

Auto Car Safety System with Air Bag and SMS Notification

Prof. P. A. Khade^{*1}, Yash Bomble^{*2}, Kaustubh Patil^{*3}, Dnyaneshwari Kade^{*4}

^{*2,3,4}, Student, Zeal College of Engineering and Research Narhe, Pune, India.

^{*1} Faculty of Zeal College of Engineering and Research Narhe, Pune, India

ABSTRACT

The number of automobiles has also grown quickly to meet the enormous population. Additionally, this resulted in an increase in accidents. The accident prevention strategies now in use are all static and dated. Additionally, there is no reliable accident detection system. Timely medical aid can help in saving lives. Drive Sentinel is an advanced vehicle safety and monitoring system aimed at reducing road accidents and improving driver accountability. The system integrates driver drowsiness detection, real-time GPS tracking, and GSM-based communication to create a comprehensive in-vehicle safety solution. Using computer vision and embedded sensors, Drive Sentinel monitors the driver's eye movements and facial cues to detect signs of fatigue or inattention. Upon detection of drowsiness or a potential accident, the system triggers immediate visual and audio alerts to wake the driver and simultaneously sends an SMS with the vehicle's GPS location to registered emergency contacts using a GSM module. The hardware implementation involves a Raspberry Pi or microcontroller, camera module, GPS receiver, GSM modem, and buzzer, all working in coordination to ensure real-time monitoring and response. The use of machine learning for face and eye detection enhances accuracy in identifying driver fatigue. This system can be particularly beneficial for long-haul drivers, public transport operators, and fleet management companies. By combining embedded systems, IoT, and artificial intelligence, Drive Sentinel contributes to building safer roads and reducing the number of accidents caused by human error.

Keywords- *Drive Drowsiness Detection, Accident Prevention, Vehicle Safety System, GPS Tracking, GSM Alert System, Real-Time Monitoring, Image Processing, IoT in Transportation*

INTRODUCTION

In recent years, road safety has become a critical concern, with a significant number of accidents being caused due to driver fatigue, inattention, and delayed emergency response. To address this issue, Drive Sentinel has been developed as a comprehensive solution that not only monitors the driver's alertness but also ensures immediate communication during accidents. The system is particularly useful in scenarios where early signs of fatigue go unnoticed or when timely help is crucial after a crash. Drive Sentinel is an intelligent

monitoring and alert system that continuously evaluates the driver's state and the vehicle's condition using a combination of computer vision and sensor-based technologies. The system is equipped with a camera module focused on the driver's face, analysing facial landmarks to calculate the Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR). These ratios help in identifying symptoms of drowsiness and yawning, which are common precursors to microsleep and loss of attention while driving. When the system detects that the EAR drops below a certain threshold or the MAR indicates repeated yawning, it promptly triggers an alert signal (e.g., buzzer or voice alert) to wake the driver and prevent potential mishaps. In addition to monitoring the driver's facial behavior, the system integrates tilt sensors to assess the vehicle's angular position. Any abnormal tilt may suggest instability, a sharp turn, or even the risk of a rollover. Simultaneously, dash-mounted sensors are employed to detect sudden impacts or collisions. These sensors play a key role in accident detection, especially in cases where the driver might be unconscious or unable to call for help. Upon detecting a crash, Drive Sentinel activates its emergency alert system, which automatically sends SMS alerts or notifications to a predefined list of contacts. This list typically includes the driver's family members, nearby hospitals, and local police stations. The alerts contain essential information such as the vehicle's location (via GPS) and the nature of the emergency, enabling faster response and assistance. Overall, Drive Sentinel combines real-time facial monitoring, vehicle orientation sensing, and automatic accident alerting to create a safer driving environment. It aims to prevent accidents before they happen and ensure that help reaches quickly when they do making it an effective solution for improving road safety and emergency response.

