Mission Folder: View Mission for 'H.O.T. C.A.R.S.'

State	Texas
Grade	6th
Mission Challenge	Food, Health and Fitness
Method	Engineering Design Process
Students	Alexa Tindall (KittyPop) Ethan Djajadi (chermender) Josiah Morales (jumpydog)

Team Collaboration

(1) How was your team formed? Was your team assigned or did you choose to work with each other?

We chose the team members based on our past experiences working together. We decided that we should work together because we all like science and math. Two of us have won in Math Olympics so we decided to have them on our team because they were good at computing. Our other member is good at science experiments. All of our members enjoy aspects of engineering, so we decided based on all this that our group could work together.

Alexa, Ethan, and Josiah have been classmates and friends since 4th grade. We have a similar interest in STEM and like working together. We decided to tackle a social problem and listed several projects which would benefit our society. Among these problems were diabetes, vaping, recycling, and hot car deaths. We then voted on the project we liked the most and found out that it bothered us a lot that Texas leads the USA in the number of hot car deaths. This is a preventable problem, and we feel like we can be part of the solution. We all had different jobs from one another by what we knew how to do. For example, Ethan knew how to code and Alexa had more experience in graphic designing, and Josiah had more mechanical knowledge. We also had science every day and on Fridays, we did Ecybermission work in class. We spent many weekends working on this project and getting together to make a difference.

(2) Provide a detailed description of each team member's responsibilities and jobs during your work on the Mission Folder.

Alexa (KittyPop) is the leader in the group, is good at speaking to people, can present projects easily, is a graphics art designer, organized all the answers for the mission folder, and is the main brainstormer. She also created the comic and the brochure and led outreach sessions in the community.

Josiah (jumpydog) is an organizer of materials and labs, has a little knowledge in testing app designs, draws conclusions very well, has some outreach coordinators that can be accessed, is brave with the public, is a researcher - victim testimonies, is a public speaker, is the timekeeper, is a visualizer of grand ideas, is an arranger of community service, and is the encourager of team members. He hosted team meetings and had an idea to connect the device to buckle.

Ethan (chermender) is the builder and engineer of the group, is the graph, charts, and tables creator. He also has been in charge of community outreach, is the engineering technician, a researcher - computer coding and apps specialist, multicultural outreach, website builder, and enthusiasm for teamwork. He coded device to the app, made and wired the device.

The team met during the week in school and on scheduled weekends to choose sections to work on, and assign areas to complete. All team members were deeply involved in every interview and presentation, as well as each experiment that was conducted throughout the year.

(3) Did your team face any problems working together? If so, how did you solve them? If not, why do you think you were able to work together so well?

Scheduling times to meet, especially with each team members' very busy lives, was one of the most troublesome parts about working as a team. The team members are in the same class and worked on the projects while in Science and English class each week, gathering data from each other, collaborating and sharing ideas. Outside of that, we also met with specialists in their fields and interviewed them. The team members also met approximately once a month at a team member's house to work on the engineering – software and hardware components to put into the project. It did take us longer to make decisions since we had to get consensus from each member of the team whenever we had a question or a problem. Instead of making individual decisions, we took the time to discuss solutions together. It was helpful to have one person be in charge each time and run the meetings to keep us on point.

(4) What were some possible advantages to working together as a team on this project? How would working as individuals have made this project more difficult?

The advantages of a team are that we get three times the work done, we have three sets of skills, and each of us can individually do different parts of our project. Having multiple points of view for the presentation and solution of each of the obstacles we encountered, it was helpful to resolve this quickly with three peoples' ideas. We also had talents in different areas which allowed each of the members to contribute to the success of the team. Working together as a team resulted in multiple solutions that, individually, would not have been thought of. Also, each team member's unique point of view and experience lead to the learning and furthering of the project very efficiently. Each team member worked well together and was very supportive of each other's ideas and thoughts. Each person's strength was also used in different areas, while every member of the team's input was important. We blended our complementary skills to come up with solutions, learned to take risks together, and trust each other more.

The disadvantage of working individually on a project is that you have only one set of skills, you cannot do more than one aspect of the project at a time, and you can only accomplish one task at a time. If this project had been a one-person project, the one person doing the project would've had to do hours of experiments, data collection, and putting all of their data into these questions. They probably would've had to research so many things, have to work very hard to learn two different programming languages, and be generally be short on time on everything else.

Uploaded Files:

- [View] **Team Checklist and Schedule - December & January** (By: KittyPop, 02/09/2019, .pdf)

  H.O.T. C.A.R.S. made checklists month by month to keep us all on schedule and finishing tasks on time. This is one example of our Dec/Jan checklist.
- [View] **Action Plan** (By: KittyPop, 02/09/2019, .pdf)

  The team's overall plans, goals, and community benefits are put into one graphic organizer which gives a brief overview of the project.
- [View] **Team Communications in Summer** (By: KittyPop, 02/09/2019, .pdf)

  This is one of the team's communication sessions with our Team Advisor in June 2018. We put questions and answers together from our chat session.
- [View] **Why did we choose this Mission?** (By: KittyPop, 02/09/2019, .pdf)

  Texas leads the nation in hot car deaths of infants and children. This document shows an article we read this summer that made us determined to change the statistics for our state.
- [View] **Timeline** (By: KittyPop, 02/09/2019, .pdf)

  The team timeline shows the work schedule, major accomplishments, and future plans of H.O.T. C.A.R.S. from April 2018 through June 2019.
- [View] **Team Roles and Responsibilities** (By: KittyPop, 02/09/2019, .pdf)

  A chart listing the major roles and responsibilities of each team member is included in this attachment.
- [View] **Science and Engineering Experiment Schedule** (By: KittyPop, 02/17/2019, .pdf)

  The schedule of the activities we completed from April 2018 to February 2019 is shown by date and include specific tasks and team members present.

Engineering Design

Problem Statement

(1) What problem in your community will your team attempt to solve using the engineering design process?

"I could hear my husband screaming," said a mom we interviewed. She was calling her neighbor trying desperately to reach her husband, who just found that he accidentally left his child in his car all day. Nobody ever thinks that this would happen to them. But over 750 children have died since 1998 being left in a hot car. (National Highway Traffic Safety Administration, NHTSA.gov) The research has shown that this happens to mostly highly educated, two income families, with lots of responsibilities. Unwell or tired parents could have their brains move into "auto-pilot" and forget something outside of their normal routine. Unfortunately, some of these have resulted in the deaths of children and it is beyond devastating to any family. We want to fight to prevent hot car deaths and save lives.

The engineering problem statement is : What device could be developed to prevent hot car deaths and potentially save the lives of young children?

(2) Research your problem. You must learn more about the problem you are trying to solve and also what possible solutions already exist. Find AT LEAST 10 different resources and list them here. They should include books, periodicals (magazines, journals, etc.), websites, experts, and any other resources you can think of. Be specific when listing them, and do not list your search engine (Google, etc.) as a resource.

The research conducted by H.O.T. C.A.R.S. was extensive and is organized in this section by the type of resources we used. Please see the uploads to the Mission Folder as accompaniments to this answer: "Bibliography", "Contact List", and "Community Partnerships" which are located under the Engineering Process and Community Benefit sections of the Mission Folder.

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Dutkin, Gage. Entrepreneur and Inventor. August 6, 2018. Personal Interview by Alexa Tindall, Ethan Djajadi, Josiah Morales.

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Pinkney, Kerrie. M.D. Chief Medical Officer. Covenant Children's Hospital. Lubbock, TX. Personal Interview January 8, 2019. Interviewers Ethan Djajadi, Alexa Tindall, Josiah Morales.

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COMMUNITY ORGANIZATIONS VISITED

Parent Life - YFC Lubbock
Young Parent Support Training 2621 34th Street
Lubbock, TX 79410
(806) 763-9794

FirstSteps Daycare
4601 82nd Street Lubbock, TX 79424 (806) 783-9046

Learning Tree Children's Academy
7713 Milwaukee Avenue Lubbock, TX 79424
(806) 771-2323

Kids Day Out Program
Southcrest Baptist Church 3801 S. Loop 289 Lubbock, TX 79423 806-797-7400

Rock Solid Athletics
6205 43rd Street Lubbock, TX 79407 (806) 795-7625

Tas Montessori School
502 Dowden Road, #100-102 Wolfforth, TX 79382
(806) 783-0054

Tega Kids Superplex
7800 82nd Street Lubbock, TX 79424 (806) 866-9765

Stepping Stones
2433 26th Street Lubbock, TX 79411 (806) 747-6688

The Kid's Clinic
5004 Frankford Avenue, #400 Lubbock, TX 79424 (806)771-5437

University Medical Center
Newborn Nursery 602 Indiana Avenue Lubbock, TX 79415 (806) 775-8200

Parkridge Pregnancy Medical Clinic
5203 79th Street, Ste A Lubbock, TX 79424 (806) 794-8555

Parenting Cottage
3818 50th Street Lubbock, TX 79413 (806) 795-7552

Family Guidance and Outreach
Young Parent Support Training 5 Briercroft Office Park Lubbock, TX 79412
(806) 747-5577

Kids Day Out Program
Southcrest Baptist Church 3801 S. Loop 289 Lubbock, TX 79423 806-797-7400

Honorable Jodey Arrington
U.S. Congressman Texas District 19 Longworth House, DC 1312 Texas Avenue Lubbock, TX 79401

Graco Baby Corporate Headquarters
Street 123 Toronto, Ontario Canada M3C-1L1

Evenflo Company Incorporated
225 Byers Road Miamisburg, Ohio 45342 800-233-5921

Cosco Products Company
2525 State Street Columbus, Indiana 47201 800-628-8321

TED TALKS

Thomas Suarez. A 12 Year Old App Developer.
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(3) Explain what you learned from your research. What did you find out about your problem that you didn’t know before? What kinds of possible solutions already exist? Be sure to put this in your OWN words, do not just copy and paste information. Also, be sure to cite your sources.

The H.O.T. C.A.R.S. team conducted extensive research beginning in June 2018. The sources of information included experts in the community, businesses with children as their focus, inventors and entrepreneurs, websites, webinars, personal interviews, Skype interviews, medical journals, news articles, TED Talks, and pamphlets. Research summaries are included here, along with the source from which the information was found. We learned a lot of new information and also discovered many ways currently being explored as a solution to the problem. This allowed us to begin the engineering process knowing what has already been done and where the gaps in a solution exist. H.O.T. C.A.R.S. then proceeded to fill in those gaps and devise a way to prevent heatstroke in vehicles to benefit all parents.

https://www.kidsandcars.org/2018/08/21/hot-car-deaths-why-do-parents-still-face-prison-for-a-normal-memory-lapse/ 9/12/2018
There are 2 types of memory systems - prospective memory (cognitive) and habitual memory (habit) which try to explain how parents can lose track of their child in the back seat of the car. Cognitive memory is fragile and is processed by the hippocampus and prefrontal cortex. The hippocampus stores new information, and the prefrontal cortex makes plans for the future. A coordinated effort between the 2 areas helps us form prospective memory, which requires awareness on the person’s part. Habit is frequently active and can override cognitive memory causing the person to “forget” new tasks. Many forgotten babies can result from this override.

https://www.cnn.com/2018/07/03/health/hot-car-deaths-child-charts-graphs-trnd/index.html 08/05/2018
Approximately 37 kids die each year in the past 10 years from heat stroke while trapped in cars. These can be from children who are intentionally left in their carseats, trapped while playing in cars or accidentally forgotten in the car. Children overheat more easily than adults and younger children usually cannot get out of the situation by themselves. Although there are laws making it illegal to leave a child in the car, it does not prevent the accidentally forgotten children. Outside temperatures don’t have to be high in order for children to die of heat stroke.

https://www.kars4kids.org/blog/not-babies-forgotten/ 07/25/2018
About half of the children who die in cars due to heat stroke are due to either the child getting trapped in a car while playing, and is unable to get out on their own, or are left in car intentionally by caregiver who believe they won’t be gone long, or they don’t think it will get too hot. Many states have made it illegal to leave the baby unattended in the car, and locking the car when you are not in it, would help prevent children getting trapped in the car. Technology can help remind parents of babies in the car, and warn if children are in the car unattended.

https://www.parents.com/parenting/better-parenting/advice/7-ways-to-not-forget-your-child-in-the-car/ 07/13/2018
There are many ways to remind yourself that you have a child in the backseat. You can place a toy in the front seat to remind you, place the car seat in the middle of the backseat where you can see it, leave something that you will remember to take with you like a shoe or your purse or phone next to the car seat, be extra vigilant when routines change, look before you lock, have your child care provider call you if your child is not there, and many others. Also, be aware of how hot the car gets even if it is not too hot outside.

https://www.which.co.uk/reviews/child-car-seats/article/child-car-seat-laws-uk-and-abroad/child-car-seats-laws-around-the-world 07/15/2018
There are many different car seat rules in different countries. We have noted that it is important to know the different car seat requirements in different countries to see if there are similarities or differences that make it safer for a child. Europe and America have very similar laws, but there are fewer hot car deaths in Europe - it may be that they do not drive as much as we do, or that they have adopted some early technology requirements to remind parents that they have children in the back. We learned about different rules in different countries.

http://www.noheatstroke.org/original/index.html, 07/24/2018
Many children under the age of two up to 14-year are vulnerable to hot car death. Multiple states have adopted laws that make it illegal to leave a baby in the car unattended to try to prevent this phenomenon. This article shows the temperature rise within a car in the first hour, and children can easily reach 107 degrees or more, the temperature when organs of the child stop working and they die. This article also shows the number of hot car deaths from 1998 to 2017 totaling 705 deaths, which average 37 per year, monthly statistics and statistics by state. Texas leads the nation in hot car deaths. The article further tracks the reasons for unattended children in cars and also has safety recommendations on how to educate and raise awareness of this issue.

https://www.rayrayspledge.com/default.html 07/08/2018
Ray Ray is a child who was left in the car by her dad and when her parents realized it, it was too late. They have started a website in her honor to remind other families to set up checkpoints to ensure it doesn’t happen to others. They advocate that the child care provider contact parents or designated persons if the child is not at the facility on time and that everyone looks in the backseat before leaving the car, every time. They have had very positive feedback from the website.

https://www.kidsandcars.org/heatstroke-day/ 08/01/2018
There is a great web page with a lot of concise information on hot car deaths - kids and cars.org. It has multiple articles regarding the science behind memory lapses, statistics of where and who and how many children have suffered this consequence, how to prevent it, and multiple tools to help. We were able to contact the website owners who sent us fliers that could be included in our campaign to prevent these deaths and learn more about their mission.

https://www.nbcnews.com/news/us-news/hot-car-deaths-senators-propose-bill-help-prevent-child-heatstroke-n788571 07/31/2018
HOT CARS Act was introduced to Congress in 2017 by 2 Senators, Al Franken, and Richard Blumenthal, requiring a standard warning on vehicles to remind parents to look in the back seat before exiting the vehicle. Although at the current time, the act has not yet passed, it is hopeful that it will. That would serve to try to decrease the number of child deaths from being forgotten in the back seat at dying from heat stroke.

https://www.nhtsa.gov/campaign/child-safety 08/01/2018
There are multiple ways to remind yourself to look in the back seat before exiting the car. This will help decrease the probability that you will leave a child trapped in a car. A car's internal temperature can increase by twenty degrees Fahrenheit in just ten minutes, and children's body temperature can increase three to five times faster than adults. Children can die if their body temperature gets to 107 Fahrenheit and It does not take long for this to happen. That is why it is important to not leave a child unattended in the vehicle even for a short period of time.

http://www.beterem.org/download/files/19076.pdf 08/01/2018
The National Highway Traffic Safety Administration (NHTSA) looked at the market and evaluated several of the products on the market to see how effective the product was in reminding parents that they had a child in the back seat. The found that there were a lot of products on the market which worked well which ranged in prices from low to high. None of them were found to be completely reliable, and it was difficult to convince parents to purchase the device since parents did not think they could forget their child in the back seat. Different device designs and reminder modalities were tested and the results of the tests were published. These devices were useful in reminding parents if they accidentally left their child in the back seat, however, they do not warn of children who get trapped in the car while playing or those who were left intentionally in the car, two other main reasons that there are child fatalities secondary to heat stroke in cars.

http://pediatrics.aappublications.org/content/116/1/e109.short
Hot car deaths are a rampant problem and there has been very little we can do to stop it. A researching experiment was conducted and the results were considered somewhat alarming. According to the research experiment, the temperature increases by about 3.4 degrees Fahrenheit every five minutes. The most amount of increase in temperature happens in the first fifteen to thirty minutes, which is also about the time a child is left in the unattended and hot car. Cracking open the window by 1.5 inches did almost nothing. It decreased the average temperature increase by about 0.3 degrees.

https://injuryprevention.bmj.com/content/11/1/33.short
In a study about hot car deaths, it was discovered that a large majority of the deaths were caused by absent-minded adults. 27% of the deaths were caused by children locking themselves in a hot car. 73% of the deaths were caused by adults not realizing the children were in the car. 43% included in the absent-minded adults category were caused by something related to childcare for the child. More than half were caused by family relatives and the rest were caused by childcare faculty.

https://injuryfacts.nsc.org/motor-vehicle/motor-vehicle-safety-issues/hotcars/
About 37 children under 15 die because of hot cars. 2018 and 2010 have the most amount of deaths. 2018 has 48 by 11/12/18, and 2010 had 49 deaths.

Dr. Amy Thompson, Pediatric Hospitalist for 11 years Chief Executive Officer Covenant Children's Hospital, Lubbock, Texas. Personal Interview.
Hot car deaths are a big problem. Most parents do not understand that large increases in temperature happen in a car. Even if it is 60 degrees Fahrenheit outside, it can reach up to 100 degrees Fahrenheit inside the car. The first ten to fifteen minutes cause the most amount of increase in temperature. The doctor's office has devised a solution to this problem; they have made a yellow insert for the child's seat. The parent wears the yellow ribbon around their neck while driving, they will insert it into the buckle, instead of the normal insert, in the child's seat after they park. Then they will take the child with them like normal.
If the parent happens to forget, they will see the ribbon and remember that their child is in the car. This device has worked for parents so far. This a step towards helping children not die in hot car deaths. But even after introducing and showing parents and giving parents the device, some parents still leave the child in the car. This is normally because of habit and that is caused by the basal ganglia. The basal ganglia is what causes habitual memory to take control and take over doing actions.

http://health.wusf.usf.edu/post/fl-leads-hot-car-deaths-year#stream/0
By June 2013, there were 15 reported deaths because a child was left in a hot car. 2010 was the worst year with 49 reported hot car deaths. Experts say that normally attentive parents can accidentally leave their child if they are under stress, have had less sleep, or have had something else happen that caused a change in their routine. Routine changes are the most common way for parents to leave a child in the car.

https://www.noheatstroke.org/original/
There have been 705 heatstroke deaths in cars from 1998 to the present day. Over 19 years, data has shown that 54% of the deaths are children forgotten by caregiver, 28% children playing in an unattended vehicle, 17% were intentional heatstroke deaths, and 1% had unknown circumstances. 32% of the children were under the age of 1, 22% were 1-year-olds, 20% were 2-year-olds, 13% were 3-year-olds, 6% were 4-year-olds, and a little less than 12% were children between the ages of 5 and 14. 1% of the deaths had children of unknown ages. I might need to change this.

https://www.kidsandcars.org/2018/08/21/hot-car-deaths-why-do-parents-still-face-prison-for-a-normal-memory-lapse/
Parents or caregivers may not remember their offspring in the vehicle. But some believe that it is a crime and a misdemeanor. The law has required for a while that all children be seated in the back of the car so they do not die from airbags, but more children have died from being in a hot car than from airbags. Most of these deaths started occurring after children were required to sit in the back because the parent cannot see the child. When they were allowed to sit in the front, parents could always observe the child.
Even a small difference in routine can make it so the child can die from a hot car. If you take the same route to the babysitters or daycare, you will not forget the child. But even just going in a different lane to avoid construction or to get out of the way of a big truck, can cause your brain to switch from "remember the child! Remember the child!" to "Remember to go to work! Remember to go to work!" Changes in routine are the main cause of the unfortunate deaths.
Many people are sure that they have brought their child to the daycare, when in fact they are dead in the back seat. Many cases include the parent(s) saying that they knew they brought the child to the care site, even when they didn't. This is caused by the brain making "fake memories" of assumptions. The sentence sounds correct, so the brain automatically assumes it is and creates the memory.
Scientists aren't willing to fund research for why parents forget their child in the car. They think it isn't an important enough experiment. Some people want to immediately make the parents sad or feel horrible about death. Some car companies have started to make devices in the cars to help with this problem, but lots of people think this will not happen to them so they do not want to get a high tech expensive device for something they think isn't going to happen to them.

Dr. Kerrie Pinkney, Pediatric Intensive Care Unit Doctor Chief Medical Officer, Covenant Children's Hospital. Personal Interview.
Hot car deaths are a dangerous problem. The sheer amount of heat can cause the brain cells to literally cook. The amount of heat also causes the child to pass out. Children, because of their size, can get to a high-temperature 3-5 times faster than adults. It is a miserable way to die because it is impossible to cool down while trapped in the car. A

child can not last in this situation most of the time. A child will usually die by the time ten minutes roll around. Other than dying in a hot car, leaving a child in the car can result in kidnapping, the car getting in a crash from being knocked out of gear, rolling over in some extreme cases, rolling into traffic, and being caught in the automatic windows.

Deannie Jacobson, Skype Interview. A parent who has experienced the Heatstroke Death of her son.
Deannie and her husband had two children. When they had Luke, it was a miracle. One day, Deannie had to go to work early so she could get home early and watch her other son's sports game. Deannie's husband had to take Luke to the daycare instead of Deannie. He forgot to stop and left the child in the back when he went to a conference. The daycare's normal owner had to go somewhere else and left her husband in charge. He didn't know who all was supposed to come, so when Luke didn't come, he didn't think to call. Deannie went to pick Luke up from the daycare center and was told that Luke never arrived. She called Leland, her husband, and he eventually checked the back seat, the child wasn't breathing. When Deannie came home, she saw her neighbor trying to do CPR on the child. The police and detectives came later and Deannie sent her two other children to her mother-in-law's house while Deannie and her husband were brought to the station and Luke was brought to the medical examiner's office.
They were interviewed for four hours. They were sent home with no punishment, but they punished themselves with grief. They think some ways to deal with this problem are to tell people, have an actual warning for this in parenting classes, spread more awareness for the problem, and to have devices for cars or car sets that can alert if a child is left in the car.

https://www.nsc.org/road-safety/safety-topics/child-passenger-safety/kids-hot-cars
NSC says how technology in the car will help prevent more hot car deaths and protect our baby's, here is two guidelines to follow: Reminder for backseat: A reminder to check rear seat if a car door is opened in 10 minutes when the vehicle is not started or five ringers (of any type) will sound and a message will show on the radio, instrument panel, or another audio device. The vehicle will then turn off and hopefully remind the driver to check the back seat. This technology is available on some GM vehicles.
Baby seat technology. The technology creates a series of sounds activated through a chest clip and receiver to tell the driver a child/children is in the backseat within two seconds of shutting off the vehicle.

https://people.com/health/hot-car-deaths-how-to-avoid-them/
People.com and The Centers for Disease Control are saying that most of the time it's not parents wanting to leave their child in a hot car to die it's that they simply forget and then they are considered bad parents. They recommend leaving a shoe, purse, wallet, or anything you have in the back as a reminder to check the backseat whether you have the baby or not. There are also several devices that have already been made and a law that is still in court for a Senate vote. The law states that every new car needs to have a built-in heat device that alerts the parent or helps prevent heat exhaustion.

https://www.cnn.com/2018/07/31/health/nissan-rear-door-alert-hot-car-deaths/index.html
CNN talks about how Nissan aims to have a full alert system on every truck, SUV, and sedans. CNN is also trying to encourage people to help. Anyone from parents, grandparents, bystanders, guardians, and babysitters can try and help to prevent vehicular heatstroke death. As heatstroke deaths have gone on some laws such as the hot cars act is trying to be passed and is still in the Senate. There have been challenges and sensors in car seats to try and decrease hot car deaths.

https://www.acs.org/content/acs/en/climatescience/climatesciencenarratives/what-is-the-greenhouse-effect.html American Chemical Society What Is the Greenhouse Effect?
This website explains the greenhouse effect. The greenhouse effect is where infrared radiation from the sun heats the earth which makes it hotter or colder. An example of infrared radiation is if you put your hand near a fire. You'll feel the heat the heat you feel is what scientists call infrared radiation. As the infrared radiation from the sun hits the earth it heats the earth and makes it the perfect temperature we need to survive.Some of the sun's infrared radiation also bounces off the earth's surface into space. The earth also makes infrared radiation but it does not all make it to space. Some of the made radiation gets stuck in the earth's atmosphere or clouds and brings it back to the surface which gradually makes the earth hotter than normal. When humans came, we have made more greenhouse gases that disturb the perfect balance of earth's heat. In conclusion, we need to help decrease greenhouse gases and lessen the effects it causes.

https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions
United States Environmental Protection Agency Sources of Greenhouse Gas Emissions

This site is stating that most of what causes the greenhouse effect comes from us humans. The EPA published an Inventory of U.S. Greenhouse Gas Emissions and Sinks which tracks all of the U.S. emissions. The gasses that we use for transportation such as diesel and fossil fuels are the biggest source of manmade causes of the greenhouse effect. The second biggest source is our production of electricity with burning natural gas, fossil fuels, and coal. The third is all of our industry that burns fossil fuels. The rest is our residential, agriculture, and properties that cause the effect. In conclusion, greenhouse gasses which are both natural and manmade, trap heat which makes the earth hotter.

https://www.eia.gov/energyexplained/index.php?page=environment_how_ghg_affect_climate U.S. Energy Information Administration - EIA - Independent Statistics and Analysis

This site explains to us that a couple of important greenhouse gases result from human activity has increased by industrialization in the mid-1800s. Most of the human-caused greenhouse emissions are from carbon dioxide (CO_2) from burning fossil fuels. CO_2 in our atmosphere is natural and part of the global carbon cycle on Earth. The flow of carbon between the atmosphere and the earth's land and oceans are controlled mostly from photosynthesis. Some of the natural processes can absorb CO_2 produced each year. Starting around 1950, it began exceeding the capacity of these processes to absorb carbon.

https://driversed.com/trending/hot-car-deaths
This site gives us a little perspective on how hot cars can get. For example, a meteorologist named Jacob Wycoff stayed in a car one summer afternoon to test how hot a car can get. In 20 minutes the car already reached temperatures of 120 degrees Fahrenheit. In just the next 10 minutes a camera overheated and Jacob was going into heatstroke. With that message we must not leave our beloved family members from dogs to babies. Even if it looks normal on the outside but they're baking on the inside. It is known that automakers use solar loading which is why the vehicle's interior doesn't melt but it does a lot of damage to our organs, lungs, brain, etc. So look before you lock.

https://www.kxan.com/news/local/texas-tech-students-build-device-to-prevent-hot-car-deaths/994647371 07/15/2018
Texas Tech student, Gage Dutkin, is an aspiring entrepreneur. He heard from his mother about the number of tragic deaths involving children in hot cars and was inspired to work on solving the issue. He started looking into different solutions and created a business plan together with two of his friends. He entered into a competition called iLaunch and won $10,000 to work on his project. He continues to work on the prototype and business plan to make the product a success.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4962190/ 07/03/2018
In Brazil, hot car deaths are also a problem. This alone shows that the incidents can happen anywhere, not just the USA. This also shows that this is a worldwide problem, not confined to one area. Finally, in Brazil, the research shows that forgetting is the most common cause of vehicular hyperthermia, so we should also make sure parents know that they're vulnerable to this tragedy, too. In Brazil, we found that increasing awareness of this problem through education is highly recommended.

https://www.arduino.cc/en/Tutorial/StateChangeDetection 8/3/2018

We designed our product by thinking of the design, then researching different resources to help us wire, design, and program it. One of the resources we used included this website which helped us wire a push button. We obtained a list of items needed to make the product, then wired it together per the instructions on this website, then programmed it to detect the different states of the button. After we made the prototype, we tested it and the product worked as expected.

https://www.instructables.com/id/Remotely-Control-LED-using-HC-05-Bluetooth-Arduino/ 8/3/2018
To make the prototype of our device, we went through the following steps:
Connect to the blue tooth module.
Set up an LED.
Program the button.
Test the connection.
Install Evothings Studio.
Program button to respond to the phone signal.
We tested the device, and it worked.

https://www.nsc.org/road-safety/safety-topics/child-passenger-safety/kids-hot-cars
The NSC says how technology in the car will help prevent more hot car deaths and protect our babies. Here are two guidelines to follow: Reminder for backseat reminder to check rear seat if a car door is opened in 10 minutes when the vehicle is not started, five ringers (of any type) will sound and a message will show on the radio, instrument panel, or other audio in the car. The vehicle will then turn off and hopefully remind the driver to check the back seat. This technology is available on some GM vehicles. Baby seat technology: The technology creates a series of sounds activated through a chest clip and receiver to tell the driver a child/children is in the backseat within two seconds of shutting off the vehicle.

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People.com and The Centers for Disease Control are saying that most of the time it's not parents wanting to leave their child in a hot car to die - it's that they simply forget and then they are considered bad parents. They recommend leaving a shoe, purse, wallet, or anything you have in the back as a reminder to check the backseat whether you have the baby or not. There are also several devices that have already been made and a law that is still in court for a Senate vote. The law states that every new car needs to have a built-in heat device that alerts the parent or helps prevent heat exhaustion.

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CNN reports that Nissan aims to have a full alert system on every truck, SUV, and sedans. CNN is also trying to encourage people to help. Anyone from parents, grandparents, bystanders, guardians, and babysitters can try and help to prevent vehicular heatstroke death. As heatstroke deaths have gone on, some laws such as the Hot Cars Act is trying to be passed and is still in the Senate. There have been challenges and sensors in car seats and cars to try and decrease hot car deaths.

To confirm our research, we did an experiment where we had vehicles and we parked them in the hot sun. We measured the temperature in five to fifteen minute intervals, then waited half the day to do the same again. We found that the connection between the time interval and the temperature rise was undeniable.

Design Development

(4) What MUST be a part of your solution? This is called the criteria. What does your solution need to have in order to solve the problem? (NOTE: Don't discuss a specific solution here, just the characteristics of a good solution).

- The solution needs an alert system to tell the caregivers that the child is in the car. We believe that the alert system should be loud and cannot easily be ignored by caregivers. It would be a plus to also have the alarm sound where others around the caregiver can hear it and remind them.

- The solution needs to have a baby sensor that detects that the baby is in the car. If the baby is in the car, the sensor would connect the system and notify the caregivers that they need to be aware that the baby is still in the vehicle. If the baby is not in the vehicle, it should not sound the alarm.

- The solution needs to have a solid connection to relay when the baby is in the car. The connection to notify the caregiver needs to be something that cannot be easily destroyed. It should also be childproof and safe, but definitely sturdy.

- The solution must be reliable. In order for the alarm to always sound when the baby is in the vehicle, it needs to be reliable and sound each time the baby is in the car.

- The solution must send a notification in a very timely way. Since it takes only 15 minutes for the temperature in the vehicle to rise to dangerous levels, the notification to the caregiver should be done in a shorter period of time for the child to be safe.

-The solution needs to be a two-pronged approach and includes a technological component and a directed educational and outreach campaign.

(5) What limits are there on your solution? These are called constraints. Does it need to be a certain size? A certain weight? Is the cost a factor? Write down all of the limits on your solution.

- The solution must be relatively compact. The solution needs to fit into a vehicle and not take up too much space since the space in the vehicle is limited, and we also have to fit a car seat into that space as well, and sometimes more than one car seat.

- The solution must be relatively inexpensive, costing under $50 so that it would be affordable for all. There are multiple solutions on the market, but if it is expensive, caregivers would not be able to afford them for each of the car seats they need, and that would be a reason for them to not purchase them.

- The solution must be lightweight and ours will weigh between 4.85 ounces and one pound. Car seats have weight limits, including the child in the seat. We must be able to have a solution that will fit within those requirements including a child. Also, if it is too heavy, it would not be portable which would make it inefficient as a device

- The solution must be portable. Car seats are portable, therefore any device that is attached to it should be portable as well. If it is too heavy or too bulky, it may get in the way of the car seat and its safety features.

- The solution must be electrically safe. Since this device will be in relatively close contact with the child, it should be very safe and not a danger for catching on fire or harming the child.

-The educational component must reach a large number of people quickly and a wide range of caregivers in terms of age and occupation.

(6) Based on your criteria and constraints, what is your proposed solution to the problem you chose? Explain what it will look like and how it will work. If you can,

include a detailed, labeled drawing.

The solution will be a two-pronged approach to the issue and include technology and engineering, along with a strong educational and outreach campaign.

One of our solutions is using a device and a phone to remind caregivers when their child is in the vehicle. We needed to remind caregivers when their child is in the vehicle, and make sure that they go back to check to see if their child is still in the vehicle. We decided to use the cell phone since most people use their phones habitually, and over 75% of Americans own a cell phone.

Next, we needed a device to be able to sense if the baby is in the car seat, which also connects wirelessly to the phone. For the wireless feature to work, we need a computer. Today, there are two widely used small computers for hobbies - Arduino and Raspberry Pi. Raspberry Pi uses Linux which takes a while to boot up. Arduino is a much simpler device because it doesn't have an Operating System, and our program can run instantaneously. So we chose Arduino over Raspberry Pi.

Furthermore, we needed to evaluate which wireless technology to use. Our options were Bluetooth, Wifi, Mobile Data, and NFC. Wifi network requires a full network stack, requiring an operating system, which we didn't have with Arduino. Mobile Data requires a SIM card, which is complex to deal with and expensive. NFC's range is too short for our use so we chose Bluetooth. After a little research, we found that there is a Bluetooth serial module for Arduino readily available on the market.

The idea is to have the Arduino baby detector connect to the phone via Bluetooth and tell the phone if the baby is in the seat or not. Bluetooth has a short range, under 100 meters. When caregivers walk away from the car, the Bluetooth connection will disconnect due to the distance. At that time, the phone can notify the caregiver if the last state communicated by the Arduino device is that the baby is in the car seat.
The system fits the criteria and is within our constraints. The system alerts the caregiver in a timely fashion. Furthermore, Arduino systems are small, inexpensive, light, portable, and readily available on the market. Bluetooth connections can connect quickly. Our system will keep track of whether the baby is in the car seat or not.
To test the device we will connect it to a car seat, and to a phone through our app, and make sure that when we walk away from the car, it will trigger our app. We will then measure the distance away from the car when our phone is notified.

(7) How will you test your solution? The BEST way to test your solution is to build a working model or a prototype that you can actually use. Or you can guess how your solution will work BASED ON your research. Which method will you use and why?

Details with diagrams and photos of the solution are included in the upload "Mission Folder"

We built a prototype and attached it to the car seat and placed the car seat in a vehicle and tested it to see if the device worked. We placed the car seat in the vehicle and strapped a bag of rice in the car seat in place of the child. We then left the "baby" in the car, walked away from the vehicle, and measured the distance at which the device sent a notification to remind us that the baby is in the vehicle. This allowed us to safely simulate leaving a baby in the vehicle without endangering any child while testing how quickly the device would notify us that the baby remains in the vehicle. We walked away from the vehicle at a normal pace, a fast pace and a slow pace, to see if it would make any difference in the distance of notification. This was done to test different conditions caregivers might encounter when they leave a parked vehicle.

Build Model or Prototype

(8) If you built a prototype or model, explain how you built your prototype or model, step-by-step including all safety precautions. If you guessed how your solution would work BASED ON your research, explain important information from your research that you used to prove how your solution would work and be sure to cite your sources.

Please see the team uploads to Engineering Design for photographs of each step of the process, data tables and graphs from the testing results,"App Development", "Device Development" and "Mission Folder" which answers the questions from start to finish in an easier way to interpret the answers + the diagrams and photos.

The H.O.T. C.A.R.S. team was not satisfied with imagining a solution based on just the research we did together. Part of the research involved finding people who were already coming up with solutions to this problem and many of them proposed solutions to car seat manufacturers based on research alone. None of these solutions have been implemented by the car seat industry because of the high cost of retrofitting devices into existing seats and changing assembly lines to make device insertion part of the seat itself. Furthermore, others have ideas about alarms based on weight in the car seats; however, they are expensive and void the warranty of the car seat itself. Instead, we chose to design an idea for a solution and then build a working prototype that would include what we learned in research plus allow us to possibly seek a patent on a device that would be affordable for all families. In order to do this, a great deal of learning was required because at the ages of 11 and 12, we have not had extensive courses in computer science, computer coding, or app development. Fortunately, there are many tutorials online and mentors who would answer our questions. We were able to use both to come up with an effective and affordable car seat device and app for mobile phones.

Our prototype consists of three different parts: A Bluetooth device, the connection to the car seat, and the phone app. We had to build each part separately and tested them as we built them.

Bluetooth Device:
Building the device started with connecting the Arduino to a button switch and to a Bluetooth serial module known as HC-05, then programming the Arduino to send data through serial communication when the button was pressed down or whether it was up. Our initial prototype looked like this below. We used Arduino hobbyist kit along with a breadboard and a bunch of wires and just make the circuit we found from our research.

We then tested that by connecting it to a readily available Serial Bluetooth Terminal app from Google Play Store, to make sure that our device sent serial communication correctly, and it did.

We then compacted the device by buying an Arduino breadboard shield to put on the top of the Arduino, and rewired the device to fit a small seat. We also researched how to power the Arduino device properly, since we want a compact solution for the battery to power our system. We could power the Arduino system using a 9V alkaline battery with the barrel plug, which goes through the voltage regulator. Another option is to use a stable 5V power straight to Vin pin, which bypasses the voltage regulator. We happened to have a compact USB rechargeable battery that offers stable 5V, and we decided to use that. The connection uses micro-USB pin, so we added that to our board. On top of that, we also added on/off switch and a mono audio jack so we can easily connect it to the car seat later.

After that, we had to retest our circuit to make sure we moved it correctly from the original breadboard. So we re-tested it again with Serial Bluetooth Terminal app. Everything seems to be working.

Car Seat Connection:
We had to figure out how to connect our device to the car seat next. Our Bluetooth device can only detect a connected/disconnected state of a button to communicate to the phone. So we needed a way so that when a baby is on the seat, something makes a connection, and when the baby is not on the seat, it disconnects. Initially, we looked into

using the weight of the baby to press a button on the seat. We wanted this mechanism to be comfortable to the baby, so we needed the button to be soft, but also reliable to handle light and heavy baby alike. This turns out to be harder than we thought.

So we brainstormed some more on other detection mechanisms. When the baby is on the seat, the caregiver will always buckle them in, so we started looking into the buckle system. A safe baby car seat has a 5-point harness system with 2 different straps: the groin strap and the chest strap. The groin strap looks solid and has a metal part, and is not easy to get into. However, the chest straps are usually made from hard plastic with a simpler locking mechanism. After thinking about it some more, we found a way to make the chest strap “connect” when it is buckled, and “disconnect” otherwise.

We basically lined the chest strap with aluminum tape, which is an acceptable conductor. We lined the “fork” side with aluminum tape and attached our wire to it. On the inside of the other side of the buckle, we lined the whole thing with aluminum tape. This makes it so that when the chest strap is buckled, the two prongs of the fork will make a connection.

App Development:
We incorporated a serial library into our app. When we pressed the button, the device sent “1”, and our app detected it and we printed “Baby on”. When we let go of the button, the device sent “0”, and our app detected it, and we printed “Baby off”.

For our system to work, we needed to detect a Bluetooth serial disconnection, which indicates that the caregiver has walked out of range of the car seat. We needed to use the disconnection as a cue to when to send the notification. Thankfully, the Bluetooth serial library we used also offered a disconnection message. We sensed disconnection using a prebuilt message that is “BLUETOOTH_DISCONNECTED.” When we got this message, we would print on our app “Disconnected.” We tested this by connecting the device to the phone, and after they were connected, we turned off the device. After a couple of seconds, our app got the disconnection, and the app displayed the disconnect message.

The next step on our list was to send a notification to the user. We needed to do this when we got the disconnection message if we detected that a child is still in the car seat. Android has detailed documentation on how to send the user notification, complete with an example code. We modified the example code and inserted it into the place of the code where we sensed a disconnection message from the previous step. We tested it by connecting the device to our phone. Then we pressed the button, indicating a child is on the seat, and then we turned off our device. After a couple of seconds, our app sensed the disconnection and now it also sent the notification to the user.

During our testing, we found that if we switch to another app, then our app will fail to send a notification to the user. This is because our app is paused by Android whenever the user switches apps. For our system to work, our app needs to keep working in the background. It turned out that we needed to use Android Service to make our app work in the background so we had to research how to use Android Service with our app. We also had to figure out how our app would communicate with the service. In the end, we decided to keep it simple. Our main app basically just needed a button to launch the service, and the service will take care of everything. So we moved all our logic from the app into the service and put a button on the app to simply launch the service. We tested everything again after we were done.

After it's completed we worked on uploading our app into Google Play Store. Once it is there, it is easier to download our app to any Android phone.
(see all of our pictures in the uploads)

Test Model or Prototype

(9) Explain how you tested your prototype or model. Be sure to include every step of your testing including all safety precautions that were taken. If not stated it will be assumed no safety precautions were taken. If you are using research to guess how your solution will work, explain step-by-step how it will work and why.

We tested each part of the prototype as we worked on them, as explained below. At the end of testing, we assembled the entire system and retested it as a unit.

Bluetooth Device:
While working with Arduino, we researched how to power the Arduino system properly to mitigate the possibility of our device overloading with power and having accidents. We also took care not to electrocute ourselves by shorting any of the batteries.

We tested our Bluetooth device initially using a readily available Serial Bluetooth Terminal app from Google Play Store. This easily connects to the Bluetooth serial module, HC-05, that we use. From the information from our research, we programmed the Arduino device to detect state-change of a button switch, so that it sent “1” when the button is pressed, and “0” when we release. So once we powered the Arduino and connected the device to our Serial Bluetooth Terminal, we pressed and released the button multiple times, and we got “101010…”.

After we moved our circuitry to the breadboard Arduino shield, we re-tested using the same mechanism, with the Serial Bluetooth Terminal app.

Car Seat Connection:
Testing the car seat connection basically involved measuring the resistance of the aluminum tape once we buckle the chest strap together.

We buckled the chest strap together, then, we used a digital multimeter to test the connection through the aluminum tape by measuring the resistance between the two terminal from the mono audio jack, which later connects to the Bluetooth device.
We found that the connection has low resistance, about 11O (Ohms) which is low enough to indicate a connection
We connected and disconnected the buckle and tested repeatedly

Resistance (O)
1
11.3
2
12.1
3
9.1
4
10.5
Average:
10.75

It turns out that on average, the resistance was about 11O, which was low enough for our bluetooth device to detect a connection. We made sure this was the case, by testing the chest strap with our Bluetooth device and made sure that it sent “1” to the Serial Bluetooth Terminal app we used, indicating that our device detected a connection.

App Development:
We tested the app in several stages, as we got the next feature implemented in the software.
The first thing we had to implement once we got the basic app from the tutorial, was to get Bluetooth serial working. We found a library online that helped us to do this. We coded into our app such that if we read a “1”, we printed “Baby on”, and when we read “0”, we printed “Baby off”. We got it working.

Next, for our system to work, we needed to detect a Bluetooth serial disconnection, which indicates that the caregiver has walked out of range of the car seat. The Bluetooth serial library we used also offered a disconnection message. We programmed the handling of the Bluetooth disconnection message by printing “disconnected”. We tested this by connecting the device to the phone, and after they were connected, we turned off the device. After a couple of seconds, our app got the disconnection, and our app printed “Disconnected” as planned.

The next step on our list was to send notification to the user. We programmed sending notification based on Android's excellent documentation, which we inserted into the place of the code where we sensed a disconnection message from the previous step. We tested it by connecting the device to our phone. Then we pressed a button, indicating a child is on the seat, and then we turned off our device. After a couple of seconds, our app sensed the disconnection and now it also sent the notification to the user.

During testing, we found that Android would pause our app when user switched to another app, which makes the notification to stop working. This would totally render our app useless. To get around this, we had to use Android Service to make our app be able to keep running in the background. After we researched how to use a Service and moved our existing logic into the Service, we had to retest. The pictures below shows when our service was trying to connect to our device, indicated by “Connecting…” and detecting the button press, indicated by “Baby on”.

Finally, we also tested to make sure that user notification is working correctly in our service. So while still having the button pressed, indicating a child is in the car seat, we turned off our Bluetooth device. Within a couple of seconds, our device detected the Bluetooth disconnection and that a child was in the seat, so it sent a user notification. And it worked.

System Test:
By this time we had all the parts for our system, so now it was time to do the system test. We took a car to a parking lot, then we strapped a bag of rice in our car seat to simulate a baby, and connected the chest strap to our Bluetooth device. We then did this sequence repeatedly:
- We paired our Bluetooth device to a phone.
- We verified that our app detected that a child is on the seat.
- We closed the car door and walked away from the car until the app sends the notification.
- We measured our distance to the car.

We did this test 20 times and found that the phone sent the notification an average distance of 82.8 feet away from the car.

We found that on average, the notification is sent about 83 ft away from the car. But the data spans over a large range, from 40 ft to 160 ft for notification. We are happy that Bluetooth will always disconnect correctly after a certain distance.

(10) What problems did you find with your solution? Be specific since you will need to redesign based on these problems.

We found that the first prototype of our Bluetooth device with the large breadboard was too brittle and too big for putting in a car seat.

Also when we worked on the chest strap by lining the inside with aluminum tape, the connection was not very solid. When we jiggled the buckled chest strap, the connection kept disconnecting. We kept adding more layers of aluminum tape to make sure the aluminum tape touches the proper parts when the chest strap was buckled. This ensured the solution would be effective.

When we worked on the app, we found that our app would stop working when the user switches to another app. This prompted us to do more research on how to get our app to work in the background on the phone.

Also, while testing, we thought that it would be better if the notification to the caregiver could continually make the phone ring. Currently, it sends a notification, which the caregiver could miss.

(11) Describe all of the changes you made to your prototype or model (or proposed prototype) after your first test. Why will these changes improve your solution?

For the Bluetooth device, from the first design to the second, we changed the way the machine connected by buying an Arduino shield with a breadboard and moved our circuit to the shield. See the difference in our uploads.

Arduino shield attaches right on top of the Arduino board, making all the connections more solid and the device more compact.

While working on the chest strap, our first prototype did not establish a very dependable connection.

We found that as the chest strap was buckled, it was still a little loose, and we could jiggle it. When we did this, we found that the connection keeps connecting and disconnecting. The solution we came up with was to make the aluminum lining thicker by adding more aluminum tape on the inside of the left piece (the one receiving the fork part of the strap). After we did this, it was a little harder to buckle the chest strap, but we no longer had a problem with the connection. We re-tested it by making sure the connection was stable:

While working on the app we found that our app stopped working if the user switched to another app. To make our app run in the background, we had to use Android Service. We moved our existing logic into the Android Service and decided that our app would simply launch the Android Service using a button. We tested this by making sure user will get a notification as we switch to another app, or even if the user put the device to sleep by pressing the power button.

(12) Present the data you collected from your tests or from your research. If you tested a prototype or model then include all of the numbers you gathered during your testing and all observations you made. Use of graphs and charts is HIGHLY encouraged. If you used research to prove how your solution would work, be sure to include all of the numbers, charts, and graphs you used to make your case.

Please see uploads of the additional data tables and graphs from all our testing.

When we tested the resistance of our aluminum-tape-lined chest strap connection, the average resistance was 10.75 Ohms.

We learned from the data that aluminum can conduct a signal and it works effectively for our device. In the future, the team could try copper tape, as copper is a better conductor than aluminum but it is also more expensive and can overheat more easily.

We did our system test by measuring the distance from the car, with the “forgotten” rice-child in the car seat, to when our app sent us the notification. We did this experiment 20 times and found the average distance from the car when notification occurred was 82.8 feet. The test was successful 100% of the time.

From the data, we learned that Bluetooth will eventually disconnect. However, we were surprised by the wide range of distance when the disconnection happens. We initially thought it would be more consistent.

The solution to this problem involved both the technical and engineering device to alert parents of a child in the car, as well as public outreach and educational component. The dual approach to solving the problem involved surveying parents about their knowledge of hot car deaths. Attached is the Survey Monkey linked to an informational pamphlet and the results of this data collection.

Survey Monkey - How to find out what the public thinks about Hot Car Deaths.Survey

The team decided to create a survey using “Survey Monkey” online in order find out what the general public thought about “Hot Car Deaths” as well as opinions on the pamphlet and key chain created by the team. The questions were designed to collect information from parents who had read over the “Hot Car” pamphlet. We collected demographic information including age group, gender, how often you drive the child(ren), and what age group does your child(ren) fall into. We also asked the parents to rate different areas such as “How effective do you think the trifold pamphlet was at educating about hot car deaths?” , “Would a bright colored key chain help remind you of the child(ren) in the car with you?”, as well “Would you be interested in an attachment that would go on the buckle of your child's car seat to alert your phone through an app that the child has been left in the car?”. After receiving 157 responses to the survey, we feel that we have a well-represented cross-section of our community from which to move forward.

After reviewing the answers in the survey, we were excited to learn what the community thought about Hot Car Deaths. Almost half of those surveyed (48.68%) were females 25-44 years old with 86% having children two years and older. A good representation had children younger than two years. Those taking the survey had the opportunity to mark as many age groups and number of children they have.

When questioned “How effective do you think the trifold pamphlet was at educating about hot car deaths?”, 80% thought it would be very-extremely effective as a means of educating our community about the dangers of Hot Car Deaths. Nearly everyone said they would share the pamphlet with someone else to help spread the word about hot car deaths. We were not sure what the response would be to, “Would you be interested in an attachment that would go on the buckle of your child's car seat to alert your phone through an app that the child has been left in the car?” The response was an overwhelming 78% of those who responded said they were very-extremely interested.

Question 10 of the survey was created to allow those taking the survey to comment. So many left messages of encouragement to continue our research on production of ways to help drivers not to forget young children latched in a car seat in the back of the vehicle. Many had words of praise for our team taking on such an important topic. Some said that they wished something like our product was available when their children were younger. There were some people who feel that irresponsible parents were the only ones who need help remembering children in the back seat. As we have learned through our research, it is the very responsible, highly educated, and two-parent-working-households with a slight change in routine that tends to be the scenario of when a child is left in the car seat in the back of the car.

Please see the "Mission Folder" upload for every table and graph from Survey Monkey.

(13) What are your potential sources of error? Remember, this doesn’t mean "Did everything work?", all tests have potential sources of error, so make sure you understand what that means. Explain how these sources of error could have affected your results.

Systematic Errors or Errors in Accuracy cannot be corrected with multiple testing, according to the Ecybermission website. The types of systematic errors made in the project involve instrumentation. From the testing data we gathered, the potential sources of errors could come from the measurement devices we used. We used a Digital Multi-Meter to measure the resistance of the aluminum tape used to line the chest buckle. We also used a thermometer to find out how hot the inside of a car could reach. We also used a timer to regulate when we took the next temperature reading to find out how long the inside car temperature could reach to be considered a fatal level. These devices could be out of calibration, causing some errors in the data. Usually, the calibration errors only matter if we are looking for accuracy. For these measurements, we took the best data and numbers possible, and the calibration errors would be minimal.

Random Errors are those made by humans and can be corrected or minimized with repeated measurements. The types of random errors made by the team involve temperature and resistance measurements. Measuring temperature is always tricky. This is because there are always slight variations of temperature of the air depending on its location in a single place. The air closest to the hot surfaces will be hotter versus the air in the shade close to insulated surfaces. Again, we're looking for average numbers for the temperature reading, so these variations will be more precise with repeated experiments.

As far as our system test goes, the distance of when the app detected Bluetooth is variable. Wireless connections like Bluetooth could easily be affected by electromagnetic interference in the air, that could cause early disconnection. There is always a slight variation of material inside the components we used, especially the Bluetooth transmitter/receiver that could affect how easily the Bluetooth connection disconnects. Also, the Bluetooth disconnection message received by our app had to go through the Bluetooth software and the Bluetooth serial library we used, and the way they work could introduce random errors into our system as well. Our primary concern is that Bluetooth will disconnect within a reasonable distance to give timely notification to the caregiver. Thus, the distance ranges were not significant and all were within the criteria stated.

Drawing Conclusions

(14) What conclusions can you draw based on the data you gathered during your tests?

The H.O.T. C.A.R.S. system fits our criteria and is within our constraints. The system alerts the caregiver in a timely fashion as seen in the data collected. This is uploaded to the Mission Folder for judges reference. 100% of the tests performed were successful in accurately and precisely indicating whether an infant was in the vehicle, according to data. The notification distance was within an average of 82 feet from the vehicle. Furthermore, Arduino systems are small, inexpensive, light, portable, and readily available on the market. Bluetooth connections can connect quickly. Our system will keep track of whether the baby is in the car seat or not. The test results from each component of our system individually, and in total, support a functioning system and notifies us in a timely fashion if a child is still in the car seat and is verified by the data we collected.
In building the prototype, we learned that there were multiple ways to solve each obstacle we came upon. However, working together as a team, we were able to brainstorm

and select solutions that best suited our criteria. The prototype gave us a very strong platform to start our project and resulted in a working device.
In addition, we gained knowledge of multiple disciplines - electrical engineering, mobile app development, car seat manufacturers, automobile manufacturers, legislature, and lobby groups surrounding this issue.

The educational component of the solution was an important segment for the team. In the data collected, 80% of the people surveyed said the pamphlet would be very effective in educating parents and caregivers about the dangers of hot car deaths and how to prevent this tragedy.

Approximately 750 children have died in this manner in the past 10 years - approximately one child every 8-9 days. The loss of life of the youngest, most innocent members of our society, and the waste of their full potential, making this a device that could significantly lessen the tragedy, very worthwhile of our efforts. This makes this project's goals successful.

Uploaded Files:

- [View] **Developing an Android App** (By: KittyPop, 02/09/2019, .pdf)

  This document explains how we were inspired to develop an Android app to alert parents of a child in a hot vehicle.
- [View] **Questions used in Interviews** (By: KittyPop, 02/09/2019, .pdf)

  All team members developed relevant questions to ask subject matter experts who were interviewed during the research phase of the project. This is one example of some questions written and asked when we interviewed Dr. Kerrie Pinkney, Covenant Children's Hospital.
- [View] **Skype Interview** (By: KittyPop, 02/09/2019, .pdf)

  The team interviewed Deannie Jacobsen, a mother who lost her son Luke to heatstroke when he was accidentally left in a hot car. We used Skype to talk with her about her family's efforts to help others prevent this tragedy.
- [View] **Scientific Survey** (By: KittyPop, 02/09/2019, .pdf)

  HOT CARS developed a survey to be taken by many people and it gave us valuable feedback. In this document, you will see the purpose of the survey, the questions asked, the Informed Consent written for the Institutional Review Board (IRB) over the student projects, and the Adult Participation Form also required by the IRB. Human subjects testing must be taken seriously and this paperwork is thorough.
- [View] **Sample of our Interview Notes** (By: KittyPop, 02/09/2019, .pdf)

  During each interview with subject matter experts, we took notes by hand and by computer. This is an example of the notes we took during one of the interviews during the research phase of the project.
- [View] **Research Plan - Preliminary** (By: KittyPop, 02/09/2019, .pdf)

  A preliminary research plan was written to include the following for the project: rationale, research, questions, design plans, risks and safety, and a bibliography prior to the beginning of the engineering tasks and experimental phase of the project.
- [View] **Engineering Board** (By: chermender, 02/12/2019, .pdf)

  This is our engineering board that we used for science fair.
- [View] **App Development** (By: chermender, 02/12/2019, .pdf)

  This is how we developed our app step-by-step.
- [View] **Device Development** (By: chermender, 02/12/2019, .pdf)

  This is how we developed our device from start to finish.
- [View] **H.O.T. C.A.R.S. photo essay** (By: jumpydog, 02/13/2019, .pdf)

  A small slide show of our project, research, device, and others
- [View] **Bibliography or Works Cited** (By: KittyPop, 02/17/2019, .pdf)

  The bibliography/works cited document for the project is attached. Please see Contact List for the specific individuals with whom we worked and Community Partnerships for the many businesses and organizations with whom we worked and learned as well. Both are uploaded under "Community Benefit".
- [View] **Project Summary Engineering Report** (By: KittyPop, 02/17/2019, .pdf)

  A must-see document showing the project's engineering design from beginning to end. This includes text, detailed schematic drawings, diagrams, photographs of the device and app throughout development, and explanations of protocols used to build the device and design the mobile app.
- [View] **Interviews with Subject Matter Experts** (By: KittyPop, 02/20/2019, .pdf)

  This file includes photos of the team interviewing many different experts from doctors, to engineers, to chief medical officers, to patent lawyers to parents who lost a child to hot car deaths. There are photos, interview notes, and important information on this phase of our research project.
- [View] **Data and Graph of Car Temperatures** (By: KittyPop, 02/25/2019, .pdf)

  The data collected by the team while measuring outdoor temperatures and those inside vehicles is presented here, along with the graphs showing what we learned. The Greenhouse Effect was very evident when we conducted testing to verify the research we read.
- [View] **Data and Graph - Testing the System** (By: KittyPop, 02/25/2019, .pdf)

  Notification signals were tested to see the distance required before the car seat device would send the signal to the app that a baby was still in the car. The data table of 20 tests and the graph of the results is attached, along with a photo.
- [View] **Mission Folder - Entire Project Details** (By: KittyPop, 02/26/2019, .pdf)

  It is difficult to describe each part of the engineering process and how this project progressed in text boxes online without diagrams, data tables, pictures, and graphs right alongside the answers. For ease of judging, this document includes the answer to each Mission Folder question in each section and has the pictures and diagrams and schematics to back up each answer right beside it. THIS IS A MUST-SEE UPLOAD

Community Benefit

(1) Explain how investigating the problem your team chose will help the community. Be sure to include the impacts your research will have on individuals, businesses, organizations, and the environment in your community (if any). Make it very clear why solving this problem would help your community.

Hot car deaths of children are literally a “hot” topic at this point in time throughout the United States. Our community and region, in general, is in need of the information we have discovered as a team because for the majority of the year we have very high temperatures that lend themselves to cars becoming very hot on the inside in a very short period of time. Also, Texas has the highest number of Hot Car Deaths each year compared to the rest of the country. We have distributed information about Hot Car Deaths of Children in many forms around our community.

The southern states are not the only ones affected by this issue. Every state except Montana and Alaska have experienced this tragedy. Even on a 60 - 70-degree day, the temperatures inside a car can reach over 100 degrees Fahrenheit and cause death to an infant or young child. The solution we propose is applicable to states throughout the country and around the world.

*** Focusing on individuals in our community

Getting the information out about Hot Cars is essentially telling everyone you know. Parents and other drivers of children (ages newborn-2 years generally) need to know that they are caring for those children in the highest risk category of the possibility of unknowingly leaving a child in the car. Those families where both parents are educated and have full-time jobs are the highest risk families. Just one small change in a daily routine is enough to have a parent off of their usual game and the brain goes into basal ganglia mode f and not take a child out of the car because they are not used to having the child with them at that time. Warning parents in this category that they are the most at risk is difficult because they are the ones most likely to think it won’t happen to them.

• We made a pamphlet and keychains that is easy to hand out to friends and family (see Attachment)

• Keychain (see Attachment) says, “Look B4 You Lock” and the keychains are bright colors and made from thick plastic. They are easy to see and feel when holding the car keys and serve as a reminder to caregivers to look for a child in the backseat.

• Alexa created an original Manga graphic novel that has a storyline that tells of an adventure of how evil tries to make the car super-hot and the hero helps the mom remember that cars can get deathly hot in a very short amount of time. It is uploaded to the mission folder.

• The graphic novel is geared toward younger parents and teen parents.

• A website (babyinhotcars.weebly.com) has also been created to give more information about hot cars. There is also a link to the graphic novel on the website.

• We also created an online survey (https://www.surveymonkey.com/r/CKTTZLW) to get the opinion of parents and others of what they knew about Hot Car Deaths as well as their opinion of some possible solutions like the keychain and pamphlet that we created.

*** Focusing on Businesses in the Community

-Contacting businesses that deal directly with young children was the focus of the types of places in which we wanted to distribute our pamphlets and keychains. Many of the places we delivered to were daycare centers to distribute to families who take their kids there. The families who take children to daycares usually have two parents working full-time jobs and are the highest at-risk group. Daycares were the ideal choice of locations to distribute the pamphlets and keychains.

-We also considered the large group of young parents that live in our community. We focused on presenting our newly gained knowledge to a large group of teen parents who were attending a Young Parent Support Training at Parent Life. The teens learn basic care for children and families. This was also an ideal location because many of these teen parents don’t have the background knowledge or awareness of how hot cars can actually get in a short period of time. (see Attachment)

-Another location we delivered pamphlets and keychains was to Parkridge Pregnancy Center. This is a facility that helps educate young women who have found themselves pregnant and don’t really know what to do next. A program Parkridge provides is called Bridges. It is an introductory class for teen pregnant moms and the director was very excited to receive the “Hot Car Deaths” pamphlet to share with the new class. (see Attachment)

-Our H.O.T. C.A.R.S team had the opportunity to present our information about “Hot Car Deaths” to the Texas Tech University Medical Center-Newborn Nursery and leave more pamphlets and keychains for the new babies they had on the floor that week. We are continuing our relationship with the Newborn Nursery and will be delivering more pamphlets and keychains to them in the near future.

