

# RFID Based Vehicle Monitoring System using Arduino and GSM

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**Abstract** - This paper presents the design and implementation of an RFID-based Vehicle Monitoring System utilizing an Arduino Uno microcontroller, RFID reader (MFRC522), RFID tags, GSM module (SIM800L), GPS module, a 16x2 LCD display, and a buzzer. The system is developed to enhance vehicle identification, real-time tracking, and security. Each vehicle is assigned a unique RFID tag, which is read upon entry or exit using the MFRC522 module. On successful authentication, the system captures the vehicle's location using the GPS module and transmits this data to a designated mobile number or server through the GSM module. The LCD displays essential vehicle information, while the buzzer provides instant audible alerts for authorized or unauthorized access. The proposed system offers a low-cost, scalable solution suitable for fleet management, school transportation, and secured access environments, contributing significantly to intelligent transportation systems and vehicle security technologies.

**Keywords**—RFID, Arduino Uno, GSM Module, GPS Module, MFRC522, Intelligent Transport System.

## I. INTRODUCTION

In recent years, the demand for intelligent vehicle monitoring systems has increased significantly due to the rising need for enhanced transportation security, fleet management, and real-time vehicle tracking. Traditional manual vehicle identification methods are often inefficient, error-prone, and lack real-time tracking capabilities. To address these challenges, this paper proposes an RFID-Based Vehicle Monitoring System using Arduino Uno as the central controller, combined with RFID technology, GPS, and GSM communication modules. Radio Frequency Identification (RFID) is a reliable and contactless technology that enables automatic identification of vehicles using unique RFID tags. The integration of the MFRC522 RFID reader allows the system to scan vehicle-specific tags and authenticate entries. Upon

successful verification, the GPS module, GSM module (SIM800L) transmits this data to a remote server or mobile device, ensuring real time monitoring. A 16x2 LCD provides visual feedback, while a buzzer signals valid or invalid tag scans.

## II. LITERATURE SURVEY

[1] K. Sharma et al. (2019) proposed an RFID and GSM-based vehicle tracking system where vehicle entry and exit were recorded using RFID tags, and notifications were sent via SMS.

[2] S. Patel and R. Mehta (2020) implemented a GPS-GSM-based vehicle tracking system using Arduino. Their model provided accurate tracking but did not include an authentication layer, making it less secure for use in restricted areas.

[3] A. Kumar et al. (2021) developed an IoT-based smart transportation system integrating RFID and cloud storage to maintain vehicle logs. While effective in storing data, the system depended heavily on internet connectivity, which could limit its functionality in remote areas.

[4] R. Singh and M. Verma (2022) designed a school bus monitoring system using RFID and GPS, where student IDs were scanned upon boarding, and their location sent to parents. The concept demonstrated the effective use of RFID and GSM modules for personalized vehicle tracking and safety.

## III. PROPOSED WORK

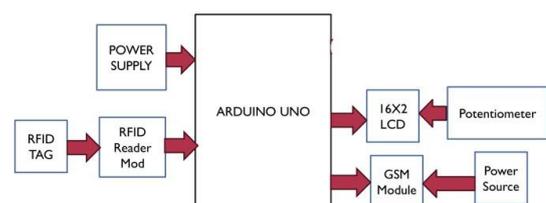


Fig. 1: Proposed system

Fig. 1 illustrates the proposed system architecture for an RFID-based vehicle monitoring system, which is designed using an Arduino UNO microcontroller at its core. The system integrates multiple components—RFID, GSM, GPS, LCD, and feedback mechanisms—to automate vehicle identification and location tracking, and to enable secure access control. Each module plays a crucial role in ensuring smooth operation and real-time monitoring.

The power supply unit delivers regulated electrical power to all hardware components. It is essential for the reliable operation of the Arduino UNO, GSM module, RFID reader, and LCD display. Proper voltage regulation ensures system stability and prevents malfunction.

Each vehicle is assigned a unique RFID tag that holds an identification number. When the vehicle approaches the monitoring station, the MFRC522 RFID reader scans the tag and transmits its ID to the Arduino UNO for verification. This step forms the core of the vehicle identification process.

The Arduino UNO microcontroller acts as the brain of the system. It receives the RFID data, verifies it against pre-stored IDs, and processes further actions such as location fetching, message transmission, or gate control. It also communicates with the GPS and GSM modules and updates the LCD display based on the current system status.

Upon successful RFID authentication, the GPS module is activated to retrieve the real-time location of the vehicle in terms of latitude and longitude. This positional data is used for tracking purposes and is transmitted to remote authorities or systems for monitoring.

The GSM module serves as the communication interface between the system and the end-user or server. It sends SMS alerts containing the vehicle ID and its location to a predefined mobile number or monitoring center, enabling remote tracking and data logging.

The LCD provides on-site visual feedback to the operator or user. It displays messages such as "Access Granted", "Invalid Tag", vehicle ID, or GPS status, allowing users to monitor the system's real-time behaviour.

The entire process of the RFID-Based Vehicle Monitoring System is carried out in the following sequential steps:

Step1: System Initialization: When powered on, the Arduino UNO initializes all connected modules including the RFID reader (MFRC522), GSM (SIM800L), GPS module, 16x2 LCD display, and servo motor. A system check is performed to ensure all components are ready.

