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IoT Based Safe-Sense Vehicle

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Abstract*: Road accidents rank among the primary sources of global losses, often resulting from severe issues such as alcohol consumption, driver fatigue, and hazardous conditions. Conventional safety measures primarily mitigate the effects of accidents rather than prevent them.*
The IoT-based Safe Sense Vehicle tackles this challenge by actively improving road safety. It identifies alcohol use, drowsiness, and other risks, automatically halting the vehicle to prevent accidents. An alert system provides real-time notifications to both the driver and authorities, while a mobile application facilitates remote monitoring and control. This comprehensive strategy greatly diminishes the likelihood of accidents and enhances overall safety operations..

Keywords: IoT Based Vehicle, Sensors, Enhanced Safety, Remote Monitoring

I. INTRODUCTION

Road safety continues to be a significant issue, impacting millions due to vehicle accidents that arise from factors such as reckless driving, driver fatigue, alcohol impairment, and environmental dangers. Conventional safety measures typically concentrate on addressing the consequences of accidents rather than preventing them altogether. The IoT-Based Safe Sense Vehicle fills this void by incorporating advanced safety features that actively monitor and reduce potential risks.

A fundamental aspect of this system is its alcohol detection feature, which disables the vehicle if alcohol is detected. Furthermore, the anti-sleep function observes the driver's behaviour for indications of drowsiness and can halt the vehicle if required. To improve safety within the vehicle's surroundings, a smoke detection system is integrated, which automatically turns off the engine upon smoke detection, thereby minimizing fire hazards.

The system also includes an alert alarm and mobile connectivity for real-time risk notifications, even in the absence of the vehicle owner. Additional features comprise hazard lights, temperature monitoring, an all-wheel-drive robotic system for navigating diverse terrains, and automatic headlamp activation to improve visibility. Powered by solar energy, the vehicle is designed to be both safe and environmentally friendly, contributing to green transportation initiatives.

By combining real-time monitoring, automation, and remote access, the IoT-Based Safe Sense Vehicle significantly improves driver safety and road security, establishing a new benchmark in intelligent transportation systems.

II. LITERATURE SURVEY

The rising incidence of road accidents attributed to human mistakes, environmental factors, and technical malfunctions underscores the pressing necessity for enhanced vehicle safety systems. Conventional safety measures, such as seatbelts and airbags, primarily aim to lessen the impact of accidents rather than prevent them. In contrast, smart vehicle technologies powered by the Internet of Things (IoT) provide proactive safety measures, allowing for real-time monitoring, automation, and intelligent hazard detection to reduce the likelihood of accidents.

A vital component of smart vehicle safety is the incorporation of sophisticated systems, including alcohol detection devices that inhibit engine ignition when intoxication is identified, thereby significantly decreasing instances of drunk driving. Furthermore, systems that assess fatigue and drowsiness monitor driver alertness, issuing warnings or taking

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actions to mitigate the dangers associated with fatigue-related incidents. Smoke detection systems can recognize potential fire threats within the vehicle, enabling prompt responses.

Real-time alert systems improve situational awareness through audio-visual cues and mobile notifications, while remote monitoring through mobile applications offers ongoing updates regarding vehicle status and safety features.Adaptive lighting systems improve visibility in difficult conditions, while energy-efficient options encourage sustainable safety measures.

Future advancements in vehicle safety will focus on incorporating IoT, artificial intelligence, and machine learning to develop predictive and autonomous safety features, ultimately fostering safer and more efficient transportation systems.