-Our team was invited to be featured on our local news channel, KCBD Channel 11. The news channel interviewed all of us and we took turns showing our creation of the buckle on the car seat that connects to our newly created app and demonstrates how it works if a child is left in the car seat. What an amazing opportunity we had to spread our information about hot car death to thousands of people at one time! (see Attachment)

Our news story on the KCBD Channel 11 website. (see Video Upload)

We were featured on the KCBD NBC Facebook page for Julie Casteneda who interviewed us. She got over 19,000 views for our story! (see Attachment)

We visited over 40 daycare centers and parent groups in the community, including the following:

• Parent Life - YFC Lubbock - Young Parent Support Training (see Attachment)

• FirstSteps Daycare - LakeRidge Baptist Church - placed a pamphlet and keychain on each child’s hook ready to be taken home (see Attachment)

• Learning Tree Children’s Academy (see Attachment)

• Kids Day Out Program - Southcrest Baptist Church

• Rock Solid Athletics (see Attachment)

• Tas Montessori School (see Attachment)

• Tega Kids Superplex-Athletic gym (see Attachment)

• Stepping Stones Daycare

• Texas Tech University Medical Center-Newborn Nursery (see Attachment)

• Parkridge Pregnancy Medical Clinic (see Attachment)

• Parenting Cottage

Overall, most people we contacted in one way or another was very supportive of our efforts for educating the community about Hot Car Deaths. After reading over our pamphlet, quite a few parents commented that they had no idea the problem was so big. Just about everyone who looked at the pamphlet wanted to be able to share it with others to help spread the word. As it has happened, many still said this is something that wouldn't happen to them. We as a team realize that parents will say this but at least we got to share the knowledge we found doing our research. Maybe one day they will be able to recall our information if needed.

Our project will be able to help many in our community by saving a child that was almost forgotten in a car. It can alert parents and caregivers who forget the child and help improve ratings and reputation of car companies and car seat companies. It can also help daycares who would have been shut down or be arrested for a heatstroke death. If we can make our device a patented product, it will give parents an easy way to be alerted in case they forget the child. We are currently seeking options for this and have completed an initial patent search. Our device will help daycares with the same problem of accidentally forgetting the children in the car. This can also help car companies who can have a higher reputation and have more sales because of saving a life with our device that they put on their car seat. If a car seat company can use this, they will be recognized as the best company because they have a system that can save a child's life. If we can make this device a solution recognized by lots, it will help lots of lives. We stand to help everyone we can from Lubbock to maybe someday the whole world. We are trying to get a patent through the Covenant Hospital Innovation Lab. We then will preemptively put our device in car seats through car seat manufacturers.

In short, using our device can save many lives and help prevent one of the greatest tragedies to families across the nation - the death of a young child and the tremendous loss of potential to society.

Uploaded Files:

- [View] **H.O.T. C.A.R.S. Team on the Nightly News** (By: KittyPop, 02/09/2019, .pdf)
  A video clip of our team on the evening news can be viewed by clicking the link in this document or by visiting https://youtu.be /V9u2tYMGoKQ
- [View] **Website Link and QR Code** (By: KittyPop, 02/09/2019, .pdf)
  The links to the H.O.T. C.A.R.S. website and the Quick Response (QR) code are provided in this document or by using the URL below. https://babyinhotcars.weebly.com
- [View] **Presentation Script** (By: KittyPop, 02/09/2019, .pdf)
  H.O.T. C.A.R.S. presented information to public and private gatherings throughout our community and state. Many times we improvised because we knew the topic well; but, other times, we used this presentation script for particular audiences.
- [View] **Contact List** (By: KittyPop, 02/09/2019, .pdf)
  Many leaders in the community provided encouragement and support throughout this project. Their names and contact information is included in this document.
- [View] **Partners in the Community** (By: KittyPop, 02/09/2019, .pdf)
  H.O.T. C.A.R.S. formed partnerships throughout the community which allowed our outreach opportunities to expand and reach a much larger audience. Our community partnerships and collaborations are listed here - along with their contact information.
- [View] **H.O.T. C.A.R.S. Information Brochure** (By: KittyPop, 02/09/2019, .pdf)
  H.O.T. C.A.R.S. created a tri-fold brochure which was distributed to thousands of families across the region. Alexa included information about heatstroke, how to prevent a hot car death, and how to help other families avoid such a tragedy.
- [View] **Newsletters Featured our Team** (By: KittyPop, 02/09/2019, .pptx)
  The Warrior Newsletter featured H.O.T. C.A.R.S. and our information and survey was distributed to hundreds of families in the community.
- [View] **Abstract** (By: KittyPop, 02/09/2019, .pdf)
  A short abstract is included here.
- [View] **H.O.T. C.A.R.S. Comic** (By: KittyPop, 02/12/2019, .pdf)
  This is a comic that our team has created to inform in a more fun way!
- [View] **Community Outreach Photo Essay** (By: KittyPop, 02/25/2019, .pdf)
  Many presentations were made throughout the community to share the news we learned and teach others about hot car deaths. This upload includes photos and shows some of the places we presented and impacted this year.

Mission Verification

(1) Does your Mission Folder project involve vertebrate testing, defined as animals with backbones and spinal columns (which include humans)? If yes, team must complete and attach an IRB approval form.

Yes

(2) Did your team use a survey for any part of your project? If yes, team must complete and attach a survey approval form.

Yes

(3) You will need to include an abstract of 250 words or less. As part of the abstract you will need to describe your project and explain how you used STEM (Science,

Technology, Engineering and Mathematics) to improve your community

Hot car deaths are a tragic issue in America, with Texas leading in heatstroke deaths in cars. Approximately 700 children have died in hot vehicles in the past ten years. Despite the tragedies, there has not been a definitive solution and 2018 saw the highest number of victims on record.
H.O.T. C.A.R.S. used a two-pronged approach to eliminating hot car deaths – raising awareness via education and designing an affordable device to remind caregivers the child is still in the vehicle.

The research found most caregivers do not believe they could possibly forget their child, but statistics show the opposite. When adults multitask and change their routine, the basal ganglia in the brain moves to autonomous mode, increasing the risk of forgetting. A manga was created to teach young parents, and presentations were given throughout the region. Raising awareness that even the best caregivers could "forget" is vital to making a difference.

H.O.T. C.A.R.S. engineered a device whereby buckling the car-seat belt signals that a child is in the vehicle. If someone leaves the car with their phone, without removing the child, an app developed by the team detects it, sending an alarm to the phone. This forces the caregiver to return to the car-seat and unbuckle the belt, thus retrieving the child. The team is seeking a patent on the device and our app is available in the Google Play Store. Under $30, it is affordable for most families. H.O.T. C.A.R.S. is changing attitudes and behaviors, and saving lives.

Uploaded Files:

- [**View**] **Informed Consent** (By: KittyPop, 02/09/2019, .pdf)

  After the Institutional Review Board (IRB) and the Scientific Review Committee (SRC) approved the use of a survey for this project, an Informed Consent document was required before anyone could participate in our team survey. This is a copy of the Informed Consent and Adult Participation Form which is in addition to the Ecybermission IRB Approval Form and Survey Approval Form.
- [**View**] **IRB FORM** (By: KittyPop, 02/25/2019, .jpg)

  IRB approval was needed for this project because of the number of human subjects who answered survey questions for the team.
- [**View**] **Survey Approval Form** (By: KittyPop, 02/25/2019, .jpg)

  The team needed a survey approval form because of the number of adults aged 18 and over who answered survey forms after seeing the link in our brochure and in the school newsletter.

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Administered by National Science Teachers Association

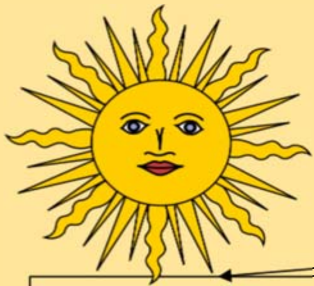
Checklist for H.O.T. C.A.R.S.

December and January

1) Complete programming on the device (Ethan)
2) Test programming and device together (Alexa, Josiah, Ethan)
3) Get volunteers to try out seat with device (or can we use dolls?
4) Write introduction to pamphlet and key chain (Alexa, Josiah)
5) Print introduction with QR code and website (Ethan – 500 copies)
6) Make appointments to do presentation
7) Do presentations for daycares, hospitals, parent gatherings (Alexa, Josiah, Ethan)
8) Pass out introduction, pamphlets and key chains (Alexa, Josiah, Ethan)
9) Track survey response
10) Create website (Ethan)
    a. Alexa's graphic novel (Alexa)
    b. QR Code to surveymonkey (Alexa to email to Ethan)
    c. All kids need to fill this in (final details – Alexa, Josiah, Ethan)
    d. Links to other websites with information (Ethan)
11) Science fair board would also be a good prop for our presentations
    a. Buy board, and title board (Ethan)
    b. Titles (Ethan)
    c. Write:
        i. Abstract
        ii. Materials and procedures –
        iii. Data, table, graphs, pictures - Data for temperature – entered, need to put in graph format, to print pictures (Ethan)
        iv. Purpose(Alexa)
        v. Hypothesis (Alexa)
        vi. Background (Josiah)
        vii. Research (Josiah, Alexa, Ethan)
        viii. Results and discussions (Alexa)
        ix. Conclusion (Josiah, Ethan, Alexa)
        x. What I learned (Alexa, Josiah, Ethan)
12) Put board together (Alexa, Josiah and Ethan)
13) Ecybermission (on website under Resources, Advisor Resources – consult the matrix of how we will be graded and questions we have to answer
    a. Mission Challenge – Technology: Engineering
    b. Mission Questions answered – there are a lot of questions to be answered (All kids)
        i. How team formed
        ii. Detailed description of each members' responsibilities
        iii. Any trouble working together as team
        iv. Advantages of working on it as a team
        v. Problem Statement
        vi. Design development (Ethan)

vii. Explain how build model/prototype (Ethan)
viii. Test model/prototype
ix. Drawing conclusions after testing
x. Explain benefit to community

14) Interview Dr. Kerrie Pinkney – effects of heat on an infant. (Ethan to schedule, All 3 to get questions together, Alexa to have on Reference List)
15) Feb 27th DEADLINE for Ecybermission – YIKES!!! **Closer than it appears!**



Action Plan- H.O.T. C.A.R.S.

Hot Car Deaths

How can we reduce hot car deaths?

Help people realize how much hotter the inside of the vehicle gets even on a day that is not too hot

Experiment: Measure inside and outside temperatures of different vehicles during the morning and afternoon, and under the shade and under the sun

Child protection services, scientists, doctors, parents, pediatrics, Texas department of transportation, car manufactures, hospitals will benefit.

If an app is developed, then it will help remind caregivers that the child is still in the vehicle

Prototype: Create an app and device, share test how far the device is before a notification is sent to the caregiver's app reminding them the baby is in the vehicle.

Caregivers with children who are unable to exit the vehicle safely on their own will benefit from this

Even in cooler temperatures, the inside of the vehicle can get very hot due to the greenhouse effect

Record inside and outside temperatures on different days and at different times - morning and afternoon, to show that inside temperatures can be much higher

CPS, doctors, parents, pediatrics, scientists, hospitals, TDOT, car manufacturers would benefit from this knowledge.

Question and Answer Session with H.O.T. C.A.R.S. Team and Team Advisor
June 2018

Ethan: Hi Mrs. Wilbanks! We met already and chose our topic – it's in the email we sent you. Will you please see if you think it is important and challenging enough for our Ecybermission project this year? Thanks! Have fun in Colorado!!!!!

Mrs. W: Hi there, glad you kids all met together – YAY! Thanks for doing that and starting the process while there's a little more time in summer. I really like the topic you guys chose – very timely and although I cannot imagine leaving a child in a car, I'm sure in this day and age where multitasking is so common, it can accidentally and tragically happen. I do know this will make an excellent Ecybermission project and do not believe you will have to move to a second topic.

Josiah: What if one of us goes out of town and can't come to a summer meeting we set? Is it okay for us to work without everybody there?

Mrs. W: Please encourage all the brainstorming and planning to happen when all 3 of you kids are present so that everyone has a part in identifying the problem and thinking of a solution. It needs to be ALL the kids brainstorming and ideas coming out while your parents are just there to encourage you. Be sure and take notes, record who is at the meeting and the date, and what was accomplished so you can have a timeline to refer back to in case you have questions later. Remember the ecyber video on the website that recommends this – www.ecybermission.com for details if you want to go back and watch it again. Sometimes there may just be one or two of you doing a certain job – but that's okay! Life happens and we all have summer plans with family!! Family comes first!!!

Alexa: What did you think about our idea for changing a car seat?

Mrs. W: The ideas sound fantastic – and the possibilities for prototypes are exciting! Y'all need to draw all the possibilities you come up with on plain white paper – like blueprints. You should draw out all ideas – even if one is going to be tossed out for whatever reason, it is a process to have thought of it, rejected it for reasons A, B, and C; and then come up with one that will eventually be tested. Label the blueprints – draw them nice and dark so it will scan well since everything they do will end up being uploaded into the computer for judges to see. Name each one – Prototype A or Body Sensor Prototype, etc.

Remember how the engineering process works! There are always lots of changes and that is okay! Basically, your prototype is the SOLUTION so for now, although you can be thinking of who can help you come up with an actual working model if you need an expert. Think about university professors, engineers at firms in town, etc.

Have fun with it and I will see you in August!

H.O.T. C.A.R.S.

A Sixth Grade Citizen Science STEM Research Team
eCYBERMISSION 2018~2019

Why and how did we choose this Mission Challenge? Watching the evening news last June, we heard about an infant whose cause of death was heat stroke due to being left in the back seat of a car on an 82-degree day in Texas. It was a tragic story and unfortunately, there were many more like this.

Research revealed this website & screenshot –

https://www.checkupnewsroom.com/texas-leads-nation-in-pediatric-hot-car-deaths/

Fort Worth, Texas, April 24, 2018

Share Tweet Like 180

Texas Leads Nation in Pediatric Hot Car Deaths. New Legislation Aimed at Prevention

A 3-year-old boy from Fort Worth died last summer after he climbed into a non-working vehicle. Police reported the boy was in the car for 45 minutes before he was found and temperatures had reached 100 degrees in Tarrant County.

It was a horrible reminder of the deadly consequences of what can happen when a child is left alone in a car.

Texas leads the nation in children dying from hypethermia after being left alone in an automobile with 55 deaths since 2010. Since 1998, 744 children have died nationally as a result of vehicular heatstroke.

For the Trauma department at Cook Children's, statistics are much more than numbers. They represent very real, too often tragic consequences.

"Every time we hear of a child dying in a hot car, it's heartbreaking for all of us," said Sharon Evans, Trauma Injury Prevention coordinator at Cook Children's. "It's especially devastating because these deaths are preventable."

Save Share

Share this infographic via social media or on your site

We learned our home state of Texas leads the nation in hot car deaths and it was a community problem for which we could make a difference. The work this year has been difficult and stories even harder to hear, but knowing we could help save even one child, made this project worth it.

H.O.T. C.A.R.S.

Timeline for eCYBERMISSION Project

Chose topic:

H.O.T. C.A.R.S. were interested in the idea of how to eliminate the problem of hot car deaths.

Team Meetings:

Action Plan Developed

Chose a schedule for completion of Mission Folder & Experiments

Hot Car Death Research:

H.O.T. C.A.R.S. began to split research topics among each other.

April 2018 | May 2018 | June 2018 | July 2018

Team and Roles:

H.O.T. C.A.R.S. was finalized with the members Alexa, Josiah and Ethan.

Roles & Responsibilities

H.O.T. C.A.R.S. learned each others strengths and assigned roles to each member. Began to think about a timeline for the project.

Team Collaboration

Summer meetings to record ideas, find experts to interview, and brainstorm solutions.

H.O.T. C.A.R.S.

Timeline for eCYBERMISSION project

Interview Gage Dutkin: Interview with Gage Dutkin, Entrepreneur, creator of C-Safe heat stroke prevention device

Creating Device and Programming: Worked on creating preliminary prototype and programming device

Interview with Dr. Thompson: Interview with Dr. Thompson, CEO of children's hospital about the dangers of hot cars. Create graphic novel to appeal to a young parent audience

August 2018 | September 2018 | October 2018 | November/December 2018

Measuring Temperatures: Measured inside and outside temperatures in vehicles & completed lab report of findings.

Mission Folder: Started working on mission folder questions for team collaboration with team. Created key chain to raise awareness

Reengineering of device: Team met and created buckle connection and updated prototype design. Created pamphlet and survey to raise awareness

H.O.T. C.A.R.S.

Timeline for eCYBERMISSION Project

Interview Dr. Pinkney, and D. Jacobson:
Interview Dr. Pinkney, Chief Medical Officer, Children's hospital and Deannie Jacobson, mother of child who died in hot car.

Southcrest School:
The team will present project to our class in a dissertation-type setting. Media interviews the team.

Texas Tech University Presentation:
The team will present project at Tech towards advancement to Texas State Engineering Fair.

January 2019 | February 2019 | March 2019

Community awareness:
Presented to newborn nursery staff and distributed pamphlet to Parent Life, and daycare centers to raise awareness, monitor responses of survey and summarized findings

Mission Folder:
Completed mission folder, questions with team and write up. Uploaded mission folder to Ecybermission website

Patent Progress:
Expand quest for patent through Covenant Innovation Lab of Texas Tech University

H.O.T. C.A.R.S.

Timeline for eCYBERMISSION Project

State Science Fair
Present information to a statewide audience at Texas A&M University College Station, Texas

Newsletter
The team will distribute newsletters throughout hospitals, daycares, and churches to reach a maximum number of families due to the coming hot weather

Hot Car Act of 2019
The team will sponsor a congressional bill with Texas District 19 Congressman Jodey Arrington requiring car seat manufacturers to include technology to stop hot car deaths

April 2019 | May 2019 | June 2019

Child Abuse Conference
Present findings and solutions to an audience of caregivers specializing in young children at the Lubbock 7th Annual Child Abuse Conference

Poster Presentations
Present poster presentation alongside the GeoSciences graduate school students at Texas Tech University for end of year dissertations

Patent Meeting
Meet with patent attorneys to finalize details of this invention.

Alexa Tindall	Josiah Morales	Ethan Djajadi
Mission Folder Organizer	Organizer - Materials & Labs	Builder & Engineer
Lead Investigator	Tests App Design	Graph, Charts, Tables Creator
Data Analyst	Draws Good Conclusions	Community Outreach
Presentation Builder	Outreach Coordinator	Engineer Technician
Researcher - Facts on Hot Cars	Brave with the Public	Researcher - Computer Coding, Apps
Public Speaker	Researcher - Victim Testimonies	Spell-check (National Spelling Bee)
Interviewer	Public Speaker	Computer Coding - Arduino
Brainstormer	Timekeeper	Google Apps Specialist
Artist & Graphic Designer	Visualizer of Grand Ideas	Website Builder
Record Keeper	Arranges Community Service	Enthusiasm for Teamwork
Creative and Innovative	Encourages Team Members	
Leader		

Science & Engineering Project Schedule for H.O.T. C.A.R.S.

Date	Task	Team Member
4-6-18	Brainstorm group and ideas	Alexa, Ethan, Josiah
5-25-18	Brainstorm ideas and consider options	Alexa, Ethan, Josiah
6-18-18	Begin writing problem statement, engineering process is divided	Alexa, Ethan, Josiah
7-20-18	Identify community collaborators and experts	Josiah, Alexa, Ethan
8-6-18	Interview with Gage Dutkin	Alexa, Ethan, Josiah, Gage
8-15-18	Conduct lab: Heat experiment with hot cars	Alexa, Ethan, Josiah
8-29-18	Register for Ecybermission	Whole 6th Grade Class
9-7-18	Finalize Solution ideas	Alexa, Ethan, Josiah
9-26-18	Interview with Dr. Amy Thompson at Covenant, Idea for Manga	Alexa, Ethan, Josiah
10-8-18	Made documents for story and pictures for manga	Alexa
10-12-18	Research	Alexa, Josiah, Ethan
10-19-18	Research	Alexa, Josiah, Ethan
10-26-18	Prototype work	Alexa, Josiah, Ethan
11-2-18	Research, Bibliography	Alexa, Josiah, Ethan
11-9-18	Research, Bibliography	Alexa, Josiah, Ethan
11-12-18	Created separate research documents	Alexa, Ethan, Josiah
11-16-18	Prototype blueprints	Alexa, Josiah, Ethan
11-26-18	Created Procedure	Alexa
11-23-18	Build prototype, work on app	Alexa, Josiah, Ethan

11-23-18	Research summaries and bibliography due in language arts class	Josiah, Alexa, Ethan
11-28-18	Research	Alexa, Josiah, Ethan
11-29-18	Finished Procedure, started Quantitative Data	Ethan, Alexa, Josiah
11-30-18	Created Website, Timeline	Ethan, Alexa
12-3-18	Worked on Mission Folder answers	Alexa, Ethan Josiah
12-4-18	Worked on action plan, worked on research	Alexa, Josiah, Ethan
12-11-18	Worked on Manga and Action Plan and Timeline	Alexa, Ethan, Josiah
12-12-18	Josiah worked on research	Josiah
12-15-18	Developed brochure to educate others	Alexa
12-18-18	Research and checking for plagiarism	Alexa, Josiah, Ethan
12-20-18	Citations for all!	Alexa, Josiah, Ethan
1-7-19	Finished Manga Finished Website tabs	Alexa Ethan
1-14-19	Practiced presentations and scripts for events this week	Josiah, Ethan, Alexa
1-15-19	Presentation at Parent Life	Alexa, Ethan, Josiah
1-16-19	Interview Dr. Pinkney at Covenant Present to Dr. Robinson at UMC & newborn nursery	Alexa, Josiah, Ethan
1-18-19	Presented to *Innovation Lab* representatives to begin the patent process	Alexa, Josiah, Ethan
1-19-19	Started presentation board, typed more summaries for research, Skype interview with Deannie on Saturday	Alexa, Josiah, Ethan,

1-20-19	Put photo essay together for mission folder upload	Josiah
1-21-19	Wrote community benefits and other mission folder questions	Alexa, Ethan
1-22-19	Posted website address, survey link, and QR code	Ethan, Josiah
1-23-19	Distributed brochures and key chains during open house at Southcrest	Alexa, Ethan, Josiah
1-24-19	Organized Google Drive for easier access to Mission Folder	Ethan
1-25-19	Created contact list to use for thank you notes	Ethan
1-28-19	Passed out more brochures and keychains	Alexa, Mrs. Tindall drove
1-29-19	Finished Mission Folder answers in Google Docs	Alexa, Ethan, Josiah
2-4-19	Finished Alphabetizing Bibliographies	Ethan, Josiah
2-6-19	Completed presentation board, wrote script	Ethan, Alexa, Josiah
2-7-19	Practiced speeches at school	Alexa, Josiah, Ethan
2-8-19	Uploaded files to the Ecybermission website	Alexa
2-12-19	Practiced presenting our poster for science fair	Josiah, Ethan, Alexa
2-15-19	Wrote abstract for Ecyber	Ethan
2-16-19	Play date for stress relief	Ethan, Josiah, Alexa
2-18-19	Practice presentations	Josiah, Alexa, Ethan
2-19-19	School Science Fair - present Ecyber work to audiences	Alexa, Ethan, Josiah
2-20-19	STEM Club - present info to students	Ethan, Josiah, Alexa
2-21-19	Regional Science Fair - present to	Alexa, Ethan, Josiah

	audiences	
2-23-19	Edit Mission Folder	Alexa, Ethan, Josiah
2-25-19	Ask Team Advisor for final suggestions before submission	Team Advisor, Alexa, Josiah, Ethan
2-26-19	Submit Mission Folder	Team Advisor
2-27-19	CELEBRATE	Ethan, Josiah, Alexa

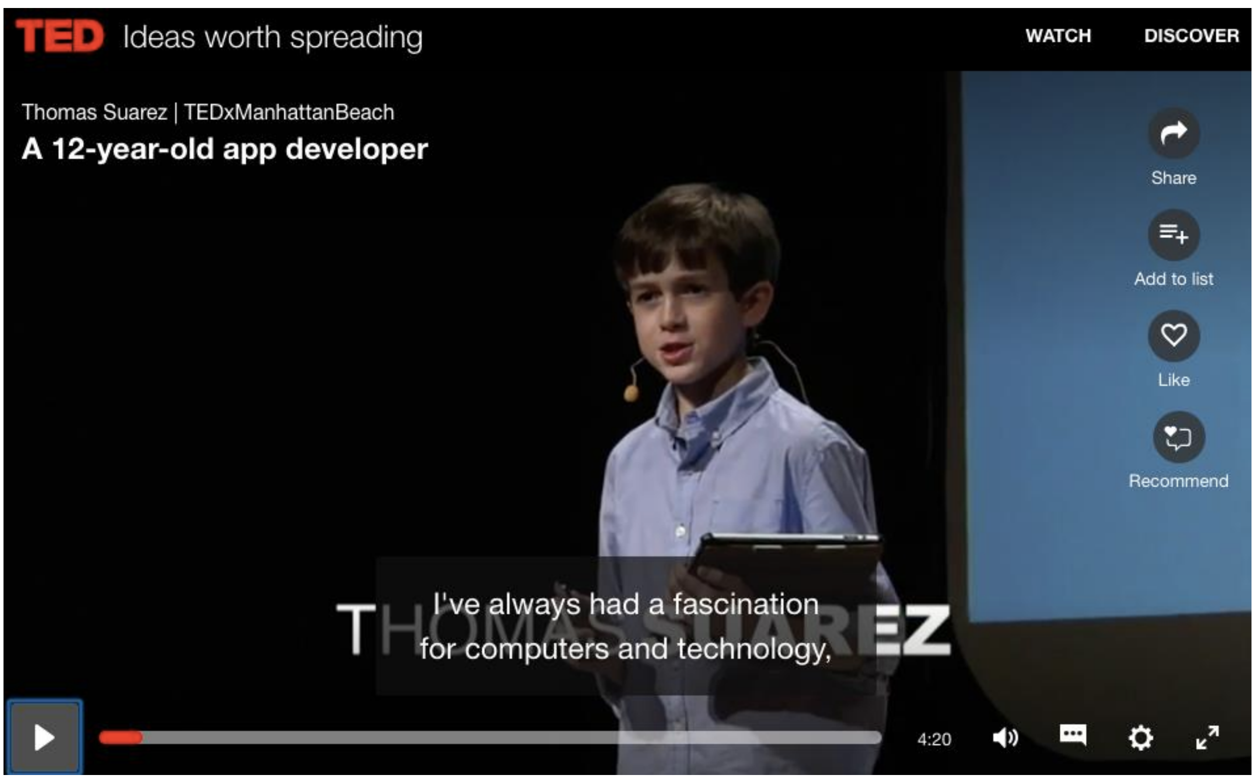
Developing an Android App

Technological Solutions to the Problem of Heatstroke in Hot Cars

After **brainstorming** ways of helping caregivers remember babies in rear-facing car seats, the idea of **programming** a clip and then creating an **app** for notification was explored. Could we do this?? HOW could we do this?

This **TED Talk** gave us inspiration and taught us that YES, we were capable of **completing this engineering project at ages 10 and 11**. We think it will inspire you as well!

https://www.ted.com/talks/thomas_suarez_a_12_year_old_app_developer#t-261442



Developing Questions for the People we Interviewed

- Our team would write questions we would like answered for the different people who were experts for the project. We would put these in Google docs and share it so everyone could add questions easily. Sometimes we emailed ideas to each other. The day before the interview, we would print a copy for each person, so notes could be taken during the interview. Sometimes we took notes on our laptops as well. Each question would lead to more discussions, so we limited our questions to under 10 and made them fairly general to allow room for expanding on different issues that would come up.

- A different set of questions was written for each person because the people offered unique talents and expertise for the project.

- This is one set of questions used when we interviewed the CEO of University Medical Center.

Dr. Pinkney Questions:

1. Please tell us about you – your background, experience, position

2. Have you ever taken care of a child from a hot car incident? Would you explain.

3. How do children in hot cars present to an emergency room doctor?

4. What are the most dangerous changes to the child when they are left in a hot car?

5. At what temperature do you start seeing these changes?

6. How long can a child withstand temperatures like that?

7. What other dangers can you think of in leaving a child unattended in a vehicle?

8. How can we help prevent this from happening?

SKYPE Interview with Houston Parents

Deannie is a parent who experienced the tragedy of leaving her 9-month-old son Luke in the hot car accidentally. We could not interview her in person because of the great distance from our town to Houston, but she agreed to a Skype interview with our team. We emailed her before the interview because this would be a very sensitive interview and we did not want to "step over the line" as far as asking anything that would be too upsetting. The tragedy was bad enough and Deannie is now helping spread awareness that this does not just happen to neglectful parents. It can happen to anyone in our busy and multi-task society.

Hi

I sent the questions below to Deannie and told her that if anything is off limits, she can just tell us, and we won't ask. Also, to add anything she'd like for us to include in our study. Thought I'd share the list of questions, so we can all add to it and can prepare for it. The Skype interview is set for Saturday morning at 10 am. See you then!

1. Tell us about you
2. Tell us about Luke
3. Tell us about what happened to Luke
4. What do you think we can do as a community for you at this time?
5. What do you think we can do as community in this situation?
6. What can we do to prevent this in the future?
7. How could we use our current and future tools to combat this problem?
8. How this affected friendships - judgment side of how most people behave in these situations.
9. How to overcome that - how to get people to realize IT CAN HAPPEN TO ANYONE.
10. How do you do it? faith? talking publicly? education and at what stage? pregnancy? young moms in the first month??? toddlers after we're a bit confident??

H.O.T. C.A.R.S. SURVEY

The H.O.T. C.A.R.S. team designed a survey using the online generator "*Survey Monkey*." In order for participants to be part of the study, the following steps were taken:

- The school's **Institutional Review Board** (IRB) and **Scientific Review Committee** (SRC) met and approved the questions on the survey and the involvement of the human participants involved.
- An **Informed Consent** form was developed and participants agreed to be part of the study voluntarily through signing a paper or initially digitally online prior to answering any questions.
- The **eCYBERMISSION Survey Approval Form** was completed and uploaded to the Mission Folder prior to the study.
- The **eCYBERMISSION Institutional Review Board Approval Form** was completed and uploaded to the Mission Folder prior to the study.
- All **informed consent forms** in paper-format were scanned and uploaded to the Mission Folder. If informed consent was granted online, it was part of the survey itself accessed at surveymonkey.com.

H.O.T. C.A.R.S. Survey Questions

The following ten questions were asked in the online survey and the data collected was analyzed and reported in the Mission Folder.

H.O.T. C.A.R.S. Survey

By participating, you agree to informed consent, you are participating voluntarily and may withdraw.

1. What age are you?
   - ○ Under 18
   - ○ 18-24
   - ○ 25-34
   - ○ 35-44
   - ○ 45-54
   - ○ 55-64
   - ○ 65+

2. What gender are you?
   - ○ Male
   - ○ Female
   - ○ Prefer not to say

3. How old is/are the child(ren) in your care? Select all that apply.
   - ☐ 0-5 months
   - ☐ 6-11 months
   - ☐ 1yr-2yrs
   - ☐ 2yrs+

4. What percentage of time do you drive the child(ren)?
   - ○ 100%
   - ○ 75%
   - ○ 50%
   - ○ 25%
   - ○ Less than 25%

5. Would a bright colored key chain help remind you of the child(ren) in the car with you?
   - ○ Yes
   - ○ No

6. If you received a key chain, rate how easy the was to use.

- ◯ Very easy
- ◯ Easy
- ◯ Neither easy nor difficult
- ◯ Difficult
- ◯ Very difficult
- ◯ Did not receive a key chain.

7. How effective do you think the trifold pamphlet was at educating about hot car deaths?

- ◯ Extremely effective
- ◯ Very effective
- ◯ Somewhat effective
- ◯ Not so effective
- ◯ Not at all effective

8. Would you recommend the trifold to other parents?

- ◯ Definitely would
- ◯ Probably would
- ◯ Probably would not
- ◯ Definitely would not

9. Would you be interested in an attachment that would go on the buckle of your child's car seat to alert your phone through an app that the child has been left in the car?

- ◯ Extremely interested
- ◯ Very interested
- ◯ Somewhat interested
- ◯ Not so interested
- ◯ Not at all interested

10. Thank you for taking our survey. Comment?

H.O.T. C.A.R.S. Survey

Adult Participant Information Sheet

Investigators Details:

Main investigators:

Alexa Tindall, 6th Grade Southcrest Christian School (*allisontindall1@gmail.com*)

Ethan Djajadi, 6th Grade Southcrest Christian School (*weimin@post.com*)

Josiah Morales, 6th Grade Southcrest Christian School (renee@yfclubbock.org)

We would like to invite you to take part in our study. Before you decide we would like you to understand why the research is being done and what it would involve for you.

What is the purpose of the study?

The purpose of the study is to see the effects of information given to participants through a brochure describing how to prevent heat stroke in children who are left in a closed vehicle. The purpose includes evaluating the effectiveness of a bright key chain used as a reminder to individuals that there is a small child in the vehicle.

As a result of the study, we hope to provide insight into how best to provide reminders to caregivers so that a tragedy of leaving a child in a hot car never happens to them.

Who is doing this research and why?

This study is part of a 6th Grade student research science project. The main investigators, Alexa Tindall, Josiah Morales, and Ethan Djajadi, are specifically interested in the effect of different types of education and intervention on a person's ability to remember a child in the backseat of a car. The information they obtain may be able to help them make recommendations for educating others.

Are there any exclusion criteria?

Participants must be over 18 years of age.

What will I be asked to do?

You will be asked to read a brochure, accept a key chain, and answer survey questions about your ability to remember a child with the added information we provide.

Once I take part, can I change my mind?

Yes. After you have read this information and asked any questions you may have if you are happy to participate we will ask you to sign your initials to represent your agreement of an Informed Consent; however if at any time, before, during or after completing the experiment you wish to withdraw from the study please just contact the main investigator. You can withdraw at any time, for any reason and you will not be asked to explain your reasons for withdrawing.

Will I be required to attend any sessions and where will these be?

No. You will be provided with the brochure and key chain and will be given a link to the survey.

How long will it take?

The experiment takes approximately 15 minutes of your time.

What personal information will be required from me?

You will be given the option to provide your name and email address so that the investigators could potentially reach out to you with follow up questions. This is optional and not required in order to complete the experiment.

Are there any disadvantages or risks in participating?

There is minimal risk and discomfort anticipated with participation in this research. The topic of hot car deaths is emotional, therefore we are requiring informed consent for participation in this project.

Will my taking part in this study be kept confidential?

Yes. The data you enter will not include personal identifiers.

In the event you agree to provide an email as a follow-up contact to participate in further research, this will be used only for the purpose of this research and will not be shared to any other parties.

All data is used for statistical purposes only and will be used to publish in science competitions. No personal information is collected, shared or published.

What if I am not happy with how the research was conducted?

If you are not happy with how the research was conducted, please contact us to have your information excluded from the study. Laura Wilbanks, Elementary Science Coordinator and

Instructional Coach, Southcrest Christian School, 3801 S. Loop 289, Lubbock, TX 79423. Tel: 806-797-7400. Email: lwilbanks@southcrest.org

What are the benefits of participating?

Participating in this experiment offers two main benefits:

1. *Outcomes of the research will be informative to you as an individual and provide a better understanding of how you can insure a hot car death never happens to you or someone you love.*
2. *Participation in this study will be personally rewarding as you know you potentially helped saved lives by being educated on this topic and can share what you learned with others.*

I have some more questions; who should I contact?

Please feel free to contact the main investigators at weimin@post.com and allisontindall1@gmail.com and renee@yfclubbock.org with any questions you have about participating not answered herein.

H.O.T. C.A.R.S. Experiment

Informed Consent

Taking Part

The purpose and details of this experiment have been explained to me. I understand that this experiment is designed to further scientific knowledge and that all procedures have been approved by the Scientific Review Committee of SPRSEF and Southcrest Christian School.

· I have read and understood the information sheet and this consent form.

· I have had an opportunity to ask questions about my participation.

· I understand that I am under no obligation to take part in the study, have the right to withdraw from this study at any stage for any reason, and will not be required to explain my reasons for withdrawing.

Use of Information

· I understand that all personal information will not be required and your participation will be treated in strict confidence and will be kept anonymous and confidential to the researchers unless (under the statutory obligations of the agencies which the researchers are working with), it is judged that confidentiality will have to be breached for the safety of the participant or others or for audit by regulatory authorities.

· I understand that anonymized quotes may be used in publications, reports, web pages, and other research outputs.

· I agree for the data I provide to be securely archived at the end of the project.

☐_____ By checking this box or initialing on the line, you are confirming that;

- That you are over 18 years of age
- You have read and understood the terms of this survey
- You are willing to take part in this study

________________________________ ________________________

Signature Date

Interview Notes with CEO of Covenant Children's Hospital
Sept. 2018

Pediatrician Hospitalist, 11 years
CEO Chief Executive Officer
Covenant Children's Hospital
Dr. Amy Thompson

Hot car deaths (under 3 major age)
ER cases
First 10 minutes to experience the worst

Greenhouse Effect

Even 60 degrees outside can get to 100+ degrees inside a car
People don't think of this - even when it is not summer, this is dangerous

Experiment Idea -
-Circulating air is the key to keeping temperatures down
-Uncracked windows cause the temperature to rise
-1.5 in
-3 in
-5 in
-open window
-open window and circulating air

Kid locks- pros and cons

1. Suction on window by rearview mirror
2. Lanyard with buckle
3. Education for those who think it's safe

Most effective-

Education and lanyard, maybe??

Neuroscience of the Brain-

Prefrontal cortex makes decisions

Hypocampus- understands that something new is happening

Basal Ganglia takes over the brain and the brain does something automatically

*** **New mom's habits** do NOT include looking in the back seat

Hypocampus need to kick in to remember the baby. 28 days makes a habit- daily for 28 days.

A good idea is to form the habit a little before the baby is born.

RESEARCH PLAN

Ethan Djajadi   Alexa Tindall   Josiah Morales

Rationale

The Manga Guide to Electricity by Kazuhiro Fujitaki
This book taught us how electricity works and describes how different electrical components and circuit works, in a fun, easy to understand way. Electricity is a flow of electrons and works like water. Potential difference, noted by V (Voltage) makes it flow. Electric current is noted by A (Ampere). Electric Power, noted by W (Watt) is the product of V and A. It also talks about how electricity is distributed into our house safely through series of breakers to prevent damages. It also taught us about Electric resistance, noted by Ω (ohm). The relationship between current, voltage, and resistance in a circuit is depicted by V=I*R (where I denotes current). Resistors can be connected in series or parallel manner.

Snap Circuits Classic SC-300 Electronics Exploration Kit by Elenco
We read the manual and experimented with different circuitry to have fun and to learn about electronics.

https://www.instructables.com/id/Remotely-Control-LED-using-HC-05-Bluetooth-Arduino/
We find out how to wire HC-05 to Arduino from this website. HC-05 needs 4 connections: ground, power, serial receive and serial transmit. Ground and power are connected to the battery and serial receive and transmit are connected to Arduino serial transmit and receive pins.

https://www.arduino.cc/en/Tutorial/StateChangeDetection
This web site helps us wire, design, and program Arduino to detect the state of a button. The button is connected to 5V power and to a pull-down resistor. When the power button is not pressed, the button connection to the pull-down resistor is 0V, and 5V when the power button is pressed. We connect that terminal to Arduino input pin 2. The website also gave us sample program that we can run. The sample program also makes a LED blink which we didn't need, so later we stripped that part out.

https://programmingelectronics.com/using-the-print-function-with-arduino-part-1/
Use Serial.print() to display Arduino output on your computer monitor. One way to transport information made by the arduino to the computer that it's connected to is to use the function Serial.print(). This function will move the data from the arduino to the serial port to send. Usually the serial port is connected to your computer for debugging. But for our use, we use this function to send information about whether a baby is on the seat to the phone.

https://computer.howstuffworks.com/serial-port1.htm
How Serial Ports Work. All Operating Systems use serial ports. Though soon enough, serial ports will be replaced by USB ports. Serial ports work by sending each bit individually of every

byte. The other three bits that serial ports will send are starting bits, stopping bits, and occasionally a parity bit. The starting bit, stopping bit, and the parity bit have a value of 0 (bits can have a value of 1 or 0). Serial ports are bi-directional. That means that data can go both ways, transmitting and receiving. Even though there is only one connection for transmitting and receiving, there are normally two pins to enable transmitting and receiving to happen at the same time. There is another component which is a UART, a Universal Asynchronous Transmitter/Receiver, and it converts the parallel port (multiple connections) generated by the computer and converts it into a serial port (one connection). Our design uses serial communication over Bluetooth.

https://www.acs.org/content/acs/en/climatescience/climatesciencenarratives/what-is-the-greenhouse-effect.html
What Is the Greenhouse Effect? This website explains the greenhouse effect. The greenhouse effect is where infrared radiation from the sun heats the earth which makes it hotter or colder. An example of infrared radiation is if you put your hand near a fire. You'll feel the heat the heat you feel is what scientists call infrared radiation. As the infrared radiation from the sun hits the earth it heats the earth and makes it the perfect temperature we need to survive. Some of the sun's infrared radiation also bounces off the earth's surface into space. The earth also makes infrared radiation but it does not all make it to space. Some of the made radiation gets stuck in the earth's atmosphere or clouds and brings it back to the surface which gradually makes the earth hotter than normal. As us humans came we have made more greenhouse gases that disturb the perfect balance of earth's heat. In conclusion we need to help the greenhouse effect.

https://computer.howstuffworks.com/serial-port1.htm
How Serial Ports Work. All Operating Systems use serial ports. Though soon enough, serial ports will be replaced by USB ports. Serial ports work by sending each bit individually of every byte. The other three bits that serial ports will send are starting bits, stopping bits, and occasionally a parity bit. The starting bit, stopping bit, and the parity bit have a value of 0 (bits can have a value of 1 or 0). Serial ports are bi-directional. That means that data can go both ways, transmitting and receiving. Even though there is only one connection for transmitting and receiving, there are normally two pins to enable transmitting and receiving to happen at the same time. There is another component which is a UART, a Universal Asynchronous Transmitter/Receiver, and it converts the parallel port (multiple connections) generated by the computer and converts it into a serial port (one connection). Our design uses serial communication over Bluetooth.

https://programmingelectronics.com/using-the-print-function-with-arduino-part-1/
Use Serial.print() to display Arduino output on your computer monitor. One way to transport information made by the arduino to the computer that it's connected to is to use the function Serial.print(). This function will move the data from the arduino to the serial port to send. Usually the serial port is connected to your computer for debugging. But for our use, we use this function to send information about whether a baby is on the seat to the phone.

https://www.acs.org/content/acs/en/climatescience/climatesciencenarratives/what-is-the-greenhouse-effect.html

What Is the Greenhouse Effect? This website explains the greenhouse effect. The greenhouse effect is where infrared radiation from the sun heats the earth which makes it hotter or colder. An example of infrared radiation is if you put your hand near a fire. You'll feel the heat the heat you feel is what scientists call infrared radiation. As the infrared radiation from the sun hits the earth it heats the earth and makes it the perfect temperature we need to survive. Some of the sun's infrared radiation also bounces off the earth's surface into space. The earth also makes infrared radiation, but it does not all make it to space. Some of the made radiation gets stuck in the earth's atmosphere or clouds and brings it back to the surface which gradually makes the earth hotter than normal. As we humans came, we have made more greenhouse gases that disturb the perfect balance of Earth's heat. In conclusion, we need to help decrease the greenhouse effect.

Research Question

Can an alert system be used effectively to tell a caregiver a child is in the vehicle?
Will an Android app be effective in alerting caregivers within a short window of time?

Engineering Goals

System Design Criteria

- The solution needs an alert system to tell the caregiver that the child is in the car.
- The solution needs to give an alert to the caregiver while the caregiver is not in the car so that they will look back to the car to find the child.
- The device has to be reliable

System Design Constraints

- The device needs to be compact.
- The device needs to be cheaper than other existing alert systems.
- The device needs to be light.
- The app needs to communicate with a device timely.
- The device needs to be portable.

Preliminary Design

A Bluetooth device that detects a baby in the car seat, paired with a phone app that notifies the user that a baby is left on the seat upon losing the Bluetooth signal. Bluetooth only operates in short distances, so the user will have a timely notification.

Final Design

A Bluetooth device using Arduino system that detects a baby in the car seat by detecting a coupled chest buckle, paired with a phone app that notifies the user that a baby is left on the seat upon losing the Bluetooth signal.

Materials

10 lb bag of rice	Arduino breadboard shield	Cars	Internet	Solder	USB battery
Android Smart Phone	Bluetooth serial HC-05	Computers	Key chain	Soldering Iron	Weebly.com
Android Studio	Breadboard	Git	Mono audio jack	Survey Monkey	Wires
Aluminum tape	Brochures	Github	Resistor 10K	Thermometer	Ibis Paint
Arduino	Button Switch	Glue gun	Screwdriver	USB cable	Stylus
Arduino software	Car seat	Google play store	Slide switch	USB charger	IPad

Procedure

There are three different components we need to make:

- **Bluetooth baby detector**
    - We need to work on the Bluetooth device first because it is the most risky and complicated part of the whole solution
    - We know the only input is whether a baby is on the seat, so it needs to detect an on/off state
- **How to Connect The Bluetooth Device to Car Seat**
    - This part was the next unknown. We need to solve the problem of detecting a baby on the car seat and send that information to the device.
- **Work on The Phone App**

    - This was the last piece because it was not that risky. We know this can be done based on the phone capability, we just need to learn how to program it.

Testing Prototype

- We downloaded a sample program from our research to Arduino to detect the button switch. It sends serial data every time the button switch is pressed or released. We did modify the program to fit our needs, where we only send “1” when the button is pressed, and “0” when released.

- We used the Serial Bluetooth Terminal app from the Google Play Store to receive the serial data from our prototype

- Once we paired the phone to HC-05, the phone got messages we sent from our Arduino program, every time the button state changed
- We powered our device with Arduino power supply
- We paired the device to our phone's blue tooth
- We downloaded and ran Serial Bluetooth Terminal app from Google Play Store
- We told the app to connect to our HC-05 Bluetooth module

- We pressed the button on our device repeatedly and made sure the device sent the "1" or "0" appropriately

Risks and Safety

Working with electrical components, work with adult supervision and be careful using aluminum tape.

Data Analysis - System Test Procedure

- We put a car seat with the modified buckle into a car
- We buckled in a ten-pound bag of rice in a car seat to simulate a baby
- We attached the buckle to our device, and turned on our device
- We paired the device to our phone and launch our app
- Launch the baby monitor service from our app and make sure it detects that a baby is in the car seat
- We walked away from the car and measure how far the phone was from the car when our app notified us that a baby was left in the car seat

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Problem

The goal of this project is to prevent hot car deaths. We are going to accomplish this by designing, building and testing a system that will utilize a smart phone to send a notification to the caregiver that the baby is still in the vehicle. We will also increase awareness of how easily a child can accidentally be left in a vehicle, and how quickly the temperature rises. Our mission is to save as many children as possible so they can go on to have rich lives in the future.

Research

The Manga Guide to Electricity by Kazuhiro Fujitaki
This book taught us how electricity works and describes how different electrical components and circuit works, in a fun, easy to understand way. Electricity is a flow of electrons, and works like water. Potential difference, noted by V (Voltage) makes it flow. Electric current is noted by A (Ampere). Electric Power, noted by W (Watt) is the product of V and A. It also talks about how electricity is distributed into our house safely through series of breakers to prevent damages. It also taught us about Electric resistance, noted by Ω (ohm). The relationship between current, voltage, and resistance in a circuit is depicted by $V=I*R$ (where I denotes current). Resistors can be connected in series or parallel manner.

Snap Circuits Classic SC-300 Electronics Exploration Kit by Elenco
We read the manual and experimented with different circuitry to have fun and to learn about electronics.

https://www.instructables.com/id/Remotely-Control-LED-using-HC-05-Bluetooth-Arduino/
We find out how to wire HC-05 to Arduino from this website. HC-05 needs 4 connections: ground, power, serial receive and serial transmit. Ground and power are connected to the battery and serial receive and transmit are connected to Arduino serial transmit and receive pins.

https://www.arduino.cc/en/Tutorial/StateChangeDetection
This web site helps us wire, design, and program Arduino to detect the state of a button. The button is connected to 5V power and to a pull-down resistor. When the power button is not pressed, the button connection to the pull-down resistor is 0V, and 5V when the power button is pressed. We connect that terminal to Arduino input pin 2. The website also gave us sample program that we can run. The sample program also makes a LED blink which we didn’t need, so later we stripped that part out.

https://computer.howstuffworks.com/serial-port1.htm
How Serial Ports Work. All Operating Systems use serial ports. Though soon enough, serial ports will be replaced by USB ports. Serial ports work by sending each bit individually of every byte. The other three bits that serial ports will send are starting bits, stopping bits, and occasionally a parity bit. The starting bit, stopping bit, and the parity bit have a value of 0 (bits can have a value of 1 or 0). Serial ports are bi-directional. That means that data can go both ways, transmitting and receiving. Even though there is only one connection for transmitting and receiving, there are normally two pins to enable transmitting and receiving to happen at the same time. There is another component which is a UART, a Universal Asynchronous Transmitter/Receiver, and it converts the parallel port (multiple connections) generated by the computer and converts it into a serial port (one connection). Our design uses serial communication over Bluetooth.

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What Is the Greenhouse Effect? This website explains the greenhouse effect. The greenhouse effect is where infrared radiation from the sun heats the earth which makes it hotter or colder. An example of infrared radiation is if you put your hand near a fire. You'll feel the heat the heat you feel is what scientists call infrared radiation. As the infrared radiation from the sun hits the earth it heats the earth and makes it the perfect temperature we need to survive.Some of the sun's infrared radiation also bounces off the earth's surface into space. The earth also makes infrared radiation but it does not all make it to space. Some of the made radiation gets stuck in the earth's atmosphere or clouds and brings it back to the surface which gradually makes the earth hotter than normal. As us humans came we have made more greenhouse gases that disturb the perfect balance of earth's heat. In conclusion we need to help the greenhouse effect.

Expert consultation: Jude Machin and Irwan Djajadi
Mr. Machin is an expert at mobile app developer, and Mr. Djajadi is a software engineer with electrical engineering background. Mr. Djajadi taught us the basics on how to use Arduino and Arduino software. He taught us basic electrical circuit design and gave us information about what parts are available to help us make our device. Mr. Machin gave us pointers on how to develop our Android app.

https://developer.android.com/training/basics/firstapp/
This is a tutorial for us to learn how to make an Android app. It taught us how to create a window, create text to display, and make a button that creates another window. Through it we learned that Android uses Java programming language, and that creating an app has a lot of parts to it, not just the program.

https://github.com/jpetrocik/bluetoothserial
This is the bluetooth serial library we found that helps us to easily communicate with our Arduino device. It also handles reconnection and disconnection notification that is very useful for our app.

https://developer.android.com/guide/topics/ui/notifiers/notifications
This describes how to make a notification to the user in Android system. It comes with overview, detailed explanation, and example code that we can use.

https://developer.android.com/guide/components/services
This describes how to create Android services. We need this to make sure our program can keep running in the background even after user switches to a different app.

http://pediatrics.aappublications.org/content/116/1/e109.short
Hot car deaths are a rampant problem and at this time, there is very little we can do to stop it. An experiment was conducted and the results were considered somewhat alarming. According to the research experiment, the temperature increases by about 3.4 degrees Fahrenheit every five minutes. The most amount of increase in temperature happens in the first fifteen to thirty minutes, which is also about the time a child is left in the unattended and hot car. Cracking open the window by 1.5 inches did almost nothing. It decreased the average temperature increase by about 0.3 degrees.

https://injuryprevention.bmj.com/content/11/1/33.short
In a study about hot car deaths, it was discovered that a large majority of the deaths were caused by absent minded adults. 27% of the deaths were caused by children locking themselves in a hot car. 73% of the deaths were caused by adults not realizing the children were in the car. 43% included in the absent minded adults category were caused by something related to childcare for the child. More than half were caused by family relatives and the rest were caused by childcare faculty.

https://www.nsc.org/road-safety/safety-topics/child-passenger-safety/kids-hot-cars
NSC says how technology in the car will help prevent more hot car deaths and protect our baby’s, here is two guidelines to follow: Reminder for backseat reminder to check rear seat if a car door is opened in 10 minutes when the vehicle is not started five ringers (of any type) will sound and a message will show on the radio,instrument panel,or other. The vehicle will then turn off and hopefully remind the driver to check the back seat. This technology is available on some GM vehicles. Baby seat technology. The technology creates a series of sounds activated through a chest clip and receiver to tell the driver a child/children is in the backseat within two seconds of shutting off the vehicle.

System Design Criteria

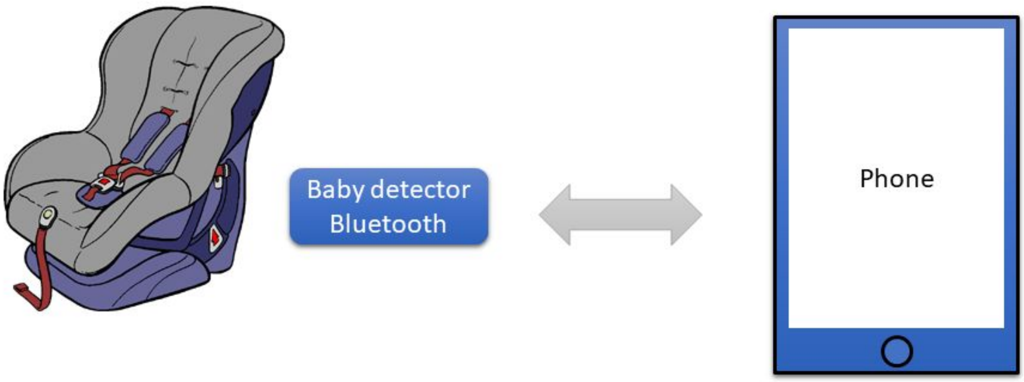
- The solution needs an alert system to tell the caregiver that the child is in the car.
- The solution needs to give an alert to the caregiver while the caregiver is not in the car so that they will look back to the car to find the child.
- The device has to be reliable

System Design Constraints

- The device needs to be compact.
- The device needs to be cheaper than other existing alert systems.
- The device needs to be light.
- The app needs to communicate with a device timely.
- The device needs to be portable.

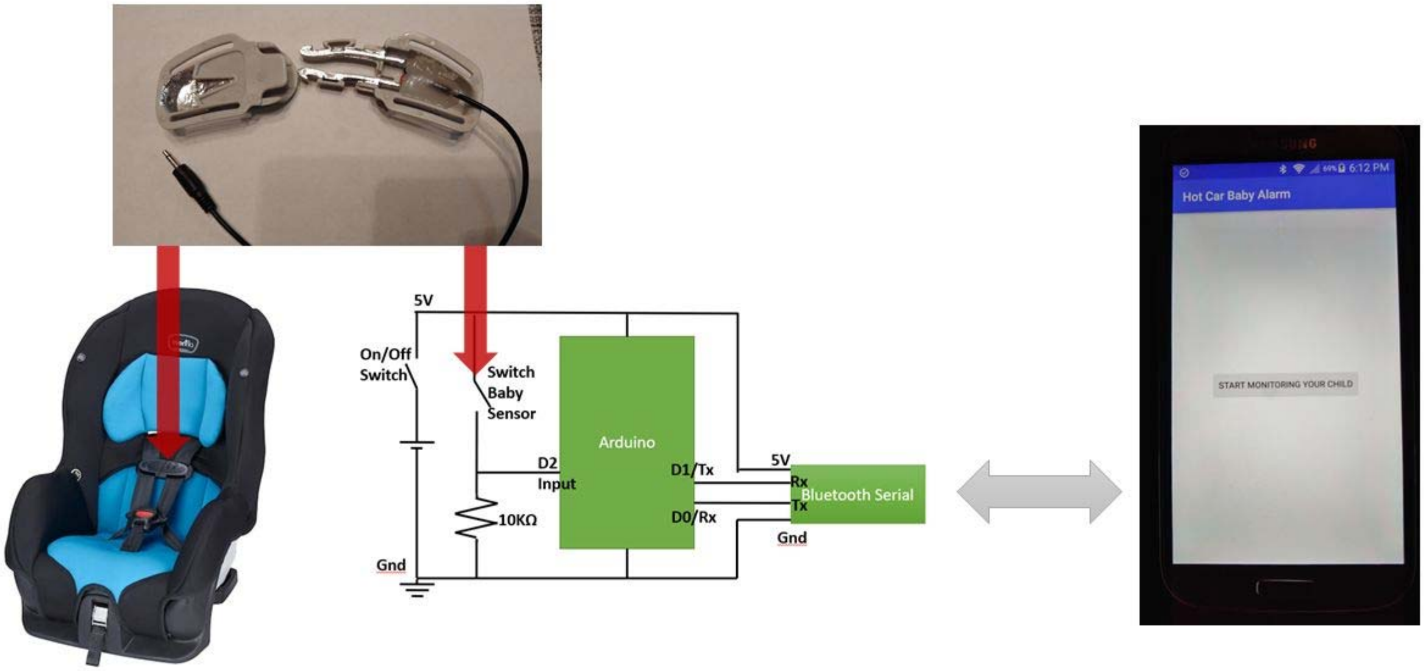
Preliminary Design

A Bluetooth device that detects a baby in the car seat, paired with a phone app that notifies the user that a baby is left on the seat upon losing the Bluetooth signal. Bluetooth only operates in short distances, so the user will have a timely notification.



Final Design

A Bluetooth device using Arduino system that detects a baby in the car seat by detecting a coupled chest buckle, paired with a phone app that notifies the user that a baby is left on the seat upon losing the Bluetooth signal.


5V
On/Off
Switch
Switch
Baby
Sensor
Arduino
D2
Input
10KΩ
D1/Tx
D0/Rx
5V
Rx
Tx
Bluetooth Serial
Gnd
Gnd
Hot Car Baby Alarm
START MONITORING YOUR CHILD


Buckle, connected to our bluetooth device
Phone running our app
100lb Booster

Materials

10 lb bag of rice	Arduino breadboard shield	Cars	Internet	Solder	USB battery
Android Smart Phone	Bluetooth serial HC-05	Computers	Key chain	Soldering Iron	Weebly.com
Android Studio	Breadboard	Git	Mono audio jack	Survey Monkey	Wires
Aluminum tape	Brochures	Github	Resistor 10K	Thermometer	Ibis Paint
Arduino	Button Switch	Glue gun	Screwdriver	USB cable	Stylus
Arduino software	Car seat	Google play store	Slide switch	USB charger	IPad

Step-by-step Procedure

There are three different components we need to make:

- **Bluetooth baby detector**
    - We need to work on the Bluetooth device first because it is the most risky and complicated part of the whole solution
    - We know the only input is whether a baby is on the seat, so it needs to detect an on/off state
- **How to Connect The Bluetooth Device to Car Seat**
    - This part was the next unknown. We need to solve the problem of detecting a baby on the car seat and send that information to the device.
- **Work on The Phone App**
    - This was the last piece because it was not that risky. We know this can be done based on the phone capability, we just need to learn how to program it.

