Adaptive Cruise Control System with Heart Rate Monitor to Avoid Collision

[1] **Dr. D. Selvaraj**
Professor
Department of Electronics and Communication Engineering
Panimalar Engineering College
Chennai, India

[2] **Akshaya**
UG student
Department of Electronics and Communication Engineering
Panimalar Engineering College
Chennai, India

3 Anchana Jegath
UG student
Department of Electronics and Communication Engineering
Panimalar Engineering College
Chennai, India

[4] **Kiran Supriya**
UG student
Department of Electronics and Communication Engineering
Panimalar Engineering College
Chennai, India

[5] **Jerika**
UG student
Department of Electronics and Communication Engineering
Panimalar Engineering College
Chennai, India

Abstract

Modern modes of transportation must incorporate safe driving to minimize the number of collisions, injuries, and fatalities on the road. The likelihood of accidents and injuries might rise due to several circumstances, such as drowsy driving, speeding, and distracted driving. The approach presented in this work uses adaptive cruise control (ACC) and heart rate monitoring sensors to keep a safe and comfortable gap between a car and the car in front of it while also enabling the car to change its speed appropriately. The ACC makes use of a lidar sensor to gauge the separation between the vehicle and the vehicle in front of it. The lidar sensor measures the distance and speed of objects in front of the car using laser beams According to several reports, using cruise control while driving raises the likelihood of becoming drowsy. Heart rate monitors can be used to detect variations in heart rate and variability, which can indicate exhaustion, drowsiness, and even heart attacks. This alarm will then sound to warn the driver and other passengers. Consequently, adaptive cruise control which automatically regulates vehicle speed and maintains a predetermined minimum distance from the car in front of it, might lessen driver stress. This study proposes a proposal for an intelligent ACC system with a heart rate monitor that is SOS-based.

Index Terms: ACC, LiDAR, heart rate monitor, Steering, Wheel, sensors, healthcare.

1. Introduction

Adoption of advanced driver assistance systems (ADAS) in cars has increased in the last few years due to technological advances and advances in computing power. One of ADAS's technologies is Adaptive Cruise Control (ACC), which helps improve driving safety and comfort. The ACC system monitors the safety distance and adjusts the speed of the car in front according to the speed of the target (finish) car. Control and sensor subsystems make up most ACC systems. The sensor subsystem provides information about the surrounding environment in various ways.

The complex operation of ACC uses Light Detection and Ranging (LiDAR) and various other devices in our application. While measuring the area around the vehicle with a 360- degree view (100-200 meters), LiDAR-based systems can identify 3-dimensional objects at long distances.

LiDAR system's 3D mapping abilities help it discriminate between vehicles, pedestrians, trees, people, and other objects as well as calculate and transmit real-time information on their velocities. According to World Population [1], the number of people over the age of 60 in the world will double between 2040 and 2100. An additional feature called a heart rate (HR) monitor has been added to the ACC. Heart rate monitors use sensors that provide cold signals and bio signals. The number of time heart beats per minute is known as heart rate or pulse rate. It serves as a warning sign because older people often have heart problems and those under 40 are now having heart attacks more often, a 2 percent increase from a decade ago. Cars will be able to monitor and track the heart rate of drivers. Instead of using electrodes attached to the skin, the technology measures heart rate while the driver's hands are on the steering wheel.

2. Related Work

The S-class from Mercedes-new Benz has an "adaptive cruise control system" that reduces vehicle speed if it senses a vehicle moving up to 150 meters ahead. This feature is designed to increase highway safety [4], [5], [6], [10],[11].

The Honda Intelligent Driver Support System (HIDS) was developed by Honda to help drivers with two driving tasks: maintaining lane position and controlling vehicle headway. Another system with a comparable idea has a been developed, but the speed is already predetermined depending on the gap between any two cars. In order to confirm the distance always stays within a range, this is done. Otherwise, the pace will automatically slow down [4], [5], [6], [10].

