

Executive Summary

Sadly, year after year, we see the devastating incidents of infants left unattended in vehicles as their parents or caregivers carry out errands. This distressing situation is strikingly highlighted in a report by US Today, which reveals that on average, such circumstances claim the lives of 38 infants per year. If we can develop a device that would provide parents with updates on their baby's condition or remind them about the presence of their child in the car, we could significantly mitigate this grave problem.

Our team began by determining the required functions for our device. We envisaged it to have the capability to check temperature, allowing us to establish a safety threshold. Additionally, we wanted it to detect the presence of a baby in the seat and verify whether the seat is securely fastened for precautionary measures. We also deemed it essential to track the distance between the child and the parents or guardians to ensure they are not too far away. Finally, the device should have the ability to communicate with the parents or guardians effectively.

Our team started with a microcontroller serving as the core unit. This microcontroller was configured to link with a temperature sensor, latch sensor, and force sensor. We initially chose the Arduino UNO as it was familiar to all team members and there is a wealth of resources available within the Arduino ecosystem.

However, our primary challenge was to facilitate wireless communication from this microcontroller to a person. To solve this, we decided to leverage cellular connections, given their widespread availability, and designed an App to connect with the device. Consequently, we selected a 4G modem add-on board compatible with Arduino UNO. An added advantage of this modem is the built-in GPS, which conveniently addressed our requirement for distance tracking.

We further enhanced our design by integrating a Bluetooth module and a Bluetooth tracking dongle. This was done to offer a backup solution for individuals who may not own a smartphone or as a failsafe measure in cases where parents might inadvertently leave their phones in the vehicle.

Our biggest challenge is to incorporate both GSM modem and Bluetooth module. We ran into a problem that both add-on boards need UART to connect to the microcontroller. However, the Arduino UNO only has 1 UART. Which means that we either need a microcontroller that has 2 UARTs or a Bluetooth module that has a built-in dedicated microcontroller. At the start we went with Arduino Nano RP2040 because of the small form factor and the built in Bluetooth with extra UART. Unfortunately we had problems connecting the GSM module via hardware serial connection to the Arduino nano rp2040 and since we ran out of time, we decided to use the nano rp2040 as a dedicated Bluetooth module on the base and revise our custom PCB so it can hold both Arduino uno/GSM module and the Arduino nano rp2040.

Project Timeline:

Fall Term:

1	Week 0-1				
1.1	Project Bidding	Individual	9/23/22	9/28/22	100%
1.1.1	All non project related class work	Individual	9/26/22	9/29/22	100%
2	Week 2				
2.1	All non project related class work	Individual	10/6/22	10/6/22	100%
3	Week 3				
3.1	All non project related class work	Individual	10/10/22	10/13/22	100%
3.2.2	Wk 3 Draft Project documentation: Section 1	Team	10/10/22	10/14/22	100%
4	Week 4				
4.1	All non project related class work	Individual	10/17/22	10/20/22	100%
4.3	Wk 4 Project Partner Update (email/canvas)	Team	10/17/22	10/20/22	100%
4.4	WK 4 Progress report 1	Individual	10/17/22	10/21/22	100%
5.1	Force Sensitive Resistance	Deon Lofton	10/13/22	11/7/22	90%
5	Week 5				
5.1	All non related class work	Individual			100%
5.2	Project Performance	Team			110%
5.3	Temperature Sensor Reading	Deon Lofton	10/13/22	11/21/22	50%
5.4	Ordered Parts (GSM)	Jazmin C	10/24/22	10/26/22	100%
5.5	Ordered Parts (Force Sensitive Resistance)	Jazmin C	10/24/22	10/26/22	100%
5.6	Ordered Parts (Pager Tablet)	Jazmin C	10/24/22	10/26/22	100%
5.7	Ordered Parts (Fearther Board)	Jazmin C	10/24/22	10/26/22	100%
5.8	Ordered Parts (Battery)	Jazmin C	10/24/22	10/24/22	100%
6	Week 6				
6.1	All non related class work	Individual	11/4/22	11/4/22	100%
6.2	Team Communication evaluation	Team	11/4/22	11/4/22	100%
6.3	Wk6 Draft project documentation: Section 2	Team	11/4/22	11/24/22	100%

7	Week 7				
7.1	Peer Review Deign Impact Assessment	Team			100%
7.2	Project Performance	Team/Individual			100%
7.3	ESP32 Feather Board Initialization(Reading)	Ting-hsuan Chen	11/14/22	11/21/22	20%
7.4	Bluetooth Module(Transmitter) HM-10 with Arduino	Ting-hsuan Chen	11/21/22	11/30/22	40%
7.5	GSM Modem Module Initialization(Communication with the board)	Allen Lee	11/12	11/21/22	75%
8	Week 8				
8.1	WK 8 Project Partner Update	Team	11/14/22	11/17/22	100%
8.2	WK 8 Project Document: section 1 and 2	Team	11/14/22	11/17/22	100%
8.3	WK 8 Teamwork reflection	Individual	11/14/22	11/18/22	100%
8.4	GSM Modem GSM network testing	Allen Lee			50%
9	Week 9				
10	Week 10				
10.1	WK 10 Project Partner Update	Team	11/22/22	12/1/22	100%
10.2	Final Design Impact assessment	Team	12/2/22	12/2/22	100%

Winter term:

WBS NUMBER	TASK TITLE	TASK OWNER	DUE DATE	PCT OF TASK COMPLETE
1	Week 0-1			
1.1	All non project related class work	Individual	1/13/23	100
1.2	Scope meeting with Don	Team	1/13/23	100
2	Week 2			
2.1	All non project related class work	Individual	1/18/23	100
2.2	Draft Block Validation:Block 1	Individual	1/20/23	100
2.3	Interface meeting with Don	Team	1/23/23	100
2.4	Project Database Update	Team	1/25/23	100
3	Week 3			
3.1	Project Partner update	Team	1/26/23	100
3.2	All non project related class work	Team	1/27/23	100
3.3	Peer Review Block Validation:Block 1	Individual	1/27/23	100
4	Week 4			
4.1	All non project related class work	Individual	10/20/22	100
5	Week 5			
5.1	All non project related class work	Individual	2/10/23	100
5.2	Block validation: Bonus Points	Team	2/11/23	100
5.3	Block Validation: Block 1	Team	2/12/2023	100

6	Week 6			
6.1	All non project related class work	Individual	2/17/23	100
6.2	Block Verification: Block 1	Team	2/12/2023	100
6.3	Project Partner update	Team	2/16/23	100
7	Week 7			
7.1	All non project related class work	individual	2/24/23	100
8	Week 8			
8.1	Block Verification: Block 1& Block 2	Team	2/26/23	100
8.2	All non project related class work	Individual	3/3/23	100
9	Week 9			
9.1	All non project related class work	individaul	3/10/2023	100
10	Week 10			
10.1	WK 10 Project Partner Update	Team	12/1/22	100
10.2	System Verification 1	Team	3/12/23	100

Key lessons learned:

1. GPS has some shortfalls with precision detection when used in a smaller timeline like this project.
2. Serial connection limitations on Arduino microcontrollers.
3. Triple check PCB designs by others.
4. Thoroughly understanding the features of the microcontroller.
5. Spending more time learning about bluetooth protocol.
6. Take a lot of videos.
7. Continue to think of future improvements.