Bluetooth Baby Detector Design

Criteria

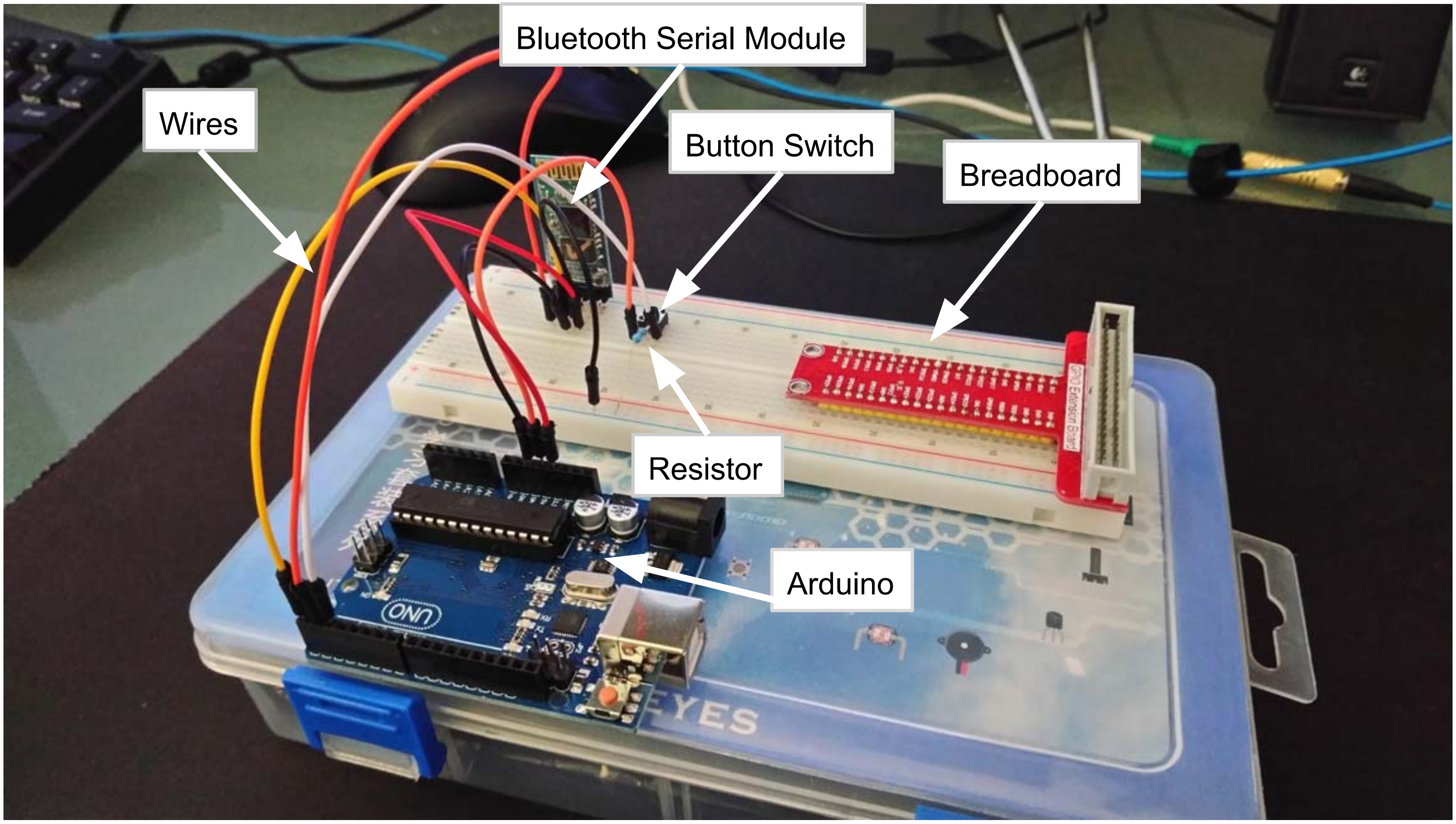
- The device must be able to communicate to a phone via Bluetooth in a timely manner
- It must be able to detect if a button is on or off so we can recognized if a baby is in the car seat
- It must have on/off switch so we can power off the device when it is not in use

Constraints

- The device should be compact and light
- The device needs to be relatively cheap
- The device needs to be portable.

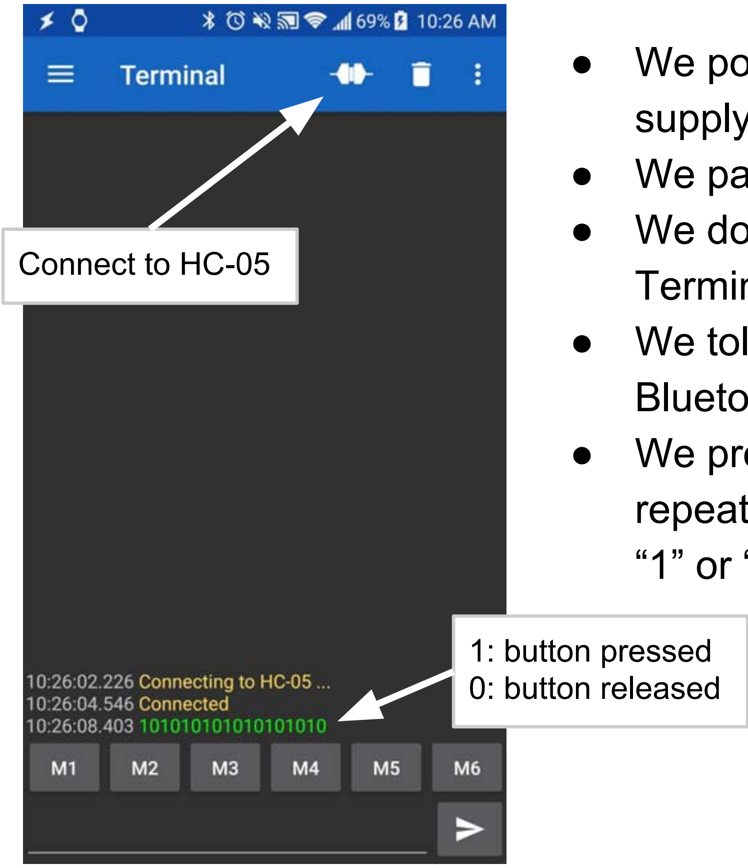
Prototype Building: Bluetooth Baby Detector

- We started with Arduino platform because:
    - Arduino is a popular small computer for hobbyists, so there are lots of internet resources
    - Bluetooth communication to a phone will require a small computer
    - Arduino supports serial communication, a common communication protocol
    - We found Bluetooth serial module for Arduino, called HC-05
- We researched how to wire HC-05 to Arduino
- We then researched how Arduino can detect an on/off state to recognize if the baby is in the car seat. We found that we needed a resistor, a switch, and some wires.
- We then put the HC-05, button switch, and the resistor on a breadboard and we wired them up according to our research above.


Bluetooth Serial Module
Wires
Button Switch
Breadboard
Resistor
Arduino
UNO
EYES
GPIO Extension Board

Testing Prototype

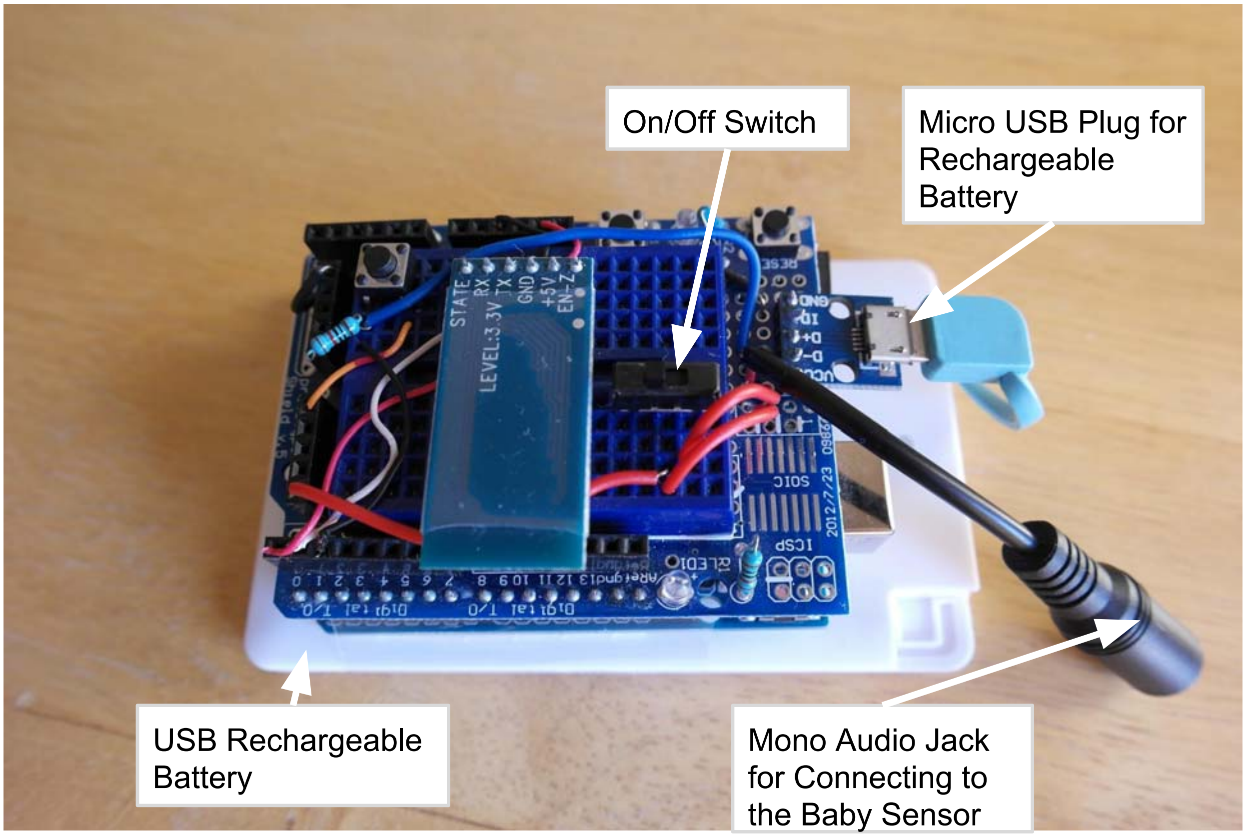
- We downloaded a sample program from our research to Arduino to detect the button switch. It sends serial data every time the button switch is pressed or released. We did modify the program to fit our needs, where we only send “1” when the button is pressed, and “0” when released.
- We used the Serial Bluetooth Terminal app from the Google Play Store to receive the serial data from our prototype
- Once we paired the phone to HC-05, the phone got messages we sent from our Arduino program, everytime the button state changed



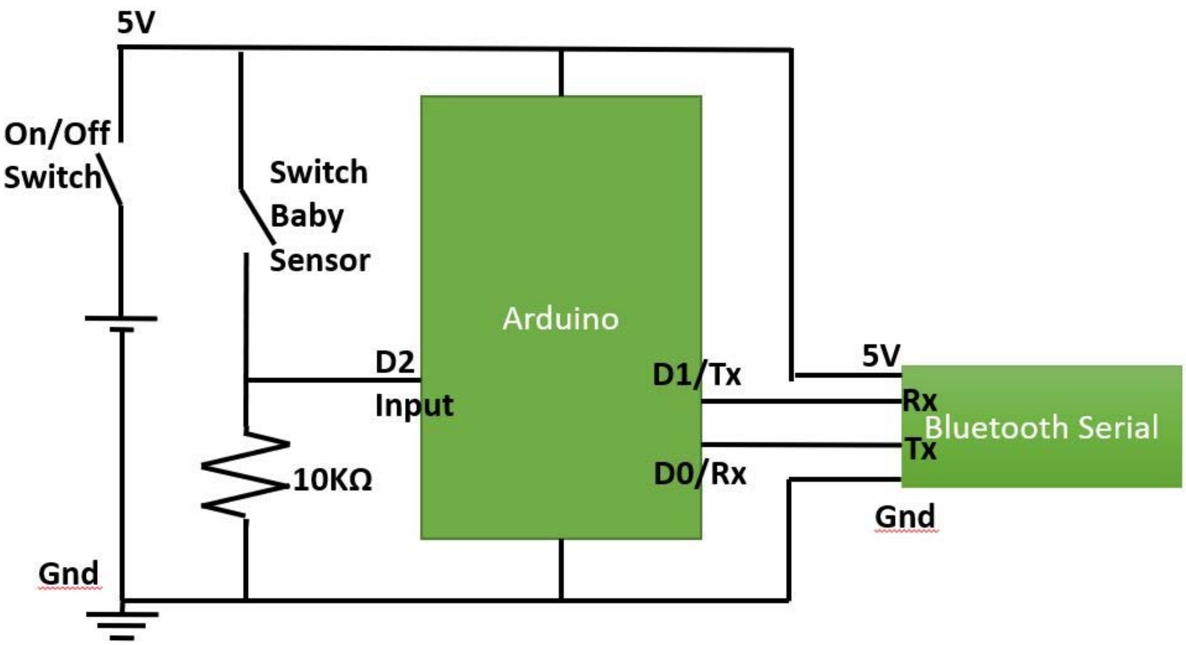
- We powered our device with Arduino power supply
- We paired the device to our phone's bluetooth
- We downloaded and ran Serial Bluetooth Terminal app from Google Play Store
- We told the app to connect to our HC-05 Bluetooth module
- We pressed the button on our device repeatedly and made sure the device sent the "1" or "0" appropriately

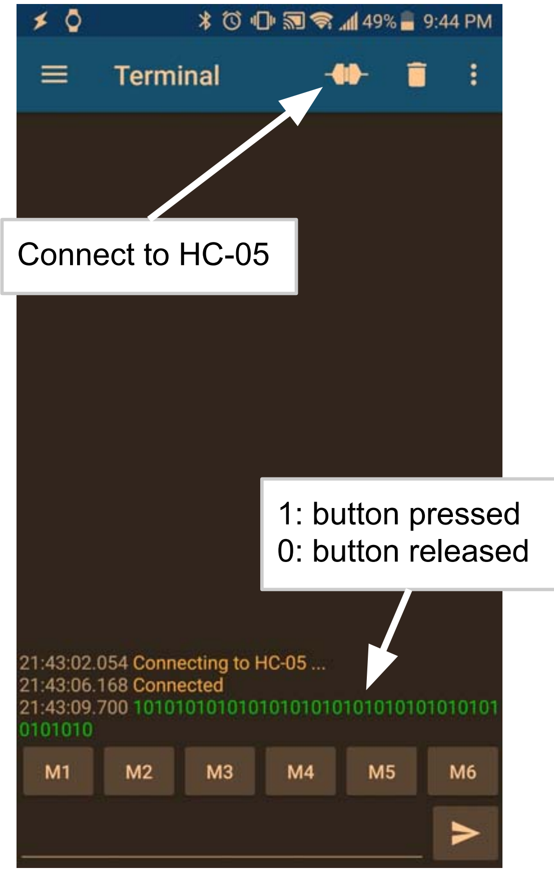
Findings and Rework

- Our bluetooth baby detector is working
    - The device communicated to a phone via Bluetooth timely
    - The device detected if a button is on or off properly
    - The device is relatively cheap (the major components cost about $30)
    - The device is relatively light
- Needed Improvements
    - The device could be more compact and portable
    - The device does not have on/off switch
- Rework
    - We moved the circuit to an Arduino breadboard shield to make it more compact
    - We also added:
        - on/off switch
        - a rechargeable battery
        - a mono audio jack, in parallel with our button, to connect to the car seat.


On/Off Switch
Micro USB Plug for Rechargeable Battery
USB Rechargeable Battery
Mono Audio Jack for Connecting to the Baby Sensor

Bluetooth Baby Detector Schematic





- We powered our device with the rechargeable battery
- We turned on our device
- We paired the device to our phone's bluetooth
- We ran Serial Bluetooth Terminal app
- We told the app to connect to our HC-05 Bluetooth module
- We pressed the button on our device repeatedly and made sure the device sent the "1" or "0" appropriately

Findings

- Our bluetooth baby detector is working
    - The device communicated to a phone via Bluetooth timely
    - The device detected if a button is on or off properly
    - The device is relatively cheap (the major components costs about $30)
    - The device is relatively light
    - The device is compact and portable
    - The device has an on/off switch
    - The device now can easily be attached to the car seat via the mono audio jack
    - As a bonus, we have a rechargeable battery to power our device

Designing How to Connect The Bluetooth Device to A Car Seat

Criteria

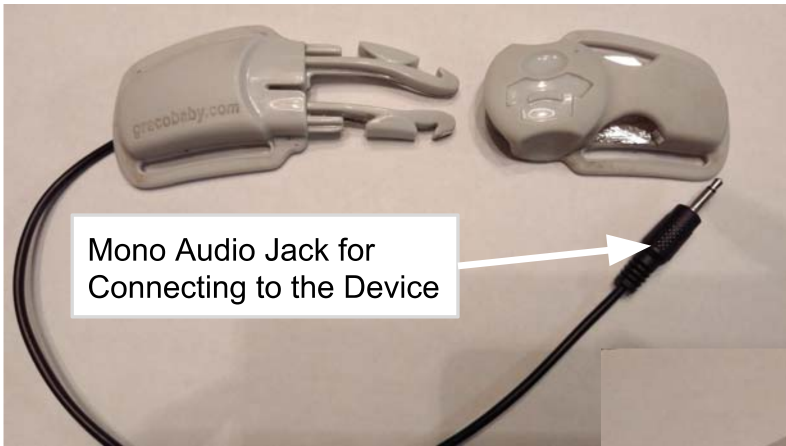
- When a baby is in the car seat, we need a connection to be established
- When the baby is off the car seat, we need the connection to be disconnected

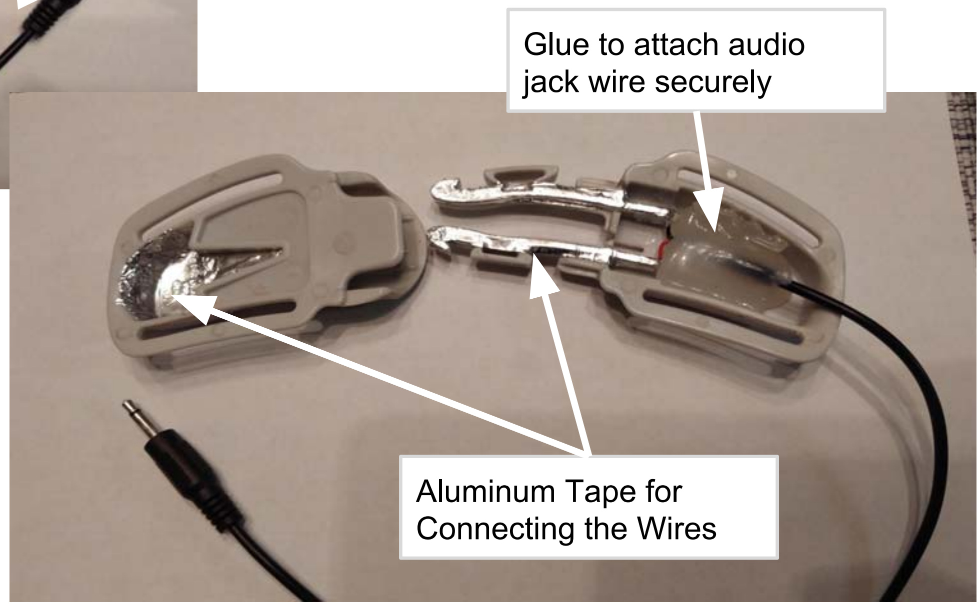
Constraints

- It needs to be safe and reliable
- It needs to be cheap
- Minimal modification to the car seat

Building The Connection of The Bluetooth Device And Car Seat

- We considered a weight-based detector, however cost and complexity were prohibitive
- We brainstormed and decided to use the buckle
- We looked at a car seat, and noticed that the chest buckle is usually simple plastic and easily accessible
- We were able to modify the buckle with simple aluminum tape creating a connection between two wires

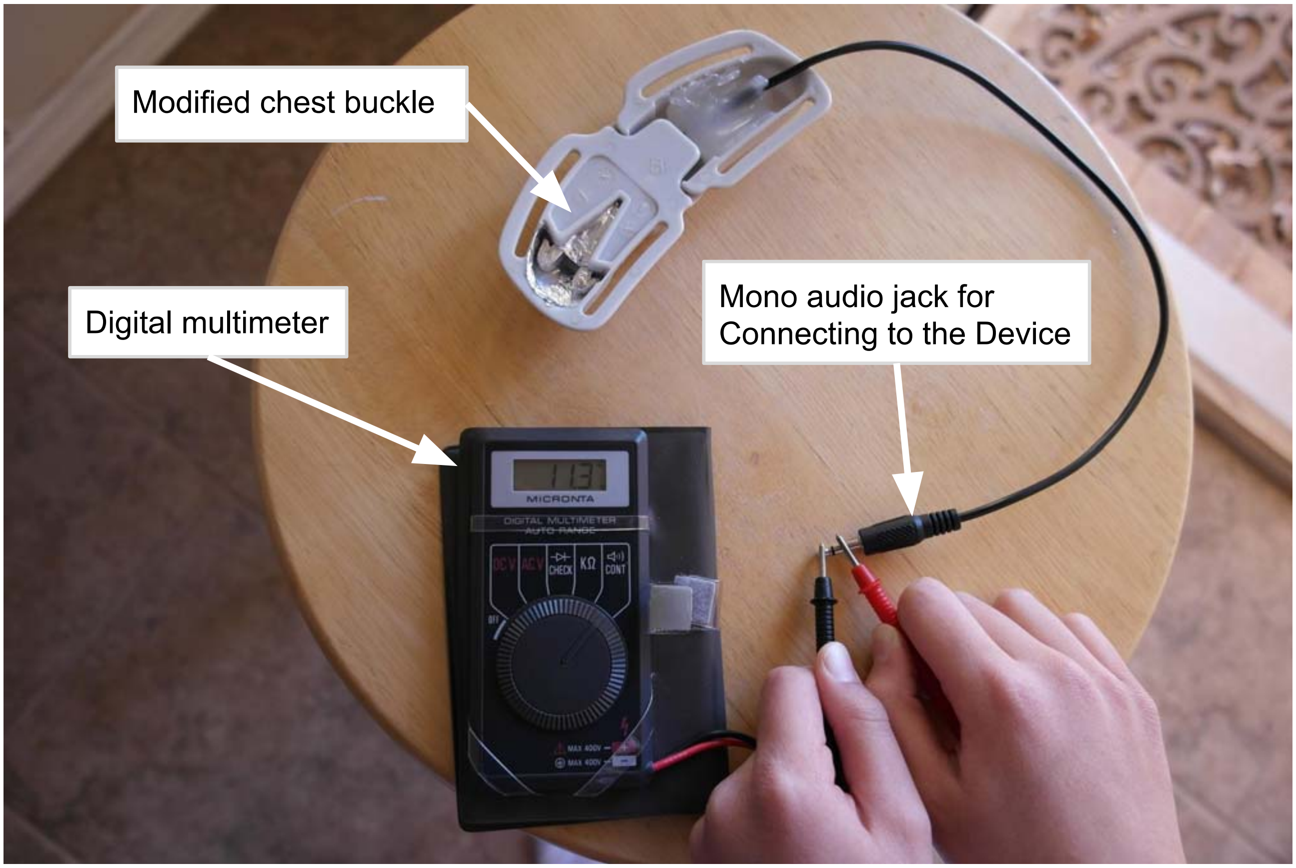

Mono Audio Jack for
Connecting to the Device


Glue to attach audio
jack wire securely
Aluminum Tape for
Connecting the Wires

Testing The Connection Mechanism

- We used a digital multimeter to test the connection via the aluminum tape
- We found that the connection has low resistance, about 11Ω which is low enough to indicate a connection
- We connected and disconnected the buckle and tested repeatedly

Test number	**Resistance (Ω)**
1	11.3
2	12.1
3	9.1
4	10.5
Average	10.75


Modified chest buckle
Digital multimeter
Mono audio jack for
Connecting to the Device
MICRONTA
DIGITAL MULTIMETER
AUTO RANGE

- We also tested the device and the buckle system together with the Bluetooth Serial Terminal app
- We got "1" sent by our device
- The resistance from the aluminum tape is low enough for our device to detect a connection

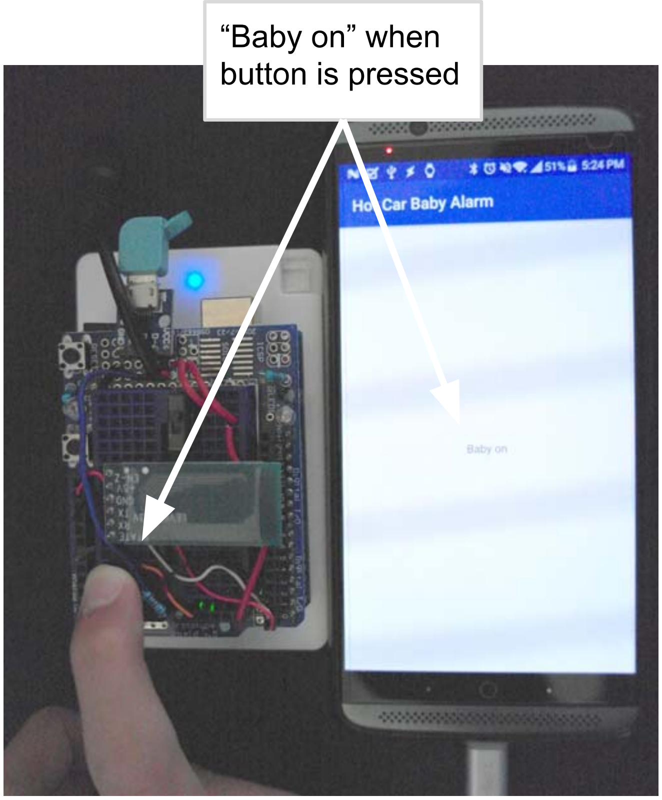
Phone App Design

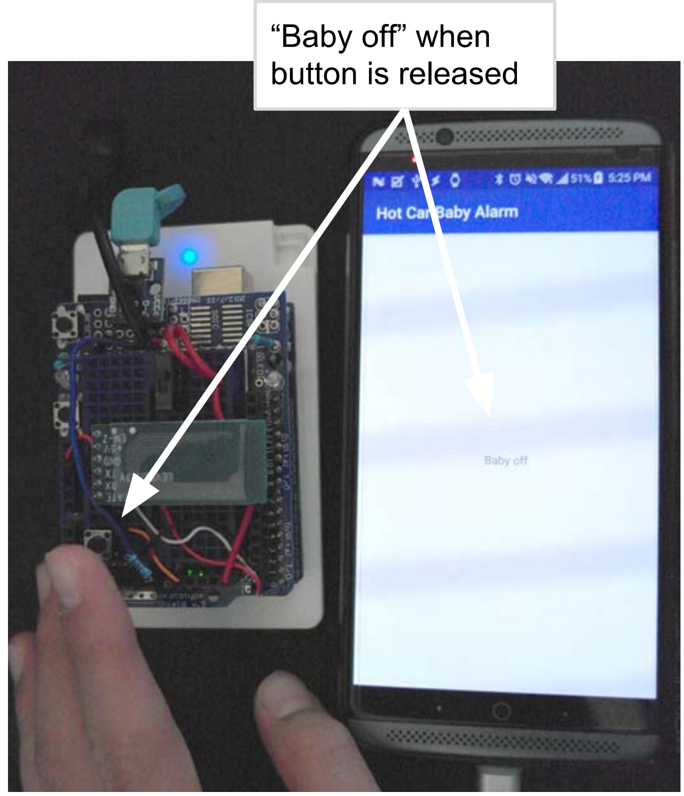
Criteria

- The phone app needs to alert caregiver if the bluetooth device is disconnected, indicating the caregiver is far enough from the car seat, and that the last communication from our bluetooth device indicates that a child is left in the car seat
- The app has to be reliable

Building Phone App: Basic Serial Communication

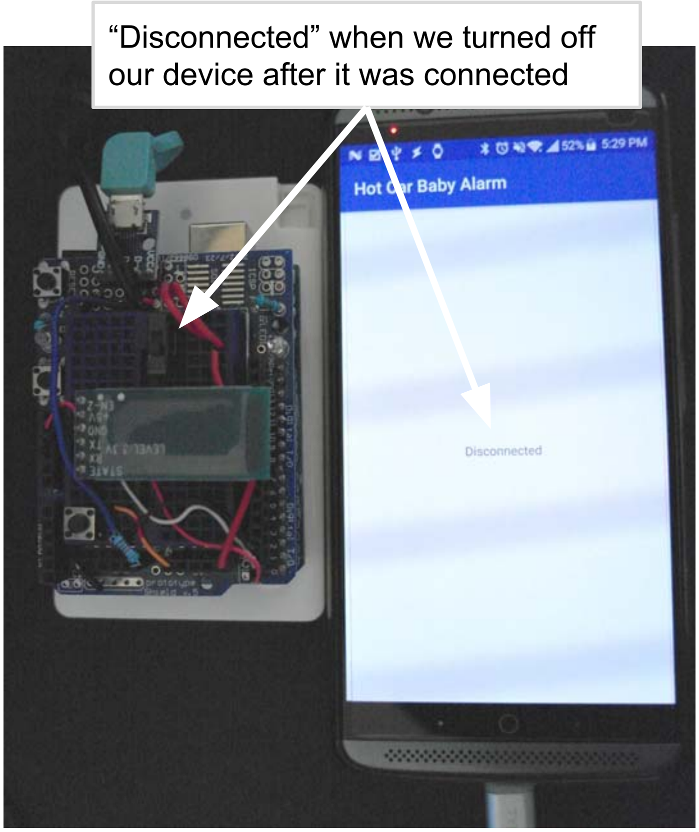
- We went with Android because it is cheaper to register as a developer
- We went through the Android Studio Tutorial on a basic app
- We found a Bluetooth Serial library to help us connect to our device
- We worked on getting basic serial communication working
- To test it, we use a text control in our app
    - We turned on our device and pair it with the phone
    - Every time we get a “1” from the device, we changed a text in our app to “Baby on”
    - When we get a “0”, we changed the text to “Baby off”


“Baby on” when
button is pressed
Baby on


“Baby off” when
button is released
Baby off

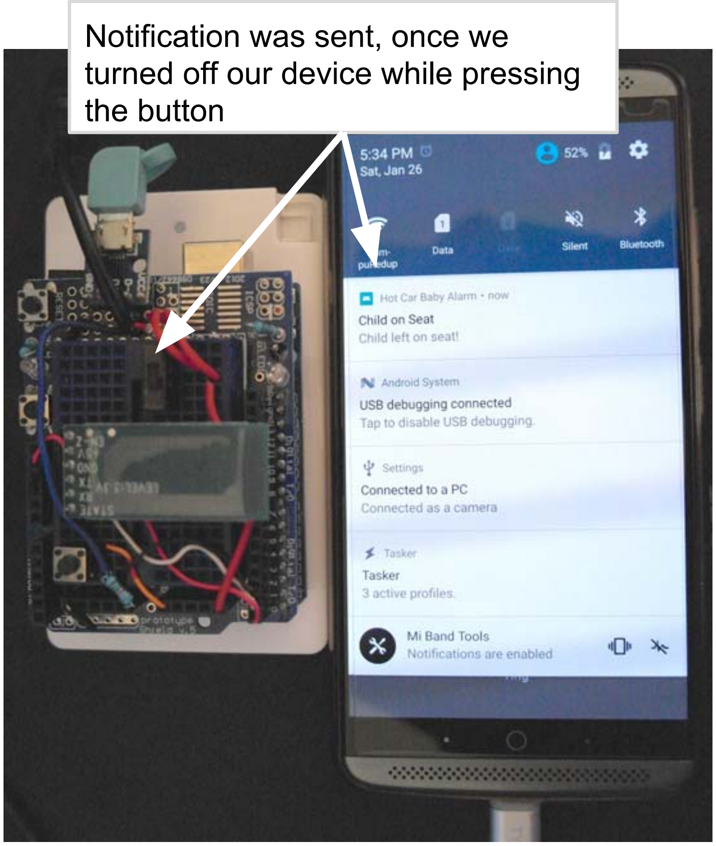
Building Phone App: Detecting Bluetooth Disconnection

- The next item we worked on was to detect Bluetooth disconnection and so that later we can send a notification to the user
- The Bluetooth Serial Library we use offers an easy way for us to do this
- We needed to register a callback function to LocalBroadcastManager for BLUETOOTH_DISCONNECTED message
- To test this, we use the same text control in our app to display “Disconnected” when our callback function is called from the previous step
    - We turned on our device and pair it with the phone
    - Then we turned off our device, and when the app detects Bluetooth the display says “Disconnected”


“Disconnected” when we turned off our device after it was connected
5:29 PM
Hot Car Baby Alarm
Disconnected

Building Phone App: Sending Notification

- The next item we worked on was to send notification to the user
- We needed to do this when Bluetooth was disconnected and the last communication from our device says that a baby is left on the seat
- Android has good documentation on how to send a notification
- Based on the documentation, we programmed the notification into our Bluetooth-disconnected-callback from our previous step
- To test this
    - We turned on our device and paired it with the phone
    - We pressed a button to simulate that a baby was on the car seat
    - While the button was pressed, we turned off our device
    - Check to see if the notification was sent

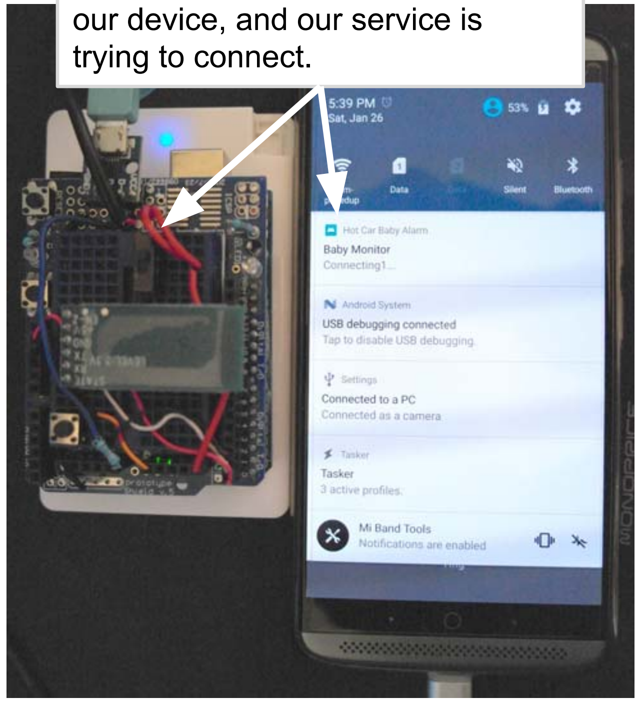

Notification was sent, once we turned off our device while pressing the button
5:34 PM
Sat, Jan 26
52%
Data
Silent
Bluetooth
Hot Car Baby Alarm • now
Child on Seat
Child left on seat!
Android System
USB debugging connected
Tap to disable USB debugging.
Settings
Connected to a PC
Connected as a camera
Tasker
Tasker
3 active profiles.
Mi Band Tools
Notifications are enabled

Phone App Problem During Testing and Solution

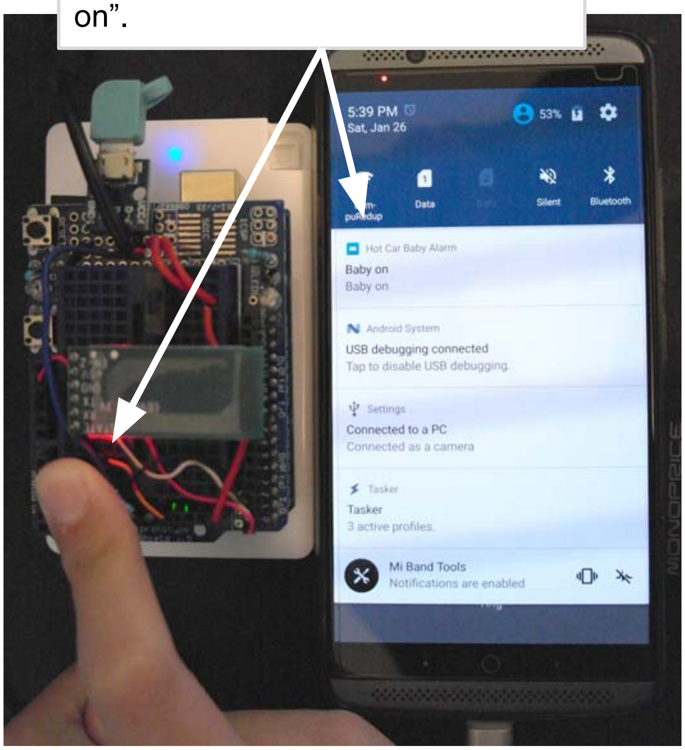
- If the user switches the app to a different one, our app ceases to run, and the user will not get the notification upon bluetooth disconnection.
- Upon research we found that to have our app keep running in the background even after the user switches apps, we needed to use Android Service.
- We reworked our app to incorporate Android Service. This took a long time since we had to learn how it works and redesign how the service will interact with our app.
- In the end we decided that it is simplest if our app is just a simple button that launches the service, and move all our existing logic into the service
- We tested the existing functionalities to make sure they still worked

Our main app is simply a button now to launch the service

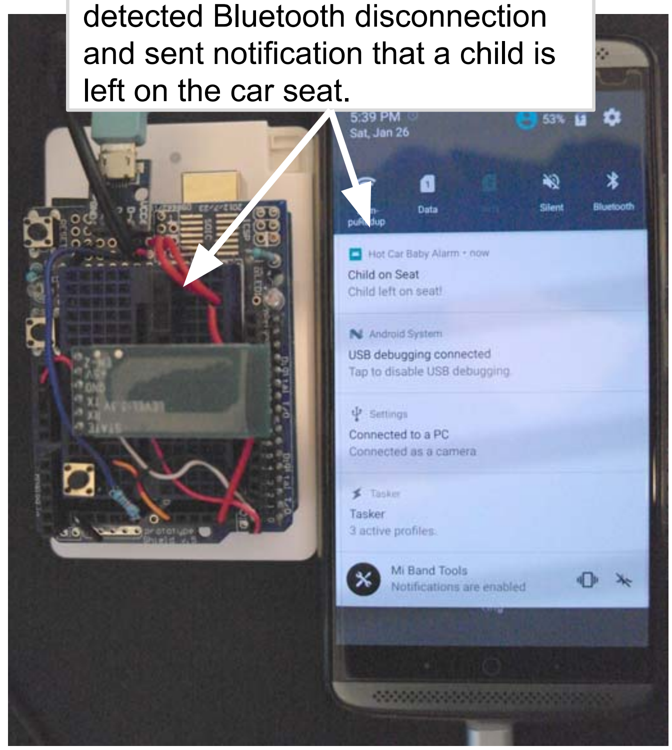
When the service is launched it uses notification to communicate its status. Here, we just turned on our device, and our service is trying to connect.



When we pressed the button, our service detects it by printing “Baby on”.



After we turned off our device while pressing the button, our service detected Bluetooth disconnection and sent notification that a child is left on the car seat.

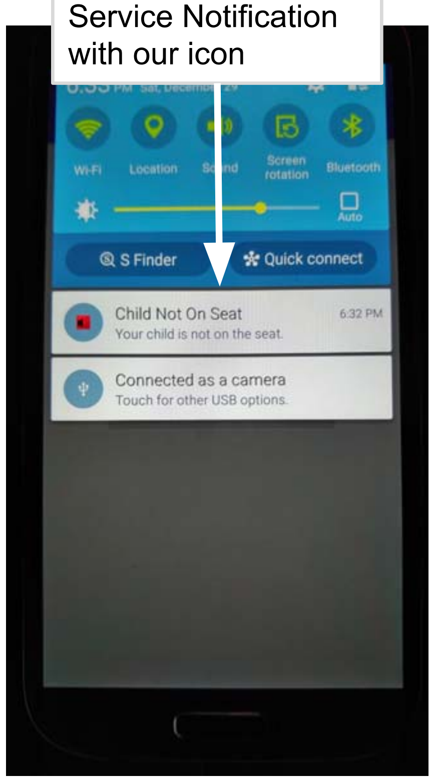


Phone App: Cleaning Up And Upload to Google Play Store

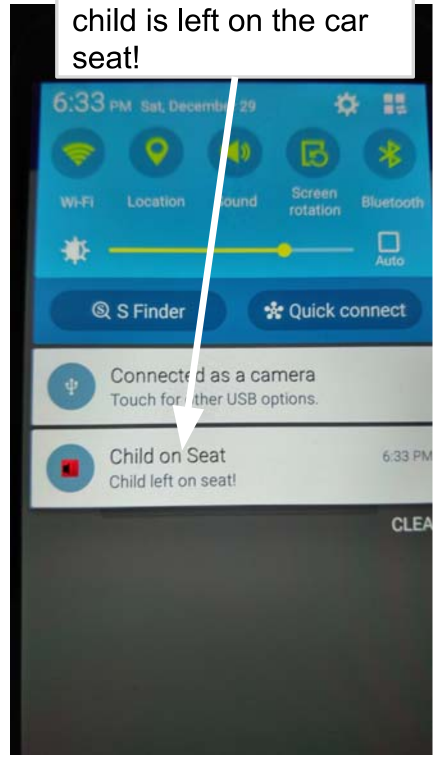
- We revisited the strings we display to the user and made them more understandable
- We also changed the icon for our app from the standard one that Android Studio generated for us initially
- We worked with our mentors to upload our app to Google Play Store, because that requires adult consent
    - This was important because it will make it easier for anybody with an Android phone able to install our app

Our main app is simply a button to launch service

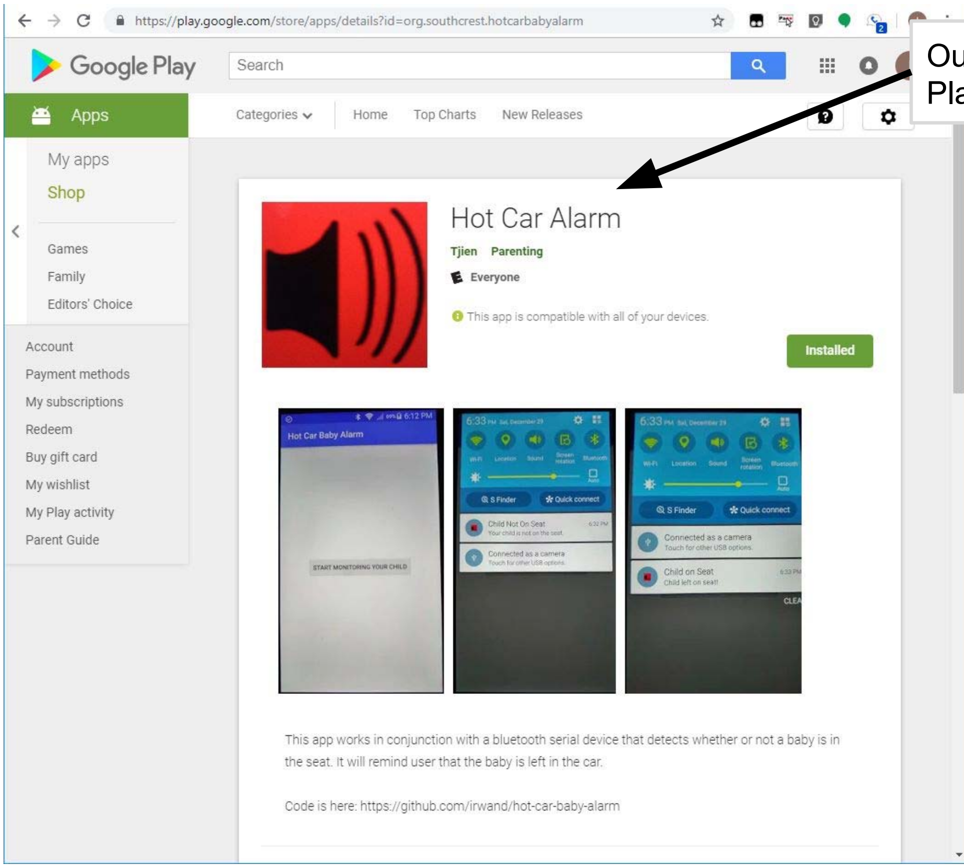
Service Notification with our icon



Notification that the child is left on the car seat!



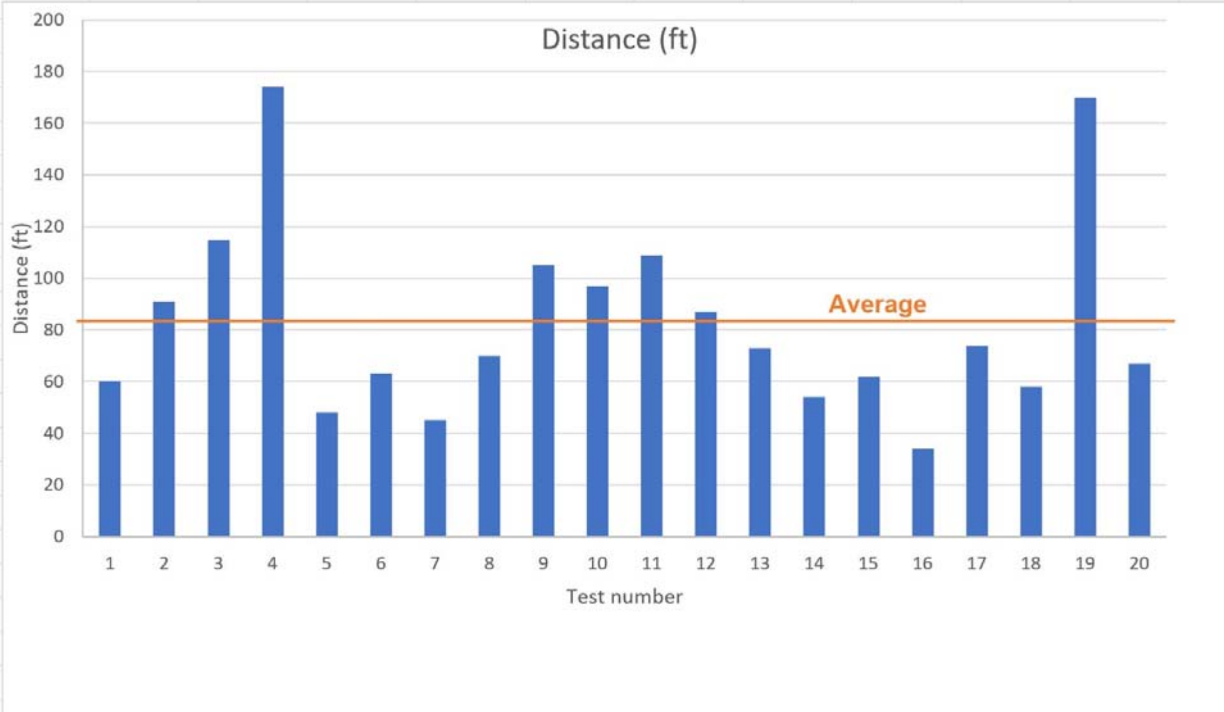
Our app in Google Play Store



System Test Procedure

- We put a car seat with the modified buckle into a car
- We buckled in a ten pound bag of rice in a car seat to simulate a baby
- We attached the buckle to our device, and turned on our device
- We paired the device to our phone and launch our app
- Launch the baby monitor service from our app and make sure it detects that a baby is in the car seat
- We walked away from the car and measure how far the phone was from the car when our app notified us that a baby was left in the car seat

Test number	Distance (ft)
1	60
2	91
3	115
4	174
5	48
6	63
7	45
8	70
9	105
10	97
11	109
12	87
13	73
14	54
15	62
16	34
17	74
18	58
19	170
20	67
Average	82.8



Distance from vehicle when app alarm goes off

Conclusion

The H.O.T. C.A.R.S. system fits our criteria and is within our constraints. The system alerts the caregiver in a timely fashion. Furthermore, Arduino systems are small, cheap, light, portable, and readily available on the market. Bluetooth connections can connect quickly. Our system will keep track of whether the baby is in the car seat or not. The test results from each component of our system individually, and in total, support a functioning system, and notifies us in a timely fashion if a child is still in the car seat.

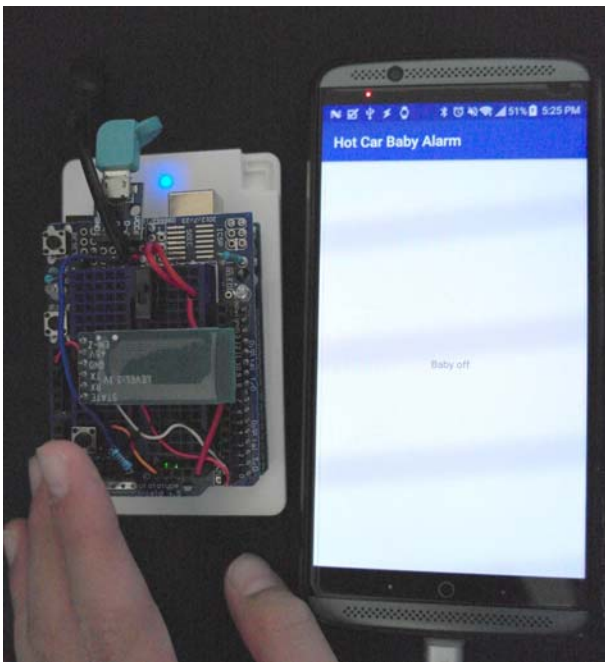
In building the prototype, we learned that there were multiple ways to solve each obstacle we came upon. However, working together as a team, we were able to brainstorm and pick solutions that best suited our criteria. The prototype gave us a very strong platform to start our project and resulted in a working device.

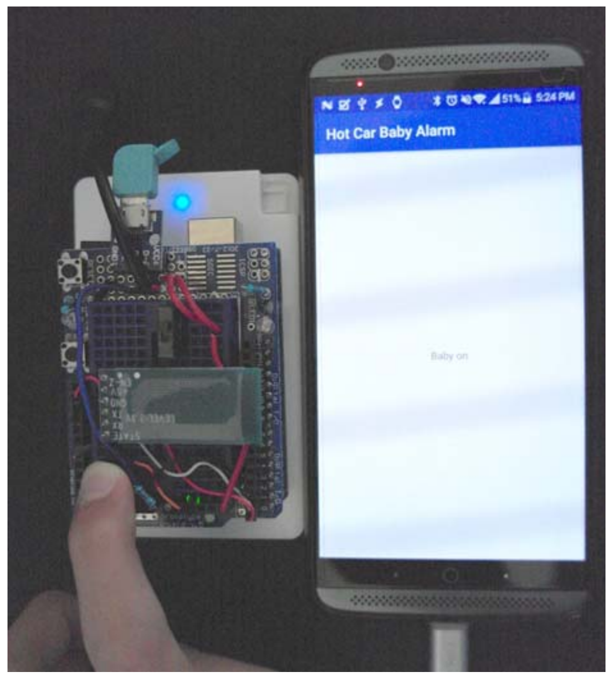
In addition, we gained knowledge of multiple disciplines - electrical engineering, mobile developer, car seat manufacturers, automobile manufacturers, legislature, and lobby groups.
Approximately 700 children have died in this manner in the past 10 years - approximately 1 child every 8-9 days. The loss of life of the youngest, most innocent members of our society, and the waste of their full potential, makes this a device that could significantly lessen the tragedy, very worthwhile of our efforts.

H.O.T. C.A.R.S.

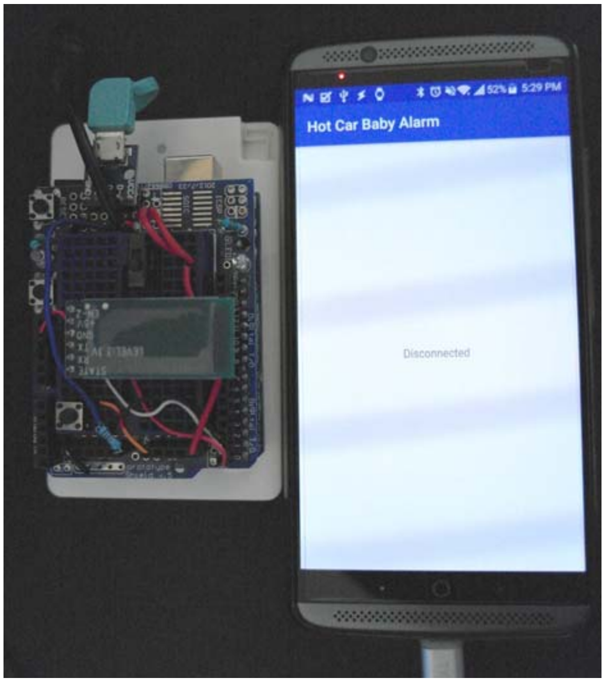
App development of our app called “Hot Car Baby Alarm”.

We started the app by deciding that we are going to use the android studio because it is cheaper than becoming a designer in Apple. We then went through the tutorial of how to use Android Studio. We found a library for serial communication to help us to connect to the device so that we don’t have to make it ourselves. Lastly for the serial communication, we got it working so that it could show this:

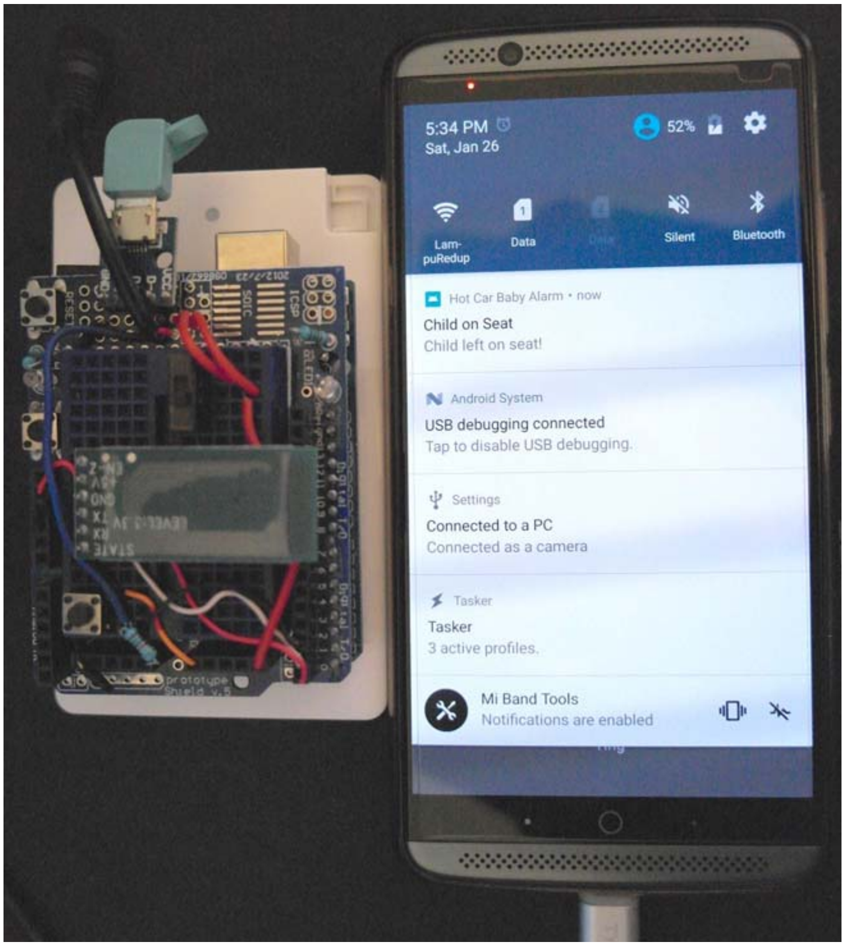




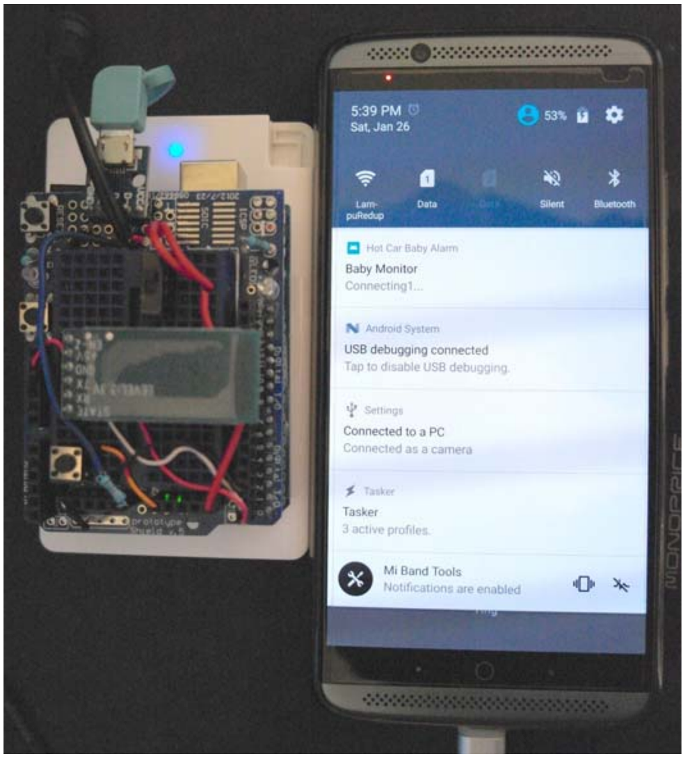
We needed to use the disconnection as a cue to when to send the notification, so we did the disconnection sensing next. Using a prebuilt message that is “BLUETOOTH_DISCONNECTED.” When we got this message, we would say on our app “disconnected.”



When we got the disconnection message, the notification was easy. All that we had to do was send a notification when the disconnection message popped up. Our notification looked like this:



We needed to keep our app functionality working, so we built the service that is required, then tested again to make sure that everything still worked. Our service looks like this:



Because of the new service, we had to make our app simply a button to launch the service. This is what it looks like:

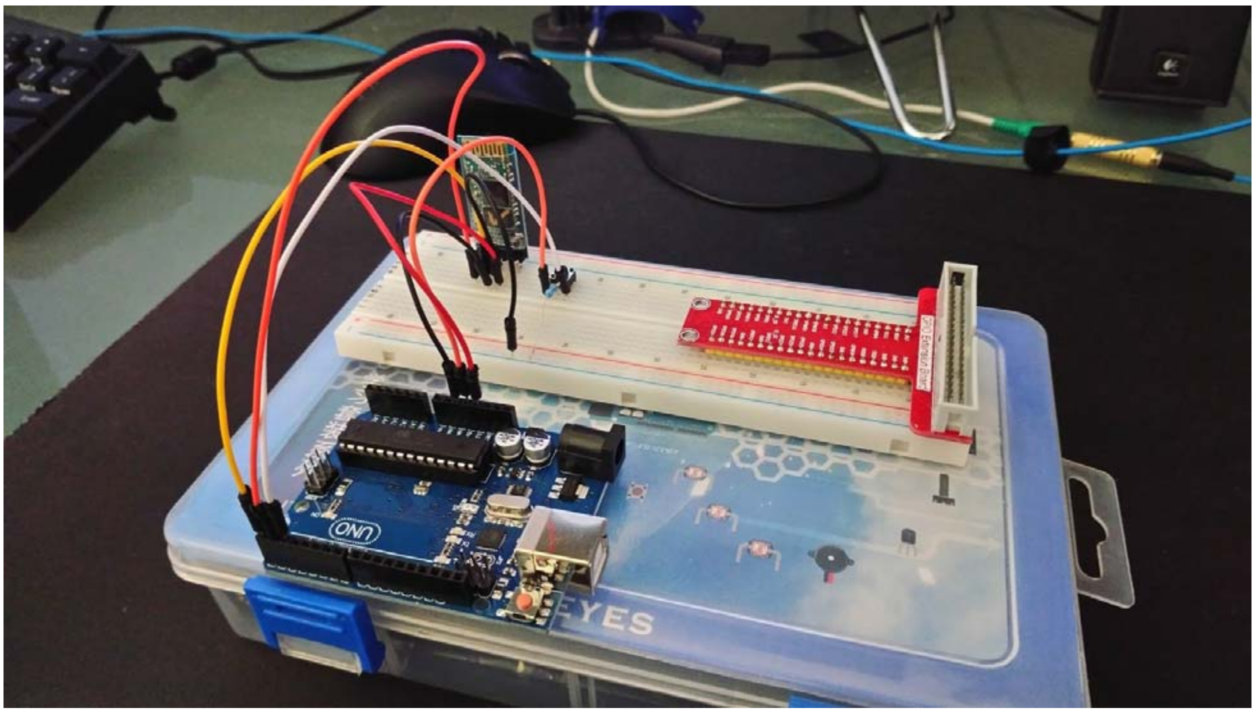
We tweaked the app so that the app can work with phones of Android API 8.0 and above, then ended up here.

Device Development

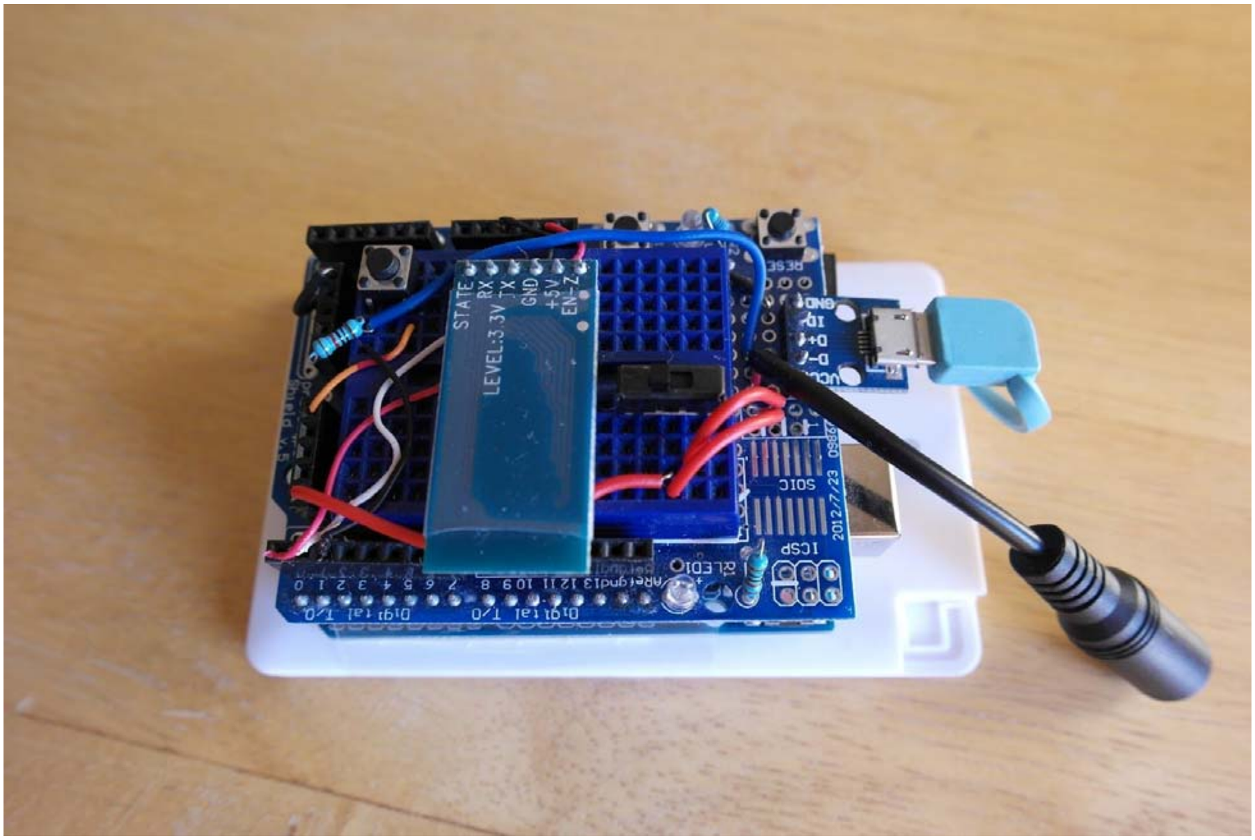
This is how we developed our device

We started with connecting a button to a bluetooth serial module known as HC-05, then programming the arduino to send a different signal when the button was pressed down or not. We then compacted the device by buying an arduino shield to put on the top of the arduino, and rewired the device to fit a small seat.

