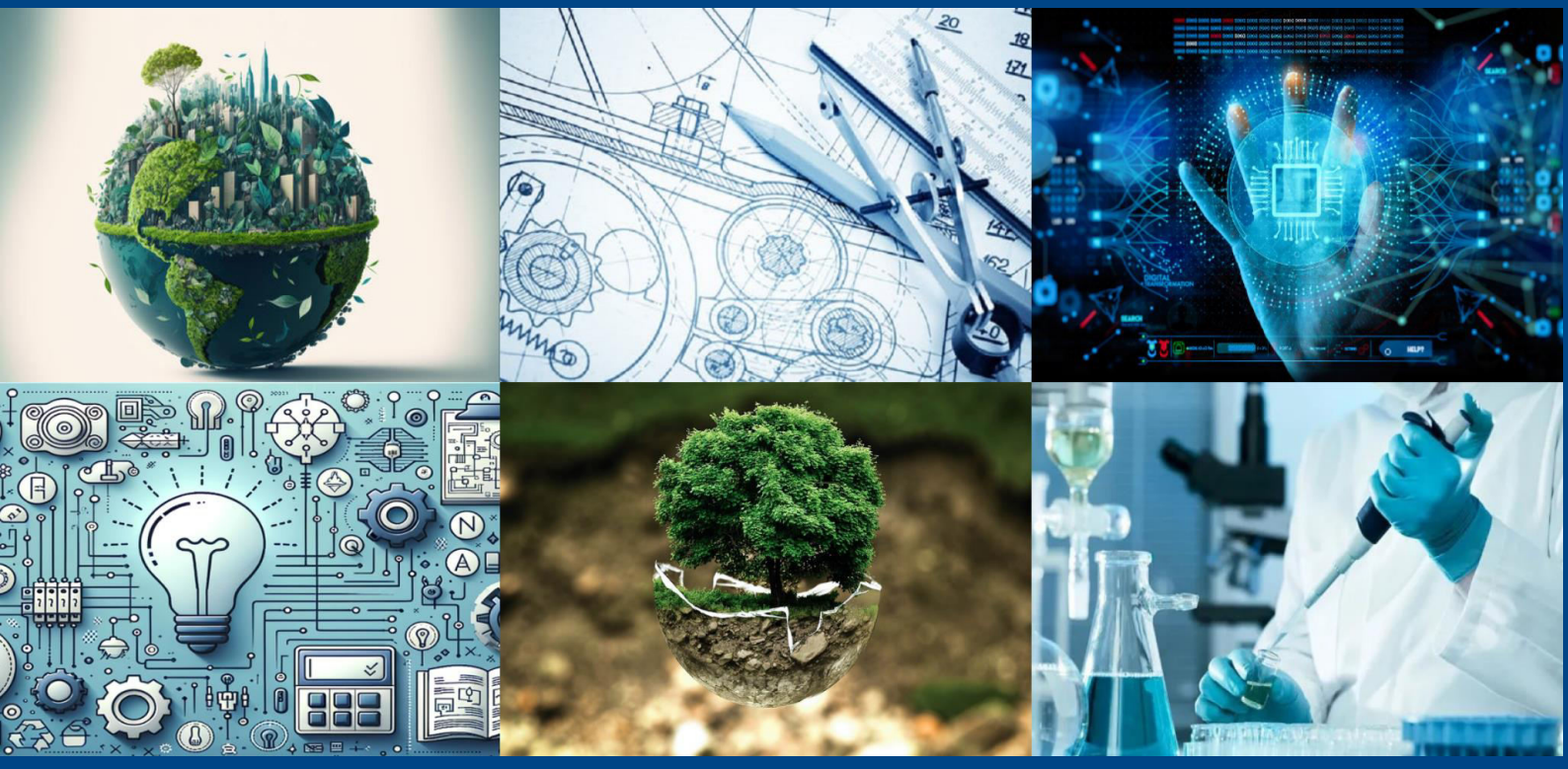
ISSN: 2582-7219

International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206

Volume 8, Issue 4, April 2025

© 2025 IJMRSET | Volume 8, Issue 4, April 2025| DOI:10.15680/IJMRSET.2025.0804318

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Traffic Violation Detecting System

