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Accident Prevention and Alerting System

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Abstract:- The project addresses the increased demand for vehicle tracking systems in the embedded systems industry by providing a solution that combines accident avoidance and real-time tracking capabilities. The system takes a holistic approach to road safety by integrating components such as the Arduino microcontroller, alcohol sensor MQ2, heartbeat sensor, limit switch, relay, Liquid Crystal Display, Global Positioning Satellite, and Global system for mobile communication module. The system's ability, in particular, to detect and prevent drunk driving incidents makes a substantial contribution to road safety. The project's goal is to avoid accidents and fatalities by automatically alerting drivers when they attempt to operate a car while intoxicated. Finally, the project's emphasis on improving road safety through proactive monitoring and intervention highlights its potential to make a significant contribution to reducing traffic accidents and saving lives.

Keywords:- *Alcohol Detection, Arduino Uno, MQ2 Sensor, Liquid Crystal Display, Global Positioning Satellite, and Global System for Mobile Communication Module., Heartbeat Sensor.*

I. INTRODUCTION

In response to the growing concerns surrounding road safety, particularly the alarming rate of accidents caused by drunk driving and the reluctance to wear seat belts, this project aims to develop an Accident Prevention and Alerting System. It addresses the dangers posed by irresponsible driving habits through proactive detection and intervention. Fundamental to this system's operation is its ability to continuously monitor in real-time and respond swiftly. By leveraging a combination of sensors, GPS, and GSM modules seamlessly integrated with an Arduino microcontroller, it can swiftly identify critical situations such as the absence of a seat belt, alcohol consumption, or irregular heart rates. Upon detecting these scenarios, the system promptly executes a series of measures to prevent accidents and notify relevant people. This approach incorporates specialized components including an alcohol sensor (MQ2), a heartbeat sensor, and a seat belt switch to continuously monitor the driver's condition and vehicle status. In instances where alcohol presence or seat belt negligence is detected, the system issues warnings and gradually decelerates the vehicle while simultaneously dispatching SMS alerts via GSM technology. Similarly, if abnormal heart rates are detected, immediate notifications are sent to designated contacts, prompting the vehicle to slow down gradually to avert potential accidents. The prototype of the system encompasses essential elements such as an LCD display for real-time feedback, a relay for motor control, and a GPS module for precise location tracking. The Arduino microcontroller acts as the central unit, analysing incoming data and orchestrating response actions effectively. In practical terms, this system offers a proactive approach to enhancing road safety and mitigating the risks associated with negligent driving behaviors. By harnessing technology to identify and address potential hazards in real-time, its aim is to foster safer road environments for all road users.

