

GPS Based Automatic Speed E-Challan Generation As Per Speed Limit:A Review

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Abstract—Today, traffic management systems play a pivotal role in enhancing road safety and maintaining adherence to traffic rules. Conventional enforcement of speed limits was highly dependent on manual involvement by traffic policemen, which entailed problems like human intervention and restricted efficiency. To overcome these problems, an IoT-based Vehicle Speed Challan Generation System was proposed and implemented with Arduino microcontrollers, GPS, and GSM modules. It continuously checks vehicle speed in real-time and issues electronic challans in case of violation.

The process starts with an audible warning sounded when a vehicle crosses the speed limit, providing an opportunity for the driver to slow down. In case compliance is not met, the system logs important violation information, such as GPS coordinates, speed, and timestamps, and uploads them to a secure cloud environment. Moreover, SMS notifications are directly sent to vehicle owners to provide timely communication. By automating traffic law enforcement and facilitating data-driven insights, this system minimizes reliance on human error and enables authorities to determine high-risk hotspots, monitor violations, and plan focused interventions. The system's advanced data-logging capabilities also facilitate long-term safety strategies and public information campaigns, promoting a safer road environment.

Keywords: GPS-Based Speed Monitoring, Automatic Challan Generation, IoT Traffic Management, Real-

Time Speed Detection, GSM-Based Enforcement, Cloud-Based Traffic Data.

I. INTRODUCTION

Speed violations are a serious safety risk to road users and remain one of the main causes of road accidents and fatalities globally. Conventional means of traffic law enforcement are usually predicated on manually intensive processes that are not just time-consuming and disparate, but also likely to be unreliable. These inherent deficits weaken the overall impact of deterring speeding infractions.

Emerging technology in the Internet of Things (IoT) and microcontroller has the potential to provide groundbreaking solutions to these problems. One such technology is the creation of a GPS-GSM-based vehicle over-speeding challan system, which marks a significant milestone towards traffic management and road safety. Utilizing Global Positioning System (GPS) technology, the system reliably tracks vehicle speeds in real time, while Global System for Mobile Communications (GSM) provides easy communication and real-time data transmission to the traffic authorities.

The system utilizes an automated workflow to facilitate efficiency and compliance. As soon as a vehicle crosses the stipulated speed limit, there is an auditory warning given to signal to the driver in order

to have a chance to change behavior. In case of non-compliance by the driver, the system creates an electronic challan that includes necessary details, including the GPS coordinates of the vehicle, speed, and the time of violation. This data is securely transferred to a cloud platform for analysis and record-keeping. The system also provides real-time messages through SMS to the owner of the vehicle to enable prompt communication and accountability.

By integrating GPS, GSM, and IoT technologies, this system not only improves road safety but also minimizes the reliance on manual enforcement, enabling authorities to adopt a data-driven approach to traffic management. Furthermore, the automated process streamlines the detection and penalization of speeding violations, contributing to a more organized, efficient, and proactive enforcement framework.

II. LITERATURE REVIEW

A. Speed Management System Based On GPS

The use of GPS in speed management systems has come as a key solution to cut down on traffic accidents, particularly in zones requiring strict speed regulations. Numerous studies have highlighted excessive speeding being a major reason for road accidents, which commonly lead to injuries, deaths, and economic losses.

Conventional approaches such as speed limit enforcement and speed limiters, while effective have not yet eliminated dangerous driving practices. This literature addresses a GPS-based speed management system that seeks to overcome these constraints by adjusting vehicle speed automatically in predefined critical zones, e.g., school grounds or building construction areas. Real-time GPS technology gives data, which allows dynamic speed adjustments as cars enter the restricted areas. This system provides major benefits for commercial vehicle tracking, encouraging safety through monitoring of vehicle speeds and storing data on cloud platforms such as Thing Speak. Similar systems have proven useful in public transport vehicles, emphasizing the system's wider applicability for improving road safety and minimizing road accidents via automatic speed control systems.

B. Vehicle Tracking System by Using GPS, GSM, and Arduino Technology

This paper uses GPS, GSM, and Arduino technologies to devise a real-time vehicle tracking system. The location of the vehicle is continuously monitored, and its locations are reported such that enhanced security and operational efficiency are ensured by the system. It uses SIM900A GSM module, NEO-6M GPS module, and Arduino Uno R3 along with the necessary transmission of information in real-time, including latitude, longitude, speed, and distance. The users can obtain vehicle location information through SMS and can navigate with Google Maps links. The proposed system has applications in fleet management, theft prevention, and driver tracking. Future improvements can include advanced sensors for enhanced functionality.

C. Vehicle Speed Detection and E-Mail Alert System

The research "Vehicle Speed Detection and E-Mail Alert System" suggests a system that uses IR sensors and an Arduino microcontroller to detect vehicle speed and alert drivers when the speed is above a specified limit. Alerts are in the form of LED signals, sound signals, and email messages with images taken through an ESP32 camera module. The system, intended to improve road safety, automates speed detection and offers real-time speed indication on an LCD for convenience. Challenges are detecting a single vehicle at a time and IR sensor sensitivity. Future improvements suggested are the inclusion of GPS and GSM modules, automatic generation of e-challans, and better performance in low-network areas, leading to sophisticated traffic management systems.

