IoT Enabled Accident Prevention

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Abstract. Modern technology is developed with the goal of protecting human life and making it convenient. Accidents on Indian roadways frequently result in fatalities because of abrupt braking, tired drivers, and speeding. An Internet of Things (IoT) solution that makes use of ultrasonic sensors and an Arduino microcontroller has been developed to address these issues. This prototype model assures driver attentiveness to prevent accidents, recognizes possible collision hazards, and informs drivers to maintain safe distances and speeds. The system also uses camera-based detection to detect driver drowsiness, alerting the user if their eyes are closed for a lengthy amount of time. This integrated method efficiently prevents accidents and improves road safety by combining video detection with IoT technologies.

Keywords: Driver drowsiness detection, Internet of Things, Embedded Systems, Arduino, Sensors, accident prevention.

1 Introduction

India's road accident statistics are frightening, according to recent data, which has prompted government action to lower the death toll. The transportation agency is addressing issue by correcting road design defects and putting in place a standard operating procedure. Even while hit-and-run instances are serious, over speeding and driver fatigue are two more causes that lead to accidents. A prototype model is created using Arduino and sensors to warn drivers, reducing accidents by guaranteeing attention and keeping a safe distance.

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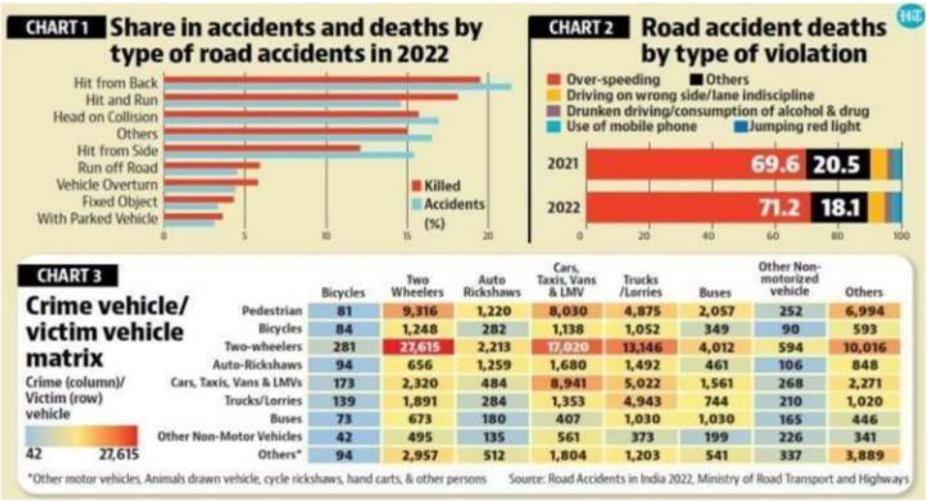


Fig. 1. Surveillance and Data on accidents in recent years

1.1 Embedded systems

An embedded system is a computational device, such a mobile phone, VCD player, or air conditioner, that performs a single, specialized task. Different from general-purpose computers like desktops or laptops, these systems feature fixed software.

Embedded System Architecture Overview: Custom-built hardware with a Central Processing Unit (CPU) at its core and memory chips with firmware are what make up embedded systems. The operating system, application software, and hardware are all layered in the architecture, with the number of levels changing according to how complicated the application is.

