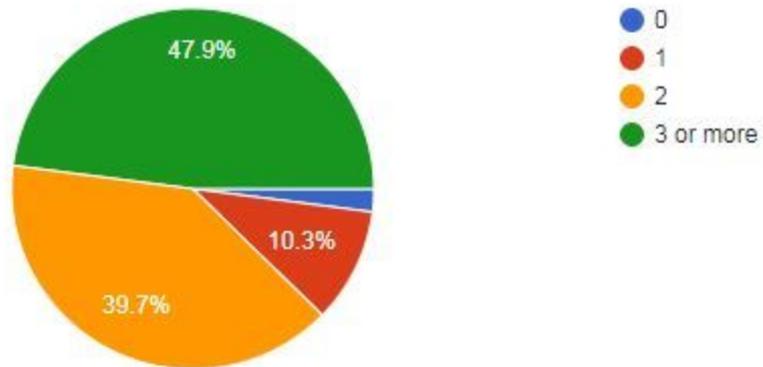
What is the age of your youngest child?

146 responses



How many times a day is your child in a car?

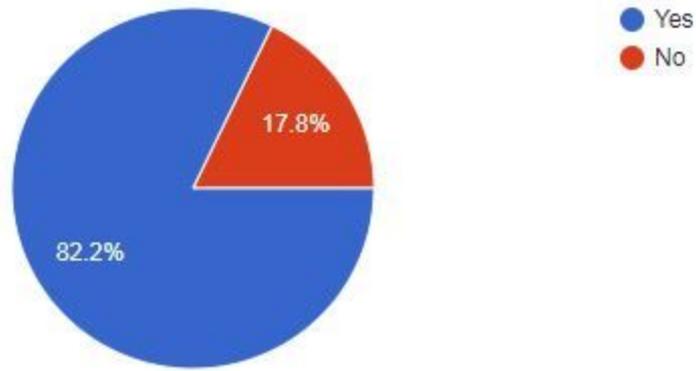
146 responses



Survey Results

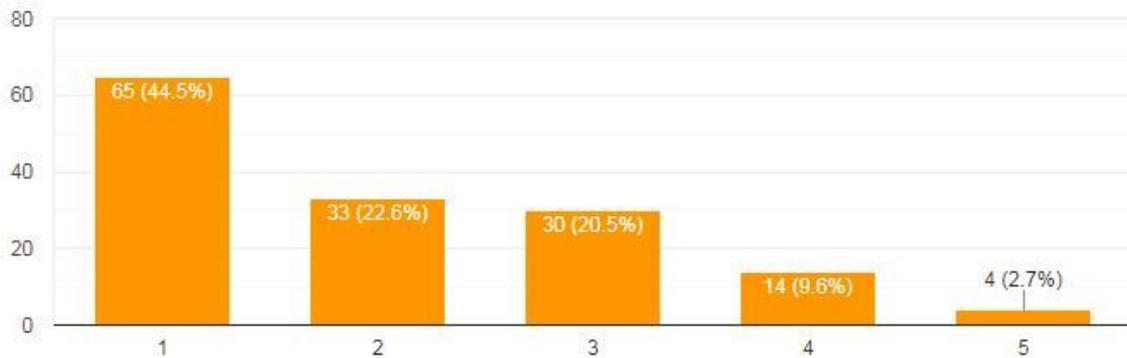
Does your child sit in a car seat?

146 responses



How often is your child sleeping when you arrive at a destination?(on a scale of 1 to 5)

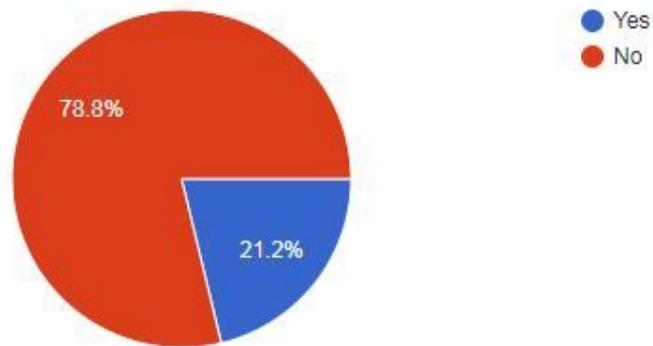
146 responses



Survey Results

Are you aware of any products that prevents your child from overheating in a car?

146 responses



If yes, provide a list of the products below. (If no, put n/a)

146 responses

N//A
Nono
Can't recall brands
Sunscreen
Dna
Not sure. Maybe a phone app.
Watee
Not aware
Alarms
Noggle which is a tube that helps cold air reach the back seat
no
Do not use any nor did I ever use any

Survey Results

If yes, provide a list of the products below. (If no, put n/a)

146 responses

N/a
n/a
N/A
Na
None
NA
No
na
Water, ice pack
Not aware of any
Cooling pads, proper hydration, driving during cooler parts of the day, shades, sunscreen, proper ventilation in car (i.e. AC, vents, etc)
Blankets, car seat covers

Survey Results

If yes, provide a list of the products below. (If no, put n/a)

146 responses

Air conditioning, cool drinks, water

There is a local woman marketing a pad that cools (haven't used it), or AC hoses that help direct air flow to backseats (haven't used them).

Alarms

N/A

Cool caboose

Na

The noggle (only if car is running)

Cooling mats and fans

I have seen advertisements but do not remember names.

I saw one online once but cannot recall the name.

Car seat covers (for when seat is not in use) noggle

Heat cooling pads

146 responses

Sunscreens

We have used a noggle

Just the air conditioning and kept them hydrated with cold bottled water

yes

We haven't had one before

Portable fan during the summer.

water

na

Yes, that hose thing

Yes we run a/c, wear loose light weight clothing, bring cold water or sports drinks with us in hot weather

Fan

Car AC

Yes, that

Survey Results

What features did you dislike? (If no, put n/a)

146 responses

- Not much effective
- Dna
- Do not know
- Not applicable
- It was in the way of the other passengers and sometimes the driver.
- no
- kids move and dislodge
- I did not use an actual device
- It's not sustainable due to the battery life.
- na
- Wasnt amazing.
- It didn't put out enough air, no good place to clip it.
- Didn't work very well

What features did you like? (If no, put n/a)

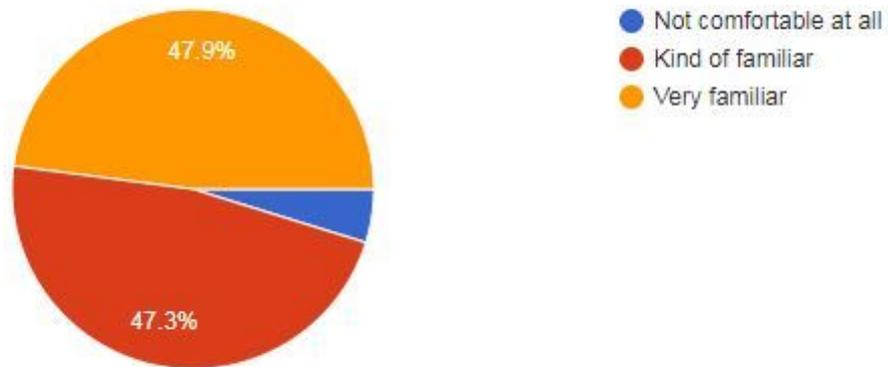
146 responses

- I did not use an actual device, they were not available when my children were young
- Assisted in circulating the air more.
- All
- convenient
- na
- N/a
- Keeps them hydrated and cool
- Um the staying cool and hydrated
- It plugged into an usb.
- Na
- Helped get air to back seat
- That my child was less hot overall and cooled down more quickly

Survey Results

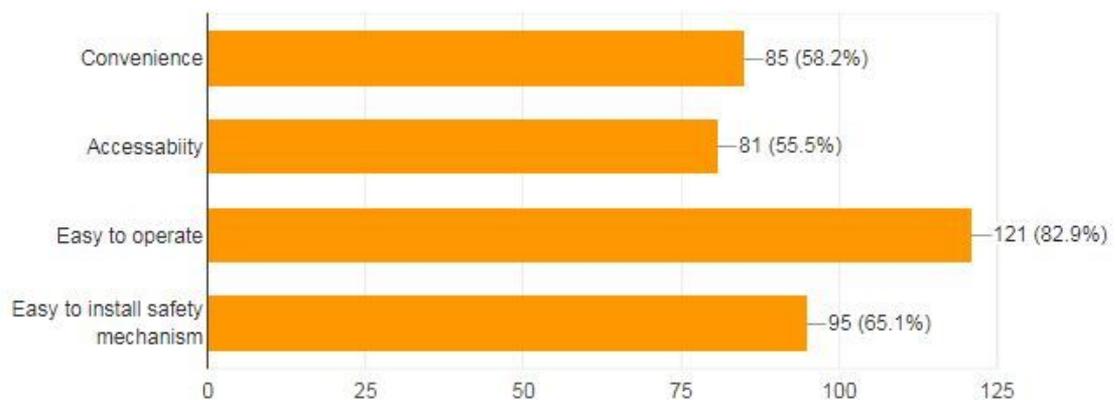
How comfortable do you feel with software technology?

