UNIVERSITI TEKNIKAL MALAYSIA MELAKA

IMPROVEMENT OF VEHICULAR HEATSTROKE SENSOR SYSTEM FOR CHILDREN

This report is submitted accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours.

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

Signature: …….

Supervisor: Dr. Nur Hazwani binti Mokhtar

ABSTRAK

Kertas ini membentangkan pembangunan Vehicular Heatstroke Sensor System for Children. Objektif utama kerja ini adalah untuk menghalang kanak-kanak sehingga 24 bulan dari ditinggal secara tidak sengaja di tempat duduk belakang dalam tertutup, meletakkan kenderaan, yang mempunyai potensi mengakibatkan strok haba. Kemujaraban teknologi-teknologi pencegahan strok haba dalam merasakan kehadiran seorang kanak-kanak dalam satu kanak-kanak menyekat dan berjaga-jaga penjaga jika dia berjalan dari kereta tanpa menyingkirkan budak itu dinilaikan. Sistem ini menggunakan penderia gas dan pengesan suhu mengesan anak-anak tidak dilayan di dalam kenderaan. Pengesan gas digunakan untuk mengesan kelembapan dan kandungan karbon di dalam kenderaan manakala pengesan suhu digunakan untuk mengesan suhu di dalam kenderaan. Penderia disertakan kepada perisai Arduino GSM, dibuat-buat dalam perisian IDE dan disambungkan kepada permohonan dalam telefon pintar sebagai pengawal. Bila kelembapan atau karbon di dalam kenderaan mencapai beberapa perkara, GSM akan hantar data kepada telefon pintar untuk memberi pesanan kepada pengguna. Vehicular Heatstroke Sensor System for Children ialah peranti diri bertenaga yang membantu dalam menjaga bateri kenderaan dari jenis-jenis sel boleh dicas semula (Powerbank). Dijangka yang peranti ini boleh membantu mengurangkan kes-kes strok haba kenderaan di kalangan kanak-kanak yang teruskan menambahkan kebelakangan.

ABSTRACT

This paper presents the development of Improvement of Vehicular Heatstroke Sensor 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 vehicle without removing the child is evaluated. This system used gas sensor and temperature sensor to detect the unattended children inside the vehicle. Gas detector is used to detect humidity and carbon content inside the vehicle while temperature sensor used to detect temperature inside the vehicle. The sensor was attached to the Arduino IDE shield, simulated in IDE software and connect to the applications in the smartphone as controller. When the humidity or carbon inside the vehicle is reach some point, IDE will send data to the smartphone for alerting the caregiver to attend their children. Vehicular Heatstroke Sensor System is self-energized device which help in preserving vehicle battery by rechargeable cell types batteries (Power banks). It is expected that this device could help reducing the vehicle heatstroke cases among children that keep on increasing lately.

DEDICATION

This report is dedicated to my father, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it is done one step at a time. To my beloved parents and families, thanks a lot for the love and infinite support that you gave. To my respected supervisor, your kindness, patience, comprehend, tolerance and encouragement are very valuable and precious.

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Thank to Allah for His grace and endorsement that this report has been successfully completed. I would like to thank my beloved parents for their support and encouragement as well as giving motivational words that had encouraged me to continue to work diligently and make this report a success. A big appreciation and a million thanks to Dr. Nur Hazwani binti Mokhtar my supervisor of this project, that had given so much guidance, encouragement, advice, remarks and cooperation and her time to teach from the beginning until the report was completed and developed. In addition, she had shared many ideas and experiences that helped me a lot for this project. Also, appreciation is given to all lectures and friends that had been involved directly or indirectly in helping to complete this project in the form of ideas and support from the beginning of the report until it has been successfully finished.