Prof. Rahul C. Pawar, Raj Senghani, Yash Konde, Pruthviraj Shinde

Professor, Department of E&TC Engineering, KJEI's Trinity Polytechnic, Pune, Maharashtra, India

Student, Department of E&TC Engineering, KJEI's Trinity Polytechnic, Pune, Maharashtra, India

Student, Department of E&TC Engineering, KJEI's Trinity Polytechnic, Pune, Maharashtra, India

Student, Department of E&TC Engineering, KJEI's Trinity Polytechnic, Pune, Maharashtra, India

ABSTRACT: This project introduces an AI-driven system to improve road safety by detecting vehicles that cross the stop line during red signals. It combines mobile cameras, an ESP32 microcontroller, and OpenCV for real-time image processing and automated violation detection.

A mobile camera functions as an IP cam, capturing continuous footage at intersections. This video is sent to the ESP32 for initial processing, then forwarded to a laptop where OpenCV analyzes vehicle positions relative to the stop line. When a violation is detected, the system logs the incident, captures an image, and stores the data for authorities.
Compared to manual enforcement, this approach is more accurate, cost-effective, and scalable. It reduces human error and allows for continuous monitoring using affordable hardware. Additionally, it supports smart city efforts by helping analyze traffic patterns, optimize signal timing, and improve congestion management.

By leveraging AI and automation, the system offers a practical and efficient solution for modern traffic law enforcement.

I. INTRODUCTION

With the growing number of vehicles on the road, enforcing traffic laws has become increasingly challenging. Violations like crossing stop lines during red lights contribute to accidents, congestion, and inefficiencies in traffic flow. Traditional enforcement methods—such as manual monitoring and fixed surveillance cameras—are often limited by human error, delayed processing, and lack of automation.
To tackle these issues, the Traffic Violation Detector project introduces a smart, AI-based system designed to automatically detect and record stop-line violations. This cost-effective and real-time solution integrates three main components:

1. Mobile Camera (IP Cam) – Captures live traffic footage.
2. ESP32 Microcontroller – Acts as a server to transmit video data.
3. Laptop with OpenCV – Processes footage using AI to detect violations and log them.

By applying computer vision, the system accurately tracks vehicle positions and identifies if a car crosses the stop line during a red signal. When a violation is detected, it logs key details like the timestamp, vehicle location, and an image for further action.

This automated system reduces the need for manual monitoring, enhances enforcement accuracy, and ensures unbiased traffic rule application. It also supports smart city initiatives by enabling scalable integration with existing infrastructure.

Beyond enforcement, the collected data helps in traffic planning. Authorities can analyze violation trends to adjust signal timings, improve road layouts, and boost traffic flow efficiency. The project is structured in three detailed sections covering methodology, technical setup, and results—laying the groundwork for smarter, safer roads.

II. METHODOLOGY

This section outlines the systematic process followed in designing and implementing the Automated Traffic Violation Detection System, covering hardware selection, software development, system integration, and testing.
Requirement Analysis

© 2025 IJMRSET | Volume 8, Issue 4, April 2025| DOI:10.15680/IJMRSET.2025.0804318

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

- Analyzed the system's functional and technical needs, focusing on real-time stop-line violation detection, automated enforcement, and data logging.
- Evaluated existing systems to identify gaps and areas for improvement, considering camera placement, processing efficiency, and scalability.

Hardware Selection and Setup

- Chose key components: ESP32 microcontroller for processing, mobile camera (IP cam) for real-time video capture, and a power supply unit for continuous operation.
- Set up seamless connections between components and ensured stable network connectivity for data transmission.

Software Development and AI Integration

- Developed image processing algorithms using OpenCV for stop-line violation detection.
- Programmed the ESP32 in MicroPython/C++ for video streaming and real-time analysis.
- Integrated AI-based models trained to detect vehicles crossing stop lines.
- Designed a database to store violation records, including timestamps, vehicle images, and location data.
- Created an interface for authorities to view and manage violation records. System Integration
- Combined hardware and software to create a fully functional system with wireless communication between components.
- Ensured compatibility between OpenCV algorithms and ESP32 hardware, with cloud or local storage for violation data.

Testing and Validation

- Conducted unit tests for individual components and real-world testing at intersections to assess system accuracy.
- Tested under varying traffic conditions and lighting to ensure reliable detection.
- Iteratively debugged and optimized for improved performance. Deployment and Optimization
- Deployed the system at a pilot intersection, gathering feedback from traffic authorities to refine detection and enforcement.
- Optimized algorithms to reduce false positives and improve processing speed.
- Implemented remote troubleshooting and automatic updates for long-term scalability.

