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Vehicle Collision Avoidance System And VitalHealth Monitoring

[1]Anu Raj, [2]Alex J Kalathil, [3]Juby P Shibu, [4]Karthik S Nair, [5]Sreeshilpa P Mohanan,

[1]Assistant professor, [2]Student, [3]Student, [4]Student, [5]Student,
[1] Department of Electronics and communication engineering,
[1]Saintgits College of engineering
Kottayam, India

Abstract : This Driver and passenger safety are one of the primary tasks of modern automobiles. Among Indian states, Kerala has suffered more traffic accidents in the past 50 years. In Kerala, where more than 4,000 people die each year, road deaths are more than 10 times the number of homicides in the state. Sleep deprived drivers still account for about 40 percent of traffic accidents. The current situation requires an urgent focus on emergency response actions across all sectors. Astonishing traffic accident statistics and the growing number of vehicles on the road require intelligent safety mechanisms to help drivers deal with immediate hazardous situations such as potential rear-end collisions. Fatigue and lack of sleep while driving are often responsible for serious accidents. But you can spot early signs of exhaustion before anything serious happens. We offer this system to overcome situations such as rear-end collisions and to detect driver drowsiness. In this way, it is a system that minimizes the causes of damage caused by causes that we encounter in our daily lives. The main goal of this project is to reduce the number of accidents in our country. This system uses an ultrasonic sensor to avoid a collision with a vehicle behind by using the distance to the vehicle in front. If the leading car applies the sudden brake or applies gentle braking, the following car driver is automatically alerted and the speed of the car is automatically reduced using CAN protocol thus preventing the collision. Driver's poor health is one of the core factors causing vehicle accidents. It monitors the driver's health status in real time and uses machine learning methods to calculate the eye closing and blink rate to determine the driver's health status. It also monitors the driver's heart rate, and if the heart rate exceeds a lower or upper threshold, the system automatically slows the vehicle, illuminates all warning lights in the vehicle, and sends an emergency call to the nearest medical facility. Way. By combining these two ideas together, our system will be able to reduce the number of traffic accidents in our country.

IndexTerms **-CAN protocol; Fatigue; Rear-end collision.**

I.INTRODUCTION

As per a report submitted by the National Institute of Disaster Management, in India every 80 seconds, there is a road accident that is 1080 accidents per day. Human errors amount to 93 percent of all accidents and according to police, rear-end collisions constitute 30 percent of all fatal accidents. The Insurance Institute for Highway Safety (IIHS) considers collision avoidance systems so important to safety that they have added it to their testing and safety evaluations. They have determined that these systems can prevent many car crashes resulting in serious injuries and fatalities. Collision avoidance safety systems rely on several cameras, lasers, sensors, short and long-range radar to monitor things that are going on around a vehicle. To get the driver's attention, the computer may issue alerts or warnings such as flashing dashboard light, a series of beeps, a tug on the driver's seatbelt, or a vibration in the steering wheel. More advanced systems will activate the braking system if the driver doesn't respond. Alarming statistics of accidents and the increased number of vehicles on the road demand an intelligent safety mechanism that helps the driver in handling immediate precarious situations like the sudden probability of a collision. The other reasons for crashes are human error while applying the break, the stimulus must be fast as light. Here the signal is being transmitted and processed at a very high speed. The next disadvantage of the existing system was the need for human intervention every time while applying the breaks. Here we use an automated braking system that curbs this disadvantage. Fatigue and microsleep at the wheel are often the cause of serious accidents. However, the initial signs of fatigue can be detected before a critical situation arises. We propose this system to overcome this situation such as rear-end collisions between cars and also monitor the health condition of the driver. So this system will minimize the cause of damage due to reasons we were facing in our day-to-day life.

II.OBJECTIVES

The main aim of our project is to reduce the number of road accidents. In recent years our state as well as our country is losing productive youths in road accidents. In 2019 itself 4000 accidents were reported only in the state of Kerala in which majority are youths. Main reason which causes this is over speeding, improper application of brakes, microsleep and fatigue of the driver. So, by implementing our project we can first automatically reduce the speed of the vehicle with respect to the position of the preceding vehicle and automatically apply the break. With our system we will be able to curb this issue by installing pulse sensors in the steering wheel. The pulse sensor would detect any abnormalities in the heart rate and if the heart rate goes above or below the prescribed normal value, the speed of the vehicle gets reduced slowly turning on all the warning lights. Our system also sends an emergency alert to nearest health or ambulance service along with driver vitals.