146 responses



What features are most important when it comes to child safety?
(Check all that apply)

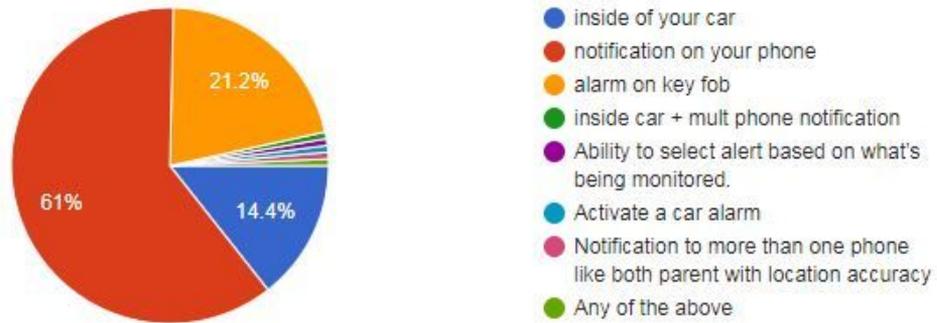
146 responses



Survey Results

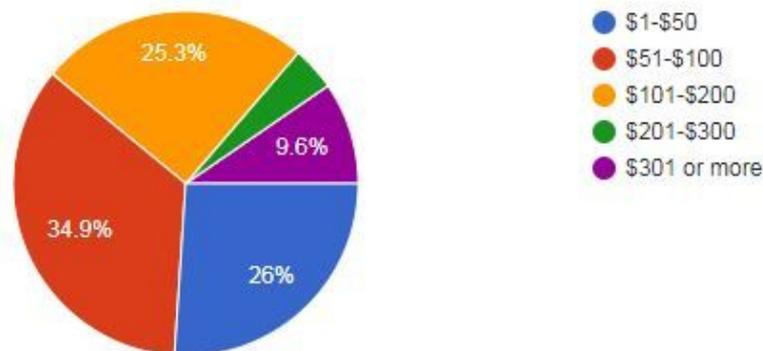
If a monitoring device that included an alarm function were created, how would you like to be notified in an emergency?

146 responses

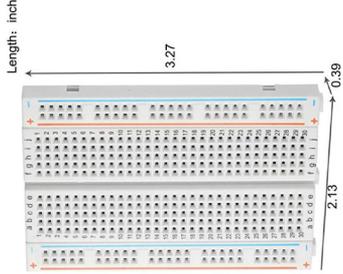


How much would you invest in a product that will ensure the safety of your child from overheating in a car?

146 responses



Part	Image	Purpose	Vendor	Price	Quantity	Notes
<p>ARDUINO UNO R3 [A000066]</p>		<p>After gramming it with commands, this board will allow the other sensors and items to perform their functions at the correct time and situation. This board will be in our car door device.</p>	<p>Amazon</p>	<p>\$20.69</p>	<p>1</p>	
<p>LED lights</p>		<p>The LED light will be an additional reminder via sight to the parent/guardian to get their child.</p>	<p>Amazon</p>	<p>\$6.99</p>	<p>1</p>	<p>White only Make it flash</p>
<p>ABS Plastic</p>		<p>In order to make our casing for the alarming device we will need to 3D print the component.</p>	<p>Mrs. Tungett</p>			<p>3D print</p>

<p>9V Battery</p>		<p>The 9V battery will specifically be used to power our Arduino Uno in the device. This component can be replaced in the device when needed.</p>	<p>Amazon</p>	<p>\$12.96</p>	<p>1</p>	
<p>Breadboard</p>		<p>We need the breadboard in order to test out our subsystems with the cables. Also, this will assist in creating circuits with the LED, magnetic sensor, and Arduino Uno for the alarming device.</p>	<p>Amazon</p>	<p>\$7.99</p>	<p>1</p>	
<p>GBSTORE 2 Pcs DC 9-15V Active Piezo Electronic Buzzer Alarm</p>		<p>This is our device used to create an alarming sound. This will allow for the driver to be reminded of their child through sound.</p>	<p>Amazon</p>	<p>\$5.80</p>	<p>1</p>	

<p>EDGELEC 120pcs Breadboard Jumper Wires 10cm 15cm 20cm 30cm 40cm 50cm 100cm Optional Arduino Wire Dupont Cable Assorted Kit Male to Female, Male to Male, and Female to Female Multicolored Ribbon Cables</p>		<p>This wire allows us to connect our materials to make a complete circuit without having to use thin copper wire by itself.</p>	<p>Amazon</p>	<p>\$5.79</p>	<p>1</p>	
<p>Cylewet 15Pcs Reed Switch with Gilded Lead Normally Open (N/O) Magnetic Induction Switch Electromagnetic for Arduino (Pack of 15) CYT1065</p>		<p>This magnetic sensor will determine when the separate systems will perform their functions.</p>	<p>Amazon</p>	<p>\$9.88</p>	<p>1</p>	
<p>Scotch 3/4 in. x 66 ft. Electrical Tape</p>		<p>The tape is used to insulate the exposed wires and protect the connection between each of the wires. It was also used to secure loose ends of cut wires.</p>	<p>Mrs. Tungett</p>			

<p>Utilitech 100-Pack 4-in Nylon Cable Ties</p>		<p>We had to use these Nylon Cable Ties because we could not find a nut with a small enough diameter to fit in the space created for the screw. These are used to secure the top of the encasing to the bottom</p>	<p>Lowe's</p>	<p>\$4.78</p>	<p>1</p>	
<p>Mens Classic Short Sleeve T-Shirt</p>		<p>We used this t-shirt as a protectant for the hardware inside of the casing. We also used it to elevate the hardware so there is less room for movement inside of the hardshell case.</p>	<p>Walmart</p>	<p>\$6.97</p>	<p>1</p>	
<p>LOCTITE Ultra Liquid Control Super Glue</p>		<p>In order to secure the magnet on the buckle, we had to super glue it so that there would not be a chance for it to get tampered with.</p>	<p>Lowe's</p>	<p>\$3.98</p>	<p>1</p>	
<p>Hillman Solid Wire Harness Wire</p>		<p>We used this 9V connector to power the arduino Uno.</p>	<p>Lowe's</p>	<p>\$0.98</p>	<p>1</p>	

Resistor		The resistor is used to insure that the circuit will work without shortening.	Mrs. Tungett		1	
Creative Hobbies Ceramic Industrial Magnets - 11/16 Inch (.709) Round Disc - 3/16" Thick (.198" or 5mm) - Ferrite Magnets Bulk for Crafts, Science&Hobbies - Grade 5-100 pcs/Box!		The magnets will trigger the reed switch to be activated. These are the only things that can have an effect on the reed switch.	Amazon	\$9.99	2	
Insulated Wire Stripper/Cutter		The wire cutters were used to strip away the insulating material. This allows us to connect other wires for an extended connection.	Mrs. Tungett		1	
USB A/B Cable		This cord was used to connect the Arduino uno to the computer in order to upload the code created on the Arduino coding software.	Amazon	\$4.99	1	

Scissors		<p>The scissors were used to cut pieces of electrical tape. This allowed us to wrap the wires in a more functional way rather than having many wires exposed.</p>	Mrs. Tungett		1	
Ruler		<p>The ruler was used for dimensioning the 3D model. This came to use when we created the 3D printed casing that all of the hardware fits inside of.</p>	Mrs. Tungett		1	
Computer		<p>In order to run the software and program, we needed a computer. This computer could have been a Mac or PC as they are both compatible with the Arduino Software.</p>	Aubrey		1	
Arduino Software		<p>The Arduino software allowed us to code the Arduino Uno and upload it to the board.</p>	Arduino	free	1	

Build Procedure

Testing:

The design that we have come up with is composed of four subsystems. There will be two magnetic sensors, speaker, and light. All of these components work fluidly with one another to alarm a parent or guardian that there is a child still buckled in his or her carseat. The magnet on the buckle will initiate the magnetic sensor on the car door once the magnetic sensor detects the magnetic field of the magnet. Once the magnet is pulled away from the magnetic sensor on the inside when the car door is opened it will then trigger the speaker and light to notify the parent or guardian that the child is still in the vehicle. The speaker will have a series of alerts at a loud enough volume for them to hear as they are exiting the car; the light will be an eye-catching color so that when the driver is exiting it will catch their eye with a pattern of flashes. First we can test the magnetic sensor and identify if it is triggered by the magnet with the program compatible with Arduino. To test that the speaker works we can trigger it to sound the iteration of alarms. The process for testing the light flashes will be similar to the speaker as we will have to connect it to the breadboard as well. In order for us to test the buckle, we will have to hardwire the magnetic sensor to the other component of the alarm system. Our repeated trials will include buckling and unbuckling the seat belt component to ensure that the connection between the magnetic sensor and the magnet works properly every time. We will also need to set of the magnetic sensor a number of times to ensure that it will trigger the alarming components of the device- the lights and speaker.

