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Anti Sleep Alarm for driver and vehicle control, Alcohol detection and Accelerometer sensor using Raspberry Pi

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Abstract - This project proposes a smart driver monitoring and safety system that utilizes Raspberry Pi to detect drowsiness, alcohol consumption, and abnormal vehicle movement. The system incorporates an live camera for identifying signs of fatigue, an MQ-3 alcohol sensor for detecting alcohol presence, and an MPU6050 accelerometer to monitor vehicle motion and detect possible collisions or erratic driving behaviour. The Raspberry Pi functions as the central processing unit, analysing real-time sensor data to ensure the driver's fitness for operating the vehicle. Upon detecting drowsiness or alcohol, the system activates warning alerts and can disable the vehicle ignition or send notifications to concerned authorities or contacts. Additionally, abnormal acceleration patterns or impacts detected by the accelerometer trigger emergency protocols, enhancing passenger safety. The system is designed to be compact, low-cost, and easily adaptable to a wide range of vehicles, aiming to minimize accidents caused by human error and improve road safety.

Key Words: Driver drowsiness, alcohol detection, Raspberry Pi, accelerometer, vehicle safety, real-time monitoring.

1.INTRODUCTION

This article explains a system that helps improve road safety by checking if a driver is feeling sleepy, drunk, or if the vehicle moves suddenly. The system uses a small computer called Raspberry Pi. It connects with sensors like an alcohol sensor, a live camera, and an accelerometer to detect problems while driving. If the system finds any danger, it gives an alert and can stop the vehicle from starting.

2. Body of Paper

1) System Design and Components

The proposed driver monitoring system integrates multiple sensors with a Raspberry Pi to detect signs of drowsiness, alcohol consumption, and sudden vehicle movement. The three main modules are:

- Live Camera Module: This module captures real-time video of the driver's face. Image processing techniques are used to detect drowsiness by monitoring eye closure and facial landmarks.
- Alcohol Sensor (MQ-3): This sensor detects the presence of alcohol in the driver's breath. If alcohol is detected beyond a set threshold, the system takes preventive action.
- Accelerometer (MPU6050): This sensor detects sudden jerks or collisions. If the vehicle undergoes unusual acceleration or tilt, the system records the event or sends a warning signal.

All sensors are interfaced with the Raspberry Pi, which serves as the control unit. Data from the sensors are continuously monitored and processed to make decisions based on predefined thresholds.

2) Hardware and Software Implementation

2.1 Raspberry Pi

The Raspberry Pi 4 Model B is employed due to its compact design and robust processing capabilities. It supports GPIO interfacing and camera module connectivity, making it suitable for embedded vision applications.

2.2 Camera Module and Image Processing

The Raspberry Pi Camera Module v2 is used to capture live video of the driver's face. The system uses OpenCV and D lib libraries in Python to perform facial landmark detection. The key steps include:

- Detecting the face and eyes using a pretrained Haar Cascade or CNN-based model.
- Calculating Eye Aspect Ratio (EAR) to measure the openness of the eyes.
- If the EAR value drops below a threshold (e.g., 0.25) for more than 2 seconds, drowsiness is detected.

2.3 Alcohol and Accelerometer Sensors

- MQ-3 Sensor measures alcohol level using analog output, interfaced via an ADC module.
- MPU6050 uses I2C communication to relay acceleration data to the Raspberry Pi. Any value exceeding ±2g is considered a sudden jerk.

2.4 Software Integration

The system is programmed in Python. OpenCV handles the video stream, while GPIO and I2C libraries manage sensor inputs. The logic includes:

- Image capture and EAR calculation from the live feed.
- Continuous alcohol and motion monitoring.
- Triggering alerts when thresholds are exceeded.
- Optional integration with a relay module to prevent vehicle ignition.

3)Working Methodology

The system follows a continuous loop of sensor and camera data acquisition. The sequence is:

1. Initialize camera and sensors.
2. Start facial landmark detection from the live camera stream.

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3. Calculate Eye Aspect Ratio. If EAR < 0.25 for >2 seconds, trigger drowsiness alert.
4. Measure alcohol level via MQ-3. If above threshold, raise alcohol alert.
5. Monitor accelerometer for sudden spikes; if detected, log or send warning.
6. Trigger buzzer alert and optionally disable ignition.
7. Optionally, send emergency SMS via GSM module.

