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Enhanced technique of regulating the vehicle and seat belt alarm

Mr. N. Murugan, Mr. P. A. Prassath, Ms. C. Sasikala, Mr. D. Satyaraj

Assistant Professor [1,2,3,4]

Department of ECE,

nmurugan@actechnology.in, paprassath@actechnology.in, csasikala@actechnology.in, dsatyaraj@actechnology.in

Arjun College of Technology, Thamaraikulam, Coimbatore-Pollachi Highway, Coimbatore, Tamilnadu-642 120

Abstract: A servo motor, an Arduino microcontroller, a GSM module, and sophisticated sensors like accelerometers and magnetic fields make up the Intelligent Vehicle Safety System, which is a technological leap forward in the realm of road safety. The safety of the passengers is guaranteed by the system's ability to automatically alter the tension of the seat belts utilising the servo motor and a magnetic reed sensor that monitors compliance in real time. When a collision occurs, the accelerometer sensor quickly detects sudden acceleration changes and immediately notifies emergency services or specified contacts using the GSM module. This all-encompassing strategy not only encourages safer driving habits by urging people to wear seat belts, but it also allows for faster reactions in the event of an accident, which reduces injuries and might save lives.

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

I. Introduction

The importance of driving safely has never been higher than it is in the modern world. The role of the Intelligent Vehicle Safety System is to address this. Envision being behind the wheel of a vehicle that tightens your seat belt without your intervention, in addition to reminding you to do so. It sounds awesome, doesn't it? This system accomplishes just that.
Before anything else, let's address the topic of seat belts. Those safety belts you fasten before you set off on your journey? Make sure you're wearing them appropriately with the help of the Intelligent Vehicle Safety System. If your seat belt is secured, it will let you know via a specialised sensor. It will remind you to fasten your seatbelt if it isn't. The cool thing is that it can tighten your seat belt automatically if it detects that it's too loose! As a result, you won't have to worry about anything other than the road ahead of you.
What if, however, an unforeseen event occurs, such as an accident or an abrupt

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halt? The system really excels in that regard. An accelerometer is another sensor on board that may detect abrupt stops or collisions. A GSM module is a specialised gadget in the vehicle that receives signals from devices like that. This module may swiftly summon assistance, such as an ambulance or the police, to ensure that they arrive at your rescue without delay. It's as if you have an angel watching out for you when you drive.

Having an IVS in your automobile is like having a smart assistant that will keep you safe in any situation. It has your back in every way, from sending an immediate aid request in the event of an emergency to reminding you to fasten your seatbelt. Keep in mind to express gratitude to technology for ensuring your safety the next time you go on a road trip.

II. Existing System

The old-fashioned way of reminding passengers to fasten their seatbelts—by flashing lights or making a noise—isn't always effective. It might be particularly time-consuming in crowded or isolated places to manually call for aid when accidents happen. Even while they don't usually immediately summon assistance, certain vehicles do feature accident detection systems. Additionally, some more recent models include systems that may notify the authorities automatically in the event of a collision; however, these systems are often reserved for more high-tech vehicles and may not be standard in everyday vehicles just yet.