RELATED WORK

Md. Ebrahim Shaik in the ELSEVIER journal study titled "A Systematic Review on Detection and Prediction of Driver Drowsiness" explores various types of measurements used by researchers to detect driver drowsiness. These measurements were categorized into four main types: physiological, vehicle-based, subjective, and behavioural. The study highlights the key challenges associated with each category and emphasizes the technological advancements made to improve detection accuracy. The article extensively reviews existing drowsiness detection systems and presents an insightful analysis of their ability to identify fatigue in real-time driving conditions. This study forms a strong theoretical base by addressing not only current solutions but also the potential future directions in the

field. The focus on forecasting driver drowsiness before it leads to accidents underlines the importance of predictive over reactive approaches in automotive safety systems. [1]

Dina Salem and Mohamed Waleed, in their 2024 Journal of Engineering and Applied Science paper titled “Drowsiness Detection in Real-Time via Convolutional Neural Networks and Transfer Learning,” present an advanced approach to detecting driver fatigue. Their system relies heavily on deep learning techniques, specifically convolutional neural networks (CNN), enhanced through transfer learning. This combination allowed them to efficiently utilize existing models and datasets while adapting them to the drowsiness detection problem. The authors reported excellent accuracy rates, between 90% to 99.86%, in both multi-class and binary classification tasks. The paper also emphasizes the importance of dataset integration for improving model generalization and robustness. Their contribution is significant in demonstrating the viability of deep learning in real world drowsiness detection applications, setting a benchmark for future systems. [2].

Safarov, F.; Akhmedov, F.; Abdusalomov, A.B.; Nasimov, R.; and Cho, Y.I., in their article “Real-Time Deep Learning-Based Drowsiness Detection: Leveraging Computer-Vision and Eye Blink Analyses for Enhanced Road Safety,” utilized custom datasets to train a real-time drowsiness 12 detection model. Their system capitalized on the analysis of eye blinks, employing computer vision techniques alongside deep learning. The experimental results showed a 95.8% accuracy rate for detecting drowsy eyes and 97% for open-eye detection. These metrics illustrate the reliability of their approach under varying conditions and among different individuals. By integrating real-time image processing with neural networks, their work effectively demonstrates how eye-based metrics can be leveraged to develop high-performance drowsiness detection systems. [3]

Shih-Nan Lu, Hsien-Wei Tseng, Yang-Han Lee, Yih-Guang Jan, and Wei-Chen Lee, in their paper titled “Intelligent Safety Warning and Alert System for Car Driving” (published on ResearchGate), proposed a comprehensive alert system designed to prevent vehicle accidents. Their system continuously records vehicle movement data, enabling proactive responses before an accident occurs. It also functions as a black box, providing valuable data for post-accident investigation. Their approach demonstrates the usefulness of a multi-functional safety system that not only alerts the driver but also maintains a historical record for accountability and analysis. This dual-purpose functionality strengthens road safety protocols and enables advanced analytics for accident reconstruction. [4].

Dr. C. K. Gomathy, K. Rohan, Bandi Mani Kiran Reddy, and Dr. V. Geetha, in their May 2022 ResearchGate paper “Accident Detection and Alert System,” developed a mobile-based application leveraging smartphone sensors like the accelerometer and GPS. Their Sensor Fusion Based

Algorithm efficiently detects sudden disturbances such as collisions. Upon such detection, an alert is generated and sent to the user, who has a 10-second window to cancel it. If no response is received, the system automatically dispatches an emergency alert with the vehicle's real-time location. Their contribution illustrates how existing smartphone technologies can be effectively utilized for accident detection and emergency communication, eliminating the need for additional hardware and lowering costs. [5]

Mr. S. Kailasam, Mr. Karthiga, Dr. Kartheeban, R. M. Priyadarshani, and K. Anithadevi, in their IEEE journal article “Accident Alert System Using Face Recognition,” addressed the major causes of road accidents such as lack of attention, drowsiness, and intoxication. Their proposed system uses a Night Vision Camera for facial monitoring and implements automatic braking and 13 steering control through Python-based programming. This integration of facial recognition and vehicle control shows a proactive approach to accident prevention. The real-time facial analysis coupled with vehicle intervention significantly enhances the system's ability to reduce accident rates caused by impaired driver behaviour. The project demonstrates the possibility of combining vision-based AI with vehicle automation for safety enhancement.[6]

Tafadzwa Petros Chikaka and Omowunmi Mary Longe, in their IEEE article “An Automatic Vehicle Accident Detection and Rescue System,” introduced a highly responsive safety mechanism that leverages accelerometers to detect unusual vehicle movement such as tilting and crashing. The system then uses GPS to pinpoint the accident location and sends this data to emergency contacts and services. Their design showed improved turnaround times in emergency response compared to conventional systems. This paper provides a vital insight into how integration between motion sensing and geolocation can facilitate faster, more accurate emergency interventions, potentially saving lives in critical situations.[7]

