Deliverable D: Conceptual Design

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Group 1

GNG1103 - B01

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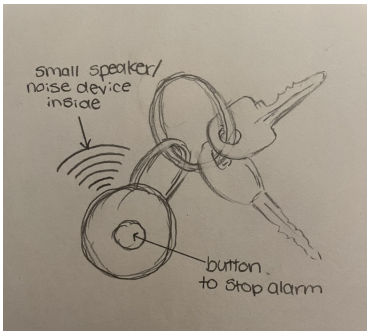
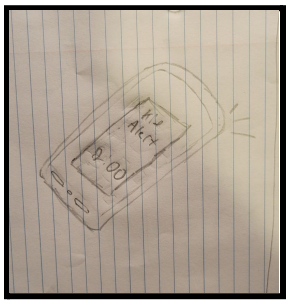
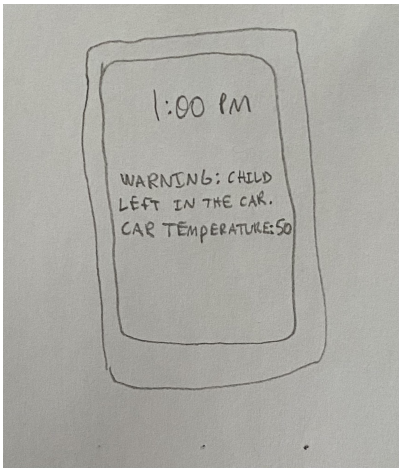
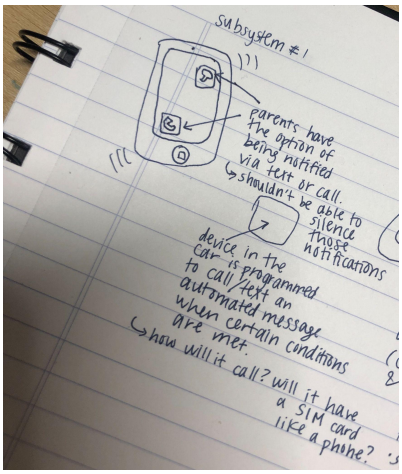
Deliverable D: Conceptual Design

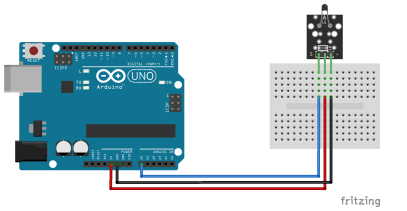
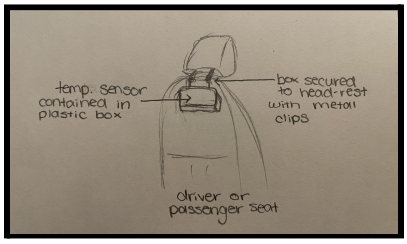
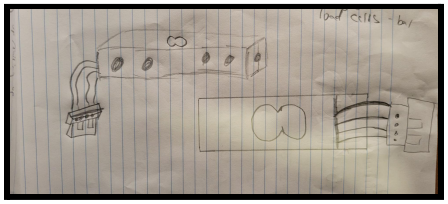
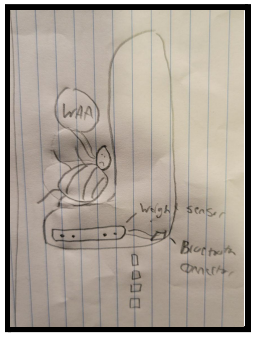
In this deliverable, we will be including conceptual designs for our problem statement. During the Thanksgiving weekend, each team member was responsible for designing a subsystem based on the information collected in the previous deliverables and we reconvened during Tuesday's lab to consolidate our top three choices based on how close the specifications were to the ideal data we identified while benchmarking and establishing design criteria. We then incorporated the features that we believed were the best from those top three choices into one global concept that will serve as our guide for the following steps in this design process.

