International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

AI Based Traffic Control System

Mr.MD. Chan Basha[1], A.Veena sindhu[2], CH.Vaishnavi[3], E.Sujatha[4], K. Praveen Kumar[5]

[1]*Mr.MD. Chan Basha (Assistant Professor)*
[2]*A. Veena Sindhu Department of Computer Science and Engineering (Joginpally B.R Engineering College)*
[3]*CH.Vaishnavi Department of Computer Science and Engineering (Joginpally B.R engineering College)*
[4]*E.Sujatha Department of Computer Science and Engineering (Joginpally B.R engineering college)*
[5]*k. Praveen Kumar Department of Computer Science and Engineering (Joginpally B.R Engineering College)*

---***---

ABSTRACT

This project explores the development of an AI-based traffic control system aimed at enhancing urban traffic management. By utilizing machine learning algorithms and real-time data from various sources, including traffic cameras, sensors, and GPS devices, the system analyzes traffic patterns and predicts congestion. We are using several AI and ML models, including Reinforcement Learning, Deep Learning, Neural Network and also Computer Vision. The integration of vehicle to infrastructure communication further enhances responsiveness, allowing for timely updates to drivers. Simulation results indicate significant reductions in travel time and improved traffic efficiency, demonstrating the potential of AI technologies to optimize urban transportation systems and support sustainable development.

Key Words: Reinforcement Learning, Neural Network, Computer Vision, YOLO.

1.INTRODUCTION

The expansion of cities has increased the amount of cars on the road which has resulted in gridlocked traffic. This has negatively affected the environment due to excessive fuel consumption, pollution and increased travel time. Current methods used to monitor traffic are outdated, as they do not take into account real time data and are ineffective during periods of high traffic. AI-based traffic management approaches solve these issues by utilizing sensors, data, and machine learning. They monitor traffic in real time, predict congestion and adjust traffic lights automatically. As a result urban mobility becomes safer and more efficient.

2.LITERATURE REVIEW

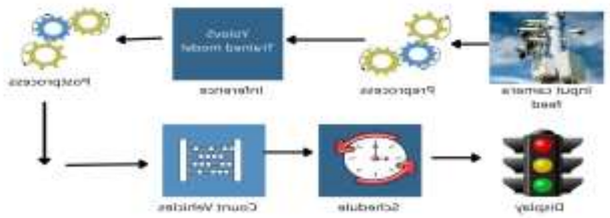
Traditional traffic control systems, such as fixed-time and sensor-based adaptive signals, have long been used to manage urban traffic. However, these systems often fail to adapt effectively to changing traffic patterns in real time, leading to congestion and inefficiency. Recent research has focused on the use of machine learning algorithms for traffic prediction and signal control. Techniques like decision trees, support vector machines, and neural networks have shown success in analyzing traffic flow and adjusting signal timings accordingly.

Reinforcement learning has emerged as a powerful tool for adaptive traffic signal control. By learning through trial and error, RL-based systems can dynamically respond to traffic conditions and optimize signal performance over time. Computer vision, powered by deep learning models such as YOLO and CNNs, has enabled real-time detection of vehicles and pedestrians from video feeds. This allows for smarter traffic monitoring without relying heavily on traditional sensors.

3.PROPOSED SYSTEM

The traffic control system that is being proposed aims to use AI to optimize the management of vehicle traffic. It utilizes real-time data acquired from sensors, cameras, and connected automobiles to adjust traffic signal timing efficiently. The system incorporates advanced machine learning techniques such as reinforcement learning associated with adaptive signal control and computer vision for vehicle recognition to improve the optimization of traffic flow. This system also integrates IoT devices and enables vehicle-to-everything (V2X) communication allowing vehicles to exchange data with infrastructural units for optimal traffic control and rapid management of incidents or traffic jams.

4. METHODOLOGY



4.1 Data Collection

The very first step involves collecting real-time traffic data by means of different sensors, including cameras, inductive loop detectors, radar, and GPS devices installed at major intersections. Every instance data regarding vehicle count, speed, and congestion level is collected.

4.2 Data Preprocessing

Preprocessing filters or transforms the collected data to remove noise and correct inaccuracies. Any data that seems irrelevant is filtered out; values are normalized; and data from all sensors in the region is aggregated to arrive at an intelligent traffic pattern.

4.3. AI Model Development

The control algorithms, i.e., machine learning and deep learning algorithms, aim at processing the data and thereby rendering optimization to traffic flow. RL is used to dynamically adjust the traffic signal timings in accordance with the existing traffic conditions. The computer vision models (CNN, YOLO) detect vehicles and pedestrians in real time from the camera feeds and set signals with higher priority to enhance safety.

