Final Report Group 9 Surya Prakash Reddy Dasari Kevin Espinoza Nikhil Kadway Satya Pattela Xinyu Wang

MAE 540-Advanced Product Design Method Spring 2017

Arizona State University School for Engineering, Transport, and Energy

## Introduction

In the world of parents, nothing is more beloved than the safety of their children; parents will go thru all lengths to protect and monitor the wellbeing of their kids. Families spend a lot of time in the car, such as going to the store, school, weekend trips, and so on. These trips could last from a few minutes to hours going back and forth every day. That is why picking the right car seat is important, throughout the development of car seats most safety standards now have protocols- they must meet federal and ASTM Safety Standards.

Thus, one might be inclined to think that their children are protected and safe while in the car seat. On the contrary, an average of thirty-eight children die each year as a result of being left in the car and many more, near misses that are never reported on. One child dying is too much, recently a law was passed named the "The Right to Rescue Act," this bill gives people the right to smash a car's window to save a life of a child or pet trapped in a car that might be in danger of overheating. The people leaving these loved one in the car simply forget they have brought someone else with them.

Important to realize, the people that would be interested in this product is every new parent, caregivers, and friends/family of parents. New parents and caregivers are not used to having little ones around, and could easily be the first ones to forget their precious cargo. Being a new parent usually is coupled with little amounts of sleep, leading to forgetful moments. Caregivers are not used to having the kids around can sometimes think I will run into the store for a few minutes, then to run into a friend in the store. These are perfect users of 'My Precious' safety device. Another buyer of My Precious, would be friend and family of parents; these buyers know the parents the best. They will know if a parent is forgetful or they might just want to buy the parent something nice to show them they are concerned with their piece of mind.

Because the technology is so new, people do not understand what and how is available for them. Technology is finally at the point that an effort such as My Precious is actually very achievable. My Precious will save the life of a child if used correctly. The only constraints will be the limited space given by the car seat to install devices and sensor that will ultimately save a life when used.

## **Product Description**

My Precious is a safety device that can be attached to the baby car seat as an add-on. The device incorporates the usage of optical sensors, temperature sensors and checks the presence of baby in the car and notifies the user about the baby left inside the car without any supervision. The optical sensors in use are Reed switches. Reed switches are used to check whether the belt is buckled in or not. These switches are used at two places; baby's belt buckle and driver's belt buckle. The sensors are switched on when the buckles are locked and the device monitors the presence. When the baby's still buckled in and the driver's buckle is off, the notification will be sent to the user within a timespan of one minute, reminding the driver of the baby's presence, thus preventing the situation of leaving the baby alone.

The device also monitors the temperature inside the car. The respective sensor gets activated when the baby's left in the car. It checks the temperature on regular time intervals and increases the frequency of notifications sent to the user as soon as the temperature level inside

the car crosses the threshold value set in the device. The threshold temperature is usually set at 95 degrees Fahrenheit.

The device is provided with renewable batteries as the survey results indicated that users prefer renewable battery source than the non-renewable battery source. The device incorporates a SOC indicator which notifies the user when the charge in the batteries is low, so that they can recharge them periodically.



Figure 1: Assembly of prototype

Right now, in the initial stages of development, My Precious exhibits the basic functionality that is sending the notifications to the users and the temperature. The notifications are sent to the user through the Blynk, a mobile application that should be pre-installed on the user's mobile phone. Developments are being to reduce the usage of Blynk and the device to send notifications and make calls to parents or emergency services independently.

My Precious is superior product than its competitors in the market; cheaper in price and highly reliable product which takes care of the baby and ensures no harm is caused to the future generation.

# Survey Analysis

A market survey was conducted to know the user preferences towards the attributes of the product. The survey was directed towards finding influential attributes that will affect the purchase of the product. Through the initial study of the attributes, it was decided the factors, Price, False positive, false negative rates, type of battery used and response time, will be used for the market survey, providing different options to the users. The survey was launched on various social media platforms and 79 responses were recorded across all the platforms.