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II. CIRCUIT DESIGN

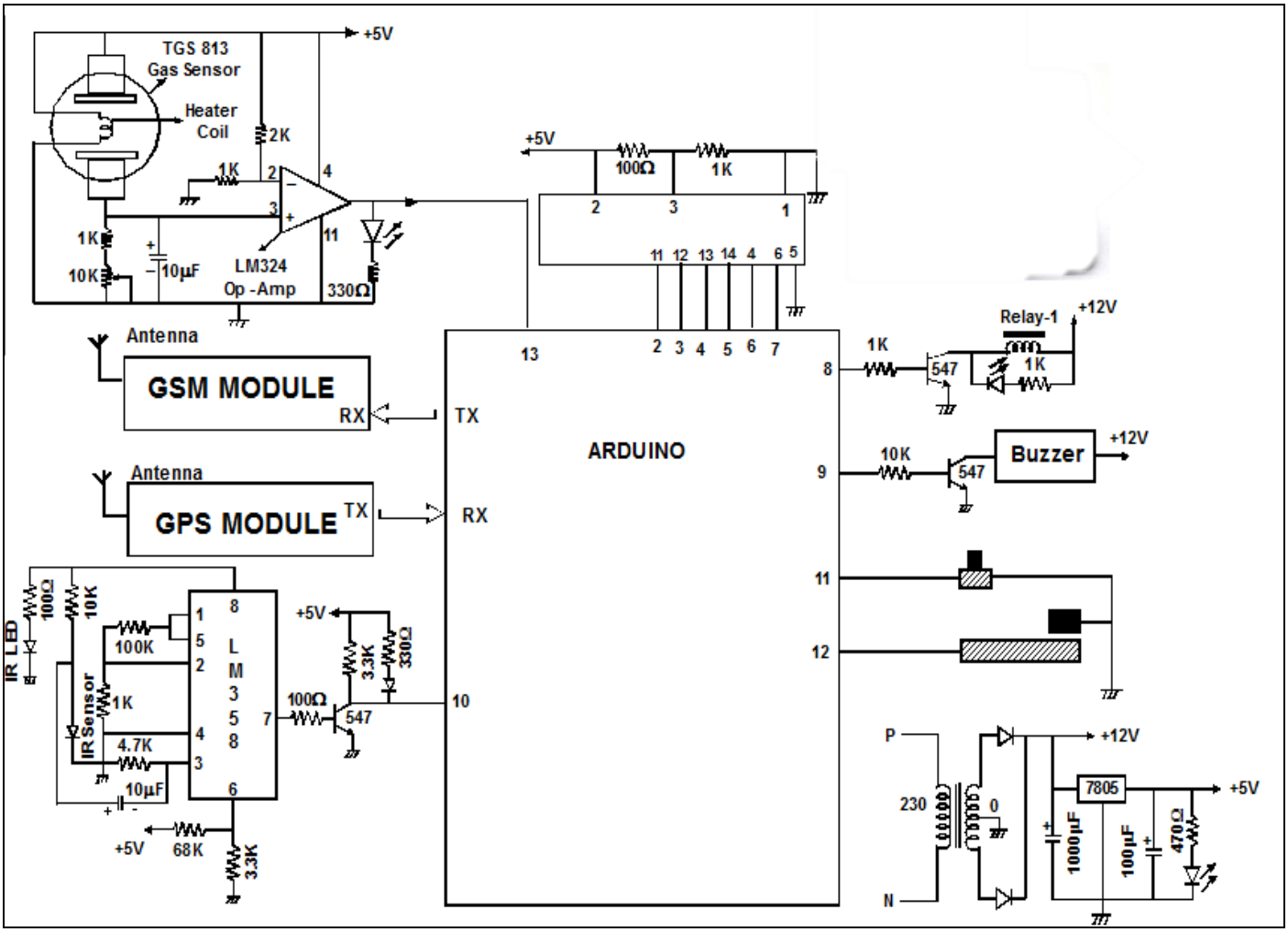

Fig 1 Circuit Design

III. COMPONENTS DESCRIPTION

➢ *Arduino Uno Controller:*

The Arduino Uno is a cornerstone of open-source hardware, widely used in professional electronics projects worldwide. It is powered by the ATmega328P microcontroller and has a number of digital and analog input/output pins, allowing for easy integration with a variety of sensors, actuators, and peripherals. Its inbuilt USB interface makes programming and data transmission easier using the Arduino Integrated Development Environment (IDE), simplifying the development process. In addition to its hardware capabilities, the Arduino Uno is supported by a vast ecosystem of software libraries and online resources, further enhancing its usability and versatility in professional electronics projects. .As a result, the Arduino Uno has become synonymous with innovation and creativity in the field of electronics, driving advancements in diverse industries such as automation, IoT, robotics, and wearable technology

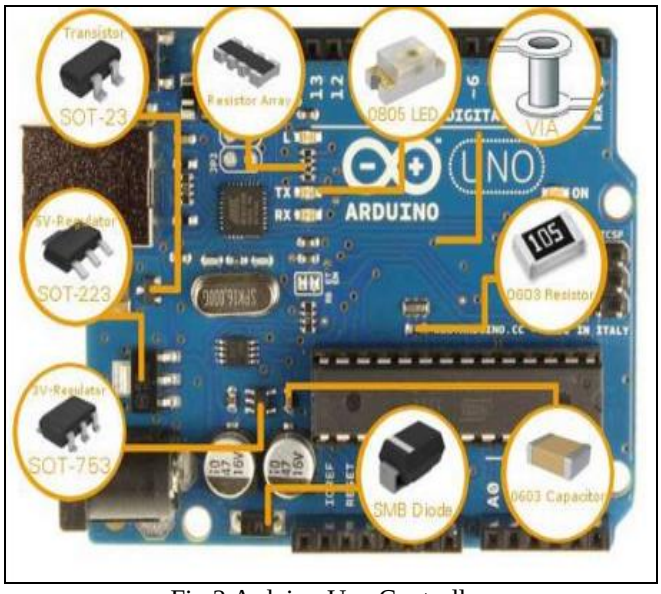

Fig 2 Arduino Uno Controller

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➢ *Limit Switch:*

The limit switch used in this project functions as a pivotal sensor for determining the condition of the seat belt, indicating whether or not it is fastened. The switch acts as a force sensor, activating when slight pressure is applied to its elongated lever. Limit switches are widely used in a variety of applications, including robotics, due to their reliability and clear signal output. The switch, which is interfaced with a microcontroller, offers critical input signals regarding the condition of the seat belt. Limit switches come in two main types: Normally open and Normally closed. In this instance, the normally open configuration is employed, where the switch signals a logic low (0) when the seat belt is secured, and a logic high (1) when it is not, contingent upon the switch's connection configuration.

