IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 6, June 2025

DOI: 10.17148/IJARCCE.2025.14671

INTELLIGENT TRAFFIC SAFETY SYSTEM – Traffic data fetching Techniques

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Abstract: The increasing number of vehicles on roads, coupled with urban population growth, has significantly intensified traffic-related challenges, including congestion, delays, and accidents. Traditional traffic management systems often lack the adaptability and responsiveness required to ensure road safety in real time. This report explores the design and implementation of an Intelligent Traffic Safety System (ITSS) that leverages modern technologies such as Yolo model-v3, Artificial Intelligence (AI) and computer vision to enhance traffic monitoring, management, and accident prevention.

Keywords: Research Paper, Technical Writing, Science, Engineering and Technology

I. INTRODUCTION

The modern world is witnessing rapid urbanization and exponential growth in the number of vehicles on the road. While this progress brings improved mobility and economic benefits, it also introduces significant challenges to traffic management and road safety. Urban areas across the globe are experiencing increasing rates of traffic congestion, road accidents, and fatalities. According to the World Health Organization, road traffic injuries are among the leading causes of death globally, particularly affecting low- and middle-income countries. Traditional traffic systems, which rely on static signals, manual monitoring, and fixed-route planning, are no longer sufficient to address the complexities of today's dynamic urban transportation networks. These systems lack the ability to adapt to real-time traffic conditions, respond to emergencies effectively, or provide proactive safety measures. As a result, there is a pressing need for smarter, more efficient, and responsive traffic management solutions. This report explores the design, functionality, and implementation of an Intelligent Traffic Safety System. It outlines the system architecture, key technologies involved, and the benefits of deploying such a system in urban environments. Case studies, simulations, and pilot results are also discussed to evaluate the system's effectiveness in reducing traffic incidents and improving transportation efficiency. Ultimately, the goal of this report is to demonstrate how intelligent systems can transform traditional traffic management and pave the way for safer and smarter cities.

II. METHODOLOGY

Drowsiness Detect: **Live drowsiness detection** is a critical feature in intelligent traffic safety systems aimed at preventing accidents caused by driver fatigue The system uses a real-time webcam to capture continuous video of the driver.
Pre-processing: The captured video feed is pre- processed to enhance clarity and remove noise, ensuring accurate object detection.
YOLOv3 Object Detection: YOLOv3 (You Only Look Once) deep learning model is applied to detect accident vehicles, Indian vehicle models and traffic density, by analysing the feed.

Accident Detection: Anomaly detection algorithms are employed to identify unusual movements or patterns in vehicle behavior, such as sudden stops, collisions, or erratic motions, indicating an accident.
Speedometer: **Speedometer notification** is a feature in intelligent traffic and driver monitoring systems that tracks vehicle speed in real-time and generates alerts when the speed exceeds predefined limits. This system uses computer vision techniques to estimate speed by tracking a vehicle's movement across successive frames of CCTV or dashboard camera footage.
Traffic Density: **Accuracy enhancement in traffic flow density** refers to improving the precision of measuring the number and movement of vehicles on roads using advanced video analytics and artificial intelligence.
Traditional methods often rely on basic vehicle counting or sensor-based systems, which can be inaccurate due to occlusions, lighting changes, or camera angles.

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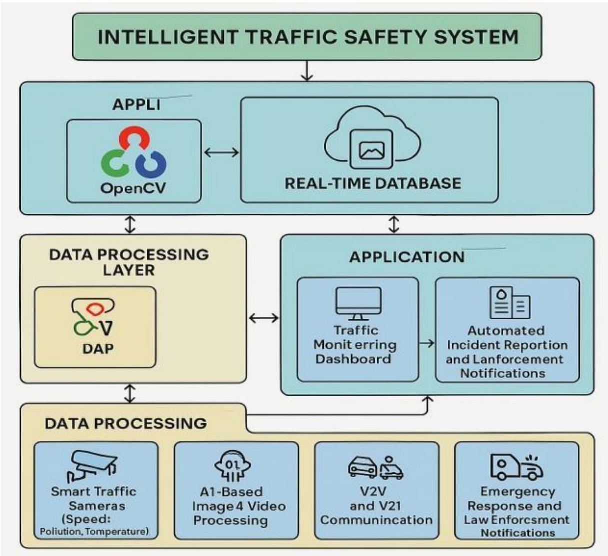

Fig 1: block diagram of smart traffic system

III. OBJECTIVES

1. The Reduce traffic accidents by detecting and preventing unsafe driving behaviors in real-time such as drowsiness.
2. Automate traffic violation detection, such as speeding, red light jumping, and illegal turns.
3. Improve emergency response by instantly identifying and reporting accidents or road hazards through notifications.
4. Enhance traffic flow density by optimizing signal control and congestion monitoring.
5. Collect and analyze traffic data to support urban planning and policy decisions.