Swapnil Titare, Shubham Chinchghare, and K. N. Hande, in their publication in the International Journal of Scientific Research in Computer Science, Engineering and Information Technology titled “Driver Drowsiness Detection and Alert System,” developed a user-interface based solution for real-time monitoring of driver alertness. Their work utilizes technologies like Eye Aspect Ratio (EAR), Dlib, facial feature extraction, and machine learning models to detect signs of fatigue. Implemented in Python, the system processes live video to analyse the driver's eye and facial movements. Their approach is particularly beneficial due to its low cost and ease of implementation on embedded platforms like Raspberry Pi, making it suitable for both commercial and personal vehicle applications. [8]

BLOCK DIAGRAM OF SYSTEM

Fig.1 shows a Block diagram of an existing system by using Raspberry Pi and GSM and GPS Module. The main controlling operation is carried out in given system is Raspberry Pi which is interfaced with different input and

output components which is briefly explained in the following ways,

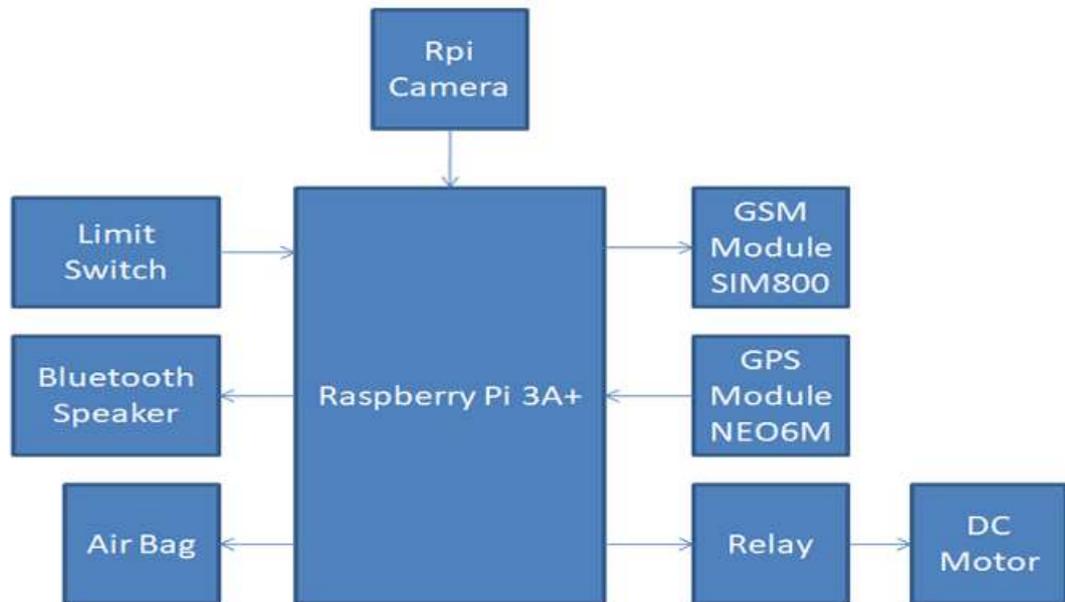


Figure 1: Block Diagram Of System

This block diagram represents a smart safety and monitoring system designed using Raspberry Pi 3A+ as the main control unit. The Raspberry Pi acts as the central processing hub, receiving inputs from different modules and controlling connected devices. The system integrates components such as a Raspberry Pi camera, GSM module, GPS module, Bluetooth speaker, limit switch, airbag mechanism, relay module, and DC motor to perform monitoring, communication, and safety operations.

The Raspberry Pi camera captures images or videos for real-time monitoring. The limit switch detects sudden movements or physical changes and sends signals to the Raspberry Pi for processing. A Bluetooth speaker is used to provide audio alerts or warning messages to notify the driver or nearby individuals during emergencies.

The airbag mechanism acts as a safety feature and is activated when the system detects a critical situation.

The GSM module (SIM800) enables wireless communication and sends SMS alerts to predefined contacts, while the GPS module (NEO-6M) provides real-time location information that can be shared during emergencies

A relay module acts as an interface between the Raspberry Pi and the DC motor, allowing the system to control higher-power devices safely. When triggered, the motor performs mechanical actions as required.

Overall, the system combines sensing, communication, and safety features to provide an automated monitoring and emergency response system, capable of capturing images, sending location alerts, and activating safety mechanisms when needed.

