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SMART DRIVER DROWSINESS AND ALCOHOL DETECTION SYSTEM

[1]Sharanya Puttarju H P, [2]Sanjana S, [3]Divyashree M S, [4]Sanjana K N, [5]Navyashree Y V

[1]Student, [2]Student, [3]Student, [4]Student, [5]Assistant Professor

[1]ECE, [2]ECE, [3]ECE, [4]ECE, [5]ECE

[1]PES College of Engineering, Mandya,India, [2]PES College of Engineering, Mandya,India,
[3]PES College of Engineering, Mandya,India
[4]PES College of Engineering, Mandya,India, [5]PES College of Engineering, Mandya,India

Abstract: The proposed Smart Driver Drowsiness and Alcohol Detection System is designed to improve road safety by continuously monitoring the driver's condition in real time. The system uses a webcam and Eye Aspect Ratio (EAR) technique to detect prolonged eye closure and an MQ-3 sensor to identify alcohol consumption. A multi-stage alert mechanism involving LED indication, buzzer warning, and automatic engine control is implemented to prevent accidents. The integration of Python, OpenCV, dlib, and Arduino provides a low-cost, reliable, and efficient solution for reducing accidents caused by driver fatigue and drunk driving.

***Index Terms* -** Driver Safety Detection System, Drowsiness Detection, Eye Blink Monitoring, Embedded System, Microcontroller, Accident Prevention, Real-Time Monitoring, Vehicle Safety.

I. INTRODUCTION

Driver drowsiness is one of the major causes of road accidents worldwide. Fatigue, lack of sleep, and long driving hours can reduce a driver's reaction time, concentration, and decision-making ability. Drowsy driving often leads to serious accidents, causing injuries, loss of life, and property damage. Therefore, detecting drowsiness at an early stage is essential for ensuring road safety.

Alcohol Consumption and Driving Hazards :Alcohol consumption significantly affects a driver's ability to operate a vehicle safely. It impairs vision, judgment, coordination, and reaction time, increasing the likelihood of accidents. Drunk driving remains a major concern in transportation systems, making alcohol detection an important safety requirement in modern vehicles.

Need for Intelligent Driver Monitoring System: Traditional vehicle safety mechanisms such as seat belts and airbags reduce accident severity but cannot prevent accidents caused by driver fatigue or alcohol consumption. Intelligent driver monitoring systems provide real-time observation of driver behavior and can detect unsafe conditions before an accident occurs. Such systems help improve road safety through early intervention.

Scope and Intended Users: The proposed Driver Drowsiness and Alcohol Detection System is intended for use in personal vehicles, commercial transportation, public transport systems, and fleet management applications. The system can be used by individual drivers, transport companies, and vehicle manufacturers to improve safety and reduce accident risks.

Proposed Driver Drowsiness and Alcohol Detection System: The proposed system integrates camera-based drowsiness detection and MQ-3 sensor-based alcohol detection into a single embedded platform. It continuously monitors the driver's condition, provides visual and audible warnings, and automatically stops the vehicle motor using a relay module when severe drowsiness or alcohol consumption is detected. This integrated approach enhances driver safety and reduces the probability of road accidents.

AbbreviationsandAcronyms

EAR	Eye Aspect Ratio
LED	Light Emitting Diode
MQ-3	Alcohol Gas Sensor Module
LCD	Liquid Crystal Display
USB	Universal Serial Bus
CPU	Central Processing Unit
RAM	Random Access Memory
GPIO	General Purpose Input Output
PWM	Pulse Width Modulation
DC	Direct Current
AC	Alternating Current
IoT	Internet of Things
AI	Artificial Intelligence
ML	Machine Learning
CV	Computer Vision
OpenCV	Open Source Computer Vision Library
GUI	Graphical User Interface
IDE	Integrated Development Environment
UART	Universal Asynchronous Receiver Transmitter
I2C	Inter-Integrated Circuit
SPI	Serial Peripheral Interface
PCB	Printed Circuit Board
GPS	Global Positioning System
GSM	Global System for Mobile Communications
BPM	Blinks Per Minute

FPS	Frames Per Second
ROI	Region of Interest
USB	Universal Serial Bus
OS	Operating System
HTML	HyperText Markup Language
CSS	Cascading Style Sheets
HTTP	HyperText Transfer Protocol
URL	Uniform Resource Locator
JSON	JavaScript Object Notation
SQL	Structured Query Language
ISR	Interrupt Service Routine
ADC	Analog to Digital Converter
MCU	Microcontroller Unit
ECU	Engine Control Unit
HMI	Human Machine Interface
DADS	Driver Alcohol Detection System
DDS	Driver Drowsiness Detection System

RESEARCH METHODOLOGY

The research methodology adopted for the Driver Safety Detection System involves the design, development, and testing of a system capable of monitoring driver alertness in real time. Initially, a detailed study of road accidents caused by driver drowsiness and fatigue was conducted to identify the key factors affecting driver safety.