III. Proposed system and its working

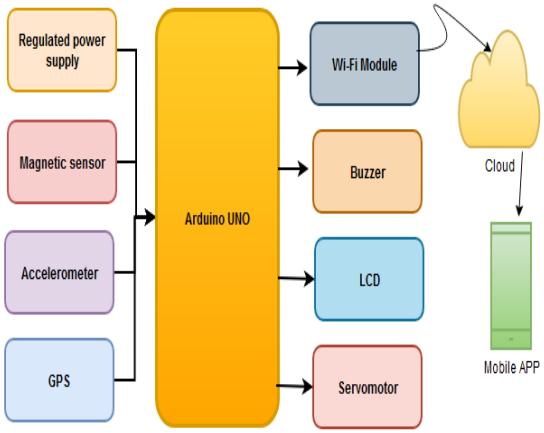

Fig 1: Block diagram of proposed system

Integrating state-of-the-art sensors and communication modules into cars, the proposed Intelligent Vehicle Safety System offers a holistic solution to enhance driving safety. An accelerometer can detect accidents, a magnetic reed switch can detect whether a seat belt is being used, and a GPS module can monitor its whereabouts. On top of that, there's an Arduino Uno for processing data and controlling operations, a Wi-Fi module for connection, an LCD screen for real-time feedback, and a buzzer for auditory alarms. Timely reactions to crises are ensured by this system's ability to identify accidents quickly and precisely and actively checks seat belt compliance.Additionally, sensor data may be sent for real-time monitoring and historical analysis via the interface with the ThingSpeak cloud platform. Through the integration of these elements, the system provides a comprehensive strategy for improving road safety, with the goal of minimising the impact of traffic accidents on victims. The Intelligent Vehicle Safety System's primary goal is to increase road

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safety by promoting responsible driving and sending timely alerts in the event of an accident or when a driver or passenger fails to wear a seat belt.

IV. Component description and working

Arduino uno: A number of sensors and modules make up the Intelligent Vehicle Safety System, and the Arduino Uno is in charge of controlling them all and analysing data in real-time. The system's central processing unit (CPU), the Arduino Uno, handles tasks such as detecting if a seat belt is properly fastened, identifying accidents, and communicating with other platforms. Its configurable features allow it to receive data from sensors, process it, and then send the results to the cloud-based ThingSpeak platform for further analysis in the event of an accident or non-compliance with seat belt regulations. Due to its adaptability and dependability, the Arduino Uno is a crucial part of the safety system, which plays a role in improving road safety and protecting individuals in cars.

Fig 2: Arduino uno

Magnetic sensor: An integral part of the ITS, the Magnetic Reed Switch monitors changes in magnetic fields to determine if the seat belts are fastened. When a seat belt is buckled, the switch stays closed to show that everyone is following the safety rules; however, if someone isn't buckled up, the switch opens and everyone is immediately warned to buckle up. Increased road safety is a direct result of this mechanism's ability to reliably track passengers' and drivers' use of seat belts in real time.

Fig 3: Magnetic sensor

Accelerometer: An essential component of the system, the accelerometer monitors the vehicle's acceleration in real time. The accelerometer activates the accident detection system, allowing for rapid reaction in the event of an emergency, if it detects abrupt changes that are suggestive of a collision. The component's ability to detect possible accidents quickly allows for the speedy deployment of emergency services, which in turn reduces the severity of injuries and the possibility of deaths in traffic events. By incorporating it, you can be certain that preventative actions will be made to protect passengers and enhance road safety in general.

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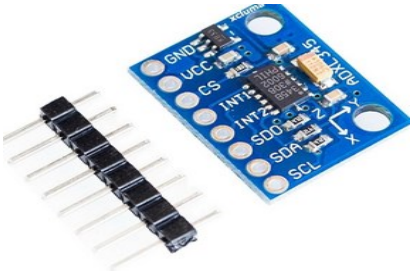

Fig 4: accelerometer

GPS module: An integral part of the IVSS, the GPS Module pinpoints the exact whereabouts of the vehicle in real time. The precise coordinates are recorded by the module in the case of an accident, allowing emergency personnel to respond quickly. In unfamiliar or distant places, this location data is especially important for rapid reactions and good coordination in times of crisis. Thanks to GPS technology, the system improves emergency response capabilities. This means that response times are reduced and accident victims have better results.

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

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

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Buzzer: When the Intelligent Vehicle Safety System detects an accident or a passenger not wearing a seat belt, the Buzzer will sound an audible alarm to provide an extra degree of protection. The buzzer successfully conveys safety-critical information to occupants via auditory warnings, guaranteeing that they are quickly alerted to any dangers or crises. The enhancement of situational awareness and reactivity via this auditory warning mechanism further supports the system's goal of encouraging safe driving habits and minimising the probability of injuries in traffic accidents.

Fig 8: Buzzer

Servo motor: One way the Servo Motor, a part of the ITS, helps make seat belts safer is by changing the tension on them automatically. The servo motor precisely adjusts the tension of the seat belts to maximise their ability to restrain passengers in the event of an emergency stop or accident. The servo motor reduces the likelihood of injuries in an accident by actively altering the tension of the seat belts in response to current circumstances, improving the safety and comfort of the occupants. Its incorporation demonstrates the system's dedication to cutting-edge technology that safeguard drivers and passengers on the road.

