RITVET

Child Presence Detection Car Alarm System using GSM

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Abstract: Various cases of child deaths occurred in the country, in 2018 and 2019 there were three deaths involving children drowning and suffering from stroke due to being left in the car. The purpose of this study is to design, develop and evaluate the functionality of Child in Car Detector with Alarm and Notification System using GSM. The researcher used an Engineering Design Process as a design model approach. Arduino UNO is used to control the system receiving input from key switches and relays then from the load cell detector then instructs buzzer 1 to sound and Global System for Mobile Communication will send a message to the car owner and buzzer 2 will sound if there are still children in the car. Three experts have evaluated this product for possible improvements that can improve the quality of this product to work better and efficiently and also can help to reduce the number of children being left in the cars.

Keywords: A Child Being Left In The Car, Car Detector, Alarm And Notification System, GSM.

1. Introduction

According to the Children Act (2001), children are defined as individuals who are under 18 years old. Parental responsibilities of childcare are important and can be an issue of national legislation. In order to assure the safety of children in cars, the use of child restraint systems (CRS) has become obligatory (Musa, 2019). The use of CRS was previously neglected but since the increased statistics of children's death in cars, now it has been a mandatory for using these CRS begins in January 2020 (Zakaria, 2019).

Forgetfulness, negligence and carelessness are human acts that can lead to negative implications in life. Forgetfulness can be defined as a lack of ability to recall the information, experiences and events that have been faced (Nofindra, 2019). Negligence is defined by the interruption of an individual's focus on the other things that cause them to lose their true purpose. Careless is meant by a lack of caution in which an individual does something wrong or imperfect (Zakaria, 2015). There is lack of proper parental

supervision of children even in Malaysia has allocated a special law to regulate the cases of negligence against children (Hashim, Yusof & Mohd Kusrin, 2019). So, this research is one of the initiatives to help reduce the risk of children being left in the car after the car has been turned off.

1.1 Research Background

A child was found drowned after being left for four hours in a car because a mother forgot her child due to a rush to go work (Bachik, 2018). This can be attributed in which parents and guardians fail to perform their responsibilities and it can have a huge impact on the lives, safety and well-being of every child (Hashim, Yusof & Mohd Kusrin, 2019).

A child in China died in a car drowning after being left in the car for nine hours and the father got a phone call on the way to the school until forgot about his intention to send his child to school and he was also distracted by a message from the WeChat app (Ghaffar, 2019). Abandonment is when parents leave their children in a situation that can be detrimental to health, education and safety (Mohd Yusof & Thambapillay, 2007).

Besides, a two-year-old boy was found dead in the car. This is due to heat stroke and drowning. The mother of the child was arrested and investigated under Section 304A of the Penal Code on negligence charges that led to her death (Rahman, 2019). Ignorance and neglect are serious offenses and the parents of a child can be held liable for neglecting children under their care of children even though they are not physically or sexually abusive (Zakaria, 2015). In Croatia, a child drowned after being left in the car for 15 minutes because his father forgot and resulted in the death of his child (Stock, 2019). Negligence like this can invite danger to children in turn capable of threatening their lives.

1.2 Problem Statement

Neglect among the child is often occurs, especially children left in cars and causing death. There are various causes for the incident. Some parents are often forgetting about having their child in the car and leaving them in a car with the engine is off. A mother forgot her child in a car whose car had been turned off and caused her to lose her child (Bachik, 2018). Sometimes, parents got to catch up in other things until they forgot about their children who are still in the car. A child drowns after being left in a car for 15 minutes by his father who is so engrossed in cutting a customer's hair (Stock, 2019). A father in China was busying with messages from the WeChat app then left his child about nine hours in the car causing his son to die in the car due to drowning (Ghaffar, 2019). Besides, there are parents or guardians who expect and depend on other people or their children to get out of the car without looking at the actual situation and this can be considered as negligence (Zakaria, 2015). The mother of a child was arrested and investigated under Section 304A of the Penal Code on negligence charges that led her child to death in car (Rahman, 2019).

1.3 Objectives

The main objectives of this project are:

i. To design a Child in Car Detector with Alarm and Notification System using GSM.
ii. To develop Child in Car Detector with Alarm and Notification System using GSM.
iii. To test the functionality of Child in Car Detector with Alarm and Notification System using GSM.