D. Vehicle tracker system design based on GSM and GPS interface using arduino as platform

The paper presents the design of a GPS and GSM-based vehicle tracking system using Arduino as the central hub. The system acquires location data in real time from satellites and transmits this to users via SMS through a SIM900A GSM module. The geographical location of the vehicle can be visualized on Google Maps. This affordable system is bound to ensure precise tracking, enhance security, and support route management.

The developed project demonstrates the efficiency of combining GSM and GPS modules with Arduino to provide real-time tracking under various weather

conditions. Future improvements may include integrating automatic mapping features, further streamlining user interaction.

III. RESEARCH MODEL

The design of the suggested GPS-GSM-based vehicle speed challan generation system includes a number of interrelated components to provide real-time monitoring and enforcement of traffic regulations. Figure 1 below depicts the overall system architecture.

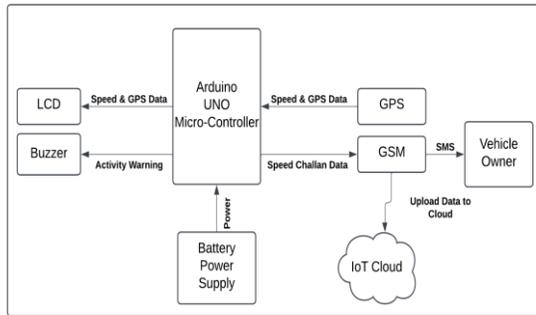


Fig1: Block Diagram

A. System Design and Integration

The system is designed to integrate hardware and software elements smoothly. It involves an Arduino microcontroller coded on the Arduino IDE to analyze speed data obtained through the GPS module. The microcontroller analyzes the speed of the vehicle in real-time and cross-checks it with the region-specific speed limits set beforehand. If the speed is within tolerance, no additional action is taken. But if the speed is above the limit, an interrupt is generated, and the GSM module is switched on for transmitting data.

B. Driver Alert and Speed Monitoring

One of the critical features of the system is its ability to offer instantaneous feedback to the driver. Whenever a vehicle exceeds the prescribed speed limit, an auditory warning is triggered by way of a buzzer for 10 seconds, alerting the driver to slow down. This real-time alert system serves as a deterrent measure to instill compliance with speed limits. If the driver does not react within the specified time limit, the system goes on to produce an electronic challan.

C. Challan Generation and Cloud Storage

The electronic challan carries key data, including the current speed of the vehicle and GPS coordinates. This

information is processed and forwarded to a cloud-based IoT platform for secure storage and further processing. The cloud infrastructure allows the records of violations to be made available to traffic authorities for enforcement. At the same time, the GSM module sends an SMS message carrying the challan details to the registered mobile number of the vehicle owner.

D. Real-World Validation

For the system to be reliable and efficient, thorough testing is done under actual conditions. Such tests confirm the hardware and software integration to guarantee the system's capability to perform well in varied environments and traffic conditions.

IV. CONCLUSION

The Vehicle Speed Challan Generation System marks a revolutionary leap in traffic management and road safety technology, proving the capability of IoT-based solutions in developing a more disciplined, data-driven traffic enforcement. By incorporating Arduino microcontrollers with GPS and GSM modules, the system offers a reliable and automated process to track real-time vehicle speeds, send alerts, and create electronic challans with accurate information for violators. The capability of the system to upload violation information to an IoT cloud platform enables traffic authorities to examine traffic violation patterns and trends, which can be priceless in terms of understanding high-risk zones, stricter enforcement of rules, and designing strategic interventions.

Those automation not only lessens dependency on conventional manpower and reduces human mistakes but also plays an important role in improving public safety and maximizing resource utilization. Beyond improving immediate traffic enforcement, this project has the potential to influence broader urban mobility solutions, leading towards the vision of smart cities with safer and more organized road systems. Subsequent versions of this system may investigate combining other sensors to track a broader range of driving behaviors, including sudden braking, lane obedience, and signal compliance. Improvements may also involve adaptive AI-based analytics for enhanced predictive modeling and insights, to help authorities more effectively prevent accidents and enforce policies. Finally, this system provides the foundation for sophisticated traffic

management, which can minimize traffic incidents, improve road discipline, and provide a more efficient, safer urban environment for everyone on the road users.

V.APPENDIX

The system combines hardware elements such as Arduino, GPS, GSM modules, and a buzzer with software applications such as Arduino IDE, IoT cloud platforms, and SMS gateways for smooth functioning. It tracks real-time vehicle speed, sends audible alerts for offenses, creates electronic challans, and sends data to the cloud and informs vehicle owners through SMS. Future plans involve AI-driven analytics and other sensors to monitor wider traffic offenses.

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