ISSN: 2454-9940

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

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www.ijasem.org

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

ISSN2454-9940

www.ijsem.org

Vol 18, Issuse.1 March 2024

Seat belt alarm and controlling vehicle for enhanced method

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Abstract: *The Intelligent Vehicle Safety System represents advancement in road safety technology, with advanced sensors, including magnetic and accelerometer sensors, with an Arduino microcontroller, GSM module, and servo motor. By continuously monitoring seat belt compliance using a magnetic reed sensor and automatically adjusting seat belt tension through the servo motor, the system ensures occupants' safety. In the event of a collision, the accelerometer sensor swiftly identifies abrupt changes in vehicle acceleration, triggering immediate alerts via the GSM module to emergency services or designated contacts. This comprehensive approach not only promotes safer driving practices by encouraging seat belt usage but also facilitates prompt responses to accidents, ultimately minimizing injuries and potentially saving lives on the road*

Keywords: road safety, sensor integration, automated response mechanisms, seat belt compliance, accelerometer sensor, magnetic reed sensor

I. Introduction

In today's world, staying safe on the roads is more important than ever. That's where the Intelligent Vehicle Safety System comes in. Imagine driving in a car that not only reminds you to buckle up but also automatically tightens your seat belt for extra safety. Sounds pretty cool, right? Well, that's exactly what this system does.

First things first, let's talk about seat belts. You know, those straps you buckle up before hitting the road? The Intelligent Vehicle Safety System makes sure you're wearing them correctly. It uses a special sensor to check if your seat belt is fastened. If it's not, it gives you a friendly reminder to buckle up. And here's the neat part: if it sees that your seat belt is too loose, it can automatically tighten it for you! That means

you can focus on the road ahead while staying safe and secure.

But what if something unexpected happens, like a sudden stop or a crash? That's where the system really shines. It has another sensor called an accelerometer, which can sense when the car stops suddenly or gets into a collision. When it detects something like that, it sends a signal to a special device in the car called a GSM module. This module can quickly call for help, like an ambulance or the police, so they can come to your aid as soon as possible. It's like having a guardian angel looking out for you on the road.

The Intelligent Vehicle Safety System is like having a smart helper in your car, making sure you stay safe no matter what. From reminding you to buckle up to automatically calling for help in an emergency, it's got your back. So next time you hit the road, remember to thank technology for keeping you safe and sound.

II. Existing System

Traditional seat belt reminder systems in cars often use visual or beeping alerts to remind people to buckle up, but sometimes, these reminders can be ignored. When accidents happen, people usually have to call for help manually, which can take time, especially in busy or remote areas. Some cars have systems that can detect crashes, but they might not always automatically call for help. There are also newer systems that can automatically alert emergency services when a crash is detected, but these are mostly found in newer cars with fancy technology and might not be in every car yet.

III. Proposed system and its working

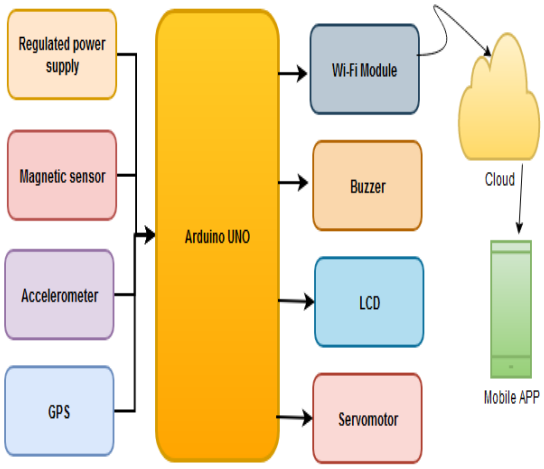

Fig 1: Block diagram of proposed system

The proposed Intelligent Vehicle Safety System is a comprehensive solution designed to make driving safer by integrating advanced sensors and communication modules into vehicles. It includes features like a magnetic reed switch to detect seat belt usage, an accelerometer to identify accidents, and a GPS module for location tracking. Additionally, there's a Wi-Fi module for connectivity, an LCD display for real-time feedback, a buzzer for audible alerts, and an Arduino Uno for controlling operations and processing data. This system not only actively monitors seat belt compliance but also detects accidents swiftly and accurately, ensuring timely

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

ISSN2454-9940

www.ijsem.org

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responses to emergencies.Moreover, the integration with the ThingSpeak cloud platform enables the transmission of sensor data for real-time monitoring and historical analysis. By combining these components, the system offers a holistic approach to enhancing road safety, aiming to reduce the severity of injuries in traffic accidents. From alerting drivers and passengers about seat belt non-compliance to providing immediate notifications in case of accidents, the Intelligent Vehicle Safety System strives to improve safety outcomes and promote responsible driving practices on the road.