FLOW CHART OF SYSTEM

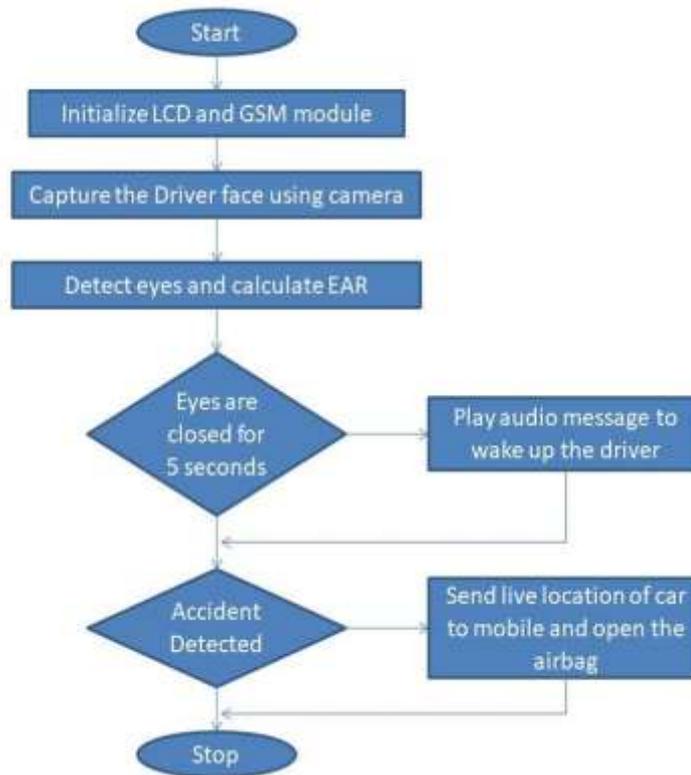


Figure 2: Flow chart of the system

This flowchart illustrates the working process of the proposed driver monitoring and accident detection system. The system begins with the initialization of the hardware components and continuously monitors the driver's condition using a camera-based detection mechanism.

The process starts by initializing the LCD display and GSM module. The LCD is used to display system status and alerts, while the GSM module enables communication by sending messages or notifications during emergency situations. Once these components are initialized, the system proceeds to activate the camera for monitoring the driver.

Next, the camera captures the driver's face in real time. The captured video frames are processed by the system to detect the driver's facial features, particularly the eyes. This step allows the system to continuously observe the driver's eye movements and determine their level of alertness.

After capturing the image, the system detects the driver's eyes and calculates the Eye Aspect Ratio (EAR). The EAR is a commonly used parameter in computer vision to determine whether the eyes are open or closed. By analysing the EAR

values from consecutive frames, the system can detect signs of drowsiness or fatigue in the driver.

The system then checks whether the driver's eyes remain closed for more than 5 seconds. If this condition is detected, it indicates that the driver may be drowsy or falling asleep. In such a case, the system immediately plays an audio warning message through a speaker to alert the driver and help them wake up or regain attention while driving. After the alert, the system continues monitoring the driver. If a severe condition occurs and an accident is detected, the system activates emergency procedures. The Raspberry Pi processes the event and sends the live location of the vehicle to a registered mobile number using the GSM and GPS modules. At the same time, the system activates the airbag mechanism to provide additional safety for the driver.

Finally, after executing the emergency response actions, the system completes the process and reaches the stop stage. Overall, the flowchart demonstrates how the system continuously monitors the driver's alertness, provides warning alerts in case of drowsiness, and automatically sends emergency notifications along with safety activation in case of an accident.

HARDWARE RESULT

Figure 3: Hardware Result System [1]

