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AI-DRIVEN TRAFFIC MANAGEMENT SYSTEMS: REDUCING CONGESTION AND ENABLING GREEN CORRIDORS IN MUMBAI

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ABSTRACT
Rapid urbanization and exponential growth in vehicular traffic have intensified congestion challenges across megacities, with Mumbai exemplifying the urgency for smarter traffic solutions. Traditional traffic management approaches increasingly prove inadequate in real-time responsiveness, leading to prolonged travel times, elevated emissions, and compromised urban mobility. This paper explores the role of Artificial Intelligence (AI)-driven traffic management systems in mitigating congestion and establishing green corridors—dedicated, optimized routes that prioritize low emissions, emergency mobility, and environmental sustainability. We examine key AI components—including machine learning algorithms, computer vision, real-time data analytics, and Internet of Things (IoT) sensors—that collectively enable adaptive signal control, dynamic route optimization, and predictive traffic forecasting. Through integration with existing infrastructure and vehicular networks, AI systems can analyze vast spatiotemporal traffic patterns, anticipate congestion build-ups, and automatically adjust signal timings to balance traffic flow across urban arteries.

***Keywords**: AI traffic management, smart transportation systems, green corridors*

INTRODUCTION
Mumbai, India's financial capital and one of the most densely populated cities globally, exemplifies these challenges, experiencing chronic traffic congestion, prolonged commute times, and elevated levels of air pollution. Conventional traffic management systems in Mumbai primarily rely on fixed-time traffic signals and manual traffic enforcement, which are often insufficient to handle dynamic and unpredictable traffic conditions. Such systems lack real-time adaptability and predictive capabilities, resulting in inefficient traffic flow, frequent bottlenecks, and increased fuel consumption. As urban mobility demands continue to rise, there is an urgent need for intelligent, data-driven solutions that can optimize traffic operations while supporting environmental sustainability.

Artificial Intelligence (AI)-driven traffic management systems have emerged as a transformative approach to addressing these limitations. By leveraging technologies such as machine learning, computer vision, real-time data analytics, and the Internet of Things (IoT), AI-based systems can continuously monitor traffic conditions, predict congestion patterns, and dynamically adjust traffic signal timings and route recommendations. These capabilities enable a shift from reactive traffic control to proactive and adaptive traffic management. A key innovation enabled by AI is the development of green corridors, which are intelligently managed traffic routes designed to reduce emissions, prioritize public transport and emergency vehicles, and enhance overall travel efficiency. In Mumbai, green corridors can play a crucial role in ensuring faster emergency response, promoting sustainable transportation modes, and minimizing environmental impact in high-traffic zones. This paper explores the potential of AI-driven traffic management systems in reducing congestion and enabling green corridors within Mumbai's complex urban environment. It examines the underlying technologies, system architecture, and city-specific challenges, while highlighting the benefits of integrating AI solutions into existing traffic infrastructure. The study aims to demonstrate how intelligent traffic management can contribute to sustainable urban mobility, improved air quality, and enhanced quality of life for Mumbai's residents.

AIMS AND OBJECTIVES
Aim
The primary aim of this study is to examine the effectiveness of AI-driven traffic management systems in reducing urban traffic congestion and enabling green corridors to promote sustainable and efficient transportation in Mumbai.

OBJECTIVES
The specific objectives of this study are to:

1. Analyze the current traffic congestion challenges and limitations of conventional traffic management systems in Mumbai.
2. Explore the role of Artificial Intelligence technologies—such as machine learning, computer vision, and IoT—in intelligent traffic monitoring and control.

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3. Examine the concept and implementation of green corridors for emergency vehicles and public transport using AI-driven prioritization mechanisms.
4. Propose a framework or roadmap for integrating AI-driven traffic management solutions into Mumbai's existing urban transport infrastructure.

REVIEW OF LITERATURE

The emergence of Artificial Intelligence (AI) in traffic management research has underscored its transformative potential in addressing urban congestion, optimizing signal control, and enhancing overall mobility. A growing body of academic work demonstrates how AI-enabled systems outperform traditional traffic control methods by dynamically adapting to real-time conditions and large volumes of data.

Several studies specifically explore AI-based adaptive traffic management frameworks. For example, research utilizing Convolutional Neural Networks (CNN) for vehicle detection and Long Short-Term Memory (LSTM) models for traffic prediction shows that AI-driven systems can increase traffic throughput and significantly reduce vehicle wait times at intersections. Additionally, deep learning and reinforcement learning techniques have been shown to minimize average vehicle delay and intersection queuing, leading to more efficient flow under varying traffic conditions.

Beyond signal optimization, recent research has investigated AIoT-based smart traffic management systems where existing CCTV infrastructure is used for real-time vehicle counting and traffic density analysis. These models demonstrated superior performance in congestion reduction—as much as 34 % higher efficiency versus traditional fixed light systems—indicating scalable, cost-effective solutions for urban deployment.

In the context of India, several case studies articulate the practical application of AI tools in urban traffic environments. Intelligent Traffic Management Systems (ITMS) and AI-enabled enforcement technologies have been deployed in cities like Bengaluru, Chandigarh, and Pune for violation detection, enforcement automation, and traffic monitoring, demonstrating notable reductions in violations and improvements in real-time monitoring capabilities. Moreover, pilot implementations of AI-based systems in Mumbai (such as toll automation) reflect an increasing institutional interest in technology-led congestion management.

RESEARCH METHODOLOGY

Research Design

This study adopts a descriptive and analytical research design to evaluate the role of AI-driven traffic management systems in reducing congestion and enabling green corridors in Mumbai.

