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Development of Child Safety Car Alert System Using Arduino and GSM Module

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Abstract. The Child Safety Car Alert System by Arduino is an integrated device that sends alerts to the driver if a child is left unintendedly in the car. The system is developed using the Arduino board which incorporates the integration between sensors and GSM module. This system uses pressure and motion sensors to detect the presence of a child located at the back seat of the vehicles. Meanwhile, the GSM or Global System for Mobile Communication allows the system to send an alert to the driver within a short period. The GSM is chosen due to its ability to lower the energy consumption per bit while providing higher data rates. Two sensors are used; Force Sensitive Resistor (FSR) Sensor and Pressure Infrared (PIR) Sensor. The alert system is triggered when both sensors detect the presence of a child at the back of the car seat which will then notify the parents or a driver immediately through a message sent via a mobile phone.

1. Introduction

Every few days in the world, there are reports of young children dying from heatstroke after being left in parked cars [1-5]. With cases of clear neglect, the justified intervention and local solution must be addressed accordingly.

Figure 1 shows the percentages of the child being left in vehicles. 54% is due to the "forgotten in-vehicle" element. Even though an emphasis on education and awareness focused at parents or drivers and to the public, in general, have been given, this could not stop the number of a child end up in this kind of tragedy. This shows that it's very important to develop a device or system that can notify the driver or alert them on the issue. To summarize this section, the death could have been prevented if the parent being notified in case, they leave a child behind. To prevent this tragedy, Arduino-based-system is developed to send out a warning message once the system detects the presence of the children based on pressure and motion sensors placed at the back seat of the car after the driver left.

This project aims to develop a lab prototype of a low-cost and simple implementation of a Child Safety Car Alert System (SCCAS) using Arduino kits and Arduino IDE 1.8.2 with intended for the system that sends alerts to the drivers

The technology has been in the market for a while. Studies and reviews on three existing products similar to this project development have been made to choose the most suitable detection mechanism for building SCCAS [4,7,8,10,11]. Based on the comparison, a Passive Infrared (PIR) sensor is chosen to detect the motion of the child through IR radiation emission. Adding to this is a pressure sensor. Both motion and pressure sensor are used to determine whether the heuristic detected is a human being.

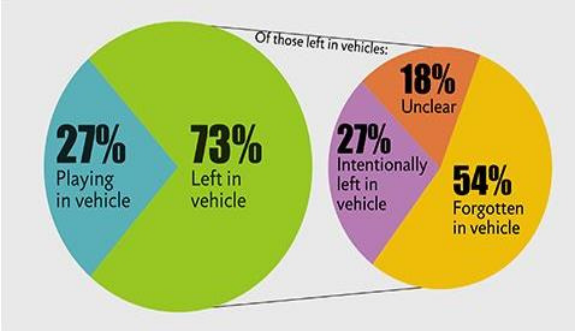

Figure 1. Percentages of child left by circumstances

For the notification alert, the dedicated fob is mainly used to send a text alert to the parents or the driver when an incident happens. This fob will beep when it is separated from the UCRS that place on the CRS (Child Restraint System) at a certain distance [12].

2. Research and Method

2.1 System Overview

Arduino is an open-source physical computing platform which implements the Processing Language on a simple input/output (I/O) board. This technology was initially introduced in Interaction Design Institute, Italy on 2005 [3,7]. The Safety Child Car Alert System is an Arduino-based system. It is a standalone system where the system does not interact with the vehicle's internal system. This system is controlled by Arduino Uno R3, a small microcontroller that turns out to be a control unit. This proposed system has two major parts which are; the detection mechanism and the prevention mechanism connected to the control unit.