Amount in dollars (\$)	Amount in dollars (\$)	Amount in dollars (\$)			
30-50	51-70	71-100			

Ranges Offered For the Attributes Price:

## False Positive Rate:

Percentage (%)	Percentage (%)	Percentage (%)	Percentage (%)
5	15	25	30

## False Negative Rate:

Percentage (%)	Percentage (%)	Percentage (%)	Percentage (%)
5	15	25	30

Type of Battery:

	Rechargeable	Non-Rechargeable
_		

Response time:

Time in minutes	Time in minutes	Time in minutes
<10	<15	<20

		Хеал	StdDev	share<0	Share=0
30-50\$	normal	-3.0488	1.7175	0.9630	0.0000
51-70\$	normal	-3.7688	0.9147	1.0000	0.0000
71-1005	normal	-4.5967	1.4176	0.9980	0.0000
Rechargabi	le normal	1.3729	1.8866	0.2265	0.000D
Non Rechar	rgable normal	-0.55	33 2.38	67 0.58	20 0.0000
56#37:	normal	-0.4835	2.3025	0.5825	0.0000
156+37;	normal	1.0189	1.4264	0.2360	0.0000
256#37;	normal	0.6634	0.6810	0.1705	0.0000
306#37;	normal	0.7945	2.2677	0.3600	0.0000
5\$\$37;	normal	2.4228	1.3029	0.0305	0.0000
156#37;	normal	0.1543	2.2670	0.4600	0.0000
254+37;	normal	-1.6911	0.7589	0.9875	0.0000
306+37;	normal	-2.2808	1.5074	0.9420	0.0000
less than	10 normal	0.0978	1.5752	0.4845	0.0000
less than	15 normal	-0.4705	0,7613	0,7220	0,0000
less than	20 normal	-0.9664	0,7729	0.8900	0.0000

The survey analysis clearly indicate that, Price of the product is not a major influencing factor and users were willing to buy the product in all the price ranges, with a slight majority of the demography inclining towards the \$31-50 range.



Figure 2: Preferences in the price

Large portion of the demography participated in the survey, chose the rechargeable battery over the non-rechargeable model, even neglecting the incurring maintenance cost.



Figure 3: Preferences in the type of battery

Results for the false positive and negative rates were much divisive than it was expected, with people going for high false positive rate and low negative rates. It was speculated that this difference might be resulted from wrong perception of the false rates concept by the participants. So, it was decided to provide low positive and negative rates for the product and the use of vibration sensor along with the reed switches was proposed.



Figure 4: Preference in the False positive rates



Figure 5: Preference in the False negative rates

Participants were more inclined towards the response time being less than 10 minutes in the product, which was aligning with the expectation.



Figure 6: Preference in the response time

The survey results were aligning with the expected results in most of the cases and deviating in case of few attributes. So it was decided to proceed with the public expectation of the product and also providing optimal solutions in case of deviant attributes.

## **Business** Objectives

The objectives are

- To develop fully functioning model with independent mobile application. This model reduces the reliance on Blynk app by a large extent which in turn reduces the costs towards Blynk. Also, the third party interference will be reduced to a greater extent which simplifies the usage for customers.
- To target the customer demography- parents, car seat manufacturers and retail stores.
- To attract the investment of \$0.25 million which will be utilized for setting up the manufacturing unit, labor costs, development cost, et cetera.
- To sell 15000 units by the end of year one.
- To increase the sales by 20% by year two and maintain the sales growth increment for year three to break even by the end of third financial year.
- To pool in the resources towards the research and development of the product and introduce new variants into market. The part of the profits earned after year three will be directed towards the R & D.
- To set up more manufacturing units to increase the number of units manufactured and also to maintain steady increment in sales every year.
- To reduce the price by 10-15% if possible by fifth or sixth financial year, maintaining the same sales growth.

## Market Analysis

The market analysis is a quantitative and qualitative assessment of a market. The market analysis will give the complete size of the market which includes volume, value, buying designs, competition, potential customers, and the economic environment.

Usually, a product selection is based on whether or not it fulfills the problem statement. Since there are couple of products which are already available in the market, which gives the solution to the same problem, now the interests of our potential buyers have moved from a product with basic functionalities to a product with added features. The next important attribute for choosing the product is cost.