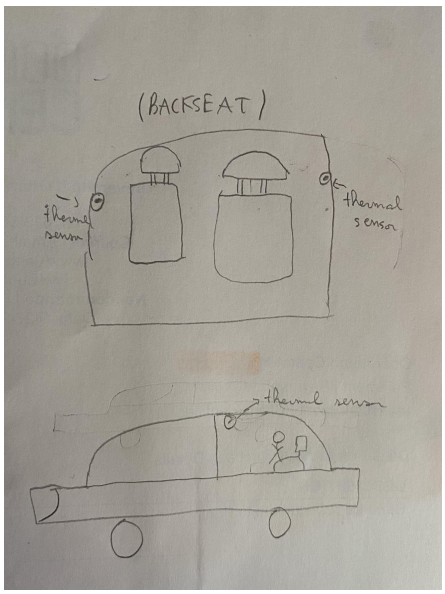
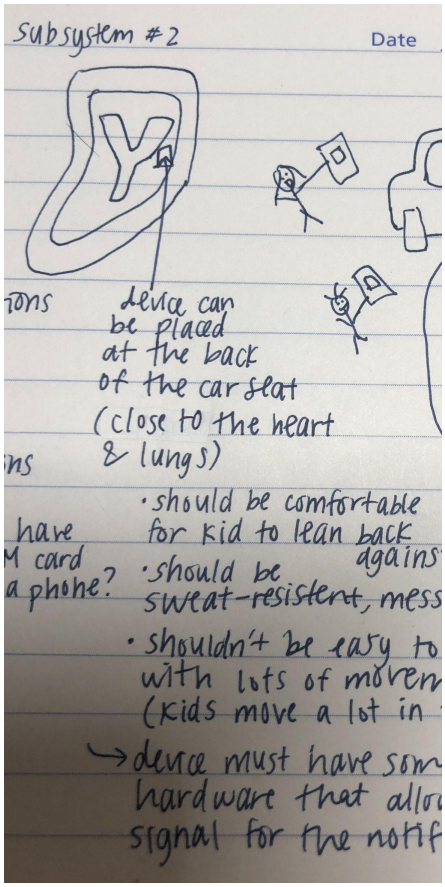
List of Subsystems:

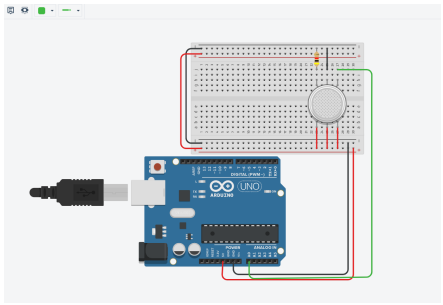
1. Our project should have the ability to notify parents of their child's presence in their car
2. Our project should have a system that can detect the presence of a child
3. Our project should have the ability to notify bystanders of a child's presence in a nearby car

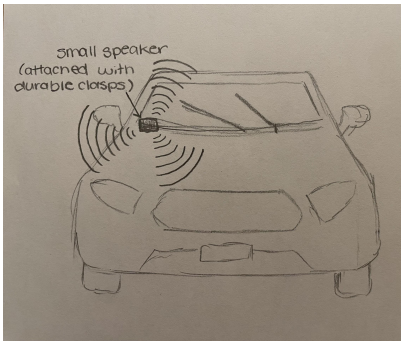
Subsystem #1: Notification method for parents make a simple sketch for each idea		
Belle		Alarm pin on car key chain This would be a small keychain which can attach to the owner's existing car keychain. An alarm from the keychain would be triggered when the sensor(s) reach certain levels; whether this be extreme heat, etc. This requires no app or smartphone, making the product more accessible. However, this would require additional research into how to connect the car's sensors with the keychain- bluetooth, etc. Keys, wallet finder tag - Arduino Project Hub
Kymani		Application After a certain amount of time, an application will send a ping notification to the car owner's cellphone. The sensor would send a bluetooth signal to the application with the data sourced from the sensor. Either the amount of time the child was seen in the vehicle, or a temp/carbon monoxide reading seen in the vehicle.