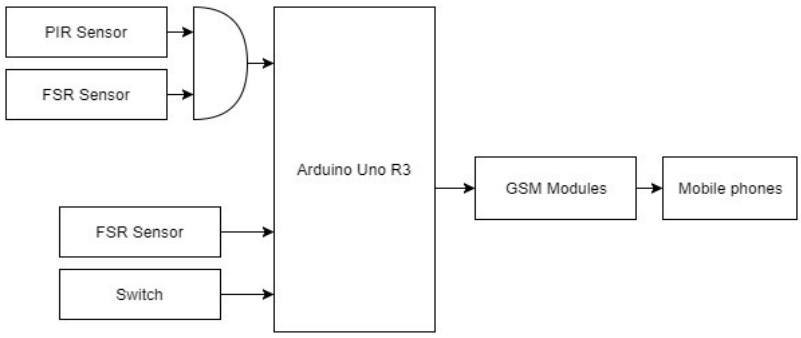

Figure 2. Block Diagram of Safety Child Car Alert System

The detection mechanism is used to detect the presence of a child at the back seat. Passive Infrared (PIR) is used to detect the motion based on IR radiation emission produce from the child [11]. For Force Sensitive Resistor (FSR), it is used to detect the force applied on the infant seat based on the average children's weight. Since both sensors are important to detect and confirm the presence of a child, the AND gate is used for this detection mechanism. Force Sensitive Resistor (FSR) is also used to detect the presence of the driver while the switch is used to simulate the car ignition ON/OFF.

Whenever the detection mechanism detects and confirms the presence of a child while the driver left, a signal will be sent to the control unit to trigger the GSM modules [9]. As the GSM modules get triggered it will send text alert to parents.

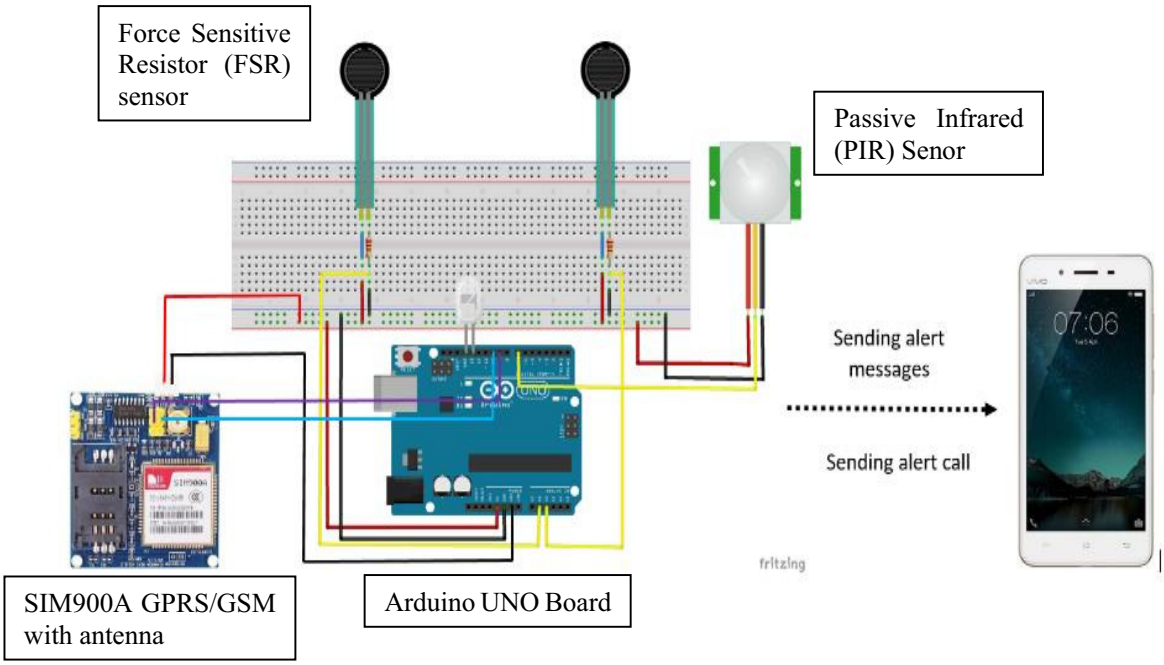

Figure 3. Final Module Integration for SCCAS

The final module of this development is shown in Figure 4. Force Sensitive Resistor (FSR) sensor placed at the driver seat and on the infant seat to detect the presence of the driver and to sense a weight produced by a child. FSR sensor will then be integrated with the GSM module. Concurrently, the Passive Infrared (PIR) sensor will be placed on the top chassis of the car between the driver and infant seat. It will be positioned at a 45° degree facing the infant seat. This sensor is required for the confirmation process to distinguish whether the weight detected by the pressure sensor is a human being or not by revealing the amount of Infrared emits from the child's motion [6,10].

