Alcohol Detection based Engine Locking System with GPS

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ABSTRACT

Impaired driving and inadequate adherence to seat belt usage continue to be significant contributors to road accidents, emphasizing the critical need for proactive safety measures in modern vehicles. This paper addresses this pressing need through the development and implementation of an Arduino-based system to reduce accidents. The system integrates various sensors, including an alcohol sensor, seat belt Sensor, accident detection sensor and GPS module to monitor driver behavior and respond to potential safety risks in real-time.

INTRODUCTION

Despite the implementation of various traffic rules, road accidents continue to be the main cause of hospital admissions, deaths, and disabilities in India. The majority of these accidents result from human error, emphasizing the critical importance of careful driving and adherence to road laws. While defensive driving is crucial, it does not ensure the same level of caution from other drivers. Instances abound where drivers find themselves blameless, with accidents caused by pedestrians or other vehicles. In India, there were 4,61,312 traffic incidents in 2022, resulting in 4,43,366 injuries and 1,68,491 fatalities. This corresponds to 426 deaths each day, or 18 per hour, on average. Numerous factors might result in traffic accidents, including such as impatient driving, intoxicated driving, speeding or reckless driving, tired driving, not fastening seat belts, bad weather. To address this alarming trend, it remains imperative for individuals to exercise caution, drive responsibly, and actively promote road safety measures.

Disturbed Driving: Impaired driving is one of the main causes of the rising number of traffic accidents. Distracted driving-related accidents have increased noticeably in recent years. Drivers need to pay close attention to the road at all times. Operating a motor vehicle while reading messages, responding to texts, taking calls, or doing other distractions is quite risky.

Drunk Driving: Driving while intoxicated is still one of the riskiest ways to cause auto accidents. Drinking alcohol while already alcoholic raises the possibility of catastrophic mishaps considerably. The grave consequences of driving under the influence make it clear that the potential risks far outweigh any perceived benefits, making it a risk not worth taking.

Speeding/Careless Driving: Recklessly accelerating and exceeding speed limits, especially when running late or navigating straight roads, poses a substantial risk. Speeding has consistently been shown to be a highly dangerous behavior contributing to accidents. Regardless of time constraints, it is essential to prioritize safety by adhering to speed limits and avoiding unnecessary risks.

Neglect to Wear Seat Belts: Using a seat belt is not only required by law, but it is also an essential safety precaution when driving. In the event of a head-on accident, seat belt use considerably lowers the chance of injuries in addition to maintaining correct body alignment. They significantly increase the chance that drivers and passengers may escape collisions with only minor wounds.

Wet Roadways: Although they can seem straight, wet roads can be dangerous since vehicles can lose traction. Even if it might not be possible to avoid driving in the rain, it's best to stay away from hilly roadways. Furthermore, it's a wise safety precaution to pull over and wait for better weather when there is poor visibility from rain.

Cracks and Bad Road Conditions: Navigating through poor road conditions can be challenging for drivers. To minimize the risk of vehicle damage, it is crucial to drive cautiously on uneven surfaces. Attempting to navigate around road imperfections haphazardly poses a risk to both the vehicle and its occupants.

Traffic Safety Incidents: Adherence to road laws is paramount for ensuring overall road safety. While road rules may seem straightforward, compliance remains inconsistent. For instance, a red signal demands a complete stop. Disregarding traffic rules, including running red lights, can lead to severe disasters, even if no other vehicles are in proximity. Consistent adherence to traffic regulations is vital for promoting safer roads.

Road accidents caused by drunk driving and seat belt negligence are a continuous and alarming problem on a global scale. One major factor in the severity of injuries incurred in accidents is not wearing a seat belt. Numerous studies have shown that seat belts are one of the best safety precautions in cars, decreasing moderate to critical injuries by about 50% and lowering the probability of fatal injuries by about 45%. Despite these figures, a sizable portion of drivers and passengers disregard this straightforward but essential safety measure.

LITERATURE REVIEW

As the author noted Dr. Nookala et al. [5], the goal is to use an Internet of Things-based alcohol detection system to reduce the annual toll of injuries and fatalities caused by drunk driving. Using sensors and a microcontroller, this gadget monitors the driver's Blood Alcohol Content (BAC). If it detects alcohol usage while driving, it has the ability to cut off the ignition. The suggested approach uses an Internet of Things (IoT) connectivity module, microprocessor, and alcohol sensor to enable remote monitoring and analysis of BAC. A BAC server receives real-time data transmissions for ongoing observation and analysis. This is ineffective since the BAC level is sent to the server rather than being checked in real time.