Step2: Vehicle Approaches the Entry Point: As a vehicle approaches the checkpoint or gate, the driver presents the RFID tag near the RFID reader.

Step3: RFID Tag Scanning: The MFRC522 module reads the unique ID.

Step4: Tag Authentication: The Arduino compares the scanned RFID tag with a list of preauthorized IDs stored in its memory. If the ID matches the database: The system proceeds to the next step (location tracking and access). If the ID is invalid or unauthorized: The buzzer sounds a warning. A message like "Access Denied" is shown on the LCD. No further action is taken, and the servo motor remains in the locked position.

Step5: GPS Location Fetching: For valid tags, the Arduino communicates with the GPS module to acquire the vehicle's current geographic location (latitude and longitude).

Step6: Data Transmission via GSM Module: Once the location is obtained, the Arduino sends an SMS through the GSM module to a predefined number (e.g., security office or central monitoring system). The SMS contains: Vehicle ID Date and time (from GPS or internal clock) Real-time location coordinates confirmation message such as "Access Granted" along with the vehicle.

Step7: LCD Feedback: Simultaneously, the 16x2 LCD displays a confirmation message such as "Access Granted" along with the vehicle ID or a portion of the location data for local monitoring.

Step8: System Reset: After a short delay, the servo returns to its original (closed) position and the system resets to standby mode, ready for the next vehicle.

The process operates in a loop, continuously monitoring and logging student entries and exits.

#### IV. RESULTS

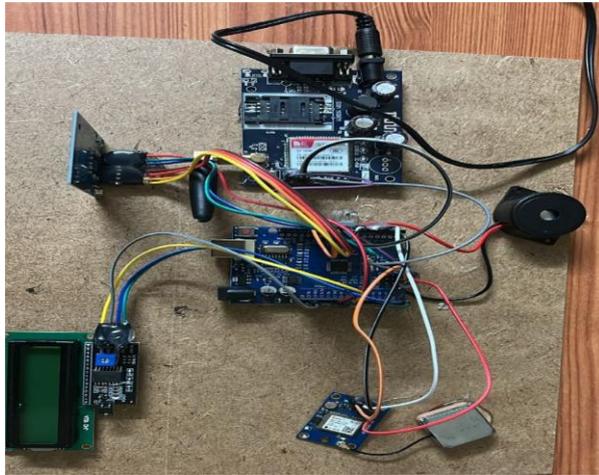


Fig. 2: Final connections of the setup

Fig 2 depicts the complete connections of the research based on RFID based vehicle monitoring system using Arduino and GSM etc.



Fig. 3.1 Boot up



Fig. 3.2: Scan RFID

The RFID-Based Vehicle Monitoring System was successfully designed, implemented, and tested using Arduino UNO and integrated components such as the MFRC522 RFID reader, GPS module, SIM800L GSM module, 16x2 LCD, servo motor, and buzzer. The system was tested under different conditions to evaluate its reliability, accuracy, and response time. Upon powering the

system, all components were initialized correctly, and the LCD provided real time feedback on system status. When a valid RFID tag was brought near the reader, the tag was successfully detected within a range of 2–3 cm. The Arduino processed the data and verified it within milliseconds. For authorized tags, the GPS module retrieved the vehicle's current location with acceptable accuracy ( $\pm 5-10$  meters in open sky conditions), and the GSM module sent SMS alerts to the designated phone number in under 15 seconds, containing the vehicle ID and live coordinates.



Fig. 4.1 After boarding vehicle



Fig. 4.2 After leaving vehicle

Figs. 4.1 and 4.2 are the images while the person boarding and leaving the vehicle respectively.

Fig. 5 shows an image about when an authorised RFID tag is scanned, it is the output on liquid crystal display.



Fig. 5: Scanning unauthorised RFID tag

## V. CONCLUSION

System presented in this paper successfully integrates RFID technology with GPS and GSM modules to create an efficient, reliable, and low-cost solution for real-time vehicle identification and tracking. Using Arduino UNO as the central controller, the system is capable of reading vehicle specific RFID tags, verifying their authenticity, acquiring the vehicle's current location, and transmitting this data through GSM communication to a remote monitoring station. The system's ability to provide automated access control, real-time alerts, and location tracking makes it highly suitable for various applications such as secured campus entry, fleet management, school transportation monitoring, and smart parking systems. The inclusion of visual (LCD) and audio (buzzer) feedback enhances user interaction and operational clarity, while the servo motor allows for physical control mechanisms like gate automation.

## VI. FUTURE SCOPE

The RFID-Based Vehicle Monitoring System has significant potential for future development and scalability. In the coming years, this system can be enhanced by integrating with cloud platforms and IoT networks to allow real time remote monitoring and data analytics. A mobile application interface can be developed to provide users with instant notifications and system control. Additional features such as camera integration for visual verification, alternative communication methods like Wi-Fi or Bluetooth, and solar power options for remote deployment can make the system more robust and versatile. Furthermore, combining RFID with technologies like automatic number plate recognition (ANPR) and real-time traffic analysis can expand its use in smart city transportation, toll systems, and fleet management solutions.

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