

Feasibility Study of Vehicular Heatstroke Avoidance System for Children

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ABSTRACT

This paper present the development of Vehicular Heatstroke Avoidance System for Children. The primary objective of this work is to prevent children up to 24 months old from being left unintentionally at the rear seat in closed, parked vehicles, which have the potential to result in heat stroke. The efficacy of heat stroke prevention technologies in sensing the presence of a child in a child restraint and alerting the caregiver if he or she walks away from the car without removing the child is evaluated. This system used motion sensor and sound sensor to detect the unattended children inside the vehicle. Motion detector is used to detect child posture and movement and is integrated as a component of a system that automatically performs a task or alerts a user of motion in an area while sound sensor used to detect sound from the baby. The sensor was attached to the Arduino GSM shield and simulated in IDE software. When the movement of the baby or the baby voice is detected, GSM will send Simple Message System (SMS or text messaging) for alerting the caregiver to attend their children. Vehicular Heatstroke Avoidance system is self-energized device which help in preserving vehicle battery by using solar power. It is expected that this device could help reducing the vehicle heatstroke cases among children that keep on increasing lately.

Keywords- Vehicular heatstroke, unattended children, Self-energized device, Avoidance system

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I. INTRODUCTION

Vehicular Heatstroke Avoidance System for Children is a device for people that unintentionally left their children unattended inside their vehicle. The tragedy of children's heat stroke death in vehicles could happen to any family that own small children. No matter how much the parents love their children, the accident still happened. Sometimes the parents or the caregivers were distracted with other tasks that make them forgot about their children and left them in the vehicle for too long. Occasionally they thought that they were away from the vehicle just for a few minutes, but they lost track of time while their children were suffering heatstroke in the vehicles.

There is a need for device that can alert parents or caregiver when someone has been left in the vehicle, alert them when an unauthorized entry to the vehicle has occurred, and the alert can be sent regardless of the distance. Vehicular heat stroke is largely misunderstood by the general public. The majorities of parents are misinformed and would like to believe that they could never "forget" their child in a vehicle. The most dangerous mistake a parent or caregiver can make is to think leaving a child alone in a vehicle could never happen to them or their family. In well over 50% of these cases, the person responsible for the child's death unknowingly left them in the vehicle. In most situations this happens to the most loving, caring and protective parents. It has happened to a teacher, dentist, social worker, police officer, nurse, clergyman, soldier, and even a rocket scientist [2].

As shown in Figure 1, the inside cabin of a vehicle heats up very quickly. Even with the windows cracked, the temperature inside a car can reach 125 degrees in minutes. Cracking the windows does not help slow the heating process or decrease the maximum temperature 80% of the increase in temperature happens in the first 10 minutes. Children could die because of heatstroke inside their vehicles in temperature as low as 60 degrees [3]

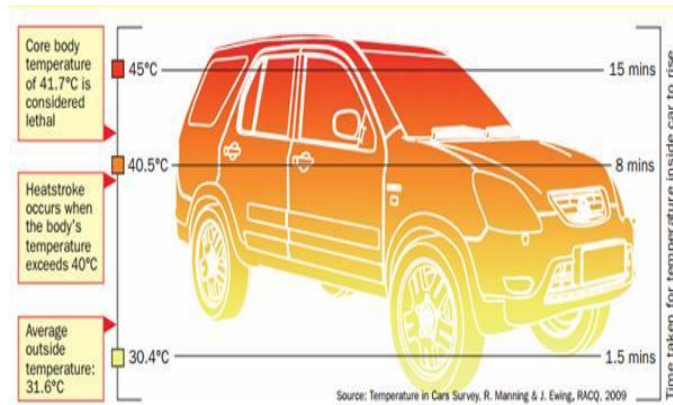


Figure 1: Outside Air Temperature & Inside Air Temperature of Car

Children are more prone to overheating than adult due to their body overheats 3-5 times faster than an adult body as shown in Figure 2. By referring Figure 3, the circumstances of an overwhelming majority of child vehicular heatstroke deaths, it was a loving, responsible parent that unknowingly left the child. The tragedy of children’s heat stroke death in vehicles could happen to any family with young children. No matter how much the parents love their children, the accident still happened. [4]

