Smart IoT System for Monitoring and Detecting Vehicle Accidents with Advanced Security Measures

[1] **K. Sundar Srinivas,** Assistant Professor, Department of ECE, PSCMR College of Engineering and Technology Vijayawada, A.P, India, Email id:- kss@pscmr.ac.in
[2] **B.V.N.S. Ajay Babu**, Department of ECE, PSCMR College of Engineering and Technology Vijayawada, A.P, India, Email id:- bandaajaybabu9@gmail.com
[3] **CH. Harika**, Department of ECE, PSCMR College of Engineering and Technology Vijayawada, A.P, India, Email id:- chatrathi.harika@gmail.com
[4] **D. Santhi Vardhan**, Department of ECE, PSCMR College of Engineering and Technology Vijayawada, A.P, India, Email id:- dande.santhivardhan1@gmail.com
[5] **V. Rohit**, Department of ECE, PSCMR College of Engineering and Technology Vijayawada, A.P, India, Email id:- Vasarohit4127@gmail.com

Abstract
Developing an IOT-based smart vehicle accident detection and monitoring system with high security is the main goal of the project with that name. The technology is supposed to offer the driver and passengers of the vehicle security and safety, as well as accident detection. The information system will be activated in the event of an accident by sending a message and location information to the appropriate authorities, such as the closest hospitals and police stations. Three modules comprise this system: one for information transmission, one for accident detection, and one for enabling security. the crash sensor is a component of the accident detection module, which is used to identify auto accidents. GPS and GSM technology are used in the information-transmitting module. The security enabling module has sensing components that use fire detection, drowsiness detection, and an alcohol sensor to determine if the driver is intoxicated or not.

Keywords: Raspberry-pi, Alcohol sensor, GPS, GSM, Crash sensor, Flame sensor, LCD, Pi Camera, Motor.

1 Introduction

The Rapid growth of technology and infrastructure has made our lives easier. The advent of technology has also increased traffic hazards and road accidents take place frequently which causes huge loss of life and property because of the poor emergency facilities. Our project will provide an optimum solution to this drawback. According to this project when a vehicle meets with an accident immediately Vibration sensor will detect the signal or if a car rolls over, and vibration sensor will detect the signal and sends it to the RASPBERRY PI controller. Alcohol detection and eye blinking are performed by the RASPBERRY PI Microcontroller send, it alerts mail through the IOT to the parents or a rescue team. So, the person can immediately then after conforming to the location necessary action will be taken. If the person meets with a small accident or if there is no serious threat to anyone`s life, then the alert message can be terminated by the driver by a switch provided in order to avoid wasting the valuable time of the medical rescue team. This paper is useful in detecting the accident precisely by means of both vibration sensors and Alcohol detection, an eye blink sensor. As there is a scope for improvement and as a future implementation we can add a wireless webcam for capturing the images which will help in providing driver`s assistance.

The development of dynamic transport systems due to technological advancements has significantly impacted society and individuals' lives, despite its countless advantages, negative consequences such as vehicle accidents, pollution, and traffic congestion have emerged. Road accidents, in particular, have become one of the most dangerous situations in densely populated areas and can cause severe injuries or even death. Apart from the physical and emotional toll on individuals, accidents can also result in severe automobile damage, making the restoration process complicated and expensive. Driving while intoxicated or fatigued and overloading the vehicle with passengers or cargo are some of the leading causes of accidents. To address these issues and reduce accidents, the "Distinguish Features for IoT-based Smart Vehicle Accident Detection and Monitoring System with

High Security" project aims to utilize cutting-edge technology to improve the smart vehicle system's safety features. When a person sits in the driver's seat, the system checks for specific parameters such as alcohol consumption using an alcohol sensor and drowsiness using an eye sensor. In the event of an accident, the crash sensor sends information to the GSM module, which can alert authorities and provide the accident location using GPS. The system also includes flame sensors to detect engine heating problems and prevent fires when driving for extended periods. By reducing the risks of accidents and loss of life, the smart system has the potential to significantly improve transportation safety and promote a better quality of life for individuals.