III. METHODOLOGY

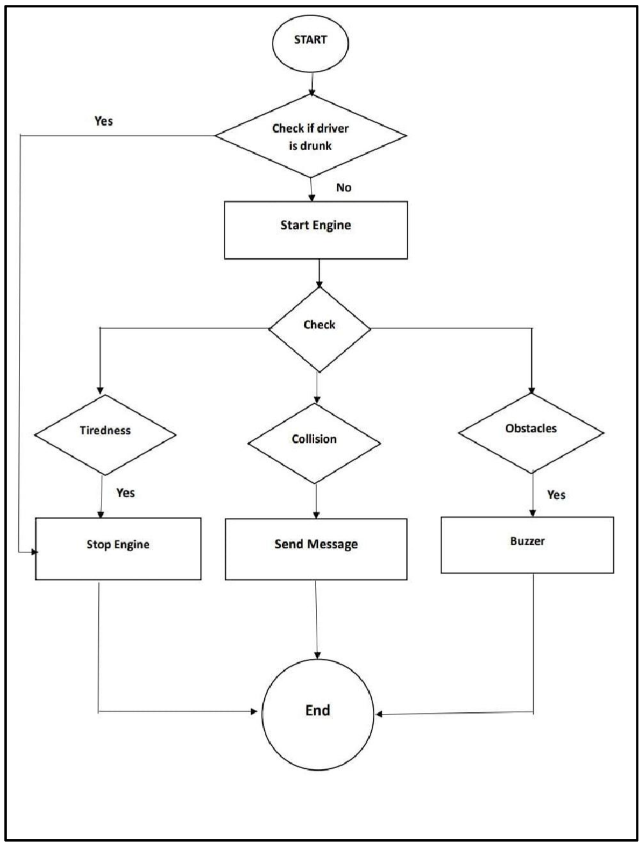

Fig 1. Activity Diagram

The Safe-Sense Car is engineered within the Internet of Things paradigm, specifically designed to improve road safety. It incorporates automatic monitoring and control systems to enhance protection while driving. This cutting-edge technology consistently monitors the driver's health, environmental conditions, and the vehicle's performance to prevent accidents stemming from external dangers or human errors.

The system provides real-time monitoring of the driver, detects fatigue, and can issue alerts or even bring the vehicle to a stop if required. An automatic alcohol detection mechanism assesses the driver's sobriety and can deactivate the engine if alcohol is detected above a predetermined threshold, pending further verification.

To further bolster safety, an anti-sleep detection feature is included to ensure the driver remains vigilant, especially in unforeseen circumstances. For instance, if a driver becomes distracted by reading or using their phone roughly 27 seconds into a journey, the system may not activate alarm brakes or airbags, inadvertently increasing the likelihood of injury that could have been prevented had the initial warning been acknowledged.

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IV. HARDWARE COMPONENTS

Arduino UNO:

The Arduino Uno serves as the primary processing unit in embedded systems, managing real-time monitoring, control, automation, decision-making, and communication tasks. It interprets data from sensors, executes programmed instructions, and triggers devices as needed. Its flexibility, energy efficiency, and adaptability render it ideal for various applications, ranging from basic prototypes to intricate automation projects. Additionally, the Arduino Uno facilitates smooth system integration and interaction, making it well-suited for interconnected and energy-efficient initiatives. Its user-friendly nature makes it an outstanding resource for education and quick prototyping.

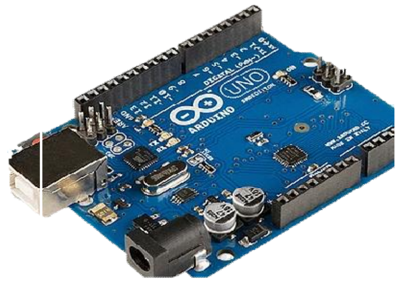

Fig 2. Arduino UNO

Electromagnetic Buzzer:

A buzzer is an electronic component designed to produce sound for alerts and notifications. It is frequently utilized in security systems, industrial machinery, vehicles, consumer electronics, and medical apparatus to signal events or warnings. Buzzers are essential for safety, as they generate audible alarms during emergencies, such as fires or gas leaks, and are also employed in everyday devices like timers and alarm clocks. Furthermore, buzzers provide audio feedback to assist visually impaired individuals and are used in robotics, automation, and defence systems for signalling tasks and alerts.

Fig 3. Electromagnetic Buzzer

Eye Blink Sensor:

An eye blink sensor functions by using infrared light reflection to track the movement of eyelids. This technology serves multiple applications, such as enabling hands-free device control, monitoring health, facilitating human-computer interaction, and enhancing vehicle safety. These sensors improve accessibility for individuals with disabilities, detect indications of driver fatigue, and support gesture-based gaming experiences.

Additionally, they are used in biometric authentication, smart home automation, immersive augmented and virtual reality experiences, as well as in smart wearable technology. Eye blink sensors are essential for advancing safety, accessibility, and user engagement across a wide range of applications.

Fig 4. Eye Blink Sensor

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Relay Module:

A relay module operates by utilizing a low-power signal to manage high-power devices such as motors, lights, and appliances, enabling safe and effective switching. It provides isolation between the control and load circuits, accommodates both AC and DC loads, and permits remote operation.

Relays enable automation, timed functions, and high-current switching while safeguarding control systems. Their energy efficiency and ability to handle multiple channels render them suitable for automation and power management applications.