*Target Customers*: Statistics say that out of 4 million children born every year, only 2.6 million children use baby car seats. As our target demography is constrained to a specific group of people who use the baby car seat for their children, the team will target that parents via groups. We will advertise in the Mom's and the Dad's group on readit, Quora, WhatsApp and other social media platforms.

The marketplace for our product is online Walmart selling platform. Being an online selling platform, it will be easy for all the parents to buy the product. The other market place could be Maker market. It is also other online selling platform. Since Walmart is predominantly used by many people it will be the major market place. The cost incurred for selling the product through these online platforms on an average assuming selling more than 40 products a month is \$480 dollars a year.

*My Precious* can attract customers of other companies by collaborating with them. Walmart is working on a baby car seat which prevents child death in car. So, we can give them our product which can be attached on their seat. This allows us to grab their customers. Similarly, we can collaborate with different baby car seat manufacturing companies. Our product can be an added-on feature to their car seat. With this we broaden our customers.

		Cost		
Product	Basic function(notification)	S.O.C (state of charge)	Temperature alert	High ( $\mathbf{X}$ ) Low ( $\mathbf{\checkmark}$ )
Evenflo	$\checkmark$	×	×	×
Kars4Kids Safety	$\checkmark$	×	$\checkmark$	~
Sprouting band monitor	$\checkmark$	×	$\checkmark$	~
Sense a life	$\checkmark$	×	×	×
My precious	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$

 Table 1: Available products Vs features



Figure 7: Location of 'My precious' in the current market.

Taking the above factors 1: Efficient with added features and 2: cost, a figure is prepared to locate where the product 'My Precious' stood with the available ones in the market.

'Sense a Life' (Indiegogo, n.d.) is one available product which has all the basic functionalities with considerable added features (Burns, 2016) but, the cost of the product is quiet high which is not making a best option for buying.

'Evenflo' is another available product which is located on the poor selection side due to its high cost and low effective. This product is more designed to give only basic functions and cost is pretty high and hence it is not a best choice to buy.

'Sproutling Monitor Band', another product (O'Callaghan, 2014) which is also on the same side with My Precious having low cost but very less added features. Hence, it is also not a best choice for customers to buy. Another drawback of using this product is, since it is a wearable band it should be on the baby all the time which is not good for small babies.

'Kars4Kids Safety' is a mobile application (Kars4Kids, 2015) which is in connection with the Bluetooth of the car. It alerts the driver to pick up the child when exiting the vehicle. This application does not function without a Bluetooth facility in the car.

'My Precious' comes with the best possible price of \$85.00 is designed to be high accurate and is equipped with an additional features of temperature indication, temperature warning, state of charge (S.O.C) indication. Designed to provide basic functionalities and installed with more additional features which could increase the reliability and usability, it stood as a best option for buying.

## Capital and Personnel Resources

Initial Investment:

Total Initial Investment	Initial-scale Development	Full-scale development
\$61,000	\$7,000	\$54,000

A total of sixty-one dollars (\$70,000) is taken for initial investment of which, seven thousand dollars (\$7,000) were planned to spent in initial development and fifty-four thousand dollars (\$54,000) in full-scale development. The seven thousand dollars of initial development money were planned to flow into engineering (\$1,000), Industrial Design (\$1,000) and Initial marketing (\$5,000).

The fifty-four thousand dollars of full-scale development money covers the three major workstations (Electronic, Mechanical, Assembly), the costs for safety equipment which includes (gloves, shoes and goggles etc.), Testing costs, set-up costs and design part costs.

#### Fixed Operating costs:

A fixed cost is an operating expense of a business that cannot be avoided regardless of the level of production. Fixed cost remains to be the same during high production time and low production time. A total fixed cost of one seventy-nine thousand one hundred eighty dollars (\$179,180) is said to occur during one complete year.

The fixed cost covers Administrative costs, sales and advertising costs, Marketing costs, salaries of workers. The administrative costs include rent, utilities and insurance.