III.LITERATURE SURVEY

CAN protocol based embedded systems to avoid rear end collision.This proposed system consists of two microcontrollers.The warning system measures the deceleration due to braking using an interfaced accelerometer and evaluate the threshold level of deceleration. The system then displays the level of deceleration using an array of LED and transmit the level of deceleration corresponding to sudden brake to the collision avoidance system to generate necessary control action.The Android application connected to the microcontroller via a Bluetooth module. If the driver has activated the application, it constantly monitors the system. This system is designed to solve the problem where drivers may not be able to manually brake exactly when required, but the vehicle can still automatically stop by sensing obstacles to avoid an accident. When the system receives data from forward-facing sensors, a collision avoidance system performs calculations to determine if obstacles are present.Accident Prevention System using Driver Drowsiness Detection.Record the driver’s heart rate for 2 min and take the average of all values as the threshold. If there is a deviation from the value, the system turns on the camera and determines the driver’s drowsiness. If the driver is drowsy, a buzzer notifies you. It transmits the location of the vehicle, the driver’s heart rate, and the level of drowsiness to the cloud and stores the information in the form of an online black box. Collision warning system using CAN protocol.Here LIDAR sensors are used to detect the imminent crash.The objective of the project is to avoid collision by sensing the fore vehicle coming through radar and immediately stopping the vehicle by applying brake pads.The hardware used in this project are LIDAR, CAN transceiver, relay, and LCD which are integrated with software and algorithms to calculate any potential obstructions present.

IV. METHODOLOGY

To detect driver fatigue, the system employs machine learning techniques. It measures the eye closure rate, eye blink rate, and heartbeat of the driver at regular intervals for fatigue detection. The CEW dataset is utilized to train the machine learning model, which is created and trained using Python programming.Using the trained model, the system can predict and identify abnormalities in the driver's behavior indicative of fatigue. When such abnormalities are detected, the system takes immediate action to ensure safety. It automatically reduces the vehicle's speed, activates all warning lights within the vehicle, and initiates an emergency call to the nearest medical facility or relevant authorities.The machine learning model plays a crucial role in accurately identifying signs of fatigue by analyzing the measured parameters. By continuously monitoring the driver's eye closure rate, eye blink rate, and heartbeat, the system can detect patterns or deviations that indicate potential drowsiness or fatigue. Python programming is utilized for the creation and training of the machine learning model due to its extensive libraries and tools available for data analysis and model development. Python provides a flexible and efficient environment for implementing the necessary algorithms and techniques required for training the model. Initial step is to preprocess the data from the sensors and use it for the subsequent steps.After that reading of the data is being done. Local Histogram Equalization is done for improving the contrast in image .It accomplishes this by effectively spreading out the most frequent intensity values, i.e. stretching out the intensity range of the image. This method usually increases the global contrast of images when its usable data is represented by close contrast values. This allows for areas of lower local contrast to gain a higher A color histogram of an image represents the number of pixels in each type of color component. Histogram equalization cannot be applied separately to the Red, Green and Blue components of the image as it leads to dramatic changes in the image’s color balance.

Model Creation:Adding Convolution Convolutional layers are the major building blocks used in convolutional neural networks.
A convolution is the simple application of a filter to an input that results in an activation. Repeated application of the same filter to an input results in a map of activations called a feature map, indicating the locations and strength of a detected feature in an input, such as an image. The max pool layer is similar to convolution layer, but instead of doing convolution operation, we are selecting the max values in the receptive fields of the input, saving the indices and then producing a summarized output volume. Dense Layer is simple layer of neurons in which each neuron receives input from all the neurons of previous layer, thus called as dense. Dense Layer is used to classify image based on output from convolutional layers.Based on the 2000 images, a model was created and that model was used to predict whether the driver is sleepy or not. The biggest limitation was the processing of large amounts of data, which requires boards with high computing power. We use raspberry pi 4 model .Here, haar-cascade algorithm is used for face detection. The number of blinks is counted and then the machine predicts whether the driver is sleepy or not. The loaded machine learning model serves as a powerful tool for real-time prediction of driver fatigue. It processes the incoming data from the measured parameters and determines if the driver’s state is abnormal or indicative of fatigue. When fatigue is detected, the system takes immediate preventive measures to ensure the safety of the driver and other road users. These measures include slowing down the vehicle’s speed, activating warning lights within the vehicle to alert the driver, and promptly notifying nearby medical facilities or emergency services. By taking proactive action in response to driver fatigue, the system aims to prevent accidents and mitigate potential risks associated with drowsy driving.