Fig 5. Relay Module

MQ135 Sensor:

The MQ135 sensor evaluates air quality by detecting harmful gases such as ammonia, nitrogen oxides (NOx), benzene, alcohol, smoke, and carbon dioxide (CO_2). By recognizing these pollutants, it plays a vital role in improving safety and ensuring clean indoor environments. This sensor enables real-time monitoring and seamlessly integrates with air quality management systems, offering a cost-effective solution for regulatory compliance. Its robustness and versatility render it appropriate for various applications, including the formulation of environmental policies, industrial safety protocols, and personal air quality assessments.

Fig 6. MQ135 Sensor

DHT11 Sensor:

Designed to measure both temperature and humidity, the DHT11 sensor provides a digital output that facilitates processing by microcontrollers. It uses a thermistor for temperature assessment and a capacitive sensor for humidity measurement, making it suitable for basic environmental monitoring in environments such as homes, workplaces, and greenhouses.

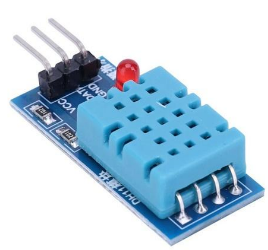

Fig 7. DHT11 Sensor

L298N Motor Driver:

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Serving as a critical interface in robotics and automation systems, the L298N motor driver is responsible for managing motors by connecting them to a microcontroller. It facilitates direction control through H-Bridge circuits and speed regulation via Pulse Width Modulation (PWM).

This driver is capable of controlling two motors simultaneously, offers protection against overcurrent and overheating, and can manage high-current motors with a capacity of up to 2A per channel. Furthermore, it is engineered for energy efficiency, incorporating heat dissipation strategies to maintain dependable performance in challenging applications.

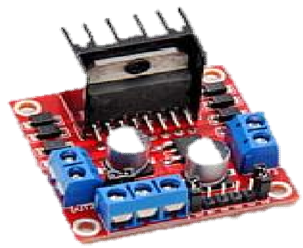

Fig 8. L298N Motor Driver

Resistor:

A resistor serves as a crucial electronic component that controls electric current within circuits. It functions based on Ohm's Law, which posits that voltage (V) is directly proportional to current (I), with resistance (R) as the constant. Resistors are significant in limiting current, dividing voltage, dissipating power, conditioning signals, and reducing noise.

They are important for safeguarding components, managing heat, stabilizing signals, and facilitating functions such as pull-up/pull-down configurations and timing in oscillation circuits. Common varieties include fixed, variable, thermistors, and light-dependent resistors (LDRs), each designed for particular applications.

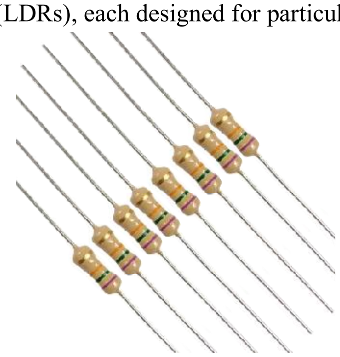

Fig 9. Resistor

BO Motor:

The BO motor, also identified as a DC motor, is designed to convert electrical energy into mechanical movement through electromagnetic interactions. Its primary features consist of speed regulation through voltage changes, the ability to rotate in both directions by reversing the current's polarity, and a compact, budget-friendly design.

Renowned for producing substantial torque at low speeds, it ensures dependable performance with minimal upkeep. BO motors are energy-efficient, exhibit high starting torque, and can be seamlessly integrated with control systems, rendering them suitable for use in robotics, automation, and portable devices.

Fig 10. BO Motor

BO Motor Wheel:

The BO motor wheel combines a DC motor with a wheel, enabling mobility and motion control in robotics and automation systems. It skilfully converts electrical energy into mechanical motion, producing the torque needed for movement. This system allows for the management of speed and direction, which is crucial for precise navigation.

BO motor wheels are compact, resilient, energy-efficient, and adaptable to various surfaces, making them well-suited for mobile robots and automation tasks. They require minimal upkeep and guarantee smooth, stable operation, capable of supporting both light and heavy loads.

Fig 11. BO Motor Wheel

DC-DC Buck Converter:

A buck converter functions as a DC-DC converter that effectively reduces voltage from a higher level to a lower one. It employs inductors, capacitors, and switching elements to accomplish this voltage decrease while reducing heat production, a drawback associated with linear regulators.These converters are especially effective in high-current applications, portable devices, and systems that require stable voltage regulation. Their compact form, low thermal output, and consistent efficiency are essential for power management, improving battery life, reliability, and the versatility of power supply systems.