The Remote photoplethysmography (rPPG) is usedto determine heart rate from skin reflections of light. Each pulse causes a slight alteration in the skin's color on the face. In reaction to these changes, the reflected light changes as a result. Although these subtle color variations are imperceptible to the human eye, sequential imaging and signal processing techniques can be used to retrieve them from reflected light [1].
Instead of RPPG, a hand-grip heart rate monitor is being used in the car's steering wheel in place of measuring heart rate via the skin of the hand. With the help of this sensor, the heart rate may be monitored while driving.

3. Methodology

A. Adaptive Cruise Control

The LiDAR sensor is used to control the Adaptive Cruise Control (ACC). The vehicle's front equipment constantly scans the road ahead. If the road ahead of the vehicle is correct, ACC controls the driver's speed. If it detects that the vehicle is slow in its sensing technology, it slows down the speed slowly by releasing the accelerator pedal or activating the brake control. Suppose the vehicle in front accelerates or veers into another lane, ACC automatically increases the speed to a level selected by the driver.
Standard ACC can be activated and assists the driver from roughly 30 km/h (20 mph) and upwards, primarily on interstates or motorways. The ACC stop & go variant is furthermore active at speeds under 30 km/h (20 mph) [12]. It can keep the predetermined distance from the vehicle in front of it even at very low speeds and complete stops. The working of ACC, which is intended to be a comfort and convenience system, is depicted in Fig.1.1. As a result, brake interventions and vehicle acceleration only take place within pre-set boundaries. Despite having the ACC on, it is the driver's duty to keep focused on their speed as well as their distance from the vehicle that is in front of them. [12].

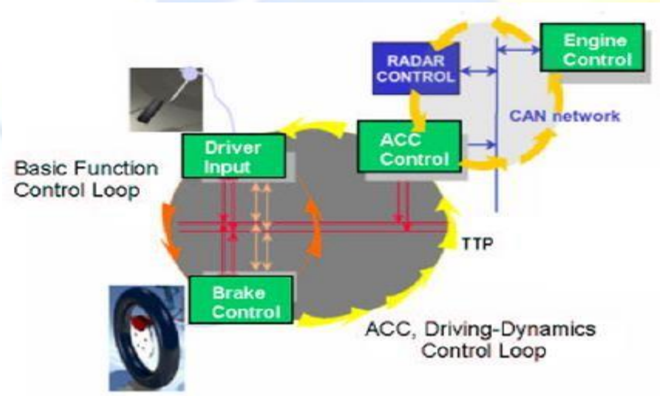

Fig 1.1. Functioning of ACC [9].

B. LiDAR

LiDAR sensors generate a three-dimensional map by emitting infrared light and measuring the amount of time it takes for the light to return to the sensor after colliding with an object.
The Time of Flight (ToF) kind of LiDAR is the most common type seen on vehicles that map their surroundings by sensing light pulses or photons that are sent out and returned. Instead of using light pulses to map its surroundings, the other type of LiDAR, FMCW, emits a steady stream of light.

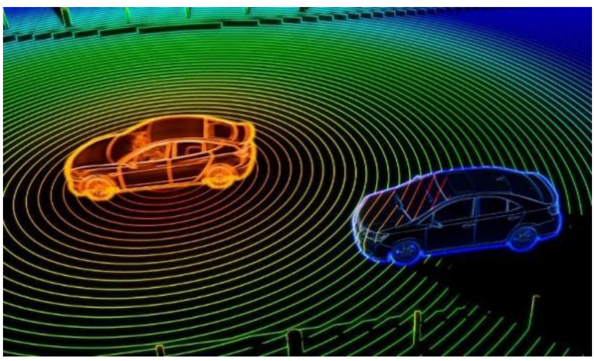

Fig 1.2. Lidar sensing [10].

As demonstrated in Fig. 1.2, ToF typically has a 360-degree field of view, which enables a single device to fulfil the same job as LiDAR, which has a constrained field of view and is typically utilized in vehicles with several LiDAR sensors. Additionally, LiDAR fills in the gaps left by other sensors. For instance, radar can be used to detect objects close to a car and determine their distance and speed. Figure 1.3 illustrates the LiDAR working environment.