The decision-making process is shown in the system flowchart in Fig. 1.

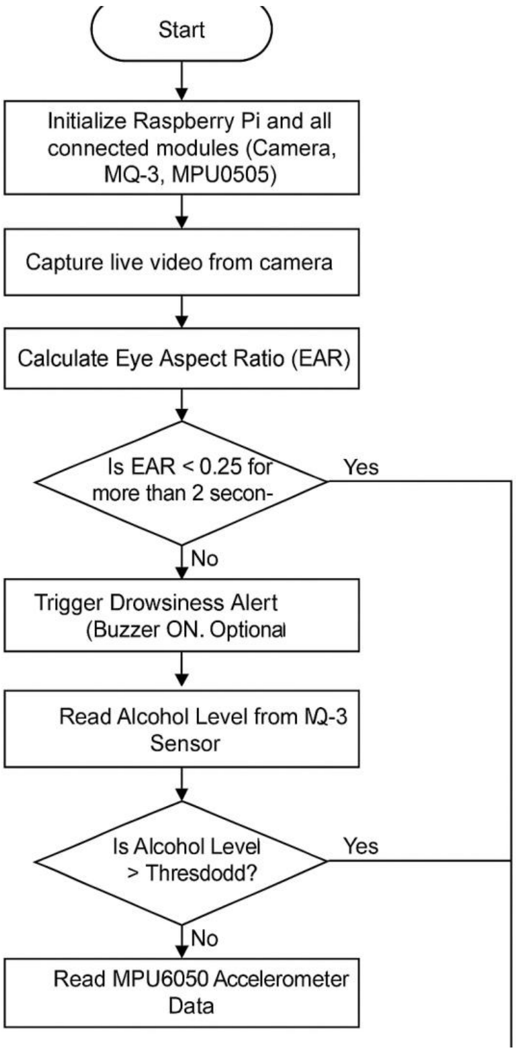


Fig .1. Decision making process

4) Results and Discussion

The system was tested under real conditions with multiple test cases. Table 1 shows sample outcomes.

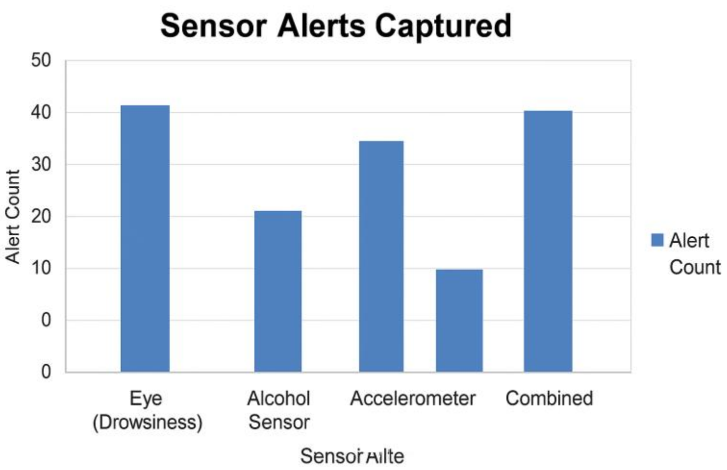
Test Condition	Sensor/Camera Triggered	System Response
Eyes closed for > 2 seconds	Camera EAR detection	Drowsiness alert, buzzer ON
Alcohol detected > 0.4V	MQ-3 sensor	Ignition disabled, warning

Test Condition	Sensor/Camera Triggered	System Response
Sudden tilt or collision	MPU6050	Emergency alert triggered

The camera-based approach improved accuracy in detecting drowsiness compared to traditional IR blink sensors. It also worked effectively in varied lighting conditions with proper calibration. In Sec. 4, facial detection and EAR values were validated using multiple user trials, confirming the robustness of the algorithm.

5) Charts

Sensor	**Alert Count**
Eye (Drowsiness)	35
Alcohol Sensor (MQ-3)	15
Accelerometer (MPU6050)	25
Combined Triggered Alerts	40



3. CONCLUSIONS

The online implementation and data outputs of this proposed system can be made available through integrated cloud-based dashboards. Institutions or researchers associated with smart vehicle safety systems may access the full architecture and source code through authorized repositories. Public users or external reviewers may only access limited modules or visual demos. For complete deployment guidelines, technical documentation, and software access, users are prompted with secure authentication and offered instructions on how to request full access or licenses.

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