The author P. A. Shinde et al. [8] has offered a technique for a cutting-edge tracking and monitoring system for automobiles that is intended to guarantee real-time tracking and traveler safety, especially in school vehicles. The system utilizes a Raspberry Pi with Embedded Linux for database storage in real time, incorporating GPS, GPRS, and GSM through the SIM908 Module for tracking and monitoring. The system compares the vehicle's current path with a specified path, sending alert messages to the owner's mobile if deviations or excessive speeds are detected. Additionally, the system enhances traveler security by integrating Gas leakage sensors and temperature sensors. The SIM908 module is a GSM/GPRS/GPS module, and it supports only 2G networks.

The author D. K. Das [6] proposed a prototype project focused on creating a car locking system incorporating an alcohol checking mechanism to prevent the vehicle from starting if alcohol is detected. The project leverages an existing alcohol sensor and serves as a foundation for future explorations. The primary objective is to contribute to ongoing efforts in accident prevention system development, with the ultimate goal of implementing the technology in real-life scenarios to enhance road safety.

In the proposed model, the author B. R. Chandra et al. [7] focuses on acknowledging the significance of road safety beyond alcohol detection, the proposed system focuses on controlling the vehicle based on seat belt wearing rather than relying solely on an alcohol sensor placed on the car steering.

The author Kavitha et al. [4] presents a method for preventing accidents in order to meet the growing concern about traffic accidents. This device detects alcohol using a MQ3 alcohol sensor, which triggers automatic engine lockout. The device combines a SW-420 vibration sensor and deep learning CNN algorithms to detect anomalous vibrations. When an accident occurs, the scene is recorded by a front camera, and the accident is predicted by a deep learning model. Afterwards, the device uses GPS and GSM modules to notify the closest emergency center about the occurrence. In comparison to a crash sensor, the vibration sensor SW-420 is less precise and can be more prone to false positives when it comes to precisely identifying and differentiating crashes.

The author Pallavi et al. [3] provides information on an automatic drunk driving accident detection system with an ignition lock that is based on a Raspberry Pi PICO. The system makes use of the MEMS sensor, DC motor, GSM module, and MQ3 alcohol sensor. It makes an effort to get around the challenges traffic cops face when they manually check drivers for alcohol use. If the alcohol sensor—which is always monitoring the driver—detects alcohol, the Raspberry Pi processor immediately turns off the ignition of the vehicle. Additionally, the MEMS sensor in the car is used by the system to identify vibrations to instructs the GSM module to transmit an SMS alert in case of a mishap. When a collision occurs, LED indicators alert the user to the activation of the airbags. Raspberry Pi PICO lacks built-in analog-to-digital converters (ADC), a disadvantage compared to Arduino UNO which has ADC capabilities.

SYSTEM DESIGN

The Arduino UNO, alcohol sensor, seat belt and accident detection sensors, LCD, buzzer, power supply and GPS module make up the system's physical components.