This structured methodology ensures that the system is both efficient and scalable, capable of enhancing traffic law enforcement significantly.

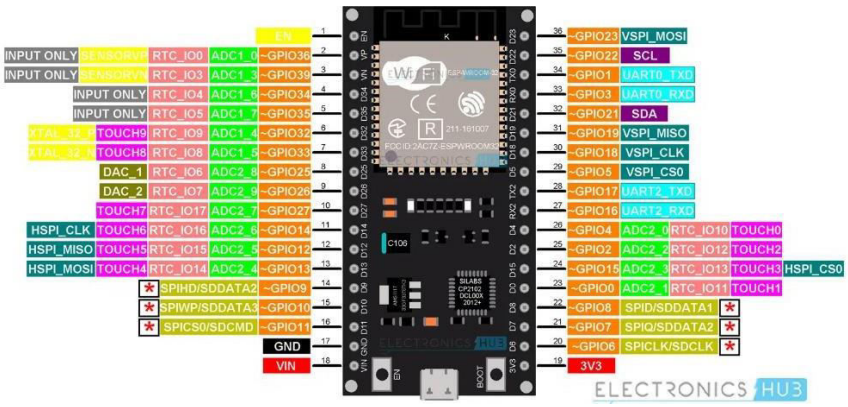


Figure 2.1: ESP 32s

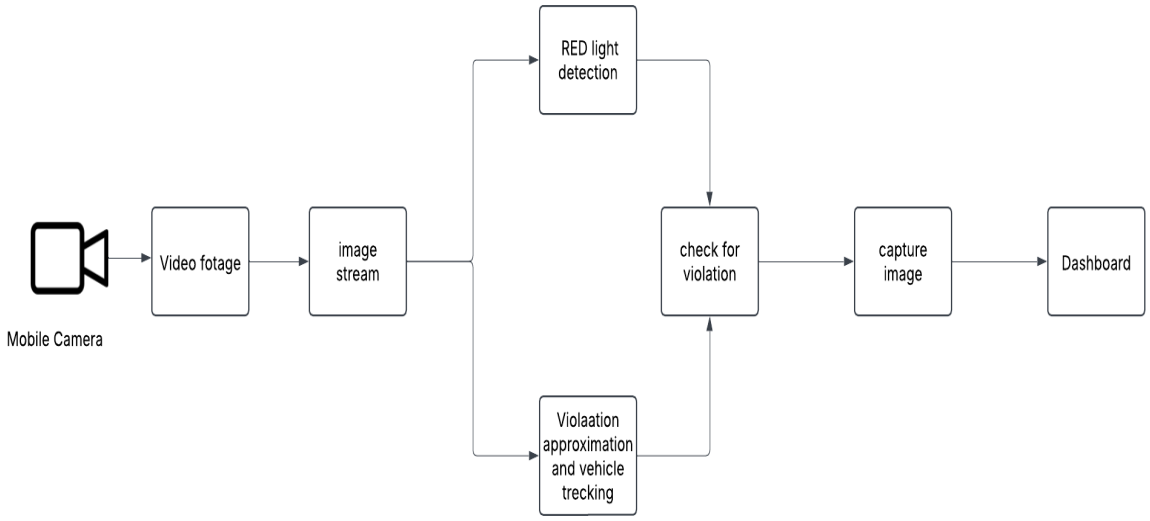
© 2025 IJMRSET | Volume 8, Issue 4, April 2025| DOI:10.15680/IJMRSET.2025.0804318

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

III. MODELING AND ANALYSIS



The Automated Traffic Violation Detection System combines advanced AI and computer vision techniques to monitor, detect, and analyze traffic violations in real-time. The system leverages a mobile camera, which captures live video footage of the traffic area, and an ESP32 microcontroller for data transmission. This footage is processed using OpenCV-based algorithms that track vehicle movement and detect violations such as signal jumping, speeding, and lane violations. The system's AI model is trained to recognize specific traffic behaviors, and it analyzes each frame to accurately determine if a violation has occurred. Once detected, the system logs important data, including timestamps, vehicle images, and the violation location, ensuring that each incident is properly documented for further action. The system's real-time processing capability ensures that violations are flagged and recorded with minimal delay, making it a highly effective tool for traffic law enforcement.