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LIST OF ABBREVIATIONS

LED	Light-Emitting Diode
VCC	Voltage Common Collector
GND	Ground
Wi-Fi	Wireless Fidelity
USB	Universal Serial Bus
CO	Carbon Monoxide
IDE	Integrated Development Environment

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CHAPTER 1
INTRODUCTION

1.0 Overview

The heat stroke occurs when the body is not capable of dissipating and absorbing the heat it produces, for instance, when it is left unattended by the body in an adjoining vehicle even if only a few minutes. Vehicular hyperthermia in young children is an uncommon, but preventable cause of heat stroke. The incidence of death from vehicle hyperthermia has increased as children are not visible in the back seat of vehicles. Child deaths from vehicle-related heat strokes occur less often than those occurring in traffic accidents; however, special attention should be paid to the nature of these fully preventable deaths. The inability of a young child to leave the vehicle in combination with a low temperature tolerance allows the children never to be left unattended. Young children have core body temperature of above 40°C and neurological dysfunction. Acute treatment includes cardiac resuscitation primarily for dehydration and shock and quick cooling.

1.1 Background Research

One of the most severe cases of hyperthermia is a heat stroke or thermal shock. It happens when the body overheats due to high temperature or excessive physical exercise. Insufficient hydration stops various organ from functioning of different organs.

Initially, mild heating diseases like heat oedema, heat rash, and heat cramps manifest the organism's reaction to extreme warmth. When the body's core temperature is above 38°C, heat exhaustion becomes inflamed and cardiac output is decreased. A rise in the core is called heat stroke, a behavioural disorder marked by changes in mental status and lac of sweating (Nixdorf-Miller, Hunsaker and Hunsaker,2006). Hot and dry skin, tachycardia, and gastric symptoms, such as nausea and vomiting, are other characteristics of heat stroke (El-Radhi, Carrol, Klein and Buchanan, 2009).

The characteristics of thermal regulation differ for children from those for adults. Children have a greater surface area to body mass ratio, which in severe environmental conditions leads to heat absorption. The reduced blood volume limits the ability to transfer heat from the core to the periphery, which ensure that heat is distributed into two environments. Another major differential in thermal regulation which children is their sweating mechanism, which in comparison with adults is not as effective (Falk,1998). Such factors make them highly susceptible to heat stroke growth in the hot environment, such as in an enclosed car park.

Prior to the middle 1990's, front passenger-side impact airbags gained increases popularities in new vehicle. Although by 1999, some new vehicles were included by the government in standard safety measures from 1995 to include driver and passenger Airbags in front of impact protection. Between 1990 to 2009, 290 deaths occurred as a result of this new safety trend and over 90% of passengers were children who did not wear seat belts in rear facing seats. (Insurance Institute for Highway Safety,2010).

Efforts to increase the buckling of parents and caregivers in the back have been successful, and accidents due to air bags began to decline by 2000 (NHTSA, 2009b). In this period, the number of children dying of heat stroke in cars increased, which were supposed to result from children less noticed by the carer in the second row, and were therefore forgotten and left unattended when they reached their destination (Null, 2015)

Since 1998, a total of 794 heat-stroke-related fatalities to youngsters left in vehicles have been reported (Figure 1.1). based on examination of the media report used combine the information, concluded that the caregiver had forgotten 54.0% of the children, 26.3% of the children gained access on their own, and an adult purposefully left 18.9% of children in the vehicle (Figure 1.2).