Elements to keep in mind:

The Arduino system is powered by a 9V battery concealed away in a 3D printed encasing. The two magnetic sensors that work together are programmed by the Arduino Uno. The only different materials that would be used if we had easy access to them would be a light source that is more attention grabbing than the mini LED light bulbs that we got. We also would change the fact that the device is entirely hardwired. The ideal solution would be to have two separate devices; one for the alarming components and one for the buckle. This would be more conventional as there would be less visible wires in the vehicle. The device that we are creating can be used universally in any vehicle for general family transportation. This excludes motorcycles, mopeds, scooters, or busses. Since this device will function the same in any vehicle there will not need to be any alterations for future marketing.

Build Procedure:

- Obtain an Arduino Uno, magnetic sensor (reed switch), mini LED light, magnet, and a piezo buzzer
- Create a circuit with the LED light to the Arduino Uno using a resistor and breadboard jumper wires
- Test reed switch, piezo buzzer, and LED light using Arduino software

Build Procedure

- Program LED light to blink in intervals of half a second until the door is shut
- Test LED light program with the Arduino program
- Program piezo buzzer to emit sound three times and then stop when the door is opened and then shut right away.
- Program the piezo buzzer to emit sound on a continuous loop until it is shut.
- Test piezo buzzer with the Arduino program
- Program magnetic sensor to set off LED light and piezo buzzer simultaneously
- Test reed switch (magnetic sensor) subsystem with the LED light and Piezo Buzzer
- Program the reed switch with the magnetic field detected on the buckle
- Assemble magnet and reed switch on and through the buckle
- Assemble Car door Device (the alarm contraption); 3D print the encasing used to house the LED light, piezo buzzer, Arduino, and Breadboard (connect everything with spiderwire)
- Include 9V battery in car door device to serve as the power source
- Test all components work together and can work properly with all of its different function (When buckle is latched--device turns on, when buckle is unlatched--device is turned off)

Subsystem Testing

The design that we have come up with is composed of four subsystems. There will be a buckle, motion sensor, speaker, and light. All of these components work fluidly with one another to alarm a parent or guardian that there is a child still buckled in his or her carseat. The buckle will initiate the motion sensor. Once the motion sensor is activated and detects motion when the car door is opened it will then trigger the speaker and light to notify the parent or guardian that the child is still in the vehicle. The speaker will have a series of alerts at a loud enough volume for them to hear as they are exiting the car; the light will be an eye-catching color so that when the driver is exiting it will catch their eye with a pattern of flashes.

In order to test this device, we will have to assemble parts of it to ensure that the connections work. First we can test the motion sensor by connecting it to a breadboard and identify if it is triggered by simple movement such as a wave of the hand with the Arduino program. To test that the speaker works we can also connect it to a breadboard and trigger it to sound the alarms. The process for testing the light flashes will be similar to the speaker as we will have to connect it to the breadboard as well. Arduino will allow us to test the individual components first without having to connect them to the whole design. If the speaker sounds and the light flashes then it will pass the test. In order for us to test the buckle, we will have to install a bluetooth device to connect to the other component of the alarm system. The system will pass or fail based on whether or not the motion sensor is activated. Once the connection is tested repeatedly and we are certain that there will not be any flukes in the process, we can then connect the speaker and light subsystems to the receiving bluetooth component. Our repeated trials will include buckling and unbuckling the seat belt component to ensure that the connection between that device and the receiving bluetooth device works properly every time. We will also need to set off the motion sensor a number of times to ensure that it will trigger the alarming components of the device- the lights and speaker.

While in the process of testing, I think that the bluetooth connection has the highest probability of causing this design to function incorrectly. The challenge will be figuring out how to incorporate the connection to the design since there will not be a direct connection between the two devices. We plan on avoiding the issue by utilizing our mentor's expertise and experience to help us connect the two main elements. If the connection does not work, then we will have to figure out a direct way to connect the components.

A similar product to ours is the patent number US9569948B1, the car seat that uses temperature and pressure sensing technology. This system can be improved by completely taking out the temperature sensing component and replace it with a system

Subsystem Testing

that will be able to notify the driver immediately. Rather than the temperature sensor having to identify the potentially dangerous surrounding temperature, a system that will notify immediately will eliminate the potential unfortunate events entirely. Our design will eliminate any delay time that it takes for the parent or guardian to realize that they have left the child in the back seat of the car.

Testing Documentation

GENERAL INFORMATION			
Test Date:	04/11/19	Tester:	Aubrey Baker
Test Case Description:	This case will test whether or not the child's car seat is buckled or not. This is the determining factor that will continue through the rest of the subsystems depending on if there is a child or not.		
INTRODUCTION			
Requirement(s) to be tested:	The reed switch needs to detect the magnetic field of the magnet on the buckle to activate the Arduino system and turn it on. This system will be tested 50 times.		
Roles and Responsibilities:	Aubrey and Sarah attached the magnet to the buckle with super glue, and we weaved the reed switch through the opposite strap. Once the reed switch detects the magnet, Aubrey will use the Arduino coding system to confirm the Arduino is on with a message.		
Set Up Procedures:	The Arduino is powered by a 9V battery, so the subsystem is ready to test. The reed switch needs to be positioned close to the magnet so the detection of the field is clear.		
TEST			
Expected Results of Case:	The test has passed if the reed switch is brought close to the magnet and the Arduino Uno is activated.		
ACTUAL RESULTS			
Output Specifications:	This system outputs a signal to the arduino uno board through the wires that signal the child's car seat is buckled in-- in other words, there is a child in in. At this particular part of the system testing, there is not visually observable outputs from the device itself. However, when hooked up to the arduino software through my computer it prints "Belt is in". This indicates that the reed switch and magnet have come in contact to where the reed switch is activated. I found that depending on the direction that the magnet faces the face of the reed switch will determine whether or not the sub system works. Once I was able to figure out the specific orientation the magnet had to be in, the test passed.		
Results:	Pass	Percentage Passed:	46/50 = 92 %

Testing Documentation

GENERAL INFORMATION			
Test Date:	04/11/19	Tester:	Aubrey Baker
Test Case Description:	This case will test whether or not the driver's side door is open or not. This will determine whether or not the alarm and light flash go off.		
INTRODUCTION			
Requirement(s) to be tested:	The magnet on the inside of the driver's door keeps the alarm from sounding when the door is closed, but the alarm will sound when the door is opened. When the reed switch attached to the box is close to the door then it will detect the strong magnetic field from the magnet. Once the door is open, the magnetic field will diminish and the alarm will sound if the first subsystem has been put into place. Our test of this subsystem will occur 50 times.		
Roles and Responsibilities :	Sarah did the wiring for the reed switch to the Uno, and Aubrey did the coding for the reed switch to detect the magnet.		
Set Up Procedures:	To test this system, we need the magnet for the inside of the car and the reed switch.		
TEST			
Expected Results of Case:	On Aubrey's computer, if the reed switch is removed from the magnetic, then a message will read that the other components, such as the LED light and Piezo Buzzer, are ready for activation.		
ACTUAL RESULTS			
Output Specifications:	This system outputs a signal to the arduino uno board through the wires that signal if the driver's side door is open. At this particular part of the system testing, there is not visually observable outputs from the device itself. However, when hooked up to the arduino software through my computer it prints "Door is open". You could say that the alarm and light are indicators that this part of the system works and are outputs, however those are not a part of this specific system. This indicates that the reed switch and magnet have come in contact to where the reed switch is activated. I found that depending on the direction that the magnet faces the face of the reed switch will determine whether or not the sub system works. Once I was able to figure out the specific orientation the magnet had to be in, the test passed.		
Results:	Pass	Percentage Passed:	48/50 = 96 %

Testing Documentation

GENERAL INFORMATION		
Test Date:	04/11/19	Tester: Aubrey Baker
Test Case Description:	This system will test whether or not the LED light is functioning properly. The LED light is an output from the Arduino board that will flash until the door is shut.	
INTRODUCTION		
Requirement(s) to be tested:	Once the car door opens, the reed switch is removed from the magnet, the Arduino Uno will command the LED light to flash. The trials for this test can be combined with trials for the second subsystem since the distance of the reed switch in relation to the magnet determines the use of the LED light.	
Roles and Responsibilities:	Aubrey did the coding for the reed switch to the LED light and did the wiring from the breadboard to the Arduino Uno. Sarah created the system of the LED light on the breadboard. Two different wires have to be in the same column as the LED, but one wire has to be connected to the positive output and the other to the negative. The system also requires a resistor to carry the current and continue the circuit.	
Set Up Procedures:	The second subsystem, with the magnet and reed switch, needs to be set up in order to test the response of the LED light.	
TEST		
Expected Results of Case:	After the door and Uno subsystem is complete, the LED light will flash until the door is closed and the reed switch detects a strong magnetic field. The test will be determined as a pass or fail if the LED lights flashes at the right time.	
ACTUAL RESULTS		
Output Specifications:	This system outputs a flashing light whenever the door is open. At this particular part of the system testing, there is a visual output. The LED will flash and will remain flashing until the door is shut. There was an issue with the LED light when the connection between the car seat seatbelt and magnet was not secure. The LED light works simultaneously with the Piezo Buzzer, therefore if the seatbelt connection malfunctions then it will mess up the LED light and Piezo Buzzer. Once the connection was fixed, this subsystem worked properly and passed the testing stage.	
Results:	Pass	Percentage Passed: 44/50 = 88 %