1.4 Literature Review

The case of the death of a child in a car became news that often appeared in local newspapers. There are various crimes involving children drowning in cars. According to Hashim, Yusof & Mohd Kusrin (2019), there are still shortcomings in terms of proper parental supervision of children even in Malaysia already provided with specific laws to control the case of neglect and neglect of children. Therefore, the project developer of Child Detector in Car with Alarm System and Notification (GSM) is one of the researcher's initiatives in helping to reduce the risk of children being left behind in the car after the car engine turns off.

A microcontroller is a computer on chip that is programmed to perform all control, sequence, monitoring and display functions. Because of its low cost, this microcontroller is a natural choice for researchers (Reza, Md. Tariq & Reza, 2010). Arduino is one of the open source computing platforms (OSEPP) in microcontrollers and used in projects to design and use the microcontroller development boards (Mithya et al., 2019). These micro- controller boards come with a variety of development board packages (Schmidt, 2011). Arduino UNO is the researcher choice as shown in Figure 1.

Figure 1: Arduino UNO.

Global System for Mobile Communication (GSM) is a specially designed model that accepts the Subscriber Identity Module (SIM) Card and operates like a mobile phone. The coverage area of each cell varies according to the execution environment (Hnin & Hla, 2014). In this regard, GSM is used in conjunction with a controller chip to produce a product that is capable of being controlled by a mobile phone. Figure 2 is the type of GSM that is used by researchers.

Figure 2: GSM SIM900a

A load cell known as a load cell is a physical element or Transducer (Flintec, 2019). This transducer can convert one form of energy into another form of energy, which is that with the power of the load cell, it can be converted into an electrical signal (Suomi, 2017). Straight Bar Load Cell as in Figure 3 can measure a maximum pressure of up to 20 kg and is made of aluminum alloy. These load cells are among the low-cost and affordable detectors. The weight of this load cell is 60 g which makes the load cell categorized as a lightweight (Mybotic, 2019) and small size allowing this load cell to be used in a limited area. The wiring color codes connected to the HX711Module are red to E +, green to A +, black to E- and white to A-. These load cells need to be connected to the Arduino for input and can operate as desired.

Figure 3: Straight Bar Load Cell

The car needs a car battery as a power source to power the engine and its system (Radzali, 2009). The Arduino requires 5 V to 12 V power supply and the operating voltage is 5 V (Hadwan & Reddy, 2016). While the GSM requires a maximum power supply of 12 V DC (Mithya et al., 2019) and the buzzer requires 5 V to 12 V DC power supply (John et al., 2017). Researchers use the Adaptor in place of the car battery with the same voltage value generated by the car battery Adaptor is easier to connect to Arduino and GSM.

A relay is an electronic component that functions as a switch which uses an electromagnet to move the mechanical switch inside the relay. Relay is a component capable of controlling high voltage using low voltage (Mason, 2011). The relay to be used is 5 V so that the input voltage corresponds to the voltage requirements of each component. Two buzzers are used in this project as an alarm in and out the car. The buzzer requires 5 to 12 V DC power supply to operate (John et al., 2017).

2. Methodology

Purpose of this study is to design, develop a product and test the functionality of Child in Car Detector with Alarm and Notification System using GSM. To make this project successful, the researcher used an Engineering Design Process as a design model approach.

A. Phase 1: Identify the problem.

The researcher collects any information related to the Child in Car Detector with Alarm and Notification System (GSM) project through observation, reading and gathering information from internet sources and other sources. The problems identified were forgetfulness, carelessness and negligent parents in the presence of children in the car after the engine was turned off because the children were sleeping in the car. This enables the researcher to come up with an idea for planning the development of a Child in Car Detector with Alarm and Notification System using Global System for Mobile Communications (GSM) to provide a solution to the problem that has been discussed.

B. Phase 2: Analyse the requirements of the problem.

The specification of the requirement is made by the researcher in which the researcher identifies several important needs in the development of this project after performing the analysis requirements. Table 1 shows the requirements that are defined according to the specifications that have been analyzed.