From this:



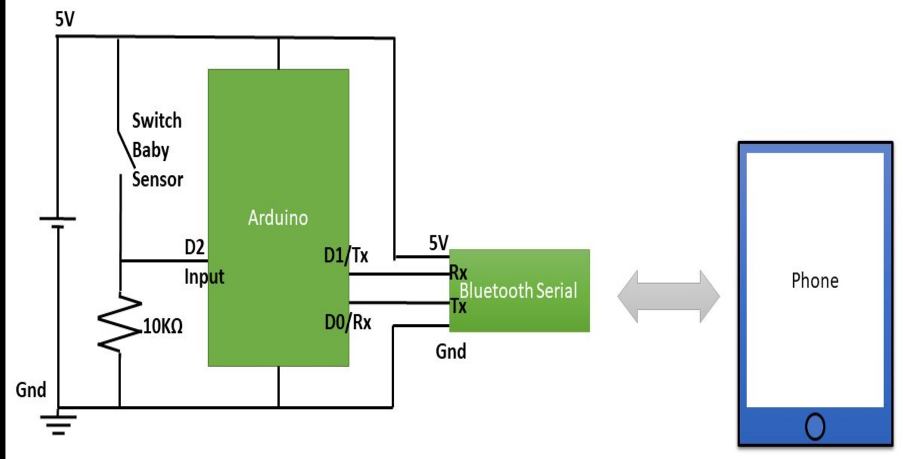
To this:


STATE
RX
TX
GND
+5V
EN-Z
LEVEL:3.3V
SOIC
ICSP
2012/7/23

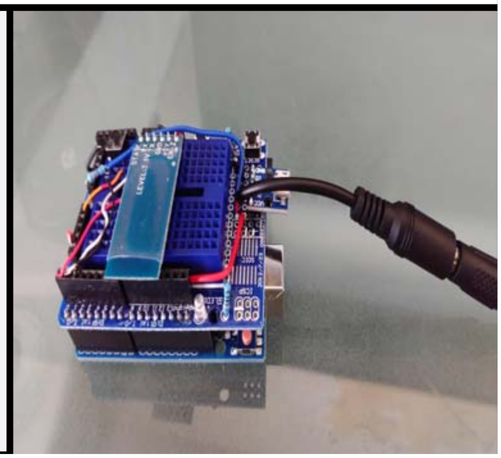
H.O.T.C.A.R.S. Photo Essay

H.O.T.C.A.R.S. • Jan/11/19

Here, we are learning the basics of how to build the prototype of our device.

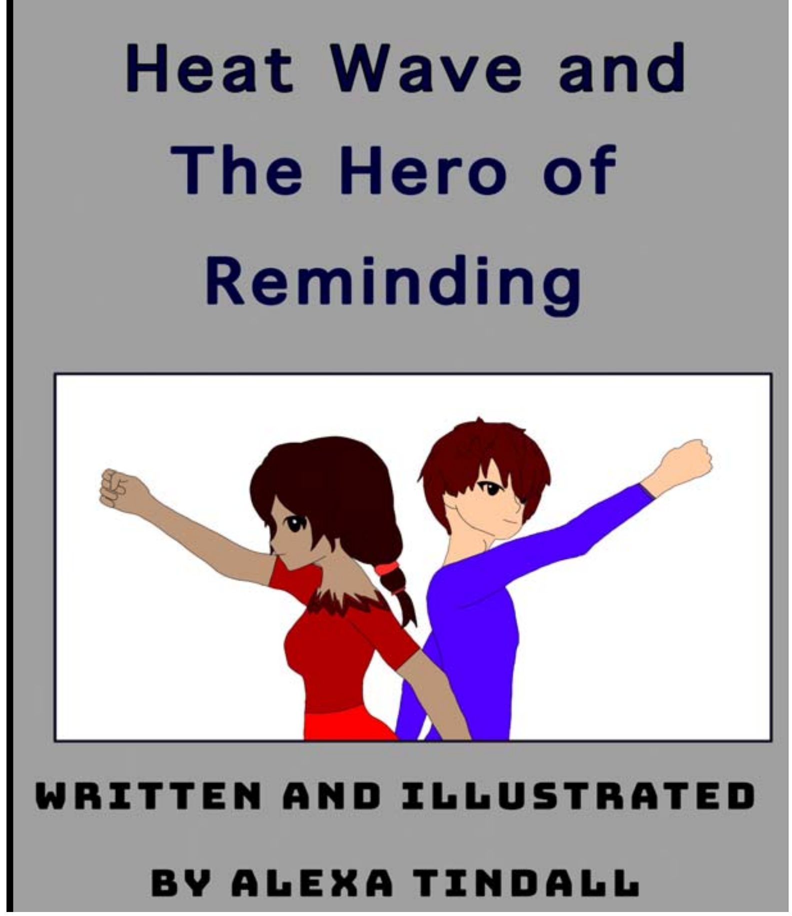


The device works by having two pieces of metal that connect in the baby's buckle. When connected, a circuit forms from the 5v to the input (d2) and that sends a signal to the bluetooth serial module to send the message to the phone that the child is in the car. If the baby is not strapped in, the sensor will not function, therefore not sending the signal to the phone. When the phone and device disconnect, the app checks if the last state of the "switch" was that the baby is in the car, and if it is, send a notification to the user and kill the app.



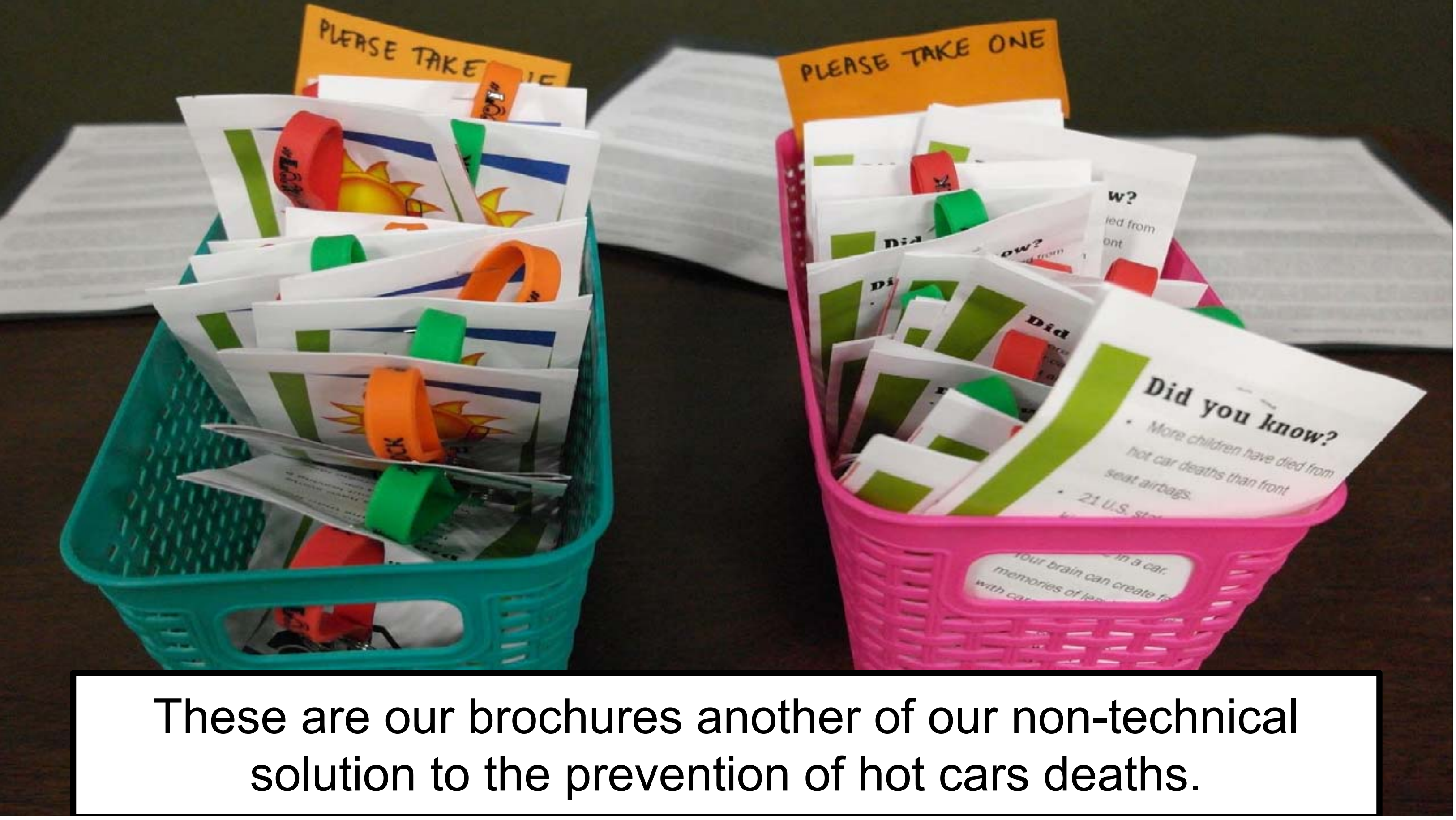
This is a picture after our interview with a Texas Tech student. He has made one of few solutions for hot car deaths.

This is one of our non-technical solutions. This is a comic that can inform about hot car deaths.



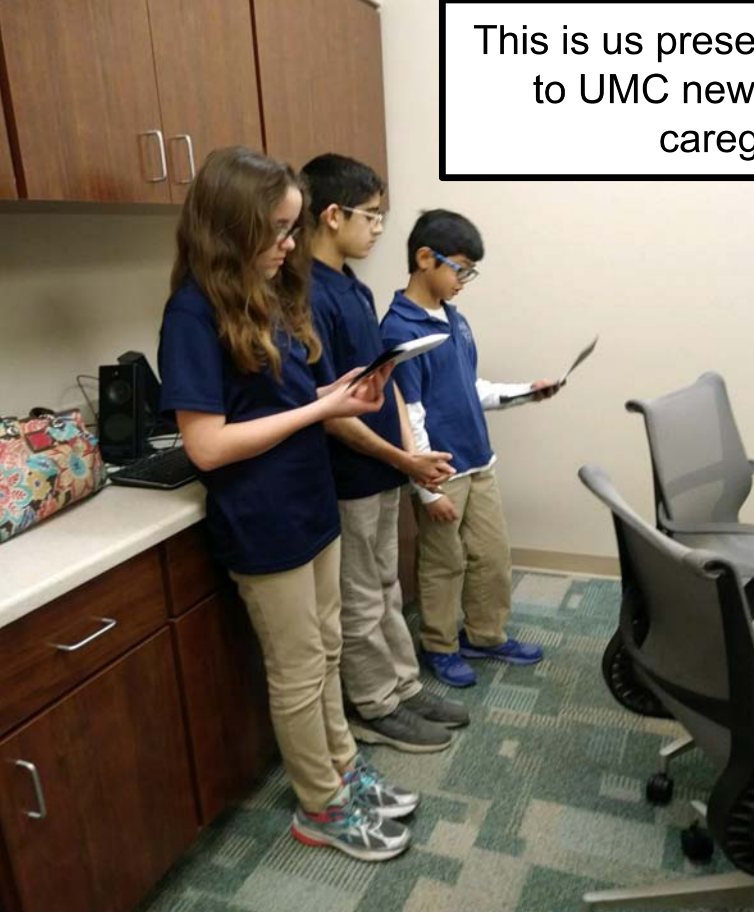
This is when we took apart a carseat to make the “switch.”

This is our first presentation to young adults about hot cars.



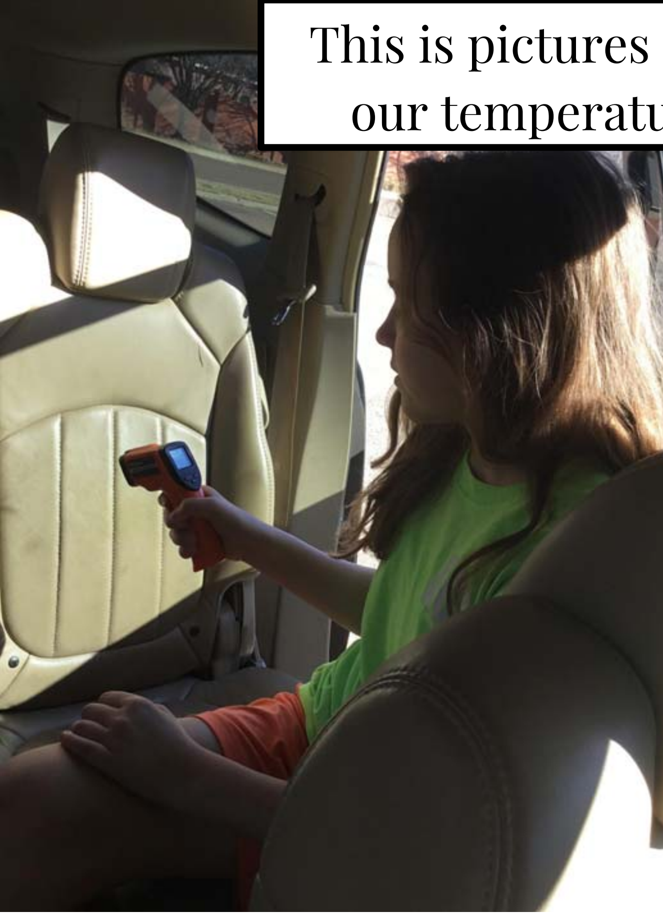
These are our brochures another of our non-technical solution to the prevention of hot cars deaths.

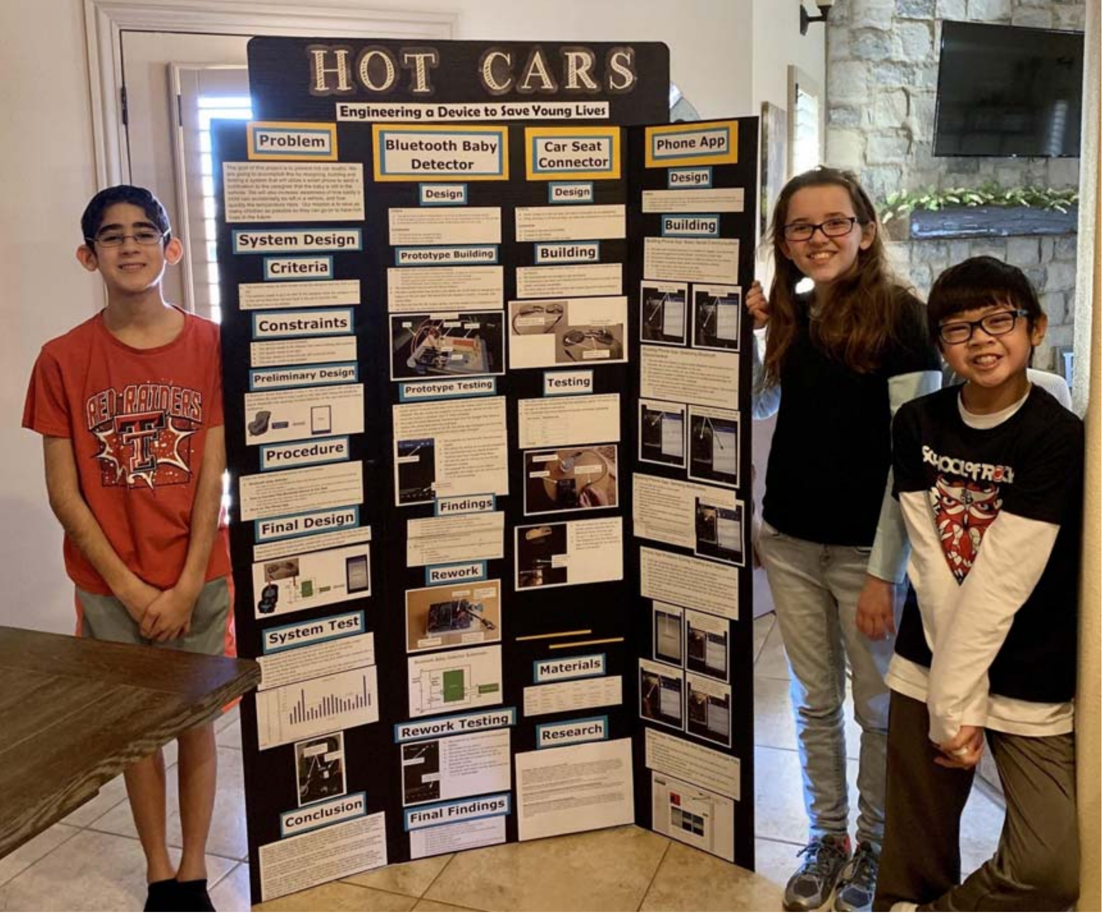
This is us presenting our device to UMC newborn nursery caregivers.



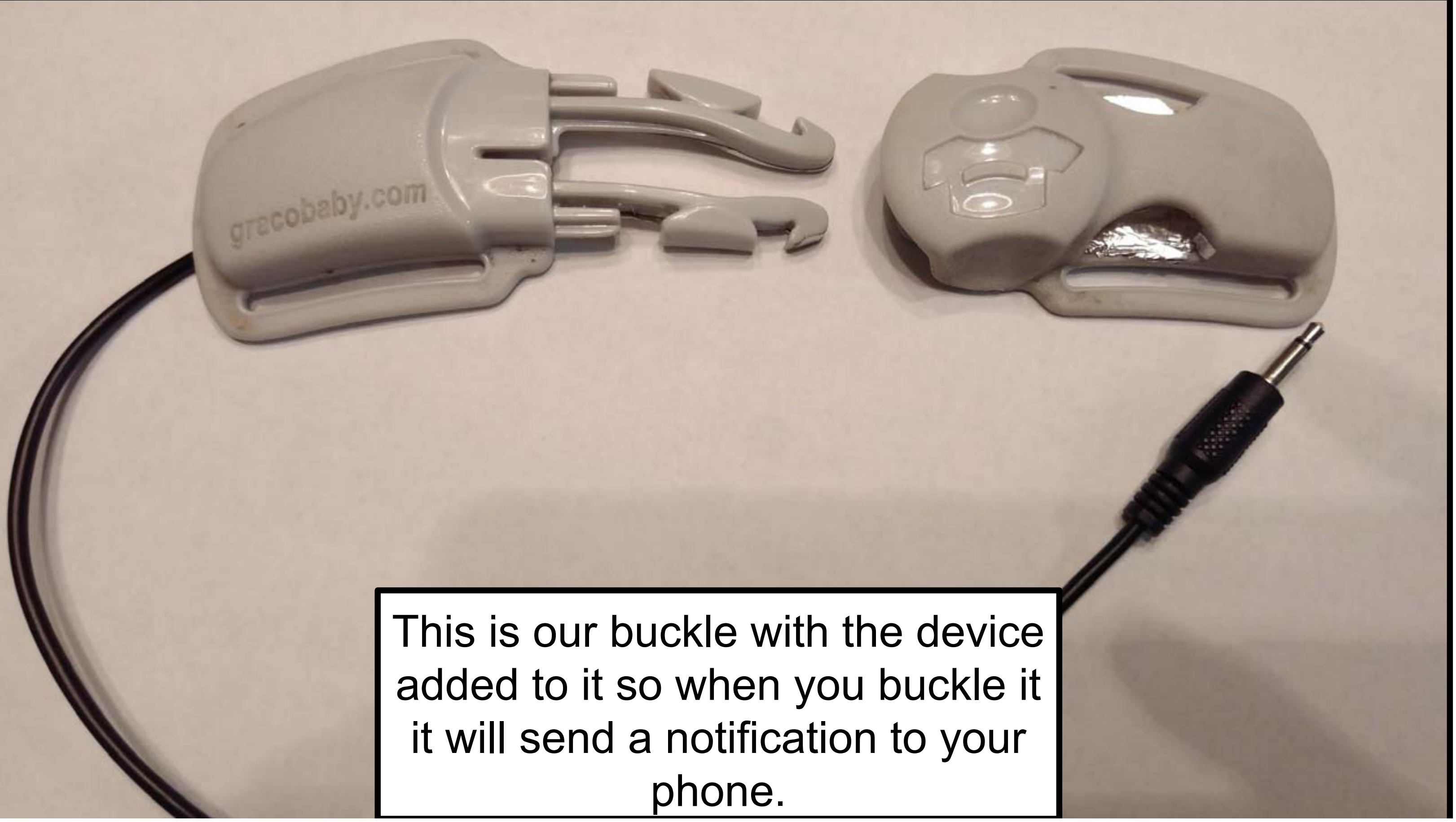
This is our presentation with Josslyn, Dr.Pinkney's friend, on our device to save children.

This is pictures of us conducting our temperature experiment





This is our board on hot car deaths holding everything from our research to our device coding and building.



This is our buckle with the device added to it so when you buckle it it will send a notification to your phone.

This is us going around to daycares in and around Lubbock and Wolfforth and handing out our brochures and key chains to give out to parents

This is our interview on KCBD channel 11 news explaining our device to our community.

Start Monitoring Your Child!

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H.O.T. C.A.R.S.

A 6TH Grade Science and Engineering Team
eCYBERMISSION 2018-2019

Problem

The goal of this project is to prevent hot car deaths. We are going to accomplish this by designing, building and testing a system that will utilize a smart phone to send a notification to the caregiver that the baby is still in the vehicle. We will also increase awareness of how easily a child can accidentally be left in a vehicle, and how quickly the temperature rises. Our mission is to save as many children as possible so they can go on to have rich lives in the future.

System Design Criteria

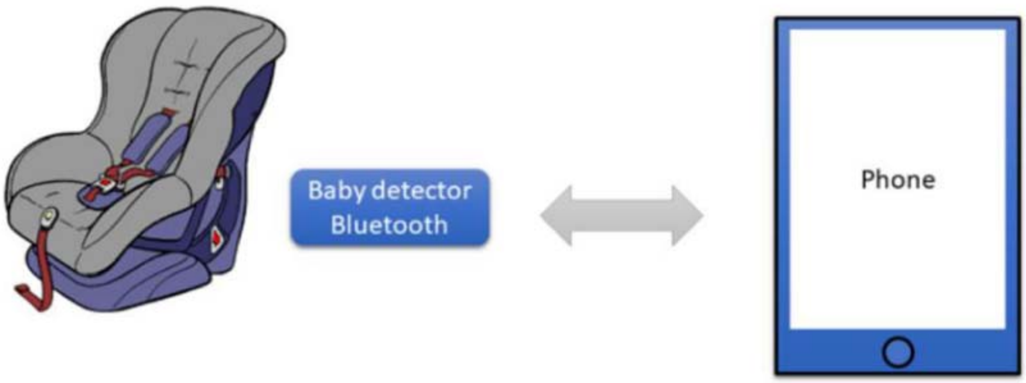
We'll need to have some form of alerting system and a receiver for the alert. We'll also need a way to inform about this problem. We need to make sure the alert happens before there is even a chance of the child dying.

System Design Constraints

The device needs to send an alert that will only be received by the parent or guardian or caregiver. The alerting device needs to be somewhat small to fit in an easy to use place. The alert needs to be sent very soon after the child is left in the car. We need to make the solution inexpensive to ensure people can afford it and will use it.

Preliminary Design

A Bluetooth device that detects a baby in the car seat, paired with a phone app that notifies the user that a baby is left on the seat upon losing the Bluetooth signal. Bluetooth only operates in short distances, so the

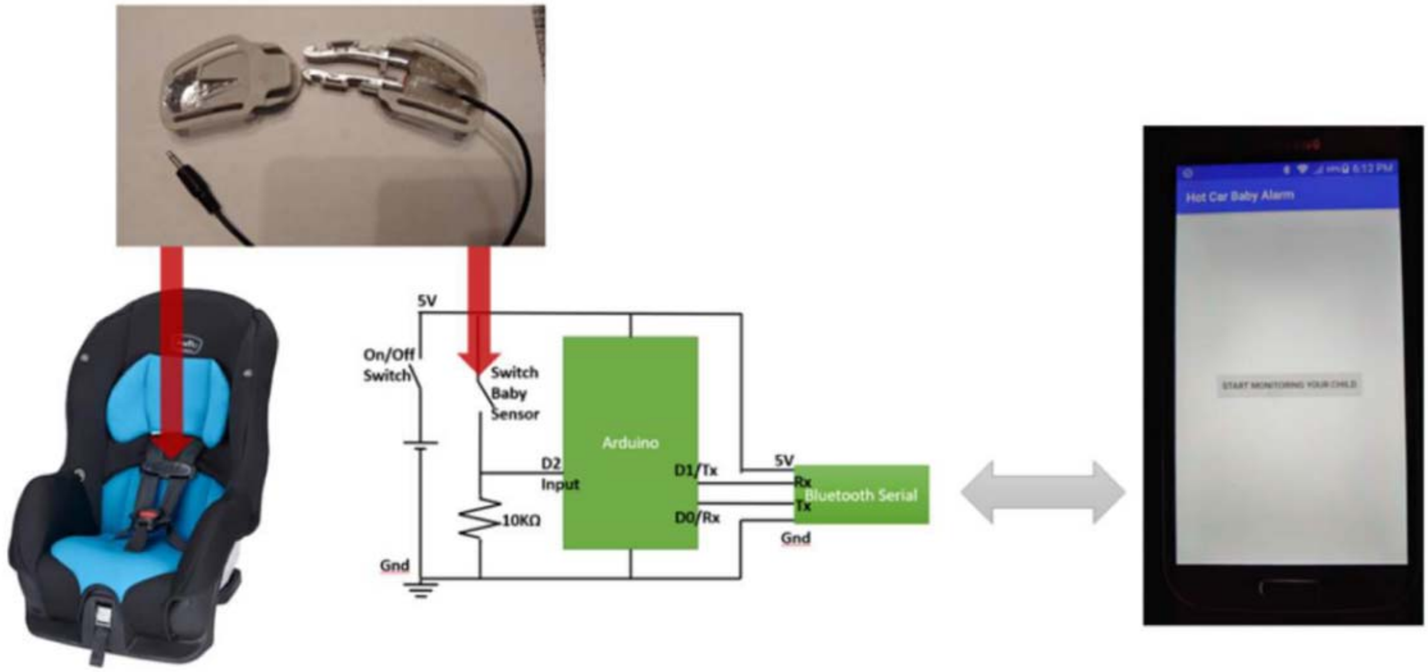


Final Design

A Bluetooth device using Arduino system that detects a baby in the car seat by detecting a coupled chest buckle, paired with a phone app that notifies the user that a baby is left on the seat upon losing the Bluetooth signal.

Materials

10 lb bag of rice	Arduino breadboard shield	Cars	Internet	Solder	USB battery
Android Smart Phone	Bluetooth serial HC-05	Computers	Key chain	Soldering Iron	Weebly.com
Android Studio	Breadboard	Git	Mono audio jack	Survey Monkey	Wires
Aluminum tape	Brochures	Github	Resistor 10K	Thermometer	Ibis Paint
Arduino	Button Switch	Glue gun	Screwdriver	USB cable	Stylus
Arduino software	Car seat	Google play store	Slide switch	USB charger	IPad


5V
On/Off
Switch
Switch
Baby
Sensor
Arduino
D2
Input
10KΩ
Gnd
D1/Tx
D0/Rx
5V
Rx
Tx
Bluetooth Serial
Gnd
Hot Car Baby Alarm
START MONITORING YOUR CHILD


Buckle, connected to our bluetooth device
Phone running our app

Step-by-step Procedure

There are three different components we need to make:

- **Bluetooth baby detector**
  - We need to work on the Bluetooth device first because it is the most risky and complicated part of the whole solution
  - We know the only input is whether a baby is on the seat, so it needs to detect an on/off state
- **How to Connect The Bluetooth Device to Car Seat**
  - This part was the next unknown. We need to solve the problem of detecting a baby on the car seat and send that information to the device.
- **Work on The Phone App**
  - This was the last piece because it was not that risky. We know this can be done based on the phone capability, we just need to learn how to program it.

Bluetooth Baby Detector Design

Criteria

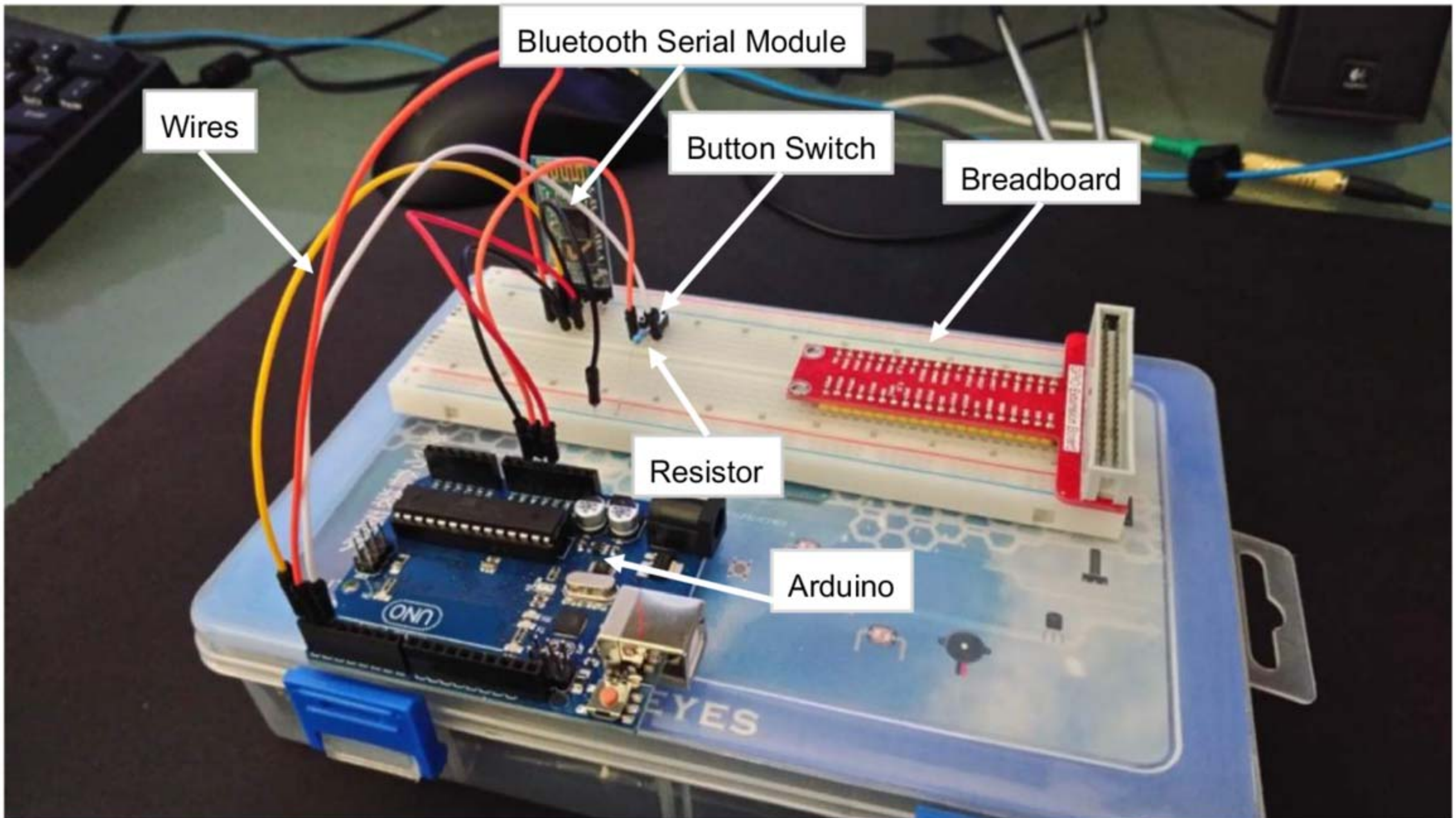
- The device must be able to communicate to a phone via Bluetooth in a timely manner
- It must be able to detect if a button is on or off so we can recognized if a baby is in the car seat
- It must have on/off switch so we can power off the device when it is not in use

Constraints

The device needs to send an alert that will only be received by the parent or guardian or caregiver.
The alerting device needs to be somewhat small to fit in an easy to use place.
The alert needs to be sent very soon after the child is left in the car. We need to make the solution inexpensive to ensure people can afford it and will use it.

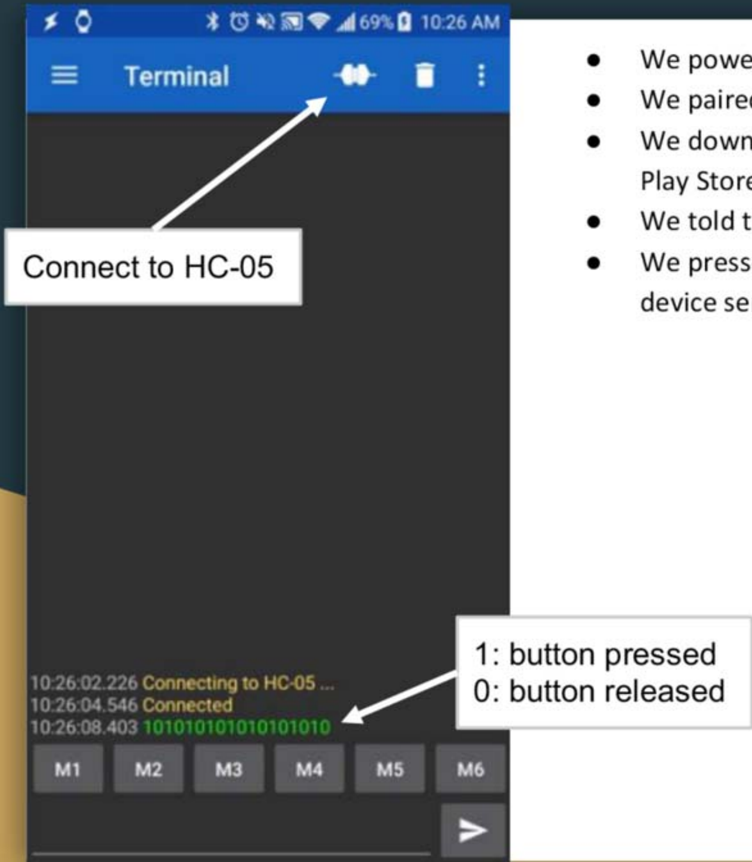
Prototype Building: Bluetooth Baby Detector

- We started with Arduino platform because:
    - Arduino is a popular small computer for hobbyists, so there are lots of internet resources
    - Bluetooth communication to a phone will require a small computer
    - Arduino supports serial communication, a common communication protocol
    - We found Bluetooth serial module for Arduino, called HC-05
- We researched how to wire HC-05 to Arduino
- We then researched how Arduino can detect an on/off state to recognize if the baby is in the car seat. We found that we needed a resistor, a switch, and some wires.
- We then put the HC-05, button switch, and the resistor on a breadboard and we wired them up according to our research above.


Bluetooth Serial Module
Wires
Button Switch
Breadboard
Resistor
Arduino
UNO
EYES

Testing Prototype

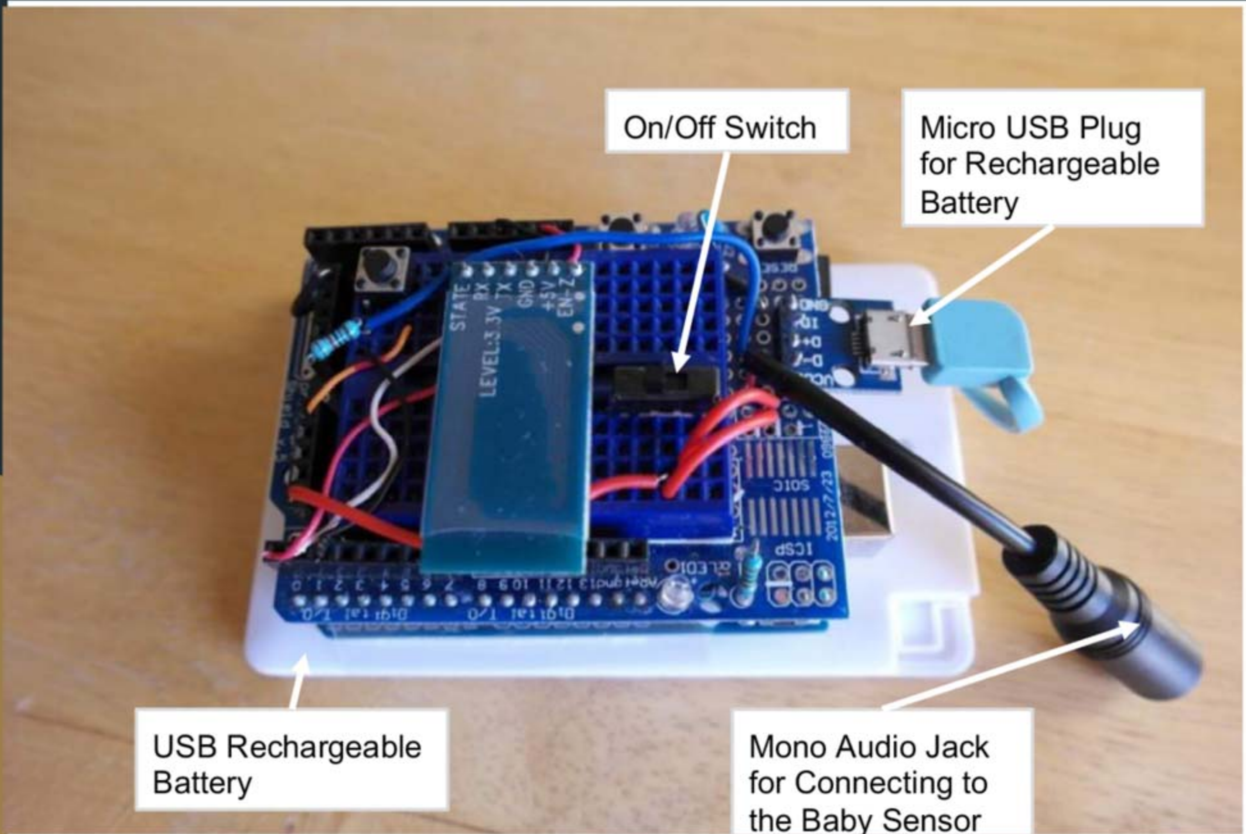
- We downloaded a sample program from our research to Arduino to detect the button switch. It sends serial data every time the button switch is pressed or released. We did modify the program to fit our needs, where we only send “1” when the button is pressed, and “0” when released.
- We used the Serial Bluetooth Terminal app from the Google Play Store to receive the serial data from our prototype
- Once we paired the phone to HC-05, the phone got messages we sent from our Arduino program, everytime the button state changed



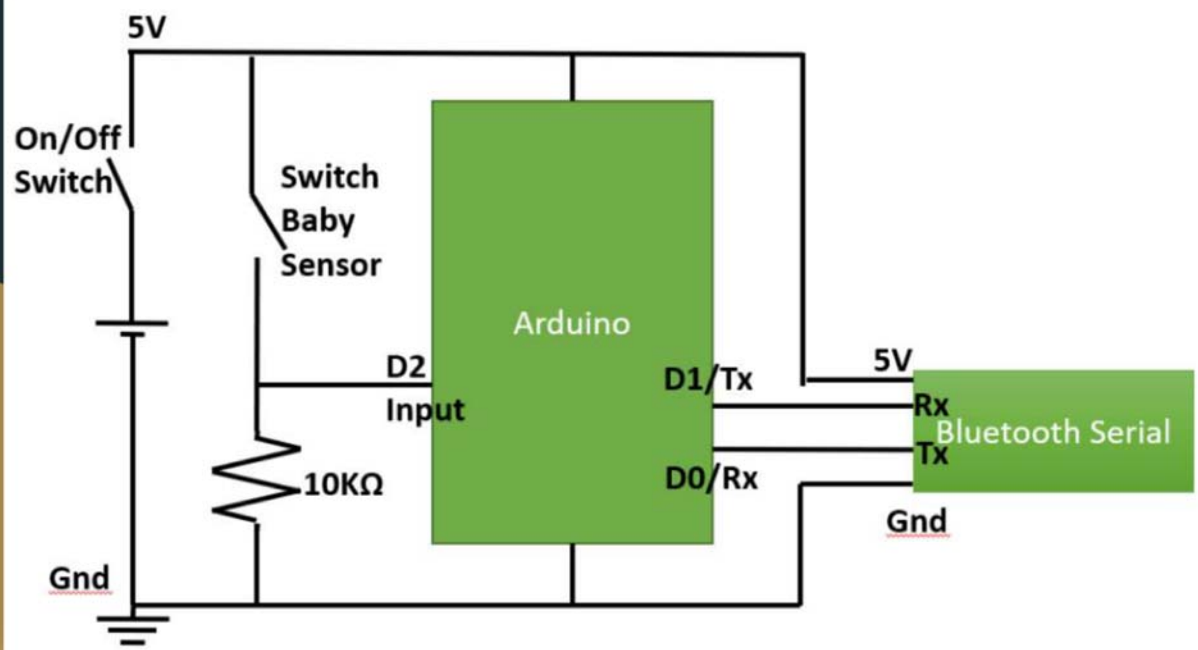
- We powered our device with Arduino power supply
- We paired the device to our phone’s bluetooth
- We downloaded and ran Serial Bluetooth Terminal app from Google Play Store
- We told the app to connect to our HC-05 Bluetooth module
- We pressed the button on our device repeatedly and made sure the device sent the “1” or “0” appropriately

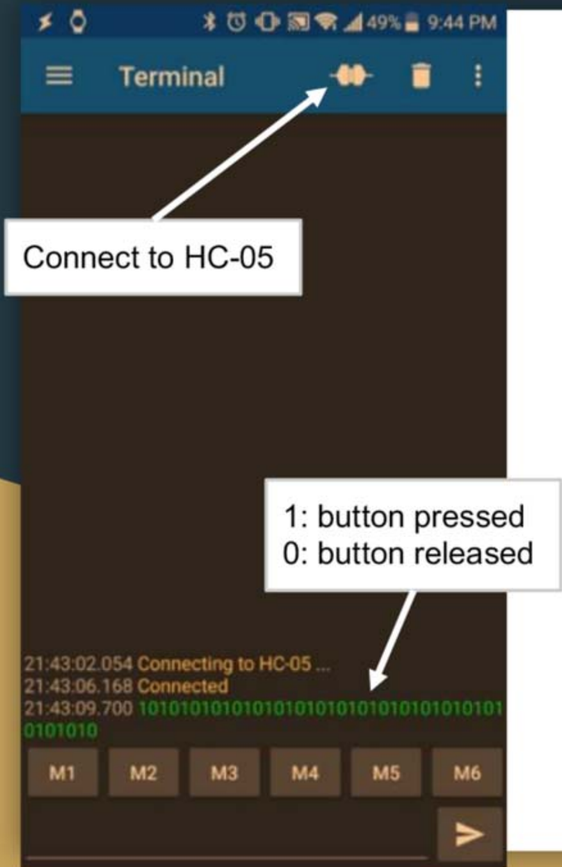
Findings and Rework

- Our bluetooth baby detector is working
    - We moved the circuit to an Arduino breadboard shield to make it more compact
    - We also added:
        - on/off switch
        - a rechargeable battery
        - a mono audio jack, in parallel with our button, to connect to the car seat.


On/Off Switch
Micro USB Plug for Rechargeable Battery
USB Rechargeable Battery
Mono Audio Jack for Connecting to the Baby Sensor

Bluetooth Baby Detector Schematic





- We powered our device with the rechargeable battery
- We turned on our device
- We paired the device to our phone’s bluetooth
- We ran Serial Bluetooth Terminal app
- We told the app to connect to our HC-05 Bluetooth module
- We pressed the button on our device repeatedly and made sure the device sent the “1” or “0” appropriately

Findings

- Our bluetooth baby detector is working

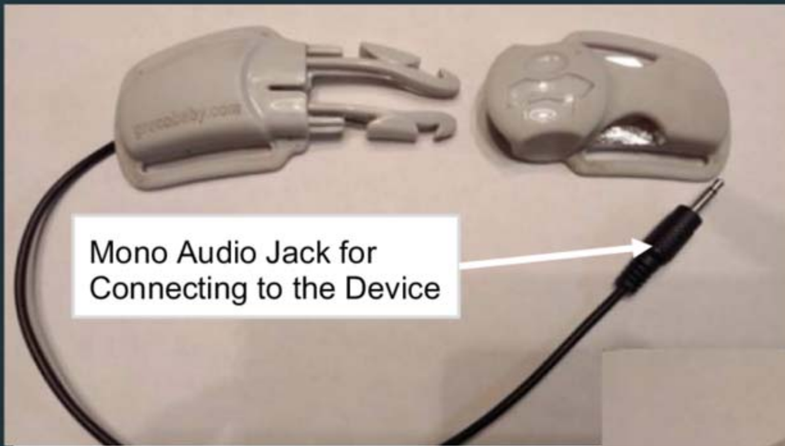
Designing How to Connect The Bluetooth Device to A Car Seat

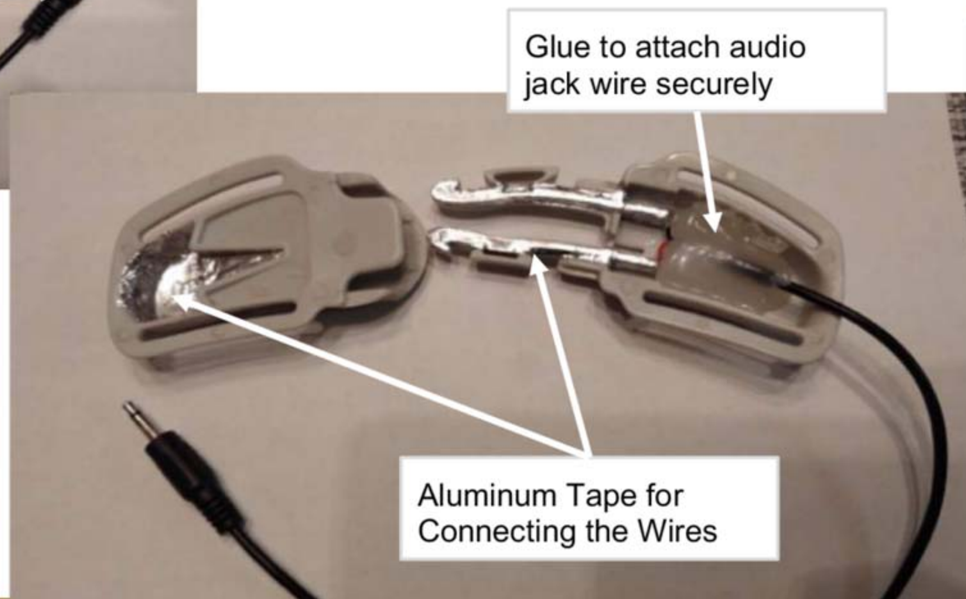
Criteria

- When a baby is in the car seat, we need a connection to be established
- When the baby is off the car seat, we need the connection to be disconnected

Building The Connection of The Bluetooth Device And Car Seat

- We considered a weight-based detector, however cost and complexity were prohibitive
- We brainstormed and decided to use the buckle
- We looked at a car seat, and noticed that the chest buckle is usually simple plastic and easily accessible
- We were able to modify the buckle with simple aluminum tape creating a connection between two wires

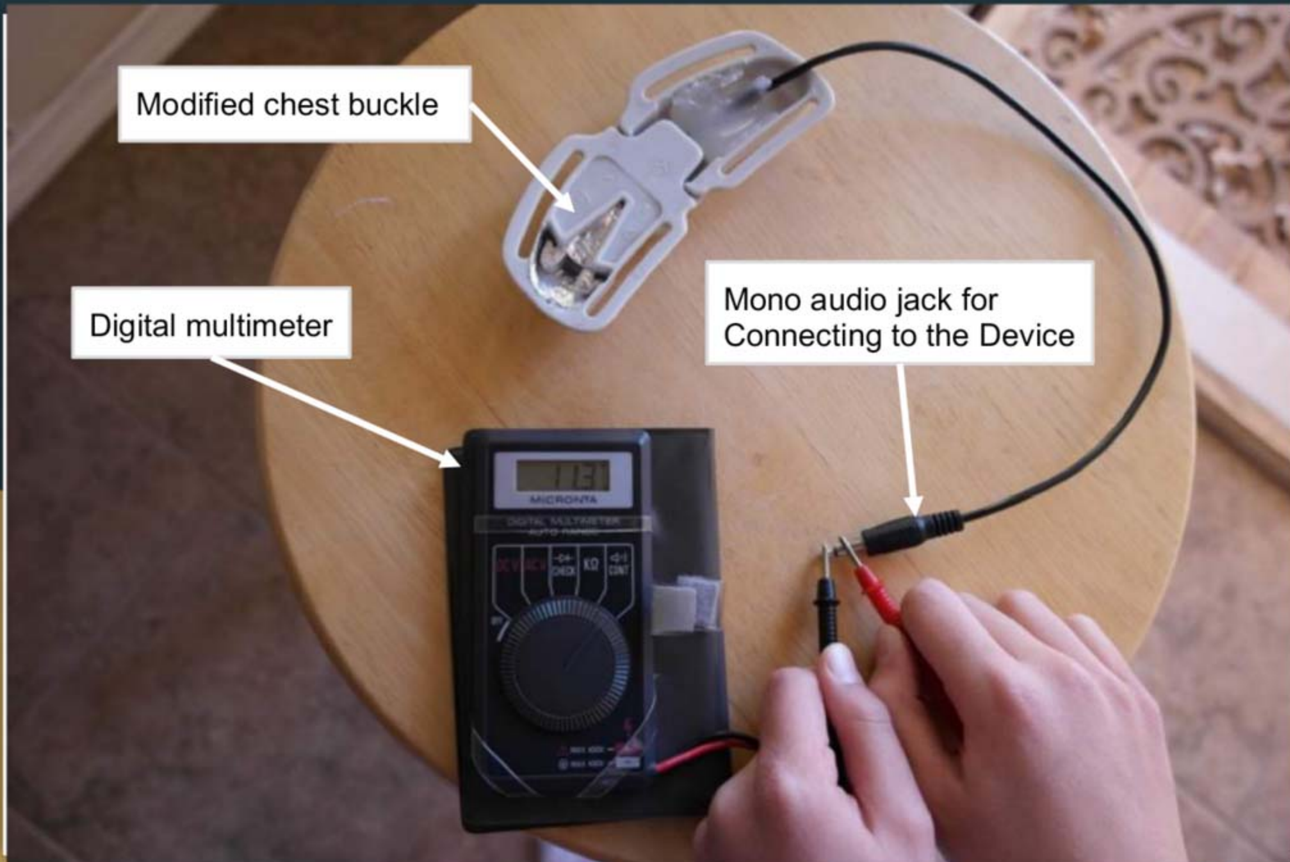

Mono Audio Jack for
Connecting to the Device

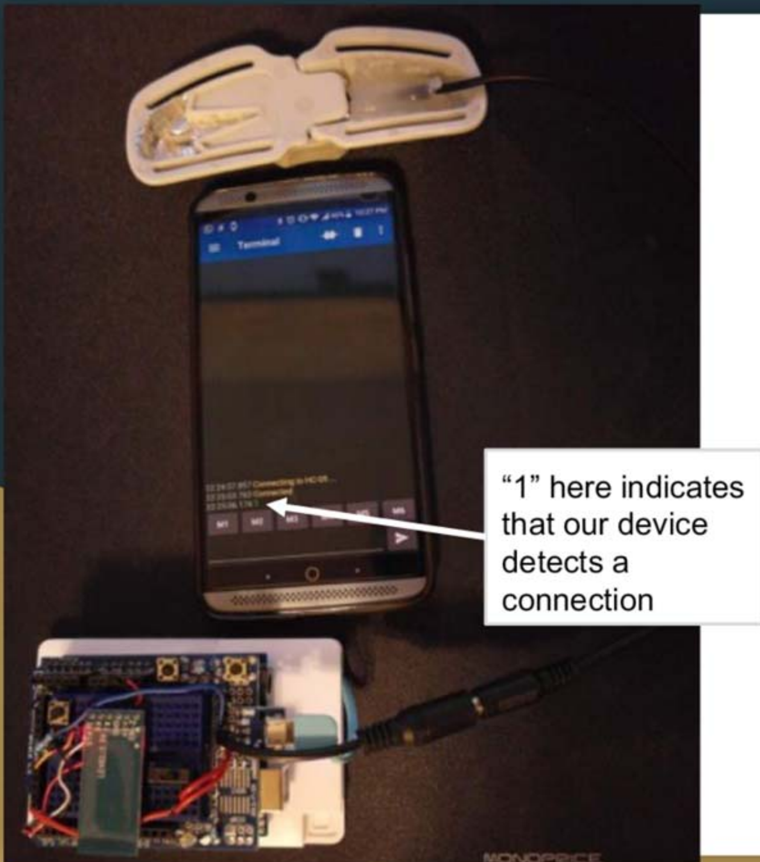

Glue to attach audio
jack wire securely
Aluminum Tape for
Connecting the Wires

Testing The Connection Mechanism

- We used a digital multimeter to test the connection via the aluminum tape
- We found that the connection has low resistance, about 11Ω which is low enough to indicate a connection
- We connected and disconnected the buckle and tested repeatedly

Test number	**Resistance (**
1	11.3
2	12.1
3	9.1
4	10.5
Average	10.75

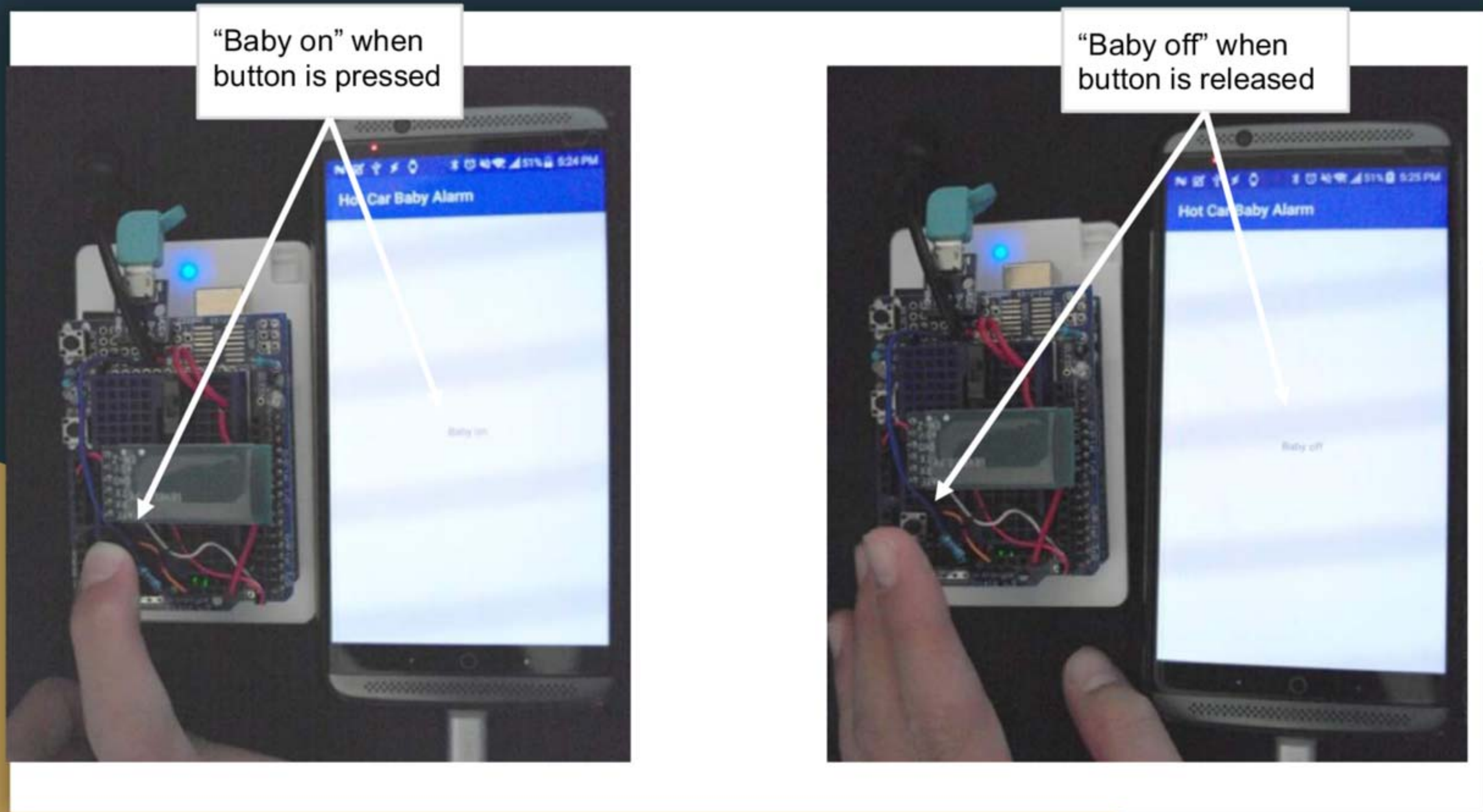

Modified chest buckle
Digital multimeter
Mono audio jack for
Connecting to the Device



- We also tested the device and the buckle system together with the Bluetooth Serial Terminal app
- We got "1" sent by our device
- The resistance from the aluminum tape is low enough for our device to detect a connection

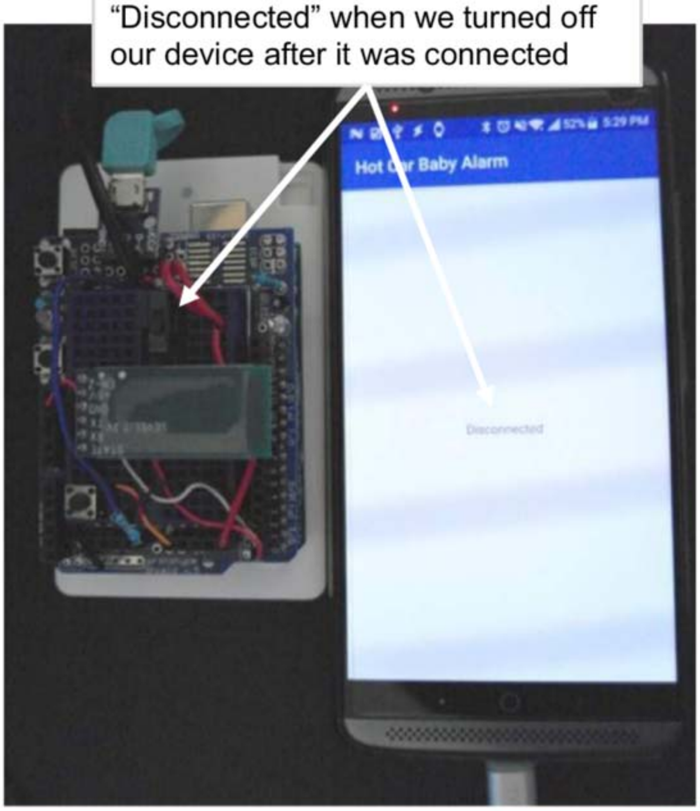
Building Phone App: Basic Serial Communication

- We went with Android because it is cheaper to register as a developer
- We went through the Android Studio Tutorial on a basic app
- We found a Bluetooth Serial library to help us connect to our device
- We worked on getting basic serial communication working
- To test it, we use a text control in our app
  - We turned on our device and pair it with the phone
  - Every time we get a “1” from the device, we changed a text in our app to “Baby on”
  - When we get a “0”, we changed the text to “Baby off”


"Baby on" when button is pressed
"Baby off" when button is released

Building Phone App: Detecting Bluetooth Disconnection

- The next item we worked on was to detect Bluetooth disconnection and so that later we can send a notification to the user
- The Bluetooth Serial Library we use offers an easy way for us to do this
- We needed to register a callback function to LocalBroadcastManager for BLUETOOTH_DISCONNECTED message
- To test this, we use the same text control in our app to display "Disconnected" when our callback function is called from the previous step
  - We turned on our device and pair it with the phone
  - Then we turned off our device, and when the app detects Bluetooth the display says "Disconnected"


“Disconnected” when we turned off our device after it was connected
Hot Car Baby Alarm
Disconnected

Building Phone App: Sending Notification

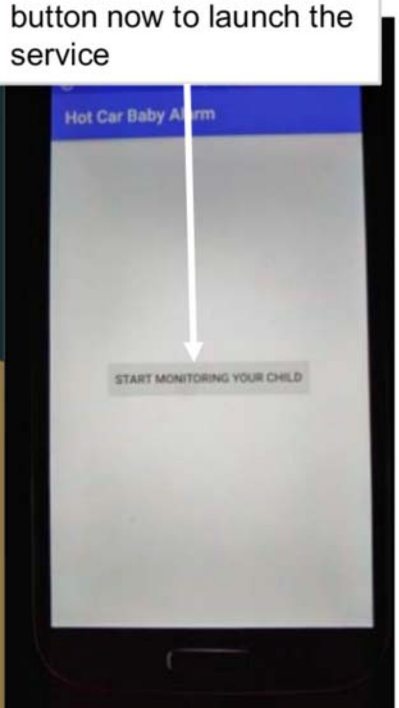
- The next item we worked on was to send notification to the user
- We needed to do this when Bluetooth was disconnected and the last communication from our device says that a baby is left on the seat
- Android has good documentation on how to send a notification
- Based on the documentation, we programmed the notification into our Bluetooth-disconnected-callback from our previous step

Notification was sent, once we turned off our device while pressing the button

Phone App Problem During Testing and Solution

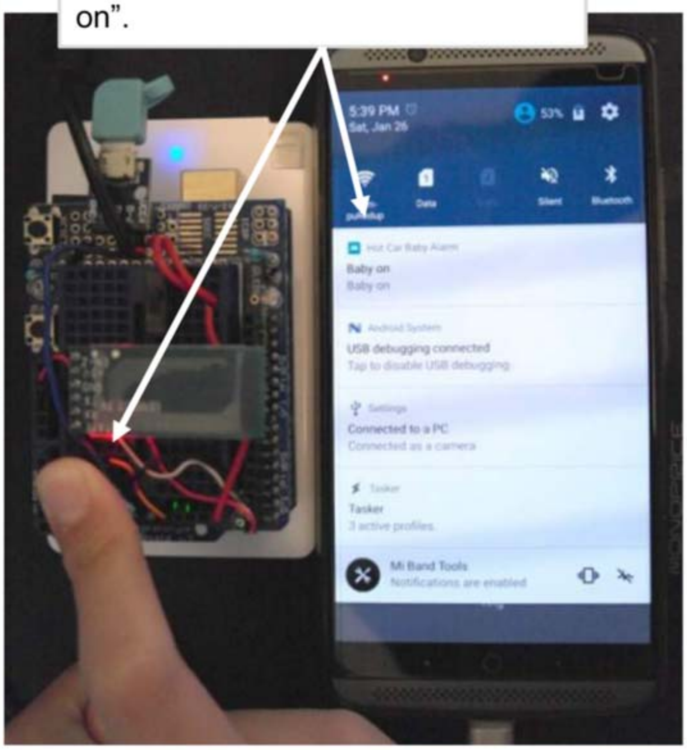
- BapcWroWhotdbScWbpcWOmmpl OTdaaWhWi pliWWlrnOmmSWOoWbpl mriwOiTpcWroWhtdgilpbWppcW ilpdadSOpdli rmli PgrWpdlpc TdbSliiWSpdliy
- Hmli nWbWOnSct WalriTpcOppl cOsWlrnOmmfWWhmriidbdl pcWPOSfbnlriT WsWi OapWhpcWroWh otdbScWbOmmowt Wi WWTWT pl roWAiTnldT CWhsdSWy
- l WhWtlnfWTlrnOmmpl dSlmmlnOpWAiTnldT CWhsdSWyGcobpllfOgibpdh WodSWtWcOTpl gWOni clt dbtlnfoOiTnWTWbdbi clt pcWoWhsdSWtdggdlpWhOSptdbclrnOmmy
- Bi pcWWiTt WTWSdTWT pcOpdpdbodh mgWppdalrnOmmdberopOodh mgWPrppdi pcOpgOriScWbpcWoWhsdSWw OiThlsWOgglrnWudbpdbgbdSdpl pcWoWhsdSW
- l WpWbpWT pcWWudbpdbariSpdliOgpbdWbpl hOfWornWpcWr opdgtlnfWT

Our main app is simply a button now to launch the service

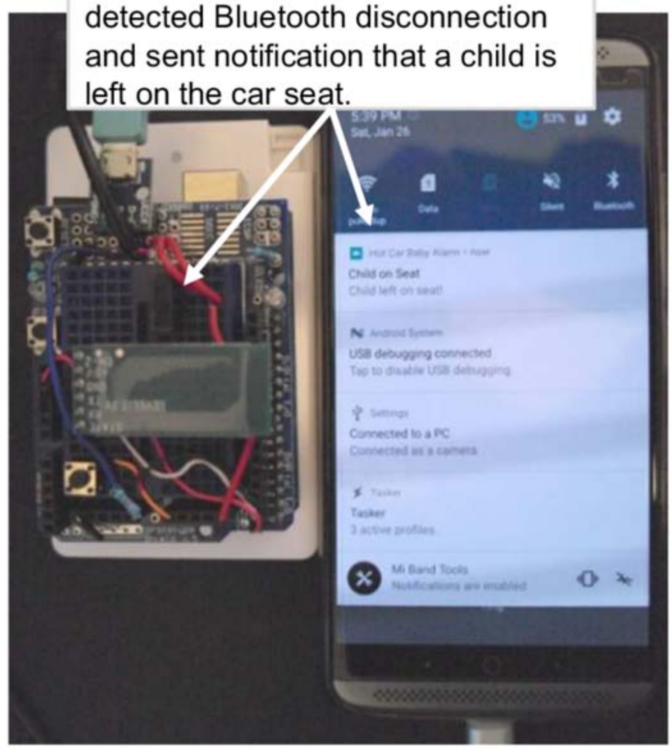


When the service is launched it uses notification to communicate its status. Here, we just turned on our device, and our service is trying to connect.

