

Advance vehicle security monitoring system using IOT

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Abstract: The rapid growth of vehicles has increased concerns regarding vehicle theft, unauthorized access, and road accidents. Traditional vehicle security systems provide limited protection and lack intelligent monitoring capabilities. This paper presents an IoT-based vehicle security system that integrates fingerprint authentication, GPS tracking, ultrasonic sensing, IR-based intrusion detection, and seatbelt monitoring. The proposed system enhances vehicle security by allowing access only to authorized users, tracking vehicle location in real time, preventing collisions, and ensuring driver safety. The system also generates alerts to the vehicle owner during theft attempts or suspicious activities. By combining IoT technologies with smart sensors, the proposed solution offers an effective, reliable, and cost-efficient vehicle security mechanism.

KEYWORDS- Internet of Things (IoT), Vehicle Security, GPS Tracking, Fingerprint Authentication, GSM, Ultrasonic Sensor, IR Sensor, Accident Prevention, Smart Vehicle Monitoring.

INTRODUCTION

The increasing number of vehicles worldwide has led to a significant rise in vehicle thefts and road accidents. Conventional security systems such as mechanical locks and alarm systems provide limited protection and are often unable to prevent unauthorized access effectively. At the same time, ensuring driver safety and real-time vehicle monitoring has become a major concern. Internet of Things (IoT) technology enables intelligent communication between devices, allowing vehicles to be monitored and controlled remotely. The proposed vehicle security system utilizes

biometric authentication, GPS-based tracking, ultrasonic sensors, and intrusion detection mechanisms to enhance vehicle protection. The system not only prevents theft but also improves road safety by incorporating accident avoidance and seatbelt-based engine control features.

RELATED WORK

Several researchers have proposed vehicle security and tracking systems using technologies such as GPS, GSM, Raspberry Pi, and IoT platforms. Existing studies primarily focus on vehicle tracking and location monitoring. GPS and GSM-based systems provide effective tracking but offer limited protection against unauthorized vehicle access.

Some solutions utilize smartphone applications for remote monitoring, while others focus on accident detection and emergency reporting. Although these approaches improve vehicle management, they often lack integrated security mechanisms such as biometric authentication, intrusion detection, and accident prevention. Therefore, there is a need for a comprehensive system that combines vehicle security, tracking, and safety features within a single IoT framework.

LITERATURE SURVEY

Several researchers have proposed IoT-based vehicle security and tracking systems to address issues such as vehicle theft, monitoring, and road safety. A vehicle tracking and anti-theft system using IoT employed GPS and GSM modules to monitor vehicle locations in real time and provide theft protection. The use of open-source technologies made the system cost-effective, while mobile network security standards ensured reliable communication. Another study utilized a Raspberry Pi-based architecture for vehicle monitoring and tracking. The system was capable of transmitting the vehicle's current location and speed to the owner's mobile device during emergencies such as theft or accidents, thereby improving vehicle safety and monitoring capabilities.

Further research focused on GPS-based vehicle data handling and analysis, where vehicle movement, speed, latitude, and longitude information were collected and analyzed using statistical techniques. The study demonstrated improved efficiency in vehicle tracking through graphical and tabular representations of collected data. Additionally, a GPS/GSM/GPRS-based vehicle tracking system integrated smartphone applications with a microcontroller-based in-vehicle unit. The system acquired vehicle location

information and transmitted it to a remote server through mobile communication networks, enabling continuous monitoring. Although these systems provided effective tracking and monitoring functionalities, they primarily focused on location tracking and lacked advanced security features such as biometric authentication, intrusion detection, accident avoidance, and driver safety mechanisms. These limitations highlight the need for a more comprehensive IoT-based vehicle security system that combines tracking, theft prevention, and safety features within a single platform.

EXISTING METHOD

The existing vehicle security systems mainly focus on vehicle tracking and theft detection using GPS and GSM technologies. These systems allow users to monitor the location of their vehicles and receive notifications during theft incidents. Some solutions employ smartphone applications and Raspberry Pi-based platforms to provide real-time tracking and monitoring.

Mechanical locking systems and alarm-based security mechanisms are also commonly used to prevent unauthorized access. However, these approaches offer limited protection because they primarily

concentrate on tracking rather than preventing theft. Furthermore, they do not include advanced security features such as biometric authentication, intelligent intrusion detection, accident-avoidance mechanisms, or driver safety monitoring. As a result, existing systems are unable to provide comprehensive security and safety for modern vehicles.

PROPOSED METHOD

The proposed IoT-based vehicle security system integrates multiple technologies to provide enhanced vehicle protection, monitoring, and safety. A fingerprint-based biometric door lock is used to ensure that only authorized users can access the vehicle, while unauthorized access attempts trigger alerts to the owner. The system incorporates a GPS module for real-time vehicle tracking, enabling continuous monitoring of the vehicle's location. An ultrasonic sensor is installed to detect nearby obstacles and prevent collisions by stopping the vehicle when the distance falls below a predefined threshold.