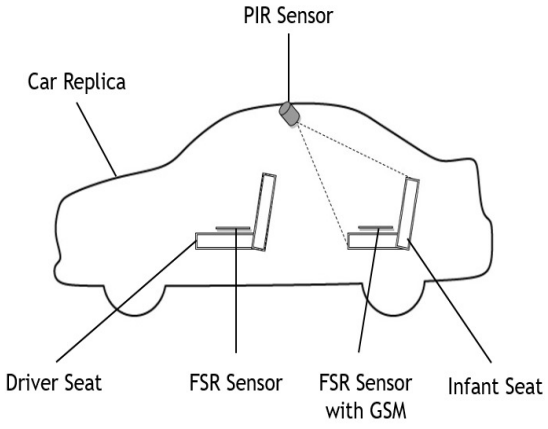

Figure 4. Implementation of SCCAS

3. Result and Discussion

In the scenario where parents left a child in a parked car after a minute passes, initialization of the process would start, and this will activate the Safety Child Car Alert System. Several seconds later, if the pressure

sensor detects a weight, the detection mechanism would be triggered and as in Figure 3. The presence of a child would need a confirmation mechanism where motion produced by a child due to prolonged heat exposure in the car would be detected. The system then sends out alert messages to parents to notify them as in figures below. The system idle once the child being removed from the seat.