4.1 Block Diagram

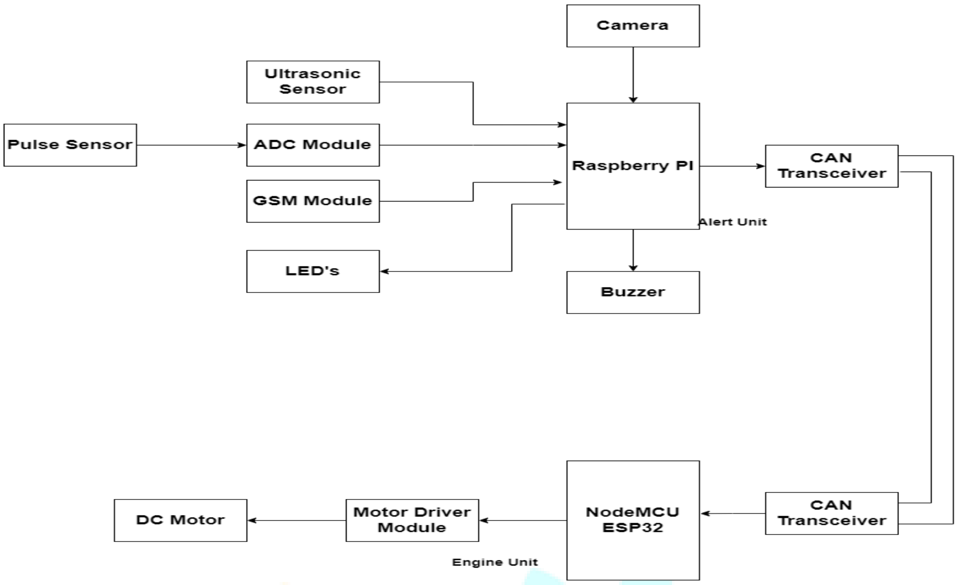

Fig 4.1.Block diagram of proposed system

The system consists of two modules. First one is Alert Unit and second one is Engine Unit. The Alert unit consisting of Raspberry PI, GSM module, ADC module, pulse sensor, ultrasonic sensor, led's, buzzer and CAN transceiver module. The primary role of the alerting system to identify the drowsiness of the driver, find the distance of the leading car. If the alert system detect either drowsiness or distance of the leading car is below the threshold value, it will send a signal to engine unit for reducing the speed of the engine. The system continuously monitors the pulse rate of driver, if the pulse rate is exceeding or lowering the threshold value an emergency call is made by the system using GSM module. Buzzer and Led's are used for alerting driver if the system detects fatigue. The engine unit consists of NodeMCU ESP32, motor driver module and DC motor. The alert system sent alert signal to engine unit when the detection is happened, the alert signal is sent from alert unit to engine unit by using CAN protocol. If the alert signal is received by the engine unit, it will reduce the speed of the car.