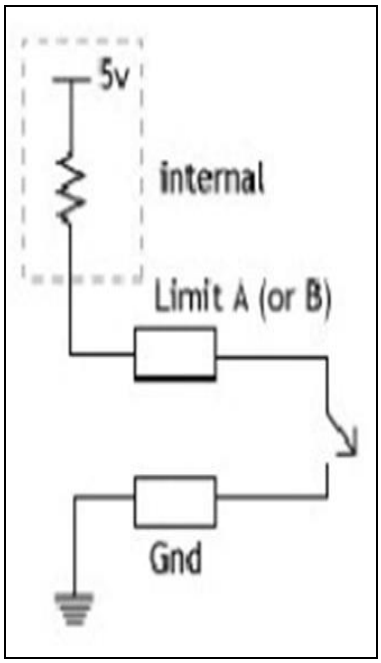

Fig 3 Wiring Diagram of Limit Switch

➢ *Heartbeat Sensor:*

The heart rate sensor employed in the project uses a beat-tobeat calculation technique, which results in a more accurate estimate of the driver's heart rate than typical average calculation methods. The sensor detects minor variations in heart rhythm by dynamically measuring each heartbeat interval, providing a full picture of how the heart responds to events such as stress and environmental circumstances. Using infrared (IR) technology, the sensor detects changes in blood volume at the fingertips, allowing for pulse wave velocity measurement and comparison with ECG signals. This photoelectric method, also known as the transmittance method, uses infrared sensors to measure blood volume changes and generates digital pulses via operational amplifiers. As blood volume fluctuates with each heart contraction, variations in light transmission through the finger are recorded, resulting in a voltage corresponding to the amount of blood present. Abnormal pulse readings trigger an automated alert system, facilitating timely intervention via SMS alerts delivered through a GSM transmitter.


Fig 4 Heartbeat Sensor

➢ *GSM Module:*

GSM (Global System for Mobile Communication) plays a crucial role in numerous applications, including vehicle tracking, remote monitoring, and communication systems. Its widespread availability across continents and countries enables global connectivity for mobile phones. Integrated with microcontrollers, GSM modems facilitate SMS transmission and reception, utilizing the Hayes AT-Command set for configuration and control. The adaptability of GSM technology allows for seamless modification and integration into a variety of applications, including voice, data, fax, and short message transfer. In car safety and monitoring projects, GSM's real-time communication capabilities are essential, enabling the transmission of accident alarms and GPS-based location data to pre-programmed numbers. Additionally, GSM's compatibility with smart modems and embedded microcontrollers offers options for automation and remote monitoring.


Fig 5 GSM Module

➢ *GPS:*

GPS, or the Global Positioning System, functions as a satellite-based navigation system deployed worldwide to determine precise locations. With a network of 24 satellites orbiting Earth, GPS receivers utilize trilateration to calculate their three-dimensional position accurately. This technology finds applications in various fields, notably GPS tracking equipment, enabling real-time monitoring of vehicles, individuals, or assets through data logging. Furthermore, GPS navigation devices use these signals to provide turn-by-turn directions, allowing users to find their way more effectively. Essentially, GPS serves as a pivotal tool in modern navigation, providing reliable solutions for location

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tracking and route assistance across a wide range of industries and activities.