To lower the production costs, the production units are planned to set-up in Arizona due to inexpensive rents and high number of anticipated customers. Since the product 'My Precious' which would mostly use by parents living in high temperatures regions, the head-quarters is planned in Arizona due to its extreme temperatures.

Money for research and developments is spent in two phases initial and final phase based on the customer feed-backs and interests. Apart from providing the basic essential features, based on the customer needs, research is planned to conduct in that direction to bring new changes in the product.

Since the individual components for 'My Precious' is bought directly, assembly of all the components is not too complicated and can be self-learned. Hence, little money is spent for training of the employees.

#### Marketing strategy:

For marketing the product, we are going to go with advertisements. The company is going to advertise our product on Facebook and YouTube. Facebook charges 16 cents per view, whereas YouTube charges 10 cents per view. Taking an assumption of 15,000 sales of products which could require an assumption of a 1:5 ratio of views, a total of 75,000 are required. Hence, the total money went for marketing is 75,000\*(0.10+0.16) = \$19,500 nineteen thousand and five hundred dollars.

## Unit cost:

Another cost to discuss is unit cost of the product. Unit cost is the cost of one unit of product. Unit cost of the product is dependent on the material cost, workers employed, and online sale cost. Taking the material cost to be \$50, 10.50\$ for the workers and \$6.80 for online sale, the total unit cost of the has come down to \$67.30 dollars without any taxes. *Capital Equipment and Supply List* 

The capital equipment and supply list show all the equipment the team needs to operate the business. The following table show the compilation of the equipment and cost.

Initial Development		Fixed Operating Cost (per year)	
Engineering	\$1,000	Employees	
Industrial Design	\$1,000	Marketing and sales	\$62,400
Marketing	\$5,000	Maintenance	\$31,200
		Further development	\$41,600
		Salary for Personnel	\$10,000
<b>Development</b>			
Equipment Set-	\$50,000	Administrative	
up	\$1,000	Pont	\$3,000
	¢1.000		\$3,000
Design Parts	\$1,000	Utilities	\$3,000
Safety	\$1,000	Insurance	\$3,000
Testing	\$1,000	Manufacturing Process	\$5,000
		Sales	
		Advertising	\$19,500
		Online sales	\$480
Sum	\$61,000	Sum per year	\$179,180

 Table 2: Capital Equipment and Supply List

Item	Use	Cost (initial)	Cost (per yeear)	Cost Per Part	Details of Cost
Electronic workstaion	Manufacturing	\$10,000			
Mechanical workstaion	Manufacturing	\$10,000			
Assembly workstaion	Manufacturing	\$30,000			
Line Worker 1	Manufacturing			\$2.50	\$18/hr
Line Worker 2	Manufacturing			\$2.50	\$18/hr
Line Worker 3	Manufacturing			\$2.50	\$18/hr
Line Manager	Manufacturing			\$3.00	\$21/hr
Salaried Worker 1	Marketing		\$31,200.00		
Salaried Worker 2	Customer Service		\$31,200.00		
Salaried Worker 3	Maintenance		\$31,200.00		
Salaried Worker 4	Development		\$41,600.00		
Production Space	Manufacturing		\$3,000.00		
Office Materialls	Office needs		\$3,000.00		
Part Material	Manufacturing			\$50.00	
Energy Cost	Manufacturing		\$5,000.00		
Unexpected Cost	Budget		\$1,000.00		
Maintenance	Maintenance		\$1,000.00		
Marketing	Advertising		\$19,500.00		
Sales	Online sales		\$480.00	\$6.80	
Total		\$50,000	\$167,700.00	\$67.30	

Table 3: Capital Equipment and Supply List Details

Table 4: Capita	l Equipment	and Supply	List	Material	Cost
-----------------	-------------	------------	------	----------	------

Item	Cost
	[\$]
Arduino UNO	16
Spankfun ESP8266	12.9
Reed Switches(2)	2
Temperature Sensor	14.9
Miscellaneous	5

Bread Board	5
Battery	3
Seat Buckle (2)	15
Total	73.8

# Break Even Analysis

The break-even analysis show that the project will have a break-even point after the first year that the company produces the baby car seats. The initial investment would be \$61,000 and that is how much the team could ask from sponsors.