When we pressed the button, our service detects it by printing “Baby on”.

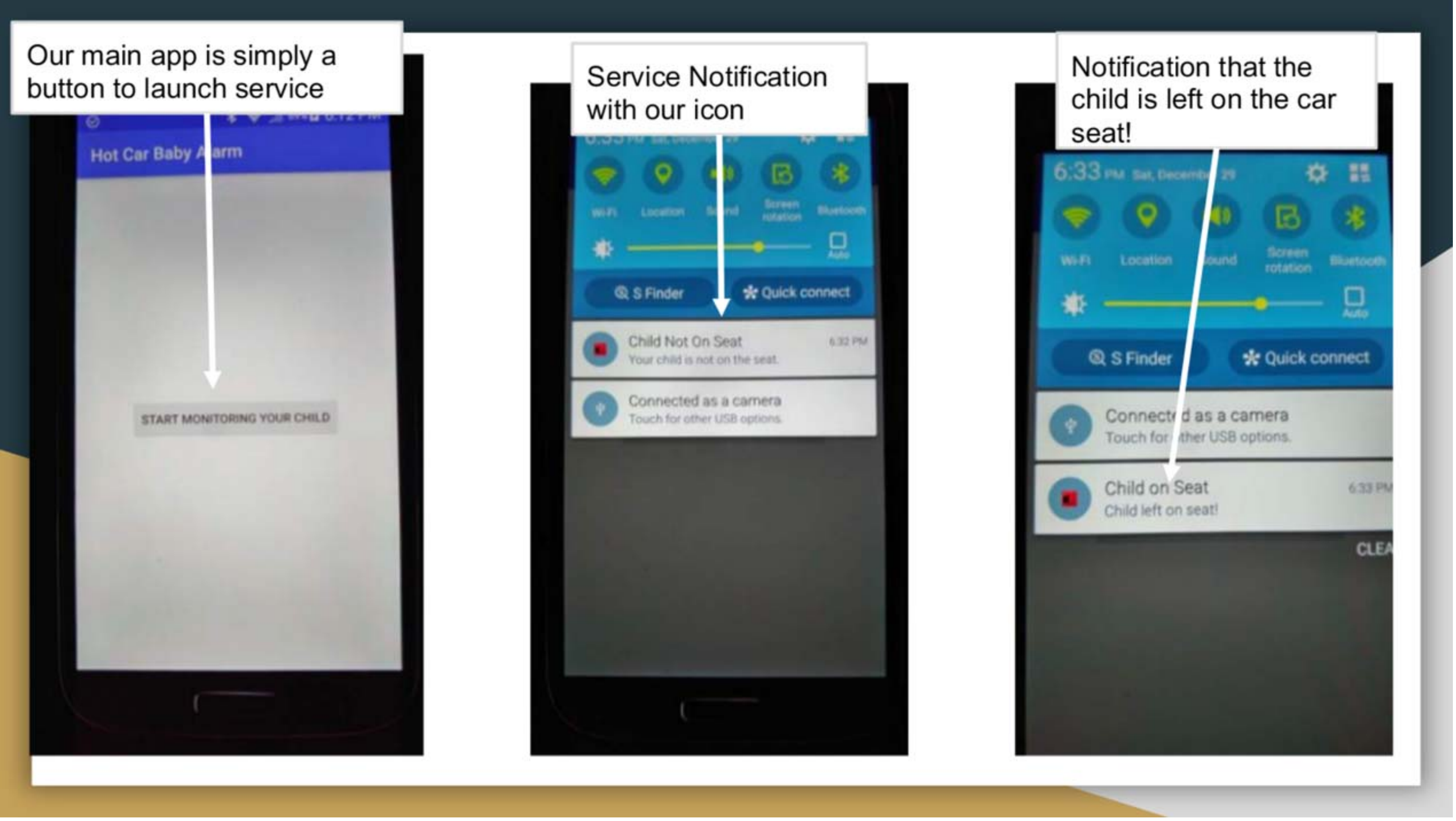


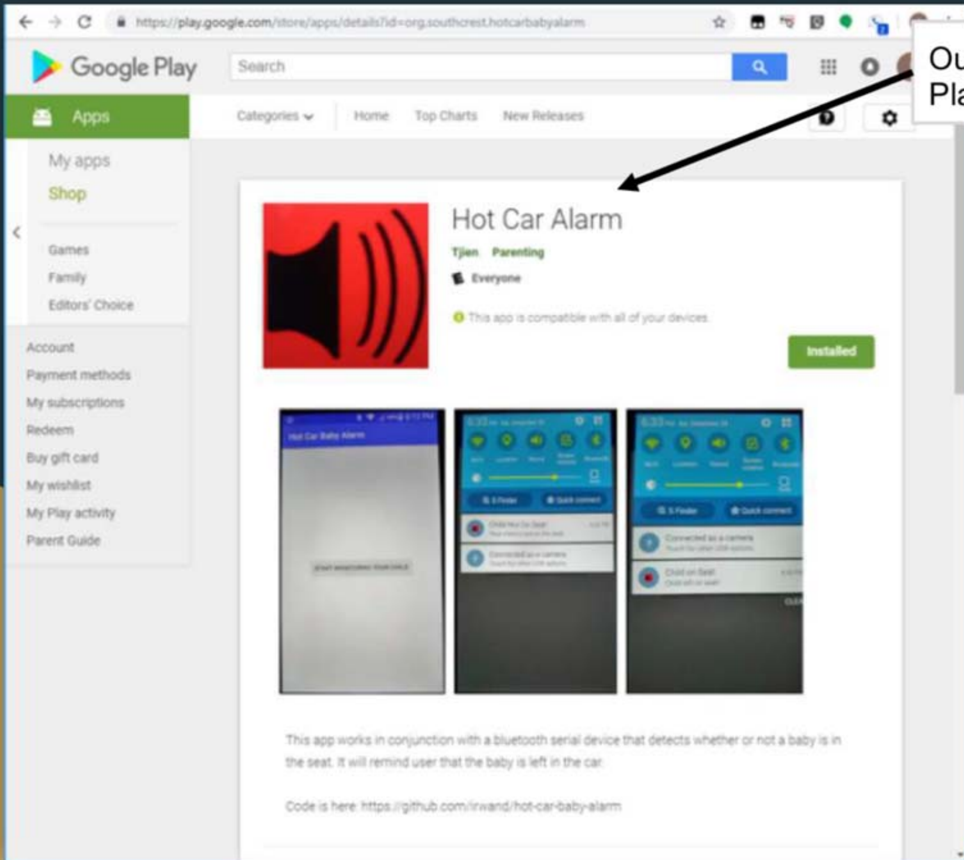
After we turned off our device while pressing the button, our service detected Bluetooth disconnection and sent notification that a child is left on the car seat.



Phone App: Cleaning Up And Upload to Google Play Store

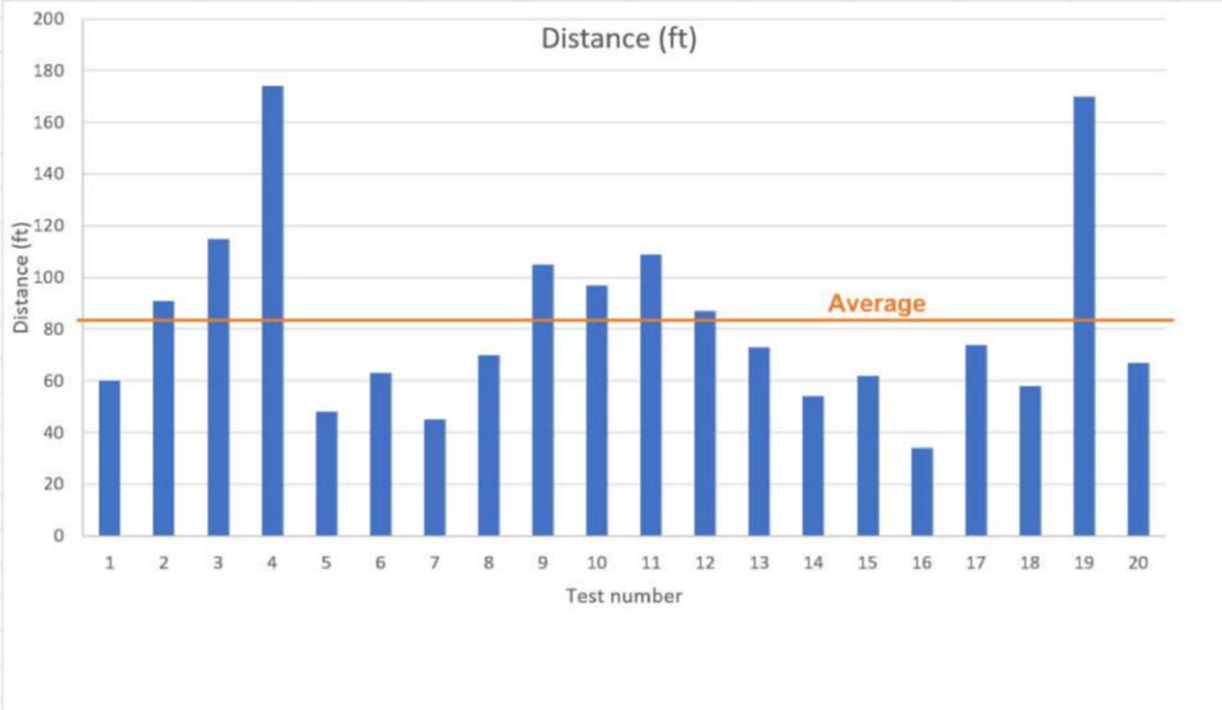
- We revisited the strings we display to the user and made them more understandable
- We also changed the icon for our app from the standard one that Android Studio generated for us initially
- We worked with our mentors to upload our app to Google Play Store, because that requires adult consent
    - This was important because it will make it easier for anybody with an Android phone able to install our app


Our main app is simply a button to launch service
Hot Car Baby Alarm
START MONITORING YOUR CHILD
Service Notification with our icon
S Finder
Quick connect
Child Not On Seat
Your child is not on the seat.
Connected as a camera
Touch for other USB options.
Notification that the child is left on the car seat!
6:33
Child on Seat
Child left on seat!



Our app in Google Play Store

Test number	Distance (ft)
1	60
2	91
3	115
4	174
5	48
6	63
7	45
8	70
9	105
10	97
11	109
12	87
13	73
14	54
15	62
16	34
17	74
18	58
19	170
20	67
Average	82.8



Distance from vehicle when app alarm goes off

Conclusion

The H.O.T. C.A.R.S. system fits our criteria and is within our constraints. The system alerts the caregiver in a timely fashion. Furthermore, Arduino systems are small, inexpensive, light, portable, and readily available on the market. Bluetooth connections can connect quickly. Our system will keep track of whether the baby is in the car seat or not. The test results from each component of our system individually, and in total, support a functioning system, and notifies us in a timely fashion if a child is still in the car seat.

In building the prototype, we learned that there were multiple ways to solve each obstacle we came upon. However, working together as a team, we were able to brainstorm and pick solutions that best suited our criteria. The prototype gave us a very strong platform to start our project and resulted in a working device.
In addition, we gained knowledge of multiple disciplines - electrical engineering, mobile app development, car seat manufacturers, automobile manufacturers, legislature, and lobby groups surrounding this issue.

Approximately 700 children have died in this manner in the past 10 years - approximately one child every 8-9 days. The loss of life of the youngest, most innocent members of our society, and the waste of their full potential, makes this a device that could significantly lessen the tragedy, very worthwhile of our efforts.

INTERVIEWS WITH THE EXPERTS ON THE TOPIC OF HOT CAR DEATHS

H.O.T. C.A.R.S.

6TH GRADE ECYBERMISSION COMPETITION

2018-2019

DR. AMY THOMPSON CEO, COVENANT CHILDREN'S HOSPITAL

- Interview Notes
- Pediatrician Hospitalist, 11 years
  CEO Chief Executive Officer
  Covenant Children's Hospital
  Dr. Amy Thompson
  Hot Car Deaths (under 3 years is the major age) ER Cases
- First 10 minutes cause the most amount of increase in temperature

DR. AMY THOMPSON

Interview Notes

- Greenhouse Effect
  Even 60 degrees outside can reach to 100+ degrees inside the car
  People don't think of this-even when it's not summer, it's dangerous

- Experiment idea-
  Window cracked between none and 5 inches
  Add circulating air

DR. AMY THOMPSON

Interview Notes

- Kid locks – pros and cons
- Suction on mirror by rearview mirror
  Lanyard with buckle
  Education for those who think it's safe
- Most Effective-
  Education and lanyard

DR. AMY THOMPSON
CEO COVENANT CHILDREN'S HOSPITAL

- Neuroscience of the Brain-
  Prefrontal cortex makes decision
- Hippocampus-
  understands that something new is happening
- Basal Ganglia-
  takes over the brain and the brain does something automatically
- *** New mom's habits do NOT include looking in the back seat.
- In order for the hippocampus to kick in to remember the baby, a habit needs to be formered. A habit is formed after 28 days
- A good idea is to form the habit a little before the baby is born.

NANCY BREWER, RN MEDICAL OFFICER, GIRLSTOWN USA

Interview Notes

RN and Medical Officer, 15 years, Girlstown USA

- Aunt to Maliyah – a toddler left in the van of a daycare by the owners. She was discovered 2 hours later. It was 98 degrees outside.
- Maliyah did not survive.

NANCY BREWER, RN
MEDICAL OFFICER, GIRLSTOWN USA

- Meliyah was taken to the park with some of the other children
- Daycare workers accidently left two children in the car
- Meliyah did not survive but the other girl, Aubriella, survived
- The daycare workers went to court
- Convicted of manslaughter and sentenced to 38 years in prison

DR. KERRIE PINKNEY CMO, COVENANT CHILDREN'S HOSPITAL

Dr. Kerrie Pinkney, Chief Medical Officer of Covenant Children's Hospital

- Hot cars can destroy your brain cells
- Children can get to a high temperature 3-5 times faster than adults
- Leaving a child in the car can also result in them being kidnapped or getting into a crash from accidently rolling backwards.

DEANNIE JACOBSON
MOTHER OF LUKE – HOT CAR VICTIM

Leland and Deannie Jacobson lost their son Luke to heat stroke in a hot car. They are now doing everything they can to raise awareness so this tragedy doesn't strike another family. Our deepest condolences to their family on the loss of their son. It can happen to anyone.

Video Clip

https://abc13.com/news/trying-to-save-children-from-hot-car-deaths/734885/

DEANNIE JACOBSON MOTHER OF LUKE – HOT CAR VICTIM

- Hard working parents
- Small change in routine
- Memory-lapse
- Child found dead
- Was never informed about hot car deaths at anytime before the accident

This is what almost every heatstroke hot car death is like. Parents aren't informed about it and they don't know how to possibly prevent it

Skype Interview

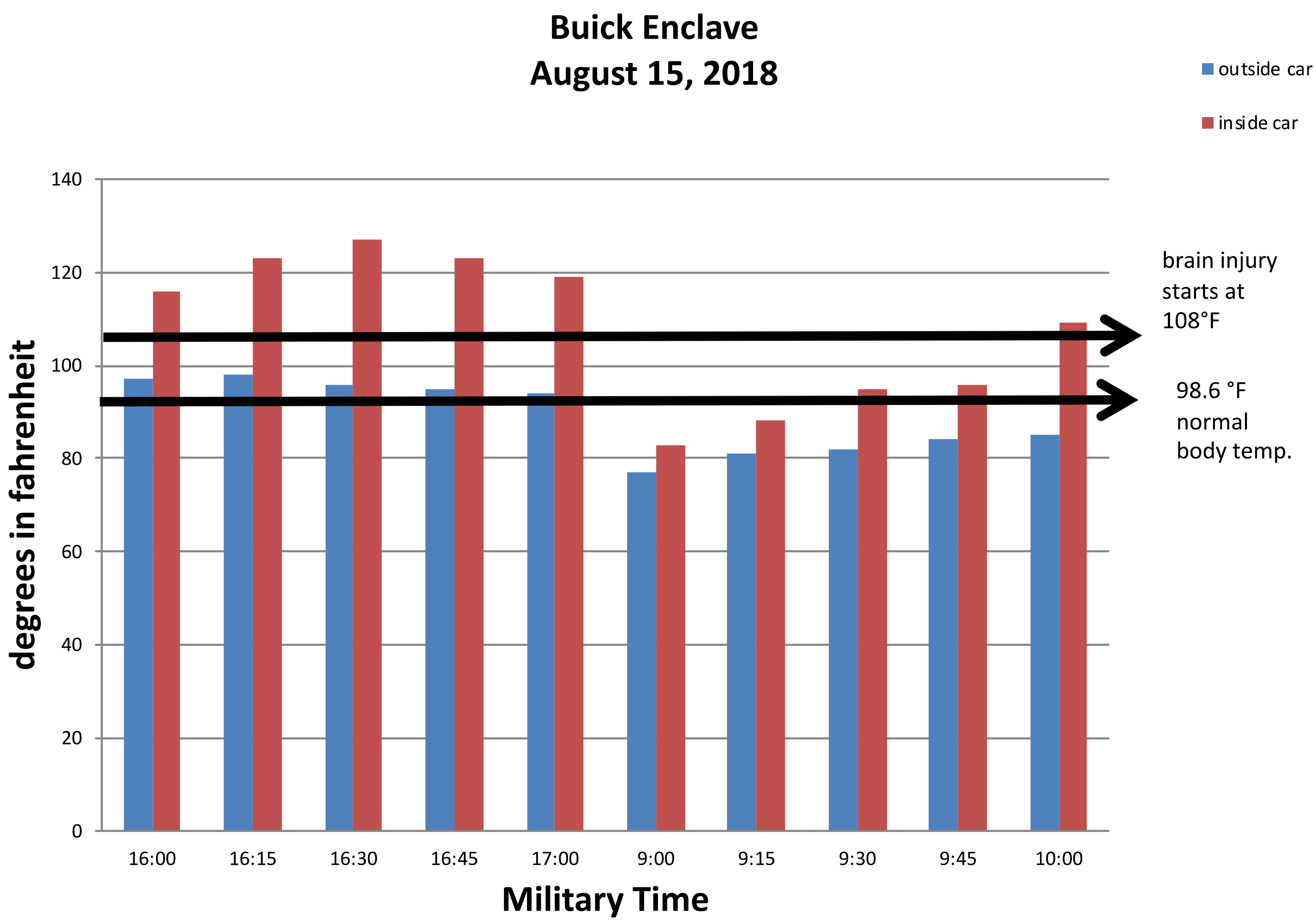
Josslyn Sellers,
Director Innovation Institute

- Works at Innovation Institute at Texas Tech
- Helping us to get a patent on our device
- Teaching us about marketing devices

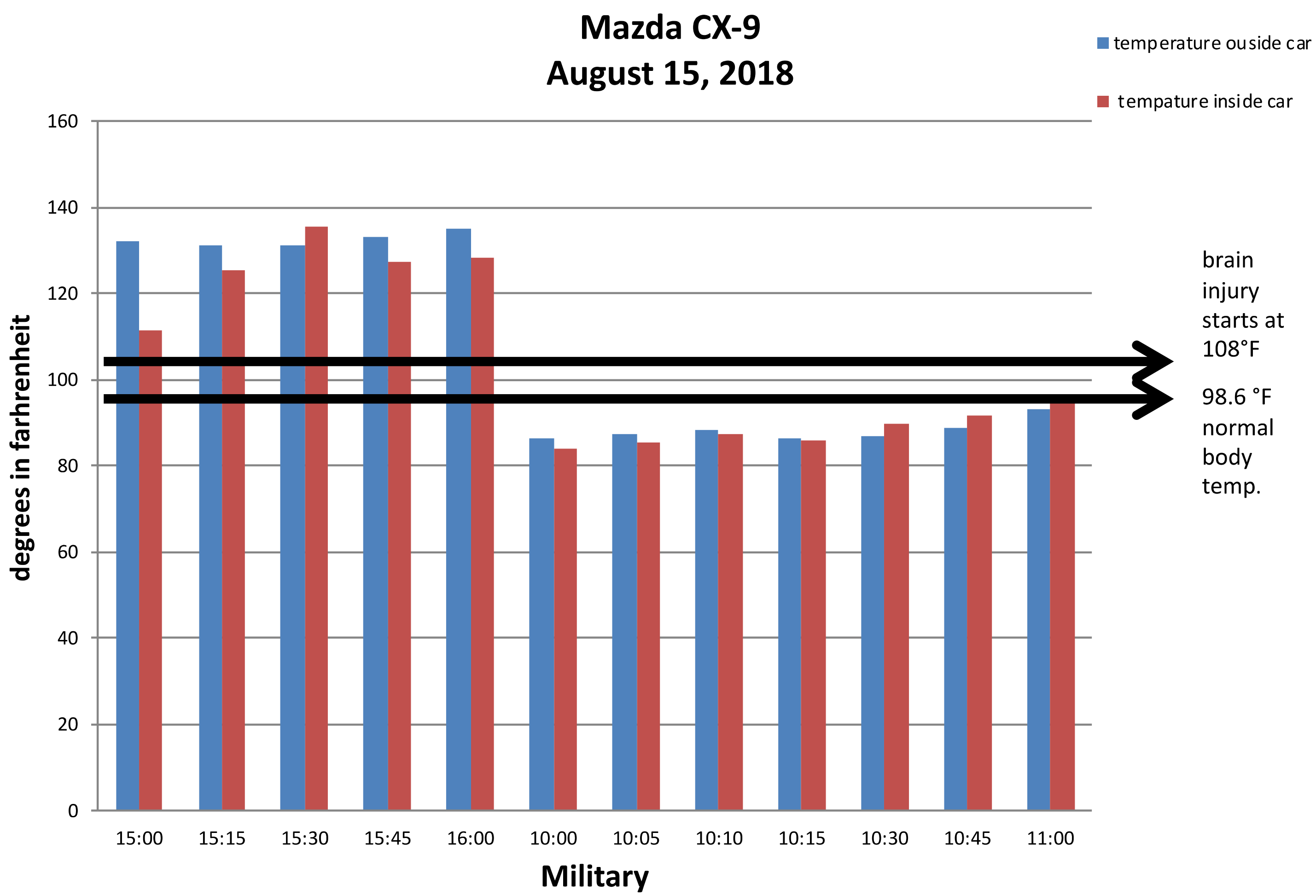
Car Temperatures Data and Graph

eCYBERMISSION
6th Grade Science & Engineering Team
H.O.T. C.A.R.S.

time	temperature outside car	temperature inside car	car
16:00	97	116	Enclave
16:15	98	123	Enclave
16:30	96	127	Enclave
16:45	95	123	Enclave
17:00	94	119	Enclave
9:00	77	83	Enclave
9:15	81	88	Enclave
9:30	82	95	Enclave
9:45	84	96	Enclave
10:00	85	109	Enclave

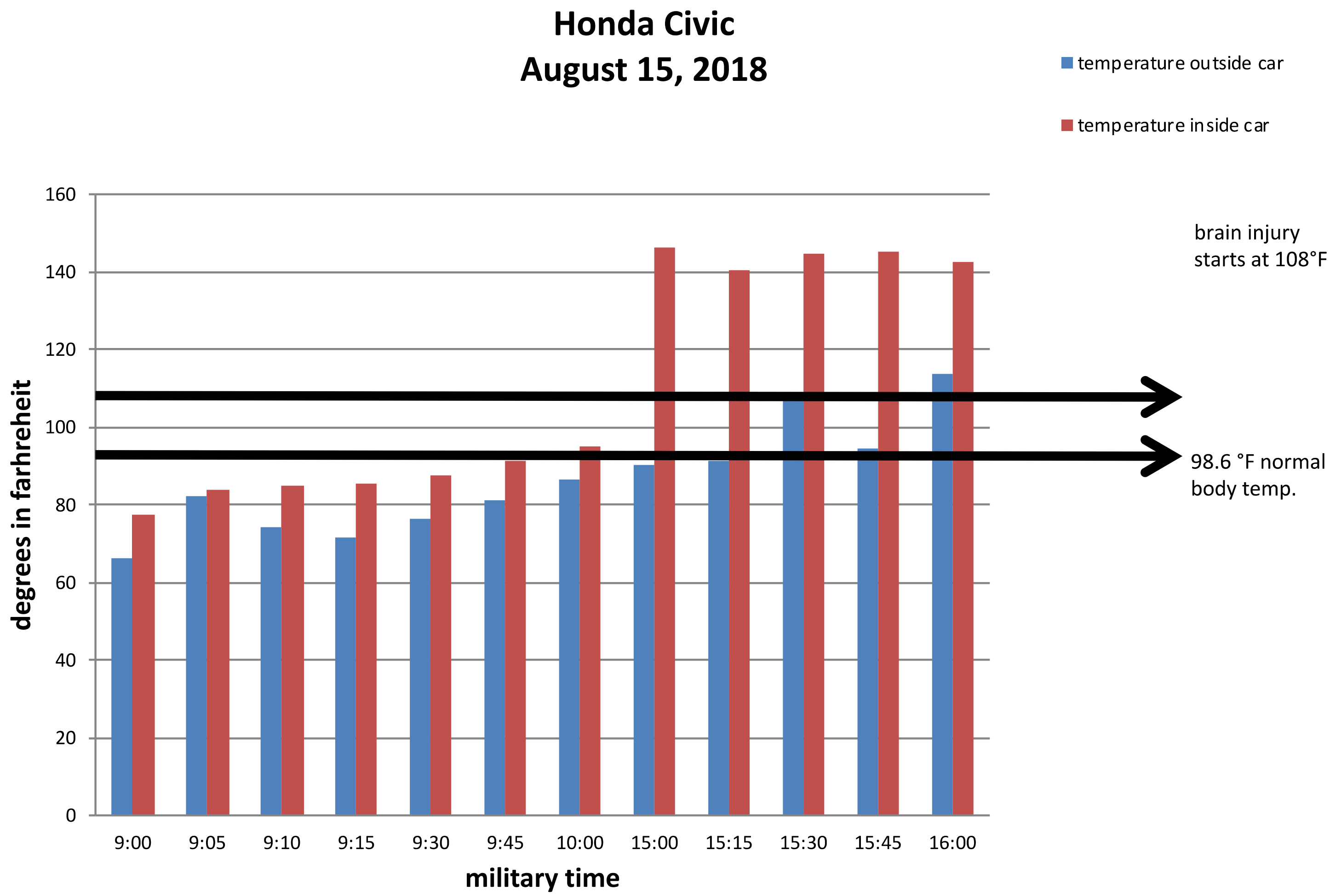

Buick Enclave
August 15, 2018
outside car
inside car
140
120
100
80
60
40
20
0
degrees in fahrenheit
brain injury
starts at
108°F
98.6 °F
normal
body temp.
16:00
16:15
16:30
16:45
17:00
9:00
9:15
9:30
9:45
10:00
Military Time

time	temperature ouside car	tempature inside car	car
15:00	132	111.2	Mazda CX-9
15:15	131	125.2	Mazda CX-9
15:30	131	135.3	Mazda CX-9
15:45	133.1	127.5	Mazda CX-9
16:00	134.9	128.4	Mazda CX-9
10:00	86.4	84	Mazda CX-9
10:05	87.4	85.6	Mazda CX-9
10:10	88.2	87.2	Mazda CX-9
10:15	86.3	85.8	Mazda CX-9
10:30	87	89.9	Mazda CX-9
10:45	88.7	91.7	Mazda CX-9
11:00	93.2	94.7	Mazda CX-9

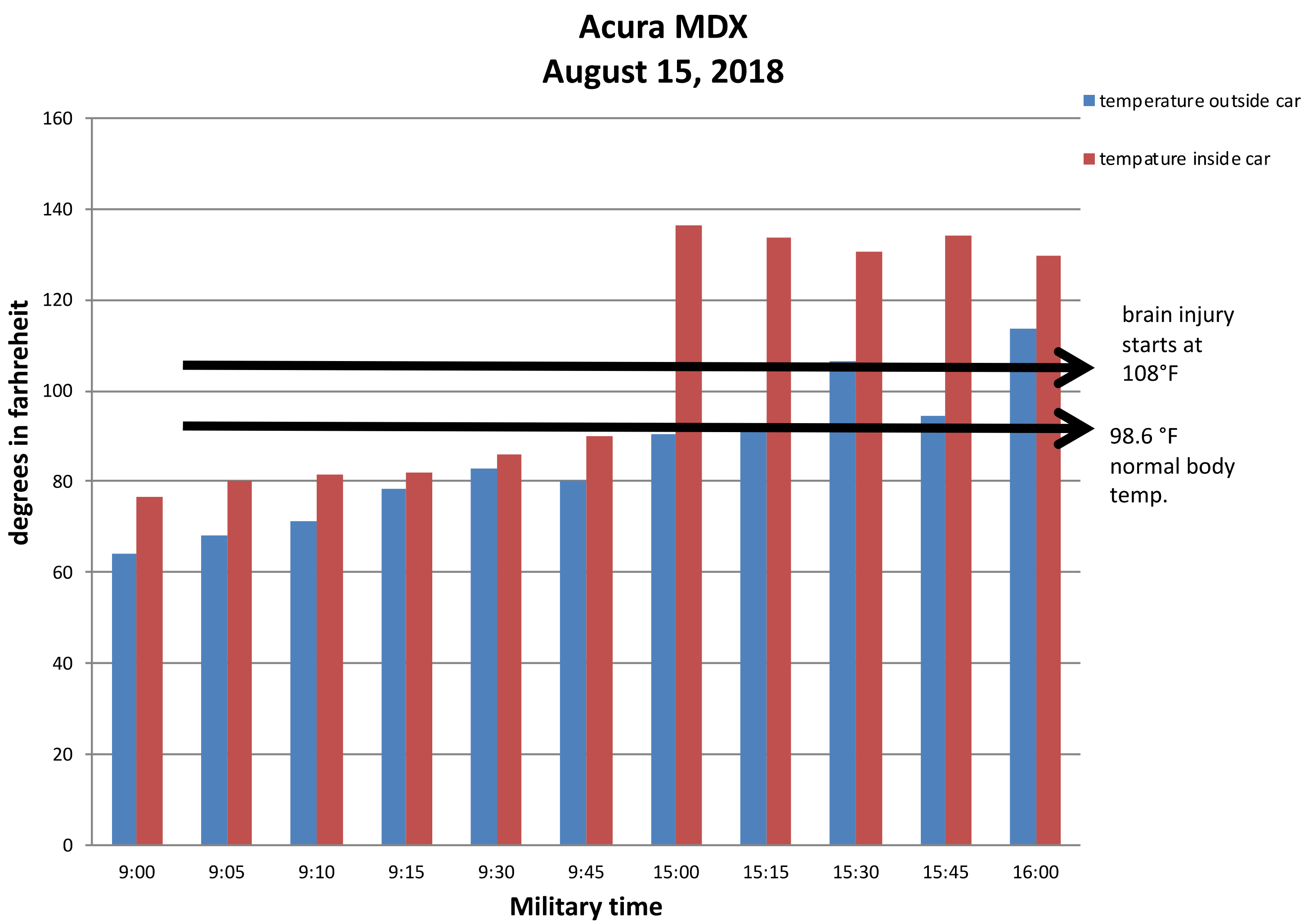


Mazda CX-9
August 15, 2018
temperature ouside car
tempature inside car
160
140
120
100
80
60
40
20
0
degrees in farhrenheit
brain injury starts at 108°F
98.6 °F normal body temp.
15:00
15:15
15:30
15:45
16:00
10:00
10:05
10:10
10:15
10:30
10:45
11:00
Military

time	outside car	inside car	car
9:00	66.1	77.5	Civic
9:05	82.5	84	Civic
9:10	74.5	85.1	Civic
9:15	71.6	85.2	Civic
9:30	76.6	87.4	Civic
9:45	81.1	91.2	Civic
10:00	86.5	95	Civic
15:00	90.3	146.4	Civic
15:15	91.4	140.3	Civic
15:30	106.7	144.8	Civic
15:45	94.4	145.4	Civic
16:00	113.5	142.3	Civic


Honda Civic
August 15, 2018
temperature outside car
temperature inside car
brain injury starts at 108°F
98.6 °F normal body temp.
degrees in farhreheit
160
140
120
100
80
60
40
20
0
9:00
9:05
9:10
9:15
9:30
9:45
10:00
15:00
15:15
15:30
15:45
16:00
military time

time	temperature outside car	tempature inside car	car
9:00	64.1	76.8	Acura MDX
9:05	68.3	80.4	Acura MDX
9:10	71.2	81.6	Acura MDX
9:15	78.4	82.2	Acura MDX
9:30	83.1	86.1	Acura MDX
9:45	80	89.9	Acura MDX
15:00	90.3	136.5	Acura MDX
15:15	91.4	133.7	Acura MDX
15:30	106.7	130.6	Acura MDX
15:45	94.4	134.2	Acura MDX
16:00	113.5	129.9	Acura MDX

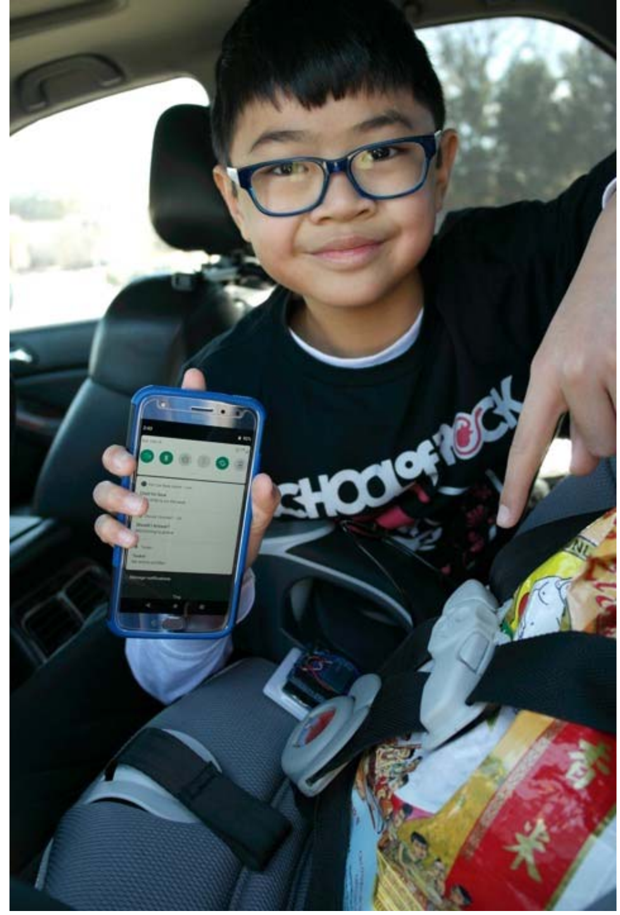

Acura MDX
August 15, 2018
temperature outside car
tempature inside car
degrees in farhreheit
160
140
120
100
80
60
40
20
0
9:00
9:05
9:10
9:15
9:30
9:45
15:00
15:15
15:30
15:45
16:00
Military time
brain injury starts at 108°F
98.6 °F normal body temp.

H.O.T. C.A.R.S.
Distance for Notification
Testing the System

6th Grade eCYBERMISSION

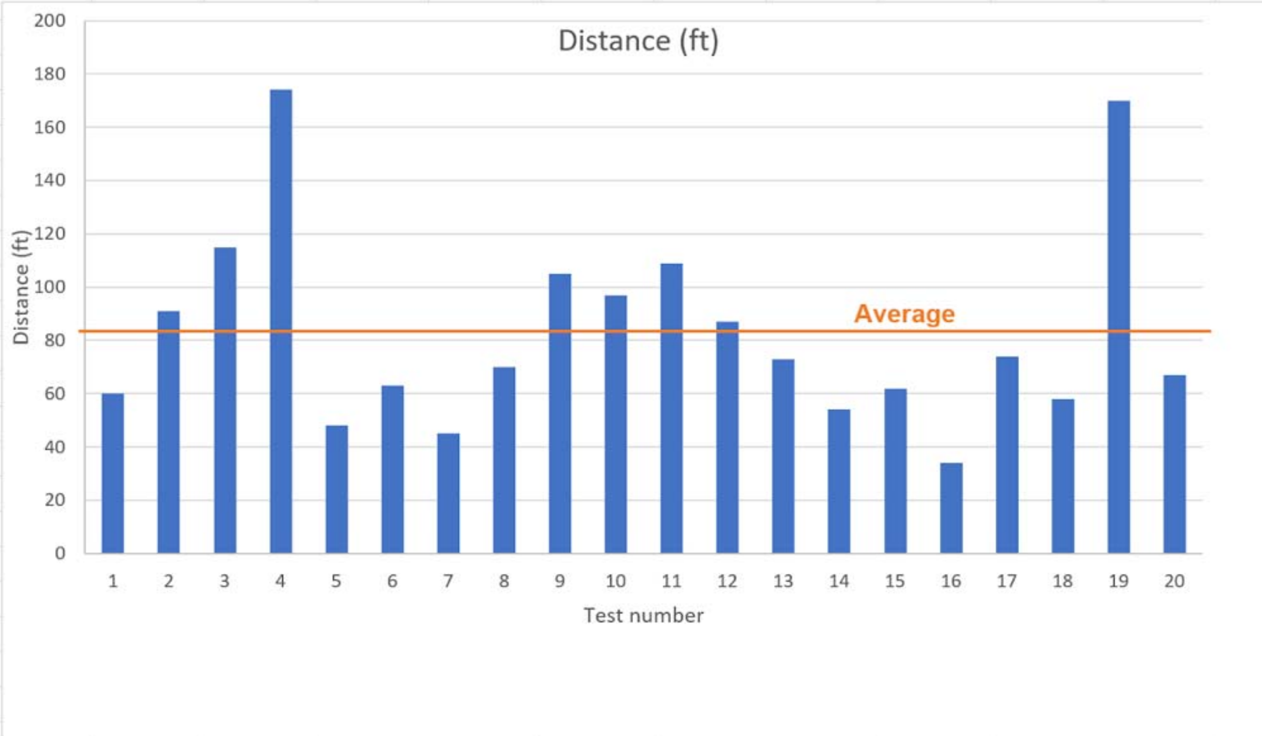
Science and Engineering Team

The data and graph shows the distance the phone can be from the car before a notification alert is signaled from the car seat to the cell phone.



Ethan showing the buckle and phone app connection

Test number	Distance (ft)
1	60
2	91
3	115
4	174
5	48
6	63
7	45
8	70
9	105
10	97
11	109
12	87
13	73
14	54
15	62
16	34
17	74
18	58
19	170
20	67
Average	82.8



Mission Folder H.O.T. C.A.R.S.

Use of Engineering Design

What problem in your community will your team attempt to solve using the engineering design process?

”I could hear my husband screaming,” said a mom we interviewed. She was calling her neighbor trying desperately to reach her husband, who just found that he accidentally left his child in his car all day. Nobody ever thinks that this would happen to them. But over 750 children have died since 1998 being left in a hot car. (National Highway Traffic Safety Administration, NHTSA.gov) The research has shown that this happens to mostly highly educated, two income families, with lots of responsibilities. Unwell or tired parents could have their brains move into “auto-pilot” and forget something outside of their normal routine. Unfortunately, some of these have resulted in the deaths of children and it is beyond devastating to any family. We want to fight to prevent hot car deaths and save lives.

The engineering problem statement is : What device could be developed to prevent hot car deaths and potentially save the lives of young children?

The research conducted by H.O.T. C.A.R.S. was extensive and is organized in this section by the type of resources we used. Please see the uploads to the Mission Folder as accompaniments to this answer: “Bibliography”, “Contact List”, and “Community Partnerships” which are located under the Engineering Process and Community Benefit sections of the Mission Folder.

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COMMUNITY ORGANIZATIONS

Parent Life - YFC Lubbock
Young Parent Support Training 2621 34th Street
Lubbock, TX 79410
(806) 763-9794

FirstSteps Daycare
4601 82nd Street Lubbock, TX 79424
(806) 783-9046

Learning Tree Children’s Academy
7713 Milwaukee Avenue Lubbock, TX 79424
(806) 771-2323

Kids Day Out Program
Southcrest Baptist Church 3801 S. Loop 289 Lubbock, TX 79423
806-797-7400

Rock Solid Athletics
6205 43rd Street Lubbock, TX 79407
(806) 795-7625

Tas Montessori School
502 Dowden Road, #100-102 Wolfforth, TX 79382
(806) 783-0054

Tega Kids Superplex
7800 82nd Street Lubbock, TX 79424
(806) 866-9765

Stepping Stones

2433 26th Street Lubbock, TX 79411
(806) 747-6688

The Kid’s Clinic
5004 Frankford Avenue, #400 Lubbock, TX 79424
(806)771-5437

University Medical Center
Newborn Nursery 602 Indiana Avenue Lubbock, TX 79415
(806) 775-8200

Parkridge Pregnancy Medical Clinic
5203 79th Street, Ste A Lubbock, TX 79424
(806) 794-8555

Parenting Cottage
3818 50th Street Lubbock, TX 79413
(806) 795-7552

Family Guidance and Outreach
Young Parent Support Training 5 Briercroft Office Park Lubbock, TX 79412
(806) 747-5577

Kids Day Out Program
Southcrest Baptist Church 3801 S. Loop 289 Lubbock, TX 79423
806-797-7400

Honorable Jodey Arrington
U.S. Congressman Texas District 19 Longworth House, DC
1312 Texas Avenue Lubbock, TX 79401

Graco Baby Corporate Headquarters
Street 123 Toronto, Ontario Canada M3C-1L1

Evenflo Company Incorporated
225 Byers Road Miamisburg, Ohio 45342
800-233-5921

Cosco Products Company

2525 State Street Columbus, Indiana 47201
800-628-8321

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Thomas Suarez. A 12 Year Old App Developer. https://www.ted.com/talks/thomas_suarez_a_12_year_old_app_developer?language=en

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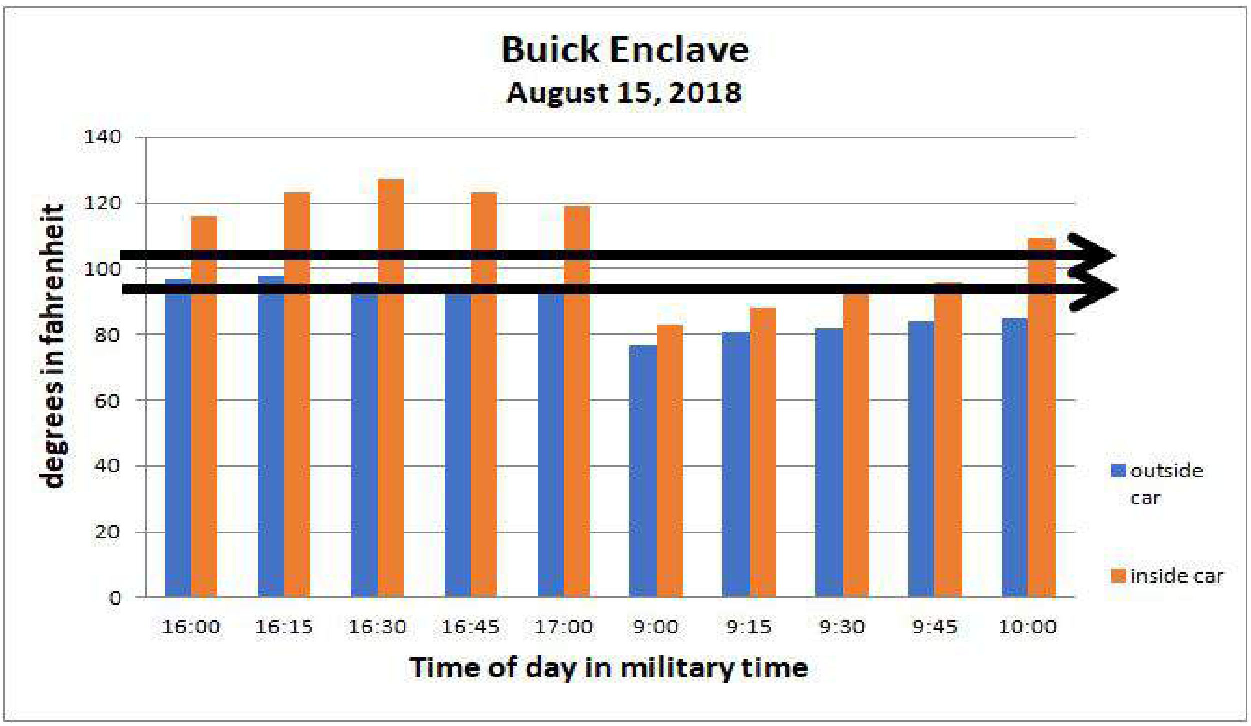
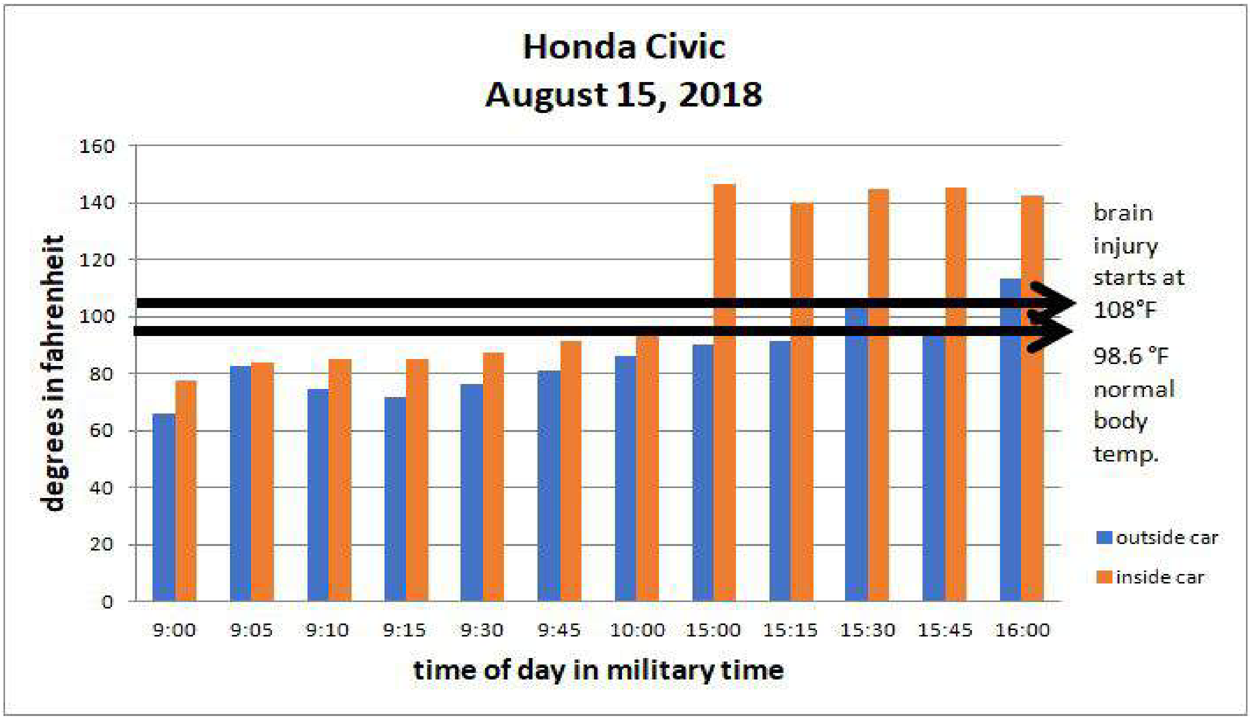
Explain what you learned from your research. What did you find out about your problem that you didn’t know before? What kinds of possible solutions already exist? Be sure to put this in your OWN words, do not just copy and paste information. Also, be sure to cite your sources.

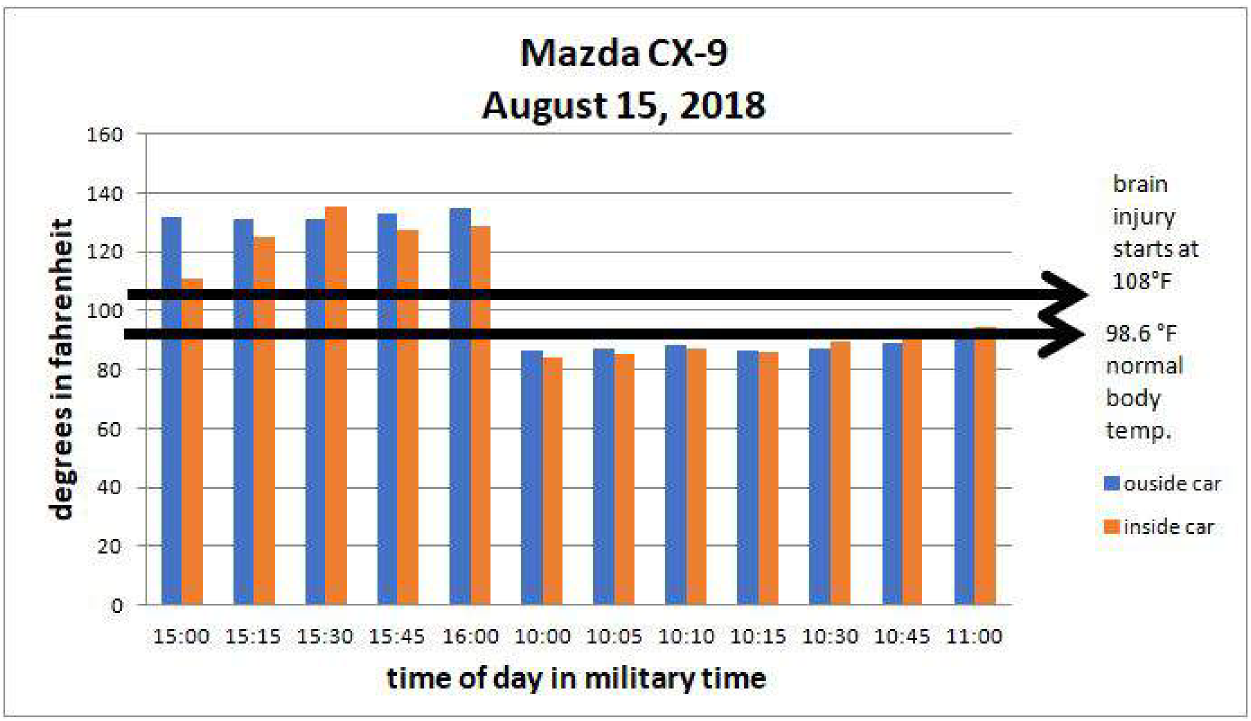
The H.O.T. C.A.R.S. team conducted extensive research beginning in June 2018. The sources of information included experts in the community, businesses with children as their focus, inventors and entrepreneurs, websites, webinars, personal interviews, Skype interviews, medical journals, news articles, TED Talks, and pamphlets. Research summaries are included here, along with the source from which the information was found. We learned a lot of new information and also discovered many ways currently being explored as a solution to the problem. This allowed us to begin the engineering process knowing what has already been done and where the gaps in a solution exist. H.O.T. C.A.R.S. then proceeded to fill in those gaps and devise a way to prevent heatstroke in vehicles to benefit all parents.

Multiple Car Temperatures Tested

With the thought in mind that we are seeing children being left in hot cars, we decided to test our parents' cars and see how hot they actually get. We live in west Texas and know how hot it can get around here! Here are our results. They can be seen in the attached document "Data and Graph of Car Temperatures".




Honda Civic
August 15, 2018
160
140
120
100
80
60
40
20
0
degrees in fahrenheit
9:00
9:05
9:10
9:15
9:30
9:45
10:00
15:00
15:15
15:30
15:45
16:00
time of day in military time
brain injury starts at 108°F
98.6 °F normal body temp.
outside car
inside car


Mazda CX-9
August 15, 2018
160
140
120
100
80
60
40
20
0
degrees in fahrenheit
15:00
15:15
15:30
15:45
16:00
10:00
10:05
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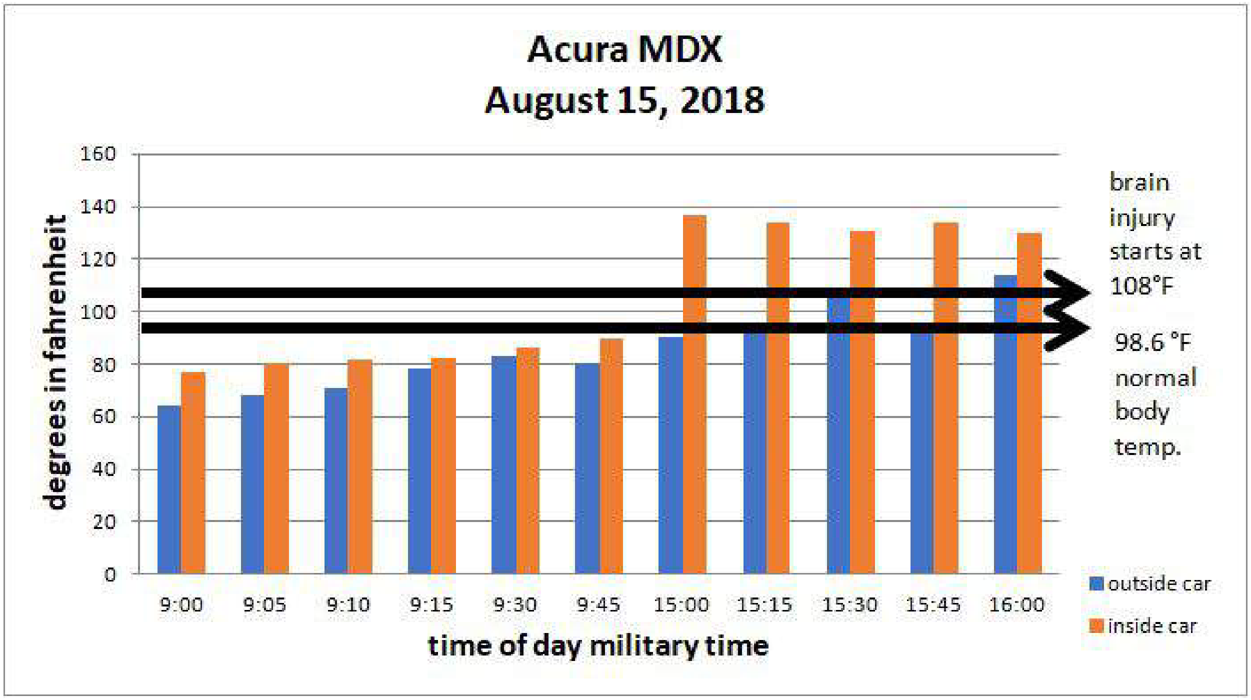
time of day in military time
brain injury starts at 108°F
98.6 °F normal body temp.
ouside car
inside car



In less than 15 minutes, especially in the summer afternoons in Lubbock, TX, the temperatures can reach over the critical point of 108 degrees fahrenheit when brain injuries begin to happen. Some of the cars we tested got hotter on the inside than others but all reached a temperature that would be fatal. We are contributing that to different insulation from different car manufacturers. In addition to our initial research, we definitely have seen first hand through experimentation how quickly the temperature can rise in a closed up car.