Testing Documentation

GENERAL INFORMATION			
Test Date:	04/11/19	Tester:	Aubrey Baker
Test Case Description:	This system will test whether or not the Piezo Buzzer light if functioning properly. The Piezo Buzzer is a an output from the Arduino board that will sound an alarm on a loop until the door is shut. If the door is shut right away, then the Piezo Buzzer will sound for three iterations and then silence itself.		
INTRODUCTION			
Requirement(s) to be tested:	Once the car door opens, the reed switch is removed from the magnet, the Arduino Uno will command the Piezo Buzzer to sound for a total of three series. The trials for this test can be combined with trials for the second and third subsystem since the distance of the reed switch in relation to the magnet determines the use of the Piezo Buzzer.		
Roles and Responsibilities :	Aubrey did the coding for the Piezo Buzzer to respond to the reed switch, and she found the right outputs for the two wires to connect the Piezo Buzzer to the Arduino Uno. Sarah connected the copper wire of the Piezo Buzzer to the spider wire that goes into the Arduino Uno. Sarah used wire cutters to take the plastic coating off of the original wires.		
Set Up Procedures:	The second subsystem, with the magnet and reed switch, needs to be set up in order to test the response of the Piezo Buzzer.		
TEST			
Expected Results of Case:	After the door and Uno subsystem is complete, the Piezo Buzzer will sound for three series then stop. The test will be determined as a pass or fail if the Piezo Buzzer sounds right after the reed switch doesn't detect the magnetic field of the magnet.		
ACTUAL RESULTS			
Output Specifications:	This system outputs a an alarming sound whenever the door is open. At this particular part of the system testing, there is not a visual output as mentioned before. The buzzer will sound and will remain on a loop until the door is shut. There was an issue with the buzzer whenever the connection from the buckle to the magnet is not fixed properly. This system works simultaneously as the LED light, therefore if the seatbelt connection malfunctions then it will mess up the LED light and Piezo Buzzer. Once the connection between the seatbelt and magnet was secure, there were not any flaws and the subsystem had passed the testing stage.		
Results:	Pass	Percentage Passed:	47/50 = 94 %

Final Prototype



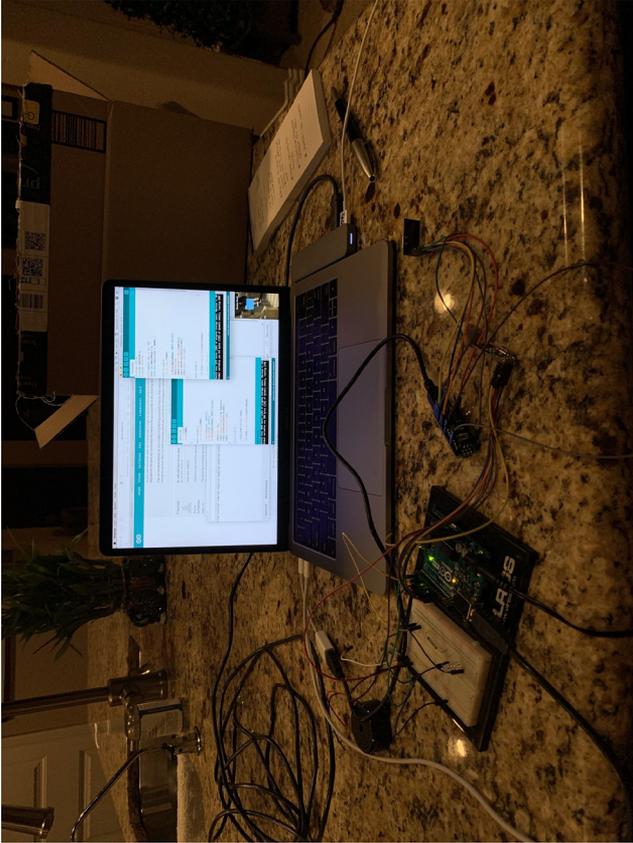
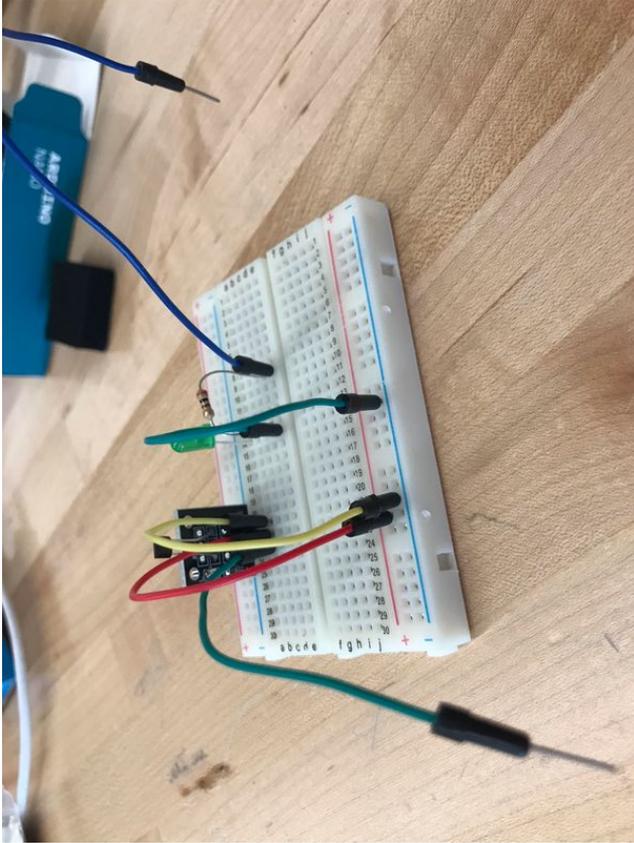
Vehicular Child Reminder Device



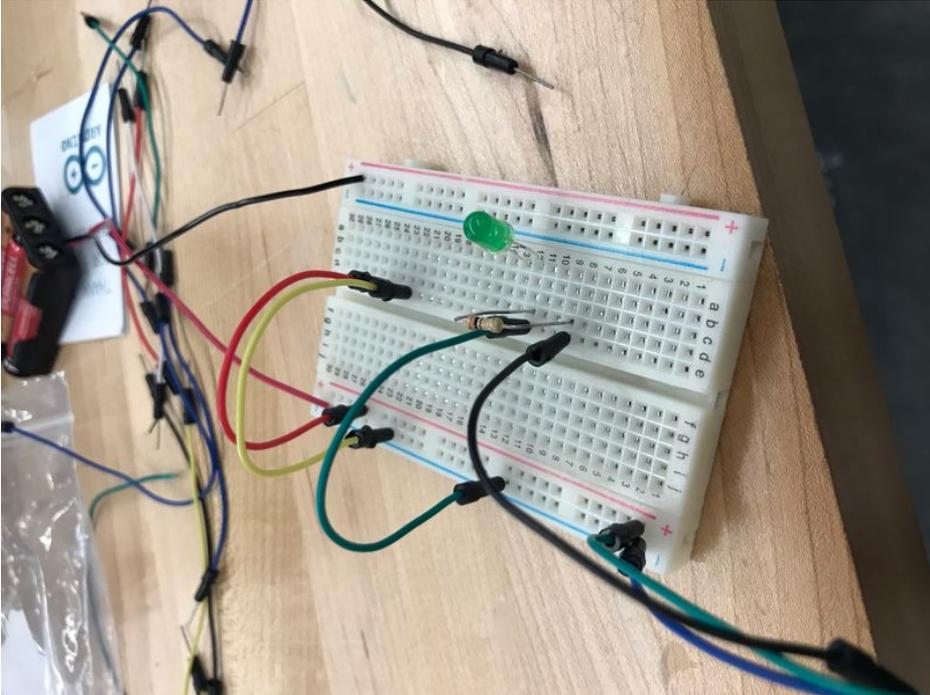
Vehicular Child Reminder Device
attached to car seat