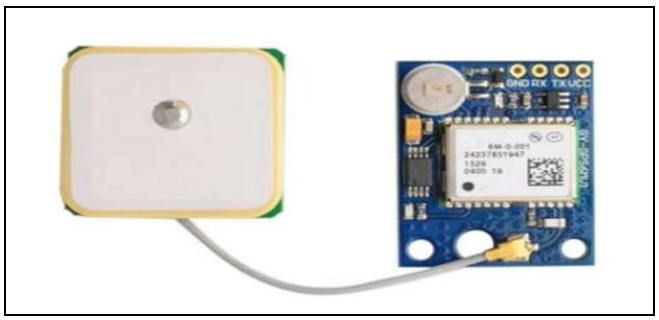

Fig 6 GPS

➢ *LCD:*

Liquid crystal display (LCD) interfacing involves connecting an LCD to a microcontroller to display information decoded from a remote source, such as an RF module. LCDs offer the advantage of displaying both alphabets and numbers, expanding their suitability for various applications. LCDs come in different formats, with common ones being 2x16 or 3x16, indicating the number of lines and characters they can display. Typically, LCD modules utilize an 8-bit interface for data transfer and control, enabling communication through specific pins. This interface includes control lines linked to the microcontroller for functions like data writing and instruction input. Each LCD panel comprises multiple pins with diverse functions, including data bus lines, control signals for row and register selection, and power supply connections. These features empower LCDs to efficiently convey text messages, graphics, and other user information.

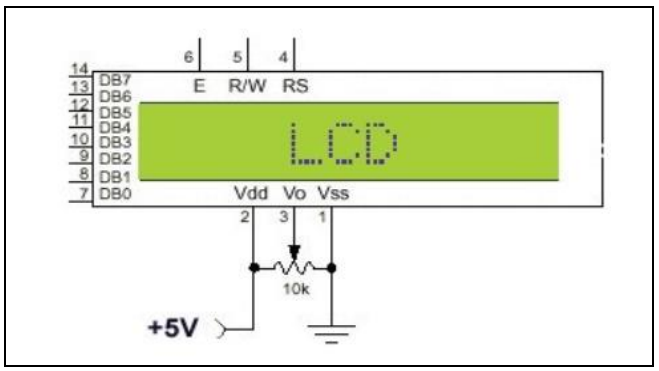

Fig 7 LCD

➢ *Relay:*

Relays are electromagnetic switches that open and close circuits in response to the effect of another electrical circuit. In essence, they act as automatic switches, capable of forming or breaking a circuit. They typically include an electromagnet, a moveable armature, contacts, and a frame. When an electric current flows through the relay coil, it generates a magnetic field that attracts the armature, causing the contacts to close and power to flow through the circuit. This electromechanical technique allows relays to control circuits of more power than the input circuit. Relays have been important in electrical applications, providing a simple, effective, and dependable method of circuit control.

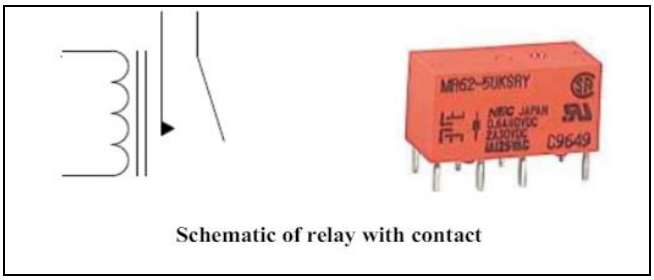

Fig 8 Relay

➢ *Alcohol Sensor :*

The MQ2 sensor is a versatile gas detector renowned for its sensitivity to various gases, including carbon-based ones like natural gas and propane. Notably, it can also detect alcohol vapors, such as those present in breath after drinking. Structurally, it features a sintered bulk semiconductor primarily composed of tin dioxide, with electrodes deposited on a ceramic tubular former. A small heater coil inside the sensor aids its operation. The sensor is robustly constructed, with components capable of withstanding high temperatures, and it includes safety features like a cover to prevent sparks from igniting explosive gases. Functionally, it offers rapid stabilization, consistent performance over time, and minimal interference from other gases, making it a cost-effective and reliable choice for alcohol detection in vehicles, crucial for preventing drunk driving incidents.

Fig 9 Alcohol Sensor

IV. WORKING

When the driver starts the vehicle, the Accident Prevention System becomes active. Integrated within the vehicle's operations, the system begins its continuous monitoring process. Throughout the journey, sensors such as the MQ2 alcohol sensor, seat belt detector, and heart rate sensor gather real-time data based on driver and vehicle conditions. If any concerning deviations are detected, like elevated alcohol levels or the absence of seat belt engagement, alerts are swiftly sent via the GSM module to a designated mobile number. These alerts serve to notify authorities or emergency contacts. Meanwhile, proactive measures are initiated to prevent potential accidents. The system gradually slows down the vehicle to a safe stop, ensuring the safety of both the driver and other road users. Simultaneously, the vehicle's precise GPS coordinates are

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transmitted to the registered mobile number, providing accurate location information for swift assistance. This seamless integration of monitoring and intervention mechanisms ensures that the system remains vigilant throughout the journey, effectively mitigating risks and enhancing road safety.

