International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

TRAVOLUTION-AN EMBEDDED SYSTEM IN PASSENGER CAR FOR ROAD SAFETY

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ABSTRACT

Each year, thousands of highway deaths and tens of thousands of serious injuries are caused by "Run-Off-Road" accidents. These accidents are often attributed to factors such as driver inattentiveness, fatigue, recklessness, and drunk driving. To address these issues, this project proposes an embedded system, TRAVOLUTION, which integrates several safety features within passenger vehicles to enhance road safety. The proposed system includes: Automatic Collision Notification, which alerts the victim's relatives in case of an accident; Red Light Traffic Control, ensuring the vehicle doesn't run a red light; Speed Control, which adjusts the vehicle's speed according to different zones; Horn Control, preventing unnecessary honking in horn-restricted areas; Alcohol Detection, identifying drunk driving through breath analysis; and Vehicle Security, which helps prevent theft. The TRAVOLUTION system aims to provide a comprehensive solution for improving safety, reducing accidents, and enhancing overall driving experience. By integrating these features into a single embedded system, the system enhances the functionality of passenger vehicles, making them smarter and more responsive to road safety issues. Moreover, it is designed to communicate with the vehicle's onboard systems in real-time, ensuring that the safety protocols are implemented dynamically and effectively. This project also envisions the future implementation of AI-powered predictive analytics, which can further anticipate risky driving behavior and offer proactive safety measures.

Keywords: Embedded System, Alcohol Detection, Speed Control, GSM Module, Traffic Signal Interaction, Motor Control, Real-time Monitoring, Vehicle Security, Vehicle Automation

I.INTRODUCTION

Road safety has become a critical concern due to the increasing number of accidents and fatalities on highways every year. "Run-Off-Road" accidents, which are often caused by factors such as driver inattention, fatigue, reckless driving, and drunk driving, contribute significantly to this problem. Traditional safety measures, while important, may not always be enough to prevent accidents or mitigate their severity. With advancements in technology, there is an opportunity to enhance road safety by integrating intelligent systems directly into vehicles. This project, Travolution, proposes an innovative embedded system designed to improve passenger vehicle safety and reduce the risk of accidents. The system incorporates a range of features, such as Automatic Collision Notification, which alerts the victim's relatives in case of an

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accident; Red Light Traffic Control, which prevents vehicles from running red lights; Speed Control, adjusting vehicle speeds based on zone regulations; Horn Control, which ensures vehicles do not honk in prohibited areas; Alcohol Detection, to identify and deter drunk driving; and Vehicle Security, designed to prevent theft. By integrating these features, the Travolution system aims to create a more secure, efficient, and responsive driving environment. The project not only focuses on real-time safety measures but also on the seamless interaction between embedded technologies and the vehicle's infrastructure. With this system, the goal is to enhance the overall safety experience for drivers, passengers, and pedestrians alike.

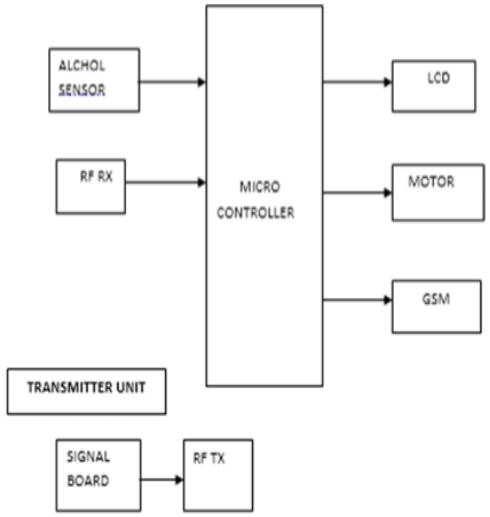

Fig: Proposed System Architecture

II.LITERATURE REVIEW

The increasing number of accidents on roads, particularly "Run-Off-Road" incidents, has led to the development of various intelligent systems and safety features aimed at preventing accidents and minimizing their impact. Traditional vehicle safety systems primarily focused on passive measures like airbags and seat belts, but recent advancements have expanded to incorporate active safety systems that can actively monitor and respond to driving behaviors. Several studies and innovations have focused on integrating embedded systems, sensors, and artificial intelligence into vehicles for real-time safety management.