IV. Component description and working

Arduino uno: The Arduino Uno serves as the central control unit of the Intelligent Vehicle Safety System, orchestrating the operation of various sensors and modules while processing data in real-time. As the brain of the system, the Arduino Uno manages the detection of seat belt compliance, accident identification, and communication with external platforms. Through its programmable capabilities, it analyzes sensor data, triggers alerts for seat belt non-compliance and accidents, and coordinates the transmission of information to the cloud-based ThingSpeak platform for further analysis. The Arduino Uno's versatility and reliability make it an essential component in ensuring the effectiveness and responsiveness of the safety system, ultimately contributing to enhanced road safety outcomes and the protection of occupants in vehicles.

Fig 2: Arduino uno

Magnetic sensor: The Magnetic Reed Switch serves as a critical component within the Intelligent Vehicle Safety System, effectively detecting the status of seat belts through changes in magnetic fields. When a seat belt is fastened, the switch remains closed, indicating compliance; however, if the seat belt is not properly secured, the switch opens, prompting immediate alerts to occupants to ensure their safety. This mechanism provides a reliable method for monitoring seat belt usage in real-time, contributing to enhanced road safety by promoting proper restraint practices among drivers and passengers.

Fig 3: Magnetic sensor

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

ISSN2454-9940

www.ijsem.org

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Accelerometer: The Accelerometer plays a pivotal role in the system by continuously measuring changes in vehicle acceleration. When sudden alterations indicative of a collision are detected, the accelerometer triggers the accident identification mechanism, enabling swift response to emergencies. By swiftly recognizing potential accidents, this component facilitates rapid deployment of emergency services, thereby mitigating the severity of injuries and reducing the likelihood of fatalities in traffic incidents. Its integration ensures proactive measures are taken to safeguard occupants and improve overall road safety outcomes.

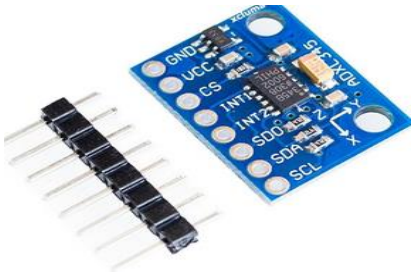

Fig 4: accelerometer

GPS module: The GPS Module is a key feature of the Intelligent Vehicle Safety System, providing precise real-time tracking of the vehicle's location. In the event of an accident, the module records the exact coordinates, facilitating prompt assistance from emergency services. This location data is crucial for ensuring timely responses and effective coordination during emergencies, particularly in remote or unfamiliar areas. By leveraging GPS technology, the system enhances emergency response capabilities, aiding in the reduction of response times and improving outcomes for individuals involved in accidents.

Fig 5: GPS module

Wi-Fi module: The Wi-Fi Module serves as the connectivity backbone of the Intelligent Vehicle Safety System, enabling seamless communication with external networks and services. By facilitating data transmission to the cloud-based platforms, such as ThingSpeak, the Wi-Fi module ensures that critical information regarding seat belt compliance, accident detection, and location tracking is promptly relayed for analysis and response. This connectivity feature enhances the system's effectiveness by enabling real-time monitoring and comprehensive data analysis, ultimately contributing to more informed decision-making and improved road safety outcomes.

Fig 6: Wi-Fi module

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

ISSN2454-9940

www.ijsem.org

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LCD display: The LCD Display provides occupants with essential real-time feedback on the status of seat belt usage and alerts for detected accidents. Through clear visual indicators and notifications, the display keeps drivers and passengers informed about safety-related events, encouraging adherence to seat belt regulations and promoting awareness of potential risks on the road. Its intuitive interface enhances user experience and reinforces the system's commitment to prioritizing occupant safety through proactive monitoring and timely alerts.