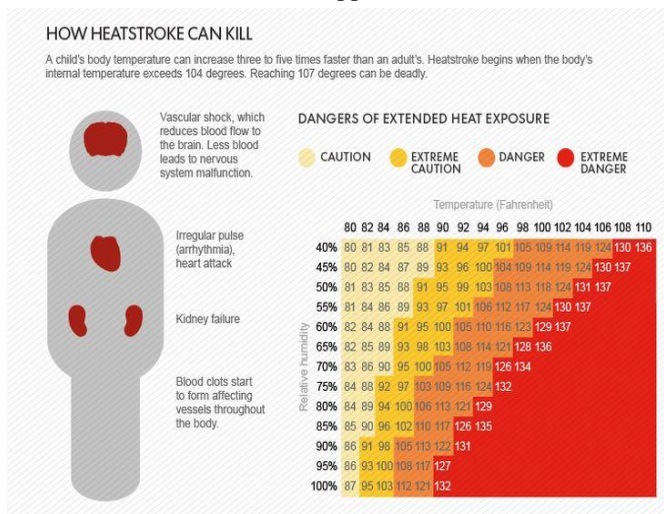


Figure 2: How Heatstroke Can Kill

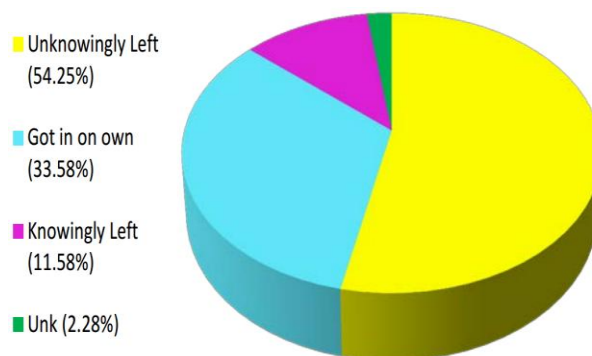


Figure 3: Circumstances of Child Vehicular Heatstroke Deaths

II. METHODS

Figure 4 shows the Logic Flow Chart that dictates how the system works:-

- If the engines off, the system will start initialized.
- Delay 1 minute for the driver to get the passengers including babies or small children out of the car.
- The sound sensor and motion sensor are engaged.
- The motion sensor checks inside the car if there is any live form. If no, the system will continue its checking. If yes, go to the next step.
- The system will send SMS (text message) to the driver or the first person. If the system is reset, the system temporarily disengages the sensor. If no, go to the next step.
- The system sends SMS to the next person. If the system still not reset, it will continue engaged the sensor until the system is being reset.

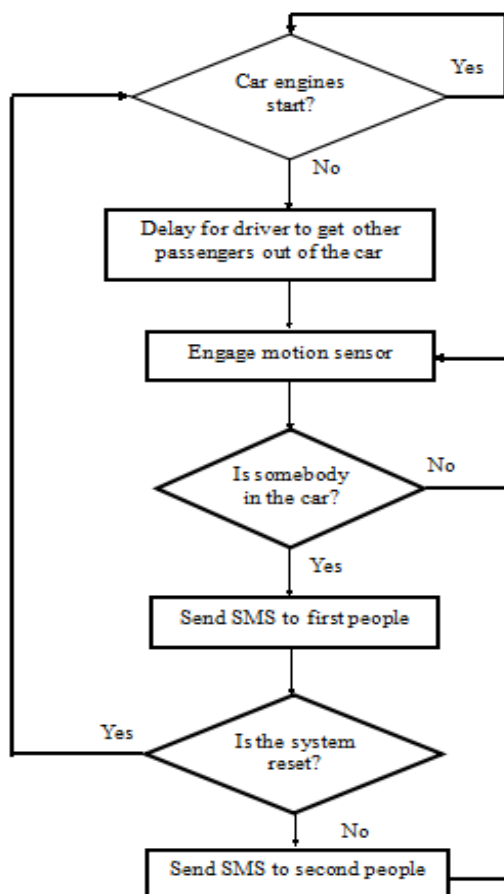


Figure 4: Logic Flow Chart of the System

Arduino Uno is the choice of microcontroller (the brain of the system.). Arduino GSM shield is use to handle the communication, the SMS to be sent from our prototype to the designated phone number.

- All the pins on GSM shield (top) is align to the Arduino Uno board (bottom) and then press them firmly together.
- A SIM card is inserted all the way into the bracket so the metal contacts are facing the shield with the notch at the top.
- Digital pins 2, 3, and 7 are reserved for communication between the Arduino Uno and the GSM modem. No other sensors should use these three pins. When the yellow status LED turns on, the modem is powered and ready to connect to the network. [1]
- GSM Library (with the codes for sending SMS) is included in Arduino IDE (Integrated Development Environment where we write our codes to make Arduino to do our bidding).

The sensors used are PIR sensor (a passive infrared sensor) and sound sensor. All objects on earth (except for the one, if there is any with, a temperature below absolute zero) emit heat energy, an infrared radiation that is invisible to human eye. The PIR sensor can measure infrared light radiating from objects in its view (about 12 feet in length), so it is able to sense the movement of people, animals, or other objects. The PIR sensor senses the heat with a pyroelectric material (when there is heat, the material gives off electricity.) Because the sensor does not generate or radiate any energy for detection purposes, it is called passive. Because the infrared does not penetrate glass very well, so any movement from the other side of glass will not be seen by PIR. It is an ideal sensor for detecting the movement inside the car, but not outside of the car [6].