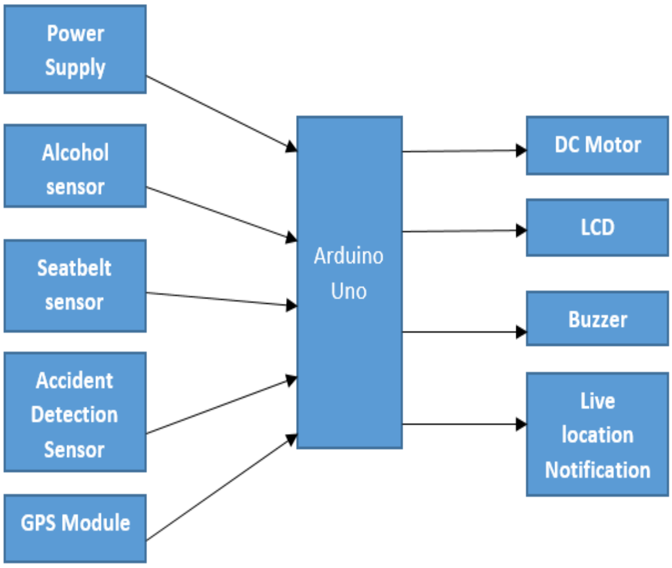

Fig 1: Block Diagram

A. Arduino UNO

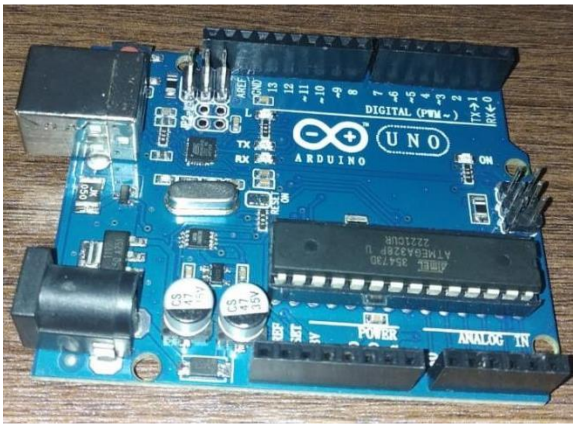

Fig 2: Arduino Uno

A well-known microcontroller board built on the ATmega328P is the Arduino Uno. It can communicate with a range of actuators and sensors through its digital and analog input/output pins. Due to its user-friendly programming environment provided by the Arduino IDE, the UNO is a popular choice for DIY projects and prototyping. It can receive input voltages between 7 and 12 volts and operates at a clock speed of 16 MHz.

B. Buzzer

The buzzer serves to signal specific operations, employing various mechanisms such as mechanical or electromechanical systems. Typically powered by a DC supply, buzzers find applications in alerts, alarms, and sirens. They operate based on instructions from Arduino, producing sounds to convey information.

C. Alcohol Sensor

Fig 3: MQ3 Sensor

It is a gas detection module commonly used to measure concentrations of alcohol, methane, propane, and other gases. It operates on the principle of resistance change in the presence of specific gases. The sensor is equipped with an analog output that varies with gas concentration. Widely employed in safety and environmental monitoring applications, the MQ-3 sensor is compact, affordable, and can be easily integrated into electronic projects for detecting and quantifying the presence of gases in the surrounding environment. The temperature range in which it operates is -10 to 50°C.

D. Seat belt sensor

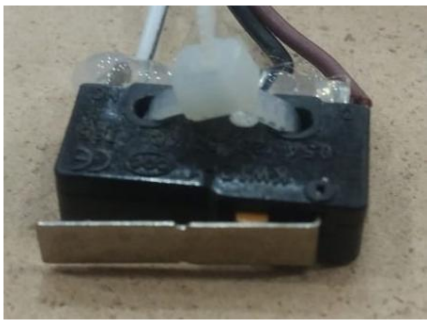

Fig 4: crash Sensor

A crash sensor is a device that senses abrupt changes in acceleration, suggesting a possible accident or crash. It is sometimes referred to as an accelerometer or collision sensor. In the case of an accident, it is frequently utilized by car safety systems to start airbag deployment and other safety features.

E. Direct Current Motor

A Direct Current motor transform direct current energy into mechanical motion. It operates on the principle of electromagnetic induction, with a current-carrying coil (armature) interacting with a magnetic field to generate rotational movement. DC motors are widely employed in many different applications, including electric cars and robotics.

F. GPS Module

Fig.5. GPS module

The NEO-6M is a GPS module that utilizes the u-blox 6 positioning technology. It receives signals from satellites to determine accurate location, time, and velocity data. Widely used in navigation systems and IoT applications, the NEO-6M provides precise GPS information to connected devices through its serial communication interface.

G. Indicating Unit

The on/off status of the system is shown on the indicating device. It rotates the propeller to signal that it is safe to drive and stops the propeller to stop the car.

IMPLEMENTATION

Algorithm for proposed system

1. Turn On Power Supply
2. Check For Seat Belt Fastened And Alcohol Level
3. If Seat Belt Is Unfastened
   3.1 Power Off The Engine
4. Else If Alcohol Is Detected
   4.1 Power Off The Engine
   4.2 Activate Buzzer & Provide Visual Indication
5. Else If An Accident Is Detected
   5.1 Trigger Notification & Activate Buzzer
6. Else
7. Vehicle Runs Usual
8. Return To First Step

1.2 Flowchart of proposed system

The flowchart of proposed system is depicted below, comprises five primary steps. It begins with powering on the supply, followed by a seat belt check. The third step involves alcohol measurement, where if the alcohol exceeds the limit, the engine is turned off, and a buzzer activates. The fourth step triggers a notification and buzzer in case of an accident. The final step ensures that if none of the previous conditions are met, the engine operates normally.