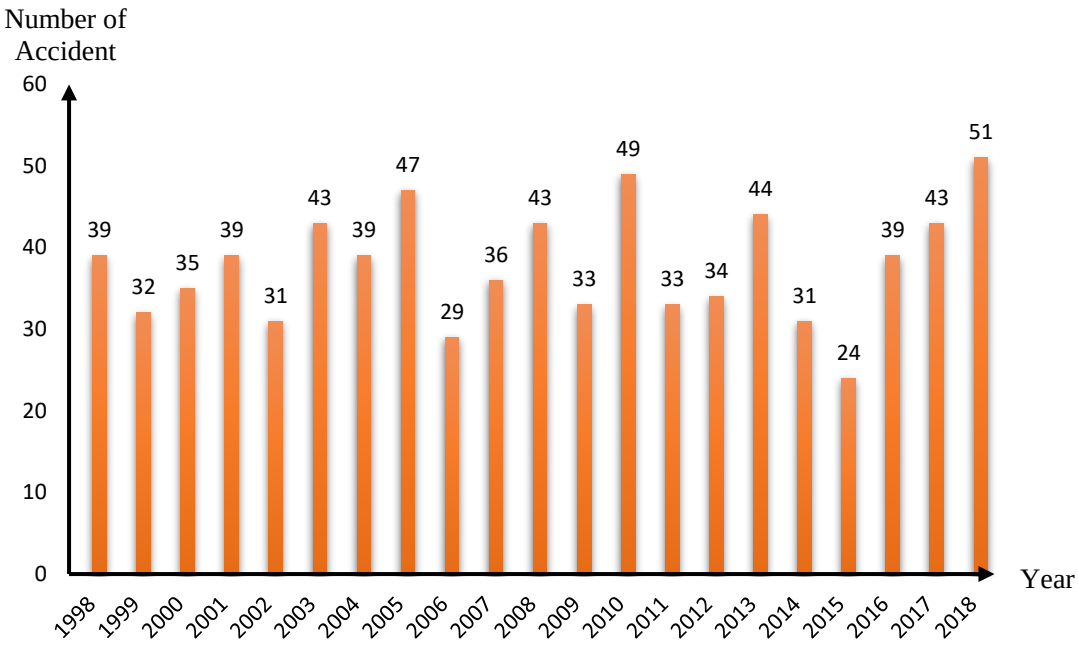

Figure 1.1 Child Vehicular Heat stroke fatalities by year (1989-2018)

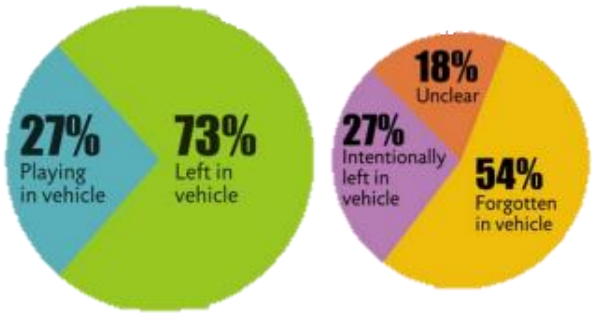

Figure 1.2 Circumstance Heat Stroke Deaths

The air temperature of vehicles is rising significantly, an effect that many parents and caregivers fail to understand. Air temperatures inside a car parked in the sun with constant outside temperature raised by 20° in 10 minutes in tests of the rise in vehicle ambient temperature. Within 20 minutes, the air temperature inside was 29° higher than the ambient. In 60 minutes, various types of vehicles and atmospheric temperature can reach similar inner peak temperature of 60 - 82°C (Figure 1.3). The

average duration of heat exposure was 4.6 hours, and the fatal exhibition reported was 15 minutes for 171 paediatric deaths due to vehicular hyperthermia. (Booth JN, Davis GG and Waterbor J, 2010).