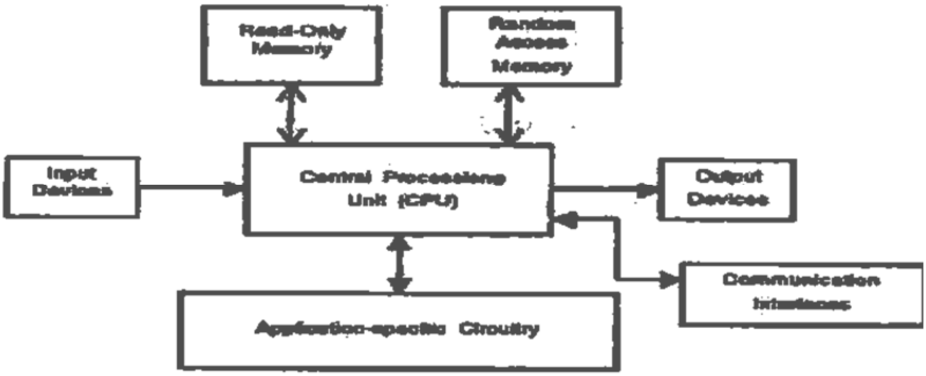


Fig. 2. Building Blocks of embedded system

Embedded System Building Blocks: The central processing unit (CPU), memory, input and output devices, communication interfaces, and circuitry tailored to a particular application are essential elements of embedded systems. Each of these components enhances the performance and functionality.
How Does Internet of Things (IoT) Work: IoT enables data interchange without the need for human intervention by connecting commonplace things to the internet. For improved performance and control, it makes use of artificial intelligence, analytics, and sophisticated automation
Features of IoT: Sensing devices are what allow IoT to actively interact with other connected technologies and identify changes in the environment. Ensuring smooth operation and preventing faults is crucial for the success of the system through effective endpoint management.
Characteristics of IoT: IoT devices use sporadic connectivity, need little power, and promote general technological progress. IoT has advantages, but it also has drawbacks, including system complexity, privacy issues, and security threats.

The technique which has been proposed and popular in recent years and also differed from the traditional image steganography known as coverless image steganography [8]. In this technique the confidential information can be mapped in to the carrier itself based on its characteristics. The communication can be possible secretly by transmitting stego images without alterations.

2 Problem Statement

The project's primary goals are to address the serious risks to road safety and human life that arise from inattentive driving, speeding, and sudden object collisions. The goal of the project is to create an advanced driver assistance system that incorporates the capabilities of a frontal face detector from Dlib's library that has been trained using a non-intrusive machine-based method. The system's goal is to identify indicators of driver fatigue, speeding, and unexpected object hazards by combining sensor data with real-time video streams from a webcam or camera. By utilizing advanced algorithms and predictive analytics, the system will promptly notify and caution the driver, enabling proactive action to avert collisions and lessen their aftermath. The project aims to improve safety by combining various safety features into a single platform. Abbreviations and Acronyms

3 Existing Methodology

The current system calculates the driver's level of weariness using various methods such as eye or facial movements, deep learning, electrocardiography (ECG), electroencephalography (EEG), or electrooculogram (EOG), as well as vehicle steering movement.

To track a driver's level of drowsiness, different deep learning algorithms are used for face and eye detection.

In order to warn drowsy drivers, the EEG technique analyzes the driver's level of sleepiness using a brain indicator signal, a camera, and sensors that are activated through the use of machine learning.

Using EEG sensors, a technique for measuring sleepiness using the Heart Rate Variability (HRV) signal is obtained.

An Arduino controller board is embedded with a K Nearest Neighbors (KNN) classifier to enhance the percentage of eye movement detected by an invasive technique for measuring eye movement using the EOG technique to build a fatigue alert system.

Demerits of existing system: The primary drawbacks of the current system are as follows: In order to measure physiological parameters, such as heart rate and muscle activity, body sensors are necessary, which may cause discomfort for the driver.

The design of the road, the kind of vehicle, and the driving ability all have a significant impact on the use of vehicle-based measurements like steering movement and lane monitoring systems. Results from these measurements may be unclear if the driver is not very skilled.

4 Proposed methodology

Component Integration: Start by physically attaching the eye blink sensor, motor, buzzer, and ultrasonic sensor to the central microcontroller unit (possibly an Arduino or a comparable device). This will connect all of the system's components. For the components to communicate with each other seamlessly, make sure the connections are sturdy and correctly interfaced.

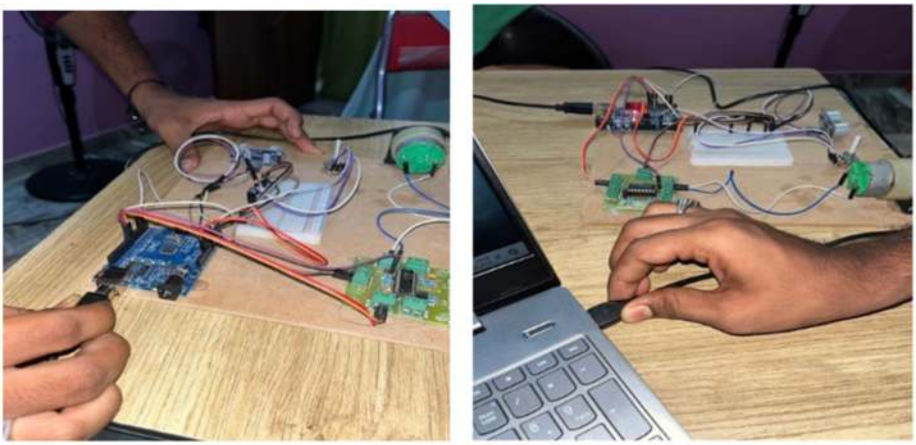


Fig. 3. Integrating the components

Functionality of Eye Blink Sensor : The eye blink sensor is an essential part of identifying indicators of driver fatigue. The sensor can detect instances of prolonged eye closures, which could be a sign of fatigue or drowsiness, by continuously tracking the driver's eye blinking patterns. To distinguish between typical blinking and possible indicators of sleepiness, set up particular parameters or thresholds.