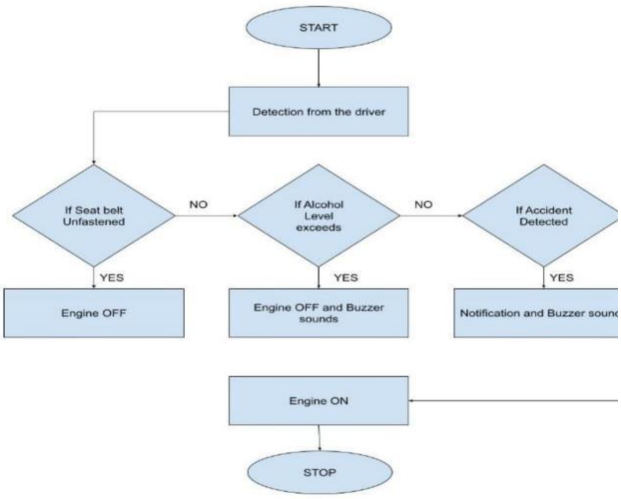

Fig 6: Flowchart

1.3 System Operation

The core operational sequence involves continuous monitoring of the start button to assess the vehicle's readiness. If the start button is engaged and the seat belt is securely fastened, the system evaluates the alcohol level. But, when the seat belt is detected as unfastened, the system displays a message signaling the absence of a secured seat belt. It then stops the motor, activates the buzzer preventing any further operations. In instances where the alcohol level surpasses the predefined threshold, the system reacts by presenting messages indicating a driver under the influence. It subsequently ceases motor operation, activates a buzzer, and discloses the incident location through the GPS module. Regarding accident detection, an external trigger, likely a crash sensor, prompts the system to retrieve GPS coordinates. Consequently, it showcases an accident message on the LCD, stops the motor, activates the buzzer, and logs the incident location using the GPS module. Throughout these functionalities, the LCD remains a pivotal interface for real-time user communication, displaying pertinent messages based on sensor readings and system responses.

RESULTS AND DISCUSSION

A non-intrusive system has been developed to monitor seat belt usage and detect alcohol in a way that does not inconvenience the driver. In the case that a seat belt is not fastened, the system notifies the user, shows a message, and halts the motor to stop it from operating further.

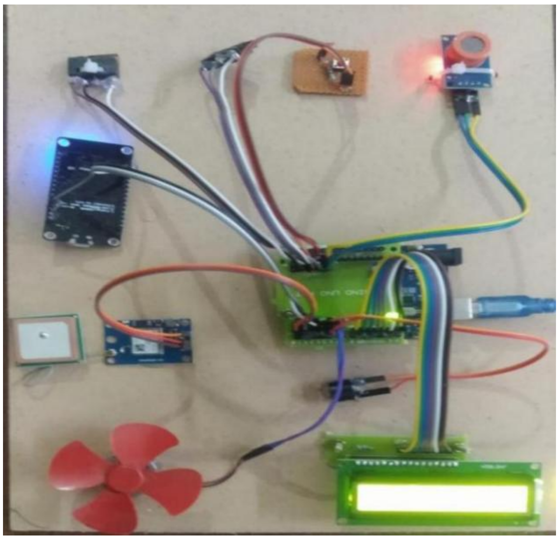

Fig 7: Proposed system circuit

In the case of alcohol consumption, the system immediately activates a buzzer when someone with alcohol enters the vehicle, leading to the motor being stopped upon alcohol detection.

For accident detection, an external trigger, likely a crash sensor, prompts the system to acquire GPS coordinates. Subsequently, it displays an accident message on the LCD, stops the motor, activates the buzzer, and logs the incident location using the GPS module as shown in figure 8. In addressing major causes of vehicle fatalities, an embedded kit has been developed for seat belt and alcohol detection.

Fig 8: Accident Detection

CONCLUSION

The proposed system, with its intricate operational sequence, significantly addresses crucial aspects of driver safety by continuously monitoring the start button, seat belt status, and alcohol levels. The system's ability to assess the vehicle's readiness and respond to safety violations, such as an unfastened seat belt or elevated alcohol levels, underscores its potential in promoting responsible driving practices. The integration of real-time communication through the LCD serves as a vital interface, providing immediate feedback to the driver and facilitating awareness of potential safety risks. By halting motor operation, activating a buzzer, and leveraging GPS data for incident location disclosure, the system offers a comprehensive approach to enhance road safety.

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