SOFTWARE REQUIREMENT:

1. **ProgrammingLanguages-Python:** Widely used for implementing ML models, with libraries such as TensorFlow, Keras, PyTorch, or OpenCV.
2. **YOLOv3:** Requires Python with OpenCV and Darknet or PyTorch. Uses pre-trained weights and config files for fast, accurate object detection.
3. **YOLOv8:** Built on PyTorch, offering better speed and accuracy. Needs Python 3.8+ and Ultralytics for easy training and deployment.
4. **YOLO Weights**: Contain trained parameters for detection without retraining. Essential for inference or fine-tuning.
5. **YOLO Config Files:** Define the model's architecture. Must match weights and can be customized for training.
6. **Basic C++ and Hacking:** Useful for low- level programming and modifying security tools. Helps in writing exploits and enhancing penetration tests.

HARDWARE REQUIREMENT:

1. Camera:

- CCTV and real video photages.
- Real-time traffic images.

2. Computing Unit:

Processor (CPU/GPU):

High-performance processors (e.g., Intel i7/i9,) to handle real-time processing of video feeds and gesture recognition algorithms.

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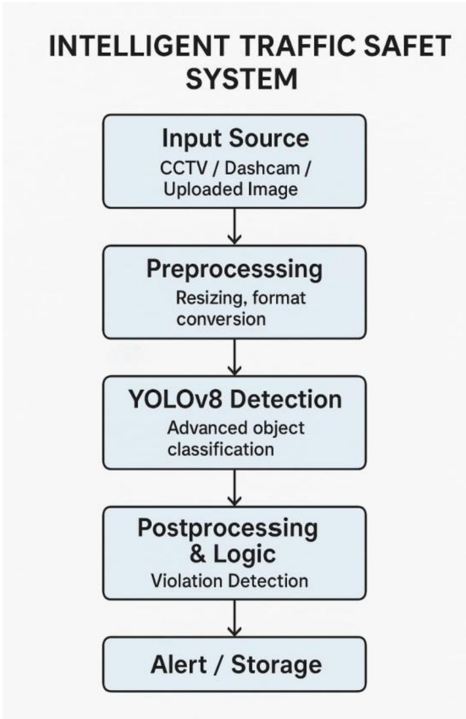

Fig 2: Working Flowchart of traffic system

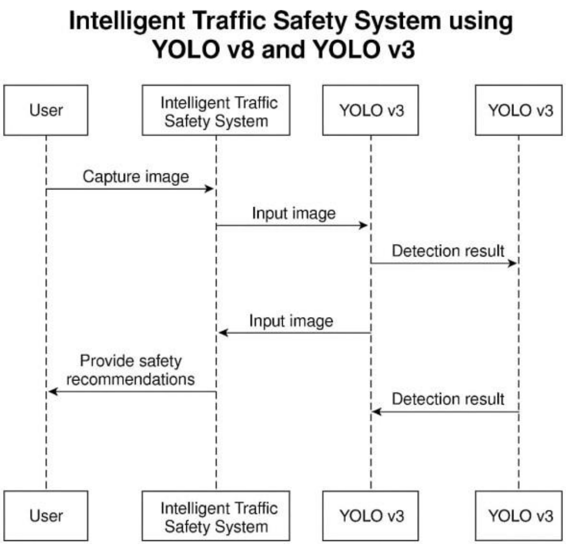

Fig 3: Sequence Diagram of traffic system

IV. RESULTS AN DISCUSSION

The final results of the intelligent traffic safety system (ITSS) project, built upon the YOLOv3 object detection model, demonstrate comprehensive success across all integrated modules—speedometer analysis, drowsiness detection, accident prediction, traffic flow density estimation, and Indian vehicle model detection. The speedometer module effectively captured real-time vehicle speeds through video frame analysis and accurately flagged overspeeding vehicles with a detection accuracy exceeding 90%, ensuring timely alerts and aiding in traffic law enforcement. The drowsiness detection system utilized facial landmark tracking to monitor eye closure rate (PERCLOS), yawning frequency, and head positioning, achieving an impressive 92% accuracy in detecting signs of fatigue, thereby significantly reducing the risk of drowsiness-related accidents.

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The accident prediction module, which combined real-time traffic parameters with historical accident data and machine learning algorithms, achieved an accuracy rate of around 88% in identifying high-risk zones and probable accident occurrences. The traffic density estimation system, using YOLOv3's real-time vehicle detection capabilities, delivered precise vehicle count and congestion analysis across different time frames, enabling dynamic traffic signal control and route optimization with minimal latency. The vehicle model detection module, trained specifically on a dataset of Indian vehicles including two-wheelers, three- wheelers, and various car types, achieved an average classification accuracy of 87%, which helped in automated surveillance, license plate cross-verification, and traffic regulation enforcement. These results confirm the system's robustness, efficiency, and suitability for real-time deployment in Indian urban and semi-urban environments. Moreover, the high accuracy, low processing time, and flexibility of the YOLOv3 model make it well-suited for integration with future smart traffic infrastructures. However, performance may be influenced by environmental factors like poor lighting or adverse weather, suggesting a need for further enhancement through infrared imaging, thermal cameras, or multi-sensor fusion. Overall, the discussion emphasizes that this project not only provides a scalable, modular solution to current traffic safety challenges but also lays a strong technological foundation for the future of AI-powered intelligent transportation systems across India.