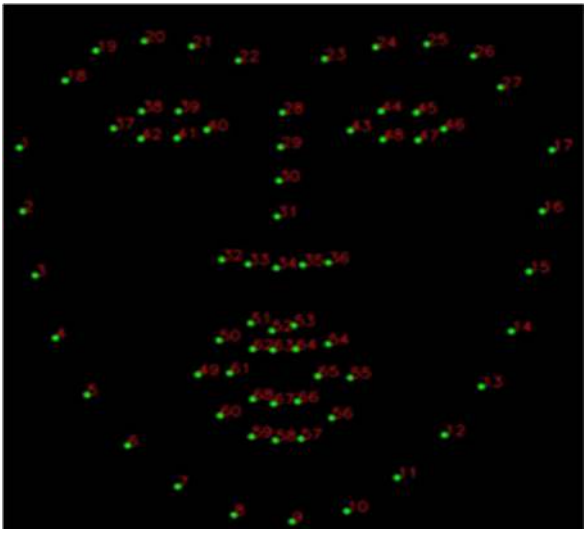


Fig. 4. Facial recognition using eyeblink sensor

Motor Speed Control: Based on inputs from the ultrasonic sensor, a DC motor's speed can be adjusted via a potentiometer that is managed by the microcontroller. By generating sound waves and timing the return of echoes, the ultrasonic sensor determines the distances to objects in the vicinity. The system can dynamically modify the vehicle's speed to keep a safe distance from objects or other vehicles by integrating this sensor data with the microcontroller.

Accident Prevention Algorithm: Construct a complex microcontroller algorithm that analyzes data from the ultrasonic sensor in real time. This algorithm looks at distance measurements to see if the car is moving too fast toward another car or an obstruction. Establish precise cutoff points or requirements for initiating braking changes in order to avert possible crashes.

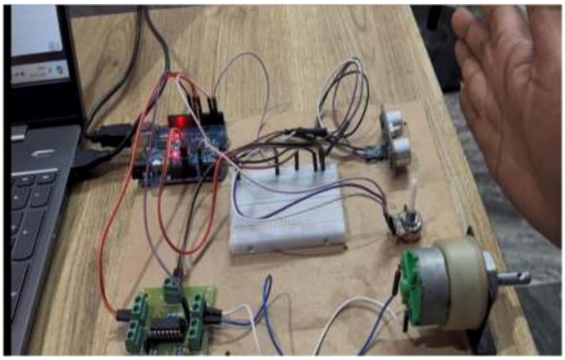
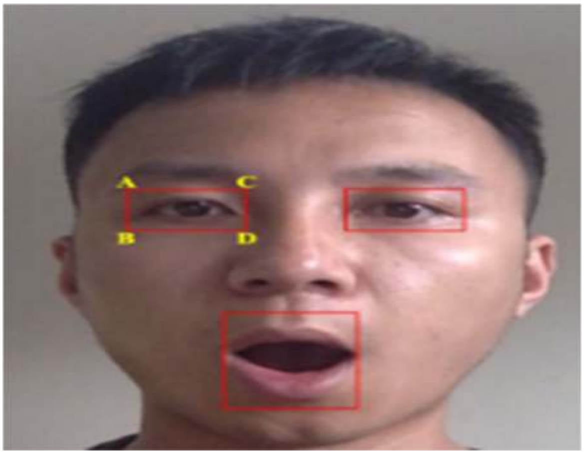
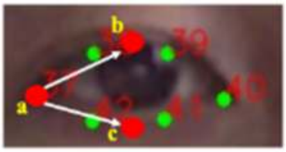


Fig. 5. Working of ultrasonic sensor

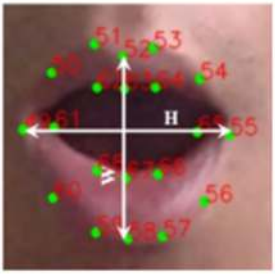
Continuous monitoring: Install a proactive accident prevention system that keeps an eye on the area around the car at all times. The system attempts to avert accidents before they happen by continuously evaluating distance measurements and modifying motor speed in real-time. Put feedback mechanisms in place to guarantee the system's efficacy and responsiveness under various driving circumstances.