Fig 7: LCD display

Buzzer: The Buzzer serves as an additional layer of safety within the Intelligent Vehicle Safety System, emitting audible alerts in response to seat belt non-compliance and collision detection events. By providing audible warnings, the buzzer effectively communicates safety-critical information to occupants, ensuring that they are promptly alerted to potential hazards or emergencies. This audible alert mechanism enhances situational awareness and responsiveness, further reinforcing the system's objective of promoting safe driving practices and reducing the risk of injuries in traffic incidents.

Fig 8: Buzzer

Servo motor: The Servo Motor, an integral component of the Intelligent Vehicle Safety System, contributes to enhancing seat belt safety by automatically adjusting seat belt tension. Through precise control, the servo motor ensures that seat belts are snugly fastened, optimizing their effectiveness in restraining occupants during sudden stops or collisions. By proactively adjusting seat belt tension based on real-time conditions, the servo motor enhances occupant safety and comfort, thereby mitigating the risk of injuries in the event of a crash. Its integration underscores the system's commitment to innovative technologies aimed at improving road safety and protecting the well-being of drivers and passengers.

Fig 8: Servo motor

V. Working Algorithm

Initialization: The system initializes upon starting the vehicle, activating all components.

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

ISSN2454-9940

www.ijsem.org

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Seat Belt Monitoring: The Magnetic Reed Switch continuously monitors the status of seat belts. If the seat belt is fastened, the system proceeds to the next step. If not, it triggers an alert.

AccelerationMonitoring:The Accelerometer constantly measures changes in vehicle acceleration. Sudden changes indicative of a collision are detected. If no collision is detected, the system returns to monitoring seat belt status.

Accident Detection: Upon detecting a collision, the system proceeds to the next step. The GPS Module records the vehicle's current location coordinates.

Alert Generation: The Wi-Fi Module establishes a connection to external networks. The Arduino Uno processes the data from the sensors and determines the severity of the situation. If necessary, the LCD Display and Buzzer provide real-time feedback and audible alerts to occupants.

Emergency Response:The system transmits relevant data, including seat belt status, accident details, and location coordinates, to the cloud-based ThingSpeak platform. Emergency services are automatically notified with the vehicle's location for prompt assistance.

Continued Monitoring: The system continuously monitors seat belt compliance and vehicle acceleration for ongoing safety. It remains active until the vehicle is turned off, ensuring continuous protection for occupants.

VI. Results

Discussion: Before connecting the seat belt, shown in Fig 9: the Intelligent Vehicle Safety System provides several key indications and functionalities. Firstly, through the LCD display, the system visually communicates to occupants that the seat belt is not fastened, serving as a constant reminder to prioritize safety. Simultaneously, the system utilizes its accelerometer to monitor the vehicle's acceleration, ensuring that there are no sudden changes indicative of a collision before the journey begins. Additionally, the GPS module actively tracks the vehicle's current location coordinates, ready to provide crucial information in case of an emergency. Despite the seat belt not being connected, the system remains fully operational and alert, showcasing its readiness to respond to any safety-related events that may occur. Through visual and audible alerts, occupants are proactively reminded to fasten their seat belts, emphasizing the system's commitment to promoting safe driving practices from the moment the vehicle is started

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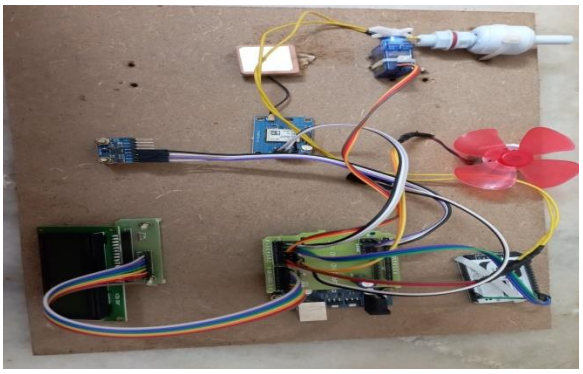

Fig 9: showing hardware and before connecting the seat belt

After connecting the seat belt, shown in Fig 10 the Intelligent Vehicle Safety System transitions into a state of active monitoring and enhanced safety. Once the seat belt is fastened, the system acknowledges this action through the magnetic reed switch, and the visual indicator on the LCD display changes to reflect that the seat belt is securely fastened. Additionally, the accelerometer continues to monitor vehicle acceleration, ensuring ongoing safety during the journey. With the seat belt properly secured, occupants are afforded an added layer of protection in the event of sudden stops or collisions. Moreover, the GPS module remains active, continually updating the vehicle's location coordinates, ready to provide accurate information to emergency services if needed. Throughout the journey, the system remains vigilant and prepared to respond to any safety-related events promptly.