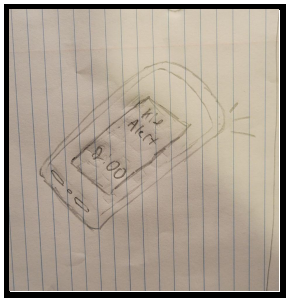
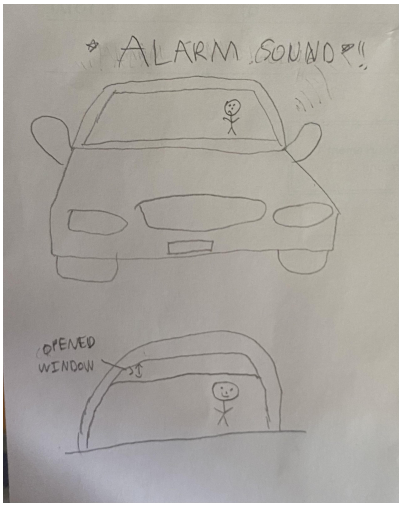
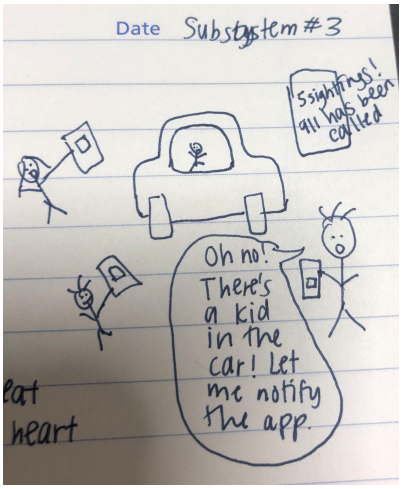
Ziad		<u>Application</u> Application you download on a smartphone that will notify you when your car is overheating and there is a human inside. It can also tell you what the temperature of your car is and show you the location of your car. This makes the product less accessible to everyone (those with no smartphones cannot use it) but more practical.
Kate		<u>Text Message/Call System</u> It is easy to disregard app notifications especially when you are a busy parent. On top of that, third-party apps often rely on a wifi connection to send those notifications and wifi isn't accessible or reliable everywhere so the most guaranteed way to successfully notify a parent would be via text or call. The device should be connected to the parent's number and have the ability to call or text when certain conditions are met. - Parents shouldn't be able to silence these notifications - How will the device be able to call? Will it have a SIM card like a phone?
Evanna		<u>SOS via smartphone</u> I assume we are all familiar with the SOS system that is available on most modern phones. Where the screen shows an emergency alert and gives 3 seconds to respond. The idea is to have the notification appear on the phone in that very way, disabling further access to anything on the phone until the owner deals with the situation. And since the SOS sends a signal via GPS, this message is also used to notify the emergency centre

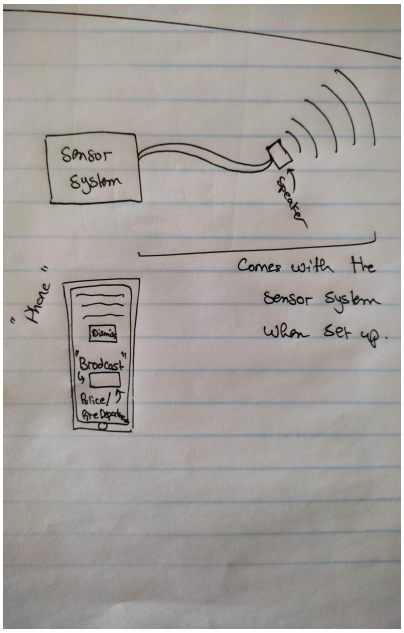
Subsystem #2: Detection Systems		
Belle	 	<u>A temperature sensor</u> KY-013 Analog Temperature sensor This sensor measures temperature based on the resistance of the thermistor. The photo below shows a sample set-up, and the website mentioned below contains some tutorials and sample codes for working with this sensor. The measurement range is -55°C to 125°C. Further research is required as I am not sure whether this range is large enough for all the extreme temperatures around the world. The accuracy of the sensor is ± 0.5°C. I believe this is accurate enough for our product. KY-013 Analog Temperature Sensor Module - ArduinoModulesInfo
Kymani	 	<u>Weight sensor</u> Once the car turns off fully, it senses if there's weight on the car seat. If weight is sensed after a few minutes the sensor will turn on and the notification system will go off. Similar to how a digital scale works, once the weight is detected, it would transform the analog signal into an electronic signal.