The proposed system was designed using suitable hardware and software components. A camera or sensor module is used to continuously monitor the driver's facial features, particularly eye movements and blinking patterns. The collected data is processed by a microcontroller or embedded processor to determine the driver's alertness level. Algorithms are implemented to detect signs of drowsiness based on predefined thresholds.

After system development, experimental testing was carried out under different driving conditions. The system's ability to detect eye closure, prolonged blinking, and signs of fatigue was evaluated. Whenever drowsiness was detected, an alert mechanism such as a buzzer or warning signal was activated to notify the driver.

The performance of the system was analyzed by comparing detection accuracy, response time, and reliability. The obtained results were used to validate the effectiveness of the proposed Driver Safety Detection System in reducing the risk of accidents caused by driver fatigue and inattentiveness.

Statistical tools and econometric models

The collected data were analyzed using descriptive statistical tools such as mean, percentage, standard deviation, and graphical representations. These tools helped summarize the data and identify patterns in the performance of the Driver Safety Detection System.

For performance evaluation, measures such as detection accuracy, error rate, precision, recall, and response time were calculated. These statistical indicators were used to assess the reliability and effectiveness of the system under different operating conditions.

Since this study is primarily based on system design and experimental testing rather than economic forecasting, no advanced econometric model was employed. Instead, comparative analysis was used to evaluate the proposed system against existing driver monitoring approaches. The results obtained from the experiments were statistically analyzed to validate the efficiency and accuracy of the developed system.

Descriptive Statistics

Descriptive statistics were used to summarize and analyze the performance data collected from the Driver Safety Detection System. Statistical measures such as mean, percentage, maximum value, minimum value, and standard deviation were calculated to evaluate the system's effectiveness.

The detection accuracy, response time, and alert generation rate were recorded during various test scenarios. These values were presented using tables and graphs to provide a clear understanding of the system's performance. Descriptive statistics helped identify trends, variations, and overall reliability of the proposed system.

The analysis showed that the Driver Safety Detection System was capable of accurately detecting signs of driver drowsiness and providing timely alerts. The statistical results confirmed the effectiveness and consistency of the system under different operating conditions.

IV. RESULTS AND DISCUSSION

Introduction

The Driver Drowsiness and Alcohol Detection System was developed and tested to evaluate its ability to detect driver fatigue and alcohol consumption in real time. The system integrates computer vision techniques, alcohol sensing, warning mechanisms, and automatic motor control to improve road safety. Various test cases were conducted to verify the performance and reliability of the proposed system.

Drowsiness Detection Results

The drowsiness detection module continuously monitored the driver's eye movements using a webcam. Facial landmarks were extracted, and the Eye Aspect Ratio (EAR) was calculated for each video frame.

Observations

- The system successfully detected open and closed eye conditions.
- Normal blinking was correctly identified and did not trigger false alarms.
- Prolonged eye closure resulted in drowsiness detection.
- The EAR value decreased significantly when the driver's eyes remained closed.

Result

The drowsiness detection module accurately identified fatigue conditions and generated alerts whenever the eye closure duration exceeded the predefined threshold.

Alcohol Detection Results

The MQ-3 alcohol sensor was used to detect alcohol concentration levels from the driver's breath.

Observations

- The sensor responded quickly to alcohol vapors.
- Sensor readings increased with alcohol concentration.
- The system accurately compared sensor values with the threshold level.

Result

The alcohol detection module successfully identified alcohol presence and generated warning signals whenever the alcohol concentration exceeded the permissible limit.

Alert System Results

The warning system consisted of LED indicators and a buzzer.

Observations

- The LED was activated during mild drowsiness conditions.
- The buzzer was activated when severe drowsiness was detected.
- The buzzer also activated when alcohol was detected.

Result

The warning system provided immediate visual and audible alerts, enabling the driver to respond to unsafe conditions promptly.

Motor Control Results

A relay module was used to control the motor representing the vehicle engine.

Observations

- Under normal conditions, the motor operated continuously.
- During severe drowsiness detection, the relay disconnected the motor.
- The relay also stopped the motor when alcohol was detected.