2 Literature Survey

The proposed driver fatigue detection module basically consists of two phases, one being the face detection phase and the second one being the eye detection phase. The classifier used in this paper is the haar cascade algorithm [4] which is derived from the viola-jones algorithm. These are object detection frameworks which perform multiple convolutions and segmentations to classify the objects based on the trained datasets. The OpenCV [4] and haar cascade algorithm are collaboratively used to perform the process of object classification. Haar cascade was chosen as it could process real-time data and could be used to sample live-stream video. The level of latency is very less when the haar cascade algorithm is employed in object detection and classification framework. Compared with the old techniques, some also involved using LEDs and multiple cameras to recognize facial expressions [4]. But these methods faced setbacks when the cameras were subjected to variable lighting and running backgrounds. Unlike the present-day algorithms like the haar cascade classifier, which is used for eye localization and tracking, there were also instances where a hough transform was put into action to detect the iris part of the human eyes using bounding circles. Finally, the eye openness estimation process was performed by techniques like the application of spectral regression embedding (SR) on the segmented eye image to learn the model of the eye shape. Then this process was followed by fusion immediately where two eye detectors (CV-ED and I2R-ED) were applied and a pair of detection windows was created by each detector. OpenCV was again used at the end to carry on the estimation process in order to locate and track the human eyes. The Haar cascade classifier was chosen over other CNN (Convolutional neural network) techniques due to its speed and performance. It offers high-speed computation depending on the number of pixels inside the rectangle feature and not depending on each pixel value of the image unlike where histograms were used. The earlier techniques for alcohol content detection were mainly based on the analysis of driver effects like acceleration of the vehicle, lane maintenance, over-speed, intoxication due to drinks, rapid closing of eyes and much more. These were just physical measurements combined with electronic elements to form networking systems in which one such prototype was named VANET (Vehicle ad hoc Networks). These employed Dedicated Short-Range Communication (DSRC) which permitted to vehicles to communicate with each other or with roadside equipment. VANET ultimately proved to be a complex system when compared with the simple eye-detection mechanism which was deterministic in nature. Speaking of sensor networks, there was one prototype which performed alcohol content detection using water-cluster detecting (WCD) [8] breath sensors. It carried out the processes based on the concepts of polarization of charges. The WCD sensor senses the exhaled breadth by measuring the electric currents of water clusters which are either positively charged or negatively charged and separated by an electric field. The WCD sensor is coupled with the alcohol sensor to form the WCD-alcohol sensor which detects electric currents from alcohol content in the breadth. In addition to this, the WCD sensors also have a proximity range of 0.5 m which is the approximate distance between the driver and the steering wheel or dashboard. But the issue with the WCD sensor is that it’s extremely susceptible to external dust and comprises its performance, unlike our MQ3 gas sensors. The final input extraction part dealing with the vehicle crash detection mechanism also had many precursors which involved electronic components like sensors and even smartphones. One such prototype was designed and implemented using OBD-II (Onboard diagnostics) devices and Android-based smartphones. The OBD interface was used to detect vehicular or automobile collisions. The application end was the smartphone in this case. The software was programmed in the Android platform [9]. The gravitational force experienced by the driver and the passengers is measured due to a frontal collision is used to detect collisions. Thus immediately, the airbags are released to save the driver’s and the passengers’ life. This android-based application also measures the fuel level, RPM (Revolutions per minute), engine temperature, and speed in order to monitor the overall stability of the automobile. This system proved to be inefficient as there have many cases where the airbags have been pressure-locked and didn't open during the collision. Hence, we need to rely on a system that's more deterministic and trustworthy like our piezoelectric system which is extremely sensitive to external vibrations and can detect real-time collisions and convert the mechanical collision into the equivalent electrical voltage based on the strain sensitivity. This also provides the user with the severity of the vehicular accident that has occurred. With all the inputs being extracted, it was now left to the Raspberry Pi 3 mini-computer and the SIM800c microcontroller to carry out the rest of the process which is the IoT end system. The Internet of things being an advanced technology holds the key to the future. This technology in collaboration with several others has created wonders. One such compatible friend is the class of smart devices like mobile phones and tablets. Cloud computing and networking assist the Internet of things as IoT connects the end devices with a cloud-based server. Queries are generated whenever there is a change in the default value. Concepts like these help us to maintain the database of drivers who either drive properly or tend to lose vigilance during the course of the journey.

3 Existing System

The current smart vehicle management system will prompt us to reduce traffic accidents. There are three major elements in this prototype of the smart vehicle management system. Firstly, there is a drowsiness detector, which will identify the drowsiness of the driver throughout driving time. Secondly, an alcohol detector will trace if there is any presence of alcohol on the body of that particular driver. Lastly, there is an overload detector, which will show if the vehicle is overloaded, or not. drowsiness detection systems include the usage of devices that detect the respiration rate, heart rate, blood pressure, etc. These devices can cause the driver to be uncomfortable driving. Cannot be assured that the drivers wear these devices all the time while driving. May get lost or improper functioning which may lead to low accuracy in the result. The existing system does not produce good results in low-light conditions. If the light conditions are dark or too low it is unable to detect the face and eyes of the driver which results in loweraccuracy.

