SAFESTREETS: INTELLIGENT SYSTEM FOR TRAFFIC RULES AND PUBLIC SAFETY

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Keywords:

YOLO Algorithm, Object Detection, Behavior Analysis, OCR (Optical Character Recognition), Video Frame Processing.

Introduction:

In today's rapidly urbanizing world, traffic congestion, rule violations, and increasing road accidents pose severe challenges to public safety and transportation management. Traditional traffic surveillance methods rely heavily on manual monitoring by law enforcement personnel, which often leads to delayed responses, limited coverage, and inconsistent enforcement of traffic rules. Additionally, growing urban populations have made it difficult for human-led systems to efficiently detect and manage suspicious activities or respond promptly to road accidents. These limitations emphasize the need for intelligent, automated solutions that can ensure both road safety and security in real time.

To address these issues, the integration of Artificial Intelligence (AI), Computer Vision, and Machine Learning offers transformative potential. AI-driven traffic systems can process large volumes of video data, recognize patterns, detect violations such as triple riding, riding without helmets, and no-parking offenses. Moreover, such systems can analyze behaviors to detect suspicious activities like tampering with vehicles or robbery, thus enhancing urban security.

This project proposes an AI-powered automated traffic violation, unusual activity recognition system and accident recognition system capable of real-time monitoring and response. It incorporates advanced algorithms like YOLO for object detection and OCR for license plate recognition. Upon detecting violations or incidents, the system can notify emergency services or law enforcement immediately, ensuring timely interventions. This solution not only reduces human dependency but also ensures consistent rule enforcement, faster accident responses, and increased public safety. It signifies a step forward in building smarter, safer cities aligned with the vision of intelligent transportation systems

Objectives:

1. **Automate Detection of Traffic Violations**: Use AI-driven image recognition to detect common traffic violations, such as signal jumping, illegal parking, triple riding, and riding without a helmet, with minimal human intervention.
2. **Enhance Accuracy and Efficiency in Law Enforcement**: Reduce the dependency on manual traffic monitoring, decreasing human error and enabling authorities to monitor larger areas more effectively.
3. **Improve Emergency Response for Accidents**: Automatically detect accidents and send immediate notifications to nearby hospitals and emergency responders to minimize response time and improve victim outcomes.
4. **Enhance Public Safety through Suspicious Activity Detection**: Identify suspicious behavior in sensitive areas, and notify law enforcement for timely intervention.
5. **Promote Safer Road Behavior**: By automating and increasing monitoring, encourage safer driving habits, ultimately reducing the rate of traffic violations and accidents.

Methodology:

1. **Data Collection & Preprocessing:** System utilizes camera feeds from urban areas to capture traffic data.Video data is preprocessed for accurate analysis, including frame extraction and cleaning.

2. **Violation Detection:** AI models (CNNs) are trained to identify violations like signal jumping, parking violations, and helmetless driving. Real-time frame processing enables immediate detection.
3. **Accident Detection:** Anomaly detection algorithms identify accidents based on sudden changes in vehicle behaviour. System triggers immediate alerts to emergency services.
4. **Suspicious Activity Detection:** Machine learning techniques analyze vehicle and pedestrian behavior to detect suspicious activities like arrest, abuse, robbery, vandalism. Alerts are sent to law enforcement for investigation.
5. **Testing & Deployment:** Rigorous testing ensures system accuracy. The validated system is deployed in real-world scenarios to enhance traffic safety.