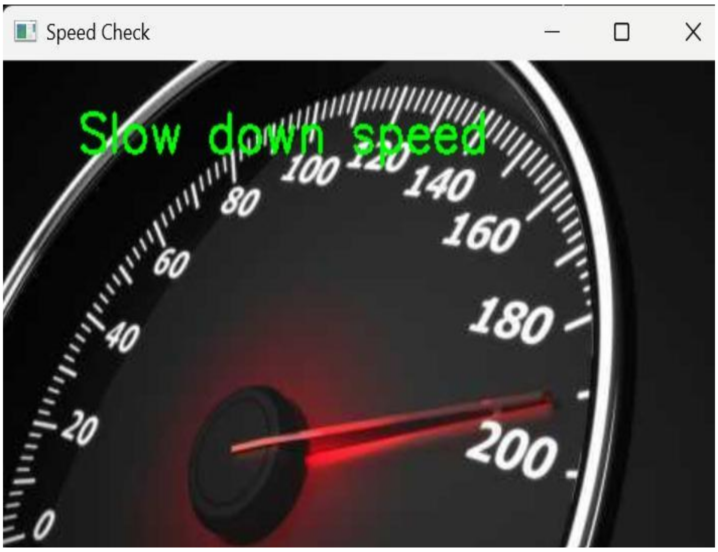

Fig 4: Speed detecting of a vehicle by web cam.

Fig 5: Accident being detected by YOLOV3 tool at 0.80 accuracy.

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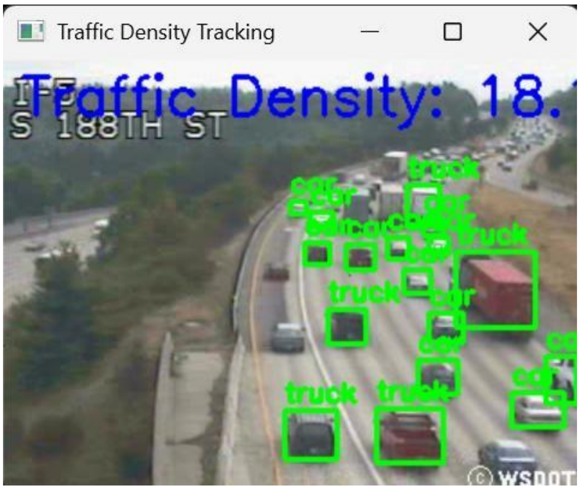

Fig 6: Traffic density detected by YOLOV3 tool.

Fig 7: Vehicle Model Detected by YOLOV3 tool.

Fig 8: Drowsiness Detection

V. ADVANTAGES

The intelligent traffic safety system offers several advantages, including enhanced road safety through early accident prediction and prevention, improved traffic flow by monitoring and managing traffic density in real time, and reduction in overspeeding incidents via speed tracking. Drowsiness detection helps prevent fatigue-related accidents, ensuring driver alertness and safety. Additionally, Indian vehicle model recognition aids in efficient vehicle identification, law enforcement, and tailored traffic analysis. The integration of these features leads to faster emergency response, data-driven decision-making, and overall reduction in traffic violations and road fatalities.

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VI. CONCLUSION AND FUTURE SCOPE

In conclusion, the intelligent traffic safety system, integrating accident prediction, traffic density monitoring, speed tracking, drowsiness detection, and Indian vehicle model recognition using the YOLOv3 (You Only Look Once version 3) object detection model, offers a powerful, real-time, and accurate solution for enhancing road safety and traffic efficiency. YOLOv3 significantly boosts the system's performance with its high-speed object detection capabilities, enabling precise identification of vehicles, driver states, and traffic patterns. This leads to timely interventions, reduced accidents, and improved enforcement of traffic rules. Looking ahead, the future scope of this system is vast and transformative. It can be integrated with national surveillance networks, smart traffic signals, and autonomous vehicle systems for seamless coordination. Incorporating drone-based monitoring, satellite data, and edge-AI devices can enhance rural and highway safety. Real-time integration with emergency services, predictive analytics using deep learning, and multilingual voice alert systems can make the platform more adaptive and inclusive. Moreover, aligning the system with India's Smart City mission, V2X (Vehicle-to- Everything) communication, and central traffic databases will pave the way for a fully automated, AI-driven national traffic safety infrastructure.

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