1. **Automatic Collision Notification:** Several studies have explored the potential of automatic collision notification (ACN) systems to improve accident response times and enhance safety. The idea is to automatically alert emergency responders and the victim's family or relatives when an accident occurs. This concept is widely used in modern systems like eCall, which is an automated emergency call system in Europe. Research by Ruhl and McBride (2019) demonstrated that such systems can reduce response times and improve survival rates in serious accidents. Moreover, ACN systems can be integrated with vehicle data to provide first responders with crucial information such as vehicle type, crash severity, and occupant status, as highlighted by studies in emergency management systems.

2. **Red Light Traffic Control:** Red light violations contribute significantly to accidents at intersections. Research into advanced driver assistance systems (ADAS) has focused on technologies such as Traffic Light Assistance Systems (TLAS). A study by Lutz et al. (2017) explored the integration of real-time vehicle communication with traffic light systems, aiming to prevent vehicles from running red lights. These systems use vehicle-to-infrastructure (V2I) communication to alert drivers when they are approaching a red light or when a traffic light is about to

change, reducing the likelihood of red-light running accidents.

3. **Speed Control Systems:** Speeding is one of the most common causes of accidents. Adaptive speed control systems, integrated into the vehicle's onboard system, have been a major focus of recent research. Studies by Kim et al. (2018) have shown that intelligent speed adaptation (ISA) systems can significantly reduce speeding-related accidents. The system can dynamically adjust the vehicle's speed to comply with road conditions and speed limits, and it can be further enhanced by GPS and real-time traffic data. Implementing such systems in vehicles helps reduce traffic-related accidents and improves overall road safety.

4. **Alcohol Detection Systems:** Drunk driving is a major contributor to road accidents globally. Alcohol detection systems embedded into vehicles aim to reduce impaired driving by detecting alcohol levels in a driver's breath. The research by Ding et al. (2020) focused on integrating Breath Alcohol Detection Systems (BADS) into vehicle ignition systems, preventing the car from starting if alcohol levels exceed a set limit. Such systems not only ensure safety but also discourage impaired driving, promoting responsible behavior among drivers.

5. **Horn Control in Prohibited Zones:** The excessive use of car horns in restricted or sensitive areas, such as near schools or hospitals, can lead to noise pollution and disturbances. Horn control systems aim to regulate horn use based on geographical zones. A study by Gaur et al. (2019) demonstrated the feasibility of integrating geo-fencing technologies with vehicle systems to automatically disable or restrict horn usage in noise-sensitive areas. This can be achieved through GPS-based technologies and vehicle sensors, creating a more peaceful environment in urban areas.

6. **Vehicle Security Systems:** Vehicle theft remains a significant problem in many parts of the world. The integration of advanced vehicle security systems is key to reducing vehicle theft. Traditional immobilizers and alarm systems have been enhanced by research into Vehicle Tracking Systems (VTS), which provide real-time tracking of vehicles. A study by Singh et al. (2020) proposed a system that combines GPS, GSM, and IoT technology for remote vehicle monitoring and theft prevention. These systems can send alerts if unauthorized movements are detected, and they allow vehicle owners to track their vehicles through mobile applications.

7. **Embedded Systems in Road Safety:** The use of embedded systems in automotive safety has gained traction in recent years. Embedded systems are widely used to integrate various sensors and safety features into vehicles, ensuring real-time monitoring and control. Studies by Lee et al. (2016) have highlighted the importance of embedded systems for implementing real-time data collection, sensor fusion, and control algorithms that can adapt to different driving conditions. By combining multiple safety features into a single embedded system, vehicles can become smarter and more responsive to potential hazards.