4.2 Circuit Diagram

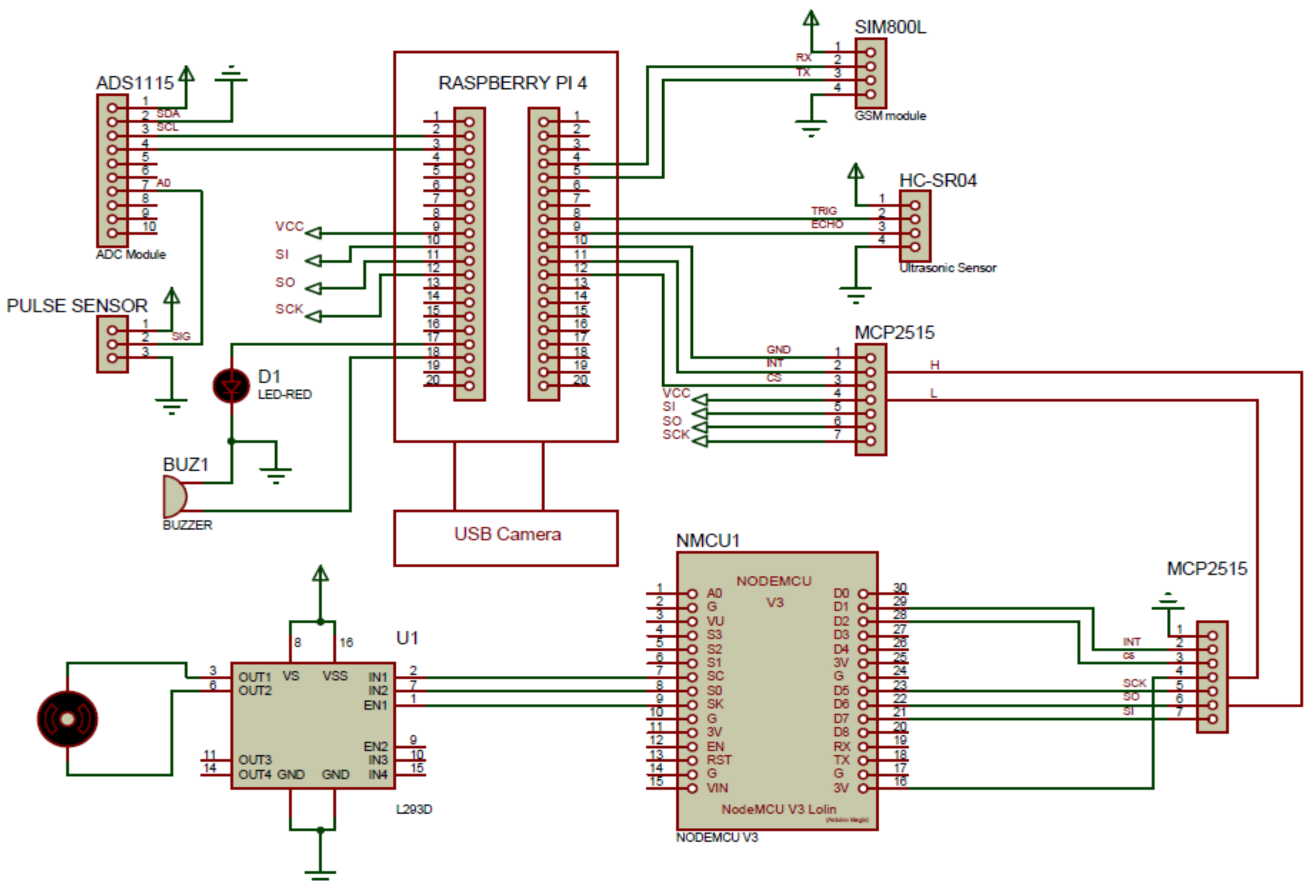

Fig 4.2 Circuit Diagram of the Proposed system

The Raspberry Pi serves as the central host controller in this setup. It is equipped with a camera port to which the Pi camera is connected. The camera enables capturing images and videos. To establish communication with a GSM module, the Tx (transmit) pin of the module is connected to the Rx (receive) pin of the Raspberry Pi, specifically GPIO 15. This allows the Raspberry Pi to send and receive data to and from the GSM module.For distance sensing, an ultrasonic sensor is utilized. The Trigger pin of the ultrasonic sensor is connected to GPIO 22 of the Raspberry Pi, while the Echo pin is connected to GPIO 23. By controlling the timing of the signal sent from the Trigger pin and measuring the time it takes for the signal to return to the Echo pin, the Raspberry Pi can calculate the distance.

To interface with an ADS1115 analog-to-digital converter, the Raspberry Pi employs the I2C communication protocol. The ADS1115 is connected to GPIO 2 (SDA) and GPIO 5 (SCL) of the Raspberry Pi. This setup allows the Raspberry Pi to convert analog signals from the connected devices, such as the Pulse sensor's signal, into digital values for processing.
Additionally, an LED and a buzzer are connected to GPIO 13 and GPIO 19 of the Raspberry Pi, respectively. These components can be controlled by the Raspberry Pi to provide visual or audible notifications or indications.
The MCP2515 module, which facilitates communication using the CAN (Controller Area Network) protocol, is connected to the SPI (Serial Peripheral Interface) pins of the Raspberry Pi. The specific pins used are GPIO 10, GPIO 9, GPIO 11, GPIO 25, and GPIO 8. These connections enable the Raspberry Pi to communicate with other devices or modules using the CAN bus.

In parallel, the MCP2515 module is also connected to the SPI pins of the NodeMCU, a microcontroller board. The corresponding pins used on the NodeMCU are D7, D6, D5, D1, and D2. This setup allows the NodeMCU to communicate with the MCP2515 module and participate in the CAN network. To control a DC motor, a motor driver module is employed. The IN1, IN2, and EN pins of the motor driver module are connected to pin numbers 7, 8, and 9 of the Raspberry Pi, respectively. The OUT1 and OUT2 pins of the motor driver module are then connected to the DC motor. This configuration enables the Raspberry Pi to control the direction and speed of the motor using the motor driver module.In summary, the Raspberry Pi acts as the central controller in a system that incorporates various components such as a camera, GSM module, ultrasonic sensor, ADS1115, Pulse sensor, LED, buzzer, MCP2515 module, NodeMCU, and a motor driver module. It facilitates communication, data acquisition, and control between these devices to achieve the desired functionalities of the system.