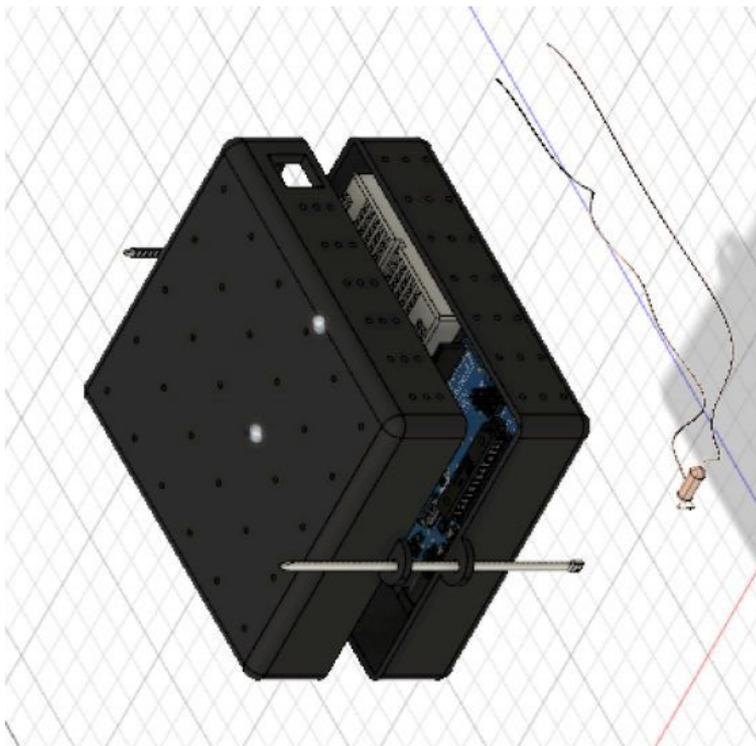
Reed Switch and magnet on car seat



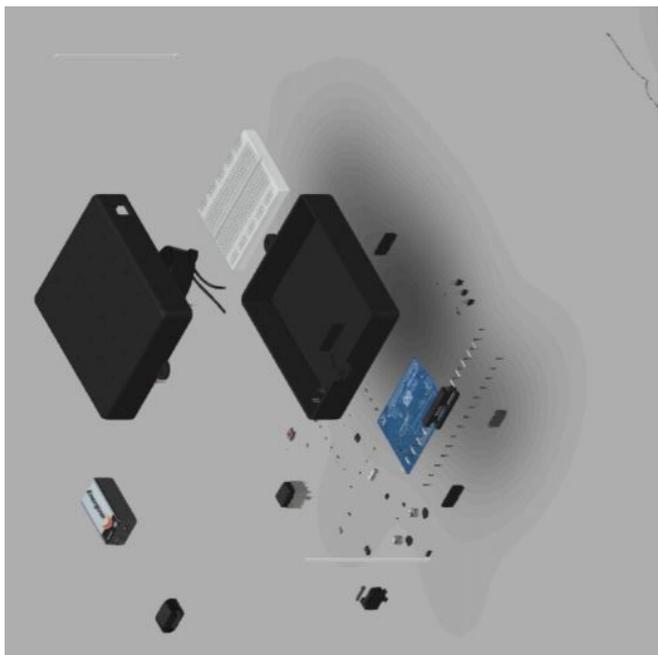
During the Build



Fusion 360 3D Model



Assembled View



Exploded View

Thank You

Mr. Barnard,

Thank you so much for selecting our project to mentor to this year. We appreciate all of the time and resources you've given us to be success in this process. You've taught us to establish a clear purpose and goal in developing our prototype, and we are truly encouraged by all of the support you've given us. Thank you for having a genuine interest in passing along your knowledge to the minds of future engineers. These past couple of months have been challenging, but your guidance and suggestions has made all the difference in the functionality of our solution. We hope to stay in touch in the years to come.

Sincerely,
Aubrey Baker and Sarah Tipoff

Mrs. Tungett,

We cannot even begin to describe the amount of influence you've had in shaping our high school careers and future college decisions. If we didn't have you for Introduction to Engineering Design our first years, then we wouldn't be as involved in STEM and Project Lead the Way activities. Thank you for all of the time and energy you take into making us more knowledgeable about engineering in the real world. Your dedication to your students is admirable, and your attention to detail pushes us to strive for perfection in every assignment. This course and the CTE PLTW program wouldn't be as memorable or enjoyable without you, so please know that we appreciate you very much. Thank you for all of the laughs, valuable life lessons, and recommendation letters. We hope to stay in touch with you in the future!

Sincerely,
Aubrey Baker and Sarah Tipoff

Thank You

Parents,

Thank you so much for all of the support you've given us throughout this course. We truly appreciate all of your patience through each Amazon order (and return), Office Depot run, and trip to Gracebridge. The encouragement we've received from you guys has kept us going even though we've made plenty of mistakes. Thank you for all that you do with all of our school and extracurricular activities!

Sincerely,

Aubrey Baker and Sarah Tipoff

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Date	Partner	Progress
10/31/18	Sarah	I worked on the brochure by finishing the association and putting the associations, research articles, and personal information into the google slides brochure
10/31/18	Aubrey	I summarized the articles we found that related to our project and I made the problem statement for our brochure.
11/2/18	Sarah	I contributed to assigning the responsibilities for November. I will be taking on 2 similar products and will be turning that in, and I will complete at turn in the article justifications and knowledge of marketplace. Aubrey and I will be working together on conducting the market research. Also, I got my EN together and make sure every page us signed, and I began editing and working on the existing and new articles.
11/2/18	Aubrey	I contributed to assigning the responsibilities for November. I have completed two of the Patent Search assignment. I also completed the partner evaluation.
11/6/18	Sarah	Today, I worked on the 2 new research articles for the problem. My work included, getting APA citations of the articles, and writing a summary and critique of the effectiveness of the articles.
11/6/18	Aubrey	I fixed the mistakes in the brochure that we turned in and I worked on the Patent Summary Sheets.
11/8/18	Sarah	I finished all 4 article justifications and turned them in at the end of class. Also, I reviewed the patent summaries to make sure the grammar was correct.
11/8/18	Aubrey	I finished the 4 patent summaries and looked over Sarah's work on the Article Justification assignment. We turned in both, the Patent Summary and Article Justification assignments at the end of class.
11/12/18	Sarah	During class, I completed a similar product entry and finished half of another one. My goal of next class is to complete and turn in the similar products and getting started on the survey.
11/12/18	Aubrey	I started the Similar Products assignment and was able to finish one of them. I am responsible to finish two of the Similar Products and will be able to finish them for homework by next class.
11/14/18	Sarah	Today, I finished my 2 similar products and turned the entire file in on Google Classroom. Also, I began the market survey and wrote 7 questions for the survey.
11/14/18	Aubrey	I looked over Sarah and I's similar products and made sure that all of the information was included. After we turned that assignment in, I created the Google Form for the survey.
11/16/18	Sarah	I finished the questions for the survey, and we put them into a google form. We

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		plan on getting them completed over the break, and I started the knowledge of the marketplace assignment.
11/16/18	Aubrey	I finalized the Google Form with Mrs. Tungett and figured out locations to publicize the QR code for the survey. I also started the Attack Path assignment.
11/27/18	Sarah	I completed the Knowledge of the Marketplace document, and proof read other files to submit later.
11/27/18	Aubrey	I finished the Attack Paths assignment at the beginning of class. Once I was done with that I emailed a combination of 12 preschools, Montessori Schools, and daycares to ask if they can send out our survey to the parents of their students.
11/29/18	Sarah	Today, I downloaded Autodesk Fusion 360 on my computer. My partner and I put the problem statement in the mentor document, and I filled out one possible solution for our problem.
11/29/18	Aubrey	I started the Mentor/Project Selection assignment and input one of our ideas. I also downloaded Fusion 360 so that I can get familiar with the program.
12/3/18	Sarah	I transferred my resume into a canva document, and then I submitted it on Google Classroom. I also signed up for Mr. Tremblay's Fusion 360 class on Autodesk. Lastly, I familiarized myself with different Fusion 360 functions.
12/3/18	Aubrey	Today I submitted my resume into Google Classroom. I also enrolled into Mr. Tremblay's Fusion 360 class through the Autodesk classroom website. Once all of that was finished I familiarized myself with Fusion 360 by attempting to create a F1 car.
12/5/18	Sarah	Mr. Thomas Tremblay came and taught us how to maneuver Fusion 360. We used premade files to practice using some of the functions such as mirror, extruding from an extended plane, and creating a hole. Mr. Tremblay later demonstrated how to put our project in different settings and create animations with our works.
12/5/18	Aubrey	Today we had an interactive tutorial with Fusion 360 from Mr. Thomas Tremblay. We got to use the premade stages to work faster.
12/7/18	Sarah	I completed the assembly of step 3(drivetrain, screws, frame, and sprocket) on Fusion 360. Also, I worked on the two sketches on ISO paper for possible solutions.
12/7/18	Aubrey	Absent
12/11/18	Sarah	I worked on the possible solution sketches and started the annotated sketches PowerPoint.
12/11/18	Aubrey	Absent
12/13/18	Sarah	I finished the sketches and the PowerPoint of the two possible solutions, and I put annotations on both.
12/13/18	Aubrey	Today I started sketching my two possible solutions for our final product.