An IR sensor is used for window protection, detecting any obstruction or intrusion attempt during window operation. Additionally, a seatbelt-based ignition mechanism ensures that the

vehicle engine starts only when the driver wears the seatbelt, thereby improving road safety. By combining biometric authentication, real-time tracking, accident avoidance, intrusion detection, and driver safety features, the proposed system offers a comprehensive, reliable, and cost-effective solution for vehicle security and monitoring.

SYSTEM ARCHITECTURE

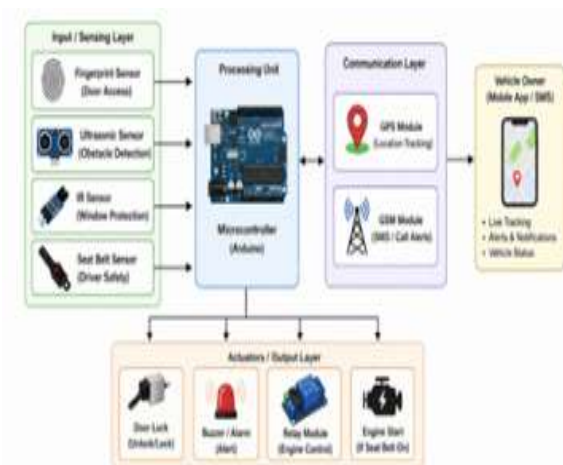


Fig.1 System Architecture

MODULE DESCRIPTION

Fingerprint Authentication Module:

This module provides secure access to the vehicle using biometric verification. A fingerprint sensor scans the user's fingerprint and compares it with the fingerprints stored in the database. If a match is found, the vehicle door is unlocked; otherwise, access is denied and

an alert is generated. This module enhances security by preventing unauthorized vehicle access.

GPS Tracking Module: The GPS module continuously monitors the vehicle's geographical location and sends real-time coordinates to the authorized user. In case of theft or unauthorized movement, the vehicle owner can track the exact location through a mobile application. This module improves vehicle monitoring and recovery capabilities.

GSM Communication Module: The GSM module enables communication between the vehicle security system and the vehicle owner. It sends SMS alerts and notifications whenever suspicious activities such as unauthorized access attempts or theft are detected. This ensures immediate awareness and response from the vehicle owner.

Ultrasonic Sensor Module: The ultrasonic sensor module is used for obstacle detection and accident prevention. It continuously measures the distance between the vehicle and nearby objects. If an obstacle is detected within a predefined safety range, the system alerts the driver or stops vehicle movement, thereby reducing the risk of collisions.



IR Sensor Module: The IR sensor is installed near the vehicle window to detect obstacles or intrusion attempts. When an object or hand is detected during window operation, the sensor sends a signal to the controller, which immediately stops the window movement. This module provides protection against theft through vehicle windows.

Seat Belt Safety Module: This module ensures driver safety by verifying whether the seat belt is properly fastened. The engine ignition process is enabled only when the seat belt is worn. This safety feature encourages compliance with safety regulations and minimizes injury risks during accidents.

Microcontroller Module: The microcontroller acts as the central processing unit of the system. It receives data from all sensors, processes the information, and controls various outputs such as door locks, alarms, engine control, and communication modules. It coordinates the overall operation of the vehicle security system.

Alert and Alarm Module: The alert module includes a buzzer and notification system that generates warnings whenever unauthorized access, theft attempts, or unsafe conditions are detected. Alerts are

transmitted to the vehicle owner through GSM and mobile applications, ensuring quick action against security threats.

Mobile Application Module: The mobile application provides an interface for users to monitor vehicle status, receive alerts, and track vehicle location in real time. It improves user convenience by allowing remote supervision and management of the vehicle security system.

Engine Control Module: The engine control module manages vehicle ignition based on safety conditions. It ensures that the vehicle starts only when authorized access is verified and the seat belt is fastened. This module enhances both vehicle security and driver safety.

RESULTS AND DISCUSSION

The proposed IoT-based vehicle security system successfully enhances vehicle protection and driver safety through the integration of multiple smart technologies. The fingerprint authentication module effectively prevents unauthorized access, while the GPS and GSM modules provide real-time vehicle tracking and instant alerts during theft attempts. The ultrasonic sensor accurately detects obstacles and helps in accident avoidance, whereas the IR sensor improves window security by detecting intrusions. Experimental



observations indicate that the system offers reliable performance, improved security, and efficient monitoring at a low implementation cost.

CONCLUSION AND FUTURE SCOPE

The proposed vehicle security system provides a comprehensive solution for vehicle protection by combining biometric authentication, GPS tracking, accident avoidance, and safety monitoring within an IoT framework. The system improves security, reduces theft risks, and enhances driver safety through intelligent sensing and real-time notifications. In the future, the system can be extended by incorporating face recognition, cloud-based data storage, artificial intelligence for threat detection, and mobile application enhancements for advanced remote vehicle management. These improvements can further increase the efficiency, reliability, and intelligence of vehicle security systems.

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International Journal of DATA SCIENCE AND IOT MANAGEMENT SYSTEM

ISSN: 3068-272X

www.ijdim.com

Original Research Paper

<https://doi.org/10.71097/IJSAT.v16>

.i2.3219