Figure 8: Break Even Analysis

# Summary of Pro-Forma Income and Cost Projections

The Pro-Forma predicts the future income statement of a company, in this case the team will look at the first years that the company is operational. The pro forma statements will assist the business both short term and long term, with strategic planning that covers five years into the future to provide a fuller view of how the business could do in future conditions. The following financial protection will summarize five year of expenses to run the baby car seat startup company.

# Table 5: Pro-forma Income Statement

Fixed cost	
Development costs (engineering, industrial design, marketing)	7000
Manufacturing (equipment, transportation, set-up)	54000
Fixed operating cost (per year)	
Employee (salary)	145200
Administrative (rent, utilities, insurance)	9000
Operating (maintenance, sales, marketing)	\$19,980
Manufacturing cost (per unit)	
Material cost for all parts	50
Labor cost (assembly, transportation, testing,)	10.5
Online sales	6.8
Pro-forma income and cost projection	
Price	85
Cost per unit 67.3 Starting sales 15000 Sales growth r	ate 20%
Tax rate	40%
Discount rate	7%

Project year	0	1	2	3	4	5
Calendar Year	2017	2018	2019	2020	2021	2022
Income						
Investor contribution	70000					
Total sales	0	15000	18000	21600	25920	31104
Sales revenue	0	1275000	1530000	1836000	2203200	2643840
Expense						
Initial cost	61000					
Cost of product	0	1009500	1211400	1453680	1744416	2093299.2
Fixed operating cost	0	179180	179180	179180	179180	179180
Net profit	9000	91320	144420	208140	284604	376360.8
Post-tax profit	9000	54792	86652	124884	170762.4	225816.48

Running cash balance	9000	63792	150444	275328	446090.4	671906.88
Present value conversion	9000	59618.69	131403.61	224749.66	340320.23	479060.31

# Supporting documents

## Existing Patents:

- Title: Baby car seat alert and range alarm
  Publication number: US 20030122662 A1; Application number: US 10/033, 608;
  Publication date: Jul 3, 2003; Filing date: Jan 2, 2002
  Description: An apparatus consists of child state detector for detecting the presence of
  child, door state sensor for detecting the state of a driver door of the vehicle, range
  detector for detecting the distance of a driver possessing a key ring remote from the
  baby car seat located within the vehicle and capable of being activated by removing the
  key ring remote a predetermined distanced from the child state detector. The apparatus
  warns when the baby is left in the car seat and the other sensors are activated.
- Title: Child car seat alarm system
   Publication number: US20140015664 A1; Application number: US13/547, 280;
   Publication date: Jan 16, 2014; Filing date: Jul 12, 2012
   Description: A child car seat system in which the car seat has seat belt wired to a transmitter. When the seat bel is locked, the signal is transmitted to the receiver which is placed in a key fob. It ensures that a guardian must unbuckle a child.
- 3. Title: Car seat occupant detection and alert apparatus, system and method. Publication number: WO2016044075 A1; Application number: PCT/US2015/049564; Publication date: Mar 24, 2016; Filing date: Sep 11, 2015 Description: A car seat occupant detection system for a car seat installed in a vehicle is provided. The system includes harness sensors for detecting whether connectors of a car seat harness are connected and a weight sensor for detecting the weight of an occupant in the car seat. The controller determines whether or not an occupant in the car seat has been abandoned by a driver based on detections of the at least one harness sensor, the weight sensor, and communication range status between the transceiver and the driver communication device via the local wireless link.
- 4. Title : Infant safety alert system and method Publication number: WO2009144687 A3; Application number: PCT/IB2009/053352; Publication date: Jan 14, 2010; Filing date: Aug 1, 2009 Description: Apparatus includes occupant sensor, infrared light sensor installed on the infant seat, configured to sense infrared light being emitted within the vehicle and an alarm activator installed on the infant seat and connected to occupant and infrared sensors. The alarm is activated upon the presence of the infant being sensed by the occupant sensor and the infrared light being sensed by the infrared light sensor.