Fig 8: Servo motor

V. Working Algorithm

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

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.

Acceleration Monitoring: 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

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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: The Intelligent Vehicle Safety System offers several important signals and functionality before the seat belt is connected, as illustrated in Figure 9. Firstly, the device clearly indicates to passengers that their seat belt is not tightened via the LCD display. This serves as a continual reminder to prioritise safety. At the same time, the system checks the vehicle's acceleration using its accelerometer to make sure there aren't any unexpected changes that may mean a collision is imminent before the trip starts. In addition, the GPS module constantly records the exact coordinates of the car, so it can be quickly and accurately located in an emergency. Even without the safety belt on, the system continues to function normally, demonstrating its preparedness to handle any situation involving safety. The system's dedication to encouraging safe driving behaviours begins the minute the car is started, with visual and audio prompts that proactively remind passengers to buckle their seat belts.

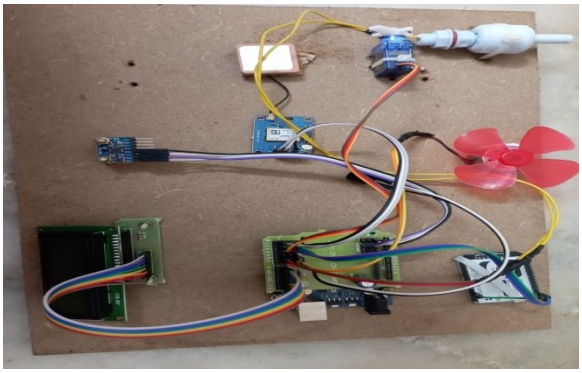

Fig 9: showing hardware and before connecting the seat belt

The Intelligent Vehicle Safety System enters a state of active monitoring and increased safety once the seat belt is connected, as illustrated in Fig. 10. The system recognises when the seat belt is secured using the magnetic reed switch, and the LCD display updates to show that the belt is firmly attached. On top of that, the accelerometer keeps an eye on the car's acceleration, so it's fair to say that safety is never compromised on the road. When passengers fasten their seat belts, they are more protected in the case of an emergency, such as an abrupt halt or accident. Additionally, the GPS module is always on, updating the vehicle's position coordinates so that emergency agencies may get precise information in an emergency. All the way through the trip, the system is on high alert and ready to react quickly to any safety-related incidents.

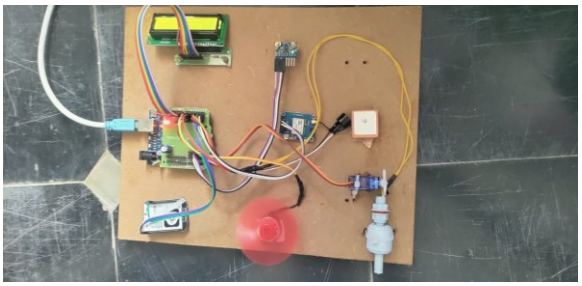

Fig 10: showing hardware and Afetr connecting the seat belt

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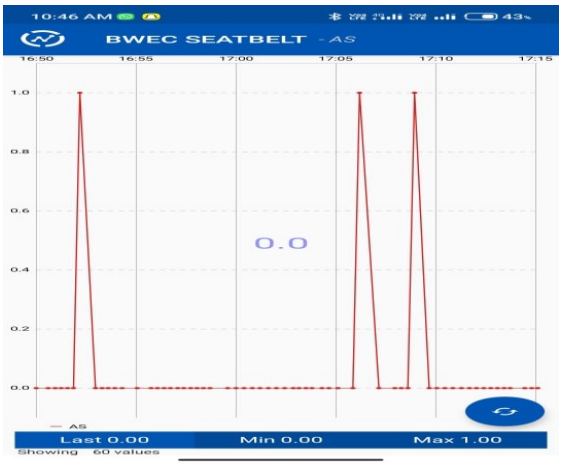

Fig 11: real time data sown in mobile app

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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