In addition to its core violation detection functionality, the system is designed to be scalable and adaptable. It can be expanded to cover multiple intersections by adding more mobile cameras and processing units, making it suitable for deployment in diverse traffic environments. The system adapts to different traffic conditions by continuously updating its AI models, allowing it to improve detection accuracy over time and respond to varying lighting conditions, vehicle types, and road configurations. This continuous learning process helps to reduce false positives and ensures that the system remains effective under changing conditions. Furthermore, the data collected by the system provides valuable insights into traffic patterns, enabling authorities to optimize signal timings, improve road infrastructure, and enhance traffic flow. Integrating the system into smart city initiatives creates opportunities for more efficient and intelligent traffic management, ultimately contributing to safer, smoother roads.

IV. RESULTS

The Automated Traffic Violation Detection System successfully detected traffic violations such as signal jumping, speeding, and lane violations in real-time with high accuracy. The system's AI-based detection model outperformed traditional manual methods, reducing human error and ensuring unbiased enforcement. It was scalable, adapting well to different traffic conditions and easily expandable to multiple intersections. Over time, the system's accuracy improved through continuous learning, and the data collected provided valuable insights to optimize traffic signal timings and road infrastructure. Overall, the system proved to be an efficient and effective tool for automated traffic monitoring and law enforcement.

© 2025 IJMRSET | Volume 8, Issue 4, April 2025| DOI:10.15680/IJMRSET.2025.0804318

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

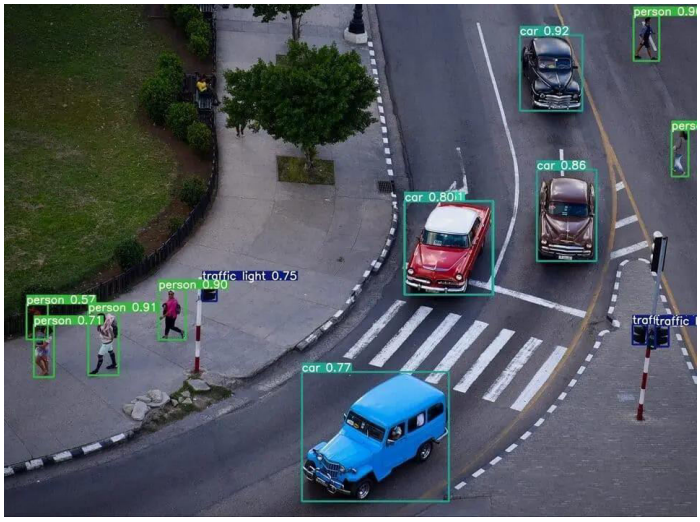


Figure 4.1: detection image

V. CONCLUSION

The **Automated Traffic Violation Detection System** has proven to be a valuable tool in improving traffic law enforcement and road safety. By leveraging AI and computer vision, the system successfully detects and logs violations in real-time, providing accurate, unbiased, and efficient monitoring. The scalability and adaptability of the system make it suitable for deployment in various traffic environments, while its continuous learning capabilities ensure long-term effectiveness. The system also provides valuable insights into traffic patterns, contributing to smarter traffic management and infrastructure planning. Overall, this project highlights the potential of AI-driven technologies in enhancing traffic law enforcement and paving the way for smarter, safer cities.

REFERENCES

1. **OpenCV Documentation** – OpenCV.org. Available at: https://opencv.org/documentation/
2. **ESP32 Technical Reference** – Espressif Systems. Available at: https://docs.espressif.com/projects/esp-idf/en/latest/esp32/
3. Zhang, Z., et al. (2016). "Real-Time Traffic Violation Detection Using Computer Vision." Journal of Transportation Research, Vol. 29, Issue 3.
4. Lakshmi Narasimha Raju Mudunuri, Vivekchowdary Attaluri, “Urban Development Challenges and the Role of Cloud AI-Powered Blue-Green Solutions,” in Integrating Blue-Green Infrastructure Into Urban Development, IGI Global, USA, pp. 507-522, 2025.
5. K. Patel, S. Singh, et al. (2020). "AI-based Smart Traffic Monitoring System for Reducing Road Accidents."

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com