Machine Learning Classification to Detect Unattended Child in Vehicle Using Sensor Signal: A Review

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***Abstract*— A significant number of children die each year in the United States and around the world as a result of being left in hot vehicles. Numerous studies aimed at reducing the number of unattended children in vehicles have employed a variety of strategies. The majority of studies use sensors to detect unattended children, while only a few integrate machine learning with the sensors. The efficacy of a sensor's system is improved by machine learning. This paper reviews the implementation of machine learning classification in child detection systems and reviews the research conducted to detect unattended children. For the majority of the research, the machine learning algorithms SVM, KNN, and Random Forest effectively classified the occupants into a few classifications with accuracies greater than 90%.**

Keywords—unattended child, machine learning, human detection, sensors

I. INTRODUCTION

The death of an unattended child due to heatstroke in a vehicle is a worldwide tragedy. Children who are left in a motor vehicle (MV) for even brief periods of time in temperatures as low as 21°C run the risk of developing hyperthermia. Despite variations in the rate of increase caused by vehicle type, colour, and window tinting, the internal temperature within a closed MV rises quickly in the first 15 minutes. Temperatures rise by 1.7–1.9C every minute on average. Regardless of whether windows are cracked open or closed, by 30 minutes, 80% of the temperature increase has been accounted for, and within 60 minutes, vehicles have reached equal peak temperatures[1]. Every year in US, an average of 38 children under 15 dies from heatstroke after being left in a vehicle.[2] Figure 1 shows the number of cases by years from 1998 to 2022. analyzing this vast

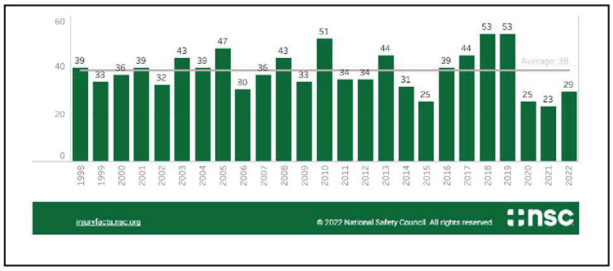

Fig. 1. The numbers of children die from heatstroke from 1998 to 2022

On hot, bright days, parked vehicles may create potentially lethal inside temperatures surpassing 70 degrees Celsius. Several deaths occur across the world as a result of heatstroke caused by being confined in parked vehicles. Children are more susceptible to hyperthermia than adults due to their larger body surface area and less efficient thermoregulation, and they may get access to or be forgotten in unattended parked automobiles.

In 2021, there were 23 fatalities involving children in overheated cars in US. Up to this point in 2022, 29 fatalities have been reported. Every year, an average of 38 children under 15 dies from heatstroke after being left in a car. Since 1998, nearly every state has had at least one fatality. In 2018 and 2019, a record 53 children died after being left in a hot vehicle[2]. In Brazil, from 2006 through 2015, there are 31 incidents, including 21 deaths of unattended child in vehicle. The majority of cases (71%) had a caregiver, often a parent, forgetting the child [3]. In India, there were 16 instances that led in 28 deaths between 2011 and 2018. 19/28, or 68%, of the children were between the ages of 4 and 6 [4] . The Malaysian Institute of Road Safety Research (MIROS) found a total of nine cases of child deaths in parked automobiles through the end of 2018 the figures increased in 2019 with the addition of two cases, bringing the total number of cases to eleven[5].

Numerous studies have been conducted to reduce the incidence of unattended children in vehicle. They employ distinct methods. Numerous studies concentrate on detecting human presence in vehicles using sensors and detectors in order to protect unattended children[6]–[29]. The system will alert the car owner if unattended children are present in the vehicle. Machine learning is used to detect human presence in vehicles using sensors. Most of its applications were limited to a single type of sensor[6], [8], [9], [13], [15].

II. DETECTION OF UNATTENDED CHILD IN VEHICLE

Table 1 shows the number of research studies conducted to detect unattended children in vehicles using sensors from 2015 to 2022. To detect unattended children, various sensors, including PIR sensors, weight sensors, radar, and cameras, were utilised.