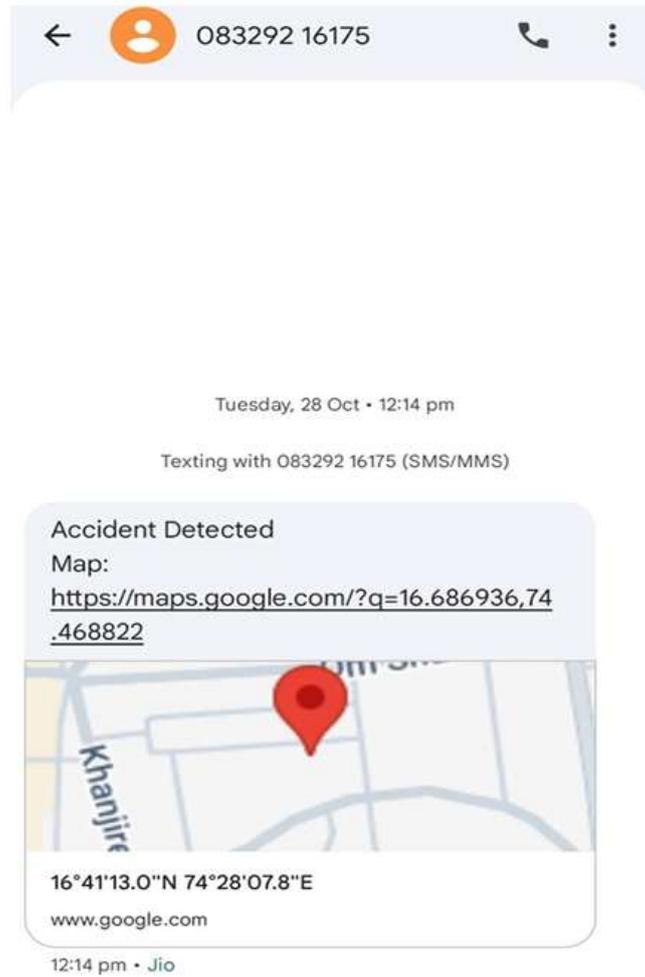


Fig. 3 shows the camera output of the Drive Sentinel system as it monitors facial expressions.

Figure 4: Hardware Result System [2]



Fig. 4 shows the SMS notification of Dash Detection and location co-ordinates.



Figure 5: Hardware Result System [3]

Fig. 5 shows that the system was fully designed, developed, and tested to generate real-time outputs by detecting driver drowsiness using a camera module.

CONCLUSION

In conclusion, this Project System represents a significant advancement in road safety technology, combining proactive and reactive measures to protect drivers and reduce accident-related fatalities. By continuously monitoring driver alertness and issuing real-time alerts when signs of fatigue are detected, the system actively works to prevent accidents caused by drowsiness, a common and dangerous risk factor on the road. Its accident detection capabilities further enhance safety by ensuring that emergency responders are notified immediately following a collision, even when the driver is unresponsive. The integration of GPS and real-time communication with emergency contacts provides a swift response, which is critical for minimizing the severity of injuries and improving survival outcomes. This system also benefits family members by offering peace of mind, knowing that their loved ones are being monitored for safety. Overall, the Driver Drowsiness and Accident Alert System is a comprehensive safety solution that addresses both driver fatigue and accident response, making it an invaluable tool for enhancing personal and public road safety. Through its dual approach of accident prevention and rapid emergency alerting, this system holds great potential to reduce the rate of road accidents and improve outcomes in critical situations, contributing to safer journeys for all.

REFERENCE

1. Md. Ebrahim Shaik, "A systematic review on detection and prediction of driver drowsiness", ELSEVIER, Transportation Research Interdisciplinary Perspectives, Sept 2023.
2. Dina Salem and Mohamed Waleed, "Drowsiness detection in real-time via convolutional neural networks and

transfer learning", Journal of Engineering and Applied Science (2024)

3. Safarov, F.; Akhmedov, F.; Abdusalomov, A.B.; Nasimov, R.; Cho, Y.I. Real-Time Deep Learning-Based Drowsiness Detection: Leveraging Computer-Vision and Eye-Blink Analyses for Enhanced Road Safety. *Sensors* 2023, 23, 6459.
4. Dr. C. K. Gomathy, K Rohan, Bandi Mani Kiran Reddy, Dr. V Geetha, "Accident Detection and Alert System", Research Gate, May 2022.
5. Mr. S. Kailasam, Mr. Karthiga, Dr Kartheeban, R. M. Priyadarshani, K. Anithadevi, "Accident Alert System using face Recognition", IEEE, 2019
6. Swapnil Titare, Shubham Chinchghare, K. N. Hande, "Driver Drowsiness Detection and Alert System", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN: 2456-3307, Volume 7, Issue 3, pp.583-588, May- June-2021.
7. F. Majeed, U. Shafique, M. Safran, S. Alfarhood and I. Ashraf (2023) Detection of drowsiness among drivers using novel deep convolutional neural network model, 26
8. G. S. M. Diyasa, A. H. Putra, M. R. M. Ariefwan, P. A. Atnanda, F. Trianggaraeni and I. Y. Purbasari Feature extraction for face recognition using Haar Cascade Classifier, International Seminar of Research, 2022