Ziad		<u>Thermal/Heat sensors</u> Place thermal sensors in the car so that it can detect if there are people inside the car, and the temperature inside the car. When a person is inside the car and the sensor can sense that the temperature inside is rising, it should notify the parents via an app, and if the parents do not respond, a program will crank down the windows just a bit, allowing airflow and preventing heatwaves.
Kate		<u>Heart-rate & respiration sensor</u> A heart-rate and respiration sensor can be placed at the back of a child's car seat (in the area where the child's lungs and heart would be when seated). If the sensor registers a heart rate and breathes in a stationary car that has recently had its car door closed, it will proceed with its notification process. - Device shouldn't be intrusive, child should be comfortable leaning back against it - Device should be sweat-resistant because the child might sweat - Device should be mess-resistant (waterproof and easy to clean) because kids can be messy - Device shouldn't be easy to remove with a lot of movement because an active kid should not be able to remove it by simply moving in their seat - Device should have some electrical hardware that allows it to send a signal for the notification process

Evanna	 	<u>Carbon Monoxide sensor</u> The idea is to have a smoke detector, more specifically a carbon monoxide detector (sensor) that can be installed in the car. So once the car is closed (which includes windows and doors) we assume there is no air circulation. If a person or animal is present in the car, with the insufficient level of oxygen in the car carbon monoxide starts building up, so the CO sensor can be used to detect a specific level of CO and send an alarm to the owner notifying them of an increase in the level of CO in the car which would usually mean there is someone in the closed un-oxygenated car. Of course the level of CO that the sensor should be able to pick up must be somewhat low, about 50ppm.

Subsystem #3: Notification method for bystanders		
Belle		<u>Automated broadcasted message</u> When the alarm is sent, but sensors still sense an animal or child inside the car in poor conditions 5 minutes later, an automated message asking bystanders to contact local police will be broadcast from the car. This will be delivered via a small speaker attached next to the car's windshield wipers. However, this design risks being stolen off the car, and thus becoming ineffective. Also, the device would either have to be manually applied by the parent everytime after leaving their car, or it would have to remain attached to the outside of the car at all times. This means it would need to be extremely durable to all extreme conditions (heat, cold, storms, etc.)

Kymani		<u>Public Push Notification</u> After a short amount of time, a push notification similar to an amber alert is forced onto the screen of nearby civilians. The phone would vibrate, make noise and it would notify them about the situation (amount of time the child was in the car, the location of the vehicle, etc).
Ziad		<u>Alarm system</u> When the notification is sent to the parents and they do not respond in a span of 3 minutes, an alarm system will go on, notifying regular bystanders that there is a child inside the car. The alarm system should not sound harsh and frightening because it will only keep bystanders away from the car and might stress the child.
Kate		<u>Public-sharing Application</u> Members of the public can be encouraged to download an application that will have a similar concept to the app Waze. On Waze, users can notify other users of sighted police presence to encourage vigilance when driving by that area. The app rates the accuracy of these possible sightings based on the frequency of the users that have notified the app of the same presence. The app gives users the ability to anonymously report incidents which can serve as an incentive for everyone to participate. Our app can allow users to report sightings of kids in cars and work in conjunction with local law enforcement in case of emergencies. An alert can be sent to local law enforcement after a certain number of possible sightings in the same spot. - How will the sorting process work because there will be many possible sightings? How do we identify if it is a group spam alert