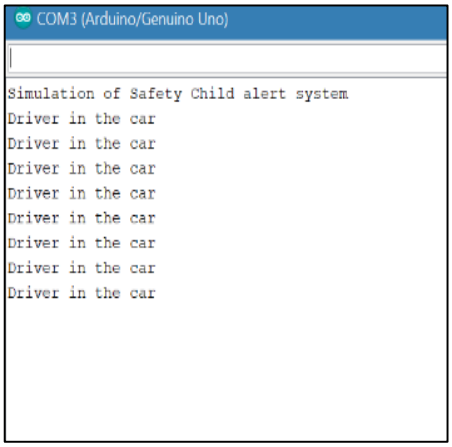

Figure 5. FSR sensor detecting the presence of driver in the car

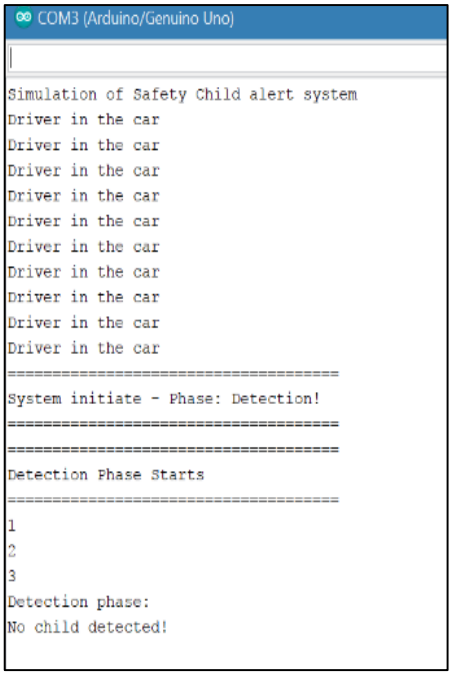

Figure 6: No child detected left in the car after the driver left

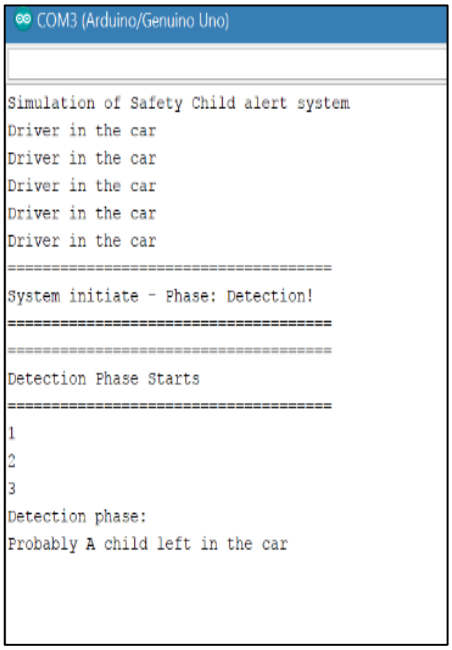

Figure 7. A child left in the car after the driver left

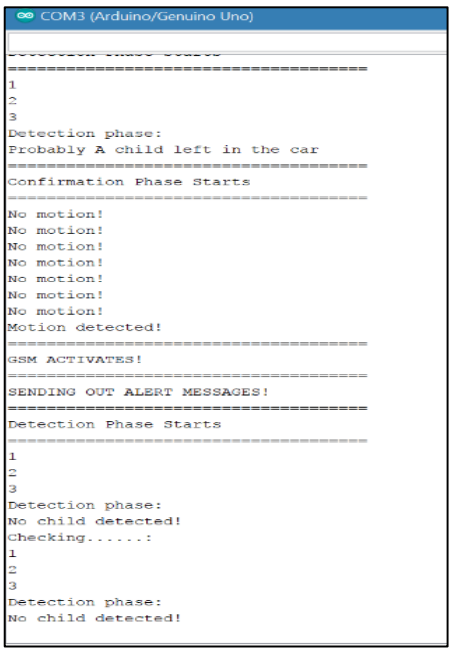

Figure 8: Alert messages send out and child being removed from seat

The results are summarized in Table 1 according to certain aspects. These assessments are being accessed for its basic system operations such as how the system activates, how detection mechanism and confirmation mechanism work and how the alert text is sent out.

Table 1. The functional assessment of SCCAS

Operational Features	Response or Units	Result	Notes
CRS Model		Safety Child Car Alert System	Lab working prototype using Arduino Development Kits.
Orientation	FF = Front Facing		Use motion sensor so, not applicable for Rear Facing (RF) child seat.
Audible Presence Detection Confirmation	Yes or No	No	The green LED flashes when the parents left the driver seat.
User Action Required for Activation	Yes or No	Yes	The parents left the driver seat when no pressure detected by the FSR sensor
User Action Confirmation	Yes, No or n/a	Yes	The green LED flashes when no pressure on driver seat and turn off when no child on the seat.
End-of-Trip Reminder Notification	Yes or No	No	The system is deactivated when the child is removed from the CRS
Left-Behind Notification	Yes or No	Yes	Text alert is triggered "15 seconds after parent left the car"
Left-Behind Notification Recipients	User, Vehicle Surroundings, Telecommunication	User	Text alert sent out if detect motion.
Left-Behind In-Vehicle Cancellation	Yes, No or n/a	No	When the child is removed from the seat, the green LED will be turn off
Snooze Function	Yes, No or n/a	No	

4. Conclusion

The Safety Child Car Alert System may not accommodate all possible technologies; however, it shows great potential for parents/driver to leverage on its benefit to prevent any fatal incident from happening. The system intends to provide reminders to parents who left their child in car unintentionally. This effort is more applicable and relevant for children in a dominant age range between newborn to toddler. The add-on confirmation detection mechanism allows a rigid and precise detection of the entity mechanism to be working perfectly. Issuance of notifications/alerts to parents on add-on integrated GSM module fulfilled the objective of the project. Nevertheless, this system does not address the effectiveness of notification once issued. Despite low-cost, the system's easy set up make SCCAS a user-friendly device. In all, the cost of this project sum up to RM 350. Yet there are always rooms for improvement. For future work, the system should ideally be equipped with robust operating capabilities such as battery life, feedback to indicate proper function, provide end-of-trip convenience reminder and minimal additional user action.

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