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12/17/18	Sarah	Today we listened to four people present their possible solution sketches for their problem statements. We provided feedback, and talked as a class on different features to include in the final product.
12/17/18	Aubrey	We listened to four people present their possible solutions and helped figure out what modifications could be made to make them even better.
12/19/18	Sarah	I presented my two possible solution sketches, and discussed with the class on how to improve them for the final product. I also listened to three other classmates present their solutions.
12/19/18	Aubrey	I presented the two possible solutions that I had sketched and annotated. My classmates gave me feedback on what I should include and reevaluate on my designs. I listened to three other students present their ideas.
12/21/18	Sarah	We listened and discussed with three more classmates on their possible solutions. Some problem include hurricane relief, battery phone charging, and disabled gaming.
12/21/18	Aubrey	There were three more presentations about possible solutions. We gave feedback and helped them understand and decide which of them is the best.
1/9/19	Sarah	Today, we listened to a fellow classmate give his presentation on the possible solutions for his project. As a class, we discussed how to easily move your feet and the accessibility of of changing direction when your feet are locked into a snowboard. Then, I brainstormed how I wanted the final product to be before I started creating it on Fusion 360. I started out by creating a half sphere that will emit sound when a car door opens.
1/9/19	Aubrey	There was one student that had to present his possible solutions for a more free-movement snowboard binding. The entire class helped him think of ways to minimize injury but maximize the movement that is necessary to be most comfortable. After presentations, my partner and I discussed how we wanted our final product to incorporate ideas from both of our solution possibilities.
1/11/19	Sarah	When I got to class, I started researching the location of certain materials in our project for the request emails. I looked on Lowe's, Amazon, and Aliexpress to find small materials to request, and I made a document so my partner and I can make a complete list of supplies we need. Right now, the major things we need are a small speaker, motion sensor, button, and possible a pulse detector. On Fusion 360, I continued working on the outer casing of the in car motion sensor. The top is a half sphere that I revolved around the y-axis, and then I hollowed out the inside. I only revolved the half sphere 180 degrees so people would be able to see the inside electrical and mechanical components. After that, I created many small holes, used the circular pattern feature, and extruded the holes downward to create space for the sound of the alarm to be emitted. Lastly, I added a Plastic Black color to the component.
1/11/19	Aubrey	Absent
1/15/19	Sarah	After doing more research for the location of possible materials, I went into Fusion 360 and worked on my speaker. To create the speaker, I used 6 different

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		layers in created the speaker. I started out with a the black, plastic casing, and I did the plastic layer next. Following the plastic, there was another layer of black plastic, then a ring of gold metal, and it ends with an aluminum ring to emit the sound. I added the spokes in the back to match the speaker that I found on AliExpress. Lastly, I used the fillet feature to round the edges of my speaker.
1/15/19	Aubrey	Absent
1/17/19	Sarah	Today, my partner and I discussed materials we thought we would need for the final product so we could start gathering the items and sending out emails. Also, we discussed how our two solutions could optimize the benefits of multiple features in one product. Also, I continued creating parts for the 3D model of my final product. I created an account on Grad Cad, and I found and imported an ultrasonic sensor. Additionally, I created a mini breadboard for the speaker and motion sensor to be attached to. In creating this piece, I used the rectangular pattern and extrusion feature to form the holes, and I used fillet to curve the edges of inside pieces.
1/17/19	Aubrey	Sarah and I discussed some details about our project and how we were going to implement our best features in the device without making it too difficult to complete in the time frame. We also talked about the general parts that we should request from companies to donate if possible. Once we figured out some of the details on our project, I worked on my 3D model. I edited my existing cushion as well as browsed Grabcad for parts that I could use in the model.
1/22/19	Sarah	Today, I started out by creating the adjustable rod for my product so that the product could be held upright and stay in position on the interior of the car door. For the adjuster, I extruded a jagged design to easily fit the peg to the needed distance. After creating those two pieces, which I classified as black plastic, I began an assembly of all the parts I've created. After importing all of the parts into one file, I used the joint tool to combine the bottom of the plastic casing with the top of the adjuster. Then, I joined the bottom of the adjuster with the top of the peg.
1/22/19	Aubrey	Absent
1/24/19	Sarah	My partner and I discussed times during the week that would be best to meet with our mentor, Clayton Barnard. We then sent him an email requesting to meet on either Monday or Wednesday, and we attached our resumes and the brochure of our problem. Then, I finished my 3-D model on Fusion 360 by creating a wire connecting the speaker to the breadboard. I first sketched a small circle on the on the bottom of the speaker. Then, I created an offset plane that was perpendicular to the center of that circle. After that, I used the the spline tool to sketch a curved line. Lastly, I used the sweep tool to make the line 3 dimensional. I used the snipping tool on my computer to save images of my final assembly and all of the parts I created, and I turned those in on Google Classroom.
1/24/19	Aubrey	At the beginning of class we talked about the dates that would work best for the both of us to meet with our mentor Mr. Clayton Barnard. Once we distinguished three times that would work for us, we put together an email that asked Mr.

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		Barnard which meeting time works with his schedule to get feedback on our possible solutions. I also worked on my 3D model for the rest of class. I created the cushion that the device would go into. I made it ergonomic to fit a standard baby neck circumference.
1/28/19	Sarah	Today, we began presentations of the 3D models we created of our solutions on Fusion 360. The presentations followed the topics of, knee braces, bike storage, and vehicular heatstroke. We explained the parts of our model that we created and the parts that we grabbed from GrabCAD. When we were done explaining our model, students in the class asked questions or made comments to help further improve our designs. Finally, we made Zoom accounts and learned how to join a meeting in Zoom to use it as an option for our mentor meetings.
1/28/19	Aubrey	We started presenting our 3D models that were created in Fusion 360. All of the ideas that were presented had original components that were created from scratch and not just grabbed from GrabCad. Once we were done Mrs. Tungett walked us through the Zoom application explaining how we get our interview to work. She also did a demonstration with two of my other classmates so that we could see exactly what buttons to press and how easy it is to work.
1/30/19	Sarah	The class listened and watched our classmates present their innovations and inventions to the class. They showed their 3D models on Fusion 360, and students gave their feedback on the functionality of their solutions. Some solution topics include, storage for fishing, drones, snowboard versatility, baker's wrist, and disabled gaming.
1/30/19	Aubrey	For the entire class period we listened to six different presentations that explained their Fusion 360 models and how they were created. The students presenting also gave us information about how they plan to construct their product. The audience then gave feedback and other supplemental ideas to make their product more efficient.
2/1/19	Sarah	Everyone worked on their subsystem analysis, and my partner and I decided what we wanted our final design to be. I explained in paragraph form that our final product will consist of four systems. The first one will be the car seat buckle to the car door device. Then, the activation of the car door device will turn on the motion sensor. Once the motion sensor detects motion, then the speaker and light subsystems will be activated to remind the parent/guardian of the child in the back seat.
2/1/19	Aubrey	Today we started our subsystem analysis. Before my partner and I got to work on our own subsystem analysis we discussed what our final product is going to be and what parts of each of our ideas are going to be incorporated. In the subsystem analysis that I created I made it clear that there are going to be 4 subsystems that work together in order to make the device function. The limit switch connected to the buckle, the activation to the car door motion sensor, the light, and then the speaker output. All of these subsystems will work together to alarm a parent and/or guardian that the child is still in the back seat of the car.
2/5/19	Sarah	My partner and I started our materials list, and filled out the columns for the motion sensor and the small speaker. Our pieces are extremely small, so they're

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		only available for purchase online rather than in bigger stores. Also, with the help of our classmates, we figure out how to connect our two devices with bluetooth. We will use either Arduino and Raspberry pi to send signals through the devices.
2/5/19	Aubrey	At the begin of class my partner and I started the materials list. We talked about the most obvious parts that we would need to fulfil our design. As we got to the more complicated materials, we discussed with our other classmates about the best way for the two devices to communicate with each other. We discussed using either Arduino or a Raspberry Pi 0 for the communication between the devices.
2/7/19	Sarah	I continued working on the Materials Lists today, and my partner and I continued to develop our plan to build the prototype. I added things such as LED lights, copper wire, limit switches, and raspberry pi 0 boards. We were able to find low prices from Amazon, Homedepot, Adafruit, and Robotshop.
2/7/19	Aubrey	We finished the materials list today. We found the distributors that we can get our LED lights, copper wire, limit switches, and raspberry pi 0 from. We found these items on amazon, Home Depot, Adafruit, and Robotshop. I am planning on calling my Uncle tonight that's an electrical engineer for some guidance about whether or not the raspberry pi 0 will be the best way to connect the two devices wirelessly.
2/11/19	Sarah	Today, I partnered with another student to complete a safety presentation for the lab tools. We were assigned the Power Miter Saw. I imported a picture of a diagram of a miter saw with the parts labelled, and I typed out the procedures of how to properly use it. Also, I found a Youtube video that clearly demonstrates how to use the tool and explains the different types of cuts that can be made with it. Lastly, I created a works cited page, and I turned in our presentation on Google Classroom.
2/11/19	Aubrey	Today we were assigned to create a safety presentation about a specific tool that would be used in the lab in the days to come. I was partnered with someone from a different team and we created our presentation on the soldering iron. We used a free google slides theme to make it more interactive and desirable to look at. We found a video to demonstrate how to properly use the tool. We also used the test as a guideline to know what we should include in our presentation.
2/13/19	Sarah	Today we did presentations on the different power tools in the lab to ensure that we can safely use them. My classmate and I taught the class how to properly use the miter saw and the different techniques that go with it. The miter saw is able to cut wood to get different lengths and different angles.
2/13/19	Aubrey	Today we gave our presentations over the tools that we researched. Everyone was able to present within one class period so now we know the basics and safety needed to use the tools properly. A lot of the presentations were very creative in their delivery that I will never forget how to use the machinery. All of the groups will start building next week in the lab.
2/19/2019	Sarah	Today, we went into the lab and our teacher showed us how to use all of the