Table 1: Determination and specification of requirements

Requirements	Determination and specification
Microcontroller	Arduino UNO R3
Software	Arduino IDE
Sensor	Load Cell Straight Bar (20 kg)
Alarm	Buzzer 5-12 V DC Buzzer 5-24 V DC
Wireless Communication	GSM SIM900a
Relay	Relay 5 V
Power Supply	Adaptor 12 V

C. Phase 3: Block diagram of this project.

Figure 4 is a block diagram of this project to be carried out to produce a Child in Car Detector with Alarm and Notification System (GSM).
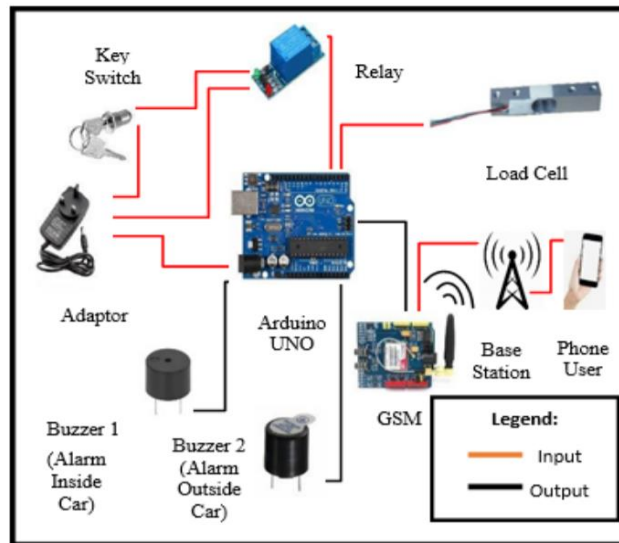

Figure 4: Block diagram of this project

D.   Phase 4: Prototype construction.

Child Detector in The Car with Alarm System and This notification (GSM) has two parts of development namely development software and hardware development. The hardware for this product is Arduino UNO, GSM SIM900a, buzzer, load cell (Weight Sensor), converter 12 V DC to 5 V DC and Adapter. Figure 5 shows a drawing of the dashboard and seat model. The dashboard model drawing along with this seat shows the exact size determined by the researcher. Researchers draw in three-dimensional drawing.
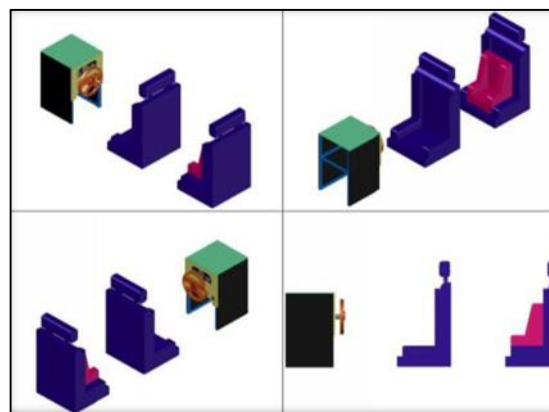

Figure 5: The dashboard and seat model

Figure 6 shows a drawing of product design. This product drawing is an initial reflection of the exact size that the researcher has determined. Researchers made in the form of three-dimensional drawings for the development of the actual project.
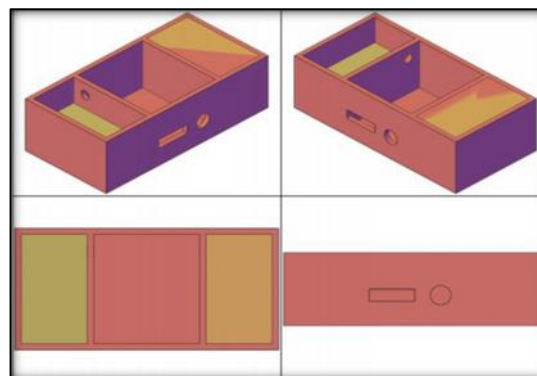

Figure 6: The drawing of product

E. Phase 5: Testing and evaluating.

This product testing is the overall testing of the product whether the product works well or not. Researchers conducted product testing in terms of functionality, time is taken for the relay to respond and time is taken for the buzzer in case the load cell detects a child's weight. Researchers have performed tests on the product and the following are how to operate a Child Detector in a Car with an Alarm and Notification System (GSM) and the researcher's test schedule of the product.

i.   If the lock switch is closed and the engine is turned on, the Child Detector in The Car with Alarm and Notification System (GSM) will not work and the load cell begins to detect weight on the seat.

ii.   When the key switch is opened and the engine is not turned on, the Child Detector in The Car with Alarm and Notification System (GSM) will start working and the load cell will start detecting the weight on the seat.

iii.   If the load cell can detect the weight on the seat, the buzzer (considered an alarm in the car) will start sounding for three minutes and stop sounding when the load cell no longer detects the child's weight.

iv.   If five seconds pass, the buzzer (considered an alarm in the car) will stop sounding but three seconds later, the buzzer (considered an alarm outside the car) will sound louder as a notification to people around the car and a short message will be sent by GSM to the number that has been registered.