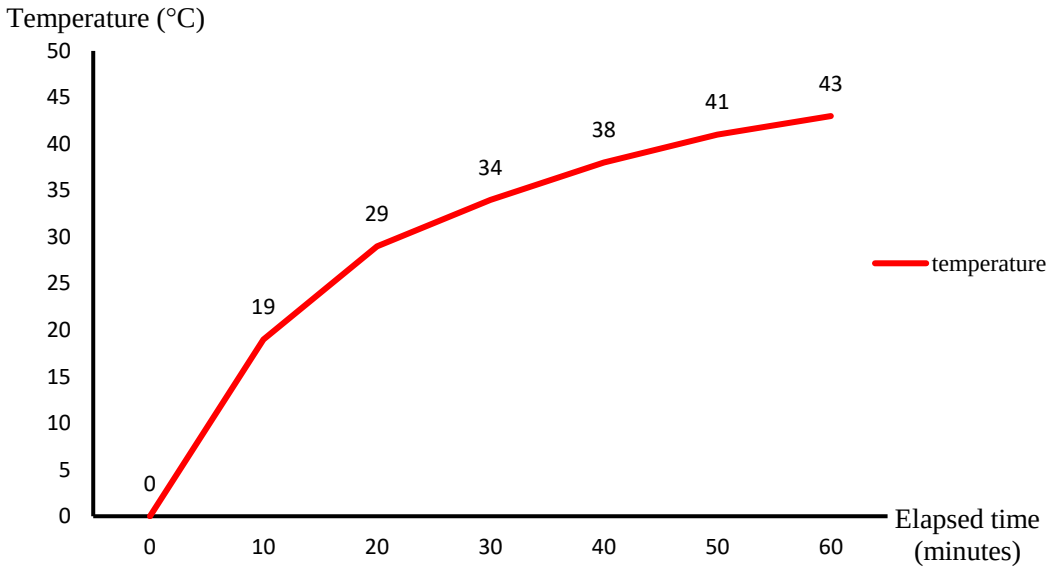

Figure 1.3 Average temperature rise enclosed vehicle

As it progresses, dehydration and electrolyte abnormalities occur, particularly hyperthermia due to water loss and hypocalcaemia due to skeletal muscle degradation. These electrolyte abnormalities affect heart and conductivity, and prevent the child from maintaining high cardiovascular performance. This decline in cardiac output leads to hypotension in the presence of dehydration and vasodilation. Two deaths from infant hyperthermia have occurred in Malaysia over the past two months. (Shaz, 2019).

1.2 Aim and Objective

1.2.1 Aim

The aim of this research is to reduce the risk of children being inadvertently left unattended in an enclosed vehicle by their caregivers. Child vehicle heat stroke is recurring accident, frequently seen in warmer regions in spring and summer months. Child vehicle heat stroke can occur when a child left unattended in a vehicle and even at mild ambient temperatures can occur quickly. Forgetting that the child is in vehicle is mentioned as the main of the heat stroke of the child's vehicle.

1.2.2 Objective

The objectives of this research are as follows:

i. To develop a circuit that can measure temperature and humidity in a vehicle.
ii. To design and implementation of an Internet of Things platform that can transmit data into the smartphone.

1.3 Scope

This scope of this project applies to detect positively the presence in conjunction with a conventional vehicle trip or when the child is left behind, of an adequately retained child in a child restrains sitting and sends notifications to the driver (carer) at particular events. This research recognizes that no child presence detection capability is needed in the reminding system. This experiment decided to consider only systems which include this technological capability while the reminder of systems without children's detection capabilities could help reduce the presence of left-hand children. Thus, a part of components which is temperature & humidity sensor, carbon monoxide sensor, nodeMCU and Arduino system to make this project perform. This experiment to improve the system use to detect the temperature and humidity from inside the vehicle to replace reminder system in market.

CHAPTER 2

LITERATURE REVIEW

2.0 Overview

Various technologies have been developed to incorporate children's restrictions to detect the presence of a child in the retention area and then to alert the carer when he or she has left the vehicle without taking the child from the retention area. The overall objectives of this chapter are to evaluate current technology solutions to avoid children up to age of 24 months in private parked vehicles that could lead to heat stroke. The National Highway Traffic Safety Administration (NHTSA) has investigated electronic reminder devices developed specifically to address this problem. There are varying reporting methods, but audible and smartphone alarm systems are included in late 2014. In addition, some items previously evaluated were revised with the intention of improving quality by the manufacturers. All of these items concentrate on children seated in childproof seats and are available for public purchase.