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		power tools. I got to test out the Miter Saw with a piece of wood, and other students got to test out tools such as the Drill Press and the Band Saw. After that, I started working on the Gantt Chart for the rest of my project. I included the major dates of when our portfolio, PowerPoint, and Presentations are due. Also, I planned when our subsystem building and testing will occur.
2/19/2019	Aubrey	At the start of class we went into the lab to get our hands on some of the power tools. This allowed us to get familiar with our particular tools and where they're located in the lab. Once we got back into the classroom we started working on our GANTT Chart and Building Procedure assignments. My partner worked on the GANTT chart while I worked on the Building Procedure. I discussed the subsystems, how we are testing, the important things to keep in mind for the future, and the step-by-step process that is needed to build our device.
2/21/19	Sarah	I began to work on the build of our prototype. I unpacked all of our materials and read the instructions on how to set up the raspberry pi. After analyzing all of the pieces, I emailed our mentor and requested March 5th or 7th for our second meeting. I made sure to Cc my partner and Bcc Mrs. Tungett. In addition, I emailed The Home Depot and requested that they supply AAA batteries for our project. I used the letter outline to properly ask for the materials, and I plan to contact Radio Shack for other electrical materials.
2/21/19	Aubrey	Absent
2/25/19	Sarah	First, I emailed my mentor to ask for guidance of how to properly set up and use the Raspberry Pi Zero board. Next, I looked up a breadboard to use for testing our subsystems. Aubrey and I watched a YouTube video on how to setup the Raspberry Pi Zero with the kit and the pre programmed SD card. Over the weekend, I emailed vendors such as Home Depot, Hobby Lobby, and RobotShop.com for items such as super glue, AAA batteries, and a motion sensor.
2/25/19	Aubrey	Today Sarah and I got familiar with the Raspberry Pi Zero. We researched how to program and install the software needed to get it to function properly. We watched youtube videos that helped us understand how to set it up as well as played around with the ports to see where what goes. We also emailed our mentor Mr. Barnard asking for any guidance or tips he may have about programming the Raspberry Pi Zero.
2/27/19	Sarah	We started off by trying to upload the Raspberry Pi Zero software to Aubrey's computer, so we were figuring out the usage/function of each cable. By looking on Youtube, we found how to properly install the program and effectively use each piece. We also discussed additional pieces that we need for the project, including a USB and HDMI cord, and we established our plan for next class on programming it. In the classroom, I continued to work and update the materials list with items such as the Canakit starter kit, the Bluetooth USB adapter, and a breadboard with cables.
2/27/19	Aubrey	At the beginning of class, we tried to put the Raspberry Pi Zero together and get it to function. However, we realized we didn't have the correct adapters that are needed to put the Noobs software on my computer. We watched more youtube videos to help us figure out how to setup the software. I decided to

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		take home our materials so that I can import the Noobs software using a USB cable, HDMI cable, and power cable. Once we realized what we still needed in order for it to work properly, we looked at our Fusion 360 model and thought about the things we still need to create for the updated model.
3/1/19	Sarah	At the beginning of class, I attached the Raspberry Pi Zero, with the HDMI cable, to the computer of the projector in the lab. On the Raspberry Pi Zero it has Genie and Python as options for coding. Aubrey and I researched more about the different functions of the Raspberry Pi board, and we looked up Youtube videos on how to code with Python to set up the subsystem of our product. We also looked up how to create circuits on a breadboard to light an LED.
3/1/19	Aubrey	During this class we set up the Raspberry Pi Zero to see if we could start coding the basics of our project. When we got the Raspberry Pi Zero to work properly, we noticed that it has Genie and Python software options to code with. We researched more to figure out which would be best to work with for our purposes. We also figured out how to create a circuit that will allow us to test our LED light bulbs on the breadboard.
3/5/19	Sarah	We started out by talking about all of our different subsystems and ensuring that we had all of the right pieces. During class we worked on our Fusion 360 3D Model. I created an LED light and used multiple layers and the extrude and fillet features. I also worked on the inside face of the speaker and I used the circular pattern and fillet feature to make it detailed. We also had our 2nd mentor meeting after class, and after much consideration we've decided to switch to Arduino because it's easier to work to wireless connection function.
3/5/19	Aubrey	At the beginning of class we talked to each other about the components that we had and each of their functions. This allowed us to make sure that we have all of the right pieces-- if not, then we could bring them next class. We worked on our Fusion 360 model for the rest of class. We created an LED light and started the speaker. I later finished creating the model of the speaker at home. After class ended, we had our second mentor meeting. We discussed the issues we would come across using the Raspberry Pi Zero, so we decided to switch to arduino. The arduino will be easier to work with for the sake of wireless communication.
3/7/19	Sarah	After figuring out that we needed an Arduino Nano due its size, I started creating the board on Fusion 360. After that, we researched the right programming for Arduino and begun planning for the new pieces we would need. We also decided that we wouldn't be using a motion sensor anymore due to its inaccurate detection, so we were thinking that another limit switch could be pressed to turn it on/off.
3/7/19	Aubrey	At the beginning of class I mentioned to Sarah that I do not think that a motion sensor would be the most conventional way of detecting a parent or guardian has left the vehicle. We started brainstorming and thought that a limit switch would work to detect if the car door is open/closed. We also started creating the Arduino Nano on Fusion 360 because the actual board had not been delivered to me yet.
3/18/19	Sarah	In the lab, I practiced creating circuits on our breadboard with cables, resistors,

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		and the battery pack to light up an LED. Also, we talked with teachers to see how to best control the on/off function of our alarming device. After deciding to switch to an Arduino Nano instead of a Raspberry Pi Zero, we found a magnetic sensor that will be more accurate in turning the device on/off when wanted. We were inspired by the design of a car welcome light to think of this specific technology.
3/18/19	Aubrey	We built a circuit on our breadboard to test the different LED lights that we ordered. Once we mastered the technique of testing we asked for teacher input on what the best hardware would be to complete the same task as the motion sensor. We figured out that we needed a magnetic sensor that we can attach to the alarm device. This magnetic sensor detects the strength of the magnetic field in order to determine if the circuit is opened or closed; this way nothing else can interfere with it.
3/20/19	Sarah	When we got into the lab, we first downloaded Java on to the computer, and then we installed the Arduino IDE programming software. After downloading those, we looked at videos on how to connect our reed switch(magnetic sensor) with our Arduino and the breadboard. In the videos, they use an Arduino and a reed switch to close and open the circuit for an LED light, which is exactly what we want to do but also add a speaker for sound.
3/20/19	Aubrey	Today we got our Arduino Nano and transceivers together and figured out what we needed to do in order to start programming. We used online resources as well as asked some of our classmates to get started. First we downloaded Java and then the Arduino software. This process took a long time as we had some issues downloading Java at first. After we got the software running we watched youtube videos that instructed us on how to test the reed switch that we are now using instead of the motion sensor.
3/22/19	Sarah	The magnetic sensors came in, so we first connected the Arduino Nano to the computer. After that, I began working on the wiring for the magnetic sensor on the breadboard. I connected the reed switch(magnetic sensor), the LED light, and a resistor with cables so all that's left is to connect it to the Arduino to begin testing. Then, we came into the classroom, and I sent an email to our mentor to schedule our 3rd and final mentor meeting. Lastly, I began to create the Arduino Nano on Fusion 360.
3/22/19	Aubrey	We got the reed switch today, so we tried to test it today. First, we connected the reed switch to the breadboard as well as the LED Light, resistor, and wires. All of these components were circled back to the Arduino nano so that we can program the switch to read the proper code. After that, we went into the classroom and worked on the Fusion 360 model. I started a new file creating the reed switch. I made everything except for the wires because I don't know how to get the curvature.
3/26/19	Sarah	When we got into the lab, we got out the materials and started the wiring for the Arduino and the wireless transceivers. We found a picture online that showed which port on the transmitter goes to the matching port on the Arduino. For the Arduino Uno I used the male to female spiderwire, and for the Arduino Nano I used the male to male spiderwire. We figured out that to power the Uno we can use a 9V battery with a cord connecting to the Arduino, but the Nano