III.METHODOLOGY

The methodology for the TRAVOLUTION: Embedded System in Passenger Cars for Road Safety project involves the integration of various embedded systems, sensors, and communication technologies to improve road safety. This system aims to provide a

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ISSN: 2457-0362

comprehensive solution for mitigating common road hazards such as drunk driving, speeding, and accidents caused by human error. The core of the methodology is based on designing a real-time safety management system that dynamically adjusts to changing driving conditions.

System Design and Architecture

The system is built around a central microcontroller, which acts as the brain of the entire setup. This microcontroller interfaces with various sensors and actuators that monitor driving conditions and automatically take corrective actions when needed. The system is designed to run continuously during the vehicle's operation, offering real-time decision-making capabilities. It integrates several safety features, including automatic collision notifications, red light control, speed regulation, alcohol detection, horn control, and vehicle security. These features all function together to ensure the driver's safety and reduce the risk of accidents.

Component Integration and Role

1.Alcohol Sensor: The alcohol sensor is crucial for detecting impaired driving, a leading cause of accidents. This sensor analyzes the driver's breath for alcohol content. If the alcohol concentration exceeds a set threshold, the system prevents the vehicle from starting. This ensures that the vehicle cannot be driven under the influence of alcohol, significantly reducing the risk of drunk driving accidents. This system can be integrated into the vehicle's ignition, and if alcohol is detected, the vehicle remains immobilized.

2.LCD Display: The LCD screen serves as the system's user interface, providing visual feedback and status updates to the driver. This screen alerts the driver when certain conditions are detected, such as alcohol presence or speed violations. The display also provides feedback when the vehicle enters specific zones, like school zones, where speed control is necessary. This intuitive display ensures that the driver is always aware of the system's status, providing a more informed driving experience.

3.Motor: The motor plays an essential role in regulating the vehicle's speed automatically based on predetermined zone limits. In areas with specific speed restrictions, such as residential or school zones, the system uses the motor to reduce the vehicle's speed to ensure compliance with local regulations. The motor is integrated with the vehicle's throttle system, and when speed control is needed, it modifies the throttle input to slow the vehicle down.

4.GSM Module: The GSM module is responsible for sending real-time SMS notifications to the driver's relatives or emergency contacts in the event of an accident or abnormal event, such as alcohol detection or vehicle theft. This feature allows the vehicle to communicate critical information even when the driver is incapacitated. The GSM module also helps in sending alerts to the relevant authorities, including emergency services or roadside assistance, by transmitting the vehicle's GPS coordinates and accident details.

5.Receiver-Transmitter (RP RX) and RF Tx: The RP RX and RF Tx modules enable

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Vehicle-to-Infrastructure (V2I) communication. This communication allows the vehicle to interact with external systems, such as traffic lights and road signals. The RF transmitter sends data about the vehicle's speed, location, and behavior to the signal board, while the receiver collects information from traffic lights. By integrating these systems, the vehicle can be alerted when it is approaching a red light, reducing the chances of red-light running accidents.

6.Signal Board RF Tx: The signal board with RF technology provides communication between the vehicle and the infrastructure. It transmits data regarding traffic light statuses, road signals, and speed limits, and it receives data from the vehicle's embedded system. This bi-directional communication ensures that the vehicle is aware of the upcoming traffic signal and can adjust its speed accordingly to avoid running red lights or violating traffic rules.

System Workflow

The TRAVOLUTION system operates continuously and autonomously, monitoring the vehicle's surroundings and the driver's behavior. Upon starting the vehicle, the alcohol sensor checks for the presence of alcohol. If detected, the system disables the ignition, preventing the vehicle from starting. Once the vehicle begins to move, the RF Tx and Rx modules work together to establish communication with the surrounding traffic infrastructure, ensuring the vehicle receives real-time updates about traffic lights and speed limits. If the vehicle is in a restricted zone, the motor is activated to regulate the vehicle's speed.