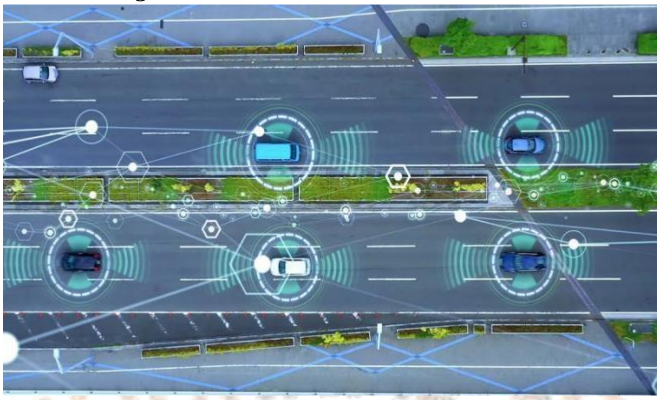

Fig 1.3. Real-time application of ACC [11].

C. Heart rate monitor

Using a device known as a heartbeat sensor, the heart rate,or pace of the heartbeat, is calculated. Checking ourbody's temperature, heart rate, and blood pressure are basic measures taken to preserve our health. Heart rate is measured using a hand grip heart rate monitor that will bemounted inside the steering wheel [7]. When a person's heart beats, tiny electrical signals are sent across their skinand recorded by the Hand-Grip Heart Rate Monitor to determine their heart rate. This signal is measured at the surface by electrodes put into the Hand-Grip Heart Rate Monitor's hand grips. Figure 1.4 provides the conceptual understanding of the heart rate monitoring system.

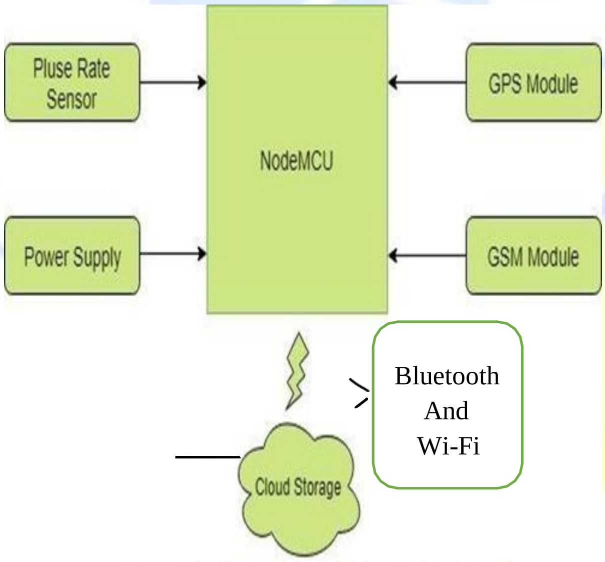

Fig 1.4. Block diagram of heart rate monitoring system [7].

a. Pulse Rate Sensor

A heartbeat or pulse rate sensor is used to figure out a person's heartbeat rate. The sensor, which measures a driver's heartbeat or pulse rate and ensures that the driver's health condition is stored in the cloud, has been installed around the steering wheel as illustrated in Fig. 1.5. It ensures the program's cut-off time, which was previously indicated in the program [7].

b. GPS Module

A GPS module can access a user's remote location and time stamp at any time and from any location. Here, it gathers data about the user or the vehicle and stores it in an open-source, real-time cloud environment. The location will be shared with the family and the rescue crew if the value exceeds the threshold heart rate level [7].

c. Arduino / Node MCU Board

The proposed system was developed using an Arduino board, which is hardware and a development board, to helptrack a driver's health and lessen traffic accidents. [7].

The cheapest Wi-Fi module is the Node MCU, which hasmemory and programmable input and output peripherals. In this instance, it is employed to automate the project procedure. Additional sensors are combined with this Node MCU module to provide the output. [7].

d. Power Supply

The development can be powered by either the USB connector or an external power source. From 7 to 12 voltsshould be adequate to run the board [7].