4 Methodology

Our primary objective of the system, whenever a person sits in the driver seat of the vehicle, the system checks for the following parameters with the driver. The Alcohol sensor, it checks if the person has consumed alcohol or not. The eye sensor makes sure that the person in the driver's seat does not fall asleep. In case of any accident, the crash sensor increases beyond the limit, and information is sent to the GSM module. The GSM can send messages to respective authorities and also send accident spot places help of a GPS system. When driving for an extended amount of time, engine heating problems can arise. As sparks start to fly from the engine, flame sensors are used to aid identify fire and release the gas to stop the fire. Thus, this system ensures life security. The smart system will be highlighted since it has the potential to reduce accidents shortly future. With the right assistance from this system, we hope to reduce the risks of losing a life.

5 Block Diagram

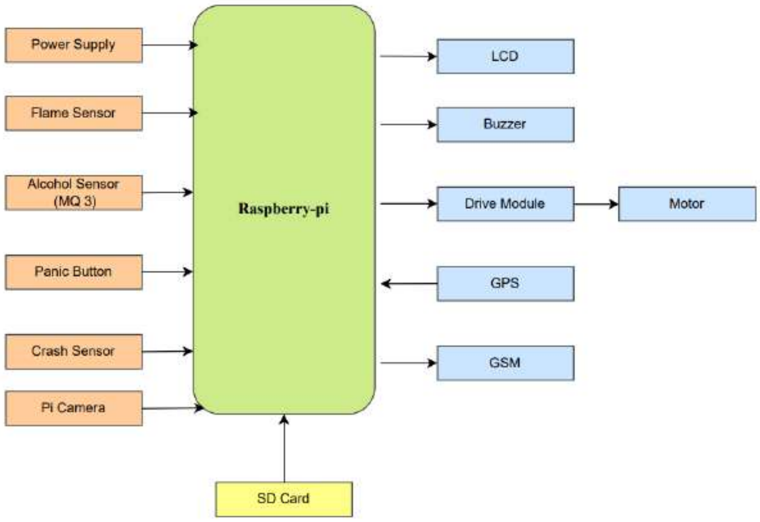

Figure 1: Block Diagram

One microcontroller is utilized to do the entire task, as shown by the block diagram. The Raspberry Pi's single microcontroller is connected to the power source. The primary function of the raspberry pi in our project is to monitor the driver's blinking eyes and facial movements. Raspberry Pi's Python software performs this procedure. The flame, crash, and alcohol sensors are all connected to the Raspberry Pi. The Raspberry Pi also has connections for the buzzer, LCD screen, GSM module, and GPS module required to finish the task. A signal is transmitted to the raspberry pi after keeping track of facial expressions and eye blink rates in case an accident occurs utilizing the crash sensor. This will activate the buzzer and send a message of alert via the GSM and GPS module to the control room or appropriate authority. In the case of an alcohol detector, the buzzer will begin to beep when the amount of alcohol present in the body exceeds the threshold level. The engine will begin to slow down after these activities. With the exception of placing a flame sensor to detect fire, the technique for detecting fire will be quite similar to detecting alcohol. On the LCD display, the entire activity will be shown a notification. In case of any issues, hitting the panic button will send an alert message to the control room or appropriate authority.

7 Hardware Implementation

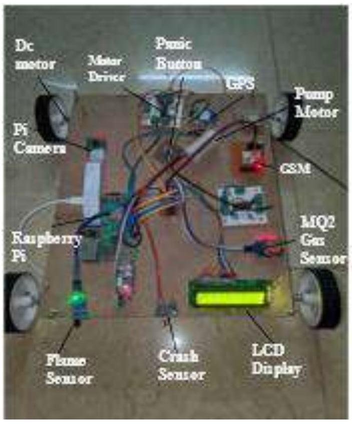

Figure 3: Completed structure of the project

Results

The first part of the process involves the gadget determining whether or not the motorist is intoxicated. If the answer is yes, the car won't start, and the raspberry pi receives the signal. It displays the outcome on the screen and turns on the buzzer to emit an audible signal. If the driver is not alcoholic, vehicle acceleration will remain the same.