3.   Results and Discussions

Product testing is testing the overall product whether this product works well or not. The Arduino UNO is used to control the system receiving input from key switches and relays then from the load cell detector then instructs buzzer 1 to sound and Global System for Mobile Communication will send a message to the car owner and buzzer 2 will sound if there are still children in the car. Three experts have evaluated this product for possible improvements that can improve the quality of this product to work better and efficiently and also can help to reduce the number of children being left in the cars.

A. Analysis of Arduino UNO R3.

Researchers are using the Arduino UNO R3 to build this project system. Signal input from the key switch and load cell detector controlled using this Arduino is to carry out the instructions according to the

programmer's prescribed programming. Once the key switch is off and then the load cell detector detects the load on it, the next command is given to buzzer 1 which is to alarm the inside of the car. Then after five seconds, the GSM directs the message to the car's owner if the load cell is still under pressure and the buzzer 2, which is an alarm for outside of the car, will start sounding. Figure 7 shows the Arduino UNO microcontroller circuit that controls and operates the Child in Car Detector with Alarm and Notification System (GSM).
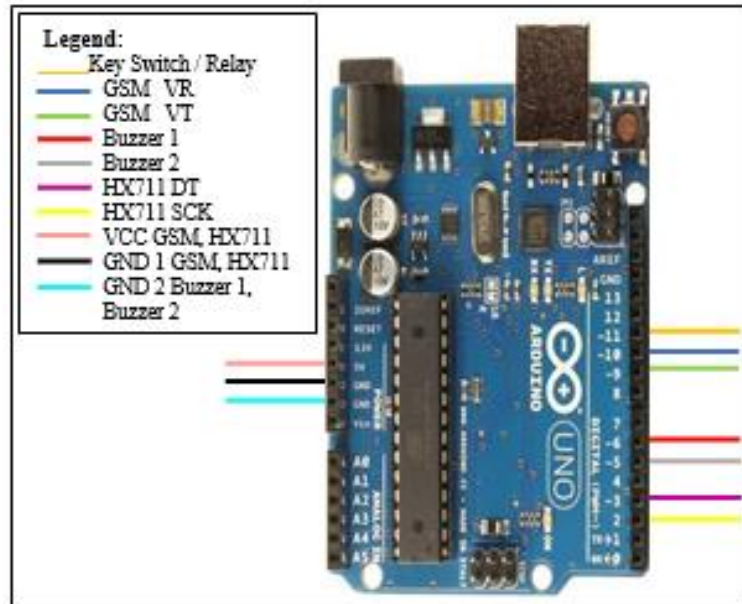

Figure 7: Arduino UNO with input and output on each pin

B. Analysis of Global System for Mobile Communication (GSM).

Researchers are testing the speed of digital data transfer from GSM to consumer phones based on 2G, 2G, 3G and 4G telephone networks. Table 2 shows the speed analysis in sending messages to registered users.

Networking from GSM to user phones	Time taken for the message to reach the user's phone (s)	
	1	2
2G to 2G	20.42	16.51
2G to 3G	15.68	10.74
2G to 4G	9.81	3.54

Table 2: The analysis of speed sending messages

Based on Table 2, the researchers found that transmission via 2G to 4G is more effective because data transmission is faster and more efficient due to the size of the bandwidth for this data transmission is larger.

C. Analysis of Load Cell 20 kg.

This load cell detector is one of the main components of this project. This load cell detector works to detect the load pressure applied to it. However, this load cell needs to be connected to the HX711 before generating a command code on the Arduino UNO. This load cell detector requires an input voltage connected to the Arduino only. Researchers have performed this load cell detector analysis by

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calibrating these load cells using several different loads. Table 3 shows the weight value of this load cell detector by comparing it to the original weight applied to it.