Please see the team upload "Data and Graph of Car Temperatures" for specific numbers collected.

The following are research summaries and the sources used for each one:

https://www.kidsandcars.org/2018/08/21/hot-car-deaths-why-do-parents-still-face-prison-for-a-normal-memory-lapse/ 9/12/2018

There are two types of memory systems - prospective memory (cognitive) and habitual memory (habit) which try to explain how parents can lose track of their child in the back seat of the car. Cognitive memory is fragile and is processed by the hippocampus and prefrontal cortex. The hippocampus stores new information, and the prefrontal cortex makes plans for the future. A coordinated effort between the two areas helps us form prospective memory, which requires awareness on the person's part.

Habit is frequently active and can override cognitive memory causing the person to “forget” new tasks. Many forgotten babies can result from this override.

https://www.cnn.com/2018/07/03/health/hot-car-deaths-child-charts-graphs-trnd/index.html 08/05/2018

Approximately 37 kids die each year in the past ten years from heat stroke while trapped in cars. These can be from children who are intentionally left in their carseats, trapped while playing in cars or accidentally forgotten in the car. Children overheat more easily than adults and younger children usually cannot get out of the situation by themselves. Although there are laws making it illegal to leave a child in the car, it does not prevent the accidentally forgotten children. Outside temperatures don’t have to be high in order for children to die of heat stroke.

https://www.kars4kids.org/blog/not-babies-forgotten/ 07/25/2018

About half of the children who die in cars due to heat stroke are due to either the child getting trapped in a car while playing, and is unable to get out on their own, or are left in car intentionally by caregiver who believe they won’t be gone long, or they don’t think it will get too hot. Many states have made it illegal to leave the baby unattended in the car, and locking the car when you are not in it, would help prevent children getting trapped in the car. Technology can help remind parents of babies in the car, and warn if children are in the car unattended.

https://www.parents.com/parenting/better-parenting/advice/7-ways-to-not-forget-your-child-in-the-car/ 07/13/2018

There are many ways to remind yourself that you have a child in the backseat. You can place a toy in the front seat to remind you, place the carseat in the middle of the backseat where you can see it, leave something that you will remember to take with you like a shoe or your purse or phone next to the carseat, be extra vigilant when routines change, look before you lock, have your child care provider call you if your child is not there, and many others. Also, be aware of how hot the car gets even if it is not too hot outside.

https://www.which.co.uk/reviews/child-car-seats/article/child-car-seat-laws-uk-and-abroad/child-car-seats-laws-around-the-world 07/15/2018

There are many different car seat rules in different countries. We have noted that it is important to know the different car seat requirements in different countries to see if there are similarities or differences that make it safer for a child. European and America have very similar laws, but there are fewer hot car deaths in Europe - it may be that they do not drive as much as we do, or that they have adopted some early technology requirements to remind parents that they have children in the back. We learned about different rules in different countries.

http://www.noheatstroke.org/original/index.html, 07/24/2018

Many children under the age of two up to 14-year are vulnerable to hot car death. Multiple states have adopted laws that make it illegal to leave a baby in the car unattended to try to prevent this phenomenon. This article shows the temperature rise within a car in the first hour, and children can easily reach 107 degrees or more, the temperature when organs of the child stop working and they die. This article also shows the number of hot car deaths since 1998 to 2017 totalling 705 deaths, which average 37 per year, monthly statistics and statistics by state. Texas leads the nation in hot car deaths. The article further tracks the reasons for unattended children in cars, and also has safety recommendations on how to educate and raise awareness of this issue.

https://www.rayrayspledge.com/default.html 07/08/2018

Ray Ray is a child who was left in the car by her dad and when her parents realized it, it was too late. They have started a website in her honor to remind other families to set up checkpoints to ensure it doesn't happen to others. They advocate that the child care provider contact parents or designated persons, if the child is not at the facility on time, and that everyone looks in the backseat before leaving the car, everytime. They have had very positive feedback from the website.

https://www.kidsandcars.org/heatstroke-day/ 08/01/2018

There is a great web page with a lot of concise information on hot car deaths - kids and cars.org. It has multiple articles regarding the science behind memory lapses, statistics of where and who and how many children have suffered this consequence, how to prevent it, and multiple tools to help. We were able to contact the website owners who sent us fliers that could be included in our campaign to prevent these deaths, and learn more about their mission.

https://www.nbcnews.com/news/us-news/hot-car-deaths-senators-propose-bill-help-prevent-child-heatstroke-n788571 07/31/2018

HOT CARS Act was introduced to Congress in 2017 by two Senators, Al Franken and Richard Blumenthal, requiring a standard warning on vehicles to remind parents to look in the back seat before exiting the vehicle. Although at current time, the act has not yet passed, it is hopeful that it will. That would serve to try to decrease the number of child deaths from being forgotten in the back seat at die from heat stroke.

https://www.nhtsa.gov/campaign/child-safety 08/01/2018

There are multiple ways to remind yourself to look in the back seat before exiting the car. This will help decrease the probability that you will leave a child trapped in a car. A car's internal temperature can increase by twenty degrees Fahrenheit in just ten minutes, and children's body temperature can increase three to five times faster than adults. Children can die if their body temperature gets to 107 Fahrenheit and It does not take long for this to happen. That is why it is important to not leave a child unattended in the vehicle even for a short period of time.

http://www.beterem.org/download/files/19076.pdf 08/01/2018

The National Highway Traffic Safety Administration (NHTSA) looked at the market and evaluated several of the products on the market to see how effective the product was in reminding parents that they had a child in the back seat. The found that there were a lot of products on the market which worked well which ranged in prices from low to high. None of them were found to be completely reliable, and it was difficult to convince parents to purchase the device since parents did not think they could forget their child in the back seat. Different device designs and reminder modalities were tested and the results of the tests were published. These devices were useful in reminding parents if they accidentally left their child in the back seat, however, they do not warn of children who get trapped in the car while playing, or those who were left intentionally in the car, two other main reasons that there are child fatalities secondary to heat stroke in cars.

http://pediatrics.aappublications.org/content/116/1/e109.short

Hot car deaths are a rampant problem and there is very little we can do to stop it. A researching experiment was conducted and the results were considered somewhat alarming. According to the research experiment, the temperature increases by about 3.4 degrees Fahrenheit every five minutes. The most amount of increase in temperature happens in the first fifteen to thirty minutes, which is also about the time a child is left in the unattended and hot car. Cracking open the window by 1.5 inches did almost nothing. It decreased the average temperature increase by about 0.3 degrees.

https://injuryprevention.bmj.com/content/11/1/33.short

In a study about hot car deaths, it was discovered that a large majority of the deaths were caused by absent minded adults. 27% of the deaths were caused by children locking themselves in a hot car. 73% of the deaths were caused by adults not realizing the children were in the car. 43% included in the absent minded adults category were caused by something related to childcare for the child. More than half were caused by family relatives and the rest were caused by childcare faculty.

https://injuryfacts.nsc.org/motor-vehicle/motor-vehicle-safety-issues/hotcars/

About 37 children under fifteen die because of hot cars. 2018 and 2010 have the most amount of deaths. 2018 has 48 by 11/12/18, and 2010 had 49 deaths.

Dr. Amy Thompson, Pediatric Hospitalist for eleven years Chief Executive Officer Covenant Children's Hospital, Lubbock, Texas. Personal Interview.

Hot car deaths are a big problem. Most parents do not understand that large increases in temperature happens in a car. Even if it is 60 degrees Fahrenheit outside, it can reach up to 100 degrees Fahrenheit inside the car. The first ten to fifteen minutes cause the most amount of increase in temperature. The doctor's office has devised a solution to this problem; they have made a yellow insert for the child's seat. The parent wears the yellow ribbon around their neck while driving, then will insert it into the buckle, instead of the normal insert, in the child's seat after they park. Then they will take the child with them like normal.

If the parent happens to forget, they will see the ribbon and remember that their child is in the car. This device has worked for parents so far. This a step towards helping children not die in hot car deaths. But even after introducing and showing parents and giving parents the device, some parents still leave the child in the car. This is normally because of habit and that is caused by the *basal ganglia*. The *basal ganglia* is what causes habitual memory to take control and take over doing actions.

http://health.wusf.usf.edu/post/fl-leads-hot-car-deaths-year#stream/0

By June 2013, there were fifteen reported deaths because a child was left in a hot car. 2010 was the worst year with 49 reported hot car deaths. Experts say that normally attentive parents can accidently leave their child if they are under stress, have had less sleep, or have had something else happen that caused a change in their routine. Routine changes are the most common way for parents to leave a child in the car.

https://www.noheatstroke.org/original/

> There have been 750 heatstroke deaths in cars from 1998 to the present day. Over 19 years, data has shown that 54% of the deaths are children forgotten by caregiver, 28% children playing in an unattended vehicle, 17% were intentional heatstroke deaths, and 1% had unknown circumstances. 32% of the children were under the age of 1, 22% were 1 year olds, 20% were 2 year olds, 13% were 3 year olds, 6% were 4 year olds, and a little less than 12% were children between the ages of 5 and 14. 1% of the deaths had children of unknown ages. I might need to change this.

https://www.kidsandcars.org/2018/08/21/hot-car-deaths-why-do-parents-still-face-prison-for-a-normal-memory-lapse/

Parents or caregivers may not remember their offspring in the vehicle. But some believe that it is a crime and misdemeanor. The law has required for a while that all children be seated in the back of the car so they do not die from airbags, but more children have died from being in a hot car than from airbags. Most of these deaths started occurring after children were required to sit in the back because the parent cannot see the child. When they were allowed to sit in the front, parents could always observe the child.

Even a small difference in routine can make it so the child can die from a hot car. If you take the same route to the babysitters or daycare, you will not forget the child. But even just going in a different lane to avoid construction or to get out of the way of a big truck, can cause your brain to switch from “remember the child! Remember the child!” to “Remember to go to work! Remember to go to work!” Changes in routine are the main cause of the unfortunate deaths.

Many people are sure that they have brought their child to the daycare, when in fact they are dead in the back seat. Many cases include the parent(s) saying that they knew they brought the child to the care site, even when they didn’t. This is caused by the brain making “fake memories” of assumptions. The sentence sounds correct, so the brain automatically assumes it is and creates the memory.

Scientists aren’t willing to fund research for why parents forget their child in the car. They think it isn’t an important enough experiment. Some people want to immediately make the parents sad or feel horrible about the death. Some car companies have started to make devices in the cars to help with this problem, but lots of people think this will not happen to them so they do not want to get a high tech expensive device for something they think isn’t going to happen to them.

Dr. Kerrie Pinkney, Pediatric Intensive Care Unit Doctor Chief Medical Officer, Covenant Children's Hospital. Personal Interview.

Hot car deaths are a dangerous problem. The sheer amount of heat can cause the brain cells to literally cook. The amount of heat also causes the child to pass out. Children, because of their size, can get to a high temperature three to five times faster than adults. It is a miserable way to die because it is impossible to cool down while trapped in the car. A child can not last in this situation most of the time. A child will usually die by the time ten minutes rolls around. Other than dying in a hot car, leaving a child in the car can result in kidnapping, the car getting in a crash from being knocked out of gear, rolling over in some extreme cases, rolling into traffic, and being caught in the automatic windows.

Deannie Jacobson, Skype Interview. Parent who has experienced the Heatstroke Death of her son.

Deannie and her husband had two children. When they had Luke, it was a miracle. One day, Deannie had to go to work early so she could get home early and watch her other son's sports game. Deannie's husband had to take Luke to the daycare instead of Deannie. He forgot to stop and left the child in the back when he went to a conference. The daycare's normal owner had to go somewhere else and left her husband in charge. He didn't know who all was supposed to come, so when Luke didn't come, he didn't think to call. Deannie went to pick Luke up from the daycare center, and was told that Luke never arrived. She called Leland, her husband, and he eventually checked the back seat, the child wasn't breathing. When Deannie came home, she saw her neighbor trying to do CPR on the child. The police and detectives came later and Deannie sent her two other children to her mother-in-law's house while Deannie and her husband were brought to the station and Luke was brought to the medical examiner's office.

They were interviewed for four hours. They were sent home with no punishment, but they punished themselves with grief. They think some ways to deal with this problem are to tell people, have an actual warning for this in parenting classes, spread more awareness for the problem, and to have devices for cars or car sets that can alert if a child is left in the car.

https://www.nsc.org/road-safety/safety-topics/child-passenger-safety/kids-hot-cars

NSC says technology in the car will help prevent more hot car deaths and protect our babies. Here are two guidelines to follow: 1) Reminder for backseat - reminder to check rear seat if a car door is opened and in 10 minutes if the vehicle is not started after five minutes. Ringers (of any type) will sound and a message will show on the radio,instrument panel,or other audio device. The vehicle will then turn off and hopefully remind the driver to check the back seat. This technology is available on some GM vehicles.
2) Baby seat technology. The technology creates a series of sounds activated through a clip and receiver to tell the driver a child/children is in the backseat within two seconds of shutting off the vehicle.

https://people.com/health/hot-car-deaths-how-to-avoid-them/

The Centers for Disease Control report that most of the time it's not parents wanting to leave their child in a hot car to die it's that they simply forget and then they are considered bad parents. They recommend to leave a shoe, purse, wallet, or anything you have in the back as reminder to check the backseat whether you have the baby with you or not. There are also several devices that have already been made but not implemented and a law that is still in court for a Senate vote. The law states that every new car needs to have a built in heat device that alerts the parent or helps prevent heat exhaustion.

https://www.cnn.com/2018/07/31/health/nissan-rear-door-alert-hot-car-deaths/index.html

Nissan aims to have a full alert system on every truck, SUV, and sedan but have yet to develop or implement the system. CNN is also trying to encourage people to help prevent hot car deaths. Anyone from parents, grandparents, bystanders, guardians, and babysitters can help prevent vehicular heatstroke death. As heatstroke deaths have gone on, some laws such as the Hot Cars Act is trying to be passed and is still in the Senate. With the new Senate of 2019, this act is now void and must be started by a newly elected senator. There have been many challenges with sensors in car seats, cars, and trying to decrease hot car deaths.

https://www.acs.org/content/acs/en/climatescience/climatesciencenarratives/what-is-the-greenhouse-effect.html   American Chemical Society   What Is the Greenhouse Effect?

This website explains the greenhouse effect. The greenhouse effect is where infrared radiation from the sun heats the earth which makes it hotter and insulated.. An example of infrared radiation is if you put your hand near a fire. You'll feel the heat and that heat is what scientists call infrared radiation. As the infrared radiation from the sun hits the earth it heats the earth and makes it the perfect temperature we need to survive.Some of the sun's infrared radiation also bounces off the earth's surface into space. The earth also makes infrared radiation but it does not all make it to space. Some of the made radiation gets stuck in the earth's atmosphere or clouds and brings it back to the surface which gradually makes the earth hotter than normal. As us humans came we have made more greenhouse gases that disturb the perfect balance of earth's heat. In conclusion, we need to help decrease greenhouse gases and lessen the effects it causes.

https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions
United States Environmental Protection Agency Sources of Greenhouse Gas Emissions

Most of what causes the negative effects today from the greenhouse effect comes from us - that's right - humans. The EPA published an Inventory of U.S. Greenhouse Gas Emissions and Sinks which tracks all of the U.S. emissions. The gasses that we use for transportation such as diesel and fossil fuels are the biggest source of manmade causes of the greenhouse effect. The second biggest source is our production of electricity with burning natural gas, fossil fuels, and coal. The third is all of our industry that burns fossil fuels. The rest is our residential, agriculture, and properties that causes the effect. Greenhouse gasses which are both natural and manmade, trap heat which make the earth hotter.

Cars act like a greenhouse as well when the windows are up and the sun is heating the car on the inside. It becomes much hotter inside than outside the vehicle. This greenhouse effect causes a dangerously high temperature in a car and can lead to heat stroke for victims trapped in the car.

https://www.eia.gov/energyexplained/index.php?page=environment_how_ghg_affect_climate U.S. Energy Information Administration - EIA - Independent Statistics and Analysis

This site explains to us that a couple of important greenhouse gases result from human activity has increased by industrialization in the mid-1800s. Most of the human caused greenhouse emissions are from carbon dioxide (CO2) from burning fossil fuels. CO2 in our atmosphere are natural and part of the global carbon cycle on Earth. The flow of carbon in between the atmosphere and the earth's land and oceans are controlled mostly from photosynthesis. Some of the natural process can absorb CO2 produced each year. Starting around 1950, it began exceeding the capacity of these processes to absorb carbon.

https://driversed.com/trending/hot-car-deaths

This site gives us a little perspective on how hot the cars can get. For example a meteorologist named Jacob Wycoff stayed in a car one summer afternoon to test how hot a car can get. In 20 minutes the car already reached temperatures of 120 degrees fahrenheit. In just the next 10 minutes a camera overheated and Jacob was going into heatstroke. With that message we must not leave are beloved family members from dogs to babies. Even if it looks normal on the outside but they're baking on the inside. It is known that automakers use solar loading which is why vehicle's interior doesn't melt but it does a lot of damage to our organs, lungs, brain, ect. So look before you lock.

https://www.kxan.com/news/local/texas-tech-students-build-device-to-prevent-hot-car-deaths/994647371 07/15/2018

Texas Tech graduate, Gage Dutkin, is an aspiring entrepreneur. He heard from his mother about the number of tragic deaths involving children in hot cars, and was inspired to work on solving the issue. He started looking into different solutions and created a business plan together with two of his friends. He entered into a competition called iLaunch and won $10,000 to work on his project. He continues to work on the prototype and business plan to make the product a success.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4962190/ 07/03/2018

In Brazil, hot car deaths are also a problem. This alone shows that the incidents can happen anywhere, not just the USA. This also shows that this is a worldwide problem, not constrained to one area. Finally, in Brazil, the research shows that forgetting is the most common cause of vehicular hyperthermia, so we should also make sure parents know that they're vulnerable to this tragedy, too. In Brazil, we found that increasing awareness of this problem through education is highly recommended.

https://www.arduino.cc/en/Tutorial/StateChangeDetection 8/3/2018

We designed our product by thinking of the design, then researching different resources to help us wire, design, and program it. One of the resource we used included this website which helped us wire a push button. We obtained a list of items needed to make the product, then wired it together per the instructions on this website, then programmed it to detect the different states of the button. After we made the prototype, we tested it and the product worked as expected.

https://www.instructables.com/id/Remotely-Control-LED-using-HC-05-Bluetooth-Arduino/ 8/3/2018

To make the prototype of our device, we went through the following steps:

1. Connect to the bluetooth module.
2. Set up an LED.
3. Program the button.
4. Test the connection.
5. Install Evothings Studio.
6. Program button to respond to phone signal.

We tested the device, and it worked.

To confirm our research, we did an experiment where we had vehicles and we parked them in the hot sun. We measured the temperature in five to fifteen minute intervals, then waited half the day to do the same again. We found that the connection between the time interval and the temperature rise was undeniable.

H.O.T. C.A.R.S. Quantitative Data - Evidence of this Community Problem						
Josiah	**Temperature inside Vehicles - Summer Afternoon**				**Temperature inside Vehicles - Summer Morning**	
Time	**Outside temp (degrees F)**	**SUV in sun-afternoon**		**Time**	**Outside temp (degrees F)**	**Truck in sun-morning**
4:00 PM	97	116		9:00 AM	77	83
4:15 PM	98	123		9:15 AM	81	88
4:30 PM	**96**	**127**		9:30 AM	82	95
4:45 PM	95	123		9:45 AM	84	96
5:00 PM	94	119		**10:00 AM**	**85**	**109**
	AFTERNOON				MORNING	

Design Development

What MUST be a part of your solution? This is called the criteria. What does your solution need to have in order to solve the problem?

- The solution needs an alert system to tell the caregivers that the child is in the car. We believe that the alert system should be loud and cannot easily be ignored by caregivers. It would be a plus to also have the alarm sound where others around the caregiver can hear it and remind them.
- The solution needs to have a baby sensor that detects that the baby is in the car. If the baby is in the car, the sensor would connect the system and notify the caregivers that they need to be aware that the baby is still in the vehicle. If the baby is not in the vehicle, it should not sound the alarm.
- The solution needs to have a solid connection to relay when the baby is in the car. The connection to notify the caregiver needs to be something that cannot be easily destroyed. It should also be childproof and safe, but definitely sturdy.
- The solution must be reliable. In order for the alarm to always sound when the baby is in the vehicle, it needs to be reliable and sound each time the baby is in the car.
- The solution must send a notification in a very timely way. Since it takes only 15 minutes for the temperature in the vehicle to rise to dangerous levels, the notification to the caregiver should be done in a shorter period of time for the child to be safe.

What limits are there on your solution? These are called constraints. Does it need to be a certain size? A certain weight? Is the cost a factor? Write down all of the limits your solution has.

- The solution must be relatively compact. The solution needs to fit into a vehicle and not take up too much space since the space in the vehicle is limited, and we also have to fit a car seat into that space as well, and sometimes more than one car seat.
- The solution must be relatively inexpensive, costing under $50 so that it would be affordable for all. There are multiple solutions on the market, but if it is expensive,

caregivers would not be able to afford them for each of the car seats they need, and that would be a reason for them to not purchase them.

- The solution must be lightweight and ours will weigh between 4.85 ounces and one pound. Car seats have weight limits, including the child in the seat. We must be able to have a solution that will fit within those requirements including a child. Also, if it is too heavy, it would not be portable which would make it inefficient as a device.
- The solution must be portable. Car seats are portable, therefore any device that is attached to it should be portable as well. If it is too heavy or too bulky, it may get in the way of the car seat and its safety features.
- The solution must be electrically safe. Since this device will be in relatively close contact with the child, it should be very safe and not a danger for catching on fire, or harming the child.

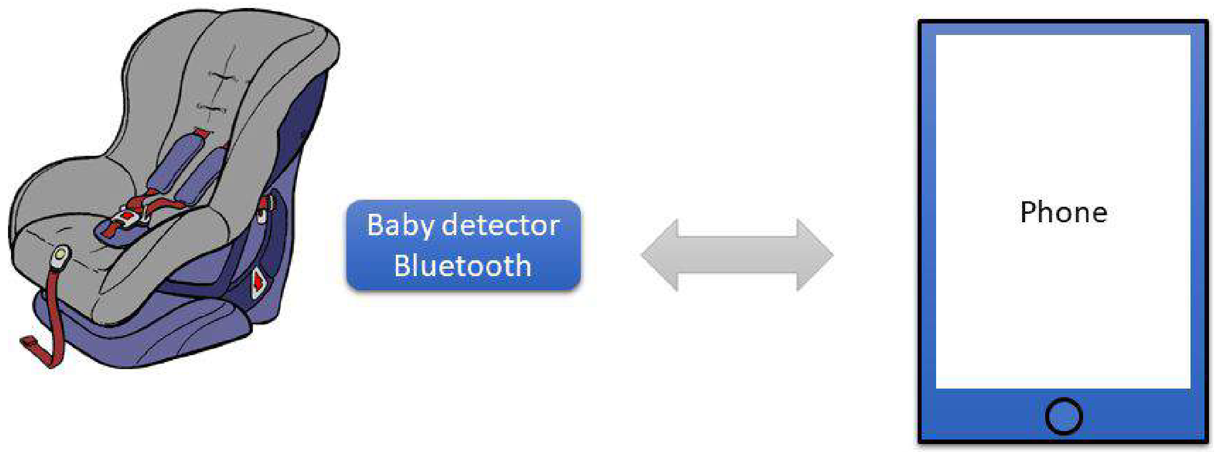
Based on your criteria and constraints, what is your proposed solution to the problem you chose? Explain what it will look like and how it will work. If you can, include a detailed, labeled drawing.

One of our solutions is using a device and a phone to remind caregivers when their child is in the vehicle. We needed to remind caregivers when their child is in the vehicle, and make sure that they go back to check to see if their child is still in the vehicle. We decided to use the cell phone since most people use their phones habitually, and over 75% of Americans own a cell phone.

Next we needed a device to be able to sense if the baby is in the car seat, which also connects wirelessly to the phone. For the wireless feature to work, we need a computer. Today, there are two widely used small computers for hobbies - Arduino and Raspberry Pi. Raspberry Pi uses Linux which takes awhile to boot up. Arduino is a much simpler device because it doesn’t have an Operating System, and our program can run instantaneously. So we chose Arduino over Raspberry Pi.

Furthermore, we needed to evaluate which wireless technology to use. Our options were Bluetooth, Wifi, Mobile Data, and NFC. Wifi network requires a full network stack, requiring an operating system, which we didn’t have with Arduino. Mobile Data requires a SIM card, which is complex to deal with and expensive. NFC’s range is too short for our use so we chose Bluetooth. After a little research, we found that there is a Bluetooth serial module for Arduino readily available on the market.

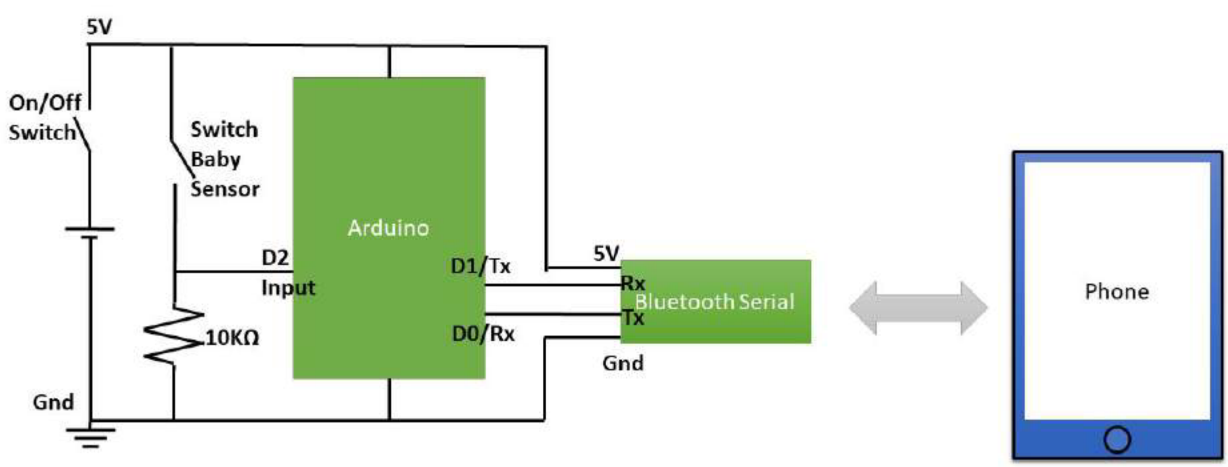
Our system would then look like the following



The idea is to have the Arduino baby detector connect to the phone via Bluetooth and tell the phone if the baby is in the seat or not. Bluetooth has a short range, under 100 meters. When caregivers walk away from the car, the Bluetooth connection will disconnect due to the distance. At that time, the phone can notify the caregiver if the last state communicated by the Arduino device is that the baby is in the car seat.

The system fits the criteria and is within our constraints. The system alerts the caregiver in a timely fashion. Furthermore, Arduino systems are small, inexpensive, light, portable, and readily available on the market. Bluetooth connections can connect quickly. Our system will keep track of whether the baby is in the car seat or not.

To test the device we will connect it to a car seat, and to a phone through our app, and make sure that when we walk away from the car, it will trigger our app. We will then measure the distance away from the car when our phone is notified.



How will you test your solution? The BEST way to test your solution is to build a working model or a prototype that you can actually use. OR you can guess how your solution will work BASED ON your research. Which method will you use and why?

We built a prototype and attached it to the car seat and placed the car seat in a vehicle and tested it to see if the device worked. We placed the car seat in the vehicle and strapped a bag of rice in the car seat in place of the child. We then left the “baby” in the car, walked away from the vehicle, and measured the distance at which the device sent a notification to remind us that the baby is in the vehicle. This allowed us to safely simulate leaving a baby in the vehicle without endangering any child, while testing how quickly the device would notify us that the baby remains in the vehicle. We walked away from the vehicle at a normal pace, a fast pace and a slow pace, to see if it would make any difference in the distance of notification. This was done to test different conditions caregivers might encounter when they leave a parked vehicle.

Build Model or Prototype

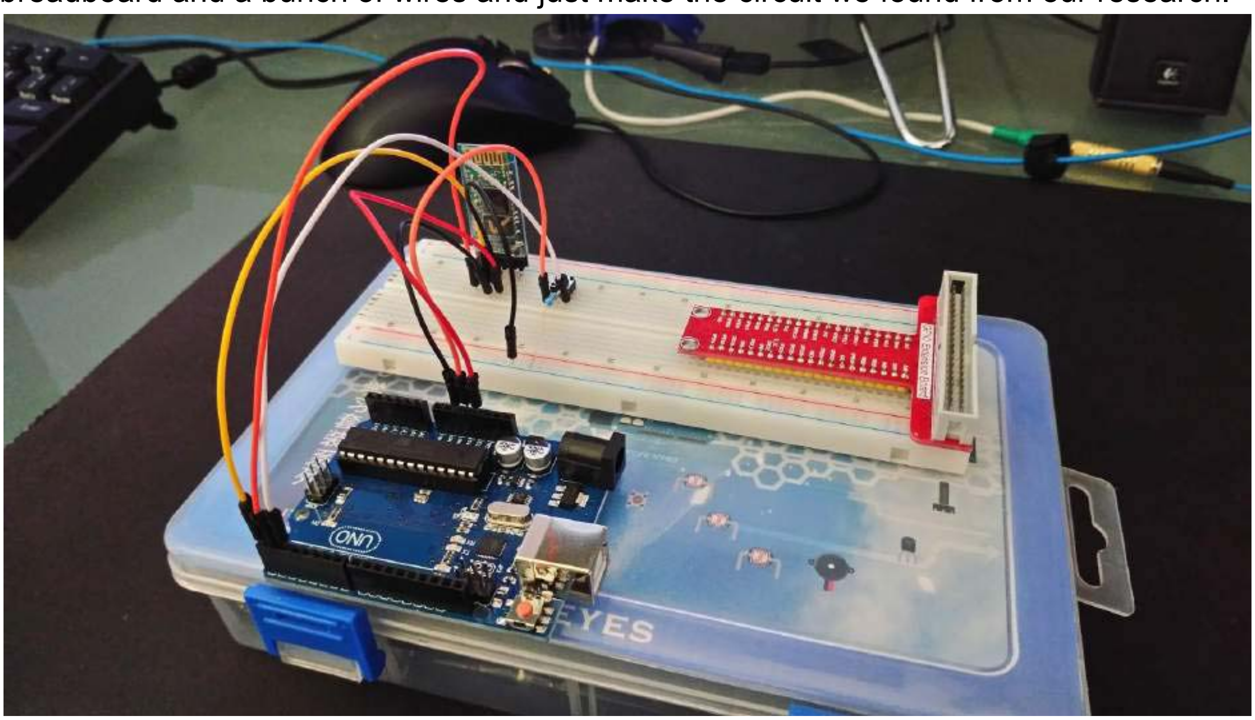
If you built a prototype or model, explain how you built your prototype or model, step-by-step including all safety precautions. If you guessed how your solution would work BASED ON your research, explain important information from your research that you used to prove how your solution would work and be sure to cite your sources.

Please see the team uploads to Engineering Design for photographs of each step of the process, data tables and graphs from the testing results, “App Development”, “Device Development”, “Project Summary”, “Engineering Board”, and “Mission Folder” which answers the questions from start to finish in an easier way to interpret the answers + the diagrams and photos.

The H.O.T. C.A.R.S. team was not satisfied with imagining a solution based on just the research we did together. Part of the research involved finding people who were already coming up with solutions to this problem and many of them proposed solutions to car seat manufacturers based on research alone. None of these solutions have been implemented by the car seat industry because of the high cost of retrofitting devices into existing seats and changing assembly lines to make device insertion part of the seat itself. Furthermore, others have ideas about alarms based on weight in the car seats; however, they are expensive and void the warranty of the car seat itself. Instead, we chose to design an idea for a solution and then build a working prototype that would include what we learned in research plus allow us to possibly seek a patent on a device that would be affordable for all families. In order to do this, a great deal of learning was required because at the ages of 11 and 12, we have not had extensive courses in computer science, computer coding, or app development. Fortunately, there are many tutorials online and mentors who would answer our questions. We were able to use both to come up with an effective and affordable car seat device and app for mobile phones.

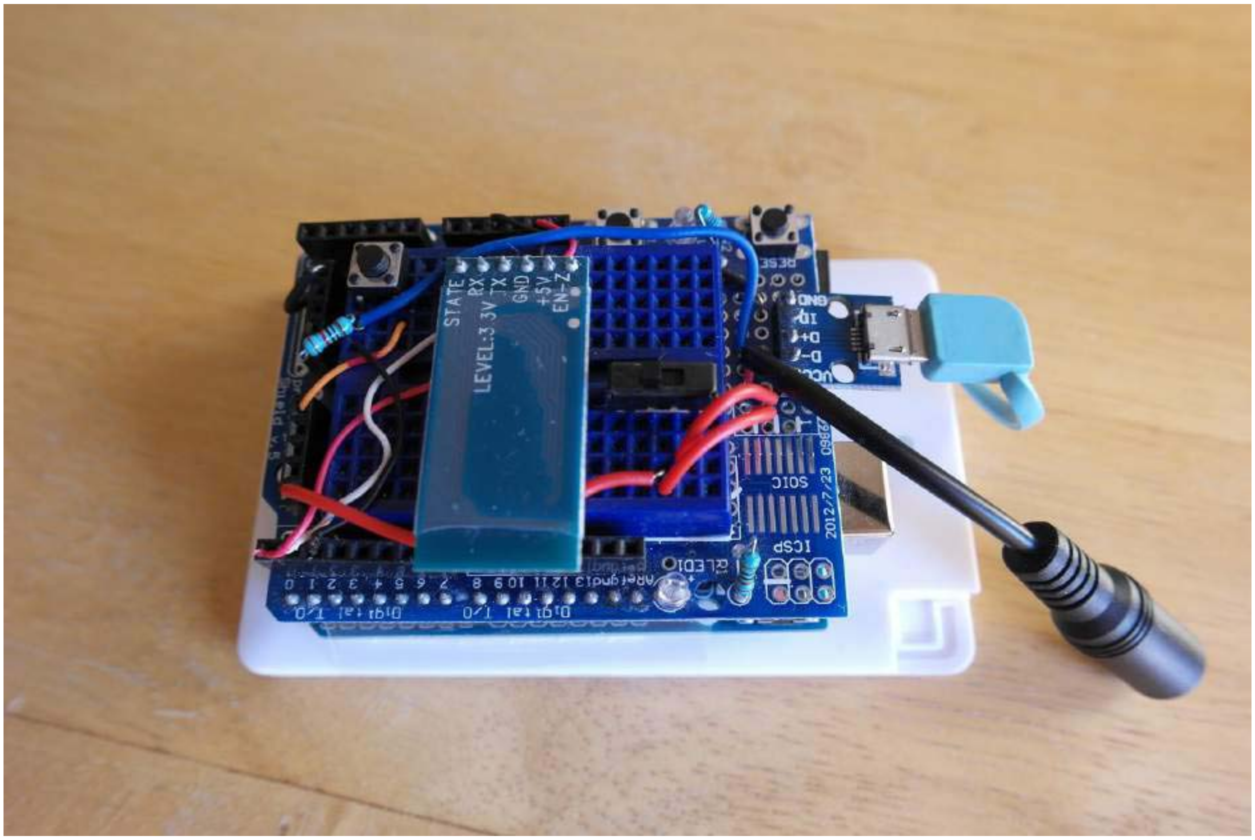
Our prototype consists of three different parts: A bluetooth device, the connection to the car-seat, and the phone app. We had to build each parts separately and tested them as we built them.

Bluetooth Device:
Building the device started with connecting the Arduino to a button switch and to a bluetooth serial module known as HC-05, then programming the arduino to send data through serial communication when the button was pressed down or whether it was up. Our initial prototype looked like this below. We used Arduino hobbyist kit along with a breadboard and a bunch of wires and just make the circuit we found from our research.



We then tested that by connecting it to a readily available Serial Bluetooth Terminal app from Google Play Store, to make sure that our device sent serial communication correctly, and it did, as shown in the picture below:

We then compacted the device by buying an Arduino breadboard shield to put on the top of the arduino, and rewired the device to fit a small seat. We also researched how to power the Arduino device properly, since we want a compact solution for the battery to power our system. We could power the Arduino system using a 9V alkaline battery with the barrel plug, which goes through the voltage regulator. Another option is to use a stable 5V power straight to Vin pin, which bypasses the voltage regulator. We happened to have compact USB rechargeable battery that offers stable 5V, and we decided to use that. The connection uses micro-USB pin, so we added that to our board. On top of that, we also added on/off switch and a mono audio jack so we can easily connect it to the car seat later. The result is shown below:

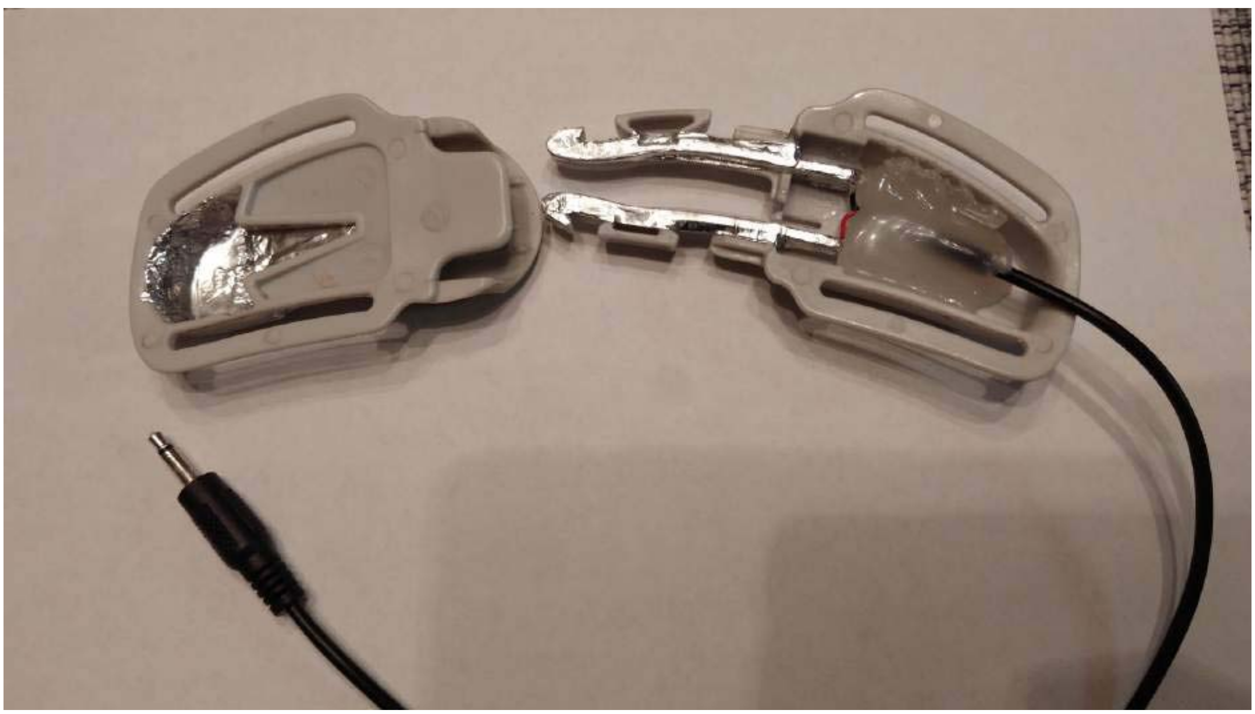


After that, we had to retest our circuit to make sure we moved it correctly from the original breadboard. So we re-tested it again with Serial Bluetooth Terminal app. Everything seems to be working.

Car Seat Connection:
We had to figure out how to connect our device to the car seat next. Our bluetooth device can only detect a connected/disconnected state of a button to communicate to the phone. So we needed a way so that when a baby is on the seat, something makes a connection, and when the baby is not on the seat, it disconnects. Initially we looked into using the weight of the baby to press a button on the seat. We wanted this mechanism to be comfortable to the baby, so we needed the button to be soft, but also reliable to handle light and heavy baby alike. This turns out to be harder than we thought.

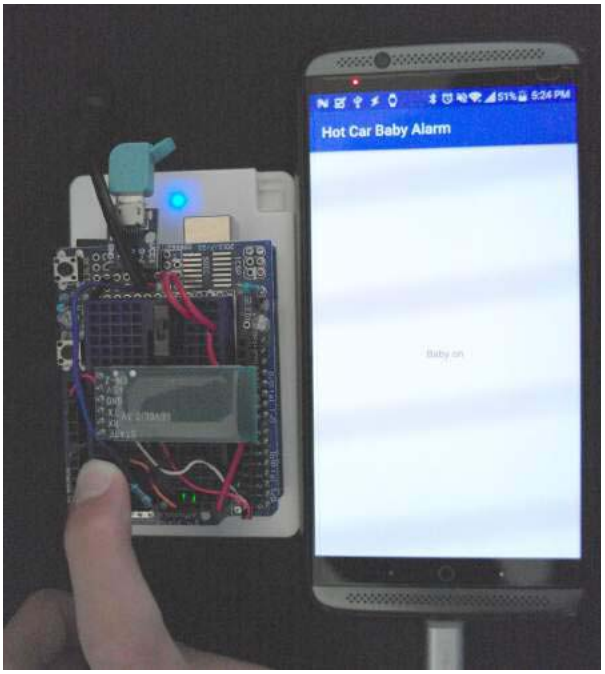
So we brainstormed some more on other detection mechanisms. When the baby is on the seat, the caregiver will always buckle them in, so we started looking into the buckle system. A safe baby car seat has a 5-point harness system with 2 different straps: the groin strap and the chest strap. The groin strap looks solid and has a metal part, and is not easy to get into. However, the chest straps are usually made from hard plastic with a simpler locking mechanism. After thinking about it some more, we found a way to make the chest strap “connect” when it is buckled, and “disconnect” otherwise.

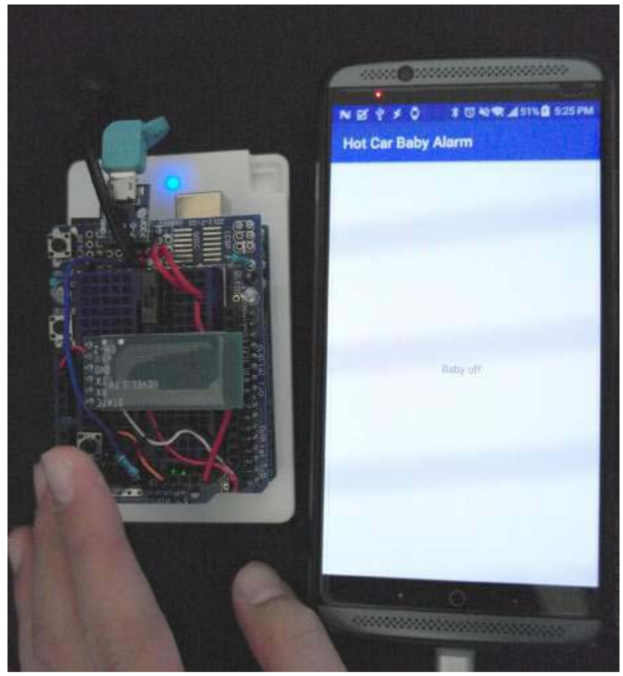
Here is how we modified the chest strap:



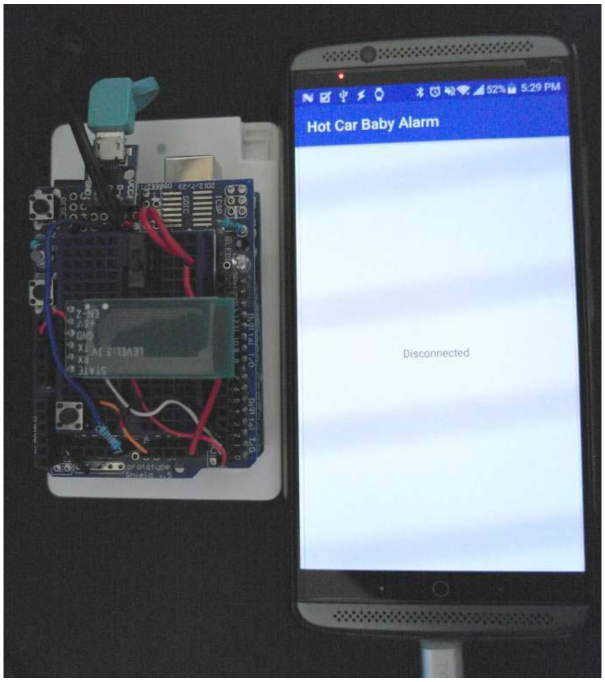
We basically lined the chest strap with aluminum tape, which is an acceptable conductor. We lined the “fork” side with aluminum tape, and attached our wire to it. On the inside of the other side of the buckle, we lined the whole thing with aluminum tape. This makes it so that when the chest strap is buckled, the two prongs of the fork will make a connection.

App Development:
We incorporated a serial library into our app. When we pressed the button, the device sent “1”, and our app detected it and we printed “Baby on”. When we let go of the button, the device sent “0”, and our app detected it, and we printed “Baby off”. Here are the pictures:

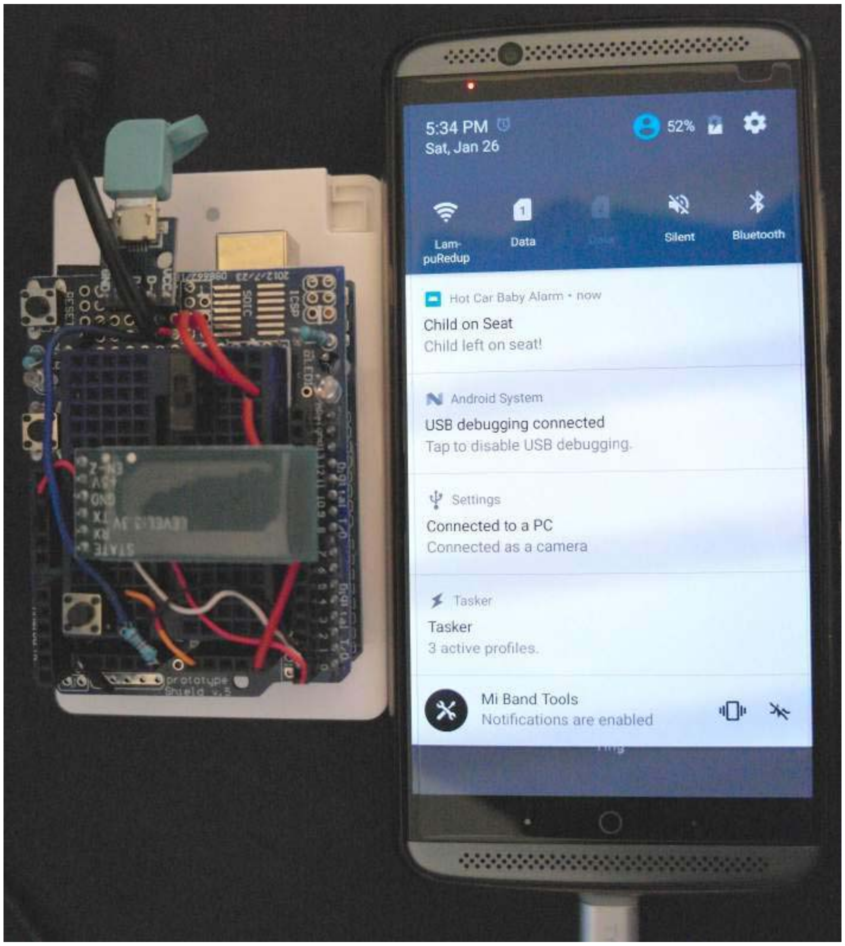




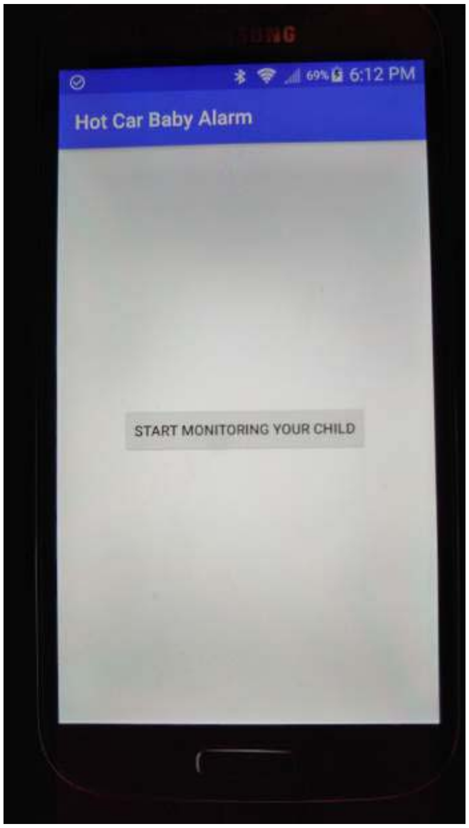
For our system to work, we needed to detect a Bluetooth serial disconnection, which indicates that the caregiver has walked out of range of the car seat. We needed to use the disconnection as a cue to when to send the notification. Thankfully, the Bluetooth serial library we used also offered a disconnection message. We sensed disconnection using a prebuilt message that is “BLUETOOTH_DISCONNECTED.” When we got this message, we would print on our app “Disconnected.” We tested this by connecting the device to the phone, and after they were connected, we turned off the device. After a couple of seconds, our app got the disconnection, and our app printed “disconnected” as planned:

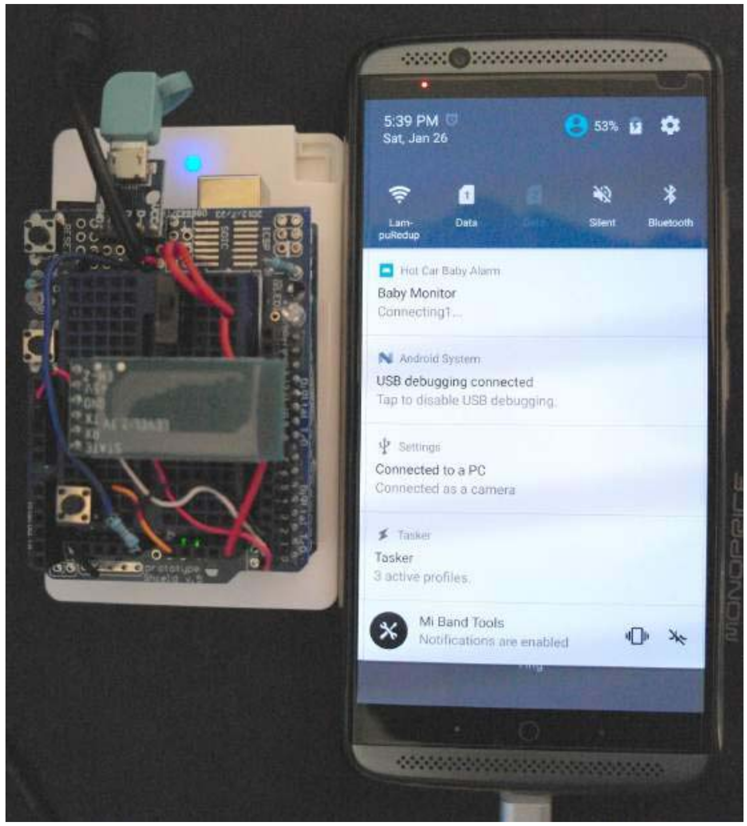


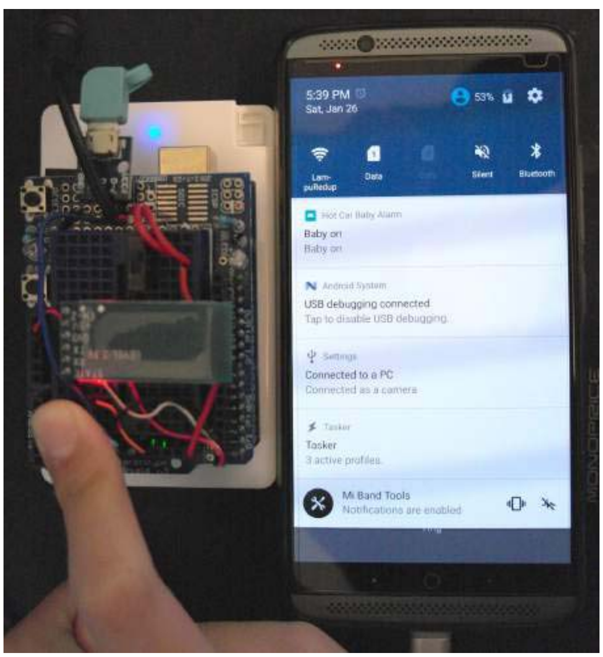
The next step on our list was to send notification to the user. We needed to do this when we got the disconnection message if we detected that a child is still in the car seat. Android has detailed documentation on how to send the user a notification, complete with an example code. We modified the example code and inserted it into the place of the code where we sensed a disconnection message from the previous step. We tested it by connecting the device to our phone. Then we pressed the button, indicating a child is on the seat, and then we turned off our device. After a couple of seconds, our app sensed the disconnection and now it also sent the notification to the user as pictured below.

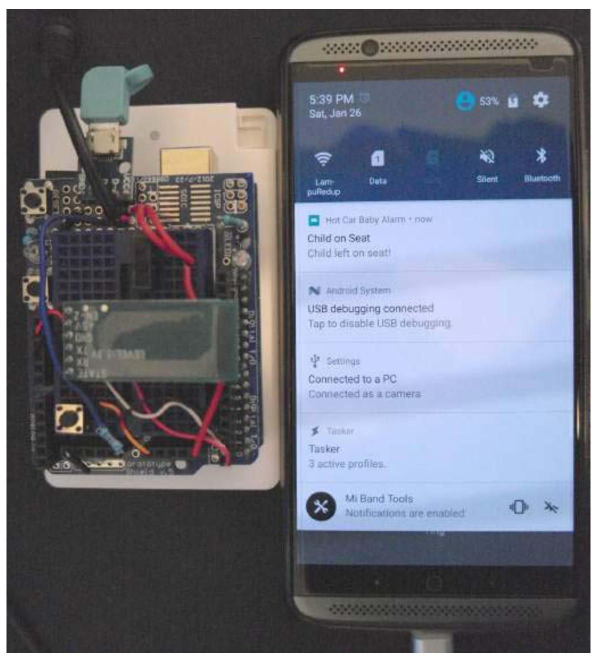


During our testing, we found that if we switch to another app, then our app will fail to send a notification to the user. This is because our app is paused by Android whenever the user switches apps. For our system to work, our app needs to keep working in the background. It turned out that we needed to use Android Service to make our app work in the background so we had to research how to use Android Service with our app. We also had to figure out how our app would communicate with the service. In the end, we decided to keep it simple. Our main app basically just needed a button to launch the service, and the service will take care of everything. So we moved all our logic from the app into the service, and put a button on the app to simply launch the service. We tested everything again after we were done. Now our app and the notification looks like the following:

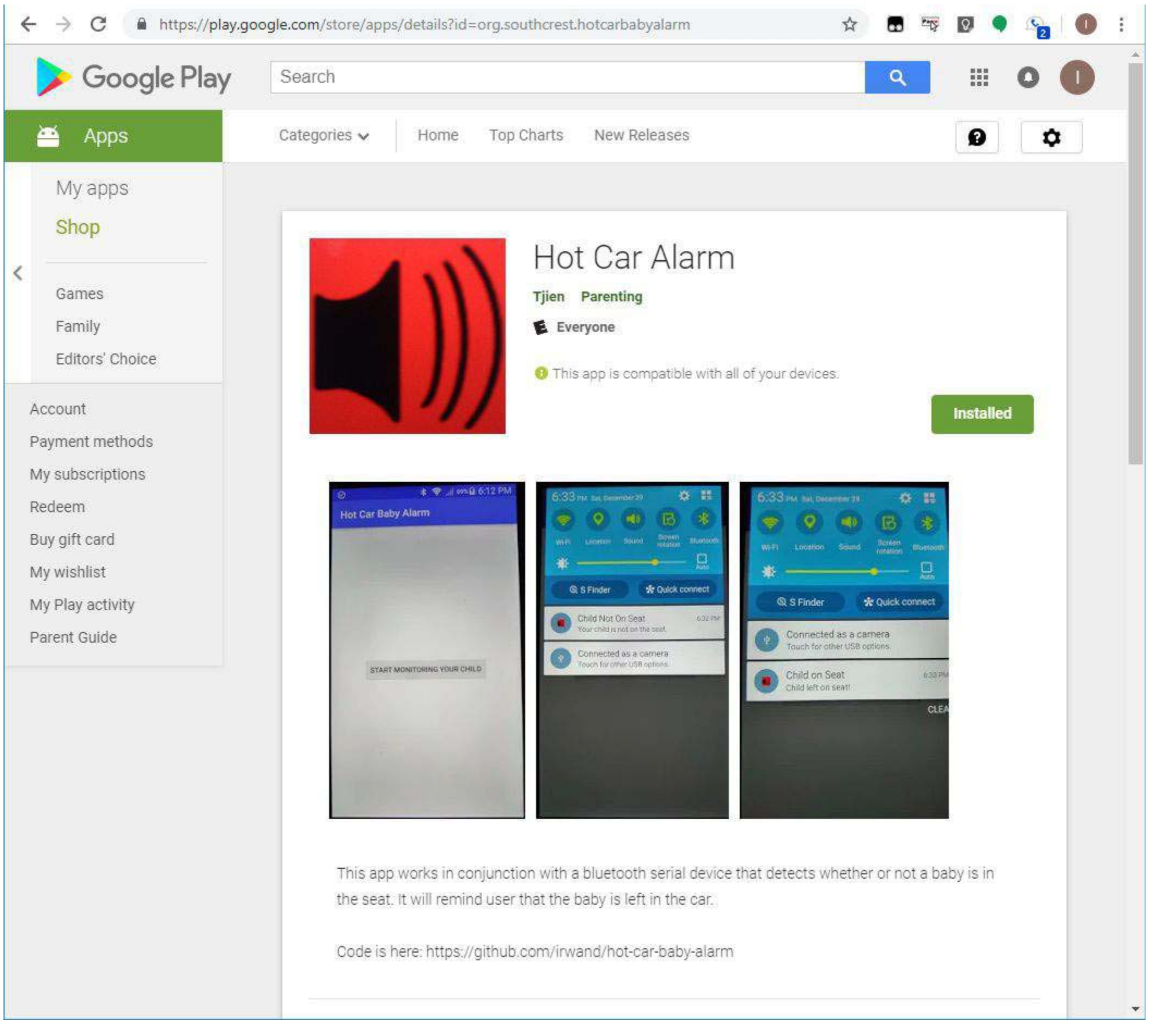








After it's completed we worked on uploading our app into Google Play Store. Once it is there, it is easier to download our app to any Android phone.



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Test Model or Prototype

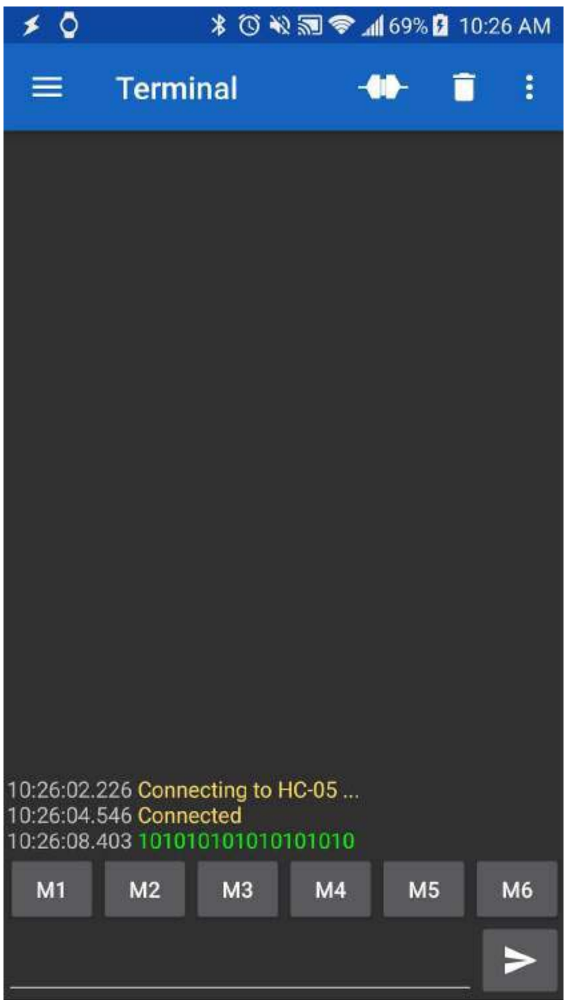
Explain how you tested your prototype or model. Be sure to include every step of your testing including all safety precautions that were taken. If not stated it will be assumed no safety precautions were taken. If you are using research to guess how your solution will work, explain step-by-step how it will work and why.

We tested each part of the prototype as we worked on them, as explained below. At the end of testing, we assembled the entire system and retested it as a unit.