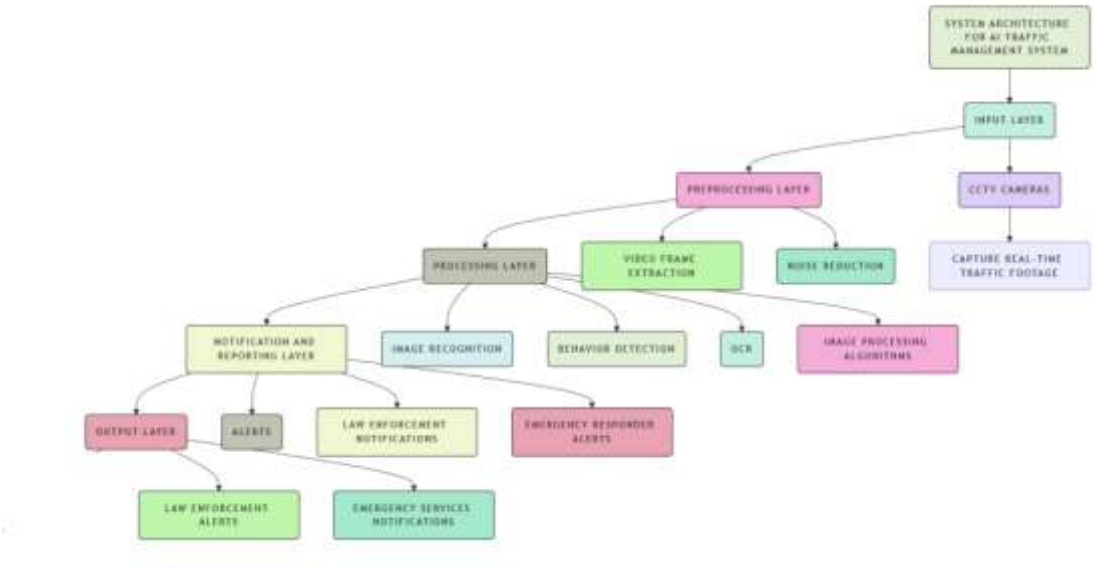

Figure 1: System Architecture

Result and Conclusion:

The implementation of the AI-based Traffic Violation and Suspicious Activity Recognition System successfully demonstrated the capability of integrating computer vision and deep learning for real-time traffic surveillance. Using the YOLO algorithm, the system accurately detected key traffic violations such as helmet-less riding, triple riding, and illegal parking in pre-recorded images and videos.

In real-time applications, the system effectively identified suspicious activities such as robbery and arrest, issuing prompt alerts to designated law enforcement endpoints. It also showed promising results in detecting accidents based on abrupt vehicle movements and crash patterns, with immediate emergency notifications sent to responders. The alert system integrated with Telegram bots functioned seamlessly, ensuring instant message delivery for violations and emergencies.

Photographic evidence of detections (see below) illustrate that the system performs well under controlled conditions. However, it also revealed areas for improvement, particularly in low-light environments and in crowded scenes where objects overlap.