 ISSN: 0972-2750
Vol-13 Issue-03 No.05: 2023

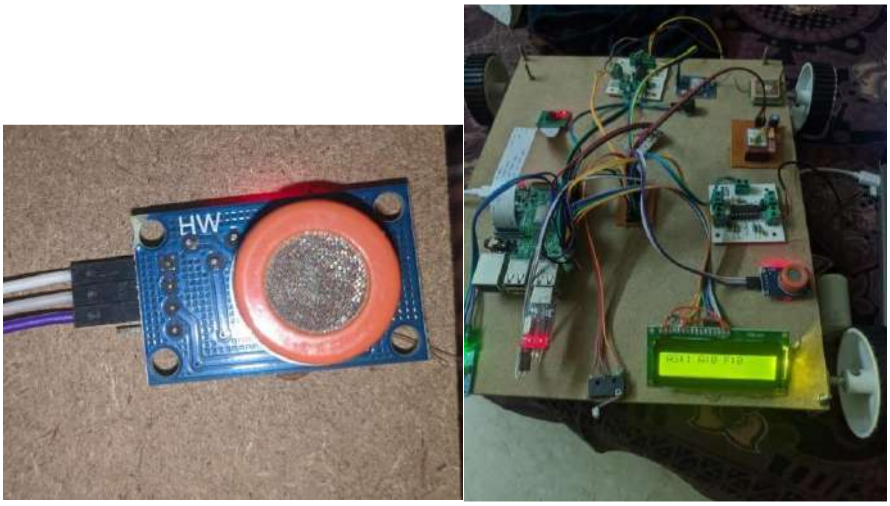

Figure 4: Detecting alcohol using the MQ3 sensor

The second section of the flow diagram involves checking for fires that may have broken out on engines as a result of prolonged, hard-driving that causes engine heating problems. When a fire starts, a flame sensor detects it and activates a buzzer to release gas to put it out.

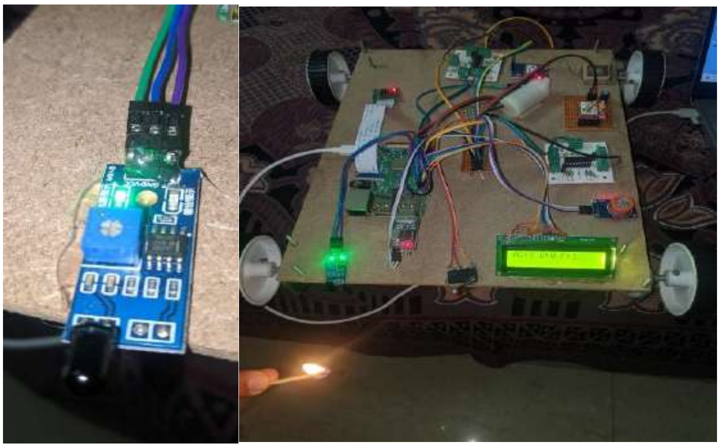

Figure 5: Detecting fire using the Flame sensor

This third section shows the Raspberry Pi camera, which is used to monitor the eyes of the person seated in front of it. The subject in front of the camera appears sleepy.

Figure 6: Running pi camera

This is the output for the face detection module. The input to this module is a continuous stream of video and the output will be face detection within rectangular bounds. The face is detected by using the haar cascade algorithm. It uses haar features through which the face is detected in a rectangular frame. The detection of the face is achieved through the Haar classifiers mainly, the **Frontal face**

ISSN: 0972-2750
Vol-13 Issue-03 No.05: 2023

cascade classifier. The face is detected in a rectangle format and converted to a grayscale imageand stored in the memory which can be used for training the model.

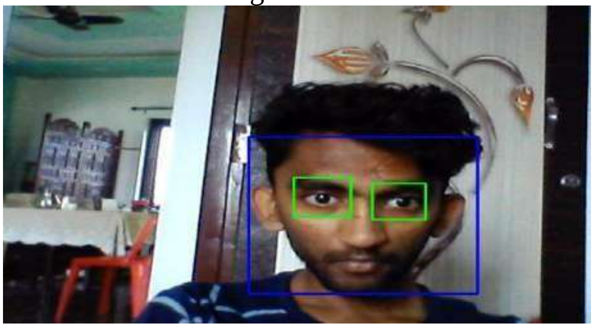

Figure 7: Scanning face values

This is output for eye detection. The system detects eyes in the given particular frame in rectangular frames. The algorithm used for detecting the eyes is haar cascade. It uses haar features which are used for detecting the eyes inrectangular frames.