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		requires power with a smaller voltage.
3/26/19	Aubrey	Today we started wiring the Arduino Nano and the Arduino Uno to the transmitter and receiver. Molly and Colton are using the same kind of wireless communication, so we asked them how they wired the hardware together. In our case we are connecting the transmitter to the Arduino Nano and the receiver to the Arduino Uno. We found an image that showed us the pins each wire goes to. In addition to figuring out the wiring to the transmitter and the receiver, we also tried to figure out how we were going to power the nano without an AC plug. We decided to use a portable charger to connect the USB to the power source.
3/28/19	Sarah	I started out by connecting the wires of the speaker with wires attached to the Uno board. I used the wire cutters to take off the plastic casing around the wire and then I twisted the copper wires of both cables together. After that, I bound them with electrical tape to ensure they'd stay. Also, my partner and I discussed our casing that needs to be 3D printed. The Uno will be enclosed in a box, but the Nano needs to be near the carseat. I created the box to be 3D printed, but I still need to figure out how to design the part for the Nano.
3/28/19	Aubrey	We extended the piezo buzzer using more electric wires. We used the wire cutters to shave off the insulation from both ground and negative ends. After we took off the insulation, we secured the connection using electrical tape. We also sketched what our encasings are going to look like for the Uno and Nano.
4/1/19	Sarah	Today, I brought in our car seat and teddy bear baby for our presentation. The casing dimensions needed to be fixed, so we eliminated parts we didn't need to minimize space required for the casings. After getting the measurements, I began a new 3D model in Fusion 360 for the car door casing. Also, we decided to encase the Nano in the box and put it behind the padding of the car seat. Both reed switches are connected to the Arduinos through wires that will be encased with fabric or flexible plastic. Then, we had our final mentor meeting with Mr. Barnard, and we showed him all of the progress we had made. After the meeting, I created both boxes for the Arduinos on Fusion 360 and emailed the step files to Mrs. Tungett to be 3D printed.
4/1/19	Aubrey	Sarah brought in the carseat and a teddy bear for us to use during our testing process. Having the carseat and teddy bear as our baby made it easier have an idea of where each component needs to be placed. We also realized that we need to make smaller casings for the Uno and Nano. I helped Sarah identify the correct measurements and create a smaller encasing that way they would print in a timely fashion rather than 16 hours. At the end of the day, we had our final meeting with Mr. Barnard. We showed him what we had done to make the project more conventional. Once the meeting was over I helped Sarah create the Fusion 360 models of our casing. The new ones are only going to take a total of 5 hours to print.
4/3/19	Sarah	We got the casing for our prototype printed, so I spent the beginning of class hallowing it out to put the system in it. After that, we put the Arduino Uno and the breadboard with all of the wiring into the casing. I made the casing with small holes in the front and on the top so the noise of the buzzer could be heard, and I created a hole in the top so the wires could come out of the box.

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		We found screws from Mr. Nunez to enclosed our box but there wasn't a nut that would fit with the dimensions of the box, so I plan on using zip ties. Mr. Horwedel tried to help us solve our transmitter problem, but it didn't work so we may have to hardwire it.
4/3/19	Aubrey	Today we focused on consolidating the wires and making the aesthetic more appealing. We hollowed out our casing to make sure that the nano and uno fit inside each printed box. We also had to figure out how to secure the two sides of the boxes because the original screws and nuts that we were going to use are now too big for the holes printed. Once we did that, we tried to figure out how to fix the transmitter and receiver. Mr. Horwedel tried to help us, but he wasn't sure how to fix the issue. I will work on it tonight at home to see if I can figure out what's wrong with the code.
4/5/19	Sarah	After assembling the main box with the Uno and breadboard, I closed it with the zip ties. We got rid of the Nano completely because we decided to hardwire the prototype since the transmitters weren't working. After that, I covered the string of wires with electrical tape so that they would be protected from disconnecting. After that, we went to test our prototype in Aubrey's car so we could get a good video to submit. We used super glue to secure a magnet on the buckle of the carseat and we weaved the magnetic sensor through the outside of the opposite latch to the buckle. Finally, we got a video of our prototype working with the car. The buckle was already latched, so the the magnetic sensor was on the magnet, and when the car door was opened the speaker sounded three times.
4/5/19	Aubrey	I worked on the code more for the past two nights. I asked Molly and Colton if they got theirs to work. Unfortunately they couldn't get theirs to function properly either. Their mentor contacted a software engineer who wasn't able to identify the issue either. I wasn't able to fix the issue, so we decided to hardwire the reed switch the is for the seatbelt. Once that was done, the system worked flawlessly. Today in class, we wrapped the seatbelt in electrical tape so that it was more conventional. We also put the magnets in place; one on the seat belt and one on the bottom of the driver side door. Once we were done placing the device in the car the way we want it to work, we took a video of our solution working.
4/9/19	Sarah	As a class, we discussed the assignments that need to be done this month. I started by looking on Canva for a presentation outline, and I searched for electrical pictures for our presentation. Additionally, I worked on the Arduino Uno piece for our 3D model. I added the output plugs and used the rectangular pattern feature for sketch to create the holes with an extrusion. My partner and I discussed the testing that needs to take place before next class.
4/9/19	Aubrey	For the entire class I worked on updating the materials list. I got rid of the Arduino Nano, speaker, screws, and the transceivers. We had to make a lot of modifications to our prototype in order to get it to work in the most conventional way. This meaning that we had to replace the speaker with a piezo buzzer, the limit switches for the reed switched, and screws for zip ties. I go into more detail in the materials list for each of their purposes. I also had to add materials such as electrical tape, t-shirt, super glue, and a 9V connector.

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4/11/19	Sarah	I worked on the 3D Model for our project since it's due next class. Aubrey and I found an Arduino Uno on Grabcad, and I created a breadboard on Fusion 360. I found the actual dimensions on Amazon, and I used the extrusion and fillet tool to construct the main piece of the breadboard. Then, I extruded a 2mm by 2mm squares and used the rectangular pattern to create the many holes on one side. Then I created an offset plane in the middle of the breadboard, and I mirrored the extruded holes to the other side. Over the weekend, I need to complete the resistor, zip ties, and wires on Fusion 360.
4/11/19	Aubrey	Today we worked on the 3D model so that we wouldn't have to spend a lot of time at home putting it together. I looked on Grabcad to see if there were any parts that we could use on our final model. We ended up finding an Arduino Uno that was extremely detailed and better than anything that we could make on Fusion 360. At the end of class, Sarah and I made a "to-create" list so that we could ensure that all of our parts were created and could be assembled by next class.
4/15/19	Sarah	I started out by fixing my resistor that I made on Fusion 360 for our 3D model. Over the weekend, I worked on the resistor and zip ties. When I was trying to create the wires out of the main body of the resistor, it wasn't producing the wire with the shell function because I had it set to cut instead of join. Also, I began the preliminary presentation for Graver to view next class. We decided to name our presentation Vehicular Child Reminder, and I completed the child slide. After that, I created the assembly of our parts by using the Joint and Joint Group functions. I created wires on the Piezo Buzzer and Reed switch by sketching a circle, drawing on the perpendicular plane with the spline line, and using the shell feature.
4/15/19	Aubrey	At the beginning of class, Sarah was trying to finish assembling the 3D model but she wasn't able to figure out how to make all of the wires work with the other parts. Over the weekend I created the Piezo buzzer, reed switches, and magnets. Once we got the main parts together in one assembled file, we started our preliminary powerpoint. The preliminary powerpoint will be used to show the Garver employee and get her input on what needs to be added and/or changed.
4/17/19	Sarah	A representative from Garver came and talked to the class on what they're expecting for our presentations. The representative told us what to do and what not to do with the information in our presentations, and she gave us tips on how to keep people's attention and make people remember our presentations. After she gave her presentation, I continued working on our presentation in Canva. I changed the title slide to have our general statement for our project.
4/17/19	Aubrey	Heather Wootton from Garver Engineering came to our class to tell us what the judges will be looking for on presentation day. She went through a powerpoint that deconstructed the way that a meaningful and effective powerpoint should include. When she finished her presentation, some of my classmates asked questions to clarify what she said. At the end of class Sarah and I pulled up our PowerPoint to show her what work we have done so far.
4/23/19	Sarah	To start off class, Mrs. Tungett explained how our Portfolio should be put together. Over the weekend, I complete the Competitor Analysis portion of our

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		<p>Preliminary PowerPoint. Today, I worked on downloading all of the documents to be put into our Portfolio next class. After downloading them all, I imported all of the PDFs into one PDF, and I put them in the order of how we wanted them for the real Portfolio. Aubrey and I decided to put our Portfolio into a binder with sheet protectors and tabs. I will go to an office supply store and get those things for next class.</p>
4/23/19	Aubrey	<p>Today was the last day we had where we were able to work on our preliminary presentations in class. I tried to condense all of the data and research we had found into our PowerPoint. I made a separate document that we could use to ensure that our presentation checked off all of the minimum requirements. We created this presentation through Canva with the intention of making it more aesthetically appealing, however I found it hard to navigate through. I didn't get to finish the presentation in class so I will be in contact with Sarah tonight to make sure that it looks good and we have included all necessary information.</p>