		prank? - We need a way for this system to work in areas without much public presence (we can't wait for other users to show up eventually before investigating) - How do we protect the vulnerable child from predators? - We need an incentive for people to download the app and to contribute apart from anonymity and a sense of satisfaction
Evanna		<u>A recorded message</u> Once the SOS message reached the owner's phone, there will be a brief moment for the owner to respond to this notification, either by dismissing (meaning they are within proximity and can get to the car and check the problem themselves) or there will be an option to notify people nearby, this can be done by broadcasting a short message addressing the situation in the car,(something along the lines of "there is a possibility that there is a human/animal trapped in this car, if this is true please contact the fire department/police . If there is nothing of concern, this message will end shortly). -Also there is a possibility of not receiving a response from the owner on their smartphone, in case that happens to the fire department/police should be notified immediately as well as the broadcasting. The speaker for the broadcast should be attached to our sensor system.

After Reconvening: Combining interesting concepts from everyone's sketches into 3 fully functional solutions (Sketches & descriptions):

<u>Our top choice for each subsystem:</u>

	Subsystem #1	Subsystem #2	Subsystem #3
Belle	<u>Text Message/Call System</u> I believe this is simple, and will grab users' attention more effectively. Small notification messages from	<u>Thermal/ heat sensor</u> This would be very effective in sensing whether a person or animal is in the car. This	<u>Automated broadcasting method</u> I believe this is simple and safest. Rather than an alarm that may be

	apps are easy to miss or ignore. This is a stronger method.	could also work to determine whether the being in the car is becoming overheated, or too cold.	frightening to the child or passerbys, this would better explain the situation. This way, bystanders can act more efficiently.
Kymani	<u>Alarm pin on key chain:</u> - This can be used in places where phones aren't widely used. - Simpler to design than an app -	<u>Heart rate sensor:</u> The heart monitor would be the easiest way to both see the child's condition in the car, and notify the parent of any drastic changes to the child. The device would also allow for the parents to know if any issues are seen with the child.	<u>Automated push notification:</u> Allows for bystanders to support the child and have knowledge of their condition. Can also be sent to the authorities in case of emergency.
Ziad	<u>Application</u> - Easily accessible and practical - Parents will easily hear the alert from their phones once they receive the notification	<u>Thermal/Heat sensors:</u> - Can detect the temperature of the car - Can detect when the car is starting to heat - AND can detect the presence of a being inside the car - Can monitor the thermal activity inside the car	<u>Alarm system:</u> - Very loud so it will definitely attract attention to the car - The sound should not be scary and frightening, it should be soothing and calm but at the same time warning you that there is a problem - In the case where no one is around or if the car is parked somewhere isolated. A system will lower the windows just a bit, allowing proper air flow and avoiding deadly heat waves.
Kate	<u>Text Message/Call System</u> - Parents are more likely to check their phone when they hear the text/call sound then if they hear an app notification alert - Using signal	<u>Heart-rate & respiration sensor</u> - Most accurate for determining if a child is in a car (temperature & CO sensors are meant to test values that are	<u>Automated broadcasted message</u> - All members of the public will be able to help because the message is broadcasted to everyone in the area

	increases the chances of a parent receiving the alert than using wifi	expected to occur during a hot car emergency however we will need to determine the 'safe' temperature values in different areas around the World, heartbeat and respiration rates are in a specific range for all kids around the World). - Parents will be able to monitor their child's condition while they are running back to the car - App can record valuable data for paramedics/first responders/doctors and for police reports - Can detect abnormalities quicker because changes in heart rate and breathing are a lot faster than changes in temperature or CO level.	- What if no one is around to hear the broadcast?
Evanna	<u>Text Message/Call System</u> I believe having the notifier be via smartphone is the best option. Since there are about 3-4 of us who already agree on this. We can further modify this by having the notification announced on the front screen on the phone with no way of accessing the	<u>Heart rate & respiration sensor</u> I think the heart rate system attached to the child's seat is a good idea since the sensor can not really miss the heart rate or the child's respiration. Though I see a problem especially when it comes to the	<u>Automated broadcasted message</u> In my opinion I like the idea of having a message broadcasting the situation once the notification to the phone has been sent. It is a bit unreliable to depend on people walking by the car. So what I think is more important is to have the

	phone unless the situation is dealt with.	possibility of the child/ animal sneaking into the car so the sensor should have a greater range and be able to detect heart /respiratory rates.	police/fire department get notified right away.