Bluetooth Device:

While working with Arduino, we researched how to power the Arduino system properly to mitigate the possibility of our device overloading with power and having accidents. We also took care not to electrocute ourselves by shorting any of the batteries.

We tested our Bluetooth device initially using a readily available Serial Bluetooth Terminal app from Google Play Store. This easily connects to the Bluetooth serial module, HC-05, that we use. From the information from our research, we programmed the Arduino device to detect state-change of a button switch, so that it sent “1” when the button is pressed, and “0” when we release. So once we powered the Arduino and connected the device to our Serial Bluetooth Terminal, we pressed and released the button multiple times, and we got “101010…” as shown below.



After we moved our circuitry to the breadboard Arduino shield, we re-tested using the same mechanism, with the Serial Bluetooth Terminal app.

Car Seat Connection:

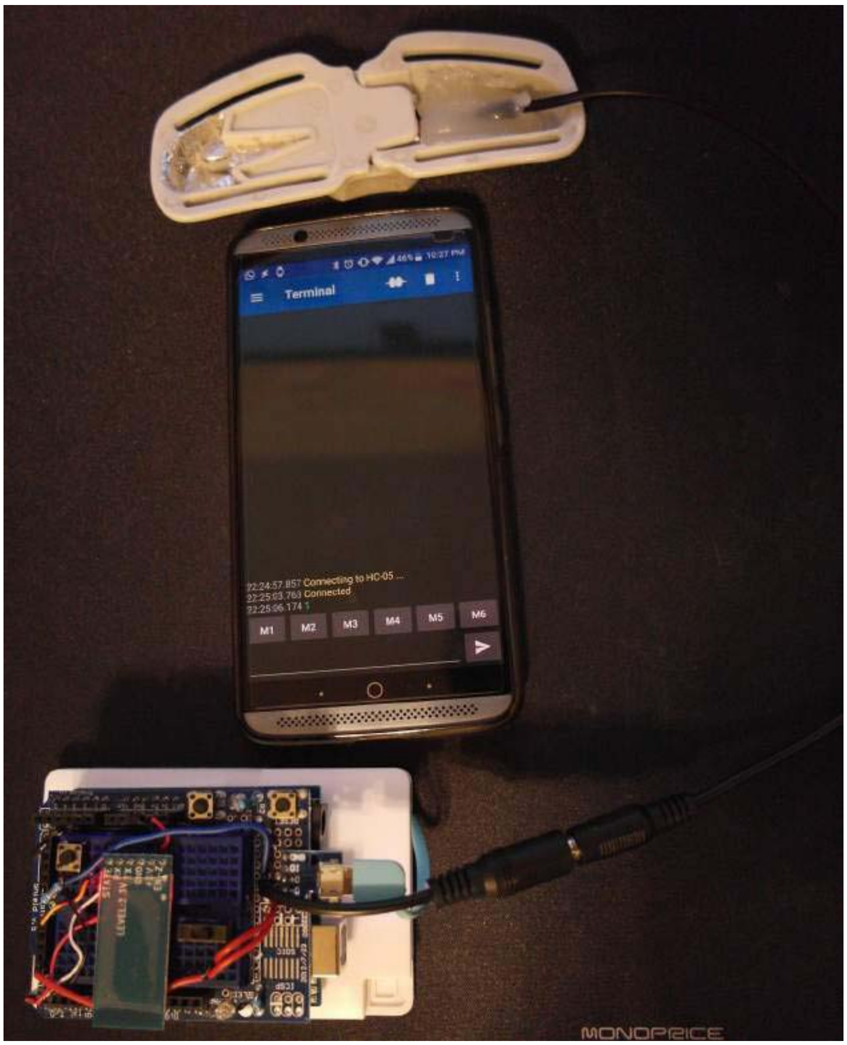
Testing the car seat connection basically involved measuring the resistance of the aluminum tape once we buckle the chest strap together. Here are the steps:

- We buckled the chest strap
- We used a digital multimeter to test the connection through the aluminum tape by measuring the resistance between the two terminal from the mono audio jack, which later connects to the Bluetooth device.
- We found that the connection has low resistance, about 11Ω (Ohms) which is low enough to indicate a connection
- We connected and disconnected the buckle and tested repeatedly

Test number	**Resistance (Ω)**
1	11.3
2	12.1
3	9.1

4	10.5
Average	10.75

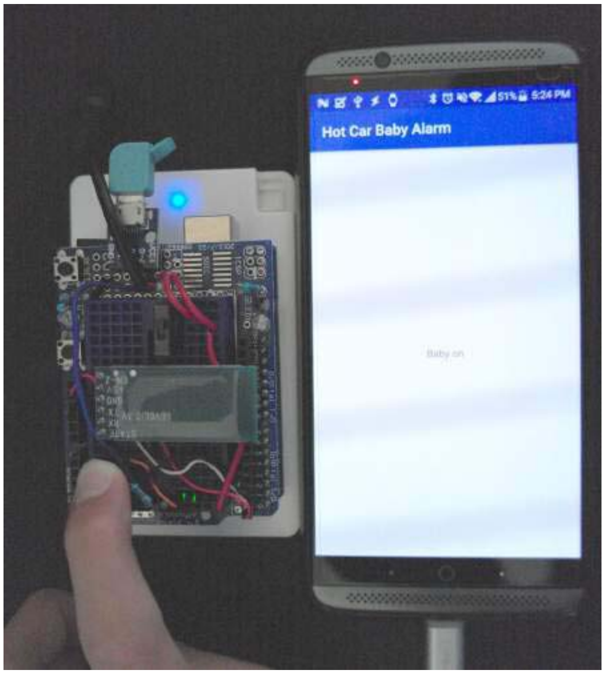
It turns out that on average, the resistance was about 11Ω, which was low enough for our bluetooth device to detect a connection. We made sure this was the case, by testing the chest strap with our Bluetooth device and made sure that it sent “1” to the Serial Bluetooth Terminal app we used, indicating that our device detected a connection.

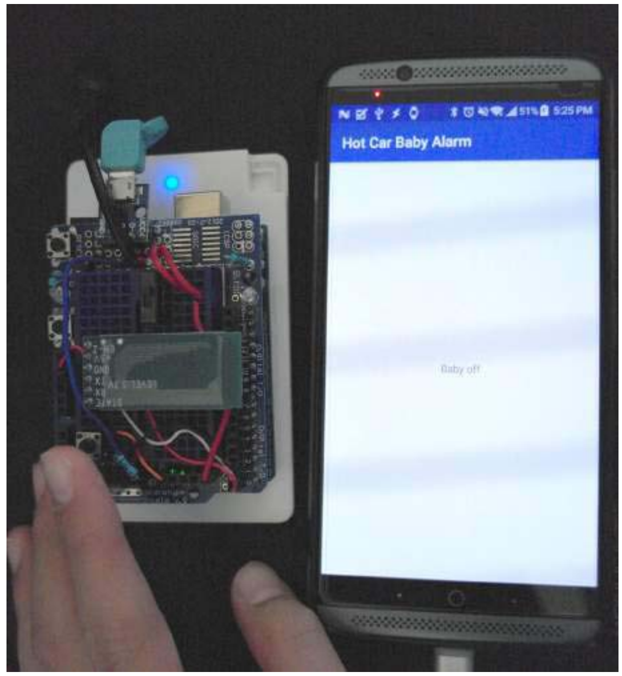


App Development:

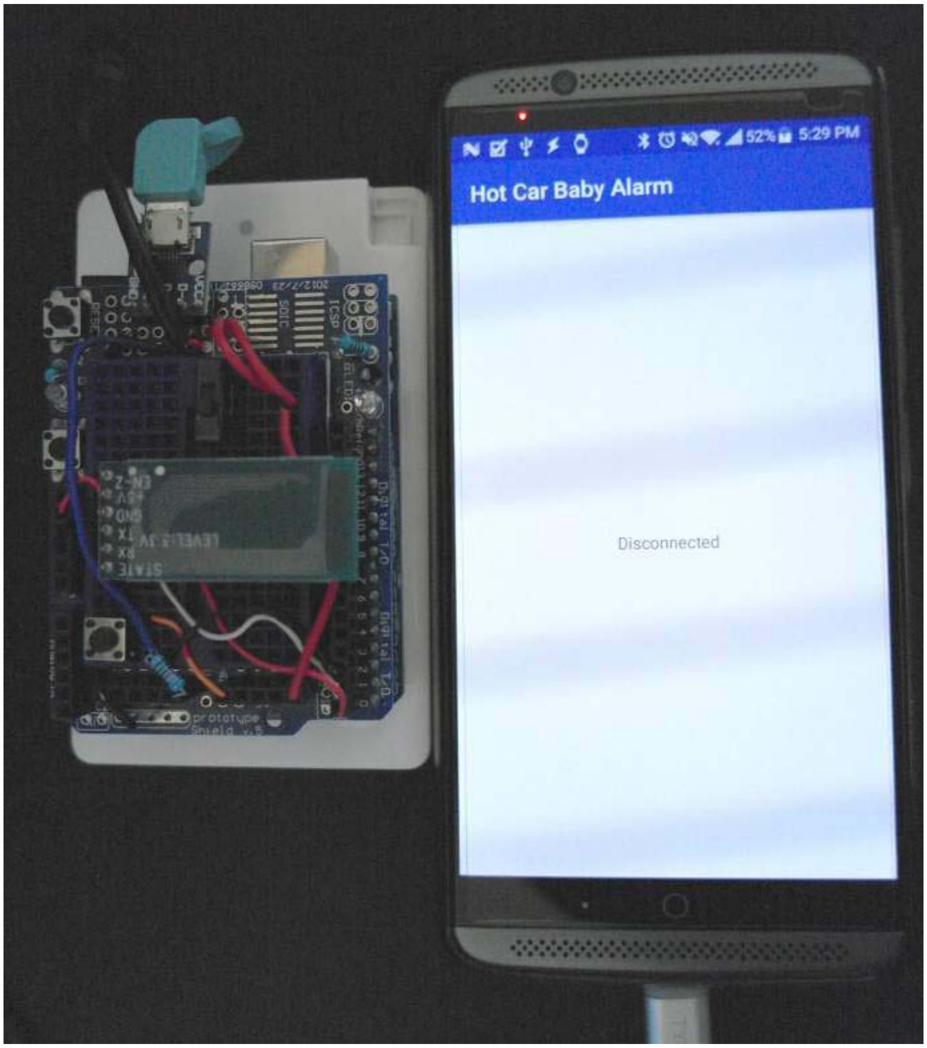
We tested the app in several stages, as we got the next feature implemented in the software.

The first thing we had to implement once we got the basic app from the tutorial, was to get Bluetooth serial working. We found a library online that helped us to do this. We coded into our app such that if we read a “1”, we printed “Baby on”, and when we read “0”, we printed “Baby off”. We got it working. Here are the pictures:

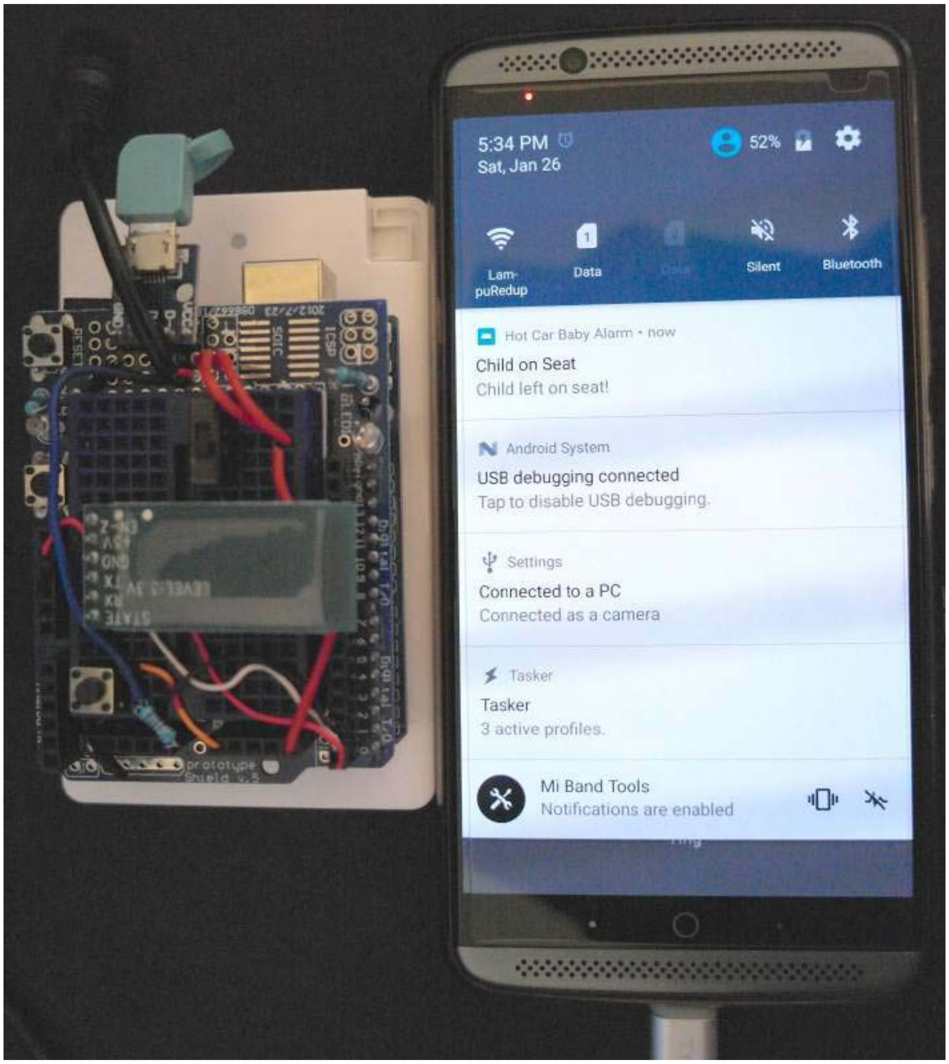




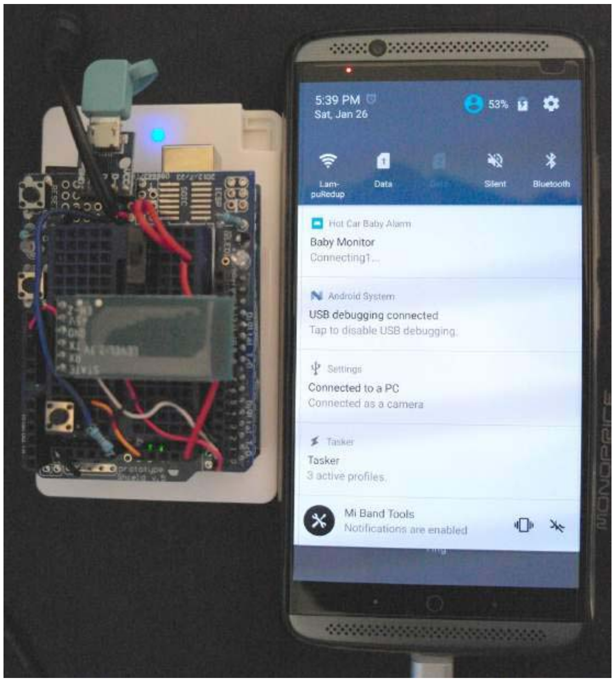
Next, for our system to work, we needed to detect a Bluetooth serial disconnection, which indicates that the caregiver has walked out of range of the car seat. The Bluetooth serial library we used also offered a disconnection message. We programmed the handling of the Bluetooth disconnection message by printing “disconnected”. We tested this by connecting the device to the phone, and after they were connected, we turned off the device. After a couple of seconds, our app got the disconnection, and our app printed “Disconnected” as planned:

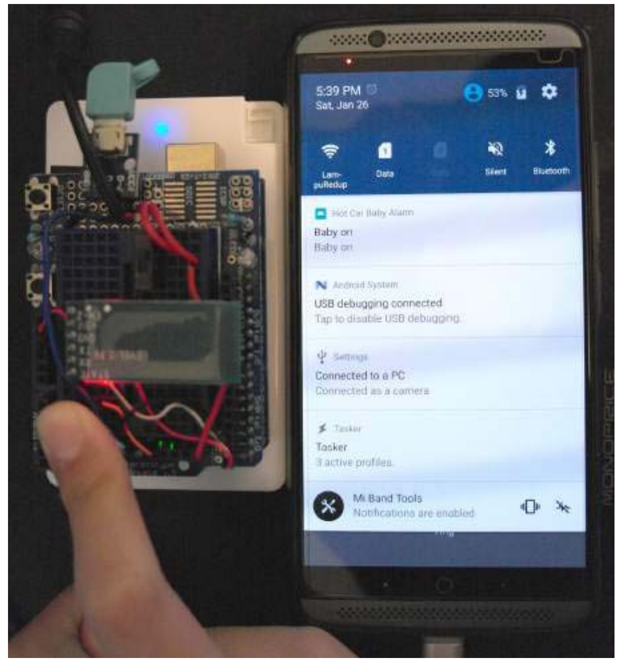


The next step on our list was to send notification to the user. We programmed sending notification based on Android's excellent documentation, which we inserted into the place of the code where we sensed a disconnection message from the previous step. We tested it by connecting the device to our phone. Then we pressed a button, indicating a child is on the seat, and then we turned off our device. After a couple of seconds, our app sensed the disconnection and now it also sent the notification to the user as pictured below.

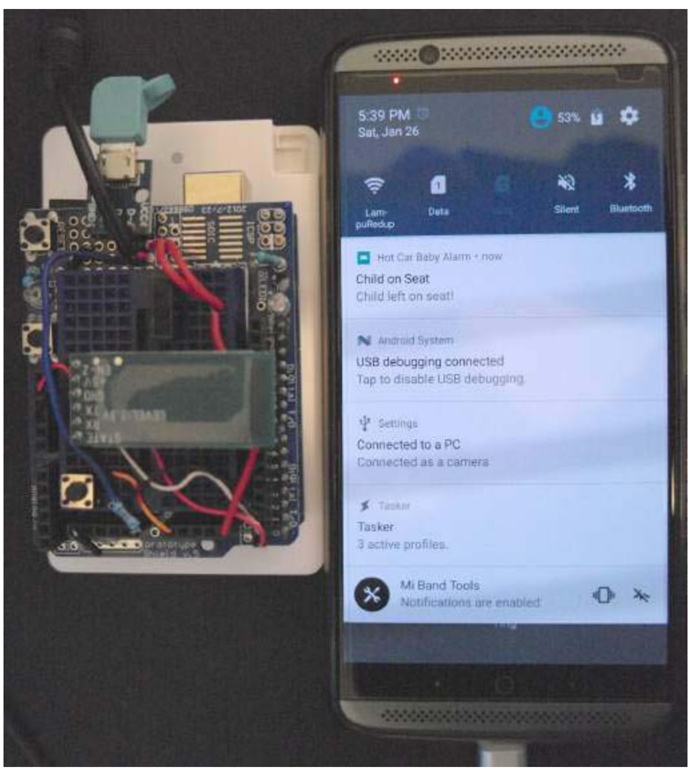


During testing, we found that Android would pause our app when user switched to another app, which makes the notification to stop working. This would totally render our app useless. To get around this, we had to use Android Service to make our app be able to keep running in the background. After we researched how to use a Service and moved our existing logic into the Service, we had to retest. The pictures below shows when our service was trying to connect to our device, indicated by “Connecting…” and detecting the button press, indicated by “Baby on”.





Finally, we also tested to make sure that user notification is working correctly in our service. So while still having the button pressed, indicating a child is in the car seat, we turned off our Bluetooth device. Within a couple of seconds, our device detected the Bluetooth disconnection and that a child was in the seat, so it sent a user notification. And it worked.



System Test:

By this time we had all the parts for our system, so now it was time to do the system test. We took a car to a parking lot, then we strapped a bag of rice in our car seat to simulate a baby, and connected the chest strap to our bluetooth device.

We then did these sequences repeatedly:

1. We paired our Bluetooth device to a phone.
2. We verified that our app detected that a child is on the seat.
3. We closed the car door and walked away from the car until the app sends the notification.
4. We measured our distance to the car.

Here are some pictures from doing this test:

We did this test 20 times and found that the phone sent the notification an average distance of 82.8 feet away from the car.

This is our graph:

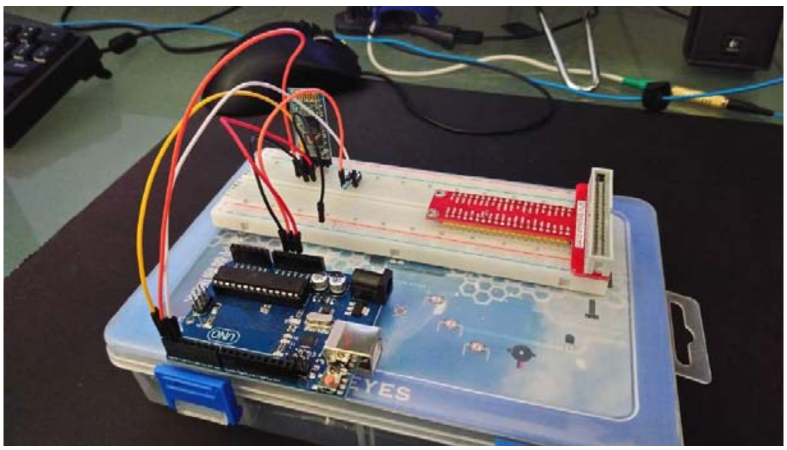
Test number	Distance (ft)
1	60
2	91
3	115
4	174
5	48
6	63
7	45
8	70
9	105
10	97
11	109
12	87
13	73
14	54
15	62
16	34
17	74
18	58
19	170
20	67
Average	82.8

We found that on average, the notification is sent about 83 ft away from the car. But the data spans over a large range, from 40 ft to 160 ft for notification. We are happy that Bluetooth will always disconnects correctly after a certain distance.

What problems did you find with your solution? Be specific since you will need to redesign based on these problems.

25 Points: Explains AT LEAST 1 problem encountered during testing OR proposed testing (if not able to build prototype), problem(s) encountered is/are explained in detail, and is very clear and free of spelling and grammar mistakes

We found that the first prototype of our bluetooth device with the large breadboard was too brittle and too big for putting in a car seat.



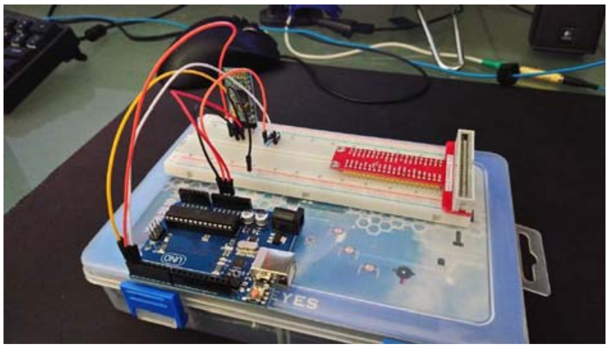
Also, when we worked on the chest strap by lining the inside with aluminum tape, the connection was not very solid. When we jiggled the buckled chest strap, the connection kept disconnecting. We kept adding more layers of aluminum tape to make sure the aluminum tape touches the proper parts when the chest strap was buckled. This ensured the solution would be effective.

When we worked on the app, we found that our app would stop working when the user switches to another app. This prompted us to do more research on how to get our app to work in the background on the phone.

Also, while testing, we thought that it would be better if the notification to the caregiver could continually make the phone ring. Currently, it sends a notification, which the caregiver could miss.

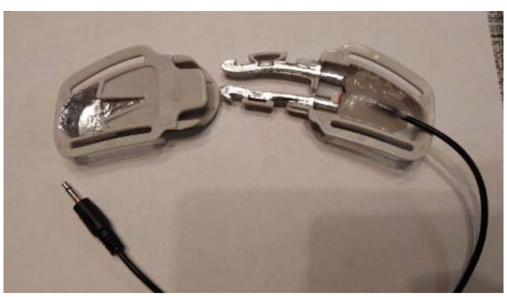
Describe all of the changes you made to your prototype or model (or proposed prototype) after your first test. Why will these changes improve your solution?

For the Bluetooth device, from the first design to the second, we changed the way the machine connected by buying an Arduino shield with breadboard and moved our circuit to the shield. See the difference:



Arduino shield attaches right on top of the Arduino board, making all the connections more solid and the device more compact.

While working on the chest strap, our first prototype did not establish a very dependable connection.



We found that as the chest strap was buckled, it was still a little loose, and we could jiggle it. When we did this, we found that the connection keeps connecting and disconnecting. The solution we came up with was to make the aluminum lining thicker by adding more aluminum tape on the inside of the left piece (the one receiving the fork part of the strap). After we did this, it was a little harder to buckle the chest strap, but we no longer had a problem with the connection. We re-tested it by making sure the connection was stable:

While working on the app we found that our app stopped working if the user switched to another app. To make our app run in the background, we had to use Android Service. We moved our existing logic into the Android Service, and decided that our app would simply launch the Android Service using a button. We tested this by making sure user will get a notification as we switch to another app, or even if the user put the device to sleep by pressing the power button.

Present the data you collected from your tests or from your research. If you tested a prototype or model then include all of the numbers you gathered during your testing and all observations you made. Use of graphs and charts is HIGHLY encouraged. If you used research to prove how your solution would work, be sure to include all of the numbers, charts, and graphs you used to make your case.

Please see uploads of the additional data tables and graphs from all our testing.

When we tested the resistance of our aluminum-tape-lined chest strap connection, here is the data we got:

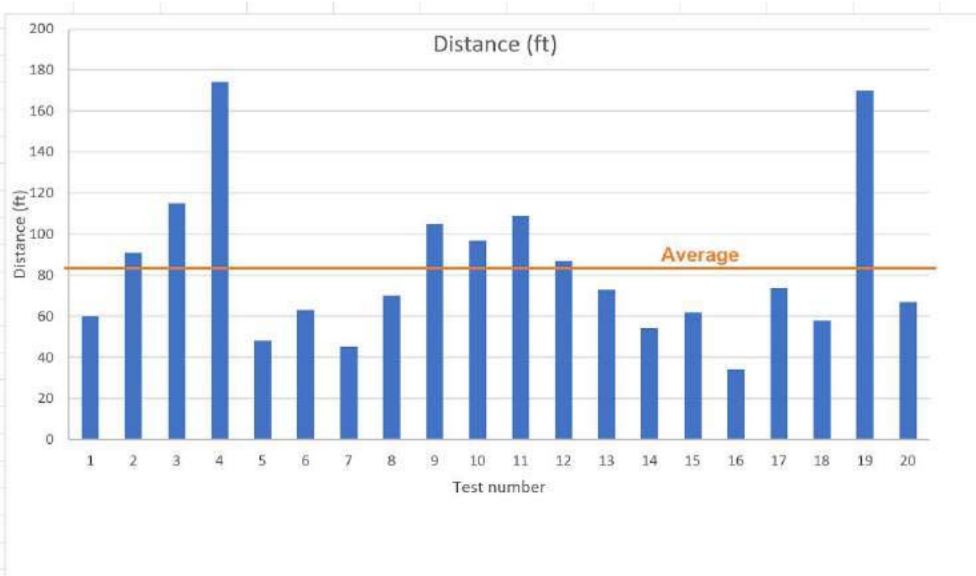
Test number	Resistance (Ω)
1	11.3
2	12.1

3	9.1
4	10.5
Average	10.75

We learned from the data that aluminum can conduct a signal and it works effectively for our device. In the future, the team could try copper tape, as copper is a better conductor than aluminum but it is also more expensive and can overheat more easily.

We did our system test by measuring the distance from the car, with the “forgotten” rice-child in the car seat, to when our app sent us the notification. We did this experiment 20 times, and here is the data we gathered:

Test number	Distance (ft)
1	60
2	91
3	115
4	174
5	48
6	63
7	45
8	70
9	105
10	97
11	109
12	87
13	73
14	54
15	62
16	34
17	74
18	58
19	170
20	67
Average	82.8



From the data we learned that bluetooth will eventually disconnect. However, we were surprised by the wide range of distance when the disconnection happens. We initially thought it would be more consistent.

The solution to this problem involved both the technical and engineering device to alert parents of a child in the car, as well as a public outreach and educational component. The dual approach to solving the problem involved surveying parents about their knowledge of hot car deaths. Below is the Survey Monkey linked to an informational pamphlet and the results of this data collection.
Survey Monkey - How to find out what the public thinks about Hot Car Deaths.

Page 1 of "Hot Car Deaths of Children" pamphlet created by the team. The pamphlet is referred to in the survey.

Team Name:

H.O.T. C.A.R.S.

Heat **O**verwhelms **T**aking **C**hildren **A**way **R**amification **S**addening

We are a team of students in the 6th grade from Southcrest Christian School who are citizen scientists for our school science program, "Science Rocks U," to make a difference in the world through STEM. The local problem we decided to research and provide a possible solution for is the prevention of hot car deaths of children.

Our solution includes an app for your phone that alerts you if a child is left in their car seat. An attachment to the buckle enables this process. Check out our website (www.babyinhotcars.weebly.com) for more information. We have also created this pamphlet to make parents aware of hot car deaths in general as well as a key chain to help parents remember to "Look B4 you lock."

Alexa

Ethan

Josiah

Did you know?

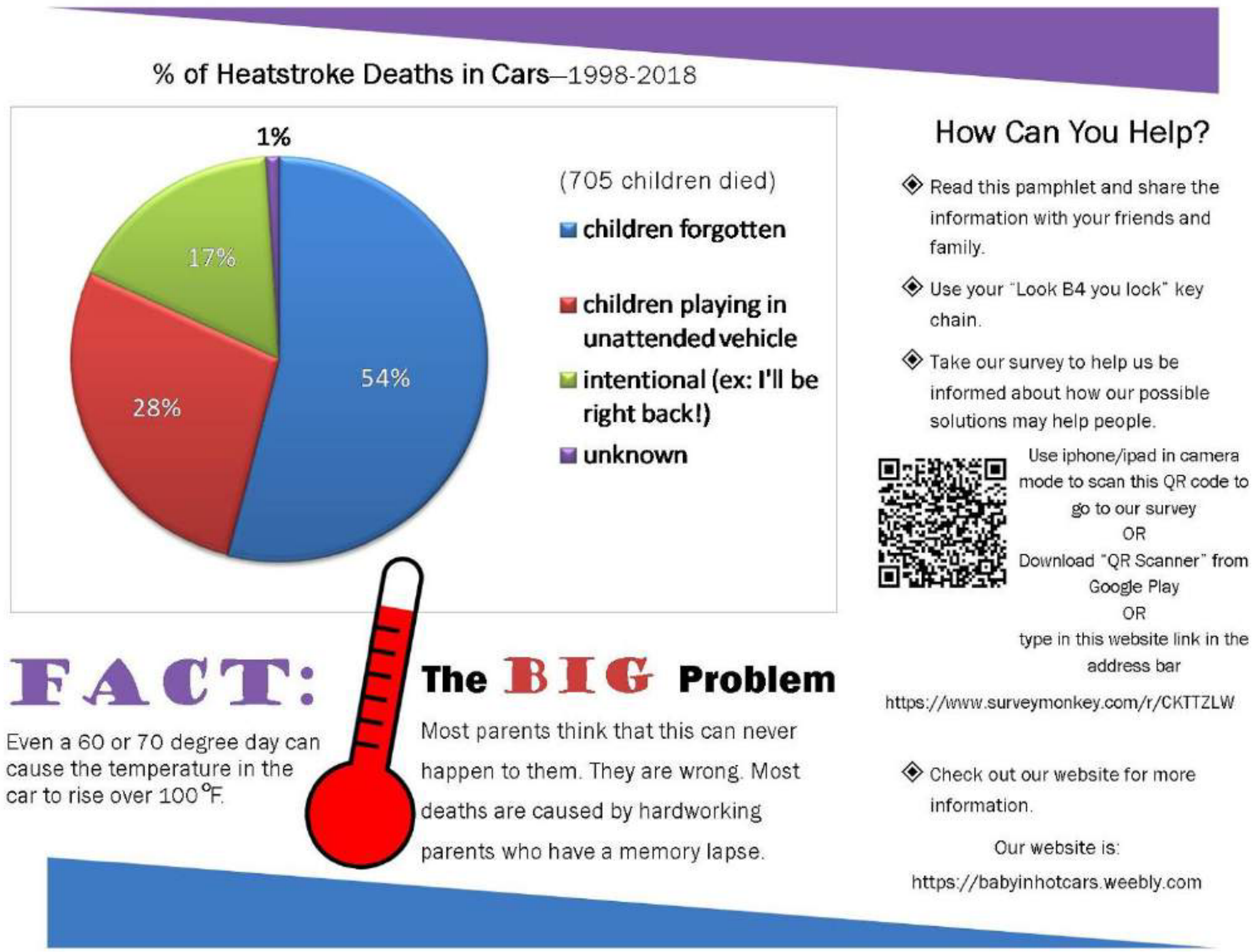
- More children have died from hot car deaths than front seat airbags.
- 21 U.S. states have some kind of law about leaving a child alone in a car.
- Your brain can create false memories of leaving a child with caregiver.
- Routine changes are the most common way for parents to leave a child in a car.

Resources:

1. Dr. Amy Thompson, CEO of Covenant Children's Hospital, Lubbock, TX, pediatric hospitalist
2. www.noheatstroke.org
3. www.kidsandcars.org
4. MS Publisher Clipart

Hot Car Deaths of Children

Page 2 of Hot Car Deaths of Children pamphlet created by the team.



% of Heatstroke Deaths in Cars—1998-2018

(705 children died)

- children forgotten — 54%
- children playing in unattended vehicle — 28%
- intentional (ex: I'll be right back!) — 17%
- unknown — 1%

FACT:

Even a 60 or 70 degree day can cause the temperature in the car to rise over 100°F.

The BIG Problem

Most parents think that this can never happen to them. They are wrong. Most deaths are caused by hardworking parents who have a memory lapse.

How Can You Help?

- Read this pamphlet and share the information with your friends and family.
- Use your "Look B4 you lock" key chain.
- Take our survey to help us be informed about how our possible solutions may help people.

Use iphone/ipad in camera mode to scan this QR code to go to our survey
OR
Download "QR Scanner" from Google Play
OR
type in this website link in the address bar

https://www.surveymonkey.com/r/CKTTZLW

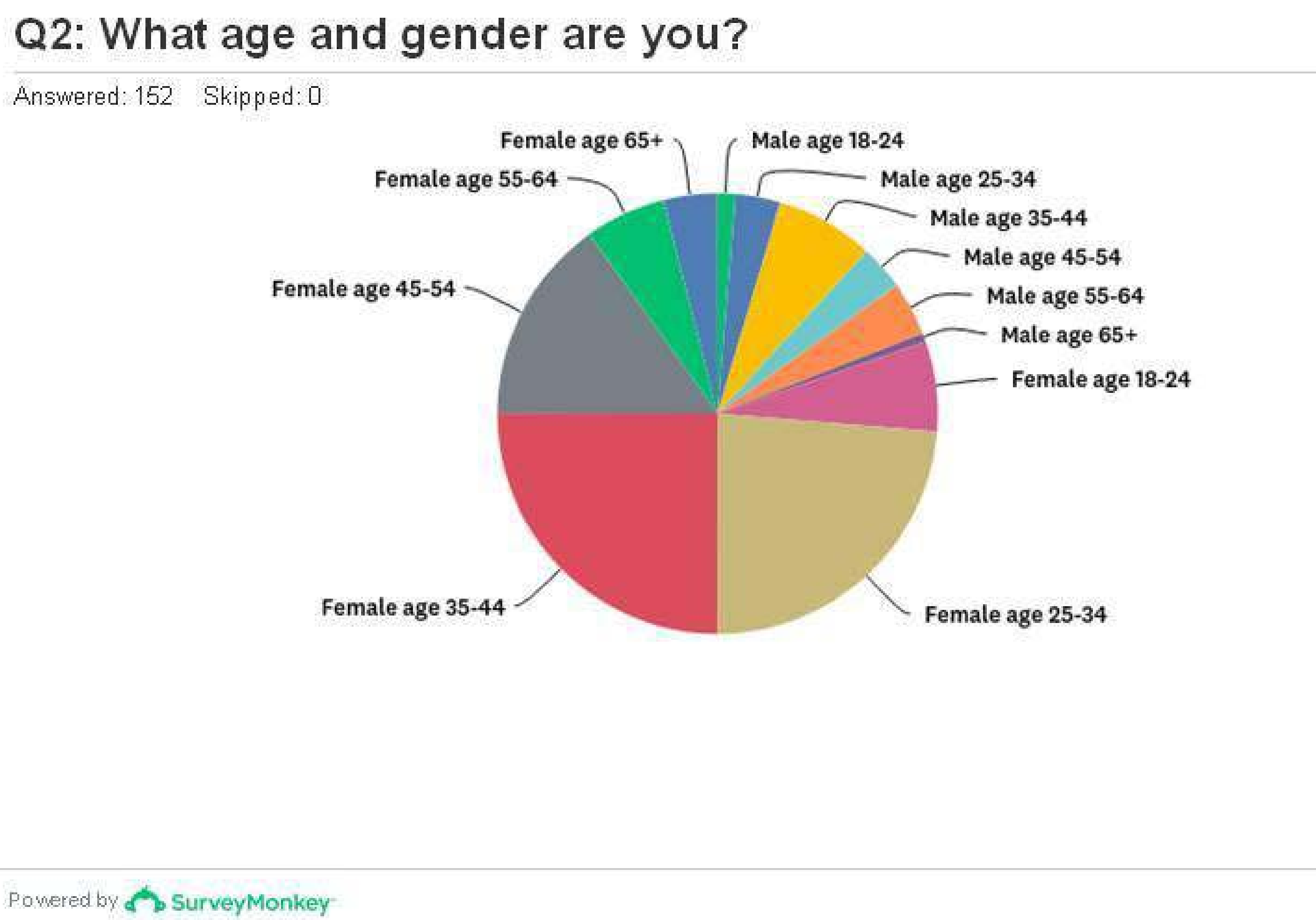
- Check out our website for more information.

Our website is:
https://babyinhotcars.weebly.com

Pamphlet and keychain.

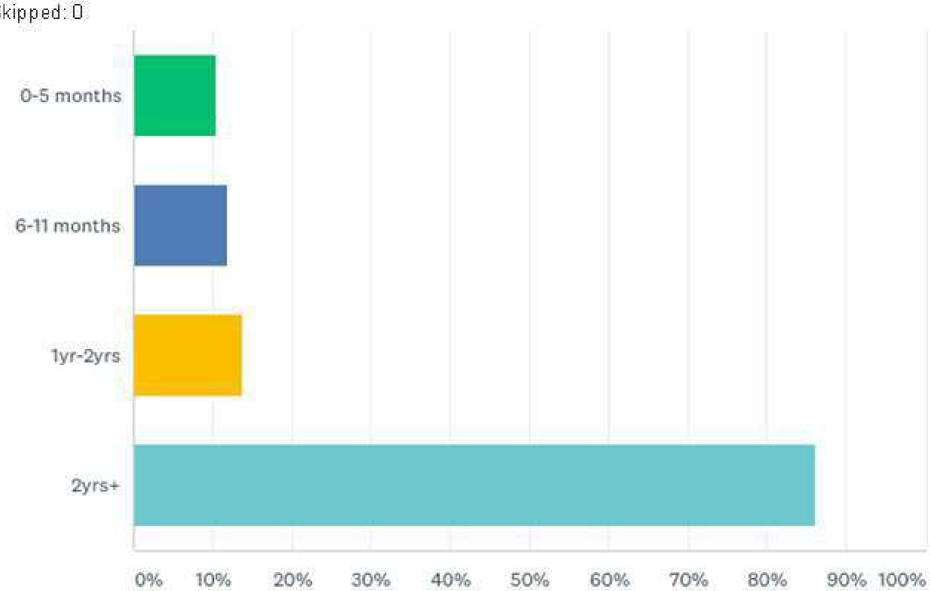
Survey

The team decided to create a survey using “Survey Monkey” online in order find out what the general public thought about “Hot Car Deaths” as well as opinions on the pamphlet and key chain created by the team. The questions were designed to collect information from parents who had read over the “Hot Car” pamphlet. We collected demographic information including age group, gender, how often you drive the child(ren), and what age group does your child(ren) fall into. We also asked the parents to rate different areas such as “How effective do you think the trifold pamphlet was at educating about hot car deaths?” , “Would a bright colored key chain help remind you of the child(ren) in the car with you?”, as well “Would you be interested in an attachment that would go on the buckle of your child's car seat to alert your phone through an app that the child has been left in the car?”. After receiving 157 responses to the survey, we feel that we have a well-represented cross-section of our community to analyze.



Q3: How old is/are the child(ren) in your care? Select all that apply.

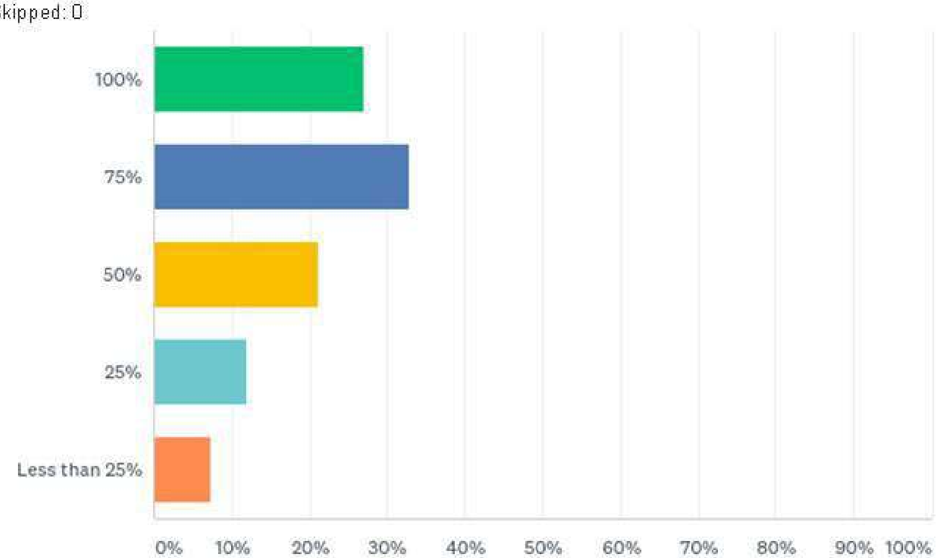
Answered: 152 Skipped: 0



Powered by SurveyMonkey

Q4: What percentage of time do you drive the child(ren)?

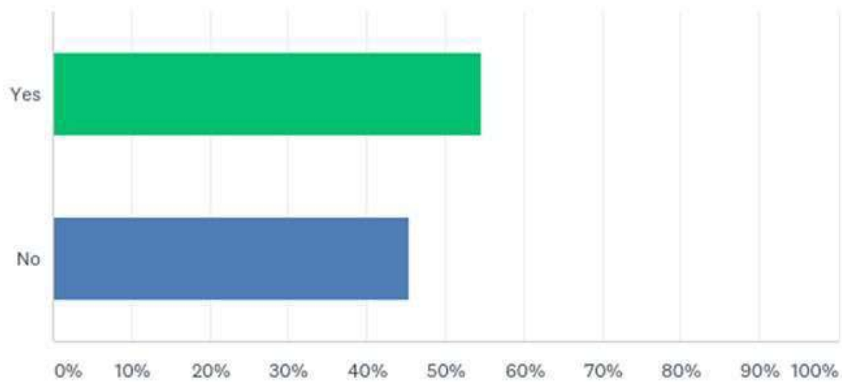
Answered: 152 Skipped: 0



Powered by SurveyMonkey

Q5: Would a bright colored key chain help remind you of the child(ren) in the car with you?

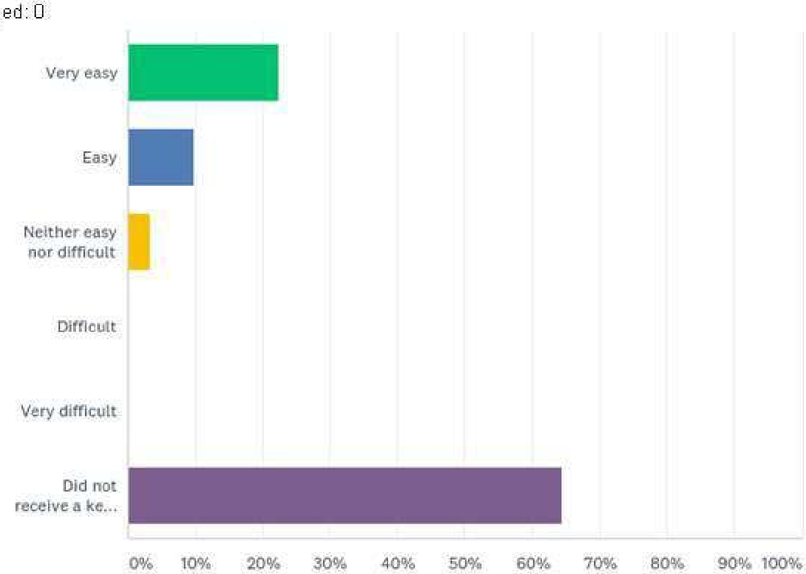
Answered: 152   Skipped: 0



Powered by SurveyMonkey

Q6: If you received a key chain, rate how easy the was to use.

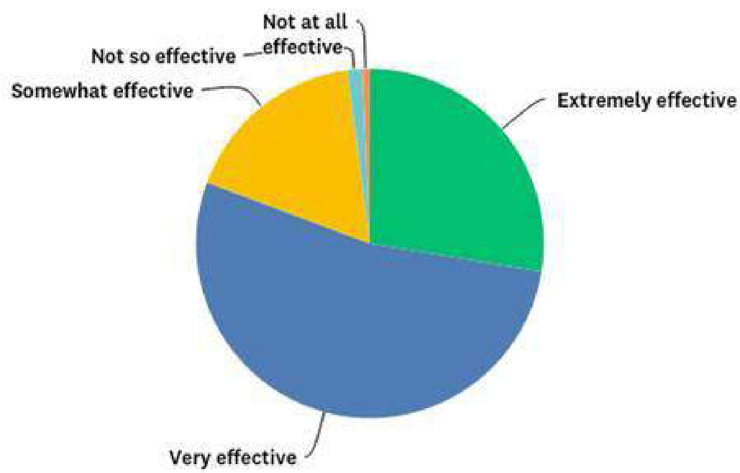
Answered: 152   Skipped: 0



Powered by SurveyMonkey

Q7: How effective do you think the trifold pamphlet was at educating about hot car deaths?

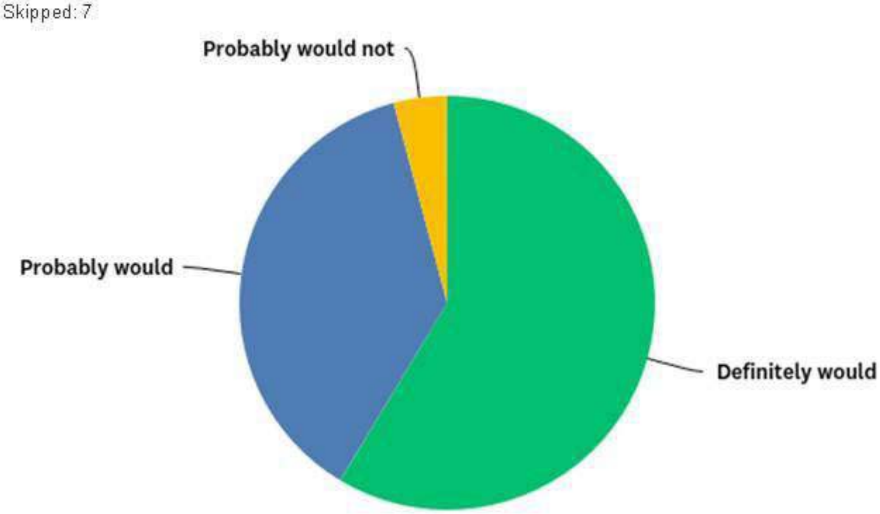
Answered: 145 Skipped: 7



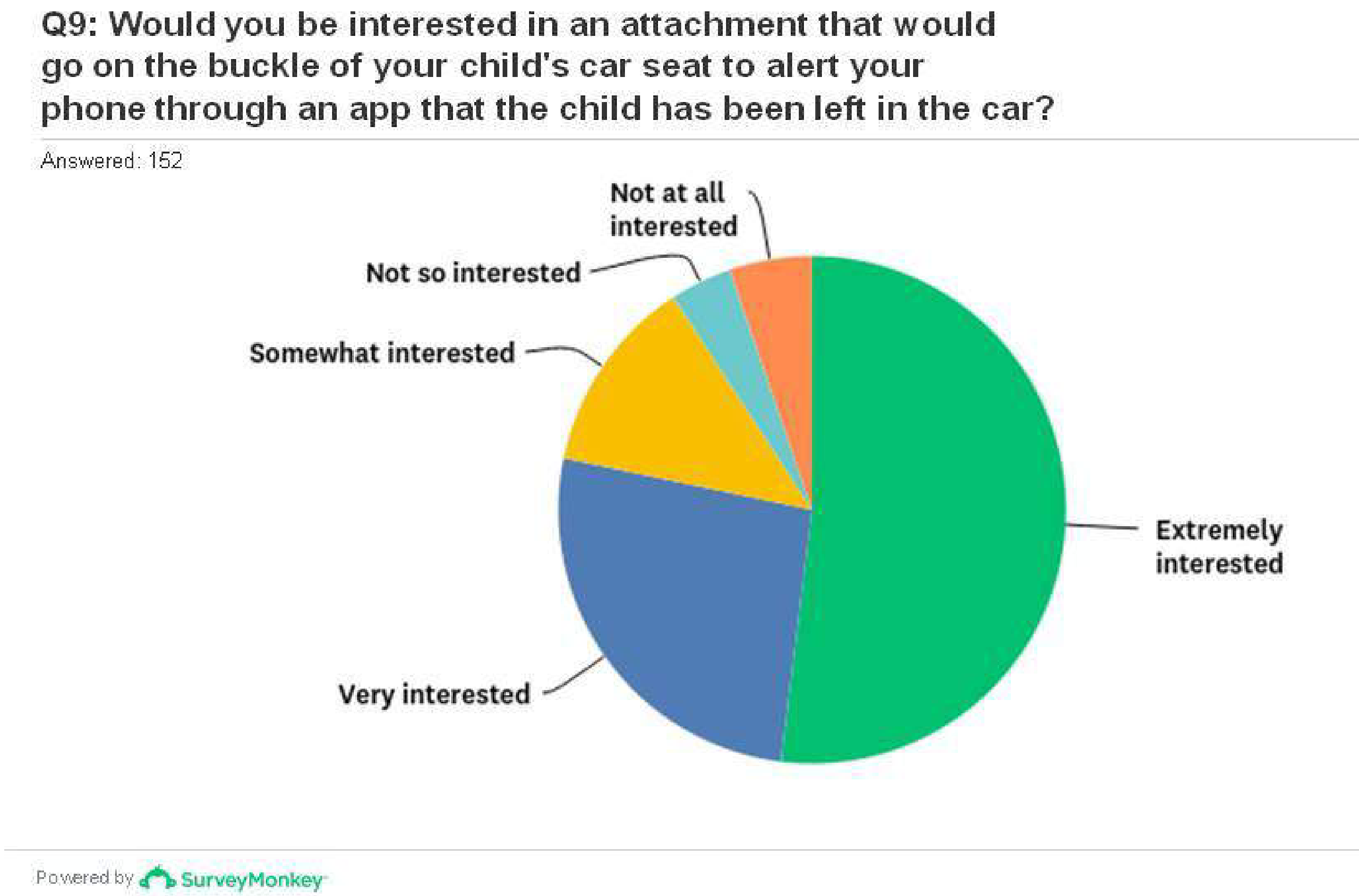
Powered by SurveyMonkey

Q8: Would you recommend the trifold to other parents?

Answered: 145 Skipped: 7



Powered by SurveyMonkey



After reviewing the answers in the survey, we were excited to learn what the community thought about Hot Car Deaths. Almost half of those surveyed (48.68%) were females 25-44 years old with 86% having children two years and older. A good representation had children younger than two years. Those taking the survey had the opportunity to mark as many age groups and number of children they have.

When questioned “How effective do you think the trifold pamphlet was at educating about hot car deaths?”, 80% thought it would be very-extremely effective as a means of educating our community about the dangers of Hot Car Deaths. Nearly everyone said they would share the pamphlet with someone else to help spread the word about hot car deaths. We were not sure what the response would be to, “Would you be interested in an attachment that would go on the buckle of your child's car seat to alert your phone through an app that the child has been left in the car?” The response was an overwhelming 78% of those who responded said they were very-extremely interested.

Question 10 of the survey was created to allow those taking the survey to comment. So many left messages of encouragement to continue our research on production of ways to help drivers not to forget young children latched in a car seat in the back of the vehicle. Many had words of praise for our team taking on such an important topic. Some said that they wished something like our product was available when their children were younger. There were some people who feel that irresponsible parents were the only ones who need help remembering children in the back seat. As we have learned through our research, it is the very responsible, highly educated, and two-parent-working-households with a slight change in routine that tends to be the scenario of when a child is left in the car seat in the back of the car.

What are your potential sources of error? Remember, this doesn't mean "Did everything work?" since all tests have potential sources of error, so make sure you understand what that means. Explain how these sources of error could have affected your results.

Systematic Errors or Errors in Accuracy cannot be corrected with multiple testing, according to the Ecybermission website. The types of systematic errors made in the project involve instrumentation. From the testing data we gathered, the potential sources of errors could come from the measurement devices we used. We used a Digital Multi-Meter to measure resistance of the aluminum tape used to line the chest buckle. We also used a thermometer to find out how hot the inside of a car could reach. We also used a timer to regulate when we took the next temperature reading to find out how long the inside car temperature could reach to be considered a fatal level. These devices could be out of calibration, causing some errors in the data. Usually the calibration errors only matters if we are looking for accuracy. For these measurements, we took the best data and numbers possible, and the calibration errors would be minimal.

Random Errors are those made by humans and can be corrected or minimized with repeated measurements. The types of random errors made by the team involve temperature and resistance measurements. Measuring temperature is always tricky. This is because there are always slight variations of temperature of the air depending on its location in a single place. The air closest to the hot surfaces will be hotter versus the air in the shade close to insulated surfaces. Again, we’re looking for average numbers for temperature reading, so these variations will be more precise with repeated experiments.

As far as our system test goes, the distance of when the app detected Bluetooth is variable. Wireless connections like Bluetooth could easily be affected by electromagnetic interference in the air, that could cause early disconnection. There is always slight variation of material inside the components we used, especially the Bluetooth transmitter/receiver that could affect how easily the Bluetooth connection disconnects. Also, the Bluetooth disconnection message received by our app had to go through the Bluetooth software and the Bluetooth serial library we used, and the way they work could introduce random errors into our system as well. Our primary concern is that Bluetooth will disconnect within a reasonable distance to give timely notification to the caregiver. Thus, the distance ranges were not significant and all were within the criteria stated.

Drawing Conclusions

What conclusions can you draw based on the data you gathered during your tests?

The H.O.T. C.A.R.S. system fits our criteria and is within our constraints. The system alerts the caregiver in a timely fashion as seen in the data collected. This is uploaded to the Mission Folder for judges reference. 100% of the tests performed were successful in accurately and precisely indicating whether an infant was in the vehicle, according to data. The notification distance was within an average of 82 feet from the vehicle. Furthermore, Arduino systems are small, inexpensive, light, portable, and readily available on the market. Bluetooth connections can connect quickly. Our system will keep track of whether the baby is in the car seat or not. The test results from each component of our system individually, and in total, support a functioning system, and notifies us in a timely fashion if a child is still in the car seat and is verified by the data we collected.

In building the prototype, we learned that there were multiple ways to solve each obstacle we came upon. However, working together as a team, we were able to brainstorm and select solutions that best suited our criteria. The prototype gave us a very strong platform to start our project and resulted in a working device.

In addition, we gained knowledge of multiple disciplines - electrical engineering, mobile app development, car seat manufacturers, automobile manufacturers, legislature, and lobby groups surrounding this issue.

The educational component of the solution was an important segment for the team. In the data collected, 80% of the people surveyed said the pamphlet would be very effective in educating parents and caregivers about the dangers of hot car deaths and how to prevent this tragedy.

Approximately 750 children have died in this manner in the past 10 years - approximately one child every 8-9 days. The loss of life of the youngest, most innocent members of our society, and the waste of their full potential, makes this a device that could significantly lessen the tragedy, very worthwhile of our efforts. This makes this project's goals successful.

Community Benefit

Explain how investigating the problem your team chose will help the community.

Hot car deaths of children are literally a "hot" topic at this point in time throughout the United States. Our community and region in general is in need of the information we have discovered as a team because for the majority of the year we have very high temperatures that lend themselves to cars becoming very hot on the inside in a very short period of time. Also, Texas has the highest number of Hot Car Deaths each year compared to the rest of the country. We have distributed information about Hot Car Deaths of Children in many forms around our community.

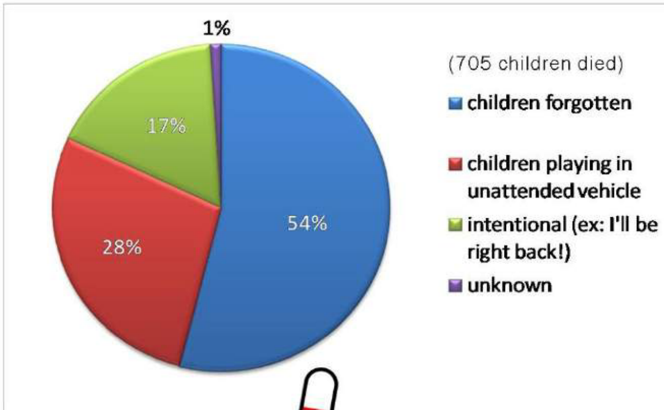
The southern states are not the only ones affected by this issue. Every state except Montana and Alaska have experienced this tragedy. Even on a 60 - 70 degree day, the temperatures inside a car can reach over 100 degrees Fahrenheit and cause death to an infant or young child. The solution we propose is applicable to states throughout the country and around the world.

*** Focusing on individuals in our community

Getting the information out about Hot Cars is essentially telling everyone you know. Parents and other drivers of children (ages newborn-2 years generally) need to know that they are caring for those children in the highest risk category of the possibility of unknowingly leaving a child in the car. Those families where both parents are educated and have full-time jobs are the highest risk families. Just one small change in a daily routine is enough to have a parent off of their usual game and the brain goes into basal ganglia mode f and not take a child out of the car because they are not used to having the child with them at that time. Warning parents in this category that they are the most at risk is difficult because they are the ones most likely to think *it won’t happen* to them.

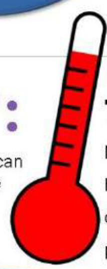
- We made a pamphlet and keychains that is easy to hand out to friends and family (see Attachment)

% of Heatstroke Deaths in Cars—1998-2018



FACT:

Even a 60 or 70 degree day can cause the temperature in the car to rise over 100 °F.



The BIG Problem

Most parents think that this can never happen to them. They are wrong. Most deaths are caused by hardworking parents who have a memory lapse.

How Can You Help?

- Read this pamphlet and share the information with your friends and family.
- Use your "Look B4 you lock" key chain.
- Take our survey to help us be informed about how our possible solutions may help people.

Use iphone/ipad in camera mode to scan this QR code to go to our survey
OR
Download "QR Scanner" from Google Play
OR
type in this website link in the address bar

https://www.surveymonkey.com/r/CKTTZLW

- Check out our website for more information.

Our website is:
https://babyinhotcars.weebly.com

-

Team Name:

H.O.T. C.A.R.S.

Heat Overwhelms Taking Children Away Ramification Saddening

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- Your brain can create false memories of leaving a child with caregiver.
- Routine changes are the most common way for parents to leave a child in a car.

Resources:
1. Dr. Amy Thompson, CEO of Covenant Children's Hospital, Lubbock, TX, pediatric hospitalist
2. www.noheatstroke.org
3. www.kidsandcars.org
4. MS Publisher Clipart

Hot Car Deaths of Children

- Keychain (see Attachment) says, “Look B4 You Lock” and the keychains are bright colors and made from a thick plastic. Easy to see and feel when holding the car keys.