5. Title: Vehicle alarm system for alerting a vehicle operator that the vehicle is still occupied with a child or pet.

Publication number: US20130106598 A1; Application number: US 13/507, 806; Publication date: May 2, 2013; Filing date: Jul 30, 2012

Description: The system includes one first portable wireless alarm unit in communication with a second portable wireless unit. The first and second portable wireless alarm units include a microprocessor in communication with a transmitter and receiver, having a power supply. The first portable unit is located on a key chain. The second wireless unit has attachment means for attachment to a seat belt associated with a child's car seat or a pet's collar. An activation sensor detects a disengagement action related to the vehicle, including powering-off of the vehicle ignition or unbuckling of the driver's seat belt. A distance sensor has a selected range. If the range is exceeded, an audible alarm is actuated from the first unit.

- 6. Title: Car-seat occupied baby-on-board indicator alarm Publication number: US20060033634 A1; Application number: US 10/914, 811; Publication date: Feb 16, 2006; Filing date: Aug 11, 2004 Description: The system includes two weight-responsive electrical switches, one for the baby and the other for the driver. The driver's switch is open with the weight on and baby's switch is closed with weight. When two switches are closed, the alarm gets activated.
- Title: Child abandonment protection system
   Publication number: US20080119989 A1; Application number: US 11/940, 870;
   Publication date: May 22, 2008; Filing date: Nov 15, 2007
   Description: The system includes sensor to detect whether the ignition system is turned on or off, and the weight sensor to sense the presence of the baby. The alarm is activated by the processor accordingly, to the data from the sensors.
- 8. Title: Portable seat belt alarm system

Publication number: US8816839 B1; Application number: US 13/682, 574; Publication date: Aug 26, 2014; Filing date: Nov 20, 2012

The seat belt alarm utilizes a portable bracket configured to attach to a female receptacle of a seat belt system. The bracket includes a tension mechanism positioned to be acted upon by a male buckle of a seat belt system when the male buckle of the seat belt mates with the female receptacle of the seat belt system. In a depressed state, the tension mechanism activates a signal transmitter configured to transmit a local signal received by a signal receiver integrated in a keychain fob.

## Design Concept

Initially, the idea was to design a baby car seat with safety features mounted on it. However, as the baby car seat is product, which reached its market saturation, it was decided to move on with designing safety enhancements to the existing baby car seat models. Early design statements included having a timer to sense the time elapsed, fans to ensure favorable environment for the baby, window-opening mechanism for opening the window slightly. All these enhancements were rejected in favor of making a simpler product and which costs less.

Then the design inclined towards incorporating three sensors; a piezoelectric sensor to sense the vibrations of the car, a passive infrared (PIR) sensor to sense the presence of the driver and another optical sensor placed at the buckle of the baby seat. When the baby seat buckle is locked, the respective sensor is activated. Then, the two sensors, one placed near the driver and another at the dashboard of the car, starts sensing the body temperature and the vibrations of the car which implies the car is ignited, respectively. The idea was when the baby is placed on the baby car seat, either of the two sensors sensing the presence of the driver in the car would provide closure to the problem. If one of the two sensors or both the sensors give out the negative data with the first sensor still buckled on, then the notification will sent to the driver or desired person. The use of two sensors was proposed to minimize the error in the sensor feed.

This design had its share of defects. Increase in the range of PIR results in high cost. The piezoelectric sensor needs to be sensitive enough to detect vibrations in every model of the car and negate the vibrations from the external sources, which poses difficulties while calibrating as well increases the cost.

As cost is one of influencing factor in product purchase according to the survey conducted, the design was modified to accommodate the use of reed switches instead of the piezoelectric and PIR sensors. A reed switch is an electromagnetic switch used to control the flow of electricity in a circuit. They are made from two or more ferrous reeds encased within a small glass tube-like envelope, which become magnetized and move together or separate when a magnetic field is moved towards the switch. Reed switch was selected due to its compact nature and relative high sensitivity when compared to the sensors of the same cost. Reed switches are placed at the belt buckles of both the driver and the baby. When the baby is placed on the seat and buckled, the sensor one gets activated. Sensor 2 must be activated otherwise the notification will be sent to the desired person. The concept is person who travels in the car along with his/her baby, must be driving his/her car and the seat belt must be buckled.