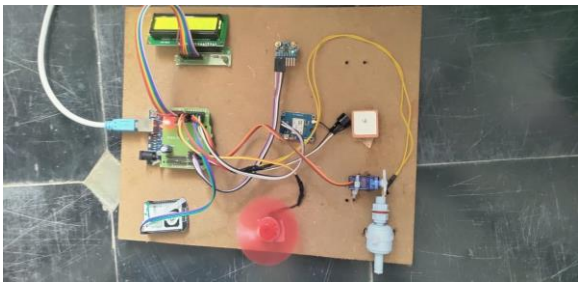

Fig 10: showing hardware and Afetr connecting the seat belt

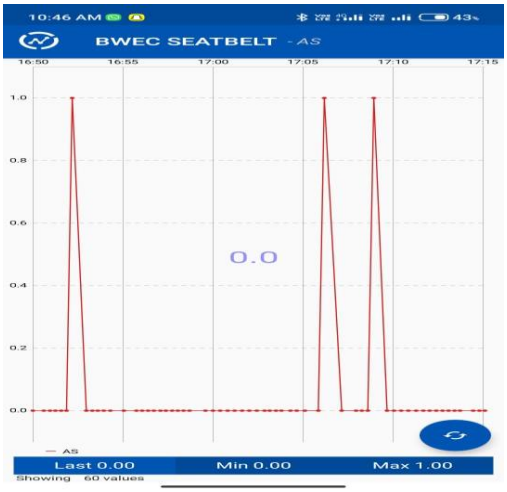

Fig 11: real time data sown in mobile app

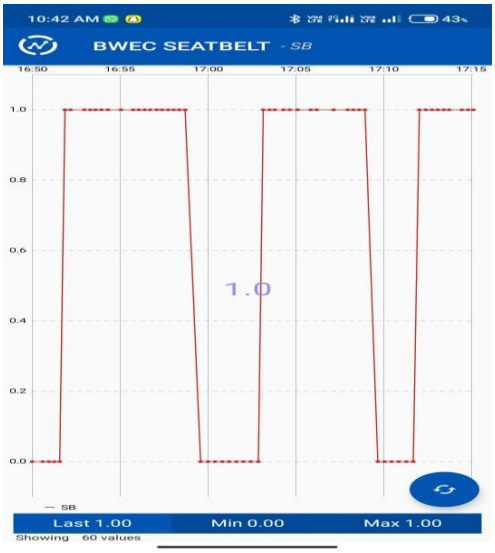

Fig 12: seat belt status shown in thingspeak interface

VII. Conclusion

In conclusion, the Intelligent Vehicle Safety System represents a significant advancement in promoting road safety and protecting occupants in vehicles. Through the

integration of advanced sensors, communication modules, and control mechanisms, the system offers a comprehensive approach to ensuring occupant safety before and after connecting the seat belt. From monitoring seat belt compliance and detecting accidents to facilitating swift emergency response, the system demonstrates its effectiveness in mitigating risks and reducing the severity of injuries in traffic incidents. By proactively reminding occupants to fasten their seat belts and providing real-time alerts and feedback, the system fosters a culture of responsible driving practices. Moreover, its seamless integration with cloud-based platforms enables continuous data analysis and monitoring, further enhancing its capabilities and responsiveness. Overall, the Intelligent Vehicle Safety System stands as a testament to the transformative power of technology in safeguarding lives on the road, offering a holistic solution to enhance road safety and protect occupants in vehicles.

VIII. Future Scope:

In the future, vehicle safety systems will get smarter with advanced technologies like AI and ML, helping to predict and prevent accidents. Vehicles will communicate with each other and the environment in real-time, using data to avoid collisions. Augmented reality interfaces will give drivers clear warnings about potential dangers, while health monitoring will ensure drivers are alert and safe. Cybersecurity will protect vehicles from digital threats, and environmental sensors will help monitor air quality. These improvements promise safer roads and better driving experiences for everyone.

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