Algorithm for sleep and yawn detection: Utilize a pre-trained frontal face detector from Dlib's library, It is based on a modification of the Histogram of Oriented Gradients and uses Linear SVM for classification. The location of 68 (x, y)-coordinates that correspond to facial structures on the face are estimated by the pre-trained facial landmark detector. The system determines whether eyes are open or closed by calculating the aspect ratio, which allows it to distinguish between normal blinks and sleepy blinks.A drowsy blink is characterized by a longer duration compared to a regular blink, typically lasting 800-900 milliseconds





(a) The angle of eye opening.



(b) The width and height of the mouth.

Implementation and Testing: Assemble the system's parts on a wooden board and breadboard, making sure the power supply and connections are stable. Evaluate the system's performance in a variety of scenarios, such as over speeding, unexpected object detection, and drowsy driving. Carry out thorough testing to confirm its reliability and effectiveness in preventing accidents.

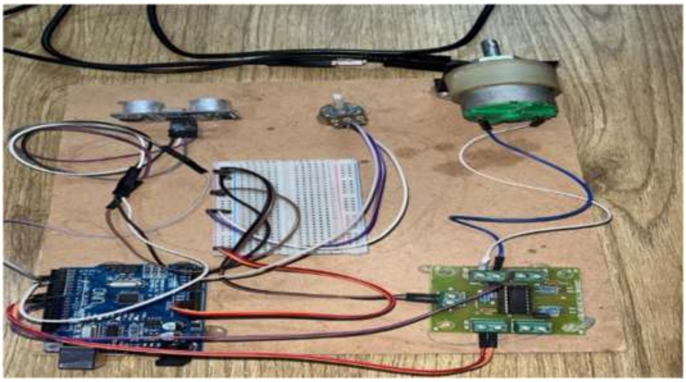


Fig. 6. Kit connection

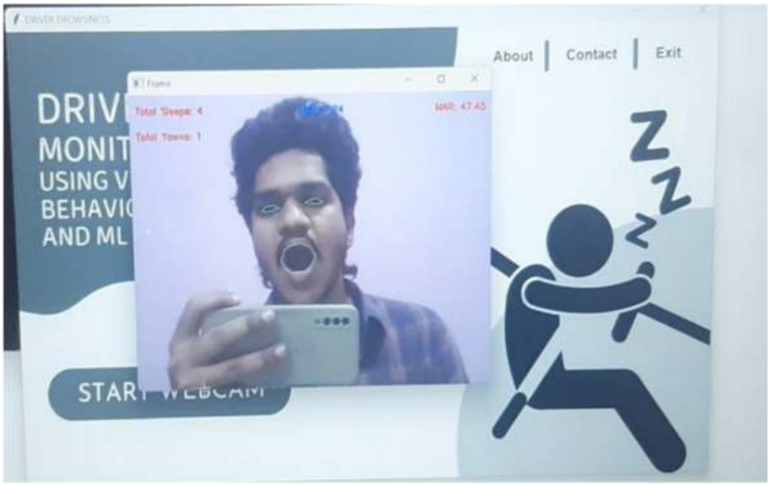


Fig. 7. Sleep and Yawn detection

5 Conclusion

Accident prevention alerts using IoT (Internet of Things) projects can significantly reduce car accidents due to several reasons IoT devices can continuously monitor various parameters such as vehicle speed, proximity to other vehicles, driver behaviour (like sudden braking or acceleration), and road conditions. Real-time monitoring allows for immediate detection of potential hazards or dangerous situations. By understanding these patterns, preventive measures can be implemented proactively to mitigate risks.

This embedded system can prevent the accident to occur, and proper preventive measures are taken in this system road safety. leading to a reduction in car accidents and improved road safety for all.

6 Future Scope

Drowsiness alert systems could play a major role in the future by drastically lowering the number of accidents brought on by fatigued drivers. These systems are anticipated to develop further and become more widely used in the future. They will probably incorporate more sensors and machine learning algorithms to increase their precision and reliability. In order to increase safety and prevent accidents brought on by sleepy operators, these systems can also be integrated into other forms of transportation, such as trains and airplane.

Disclosure of Interests. The authors have no competing interests to declare that are relevant to the content of this article.

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