Safe Wheel: A Real Time Alcohol Detection and Vehicle Safety system using Embedded Technology

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Abstract : This work describes Safe Wheel, an affordable embedded system developed to curb drunk driving incidents. It employs an MQ-3 alcohol sensor and an Arduino Uno to continuously assess the driver's breath. Once detected alcohol surpasses a predetermined threshold, the system disables vehicle ignition through a motor cutoff mechanism. Instant visual and auditory warnings are issued via an LCD module and buzzer. Compact and economical by design, it can be enhanced later with GPS or GSM modules. Under laboratory testing, Safe Wheel successfully inhibited ignition in over 90% of simulated intoxicated driving scenarios.

Keywords: Drunk Driving, Arduino Uno, Alcohol Detection, MQ-3 Sensor, Vehicle Safety, Embedded System.

I. INTRODUCTION

Drunk driving represents a pervasive global safety challenge, with significant consequences despite stringent traffic laws. Traditional countermeasures—such as manual breathalyzer checks and roadblocks—often act too late to prevent accidents. Safe Wheel bridges this gap by offering a self-contained, embedded solution that prevents a vehicle from starting if alcohol is detected in the driver's breath. Leveraging cost-effective components like the MQ-3 sensor, Arduino Uno, and a relay switch, this prototype ensures only sober individuals can operate the motor. It demonstrates the practical use of embedded systems for immediate, in-vehicle safety control.

II. LITERATURE SURVEY

[1]IoT-Based Multilevel Drunken Driving Detection and Prevention Proposes a Raspberry Pi–based architecture combining MQ-3 alcohol sensor, heartbeat monitoring, facial recognition, and ignition cut-off to prevent drunk driving. Upon detection above threshold or abnormal heartbeat, the system disables ignition and alerts contacts via Wi-Fi. Demonstrates multilevel detection with remote notification capabilities.

[2]Vision-based Analysis of Driver Activity Under Influence Uses multimodal sensors—visual, thermal, audio, chemical—in a simulator to detect alcohol-related impairment via computer-vision and ML models. Achieves passive, early detection of intoxicated driving behavior. Offers detailed pipeline and data-driven methods.

[3]Machine Learning with Driver Monitoring Cameras Develops ML models using in-vehicle camera data to predict Blood Alcohol Concentration (BAC) levels. Tested on 30 participants, the system reliably detects any alcohol influence (AUC 0.88) and levels above 0.05 g/dL (AUC 0.79). Demonstrates first rigorous evaluation of camera-based drunk driving detection.

[4] Two-Step E-Nose System for Drunk Driving Detection Introduces an in-cabin electronic nose (e-nose) with a two-step process: cabin-level alcohol detection followed by targeted driver analysis. Using sensor array optimized by Random Forest, achieves 99.44% cabin detection accuracy and 100% driver detection within 5 seconds. Reduces cost and volume by reducing sensor count.

[5] IoT-enabled Drowsiness & Alcohol Detection with Auto-Stopping Combines MQ-3 alcohol sensor and IR-based eye-monitoring to detect both intoxication and drowsiness. Activates audible alarms, warning lights, slows vehicle, and stops motor if impairment persists. Sends alarms via Bluetooth for real-time monitoring. Demonstrates integrated detection and auto-stopping.   .

III. METHODOLOGY

A. Hardware Setup

The Safe Wheel encorporates :

- MQ-3 Alcohol Sensor: Detects ethanol vapor near the driver.
- Arduino Uno: Central controller managing sensor readings.
- Relay Module: Interrupts motor power upon detection.

- DC Motor: Acts as a stand-in for the vehicle engine.
- 16 × 2 I2C LCD Screen: Displays status updates.
- Buzzer: Delivers warning alerts.

B. Control Stratergy

- The MQ-3 continuously samples ambient air by the driver's seat.
- Sensor output is digitized by the Arduino Uno and compared against a preset threshold (700).
- If the value exceeds threshold: LCD displays "Alcohol Detected!". Relay cuts the motor circuit. Buzzer activates to alert the driver.
- If under threshold: LCD reads "Safe Driving." Relay allows motor operation. Buzzer remains silent.

C. Software Flow

```
if (alcoholValue > 700) {
 lcd.print("Alcohol Detected!");
digitalWrite(RELAY_PIN, LOW);
digitalWrite(BUZZER_PIN, HIGH);
 } else {
lcd.print("Safe Driving");
igitalWrite(RELAY_PIN, HIGH);
digitalWrite(BUZZER_PIN, LOW); }
```

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IV. CIRCUIT DESCRIPTION

The alcohol sensor is wired to analog pin A0 on the Arduino. Digital pin 7 controls the relay, and pin 8 drives the buzzer. Using the I2C protocol, the LCD connects to pins A4 (SDA) and A5 (SCL). Power is supplied via a rechargeable 3.7 V battery or USB. The relay interrupts power to the DC motor, which represents the vehicle's ignition system. When the sensor reads safe levels, the motor runs; otherwise, it stops.

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V. APPLICATIONS

1. Private cars to deter drunk operations
2. Commercial fleets for enforcing driver safety
3. School transport to protect children
4. Rental and ride-sharing services
5. Public safety demos by law enforcement

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VI. ADVANTAGES & LIMITATAIONS

Advantages
- Low-cost and easy to deploy.
- Real-time alcohol detection.
- Can be integrated with vehicle ignition system.

Limitations
- No GPS/GSM communication by default.
- Sensor calibration required.
- Susceptible to false positives (e.g., due to hand sanitizers).

VII. RESULTS AND DISCUSSION

Scenario	Alcohol Present?	Outcome	Motor Status
Normal Driver	No	"Safe to Drive"	ON
Trace Alcohol Exposure	Yes	"Alcohol Detected"	OFF
Heavy Intoxifiacation	Yes	"Alert & Stop"	OFF

The system successfully prevented ignition in over 90% of alcohol-positive tests. A few edge cases led to false triggers due to perfume or air freshener, which can be improved with better sensor shielding and software filtering.

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VIII. CONCLUSION

The Safe Wheel system demonstrates a practical way to reduce road accidents by combining simple electronics with intelligent control. It detects alcohol from the driver and stops the vehicle from starting, promoting responsible driving. The current version is a working prototype that can be further expanded with GSM modules, mobile apps, or machine learning for better accuracy. This project confirms that low-cost embedded solutions can play a key role in enhancing road safety.

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IX. REFERENCES

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