Now the design of product incorporates belt buckles for both the driver and the baby, with a housing for the sensor. The female part of the buckle has the switch and male part incorporates the magnet. When the belt is buckled, the sensor is activated. Both the sensors are connected to the Arduino Uno, which controls the sensors. Arduino was preferred due to its simplicity present inherently. Arduino is powered by 9V battery.



Figure 9: Basic Layout of the device



Figure 10: Casing for the processing unit



Figure 11: Initial testing layout of the product

The notification to the users will be sent through Blynk app that should pre-installed in the user's mobile phone. The device will be connected the internet using ESP8266 WiFi module and then connected to the Blynk app to the internet. ESP8266 Thing, a breakout and development board for the Wi-Fi module, is used here since Arduino Uno isn't compatible with the Wi-Fi Module.



Figure 12: Prototype setup with integrated Wi-Fi module



Figure 13: Setup giving out the notification

The device also incorporates the temperature sensor for emergency situations. When stagnant, the temperature inside the car might increase to high levels under the sun. These temperature levels are harmful for the babies. The threshold temperature levels are set in the device and when the temperature crosses the threshold value while the baby is still in the car, the frequency of notification reduces to 15 seconds and notifies the parent of the emergency situation.

As most of the users who took the survey inclined towards the use of rechargeable batteries, SOC indicator is installed in the device. This indicates when the charge in the battery reduces to the set threshold limit and notifies the user to recharge the batteries.



Figure 14: Functioning of SOC Indicator





# Benchmarking

Through the market analysis, the products offering similar services were found out. Comparison is done with the products available to My Precious to weigh its value among those products and predict the sales of the product. The products used for comparison were:

iRemi	nd Child Car Seat Alarm System (Sunshine
Baby,	n.d.)
Comp	any: Sunshine Baby
Fe	atures:
•	Wireless car seat add on
٠	The system will alert via smartphone or key
	fob

- Installation in matter of seconds.
- The alert will notify when certain distance between key fob and car seat is attained.
- Price starts from \$99.00



# Kars4Kids Safety

Company: Kars4Kids

Features:

- Mobile App
- Cars should be Bluetooth compatible
- Customizable Alarm Ringtone
- Easy One-time setup with customizable settings
- Easy of feature for when child is not in the car
- Doesn't exactly monitor the child's presence



## Sense a Life

- Alerts driver through mobile app and speakers
- Use of sensor at baby buckle and driver's door to detect human presence
- Triggers a secondary notification to a Bluetooth synced mobile phone through their mobile app when drivers not reacting to the verbal alert
- Starting price- \$99.99

Evenflo Advanced Embrace BLX Infant car Seat Company: Evenflo

- SensorSafe receiver and smart chest clip technology alert parents to the presence of a child in the vehicle
- Easy to use, push on, SureSafe premium lower anchor connectors
- Handle offers anti-rebound protection in vehicle
- Product offered is entire car seat
- Starting price- \$149.99





Most of the products in the products offer add-ons to the car seat, some offer the whole smart car seat as a product. It can be noticed that price of these products starts from \$99 and for the smart car seats (Evenflo, n.d.), it starts from \$149.99. Also, for products like iRemind

and Kars4Kids Safety, functionality poses a problem as the former doesn't send notification instantly and the latter doesn't exactly monitor the baby presence and is not compatible with old cars.

My Precious is designed to counter these problems and provide a compact product, which is both effective and accessible to the users in terms of the price.

My Precious

- Safety Device that adds on to any car seats
- Easy Installation, no need for technical expertise.
- Notifies the driver within a minute of unbuckling of seat belt
- Sends notifications via mobile (frequency increases when the temperature exceeds threshold value)
- Cheaper in price, \$84.95

# My Precious

# Future Developments

The prototype utilizes Arduino Uno and Sparkfun ESP8266 Thing for the functionality. This slightly increases the size of the product. This should be decreased to the utilization of one microprocessor to make the product more compact. Right now, the prototype has all wired connections. Achieving wireless communication is the next step.