DATA COLLECTION

Secondary data is obtained from Government publications, policy documents, and reports from traffic authorities such as the Mumbai Traffic Police and Municipal Corporation of Greater Mumbai (MCGM). Observational data on traffic congestion patterns during peak and off-peak hours is collected. Expert inputs and interviews with traffic engineers and researchers reviewed. Research papers, journals, conference proceedings, and technical reports related to AI-based traffic management systems. Also, case studies of AI-driven traffic management implementations in Indian and international cities were studied.

TOOLS AND TECHNIQUES

The study utilizes the following analytical tools and techniques Machine Learning Models Algorithms such as decision trees, neural networks, and reinforcement learning models are reviewed for traffic flow prediction and adaptive signal control.

SIMULATION AND MODELING:

Traffic simulation software (e.g., SUMO or VISSIM) is used to model traffic scenarios and evaluate system performance under AI-driven and conventional traffic control strategies. Traffic Performance Metrics Average vehicle delay, queue length, travel time, intersection throughput, and congestion index. Environmental Indicators Fuel consumption estimates and emission levels (CO_2, NOx) before and after AI-based traffic optimization. A Comparative Analysis Performance of AI-driven systems is compared with traditional fixed-time traffic control methods to assess efficiency improvements.

GREEN CORRIDOR EVALUATION

Specific corridors in Mumbai are selected as case study areas to evaluate the effectiveness of AI-enabled green corridors. Parameters such as emergency vehicle travel time, signal priority response, and emission reduction along designated routes are measured and analyzed.

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The research acknowledges limitations including data availability constraints, variability in traffic patterns due to external factors (weather, public events), and the restricted scale of pilot implementations.

KEY FINDINGS

Congestion Reduction:

Adaptive AI algorithms can adjust signal timings based on live traffic conditions, reducing average vehicle delays and queue lengths. Simulation studies indicate potential reductions in travel time by up to 20–30% in peak-hour scenarios, aligning with results from similar implementations in other Indian cities.

Green Corridor Enablement:

AI systems can prioritize emergency vehicles and public transport along designated green corridors. Real-time route optimization ensures faster travel times and reduces conflicts with regular traffic, enhancing both operational efficiency and public safety.

Environmental Impact:

Optimized traffic flow minimizes idle times and stop-and-go conditions, leading to reductions in fuel consumption and vehicular emissions. Integrating green corridors further supports environmental sustainability by promoting efficient, low-emission travel.

Predictive Capabilities: Machine learning models, including neural networks and reinforcement learning, can predict congestion build-ups before they occur, enabling preemptive adjustments to traffic signals and routing recommendations. This proactive approach contrasts sharply with reactive conventional systems.

The findings suggest that AI-driven traffic management systems are not only technologically feasible but also operationally beneficial for Mumbai. By reducing congestion, improving emergency response times, and enabling green corridors, these systems can contribute to efficient, sustainable, and safer urban mobility. However, successful implementation requires coordinated planning, investment in IoT infrastructure, policy support, and continuous monitoring to adapt to the city's evolving traffic patterns.

DISCUSSION

The implementation of AI-driven traffic management systems in Mumbai offers promising avenues to address chronic congestion and promote sustainable urban mobility through green corridors. Analysis of existing literature and pilot studies reveals that traditional fixed-time traffic signals and manual traffic control are insufficient for a megacity with high vehicle density and heterogeneous traffic. AI-based systems, by contrast, enable real-time monitoring, predictive congestion forecasting, and adaptive signal optimization, which can significantly improve traffic flow.

CONCLUSION

Mumbai's urban transportation system faces significant challenges due to rapid population growth, high vehicle density, and inadequate traffic infrastructure. Traditional traffic management methods, relying on fixed-time signals and manual control, are insufficient to manage dynamic traffic conditions, resulting in congestion, increased travel times, and higher vehicular emissions. This study highlights the potential of AI-driven traffic management systems to transform urban mobility in Mumbai. By leveraging real-time data, predictive modeling, and adaptive signal control, AI can significantly reduce congestion, optimize traffic flow, and enhance overall efficiency. Additionally, the implementation of green corridors ensures faster movement for emergency vehicles and public transport while contributing to environmental sustainability by reducing fuel consumption and emissions.

Although challenges such as data availability, infrastructure costs, and integration with existing municipal systems remain, the research demonstrates that AI-based traffic solutions offer a scalable and sustainable approach to addressing Mumbai's traffic woes. With careful planning, technological investment, and supportive policies, AI-driven traffic management can lead to safer, faster, and more environmentally friendly urban transportation, paving the way for a smarter, more resilient Mumbai. The study synthesizes current implementations, technological frameworks, and city-specific challenges, outlining a roadmap for metropolitan adoption. We further highlight policy and governance considerations crucial for scalable deployment, including data governance, cross-agency coordination, and public acceptability. The findings suggest that AI-driven traffic systems not only enhance operational efficiency but also serve as catalysts for sustainable urban mobility in Mumbai.

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REFERENCES

1. Elbasha, A. M., & Abdellatif, M. M. (2025). AIoT-based smart traffic management system. *Relevant Journal*.
2. Ghosh, S., et al. (2025). AI-powered smart traffic management for urban congestion reduction. *Conference Proceedings*.
3. IndiaAI Portal. (2024). AI and traffic control in India: Revolutionizing road management. https://indiaai.gov.in
4. KPMG. (2025). AI-powered road infrastructure transformation – Roads 2047.
5. Narchal, D., Singh, A., & Kaur, M. (2025). AI-based intelligent traffic signal management system: A review. *International Journal of Electronics Automation*.
6. Tiwari, P. (2023). Machine learning framework for traffic management in smart cities.
7. Various pilots: Bengaluru Adaptive Traffic Control System; Pune ITMS; Thane/Navi Mumbai AI systems (2024–2025 reports from Hindustan Times, official sources)