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Over Speed Detection and Number Plate Recognition

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Abstract

The project focuses on developing an innovative travel website designed to enhance user experience through personalized travel plans and comprehensive budget management. The platform allows users to input their desired destination, trip duration, and estimated budget, generating a detailed day-by-day itinerary that covers activities, accommodations, dining, and travel suggestions between cities. Incorporating advanced algorithms like Dijkstra's Algorithm for finding the shortest path between cities, Kalman Filters for improving GPS data accuracy and providing smoother route transitions, and the Knapsack Problem Algorithm for selecting the best combination of travel activities within budget constraints, the platform ensures efficiency and value. Users can choose from pre designed packages or customize every aspect of their travel plans. Real-time expense tracking enables accurate budget management, and the platform provides a clear summary of spending at the end of the trip. This project aims to offer a seamless, tailored travel planning experience, helping users create memorable trips while maintaining control over their budget.

Keywords: *Automatic Number Plate Recognition (ANPR), Computer Vision, OCR, Speed Detection, Traffic Management, YOLO.*

1. Introduction

The rapid expansion of urban transportation and the rise in vehicle ownership have led to significant challenges in traffic regulation and environmental safety. Among these, over-speeding is a major cause of road accidents, while gas leakage from CNG-powered vehicles poses serious health and fire hazards. Traditional monitoring systems are limited in automation, scalability, and responsiveness, often relying on manual surveillance or basic sensors that lack integration and intelligence. This project introduces an innovative Smart Vehicle Monitoring System that combines AI-based over-speed detection and number plate recognition with IoT-enabled speed tracking and CNG gas leakage monitoring [1]. The system utilizes video analytics and machine learning to automatically identify vehicles violating speed regulations and extract their license plate numbers. In parallel, an Arduino-based setup measures real-time speed and monitors gas concentration levels using sensors, triggering alerts when critical thresholds are breached. The project aims to provide a low-cost, scalable, and automated solution that enhances road safety, supports law enforcement, and minimizes environmental risks [2].

1.1 Motivation

In recent years, India has witnessed a surge in road accidents, with over-speeding accounting for a large percentage of fatalities. Simultaneously, the shift towards eco-friendly CNG vehicles has introduced new challenges, particularly the risk of undetected gas leaks, which can lead to catastrophic consequences in populated areas. Existing systems are either too expensive, lack integration between AI and IoT, or fail to provide real-time, actionable insights. This motivates the development of a hybrid solution that leverages the best of both domains

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AI/ML for smart analytics and IoT for physical world sensing and communication [3].

1.2 Problem Statement

Table 1 Tools and Technology

Component	Technology / Tool Used
Microcontroller	Arduino Uno/Nano
Programming Language	C/C++ (Arduino), Python (AI + OCR + IoT)
AI/ML Libraries	OpenCV, EasyOCR/Tesseract, NumPy
OCR Engine	EasyOCR / Tesseract
IDEs	Arduino IDE, VS Code / PyCharm
Communication	GSM Module (SIM800L) or Twilio API
Sensors	IR Sensors, MQ-5/MQ-6 (CNG gas detection)
Display	I2C LCD 16x2
Component	Technology / Tool Used
Microcontroller	Arduino Uno/Nano
Programming Language	C/C++ (Arduino), Python (AI + OCR + IoT)
AI/ML Libraries	OpenCV, EasyOCR/Tesseract, NumPy

Existing traffic enforcement and vehicle safety systems are fragmented and inefficient in handling real-time over-speed detection, vehicle identification, and environmental hazards like CNG gas leakage. Figure 1 shows Proposed System Architecture. There is a need for an integrated solution that combines AI-based analytics with IoT-based sensing, ensuring real-time detection, alerting, and logging of critical vehicular violations and safety issues [4]. Table 1 shows Tools and Technology.

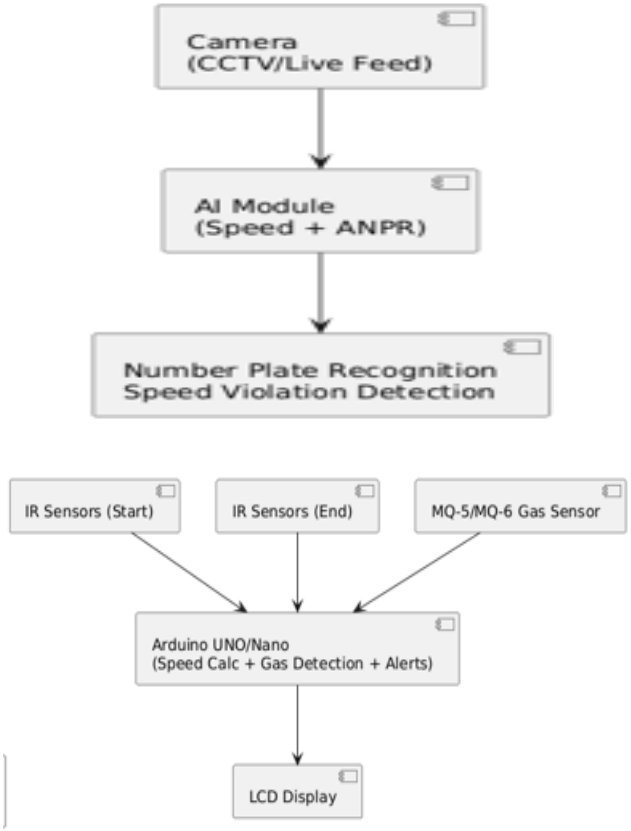

Figure 1 Proposed System Architecture

2. Results and Discussion

2.1 Results

Speed Detection Module (Hardware-Based) The IR sensor pair accurately detected vehicle movement and calculated speed based on the time taken to travel a known distance (typically 1–2 meters). The Arduino computed and displayed speed in km/h with an average error margin of ±5%. CNG Gas Detection Module The MQ-5 gas sensor successfully detected gas concentrations near CNG-powered vehicles. When the gas concentration crossed the defined threshold (~200 ppm), the system activated a buzzer and LED alert. AI-Based Over-Speed Detection & Number Plate Recognition The video feed captured by a USB camera was processed using OpenCV and EasyOCR. Vehicles exceeding the speed threshold were successfully identified, and their license plate numbers were extracted with ~85–90% accuracy under ideal lighting. Display and Logging Module Real-time

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speed and gas data were shown on the LCD. Speed violations and gas leakage events were logged to ThingSpeak (or Firebase), including timestamp, plate number, and event details [5].

2.2 Discussion

This multi-functional system effectively combines sensor-based and AI-based approaches for monitoring vehicle speed, detecting environmental hazards, and logging violations. While each module performed well individually, integration was key to enabling automated, intelligent traffic monitoring. The system has potential applications in smart cities, toll plazas, and highway monitoring setups.

Limitations and Improvements

- Accuracy of OCR is dependent on environmental factors.
- System scalability may require more robust computing (e.g., Jetson Nano or PC).
- Camera placement and calibration are critical for optimal performance.
- Future enhancements could include:
- Vehicle classification (car, bike, truck)
- Real-time enforcement notifications to authorities

Conclusion

The proposed Smart Vehicle Monitoring System successfully integrates hardware-based sensing and AI-driven analytics to detect over-speeding, identify vehicle number plates, and monitor CNG gas leakage in real time. It addresses key issues in road safety, traffic enforcement, and environmental hazard prevention using a cost-effective, scalable solution. By combining the power of Arduino, IoT, and machine learning, the system lays the foundation for advanced intelligent transportation and public safety mechanisms. With future upgrades, it can serve as a core module in the development of smart cities and AI-enabled infrastructure.

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