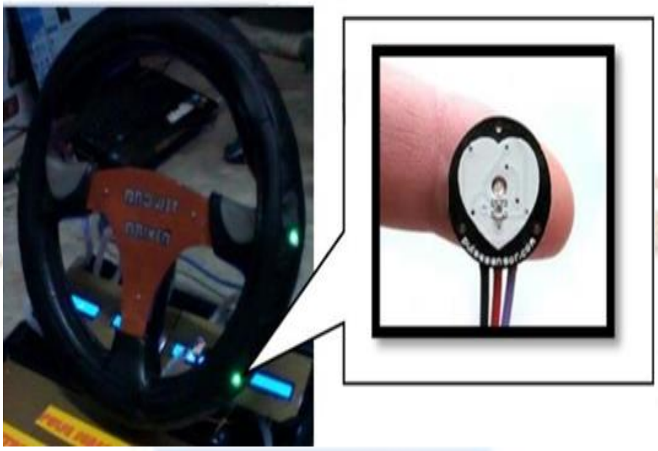

Fig 1.5. Pulse rate sensor in the steering of the car [8].

6. Conclusion

The proposed hypothesis in this study has the potential to significantly improve transportation safety. Driving safely is essential to preserving the lives of all road users, including drivers, passengers, and pedestrians. This can be aided by systems like adaptive cruise control with heart-rate monitoring. Some key strategies have been identified for enhancing driving safety through our examination of the literature and information on safe driving practices.

But it is crucial to realize that putting this concept into effect could be limited or challenging. Despite any potential difficulties, the suggested strategy merits more research. Overall, the proposed notion has a lot of potential, but further research is necessary to properly understand its significance. On the other hand, greater study on this topic is encouraged. However, it is advised that more research to be done on this area.

References

[1] R. M. Fouad1,2,3, A. Onsy1, Osama A. Omer2,3 1 School of Engineering, University of Central Lancashire, Preston, United Kingdom.

[2] Kubera Kalyan, Vinit Kumar Chugh, Anoop C. S., Member IEEE Dept. of Electrical Engineering, Indian Institute of Technology Kharagpur West Bengal, India.

[3] Sakchai Muangsrinooni and Poonpong Boonbrahmi I School of Informatics, Walailak University, Nakorn SiThammarat, Thailand.

[4] Ahmat Sanudin Department of Electronic EngineeringFaculty of Electrical and Electronic Engineering University Tun Hussein Onn Malaysia, P.O. Box 101,Batu Pahat, Johor.

[5] Mohd Helmy Abd Wahab, Department of Computer Engineering Faculty of Electrical and Electronic Engineering University Tun Hussein Onn Malaysia,P.O. Box 101, Batu Pahat, Johor.

[6] Ayob Johari, Department of Communication Engineering Faculty of Electrical and Electronic Engineering University Tun Hussein Onn Malaysia,P.O. Box 101, Batu Pahat, Johor.

[7] Gunasekaran M, Associate Professor in the Department of Information Technology, BannariAmman Institute of Technology Sathya MangalamTamil Nādu India.

[8] Herlina Abdul Rahim, Ahmad Dalimi, Protom-i Research Group, Infocomm Research Alliance, Control and Mechatronic Engineering Department,Universiti Teknologi Malaysia, 81310 UTM JohorBahru, Johor, Malaysia.

[9] Jean-Yves Brunel, Cadence Automotive Team, Paris, FR, Marco Di Natale,Scuola Superiore Sant'Anna,Pisa, IT, AlbertoFerrari,PARADES,Roma, IT, Paolo Giusto,Cadence Automotive Team, San Jose, CA, Luciano Lavagno,Cadence Berkeley Labs, Berkeley, CA.

[10] https://www.azom.com/article.aspx?ArticleID=16424

[11] https://levelfivesupplies.com/lidar-applications-

[12] automotive-mobility/

[13] www.bosch-mobility-solutions.com

[14] www.coursehero.com