V. RESULTS

The first output of the system is obtained from the ultrasonic sensor, which measures the distance between the vehicle and any obstacles in front of it. If the measured distance is less than 50 cm, indicating a potential collision, the system activates an LED buzzer to provide an audible alarm to the driver. Simultaneously, the system triggers an automatic speed reduction mechanism, ensuring that the vehicle slows down to mitigate the risk of an accident. The real-time variations in the steering and pedal inputs are continuously monitored and displayed on a device within the vehicle.

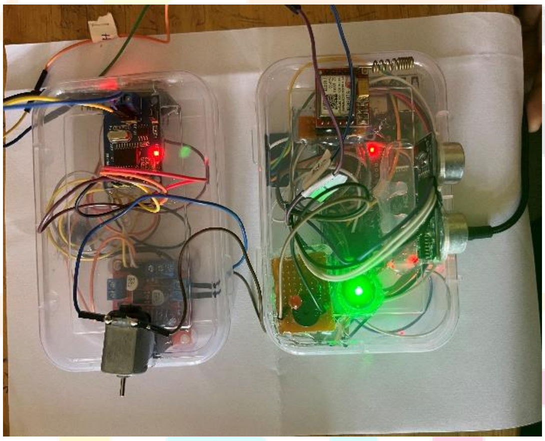

Fig 5.1 Experimental Setup

Additionally, the model incorporated into the system is specifically trained to detect signs of driver drowsiness. By tracking the number of eye blinks, the model can make predictions about the driver's alertness level. The system calculates the sleep cycle based on these blink counts. After every 20 seconds, if the number of blinks exceeds 4, the value displayed on the device changes to '1', indicating that the driver may be experiencing drowsiness. This information is also shown on the screen, alerting the driver to their potential fatigue.

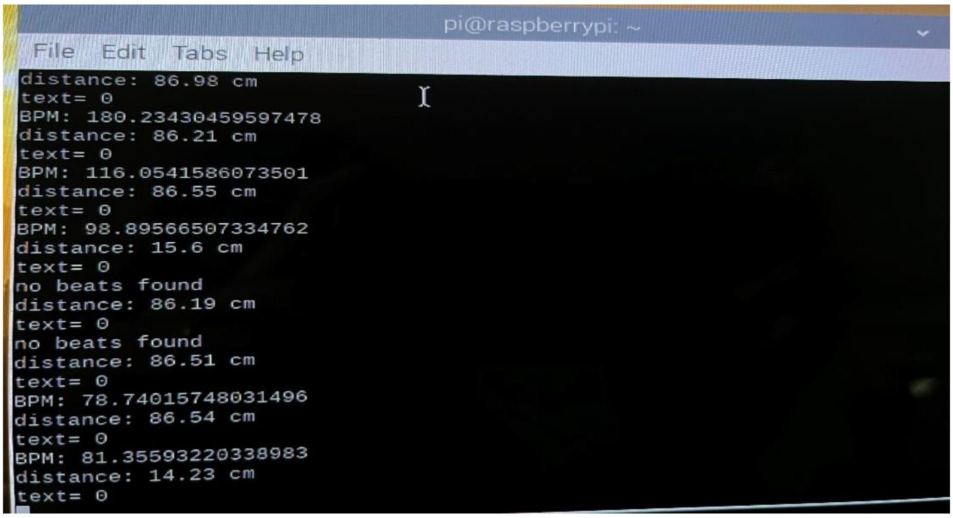

Fig 5.2 Measured values

Moreover, the system accounts for drivers with underlying health conditions. If it detects a health problem or anomaly in the driver's vital signs, such as an irregular heartbeat or a sudden drop in blood pressure, it immediately sends an emergency notification to a designated contact for prompt assistance. In the event that the displayed value changes to '1' due to drowsiness, the system triggers an automatic reduction in the vehicle's speed to ensure additional safety measures are taken, such as preventing sudden accidents caused by driver fatigue.Overall, this integrated system employs various sensors, predictive models, and automated mechanisms to enhance driver safety. By alerting drivers to potential dangers, monitoring signs of drowsiness, and taking proactive measures to reduce speed, it aims to minimize the risk of accidents and promote safer driving conditions.

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