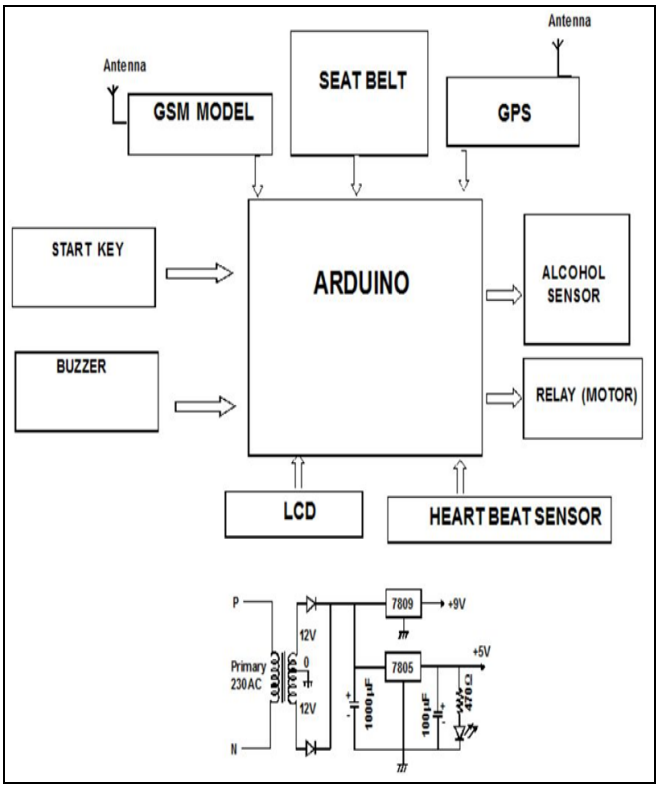

Fig 10 Working

V. RESULTS

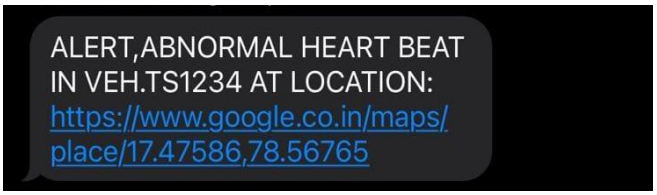

Fig 11 Alert Received when the System Detected Abnormal Heartbeat

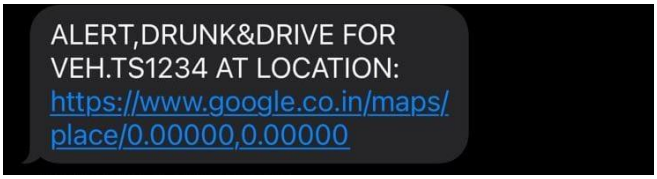

Fig 12Alert Received when the System Detected Alcohol

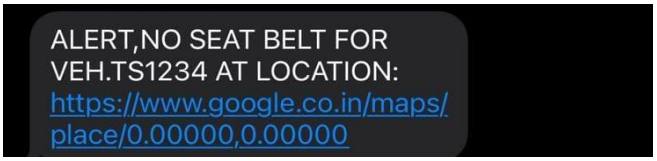

Fig 13 Alert Received based on the Status of the Seat Belt

VI. CONCLUSION

Through the integration of sensors, GPS, and GSM modules with microcontrollers, these systems have shown promising potential in mitigating the dangers associated with irresponsible driving behaviors. By swiftly identifying critical situations such as drunk driving, seat belt negligence, and abnormal heart rates, these systems can initiate proactive measures to prevent accidents and promote safer road environments. The effectiveness of these measures, including issuing warnings and sending alerts to relevant authorities, underscores the importance of leveraging technology to address road safety concerns. Moreover, the successful implementation and testing of these systems highlight their feasibility and practicality in realworld scenarios. Looking ahead, efforts should be directed towards refining and expanding these systems to ensure widespread adoption and implementation. The integration of features such as Google Maps for precise location tracking further enhances the functionality of these systems, providing users with valuable insights into vehicle positioning and movement. In summary, Accident Prevention and Alerting Systems offer a comprehensive solution to the challenges of road safety. As technology continues to evolve, these systems have the potential to significantly reduce road accidents and save lives, ultimately creating safer road environments for all road users.

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