Top Choice

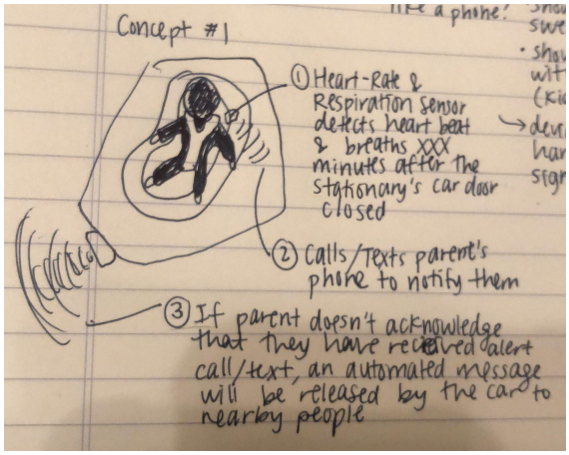
2nd Top Choice

3rd Top Choice

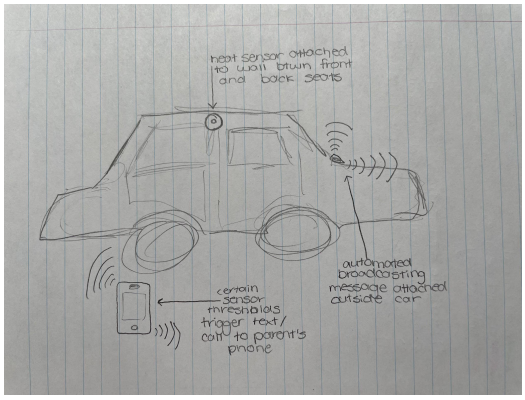
Ordered top choices for Subsystem #1: Text/Call System, App, Keychain
Ordered top choices for Subsystem #2: Heart-rate & respiration sensor, heat sensor
Ordered top choices for Subsystem #3: Automated broadcasting message, automated push notification, alarm system

<u>3 fully functional solutions:</u>

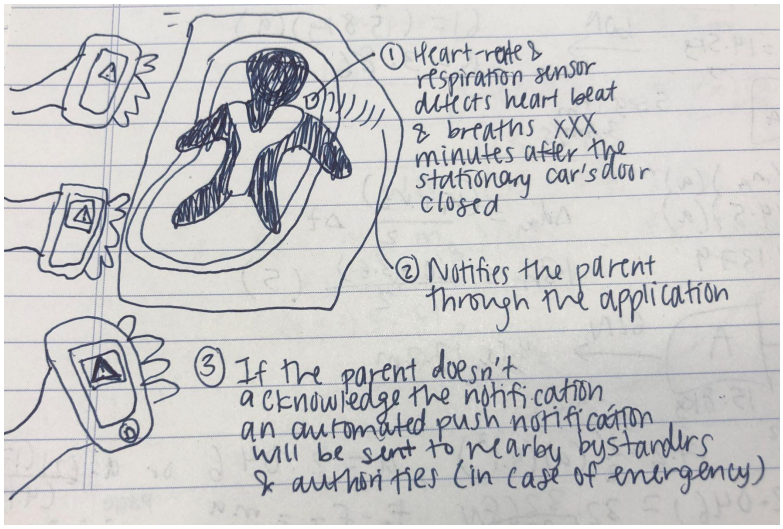
- Concept #1: (Text/Call System) + (Heart-rate & respiration sensor) + (Automated broadcasting message)



- Concept #2: (Text/Call System) + (Heat sensor) + (Automated broadcasting message)