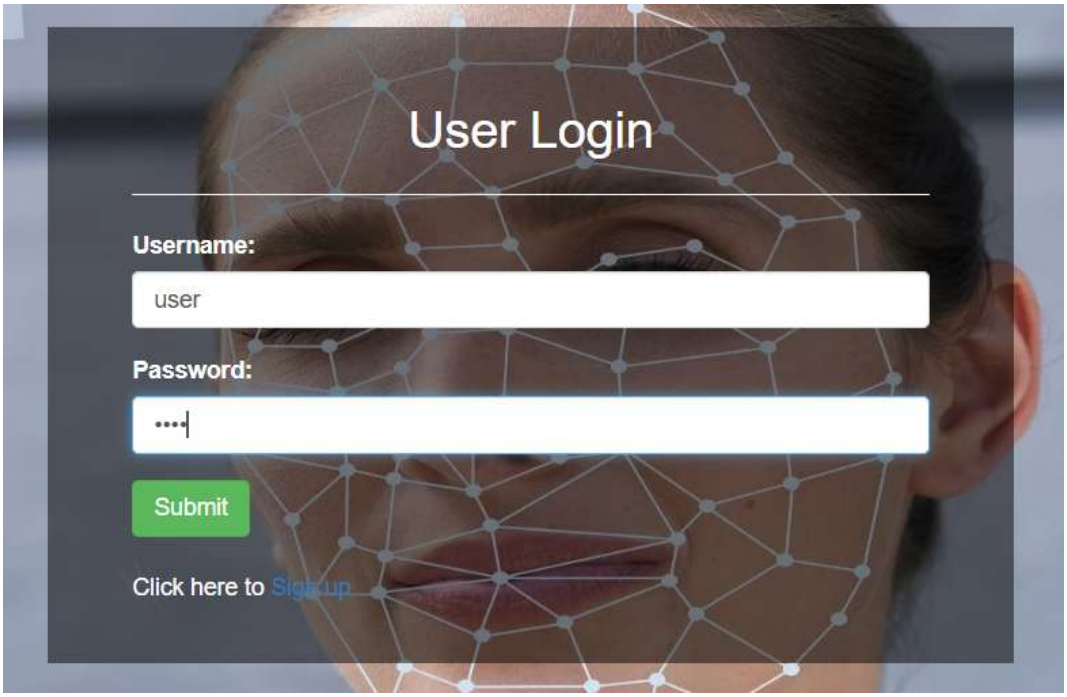

Figure 2: User Login

Figure 3: Webpage

Figure 4: Uploading the video

Figure 5: Traffic rules violation detection

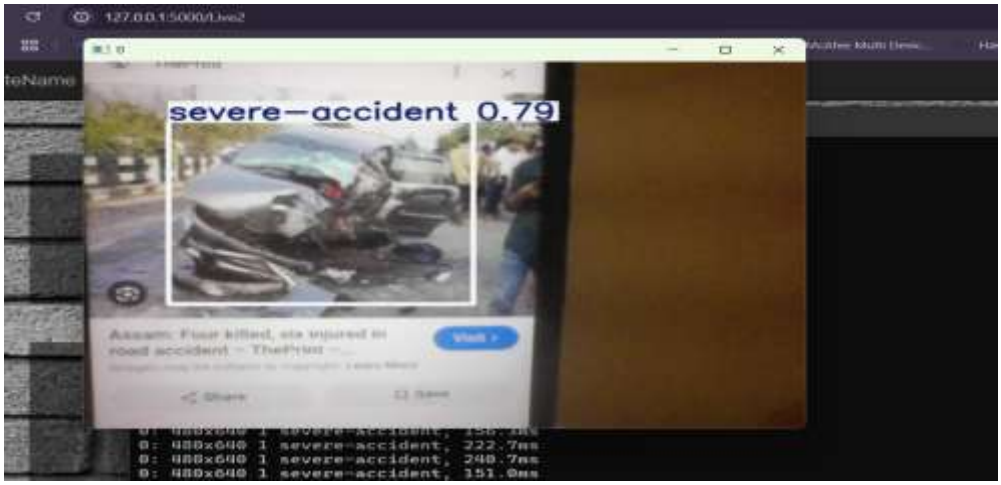

Figure 6: Accident detection

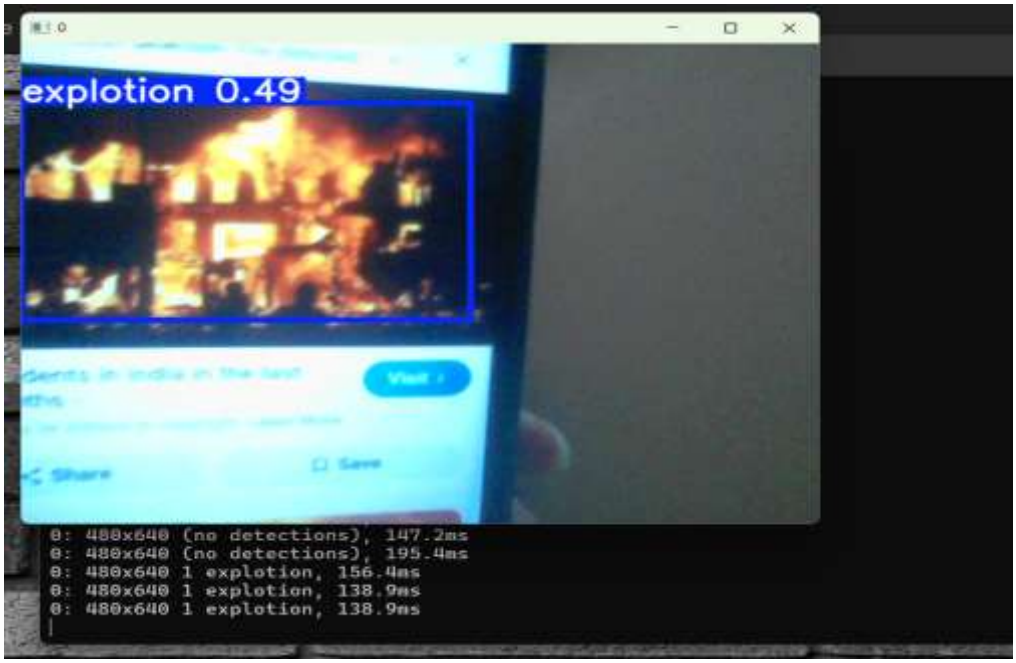

Figure 7: Explosion Detection

Figure 8: Weapon Detection