While for the sound sensor, it work by mimicking the human body process that involves the ears and signal transmission to the brain. Microphones are sound sensors that convert a sound signal into a voltage or current proportional to the detected signal [7]. They typically have a small diaphragm made of magnets surrounded by coiled metal wire. Sound waves cause the diaphragm to vibrate, which vibrates the magnets and induces a current in the coil. Although microphones are the most recognized sound sensor, electrostatic and piezoelectric sensors are also used to detect sound in applications such as industrial, medical, robotics, and identification and tracking. These sensors can detect sound pressure waves that are not within the audible range, which makes them suitable for a wide range of tasks [5]. Arduino Nano is use for the transmitter. RF transmitter is connected to the Arduino Nano pin. While for the receiver is connect to the Arduino Uno pin. The RF Transmitter has 3 pins (VCC, GND, and Data) [8].

III. RESULT AND DISCUSSION

PIR sensor could sense movement 180° detection angle for widespread motion detection and detects people up to 30 ft away as shown in Figure 5. This is the key feature to determine either there is a children's movement or not inside the vehicle. If the sensor detect the existence of children inside the vehicle, the LED that act as warning light will turn ON and automatic OFF when the sensor detect no movement.

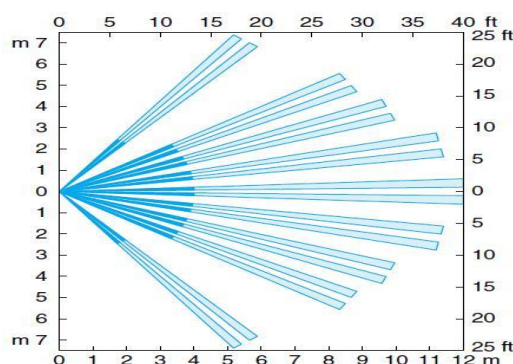


Figure 5: Range for PIR sensor

The sound sensor detects sounds with frequency between 100 Hz and 8kHz and measures sound pressure level between 50dB to 100 dB. Table 1 shows the result of sound signal applied to this device.

Table 1 : Result for the sound sensor

ITEMS	RESULT
Sensor Output Type	Non-Ratiometric
Sound Level Min	50 dB
Sound Level Max	100 dB
Sound Frequency Min	100 Hz
Sound Frequency Max	8 kHz
Sound Resolution	0.16 dB

IV. CONCLUSION AND RECOMMENDATION

In this work, it can be concluded that the sensors used for this system could perform well to serve its function to detect unattended children inside the vehicle. This device could benefit the community to prevent children heat stroke death in vehicles by actively monitoring the inside of a vehicle and sending appropriate signal (light, sound, alarm and SMS) according to the situation. The programmed code that attached to the microcontroller also prevents a child sneak in a unattended vehicle which is also crucially important.

In future, it is recommended to upgrade the Vehicular Heat Stroke Avoidance System for Children by adding a keypad for user input. This device currently programmed in the user mobile phone number to send the text message. The regular user will not have the same access and need change the code on the phone number. If add a keypad in this prototype and change our code to allow user input, the user can set up and change phone number themselves.

Acknowledgment

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REFERENCES

- [1] Retrieved 2015. from Arduino GSM Shield <<http://www.arduino.cc/en/Main/ArduinoGSMShield> >
- [2] By Ryan Jaslow CBS NEWS Retrieved July 31, 2012, <http://www.cbsnews.com/news/govt-study-devices-that-alert-parents-they-left-a-child-in-car-deemed-unreliable/>
- [3] By CSN Infographic. Heatstroke Deaths of Children in Vehicles. <http://www.childrensafetynetwork.org/infographics/heatstrokeinfographic>
- [4] Guard, A., & Gallagher, S. S. (2005). Heat related deaths to young children in parked cars: an analysis of 171 fatalities in the United States, 1995-2002. *Injury prevention journal of the International Society for Child and Adolescent Injury Prevention*, 11, 33-37. doi:10.1136/ip.2003.004044
- [5] "Sound sensitive lights w/ sound sensor & Arduino," [Online]. from <<http://www.princetronics.com/sound-sensitive-lights-w-sound-sensor-arduino#Requirements>>
- [6] How PIRs Work. Retrieved 04 Mei, 2015, from <<https://learn.com/pir-passive-infrared-proximity-motion-sensor>>
- [7] Espen Dalmo. How Sound Sensor Work. 2015 . From <<http://www.ask.com/technology/sound-sensor-work-649a23beabb3f1f> >
- [8] By deba168. How To Make PIR Wireless. 2014. <<http://www.instructables.com/id/ARDUINOWIRELESS-HOME-SECURITY-SYSTEM/?ALLSTEPS>>