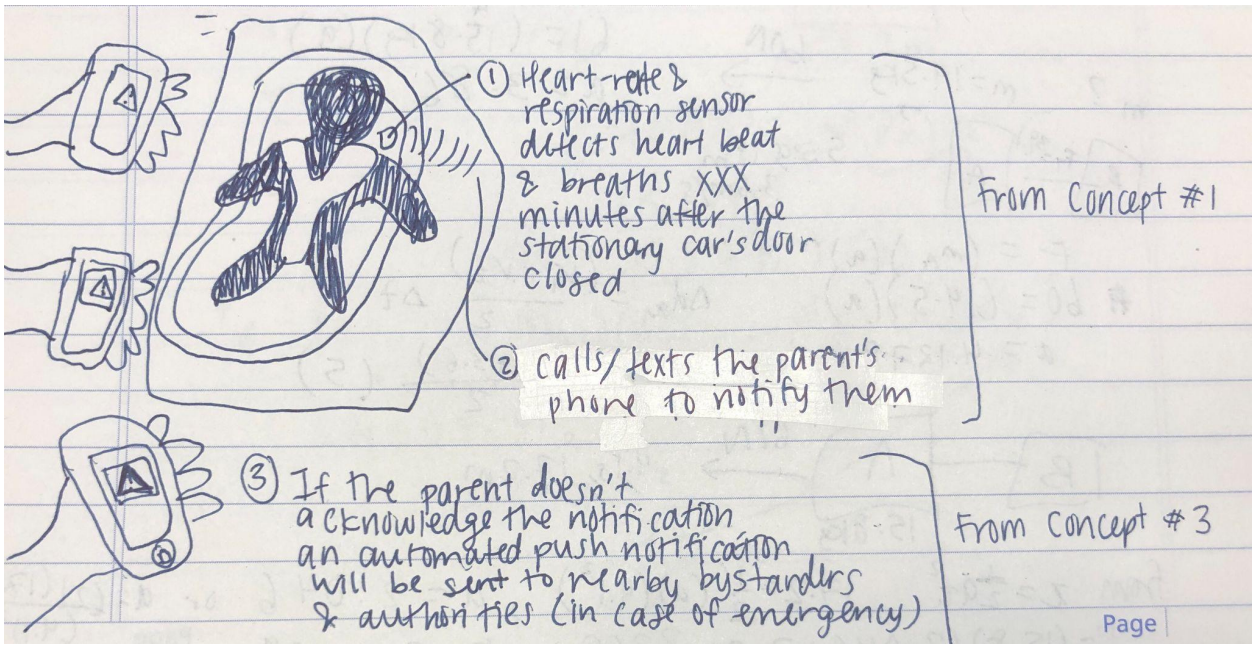


- Concept #3: (App) + (Heart-rate & respiration sensor) + (Automated push notification)



After evaluating against design criteria: the Best Global Concept

- List benefits & drawbacks of diff. concepts and why you chose certain ones for best global concept



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Benefits	Drawbacks
- The heart rate & respiration sensors are the most accurate sensors out of all the proposed ones for solving our main goal of identifying the presence of a child in the car - Heart rate & respiration sensors can keep track of the child's condition (as	- The heart rate & respiration sensor may be inaccurate if the child moves a lot, is wearing a lot of clothes, isn't sitting in their car seat, etc. - Parents can put their phones on silent which silences text and call notifications and the alert wouldn't be

well as give an idea of the car's condition ex: temperature, humidity, CO level, factors that the other mentioned sensors detect) - It is easy for busy parents to disregard app notifications because they receive countless ones during the day. Text/call notifications are less frequent and usually more urgent, making the parent more likely to see it and do something about it - Sending an automated push notification (like an Amber Alert) to nearby phones has higher rates of successfully reaching someone than an alarm that can only be heard within a restricted radius.	seen - An automated push notification to every phone in an area can be dangerous and put the vulnerable child in danger - However, sorting who can and who can't receive these notifications could be the reason why a child doesn't receive help