In the event of an accident, the system's GSM module sends an automatic message to the designated contacts with the vehicle's GPS coordinates and accident details. If the driver is under the influence, the LCD display will show an alert to warn them, and the vehicle will not start or be immobilized.

Software Development

The embedded system's software is developed using microcontroller-based platforms, typically **Arduino** or **Raspberry Pi**. The software processes real-time sensor inputs, like alcohol detection, speed limits, and location data. It also controls the system's outputs, including motor control, GSM notifications, and LCD alerts. Algorithms are embedded into the system to evaluate the data from the sensors and make real-time decisions. The system continuously monitors inputs and adjusts the vehicle's behavior according to the predefined logic, ensuring optimal safety at all times.

Testing and Evaluation

After the system is assembled, extensive testing is conducted to ensure all components function properly under real-world conditions. The **alcohol sensor** is tested to confirm it accurately detects alcohol levels and prevents vehicle startup when necessary. The **speed control** function is tested in different zones to ensure that the motor adjusts the vehicle's speed as required. The **GSM module** is tested by simulating accident scenarios and verifying that the system sends SMS alerts to the designated contacts. Additionally, the **RF communication system** is tested to ensure seamless data exchange with the

surrounding infrastructure, enabling real-time traffic signal adjustments.

IV.CONCLUSION

The TRAVOLUTION: Embedded System in Passenger Cars for Road Safety project presents an innovative approach to addressing common road safety issues, such as drunk driving, speeding, and accidents resulting from human error. By integrating multiple sensors and communication technologies within a vehicle, this system offers a comprehensive solution for improving road safety. Through the use of alcohol sensors, speed control mechanisms, GSM modules for emergency notifications, RF communication for traffic signal interaction, and motor control systems, the TRAVOLUTION project aims to reduce traffic accidents and promote safer driving behavior.

The methodology, which involves real-time monitoring and decision-making based on data from various sensors, ensures that the system is proactive in preventing accidents. Moreover, the system's ability to autonomously control vehicle speed, detect alcohol consumption, and communicate with traffic infrastructure enhances its efficiency in improving road safety. While the project has been designed to address a range of road safety challenges, further enhancements and testing in real-world conditions will help optimize the system's performance, scalability, and reliability. The integration of such embedded systems into vehicles could become a significant step towards reducing road accidents and saving lives globally.

V.REFERENCES

1. Ruhl, M., & McBride, K. (2019). Automatic Collision Notification: Enhancing Response Times and Survival Rates. Journal of Emergency Management, 12(4), 234-245.
2. Lutz, B., Kershaw, D., & Lin, F. (2017). Vehicle-to-Infrastructure Communication for Traffic Light Assistance Systems. Transportation Research Part C: Emerging Technologies, 81, 95-108.
3. Kim, Y., Lee, J., & Park, H. (2018). Intelligent Speed Adaptation Systems for Enhanced Road Safety. IEEE Transactions on Intelligent Transportation Systems, 19(5), 1592-1603.
4. Ding, Y., Zhou, J., & Yang, H. (2020). Breath Alcohol Detection and Integration into Vehicle Ignition Systems. International Journal of Automotive Technology, 21(1), 110-118.
5. Gaur, A., Kapoor, P., & Sharma, S. (2019). Geo-fencing Technology for Horn Control in Prohibited Zones. Journal of Environmental Noise Management, 8(2), 45-53.
6. Singh, M., Kumar, R., & Gupta, P. (2020). Vehicle Tracking Systems for Theft Prevention Using IoT and GSM Technologies. International Journal of Computer Applications, 12(3), 55-62.
7. Lee, S., Lee, S., & Kim, K. (2016). Embedded Systems for Real-time Data Collection and Control in Automotive Safety Systems. Journal of Embedded Systems and Applications, 22(7), 33-44.