4.4. Real-Time Traffic Analysis

Ongoing real-time monitoring takes place on traffic conditions as continuous data streams forth. AI-based models evaluate streaming inputs and effectuate decisions on signal timings,which lanes to prioritize.

5. MODELING AND ANALYSIS

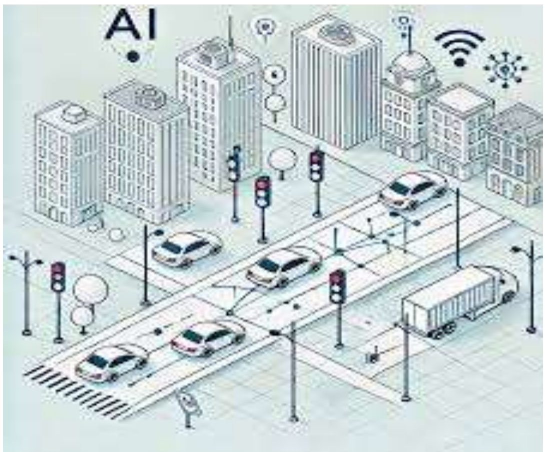
5.1 Traffic Flow Modeling:

To replicate time-of-day traffic conditions, traffic at an intersection is modeled in terms of vehicle arrival rates, length of queues, and waiting times. It considers both macroscopic and microscopic traffic dynamics. The macroscopic description involves larger-scale flow patterns across intersections, whereas the microscopic one concentrates on individual vehicle movements that interact with traffic signals.

5.2 AI Model Development

The core AI architecture consists of Reinforcement Learning (RL) and Deep Learning (DL)based algorithms. In the RL case, the system operates within a framework defined by the Markov Decision Process (MDP), where each intersection acts as an agent wishing to learn the best traffic signal timings through trial and error by interacting with its environment-the traffic conditions. The design is such that an agent rewarded for minimizing waiting times and congestion. For Computer Vision purposes, Convolutional Neural Networks (CNNs)detect vehicles, pedestrians, and other traffic-related objects is from camera feeds. These models are trained on labeled datasets and then.

6. SYSTEM ARCHITECTURE AND DESIGN



6.AI in Traffic Management

6.1. Data Collection Layer

The Data Collection Layer accumulates traffic data real-time with different types of sensors: inductive loops, radar, and cameras at intersections. GPS-enabled vehicles, along with IoT devices, provide further means of acquiring information regarding traffic conditions, vehicle positions, and environmental factors. The cameras, combined with AI-models, provide real-time detections of vehicles, pedestrians, and other traffic elements through computer vision techniques.

6.2. Data Communication Layer

The data gathered are relayed over secure, high-speed communication networks. Edge computing is employed at local intersections, processing data close to the very source, thereby eliminating latency. Besides, 5G/IoT networks are used wherein rapid data exchanges take place between vehicles, traffic infrastructure, and central control systems, thereby maintaining real-time updates.

6.3. Data Processing and Analysis Layer

Upon receipt of data, it is processed by the layer using several machine learning and deep learning models. Reinforcement model used to adjust traffic signal timings dynamically, optimizing vehicle throughput and reducing congestion. Computer vision models (such as YOLO and CNNs) analyze visual data from cameras to detect and classify traffic conditions. Traffic prediction models forecast congestion and adjust control strategies based on historical data and real-time inputs.

6.4. Decision-Making Layer

The processed data is used to make real-time decisions about traffic signal adjustments. The AI model continuously adapts signal timings to prioritize lanes with heavy traffic, reduce waiting times, and alleviate congestion. The system can also manage incidents, such as accidents or roadblocks, by rerouting traffic and providing emergency vehicle prioritization.

6.5. User Interface Layer

This layer includes user interfaces for both traffic management authorities and end-users. Centralized dashboards allow authorities to monitor traffic conditions, adjust system settings, and receive alerts. Mobile apps provide real-time traffic updates to drivers, suggesting optimal routes and alerting them to incidents or delays.