Table 3: Weight value detected by load cell detector

Calibration factor that have been used	Real weight (kg)	The reading of weight detected by load cell (g)		
		1	2	3
-375	1	10.12	10.07	10.02
	2	20.14	20.09	20.04
	3	31.13	30.08	30.03
-300	1	4.14	4.10	4.05
	2	5.12	5.07	5.02
	3	6.13	6.08	6.03
-250	1	1.13	1.08	1.04
	2	2.14	2.09	2.05
	3	3.11	3.06	3.02

The researcher found that by using the calibration factor of -250, the total weight of the load was detected in line with the actual load weight. Therefore, the value of the calibration factor is applied to the Arduino command code for the entire project in order to provide the function of the load cell detector to correctly detect the load applied.

D. Analysis of Power Supply

Power supply input is the main power source for turning the entire circuit. If in a real car, the battery is the main source of power directly to the electronic components inside the car. Researchers use the 12 V Adapter instead of the car battery. The Arduino UNO microcontroller requires 5V to operate and the GSM also needs to be within 5 V to 12 V. However, the researchers still use the 12 V Adapter as Figure 8 and not the 5V Adapter because the car battery voltage value is 12 V as shown in Figure 9.

implemented a DC to DC Converter to step down the voltage of 12 V to 5 V to suit this project. The voltage converter used is as shown in Figure 10.

Figure 8: The reading of voltage measurement on Adapter

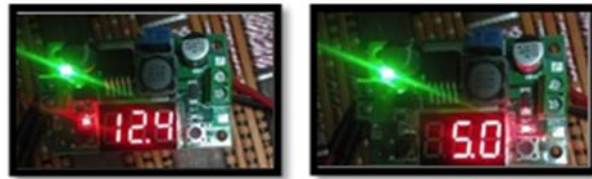**Figure 9: The reading of voltage measurement on car battery**

Figure 10: DC to DC converter which steps down the voltage of 12 V to 5 V

Table 4: The differences of voltage on battery, adapter and DC voltage converter

Source	Voltage Values (V)			
	1	2	3	4
Car Battery (engine is ON)	15.1	15.1	15.2	15.3
Car Battery (engine is OFF)	12.8	12.6	12.5	12.5
Adaptor	12.3	12.3	12.4	12.4
DC to DC Converter	4.9	4.9	5.0	5.0

Referring to Figure 8, 9, 10 and Table 4, there is a slight difference in the value of the voltage resulting. This is because in real car, there is a battery charger called Alternator. The alternator produces alternating current voltage, but the existing voltage regulator converts the current to a direct current (Mazlan et al., 2017). Therefore, there is a difference in the voltage value on the battery when the engine is on and the engine is off. However, this voltage range between 12 V and 15 V can still be used because Child in Car Detector with Alarm and Notification System (GSM) uses Adjustable DC to DC Converter (Step Down) to produce a voltage of 5 V. So, 12 V adapter to replace the car battery is acceptable in this project.

E. Analysis of Relay.

The relay used in this project is the result of construction by the researcher. This relay is used to allow Arduino to detect the key switch has been adjusted to the off and to enable the Arduino to obtain input from the load cell detector. The relay has two terminals only, the terminal of normally closed and the terminal of normally open. Therefore, the researcher analyzes the relay and records it in Table 5, which allows the researcher to select the correct terminal to connect to the key switch.

Table 5: The voltage of relay to be connected to the key switch

Voltage of Adaptor	Voltage of Normally Close Terminal	Voltage of Normally Open Terminal
12.4 V	0 V	12.4 V
0 V	0 V	0 V

Researchers have chosen the terminal of normally open for this relay system as they will break the circuit at once as it is turning off the car's engine like a real car. The researchers also found that the relay would not interfere with the user's drive as it would not interfere with the input voltage of the car battery.

F. Analysis of Key Switch.

The researcher used a 12 V power input on the key switch to obtain data on the internal connectivity of this key switch and to see its functionality. Table 6 shows the results of the analysis performed on the key switch used by the researcher.

Table 6: The analysis results of key switch connectivity

Function	Input Power	Output Power
ON	12.4 V	12.4 V
OFF	12.4 V	0

Referring to Table 6 above, when the key switch is adjusted to the ON, the input and output power of the key switch are the same which indicates that the engine is switched ON. This is because the circuit is closed and while the switch is adjusted on the OFF, there is no output power from the key switch due to the open circuit causing the car engine to shut down.