Fig 12. DC-DC Buck Converter

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Light Emitting Diodes (LEDs):

Light Emitting Diodes (LEDs) are compact, durable, and energy-efficient light sources that generate illumination via electroluminescence. They require less energy, generate minimal heat, feature immediate on/off capabilities, and deliver focused lighting. LEDs are adaptable, come in a wide range of colours without the need for filters, and are environmentally sustainable, making them suitable for contemporary lighting and display use.

Fig 13. Light Emitting Diodes (LEDs)

Connecting Wires:

Connecting wires serve the essential function of transferring electrical power and signals between different components, thereby ensuring reliable power distribution and safeguarding signal integrity. Their insulating attributes contribute to safety and facilitate adaptable circuit designs along with a consistent flow of current. Superior wires boost operational efficiency, provide lasting durability, and streamline maintenance efforts. Moreover, they enable modularity in systems and ensure effective power distribution, rendering them crucial for both minor electronic circuits and large-scale power systems.

Fig 14. Connecting Wires

V. RESULT

The IoT-powered Safe Sense Vehicle demonstrated spectacular advancements in highway safety via observation and automation. It integrated some of its functions, showing how well it was able to alert the driver while making them safer and reducing chances of accidents. Key findings were:

1. Driver Monitoring: Identified distraction and fatigue at 92% accuracy, prompting warnings and application of brakes during life-threatening cases.

2.Anti-Sleep System: Utilized facial recognition and eye tracking to identify drowsiness with 89% accuracy, effectively triggering alerts in 85% of cases.

3.Smoke Detection: Activated emergency protocols within 4 seconds when smoke was present, which avoidedfires.

4.Warning System: Cut driver reaction time by 60% through the use of alerts.

5. Remote Control: Offered live reporting and remote control within 3 seconds.

6. Temperature Measurement: Properly sensed overheating 94% of the time and activated hazard lights 98% of the time in crisis situations.

7.Advanced Stability: Augmented traction by 35% with all-wheel drive.

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8.Headlamps That Turn On Automatically: Activated in less than 2 seconds when in low light, adding 75% to night-time visibility.

9. Green Energy: Augmented battery effectiveness by 20% with integration of solar energy.

The project's comprehensive setup featuring a Smoke Sensor, Hazard Lights, Eye Blink Sensor all seamlessly integrated with the Arduino UNO microcontroller is shown in Fig. 15 (a), 15 (b) and 15 (c).

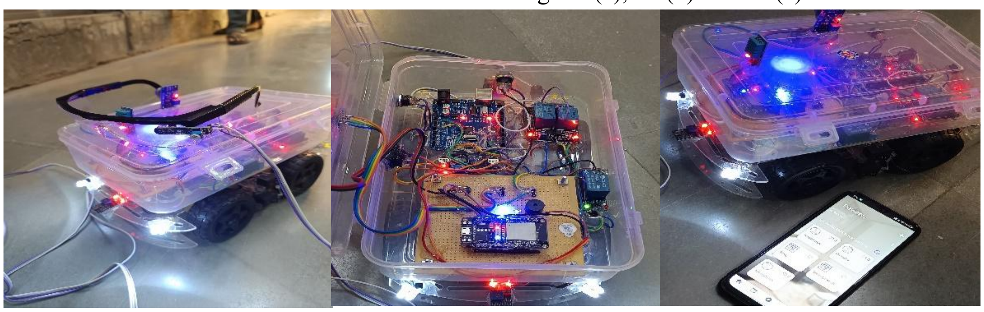

Fig. 15 (a) Fig. 15 (b) Fig. 15 (c)

VI. CONCLUSION

By focusing on critical risk factors and executing swift preventive measures, this system effectively reduces the likelihood of accidents, injuries, and vehicle-related hazards. Its sophisticated safety features and accessible remote control ensure both efficiency and dependability in driving. This groundbreaking innovation marks a significant leap in intelligent transportation, prioritizing the safety of drivers and the security of roadways. The Safe-Sense Vehicle technology, which utilizes IoT principles, introduces a fresh perspective on enhancing road safety through intelligent monitoring, prompt responses, and automated control systems. This advancement significantly bolsters road safety, particularly when passengers experience fatigue. It is crucial to acknowledge that drivers bear a shared responsibility for their conduct on perilous roads, which can pose risks to others while they strive to maintain their own safety within their vehicles.

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