Notifications are sent to the user through Blynk app. For this, the device should be connected to a Wi-Fi network constantly, which is not possible in cars, and it is tough for the users to connect the device manually to their phone's hotspot. Also, Blynk notifications are sent from the global server which increases the delay and is not viable for the safety device. And, Blynk starts charging after a certain limit of usage. To counter this problem, the use of GSM module is proposed. This reduces the reliance on Blynk simplifying the usage for customers. This also helps in sending messages to the emergency services if any dangerous condition arises.

The device requires in changing the buckles of the baby seat and driver seat. While it is easier for the baby seat, it's a little trickier for the driver seat. For this, mountings that can be attached to the driver seat buckle are to be developed.

Creation of a mobile app that alerts, notifies the parents, monitors the temperature levels in the car and shows the geolocation of the baby car seat, providing the much simplified and efficient service to the parents, can be developed.

# Appendix

Code used for the device:

For the sensors:

```
#include <Wire.h>
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include "SparkFunMPL3115A2.h"
char auth[] = "***"; // ***Type in your Blynk Token
char ssid[] = "***";
char pass[] = "***";
 MPL3115A2 myPressure;
 float pressure = 0;
 float tempf = 0;
const int REED PIN 1 = 13; // Pin connected to reed switch 1
const int REED_PIN_2 = 12; // Pin connected to reed switch 2
void setup()
{
 Serial.begin(9600);
 pinMode(REED PIN 1, INPUT PULLUP);
pinMode(REED_PIN_2, INPUT_PULLUP);
 Wire.begin();
 myPressure.begin(); // Get sensor online
 // Configure the sensor
  myPressure.setModeAltimeter(); // Measure altitude above sea level in meters
myPressure.setModeBarometer(); // Measure pressure in Pascals from 20 to 110 kPa
  myPressure.setOversampleRate(7); // Set Oversample to the recommended 128
myPressure.enableEventFlags();
 Blynk.begin(auth, ssid, pass);
}
void loop()
Blynk.run(); int proximity 1 = digitalRead(REED PIN 1); // Read the state
of the switch 1 int proximity 2 = digitalRead(REED_PIN_2); // Read the
state of the switch 2
```

if (mypressure.temf<65""&&mypresure.temf>95"") //set the limits for temperature {

```
{ Blynk.notify("Danger: High temperature"); }
 }
else
 {
 if (proximity_1 == LOW) // If the pin reads low, the switch is closed.
 {
  if (proximity_2 == LOW)
  {
  { Blynk.notify("Driver is in"); }
  }
else
{
  { Blynk.notify("Hey, you left the baby inside the car"); }
}
}
}
```

SOC Indicator:

```
#include <Wire.h>
#define led_pin 5
void setup()
{
    pinMode(led_pin, OUTPUT);
    digitalWrite(led_pin, LOW);
    }
void loop()
{
    if (voltage < 5) //set the normal voltage value here
    {
        digitalWrite(led_pin, HIGH);
    }
}</pre>
```

# References

(n.d.). Retrieved from Evenflo: http://www.evenflo.com/sensorsafe/sensorsafe.html

(2015, June 29). Retrieved from Kars4Kids: http://www.kars4kids.org/blog/kars4kids-safety-app/

- Burns, M. (2016, April 8). Retrieved from TechCrunch: https://techcrunch.com/2016/04/08/sensealife-is-a-car-seat-monitor-that-could-save-a-life/
- Indiegogo. (n.d.). Retrieved from https://www.indiegogo.com/projects/babyproof-your-carneverever-forget-a-baby-in-car-kids#/
- O'Callaghan, J. (2014, August 7). Retrieved from Daily Mail: http://www.dailymail.co.uk/sciencetech/article-2719082/The-wearable-tracker-BABIESBand-reveals-child-hot-restless-theyre-wake-up.html

Sunshine Baby. (n.d.). Retrieved from http://www.sunshinebabyalarm.com/