Figure 8: Detecting Drowsiness

This is the output for drowsiness detection. If the driver seems to be detected as drowsy then it will give an alert. The alert will be in the formof message "YOU ARE SLEEPY.PLEASE TAKE A BREAK" and also in form of sound. The aim is to make the driver wake with that sound. The drowsiness is detected by using parclo's algorithm. The algo calculates the distance between two eyelids and if it found a distance less than a threshold value then it raises thealarm.

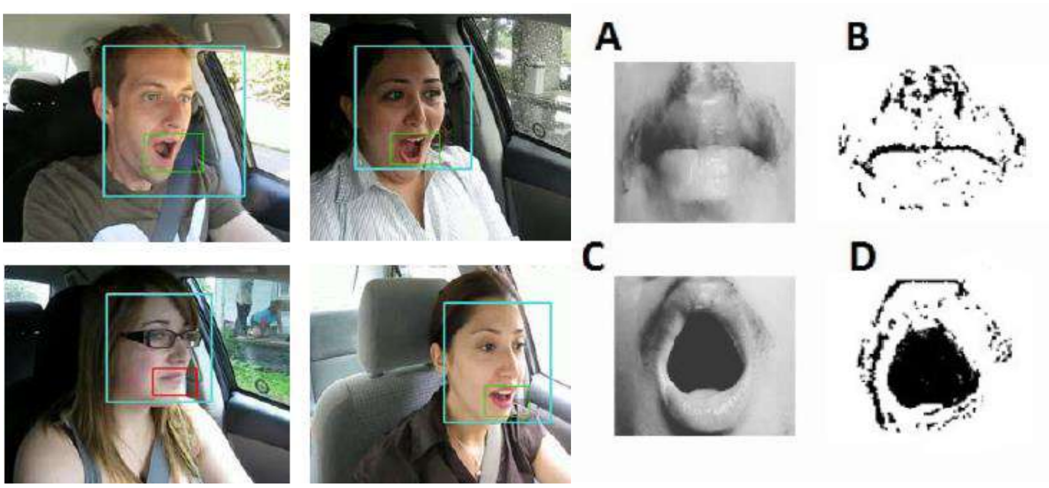

Figure 9: Yawning detecting

This is the output for yawning detection. If the driver seems to be detected as yawning then it will give an alert. The alert will be in the formof the message as "YOU ARE YAWNING PLEASE TAKE A BREAK" and also in form of sound. The aim is to make the driver wake with that sound. The algo calculates the distance between two eyelids and if it found a distance less than a threshold value then it raises thealarm.

The final component of the system If a moving vehicle is involved in an accident, the crash sensor connected to the microcontroller will sense the vibration and alert the controller, and press the panic button Under our system, if a driver has a medical emergency due to cardiac problems, pressing the panic button will send a message of alert to the control centre or the relevant authority.

Figure 10: Accident detection using the Crash sensor

The function identified the accident and drowsiness system and delivered the information as the output with an alarm through the SIM900 GSM Module to the control room. In this procedure, tiredness has been recognized to snap the images and also provide the actual location using a GPS module. Once an accident or sleepiness is detected, send a snapshot to Gmail of the particular contact within the vehicle's state.

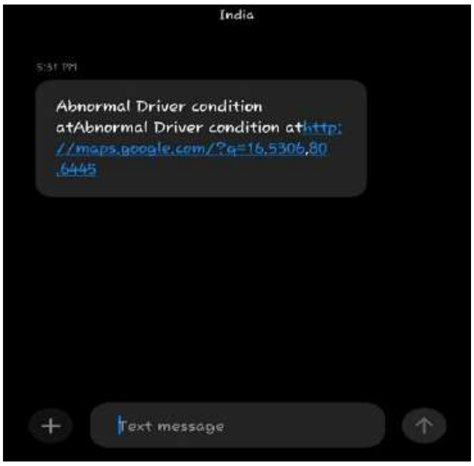

Figure 11: Location of the vehicle sent to a specified contact

Conclusion

This study has successfully addressed several critical issues such as alcohol consumption, fire hazards, driver fatigue, accident detection, and information transmission in road transportation. As a result, the implementation of this system is likely to lead to a reduction in accidents, ultimately saving human lives. Moreover, this approach is both effective and cost-efficient. The experiments conducted in this study have shown that the system is easy to deploy in real time. However, it is possible to improve the system by incorporating automation concepts such as driverless cars and inter-vehicular communication. Although this project has limitations, it is hoped that future research with the help of qualified sponsors can further enhance the product's potential to help society.

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