G. Analysis of Expert Evaluation

After conducting several tests on this product, the researcher performed an analysis based on the feedback made by three selected experts. The experts are a lecturer of the Faculty of Technical and Vocational Education, an assistant engineer of the Faculty of Technical and Vocational Education and a lecturer of the Kluang Vocational College. The assistant engineer from the Faculty of Technical and Vocational Education and lecturer from Kluang Vocational College are parents of children who can use this system.

i.   Expert Analysis for Product Design.

Table 7: Expert analysis of the design of Child in Car Detector with Alarm and Notification System (GSM)

No.	Item	Yes %	No %
1	The product has the appropriate size	100	0
2	The product has a user- friendly design	100	0
3	This product is safe to use	100	0
4	An attractive and appropriate design	100	0

Based on Table 7, the researcher can analyze that the design of this product is suitable and attractive and has the appropriate size. This allows the product to attract users to apply this system to the user's car. In addition, this product is also viewed as safe by experts and the user-friendly design of this product enables the product to be commercialized. This is because safety is a key element that researchers often emphasize.

ii.   Expert Analysis for Product Development.

Table 8: Expert analysis of the development of Child in Car Detector with Alarm and Notification System (GSM)

No.	Item	Yes	No
		%	%
1	Product use the appropriate software	100	0
2	Product is used the appropriate materials and components	100	0
3	Load Cell is suitable for this product	100	0
4	This product can be applied to the real car	100	0

Based on Table 8, it is shown that this product uses appropriate software based on the micro controller used. The use of materials to develop this product is also appropriate and the use of components in line with the functionality that the researcher wants to perform is also appropriate. In addition, the load cell detector used in this product is suitable. So, this product can be applied to real cars as its development is based on the design of real cars.

iii.   Expert Analysis for Product Development.
The finalized prototype images of the project Child Detector in The Car with Alarm and Notification System (GSM).
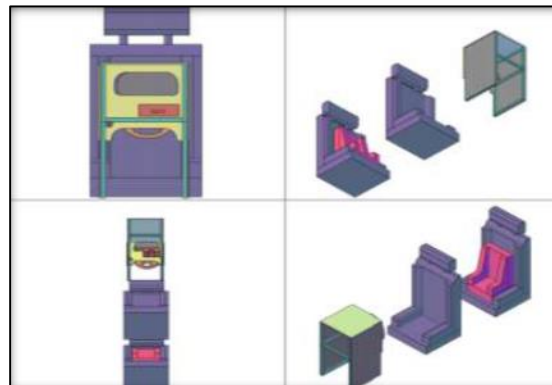

Figure 11: The finalized prototype images

Table 9: Expert analysis of the functionality of Child in Car Detector with Alarm and Notification System (GSM)

No.	Item	Yes %	No %
1	The product works and operates well.	100	0
2	The load cell on this product can detect the weight of the load on it	100	0
3	Products can send messages to users.	100	0
4	This product can ring a buzzer if the load cell detector can detect the load.	100	0

Based on Table 9, the researcher can analyze that the functionality of this product is in good condition and able to operate correctly. The load cell detector on this product is also able to detect the weight of the load imposed on it. Besides that, this product can send messages to users correctly and can ring both buzzers if the load cell detector detects the load.

3.1 Implication

Experts suggest that the Child in Car Detector with Alarm and Notification System (GSM) can be improved by using existed sensors on the car seat if not wear a seat belt and add another buzzer to alert drivers that there is a child that does not wear a seat belt when the key switch is in ON. Next, expert also think this product works well and has the potential to be marketed.

4. Conclusion

Child in Car Detector with Alarm and Notification System (GSM) aims to be one of the alternatives to help track the children in the car after the engine is turned off by alerting alarms and GSM notifications by sending a message to car owners. These numbers are registered to the GSM and increases the safety of the child while in the car once the engine is switched off. The materials used to produce this product can be categorized as accessible and affordable. Therefore, overall, the development of Child in Car Detector with Alarm and Notification System (GSM) has achieved its goals and objectives. However, there are still some shortcomings and weaknesses during the testing conducted by the researcher, but the researchers are still satisfied that the Child in Car Detector with Alarm and Notification System (GSM) works as planned.

Acknowledgement

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