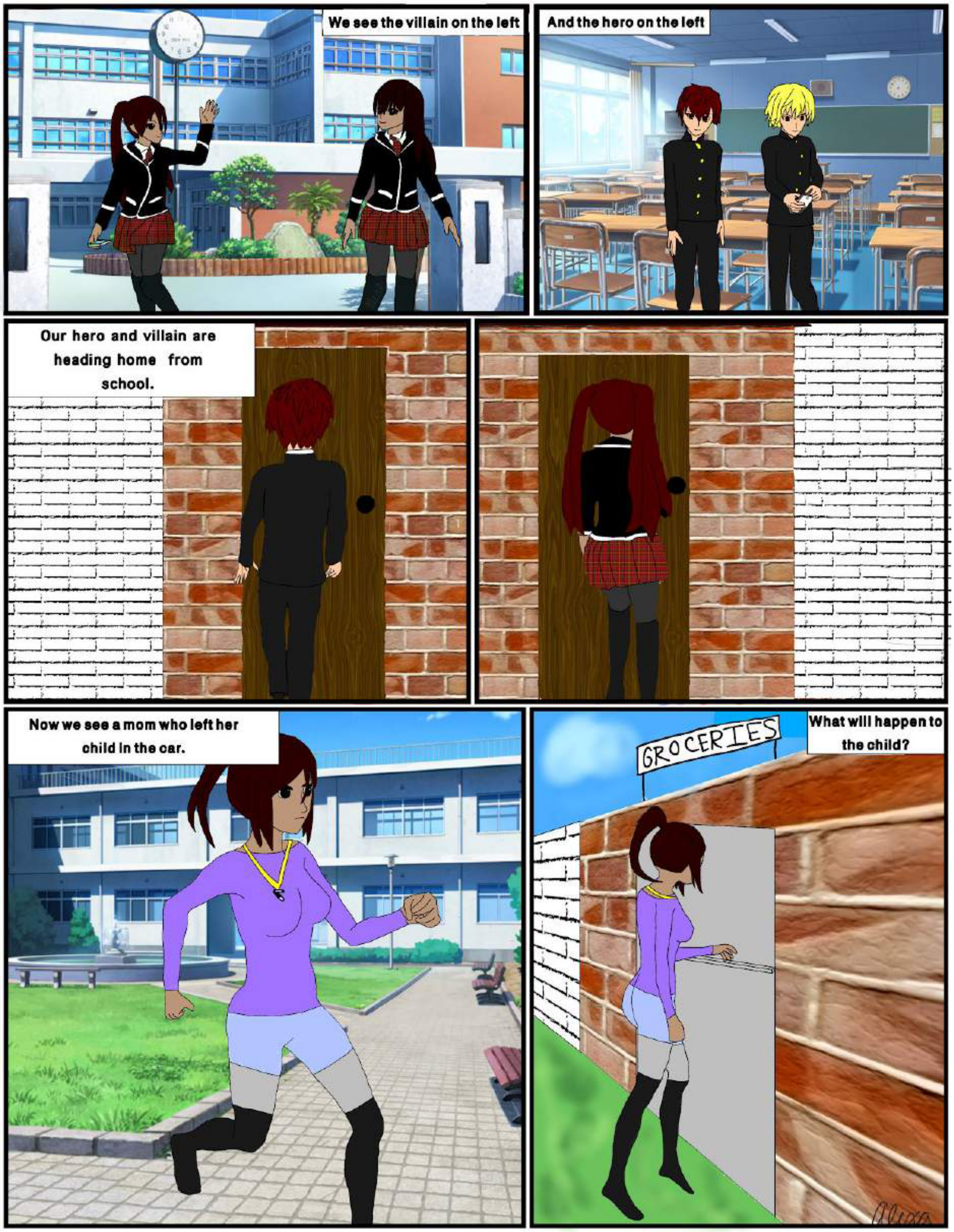
- Made a graphic novel that has a storyline that tells of an adventure of how evil tries to make the car super hot and the hero helps the mom remember that cars can get deathly hot in a very short amount of time.

- The graphic novel is geared toward younger parents and teen parents.

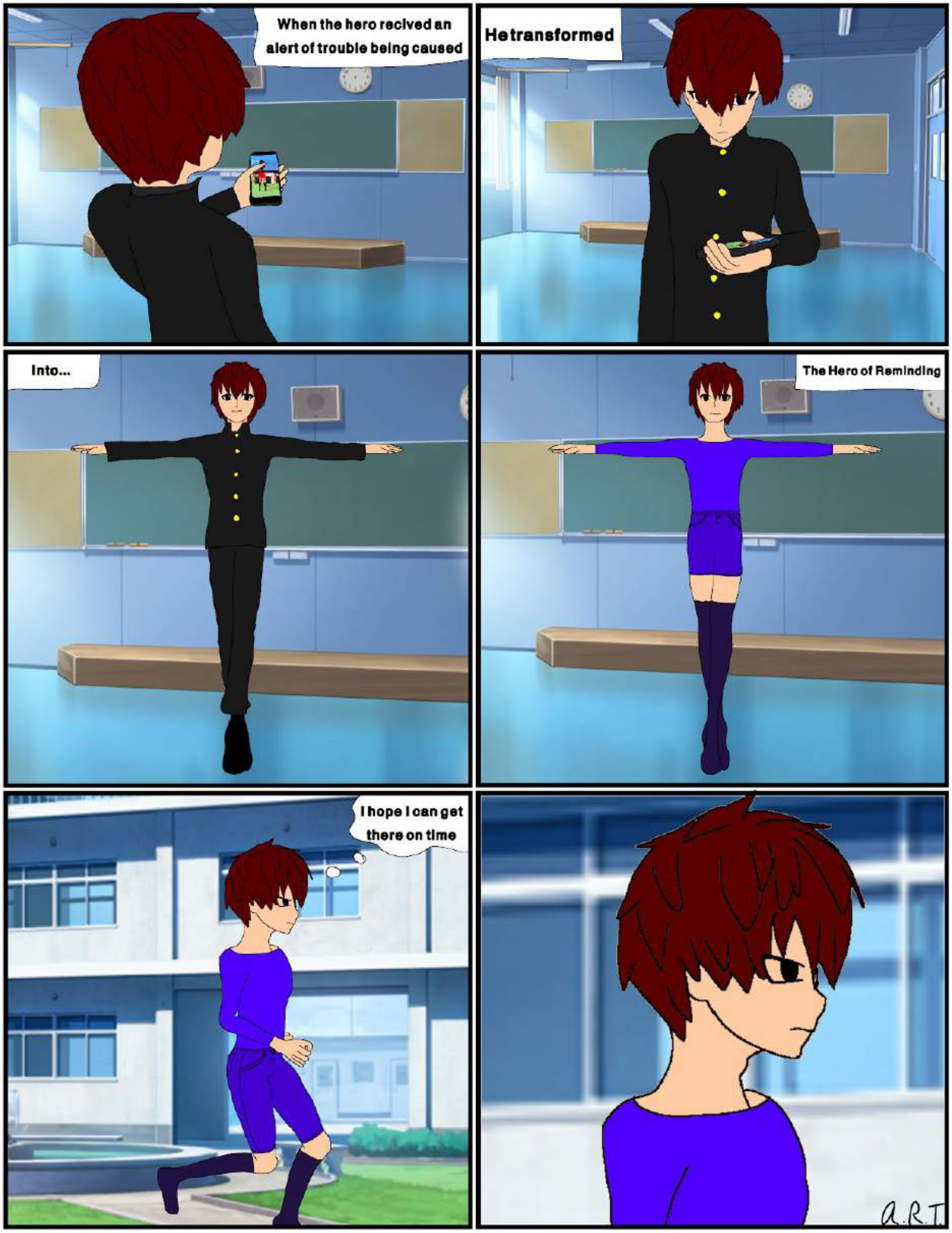
Heat Wave and The Hero of Reminding

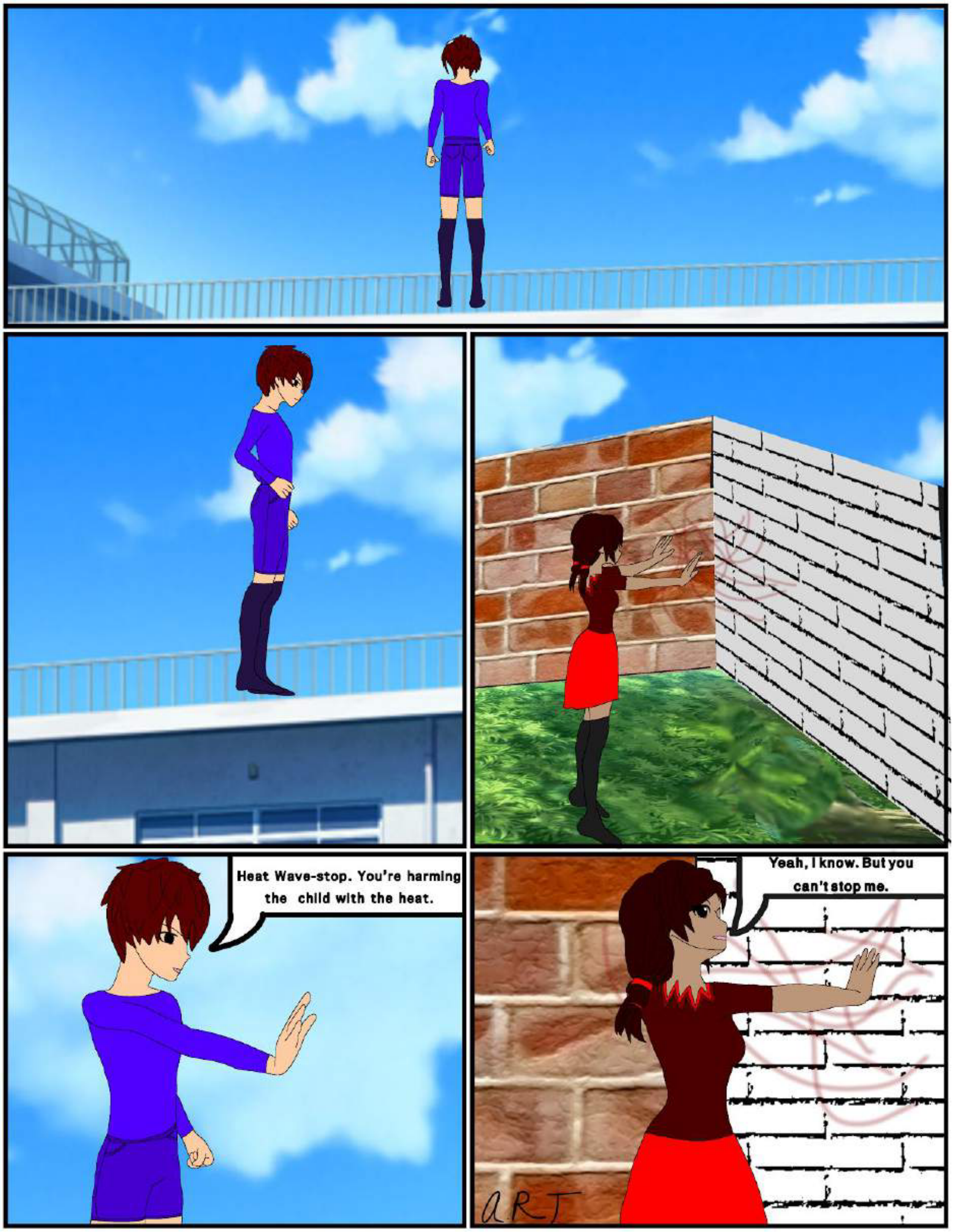
WRITTEN AND ILLUSTRATED

BY ALEXA TINDALL

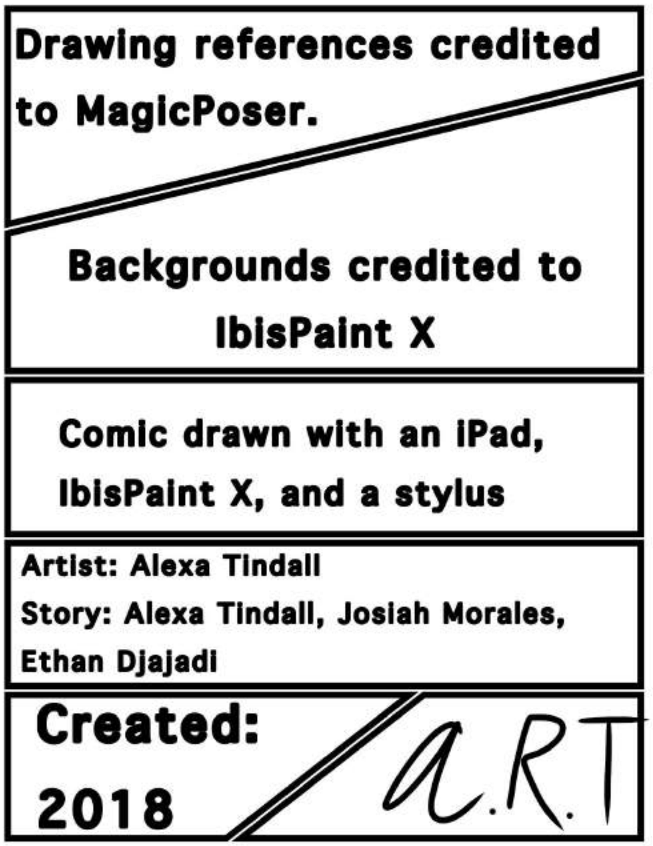

We see the villain on the left
And the hero on the left
Our hero and villain are heading home from school.
Now we see a mom who left her child in the car.
GROCERIES
What will happen to the child?


Mission Assignment: Target child left in car outside grocery store
Mission Accepted
Transform
Into Heat Wave
By simply increasing the temperature outside to 70 degrees F, will cause the temperature inside the car to climb to over 100 degrees F
a.R.J.


When the hero recived an
alert of trouble being caused
Hetransformed
Into...
The Hero of Reminding
I hope I can get
there on time
a.R.T.


Heat Wave-stop. You're harming the child with the heat.
Yeah, I know. But you can't stop me.
aRT


The Hero of Reminding used his mental telepathy on the child's mom
Look at your reminding ribbon
The mom remembered her child and rushed back to the car to save it.
EVEN A QUICK TRIP TO THE STORE CAN BE DANGEROUS FOR A CHILD IN A CAR



- A **website** (babyinhotcars.weebly.com) has also been created to give more information about hot cars. There is also a link to the graphic novel on the website.

- We also created an **online survey** (https://www.surveymonkey.com/r/CKTTZLW) to get the opinion of parents and others of what they knew about Hot Car Deaths as well as their opinion of some possible solutions like the keychain and pamphlet that we created.

Contacting Businesses

-Contacting business that deal directly with young children were the focus of they types of places we wanted to distribute our pamphlets and keychains. Many of the places we delivered to were daycare centers to distribute to families who take their kids there. The families who take children to daycares usually have two parents working full-time jobs and are the highest at-risk group. Daycares were the ideal choice of locations to distribute the pamphlets and keychains.

-We also considered the large group of young parents that live in our community. We focused on presenting our newly gained knowledge to a large group of teen parents who were attending a Young Parent Support Training at Parent Life. The teens learn basic care for children and families. This was also an ideal location because many of these teen parents don't have the background knowledge or awareness of how hot cars can actually get in a short period of time. (see Attachment)

-Another location we delivered pamphlets and keychains was to Parkridge Pregnancy Center. This is a facility that helps educate young women who have found themselves pregnant and don't really know what to do next. A program Parkridge provides is called **Bridges.** It is an introductory class for teen pregnant moms and the director was very excited to receive the "Hot Car Deaths" pamphlet to share with the new class. (see Attachment)

-Our H.O.T. C.A.R.S team had the opportunity to present our information about "Hot Car Deaths" to the Texas Tech University Medical Center-Newborn Nursery and leave more pamphlets and keychains for the new babies they had on the floor that week. We are continuing our relationship with the Newborn Nursery and will be delivering more pamphlets and keychains to them in the near future.

-Our team was invited to be featured on our local news channel, KCBD Channel 11. The news channel interviewed all of us and we took turns showing our creation of the buckle on the car seat that connects to our newly created app and demonstrate how it works if a child is left in the car seat. What an amazing opportunity we had to spread our information about hot car death to thousands of people at one time! (see Attachment)

Our news story on the KCBD Channel 11 website. (see Video Upload)

Southcrest Christian 6th graders invent device to help prevent hot car deaths in children

By Julie Castaneda | January 31, 2019 at 5:03 PM CST - Updated January 31 at 5:35 PM

LUBBOCK, TX (KCBD) - 794 children have died due to pediatric vehicular heatstroke in the U.S. since 1988. 51 of those deaths were in 2018.

Three local sixth graders have come up with an invention to help prevent hot car deaths.

Alexa Tindall, Ethan Djajadi and Josiah Morales are all sixth graders at Southcrest Christian School. Together, they developed a device to help alert parents or caregivers if a child is left in the car. They said they've been working on this project for about eight months.

Alexa said, "I personally feel really happy that we can prevent something that is a major problem in our community because Texas is actually leading the nation in hot car deaths"

According to data from noheatstroke.org, Texas has the highest number of child hot car deaths in the U.S. with 119 from 1998 until 2018.

The students say their invention actually started with a science fair project.

"We were trying to figure out a topic and we saw (an article) on the web," Ethan said. "It was about child that had died after being left in a hot car. We thought, this could be preventable. This is preventable. There is no way that we cannot prevent this. So, we thought we were going to help fix this problem."

These 12-year-old's have invented a way to alert parents (or caregivers) if a child is accidentally left in the car. Hear more from the sixth graders from Southcrest Christian School about their invention tonight on KCBD NewsChannel 11 at six!
Posted by Julie Castaneda KCBD on Thursday, January 31, 2019

The students had to learn how to build the circuit and programming for the app had to be done. They also had to gather information to put in their pamphlet.

These sixth graders say all the hard work is worth it.

"We're just really hoping that it can help at least one or two children just so that they can be saved." Alexa said.

"Probably knowing that out of all this we'll be able to save a life and know that it will be appreciated." Josiah said.

"I also feel very, very satisfied about how this project turned out. We made the device that costs less than $30. If it can even save one life it's completely worth it." Ethan said.

The students don't have a name for their invention yet and they are still waiting on their patent on the device.

They've made presentations on their invention to Covenant Health, UMC and local parents.

They need feedback from the public, you can help out by taking their survey here.

Check out their website, here.

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RECENT CONTENT

Man wanted for exploitation
Lubbock
The FBI is asking the public's help in
Shouse of Richmond, who is thought t
Lubbock. Shouse is wanted for exploit
of child pornography.
By **Michael Cantu**

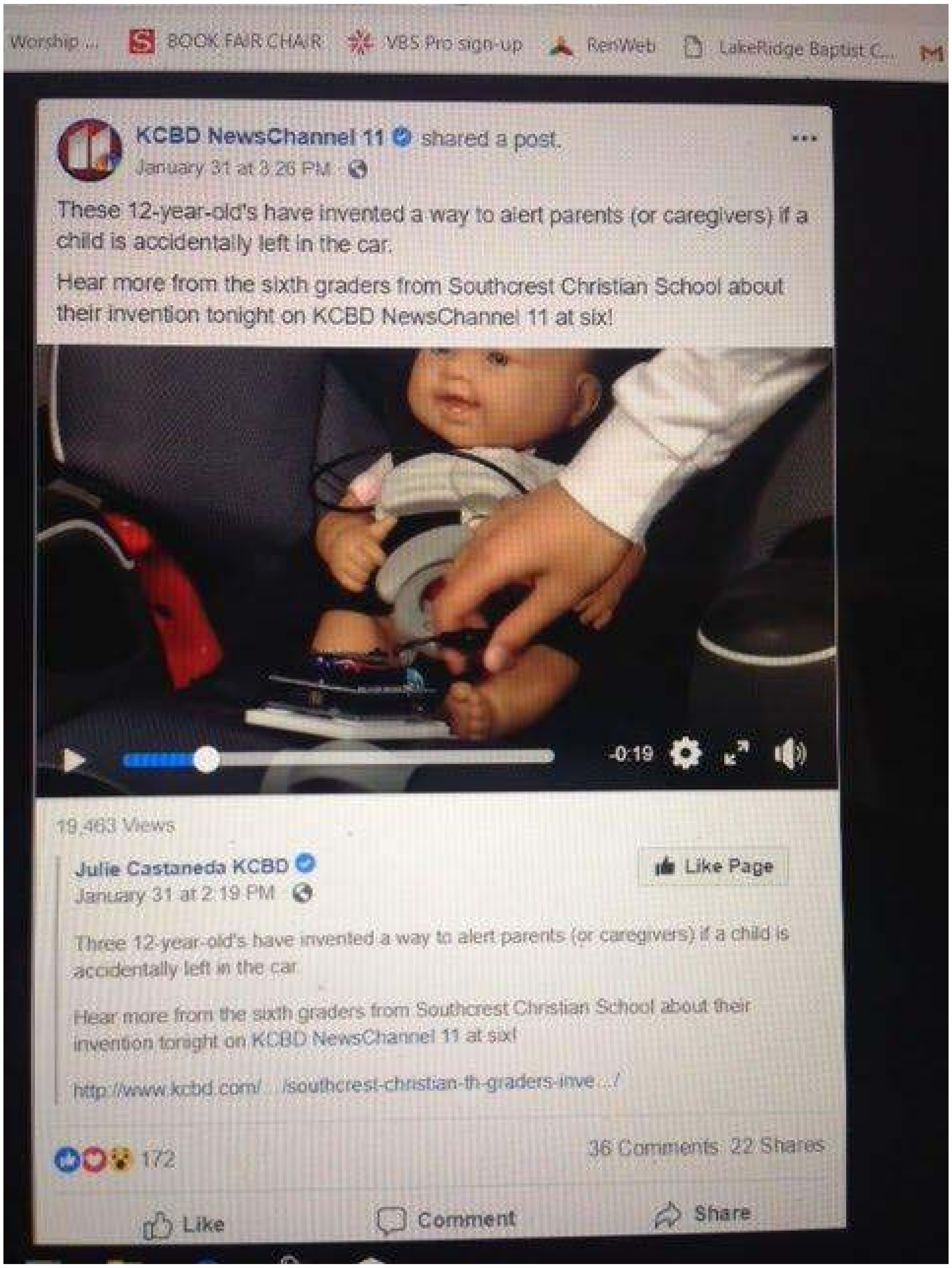
Seminole man arrested, charge
minor
After a more than two-week investigatio
Department and the Andrews office of th
has been made of Vital Zuniga Mares, 5
prostitution of a minor in Seminole.

Levelland Fire Department fighting structure fire in 100 block of Walnut

McDougal Companies out of Reagor-Dykes restructuring plans

Lubbock diocese releases names of priest accused of sexual abuse

Polar vortex drifts east, bringing respite to Midwest and freeze to Northeast



Facebook page for Julie Casteneda who interviewed us. She got over 19,000 views for our story! (see Attachment)

- Parent Life - YFC Lubbock - Young Parent Support Training (see Attachment)

- FirstSteps Daycare - LakeRidge Baptist Church - placed a pamphlet and keychain on each child's hook ready to be taken home (see Attachment)


- Learning Tree Children's Academy (see Attachment)

- Kids Day Out Program - Southcrest Baptist Church

- Rock Solid Athletics (see Attachment)

- Tas Montessori School (see Attachment)

- Tega Kids Superplex-Athletic gym (see Attachment)

- Stepping Stones Daycare

- Texas Tech University Medical Center-Newborn Nursery (see Attachment)

- Parkridge Pregnancy Medical Clinic (see Attachment)

- Parenting Cottage

Overall, most people we contacted in one way or another was very supportive of our efforts for educating the community about Hot Car Deaths. After reading over our pamphlet, quite a few parents commented that they had no idea the problem was so big. Just about everyone who looked at the pamphlet wanted to be able to share it with others to help spread the word. As it has happened, many still said this is something that wouldn't happen to them. We as a team realize that parents will say this but at least we got to share the knowledge we found doing our research. Maybe one day they will be able to recall our information if needed.

Be sure to include the impacts your research will have on individuals, businesses, organizations, and the environment in your community (if any). Make it very clear why solving this problem would help your community.

Our project will be able to help many in our community by saving a child that was almost forgotten in a car. It can alert parents and caregivers who forget the child and help improve ratings and reputation of car companies and carseat companies. It can also help daycares who would have been shut down or be arrested for a heatstroke death. If we can make our device an actual product, it will give parents an easy way to be alerted in case they forget the child. It will help daycares with the same problem of accidentally forgetting the children in the car. This can also help car companies who can have a higher reputation and have more sales because of saving a life with our device that they put on their carseat. If a carseat company can use this, they will be recognized as the best company because they have a system that can save a child's life. If we can make this device a solution recognized by lots, it will help lots of lives. We stand to help everyone we can from Lubbock to maybe someday the whole world. We are trying to get a patent through Covenants Innovation Lab. We then will preemptively put our device in car seats through car seat manufacturers.

In short, using our device can save many lives and help lots of people in the community.

Team Collaboration

How was your team formed? Was your team assigned or did you choose to work with each other?

We chose the team members based on our past experiences working together. We decided that we should work together because we all like science and math. Two of us have won in Math Olympics so we decided to have them on our team because they were good at computing. Our other member is good at science experiments. All of our members enjoy aspects of engineering, so we decided based on all this that our group could work together.

Alexa, Ethan and Josiah have been classmates and friends since 4th grade. We have similar interest in STEM and like working together. We decided to tackle a society problem and listed several projects which would benefit our society. Among these problems were diabetes, vaping, recycling, and hot car deaths. We then voted on the project we liked the most and found out that it bothered us a lot that Texas leads the USA in number of hot car deaths. This is a preventable problem, and we feel like we can be part of the solution. We all had different jobs from one another by what we knew how to do. For example Ethan knew how to code and Alexa had more experience in graphic designing, and Josiah had more mechanical knowledge. We also had science every day and on Fridays we did Ecybermission work in class. We spent many weekends working on this project and getting together to make a difference.

Provide a detailed description of each team member's responsibilities and jobs during your work on the Mission Folder.

Alexa (KittyPop) is the leader in the group, is good at speaking to people, can present projects easily, is a graphic/art designer, organized all the answers for the mission folder, and is the main brainstormer. She also created the comic and the brochure.

Josiah (jumpydog) is an organizer of materials and labs, has a little knowledge in testing app designs, draws conclusions very well, has some outreach coordinators that can be accessed, is brave with the public, is a researcher - victim testimonies, is a public speaker, is the timekeeper, is a visualizer of grand ideas, is an arranger of community service, and is the encourager of team members. He hosted team meetings and had idea to connect device to buckle.

Ethan (chermender) is the builder and engineer of the group, is the graph, charts, and tables creator. He also has been in charge of community outreach, is the engineer technician, a researcher - computer coding and apps specialist, multicultural outreach, website builder, and enthusiasm for teamwork. He coded device to app, made and wired the device.

The team met during the week in school and on scheduled weekends to choose sections to work on, and assign areas to complete.

Did your team face any problems working together? If so, how did you solve them? If not, why do you think you were able to work together so well?

Scheduling times to meet, especially with each team members' very busy lives, was one of the most troublesome parts about working as a team. The team members are in the same class and worked on the projects while in Science and English class each week, gathering data from each other, collaborating and sharing ideas. Outside of that, we also met with specialists in their fields, and interviewed them. The team members also met approximately once a month at a team member's house to work on the engineering – software and hardware to put the project. It did take us longer to make decisions since we had to get consensus from each member of the team whenever we had a question or a problem. Instead of making individual decisions, we took the time to discuss solutions together. It was helpful to have one person be in charge each time and run the meetings to keep us on point.

What were some possible advantages to working together as a team on this project? How would working as individuals have made this project more difficult?

The advantages of a team are that we get three times the work done, we have three sets of skills, and each of us can individually do different parts of our project. Having multiple points of view for the presentation and solution of each of the obstacles we encountered, it was helpful to resolve this quickly with three peoples' ideas. We also had talents in different areas which allowed each of the members to contribute to the success of the team. Working together as team resulted in multiple solutions that, individually, would not have been thought of. Also, each team member's unique point of view and experience lead to the learning and furthering of the project very efficiently. Each team member worked well together and were very supportive of each other's ideas and thoughts. Each person's strength was also used in the different areas, while every member of the team's input was important. We blended our complementary skills to come up with solutions, learned to take risks together, and trust each other more.

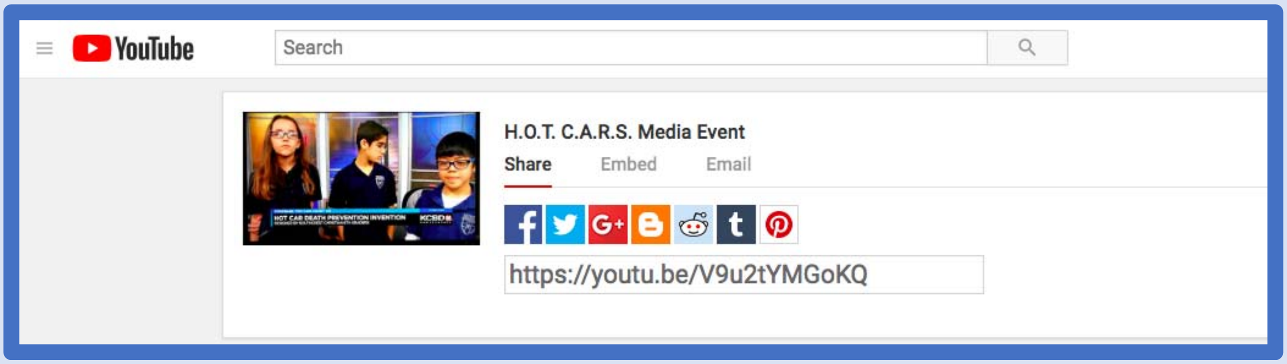
The disadvantage of working individually on a project is that you have only one set of skills, you cannot do more than one aspect of the project at a time, and you can only accomplish one task at a time. If this project had been a one person project, the one person doing the project would've had to do hours of experiments, data collection, and putting all of their data into these questions. They probably would've had to research so many things, have to work very hard to learn two different programming languages, and be generally be short on time on everything else.

H.O.T. C.A.R.S.

Engineering a Device to Save Lives

Please click on this link to see a short video clip of our team featured on the evening news at KCBD NewsChannel 11 in Lubbock, Texas.

https://youtu.be/V9u2tYMGoKQ



H.O.T. C.A.R.S.

Heat **O**vercomes **T**aking
Children **A**way … **R**amifications **S**addening

A website was developed by the team to spread awareness and inform others about the danger of children + hot cars. It is updated regularly, and links are shared through social media, newsletters, email blitzes, newspaper articles, brochures, newborn nurseries, pediatrician offices, and in our public presentations.

Link to our Website

https://babyinhotcars.weebly.com

Quick Response Code

The team presented information, distributed keychains and brochures, and educated many groups of caregivers in the community. This is one of the scripts we used for educational campaigns with daycare centers and new-parent groups.

H.O.T. C.A.R.S. Presentation Script

Ethan: Hello – we are the sixth grade HOT CARS scientific and engineering research team from Southcrest Christian School. I'm Ethan and these are my STEM colleagues Josiah and Alexa. Thank you for giving us the time to speak with you about an important issue of national proportions – hot car deaths.

Josiah: 705 children have died since 1998 due to heat stroke from being left in an unattended vehicle. This tragedy affects not only the child, but the families and friends left behind. When a child is in a rear-facing car seat, they are most at risk for being left in a hot car by caregivers. Although many people believe this is due to pure negligence, the research says otherwise. The guilt that accompanies this tragedy is endless.

Alexa: Imagine this scenario … A hardworking parent had to make a small change in their routine one day. They normally take the child to daycare but because of the small change they forget to stop. Arriving at work, it is an hour later when she receives a phone call from the daycare wondering why the child did not arrive this morning. The parent is convinced she dropped the child off because it is what she does every day. A look into the back seat shows the parent's worst nightmare. You may believe this could never happen to you, that this only happens to the worst parent, but let Ethan prove you otherwise.

Ethan: The Basal Ganglia is the part of your brain that handles your habits and autonomous memories and is extremely powerful once you enter this state of mind. It is almost like a one-way door in your brain that you can enter very easily. A simple lane change can put you into this door, and you cannot escape it until you make it to your mental destination, and even then you could stumble and stay in your habitual memory system because of your basal ganglia. If you've ever driven somewhere many times you get to where you don't even remember passing obvious landmarks anymore. This is because you drive the route so automatically, your brain jumps into basal ganglia mode.

Alexa: Despite the extreme love of a parent, a change in routine can throw the mind into the basal ganglia memory of a ***childless*** car route. This is how most hot car deaths occur. When this occurs, a parent can leave a young child in the backseat of a car unintentionally. It is not due to neglect. It is due to the way the brain processes new information vs. routine memories.

Josiah: Texas leads the nation in the number of deaths in hot cars and our goal was to find a solution to this problem. We must save as many families from this tragedy as possible. Our team conducted thorough research and interviewed CEO's of major hospitals. We consulted childcare specialists, parents who experienced this loss, congressmen, and industrial engineers.

Ethan:
I learned to use Arduino programming and how to get the state of a switch. We also programmed a phone app to receive a notification and alarm through a car seat device that our team designed. Our switch on the buckle of a car seat uses an innovative material known as aluminum tape to make a connection between wires. This sends an electrical pulse through the system, thus activating the switch. If the caregiver moves out of range while the switch is still activated, then a notification is sent to the phone through an app I designed using Android Studio.

Josiah: Although there are technological advances such as these on the market, they are too expensive for most families. The advantage of our device is the low cost of under $30 and a 99% rate of effectiveness.

Alexa:
H.O.T. C.A.R.S. designed a technology-based solution combined with a targeted and intentional educational campaign. In addition, our team is sponsoring a congressional bill called The Hot Car Act that would require all new cars manufactured to come with a standard prevention alarm system such as ours. The combination of the STEM fields allowed our team to find a solution to one of the most pressing problems affecting children and families today.

CONTACT LIST

H.O.T. C.A.R.S

Sixth Grade Scientific and Engineering Research Team

Major supporters, subject matter experts, and community partners of this project are listed below with contact information for judges' convenience.

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Kirsten Robinson, MD
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University Medical Center
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Lubbock, TX 79415
(806) 775-8200

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Austin, TX 78759
(512) 683-0100

Community Partnerships

H.O.T. C.A.R.S

Sixth Grade Scientific and Engineering Research Team

Many of the community organizations, businesses, and government agencies with whom the team reached with solutions for addressing heat stroke in hot cars are included here.

Parent Life - YFC Lubbock
Young Parent Support Training
2621 34th Street
Lubbock, TX 79410
(806) 763-9794

FirstSteps Daycare
4601 82nd Street
Lubbock, TX 79424
(806) 783-9046

Learning Tree Children's Academy
7713 Milwaukee Avenue
Lubbock, TX 79424
(806) 771-2323

Kids Day Out Program
Southcrest Baptist Church
3801 S. Loop 289
Lubbock, TX 79423
806-797-7400

Rock Solid Athletics
6205 43rd Street
Lubbock, TX 79407
(806) 795-7625

Tas Montessori School
502 Dowden Road, #100-102
Wolfforth, TX 79382
(806) 783-0054

Tega Kids Superplex
7800 82nd Street
Lubbock, TX 79424
(806) 866-9765

Stepping Stones
2433 26th Street
Lubbock, TX 79411
(806) 747-6688

The Kid's Clinic
5004 Frankford Avenue, #400
Lubbock, TX 79424
(806)771-5437

University Medical Center
Newborn Nursery
602 Indiana Avenue
Lubbock, TX 79415
(806) 775-8200

Parkridge Pregnancy Medical Clinic
5203 79th Street, Ste A
Lubbock, TX 79424
(806) 794-8555

Parenting Cottage
3818 50th Street
Lubbock, TX 79413
(806) 795-7552

Community Partnerships

H.O.T. C.A.R.S

Sixth Grade Scientific and Engineering Research Team

Many of the community organizations, businesses, and government agencies with whom the team reached with solutions for addressing heat stroke in hot cars are included here.

Family Guidance and Outreach
Young Parent Support Training
5 Briercroft Office Park
Lubbock, TX 79412
(806) 747-5577

Kids Day Out Program
Southcrest Baptist Church
3801 S. Loop 289
Lubbock, TX 79423
806-797-7400

Hon. Jodey Arrington
U.S. Congressman
Texas District 19
Longworth House, DC
1312 Texas Avenue
Lubbock, TX 79401

Graco Baby Corporate Headquarters
Street 123
Toronto, Ontario
Canada M3C-1L1

Evenflo Company Incorporated
225 Byers Road
Miamisburg, Ohio 45342
800-233-5921

Cosco Products Company
2525 State Street
Columbus, Indiana 47201
800-628-8321

Team Name:

H.O.T. C.A.R.S.

Heat **O**verwhelms **T**aking

Children **A**way **R**amification **S**addening

We are a team of students in the 6th grade from Southcrest Christian School who are citizen scientists for our school science program, "Science Rocks U," to make a difference in the world through STEM. The local problem we decided to research and provide a possible solution for is the prevention of hot car deaths of children.

Our solution includes an app for your phone that alerts you if a child is left in their car seat. An attachment to the buckle enables this process. We have also created this pamphlet to make parents aware of hot car deaths in general as well as a key chain to help parents remember to "Look B4 you lock."


Alexa


Ethan


Josiah

Did you know?

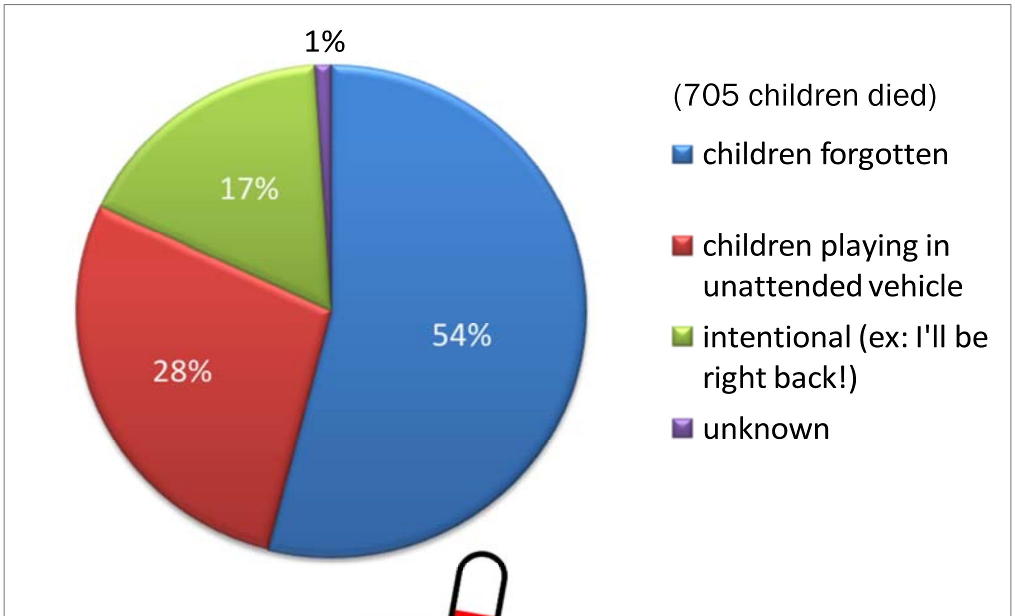
- More children have died from hot car deaths than front seat airbags.
- 21 U.S. states have some kind of law about leaving a child alone in a car.
- Your brain can create false memories of leaving a child with caregiver.
- Routine changes are the most common way for parents to leave a child in a car.

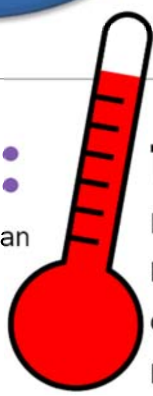
Resources:

1. Dr. Amy Thompson, CEO of Covenant Children's Hospital, Lubbock, TX; pediatric hospitalist
2. www.noheatstroke.org
3. www.kidsandcars.org
4. MS Publisher Clipart

Hot Car Deaths of Children

% of Heatstroke Deaths in Cars—1998-2018





FACT:

Even a 60 or 70 degree day can cause the temperature in the car to rise over 100°F.

The BIG Problem

Most parents think that this can never happen to them. They are wrong. Most deaths are caused by hardworking parents who have a memory lapse.

How Can You Help?

- Read this pamphlet and share the information with your friends and family.
- Use your "Look B4 you lock" key chain.
- Take our survey to help us be informed about how our possible solutions may help people.

Use iphone/ipad in camera mode to scan this QR code to go to our survey
OR
Download "QR Scanner" from Google Play
OR
type in this website link in the address bar

https://www.surveymonkey.com/r/CKTTZLW

- Check out our website for more information.

Our website is:
https://babyinhotcars.weebly.com

H.O.T. C.A.R.S. IN THE NEWS

The H.O.T. C.A.R.S. team was featured in the news through local and regional media. Articles were collected and are shown in this document.

Southcrest Christian School Warriors Newsletter

SOUTHCREST CHRISTIAN WARRIORS

THINGS TO KNOW AND PLACES TO GO

SCS OFFICE

SCS is using Smore newsletters to spread the word online.

Get email updates from **SCS**:

Follow SCS OFFICE

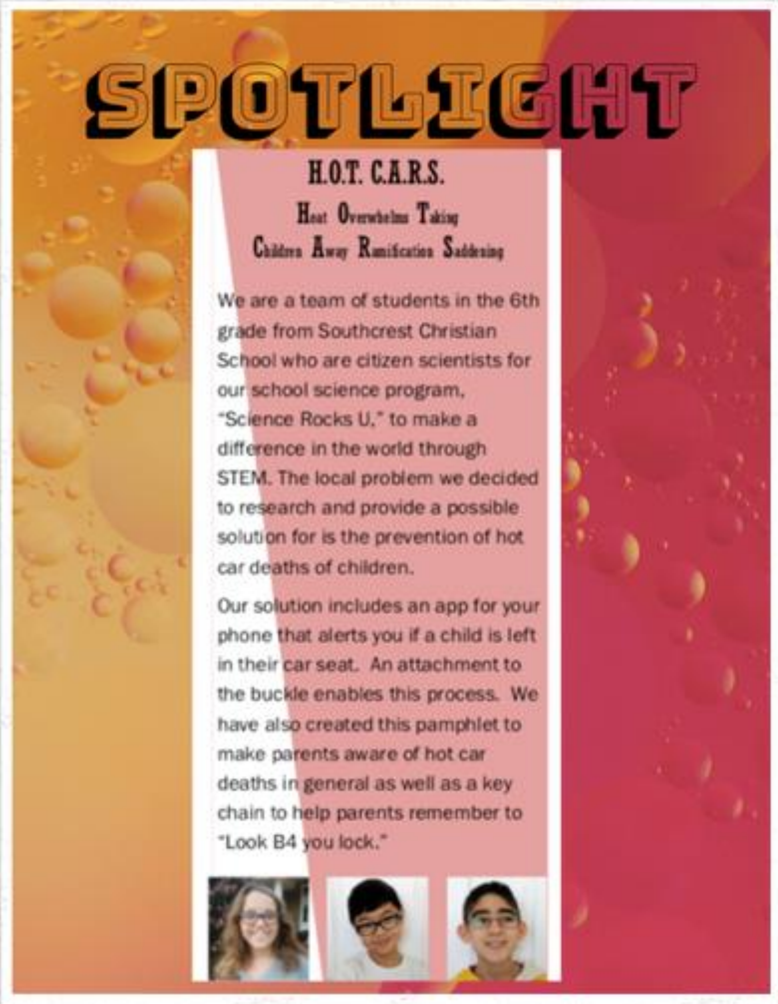
Contact SCS OFFICE

SUPERINTENDENT'S SLANT

Welcome back! The start of the new semester has been very smooth. We are excited to be beginning our four day school week. I have been asking students what they think about the longer days and almost everyone has said, "I did not even notice." Students are engaged and classrooms are humming with activities. God is good! I pray this new school week is a blessing to your child and your family! Please let us know what you think!

School Week
Jan 14-18

Our team was the featured engineering team in January which spread awareness of hot cars.



SPOTLIGHT

H.O.T. C.A.R.S.

Heat Overwhelms Taking Children Away Ramification Saddening

We are a team of students in the 6th grade from Southcrest Christian School who are citizen scientists for our school science program, "Science Rocks U," to make a difference in the world through STEM. The local problem we decided to research and provide a possible solution for is the prevention of hot car deaths of children.

Our solution includes an app for your phone that alerts you if a child is left in their car seat. An attachment to the buckle enables this process. We have also created this pamphlet to make parents aware of hot car deaths in general as well as a key chain to help parents remember to "Look B4 you lock."

Newsletters allowed us to reach hundreds of families with survey information to evaluate the team’s effectiveness in education.

PLEASE HELP US

How Can You Help?

- Read this pamphlet and share the information with your friends and family.
- Use your "Look B4 you lock" key chain.
- Take our survey to help us be informed about how our possible solutions may help people.

Use iphone/ipad in camera mode to scan this QR code to go to our survey
OR
Download "QR Scanner" from Google Play
OR
type in this website link in the address bar

https://www.surveymonkey.com/r/CKTTZLW

- Check out our website for more information.

Our website is:
https://babyinhotcars.weebly.com

Please take our Survey and visit our website... We need to collect data

Abstract

Hot car deaths are a tragic issue in America, with Texas leading in heatstroke deaths in cars. Approximately 700 children have died in hot vehicles in the past ten years. Despite the tragedies, there has not been a definitive solution and 2018 saw the highest number of victims on record.

H.O.T. C.A.R.S. used a two-pronged approach to eliminating hot car deaths – raising awareness via education and designing an affordable device to remind caregivers the child is still in the vehicle.

The research found most caregivers do not believe they could possibly forget their child, but statistics show the opposite. When adults multitask and change their routine, the basal ganglia in the brain moves to autonomous mode, increasing the risk of forgetting. A manga was created to teach young parents, and presentations were given throughout the region. Raising awareness that even the best caregivers could “forget” is vital to making a difference.

H.O.T. C.A.R.S. engineered a device whereby buckling the car-seat belt signals that a child is in the vehicle. If someone leaves the car with their phone, without removing the child, an app developed by the team detects it, sending an alarm to the phone. This forces the caregiver to return to the car-seat and unbuckle the belt, thus retrieving the child. The team is seeking a patent on the device and our app is available in the Google Play Store. Under $30, it is affordable for most families. H.O.T. C.A.R.S. is changing attitudes and behaviors and saving lives.

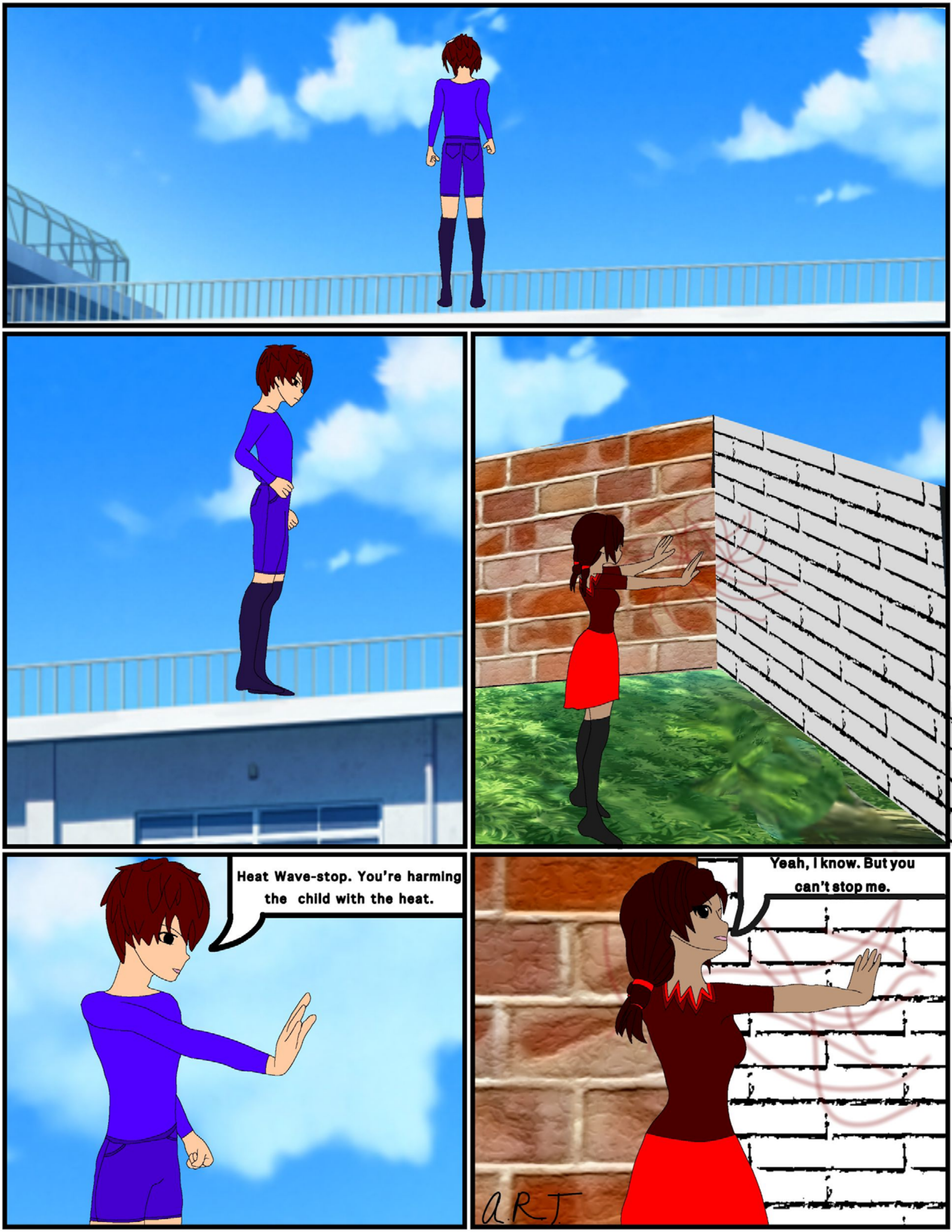
Heat Wave and The Hero of Reminding

WRITTEN AND ILLUSTRATED BY ALEXA TINDALL


We see the villain on the left
And the hero on the left
Our hero and villain are heading home from school.
Now we see a mom who left her child in the car.
GROCERIES
What will happen to the child?
Alexa


Mission Assignment: Target child left in car outside grocery store
Mission Accepted
Transform
Into Heat Wave
By simply increasing the temperature outside to 70 degrees F, will cause the temperature inside the car to climb to over 100 degrees F
a.R.T.


When the hero recived an alert of trouble being caused
He transformed
Into...
The Hero of Reminding
I hope I can get there on time
A.R.T.


Heat Wave-stop. You're harming the child with the heat.
Yeah, I know. But you can't stop me.
a.R.J.


The Hero of Reminding used his mental telepathy on the child's mom
Look at your reminding ribbon
The mom remembered her child and rushed back to the car to save it.
EVEN A QUICK TRIP TO THE STORE CAN BE DANGEROUS FOR A CHILD IN A CAR

Drawing references credited to MagicPoser.

Backgrounds credited to IbisPaint X

Comic drawn with an iPad, IbisPaint X, and a stylus

Artist: Alexa Tindall

Story: Alexa Tindall, Josiah Morales, Ethan Djajadi

Created: 2018

a.R.T

Presenting throughout the Community –
Education and Outreach

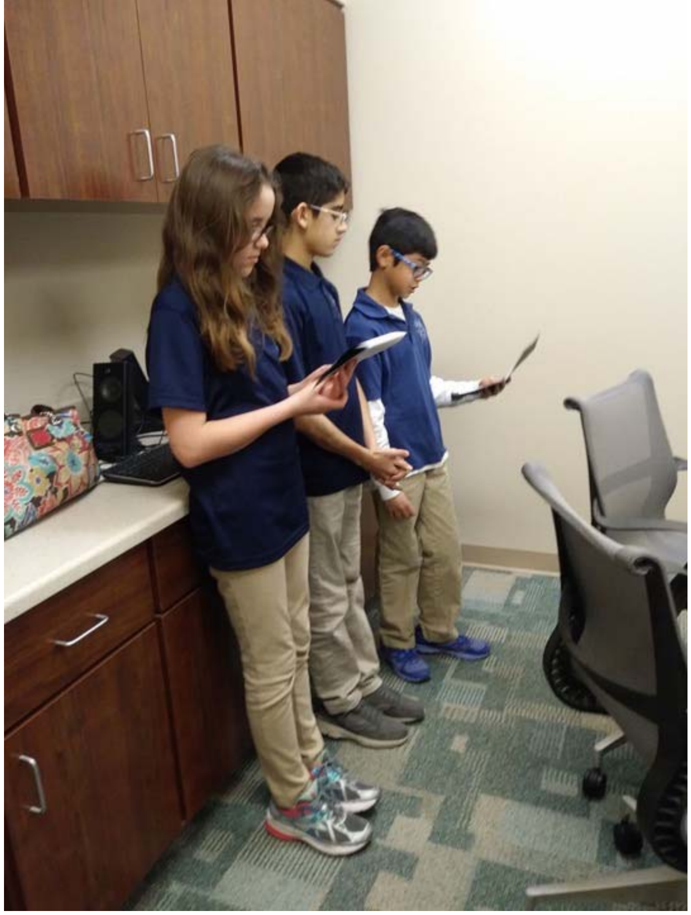
eCYBERMISSION 2018 – 2019

H.O.T. C.A.R.S.

6th Grade STEM Research Team


Covenant Children's


SCS




Snack Stop
EXIT
SPORTS
PROGRAMS


NBC
gray


be FOCUSED
ROCK SOLID DAY


KCBD


DAN C


Tips
Skype
Zillow
YouTube
Bubble Level
GoodRx
ecobee
MoneyGram
Uber
Wemo
TRAIN
Home
Sheets
SCS
SCS


SCS
SCS

H.O.T. C.A.R.S. Survey

Adult Participant Information Sheet

Investigators Details:

Main investigators:

Alexa Tindall, 6th Grade Southcrest Christian School (*allisontindall1@gmail.com*)

Ethan Djajadi, 6th Grade Southcrest Christian School (*weimin@post.com*)

Josiah Morales, 6th Grade Southcrest Christian School (renee@yfclubbock.org)

We would like to invite you to take part in our study. Before you decide we would like you to understand why the research is being done and what it would involve for you.

What is the purpose of the study?

The purpose of the study is to see the effects of information given to participants through a brochure describing how to prevent heat stroke in children who are left in a closed vehicle. The purpose includes evaluating the effectiveness of a bright key chain used as a reminder to individuals that there is a small child in the vehicle.

As a result of the study, we hope to provide insight into how best to provide reminders to caregivers so that a tragedy of leaving a child in a hot car never happens to them.

Who is doing this research and why?

This study is part of a 6th Grade student research science project. The main investigators, Alexa Tindall, Josiah Morales, and Ethan Djajadi, are specifically interested in the effect of different types of education and intervention on a person's ability to remember a child in the backseat of a car. The information they obtain may be able to help them make recommendations for educating others.

Are there any exclusion criteria?

Participants must be over 18 years of age.

What will I be asked to do?

You will be asked to read a brochure, accept a key chain, and answer survey questions about your ability to remember a child with the added information we provide.

Once I take part, can I change my mind?

Yes. After you have read this information and asked any questions you may have if you are happy to participate we will ask you to sign your initials to represent your agreement of an Informed Consent; however if at any time, before, during or after completing the experiment you wish to withdraw from the study please just contact the main investigator. You can withdraw at any time, for any reason and you will not be asked to explain your reasons for withdrawing.

Will I be required to attend any sessions and where will these be?

No. You will be provided with the brochure and key chain and will be given a link to the survey.

How long will it take?

The experiment takes approximately 15 minutes of your time.

What personal information will be required from me?

You will be given the option to provide your name and email address so that the investigators could potentially reach out to you with follow up questions. This is optional and not required in order to complete the experiment.

Are there any disadvantages or risks in participating?

There is minimal risk and discomfort anticipated with participation in this research. The topic of hot car deaths is emotional, therefore we are requiring informed consent for participation in this project.

Will my taking part in this study be kept confidential?

Yes. The data you enter will not include personal identifiers.

All data is used for statistical purposes only and will be used to publish in science competitions. No personal information is collected, shared or published.

What if I am not happy with how the research was conducted?

If you are not happy with how the research was conducted, please contact us to have your information excluded from the study. Laura Wilbanks, Elementary Science Coordinator and Instructional Coach, Southcrest Christian School, 3801 S. Loop 289, Lubbock, TX 79423. Tel: 806-797-7400. Email: lwilbanks@southcrest.org

What are the benefits of participating?

Participating in this experiment offers two main benefits:

1. *Outcomes of the research will be informative to you as an individual and provide a better understanding of how you can insure a hot car death never happens to you or someone you love.*
2. *Participation in this study will be personally rewarding as you know you potentially helped saved lives by being educated on this topic and can share what you learned with others.*

I have some more questions; who should I contact?

Please feel free to contact the main investigators at weimin@post.com and allisontindall1@gmail.com and renee@yfclubbock.org with any questions you have about participating not answered herein.

H.O.T. C.A.R.S. Experiment

Informed Consent

Taking Part

The purpose and details of this experiment have been explained to me. I understand that this experiment is designed to further scientific knowledge and that all procedures have been approved by the Scientific Review Committee of SPRSEF and Southcrest Christian School.

· I have read and understood the information sheet and this consent form.

· I have had an opportunity to ask questions about my participation.

· I understand that I am under no obligation to take part in the study, have the right to withdraw from this study at any stage for any reason, and will not be required to explain my reasons for withdrawing.

Use of Information

· I understand that all personal information will not be required and your participation will be treated in strict confidence and will be kept anonymous and confidential to the researchers unless (under the statutory obligations of the agencies which the researchers are working with), it is judged that confidentiality will have to be breached for the safety of the participant or others or for audit by regulatory authorities.

· I understand that anonymized quotes may be used in publications, reports, web pages, and other research outputs.

· I agree for the data I provide to be securely archived at the end of the project.

☐____ By checking this box or initialing on the line, you are confirming that;

- You are over 18 years of age
- You have read and understood the terms of this survey
- You are willing to take part in this study

___________________________________ ___________________________

Signature Date

INSTITUTIONAL REVIEW BOARD

APPROVAL FORM

Student(s) User Name(s): KittyPop chermender jumpydog

Grade: 6 **Team Advisor:** Laura Wilbanks

Team Name: H.O.T. C.A.R.S.

Brief Description of Project:
Adults will be asked to try a variety of apps developed by the team. The app is designed to alert an adult if there is a child in the car. Tests will be conducted using babydolls in carseats for those adults who are not parents. [redacted] ~~will use the app as a reminder for their own children.~~ They will also answer survey questions.

Team Advisor: Please sign here if the project proposed is a viable eCYBERMISSION Project in which neither animals nor humans will be harmed.
Team Advisor Approval Signature: Laura Wilbanks **Date:** 9-1-18

IRB Waiver of Written Informed Consent for Human or Animal Participation

The IRB may waive the requirement for documentation of written informed consent/assent/parental permission if the research involves **only minimal risk** ***and*** **anonymous data collection** ***and*** **if it is one of the following:** (NOTE: This statement only applies to providing the written certification mentioned in 1a or 2a above).

- Research involving normal educational practices.
- Research on individual or group behavior or characteristics of individuals where the researcher does not manipulate the subjects' behavior and the study does not involve more than minimal risk.
- Surveys, questionnaires, or activities that are determined by the IRB to involve perception, cognition, or game theory and do NOT involve gathering personal information, invasion of privacy or potential for emotional distress.
- Studies involving physical activity where the IRB determines that no more than minimal risk (Daily Activity) exists and where the probability and magnitude of harm or discomfort anticipated in the research are not greater than those ordinarily encountered in DAILY LIFE or during performance of routine physical activities.

If there is any uncertainty regarding the appropriateness of waiving written informed consent/assent/parental permission, it is strongly recommended that documentation of written informed consent/assent/parental permission be obtained.

HUMAN or ANIMAL SUBJECTS
Permission Slips needed? (see above to determine) Yes ☐ No ☑ **(Scan and attach slips to Mission Folder)**
Check-up of Human or Animal Subjects required by Doctor, school nurse or Veterinarian? (see above to determine) Yes ☐ No ☑ **If yes, Doctor's, Nurse's or Veterinarian's (before and after experimentation) current evaluation report must be attached to Mission Folder.**

APPROVALS

Susie Driscoll — 9-1-18
Principal / Administrator Signature — Date Reviewed

[illegible] M.D — 09/01/18
Doctor or Medical Professional Signature — Date Reviewed

Mike de Faurs — 09/01/2018
Science Fair Coordinator or other Science Teacher Signature — Date Reviewed

aeop ARMY EDUCATIONAL OUTREACH PROGRAM | eCYBERMISSION ACCEPT THE CHALLENGE | U.S. ARMY

eCYBERMISSION Survey Approval Form**

eCYBERMISSION team name: H.O.T. C.A.R.S.

Team Advisor name: Laura Wilbanks

Team Advisor email: sciencerocksu@yahoo.com

Team Advisor phone: 806-891-1034

Student usernames: Kitty Pop, chermender, jumpydog

School name: Southcrest School

School address: 3801 S. Loop 289 Lubbock, TX 79423

Describe the survey your team will conduct:

We Vill try to conduct a survey of people who might of experinced or know some one who has lost their child in a hot car death, we will make our surve on Survey monkey and also post a link in brochures and online. It will al participants about trying to remember babies

Describe the participants you plan to distribute your survey to:

Our participants we are planing to distribute our survey to is young parents. People who are interested in helping to prevent heatstroke in kids in cars may also take our survey.

Project approved by school administration?

■ Yes ☐ No

Approved by: Susie Driscoll

Title: Principal

Date approved: 09/01/2018

Signature, School Administrator: Susie Driscoll

*Please have form completed, signed and dated BEFORE surveys are administered.

**As of August 2017, an IRB approval form (below) must be completed for all surveys as well as the information requested above.