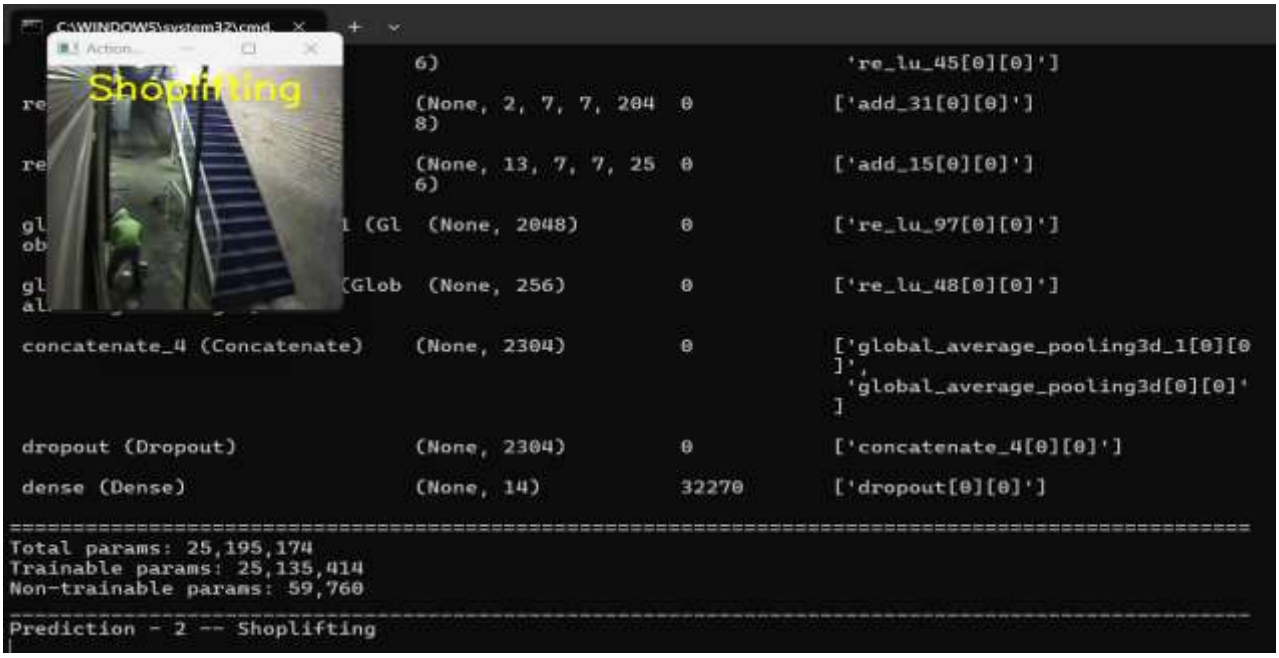

Figure 9: Unusual Activity Detection

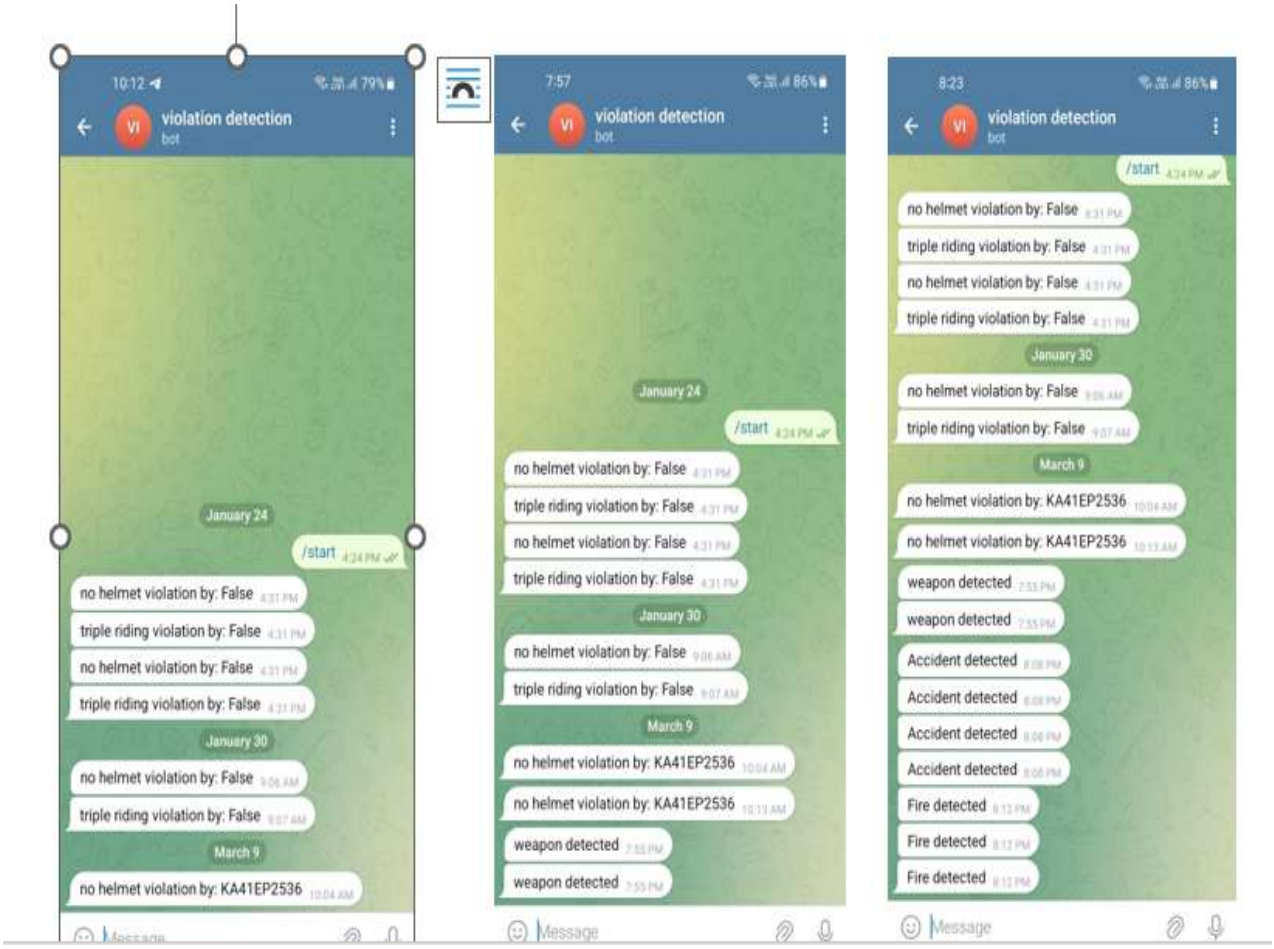

Figure 10: Telegram Chat Bot integration

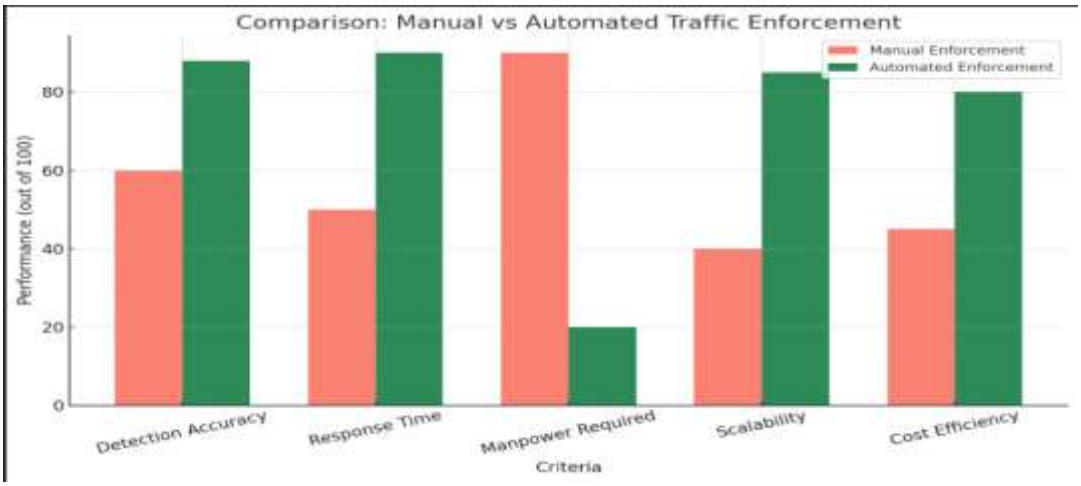

Figure 11: Comparison graph for manual and automated enforcement

In conclusion, the project achieved its primary goals of automating traffic monitoring, improving road safety, and reducing manual enforcement efforts. The system is scalable and has potential for integration with smart city infrastructure. Future enhancements such as improved OCR accuracy, night vision camera support, and advanced behavior analysis could further strengthen the solution's effectiveness in real-world deployments.