Result

The motor control mechanism effectively prevented vehicle operation during unsafe driving conditions.

Integrated System Performance

The complete system was tested by combining drowsiness detection, alcohol sensing, warning generation, and motor control.

Table 1: Test Scenarios and Results

Test Case	Condition	System Response
1	Normal Driving	No Alert, Motor ON
2	Normal Blinking	No Alert, Motor ON
3	Mild Drowsiness	LED ON
4	Severe Drowsiness	LED ON, Buzzer ON, Motor OFF
5	Alcohol Detected	Buzzer ON
6	Drowsiness + Alcohol	LED ON, Buzzer ON, Motor OFF

The "Drowsiness and Alcohol Detection System with Multi-Stage Engine Control" was successfully designed and tested. The system continuously monitored the driver's eye movements using a webcam and detected drowsiness based on eye closure duration. The MQ3 sensor also detected alcohol levels effectively. During testing, the system provided different warning stages such as LED indication and buzzer alerts when unsafe conditions were detected.

If the driver remained drowsy for a longer duration or alcohol was detected above the threshold level, the relay module automatically stopped the motor to improve safety. The project worked in real time and showed proper coordination between software and hardware components. Overall, the system proved to be a simple, low-cost, and effective solution for preventing accidents caused by driver fatigue and alcohol consumption.

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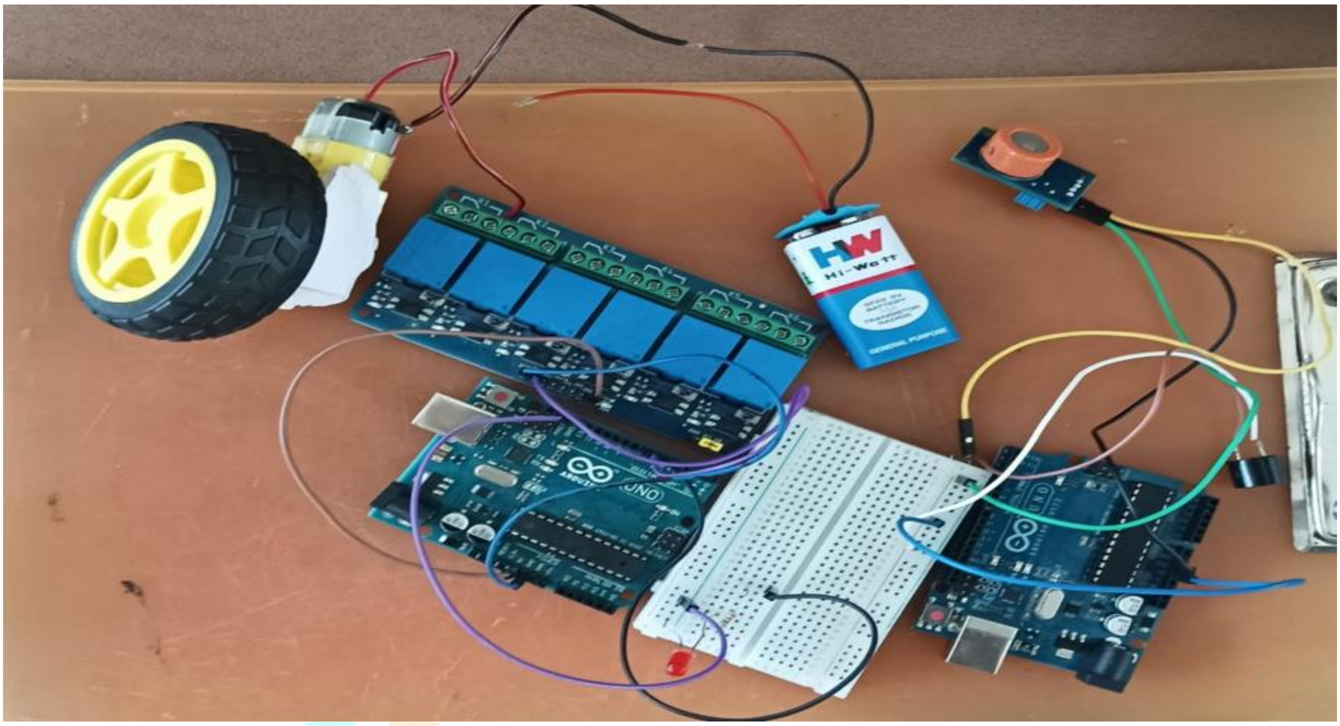

Figure 1: Connnection result

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