6.6 Feedback Loop and Continuous Learning

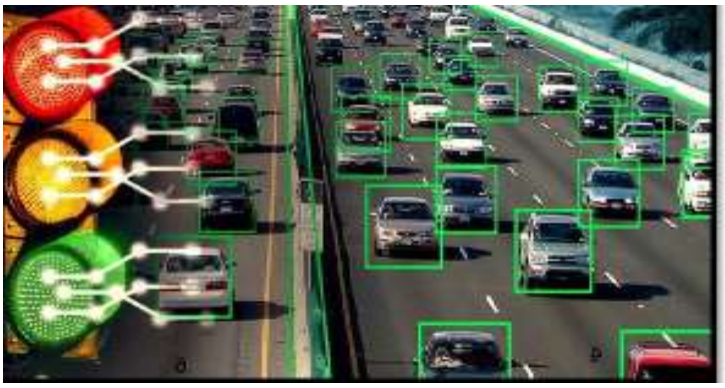
The system features a feedback loop that enables continuous learning and adaptation. The AI models refine their strategies based on the outcomes of previous decisions, ensuring that the system improves over time. Data from vehicle movements, traffic congestion, and incident resolution is used to fine-tune the system's performance, improving efficiency and traffic management in the long run.

7. RESULTS

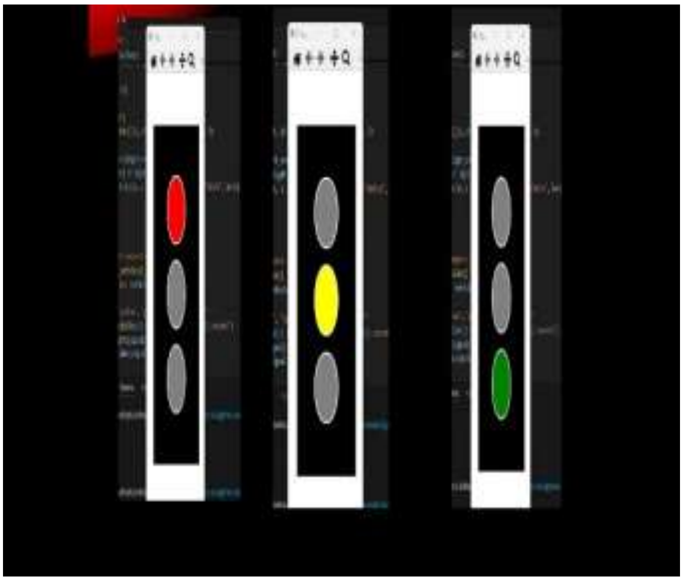
Detection Algorithim	Platform	FPS
Yolov5s	Pytorch	3.125
Yolov5s	ONNX	4
Yolov5s	Tensorrt	13
Yolov4	Darknet	-
Yolov3	Darknet	-
Yolov3-tiny	Darknet	-

7.1 comparison

7.1 detected output



7.2 real time implementation



8. CONCLUSION

An AI-based Traffic Control System represents a transformative solution to modern urban mobility challenges. By leveraging real-time data, machine learning, and advanced sensor networks, these systems can intelligently adapt to changing traffic conditions, reduce congestion, enhance road safety, and lower emissions. As cities continue to grow, the integration of AI into traffic management will play a crucial role in building smarter, more sustainable urban environments. Implementing such systems not only improves the commuting experience but also lays the foundation for future innovations like autonomous vehicles and fully connected smart cities.

8. REFERENCES

1. **Tan, K. L., Poddar, S., Sharma, A., & Sarkar, S.** (2019). Deep Reinforcement Learning for Adaptive Traffic Signal Control.
2. **Elbasha, A. M., & Abdellatif, M. M**. (2024). AIoT-based Smart Traffic Management System.
3. **Boppuru, P. R., Kukatlapalli, P. K., Chowdary, C. R., & Hussain, J.** (2023). *AI-*based YOLO V4 Intelligent Traffic Light Control System.
4. **LYT. (2024**). Emergency Vehicle Signal Preemption System Reduces Response Time. *The Sun.*
5. **Google. (2023**). Green Light Traffic Optimization Program. *The* Wall Street Journal.
6. **Mangaluru Smart City Limited**. (2024). Smart Traffic Signals Face Delays and Disruptions. The Times of India.
7. **Ahmedabad Municipal Corporation**. *(2024).* AI Dashcams to Detect Potholes and Violations. *The Times of India.*
8. **Chen, L., Li, K., & He, X.** ***(**2020*). An intelligent traffic signal control system based on reinforcement learning.
9. **Wei, H., Zheng, G., Yao, H., & Li, Z. *(2019).*** IntelliLight: A reinforcement learning approach for intelligent traffic light control.
10. **Mousavi, S. S., Schukat**, *M., & Howley, E. (2017).* Traffic light control using deep policy-gradient and value-function-based reinforcement learning.