Project Outcome & Industry Relevance:

The project successfully demonstrates the potential of AI and computer vision in addressing critical challenges in urban traffic management and public safety. By automating the detection of traffic violations, accidents, and suspicious activities, the system reduces the dependency on manual enforcement, ensuring faster response times and consistent rule implementation. The integration of object detection (YOLO) and OCR technology allows for accurate identification of vehicles and the automatic issuance of fines, significantly improving operational efficiency.

In real-world applications, this system can be deployed by municipal corporations, traffic police departments, and smart city initiatives to enhance surveillance, streamline law enforcement, and reduce road accidents. It can also be extended for use in sensitive zones such as government buildings, airports, and schools for suspicious activity monitoring.

Industrially, it supports the growing demand for intelligent transport systems (ITS) and urban mobility solutions, making it highly relevant to sectors like public safety,

automotive surveillance, and smart infrastructure development. The project not only reinforces academic concepts of AI, machine learning, and IoT but also provides a scalable model that can contribute to safer, smarter, and more secure cities.

Working Model vs. Simulation/Study:

This project involved the development of a working model that demonstrates real-time detection of traffic violations, suspicious activities, and accidents using AI and computer vision techniques. The system was implemented using actual pre-recorded videos and images for violation detection and unusual activity detection, and live camera footage for real-time analysis of suspicious activities and accident scenarios.

YOLO was integrated for object detection, and OCR was used to extract vehicle number plates. Additionally, a Telegram bot was used to simulate live alerts for emergency and law enforcement notifications. While the model was tested on a smaller scale, it effectively showcases real-world applicability and practical implementation of the proposed solution, proving it to be beyond just a theoretical or simulated study.

Project Outcomes and Learnings:

The key outcome of this project is the successful development of an AI-powered system capable of automatically detecting traffic violations, accidents, and suspicious activities through video analysis. The model demonstrated effective real-time detection using YOLO for object identification and OCR for license plate recognition, along with an automated notification mechanism to alert law enforcement and emergency services via Telegram. The system achieved high accuracy under controlled conditions and proved to be a scalable solution for enhancing urban traffic enforcement and safety.

Throughout the project, we gained valuable hands-on experience in designing and implementing AI-based surveillance systems. We learned how to process and analyze video data using computer vision techniques, integrate deep learning models like YOLO, and handle real-world constraints such as lighting, occlusion, and frame quality. I also understood the importance of system architecture planning, efficient data flow, and integrating external APIs for real-time communication. This project helped me bridge the gap between theoretical AI concepts and their practical applications in

solving real-world problems, particularly in the domains of smart cities and intelligent transport systems.

Future Scope:

The future scope of this project includes:

1. **Integration with Smart City Infrastructure:** The system can be integrated with centralized smart city surveillance networks, traffic signal automation, and IoT-enabled road sensors to improve overall urban traffic management.
2. **Implementation of Predictive Analytics:** Machine learning algorithms can analyze historical traffic data to predict accident-prone zones, high-risk areas for violations, and patterns of suspicious activities, allowing authorities to take preventive actions.
3. **Expansion to Multi-City and Nationwide Adoption:** The system can be scaled to cover multiple cities, creating a nationwide network of AI-powered traffic monitoring and law enforcement, reducing manual intervention significantly.
4. **Integration with Automated Payment Systems:** Fines generated for traffic violations can be directly linked to an online payment system using digital wallets, UPI, or government e-challan services, ensuring seamless penalty collection.
5. **AI-based Facial Recognition for Offender Identification:** In cases where number plates are not clearly visible, integrating facial recognition technology can help identify repeat offenders, especially for helmet-less riding or criminal activities.
6. **Integration with Autonomous Vehicles:** The system can be integrated with autonomous vehicles to ensure compliance with traffic laws by monitoring their driving behavior, lane discipline, and adherence to signals. Real-time AI analysis can help autonomous systems make safer navigation decisions, reducing accidents and improving overall traffic efficiency.