The Role of Artificial Intelligence in Road Traffic Safety: Applications in Smart Traffic Lights and Pedestrian Crossings

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Abstract
This thesis explores the growing use of artificial intelligence (AI) technologies in improving road traffic safety, with a particular focus on their application in smart traffic lights and pedestrian crossings. Drawing on international experiences from the United States, China, Japan, and Europe, as well as recent pilot projects in Uzbekistan, the study highlights the potential of AI to reduce traffic congestion, prevent accidents, and enhance pedestrian safety. The research methodology includes analysis of academic literature, review of international case studies, and examination of the latest developments in AI-powered traffic management systems during 2023–2025.
Keywords: Artificial Intelligence (AI), Smart Traffic Lights, Pedestrian Crossing Safety, Road Traffic Optimization, Traffic Congestion, Urban Mobility, Intelligent Transportation Systems (ITS)

Introduction
In recent years, road traffic safety has become a growing concern across many urban areas due to rising vehicle numbers, increased pedestrian movement, and frequent traffic congestion. According to the World Health Organization (2023), approximately 1.19 million people die annually in road traffic accidents worldwide. Governments and urban authorities are increasingly turning to artificial intelligence (AI) technologies as modern solutions to these challenges.

AI is being integrated into traffic management systems to optimize traffic light cycles, monitor pedestrian crossings, and improve traffic flow in real-time. Countries like the United States, China, Japan, and several European nations have already launched successful AI-based smart traffic programs, demonstrating measurable reductions in congestion and accidents. Uzbekistan has also started piloting similar systems in its capital, Tashkent, with the installation of smart traffic lights and AI-powered pedestrian monitoring systems in 2023–2025.

This thesis aims to investigate how AI-based traffic technologies can contribute to safer and more efficient urban transportation systems, with a focus on their practical benefits and implementation challenges.

Main Section
Artificial intelligence (AI) is emerging as an effective tool for improving road traffic safety, particularly through smart traffic lights and pedestrian crossing systems. Between 2023 and 2024, several cities across the United States, the United Kingdom, and China have reported positive results from AI-powered traffic control systems. For example, Los Angeles implemented AI in 450+ traffic lights through Google's Green Light project, reducing average traffic stoppage by up to 30% and improving flow by 12–15% (Wall Street Journal, 2024).

In Hangzhou, China, the Alibaba City Brain system has improved average traffic speed by 15% and reduced accidents by 20% since its deployment in 2022. The AI continuously monitors real-time traffic video feeds to optimize signal timings city-wide.

In terms of pedestrian safety, Tokyo has implemented AI-powered pedestrian crossing systems using advanced sensors and cameras. These systems dynamically adjust signal durations

based on real-time pedestrian presence, leading to a 25% reduction in pedestrian-related accidents (Tokyo Metropolitan Government, 2023).

In the UK, VivaCity's AI-based smart traffic signals on the A34 corridor use sensors to detect cyclists within 30 meters, automatically giving them priority, which has been reported to improve cyclist safety by over 20% (The Times UK, 2024).

Recent research published on arXiv in 2025 shows that reinforcement learning applied to joint pedestrian and vehicle traffic optimization can reduce waiting time by up to 67% in urban areas by analyzing video and Wi-Fi data streams in real time.

In Uzbekistan, notable advancements are also taking place. Since 2023, pilot zones in Tashkent have implemented AI-powered cameras at key intersections. For instance, trials on Bobur and Nukus streets have resulted in a 10–12% reduction in congestion. In 2024, Tashkent expanded its AI traffic program with 30 new AI-equipped intersections, reducing unauthorized public transport lane violations and improving overall flow.

Notably, in June 2025, AI-based pedestrian safety cameras were installed at 10 pedestrian crossings in Tashkent. According to local reports, these systems have led to a noticeable increase in pedestrian safety within just three days of deployment. City officials plan to expand the system to an additional 30 intersections soon.

Moreover, Tashkent launched its first AI-driven Traffic Situation Center in 2025, capable of monitoring real-time traffic flows, reducing congestion by up to 50%, and significantly improving emergency response and road safety.

Overall, the integration of AI into road infrastructure demonstrates clear potential in reducing traffic congestion, improving pedestrian safety, and creating a more efficient urban transport system.

Conclusion

The application of artificial intelligence (AI) in traffic safety systems has shown clear and measurable improvements in both vehicle flow management and pedestrian safety. Real-world implementations in countries like the United States, China, Japan, and the United Kingdom have demonstrated reductions in congestion by 10–30%, quicker response times, and significant decreases in traffic-related accidents—especially at pedestrian crossings.

In Uzbekistan, early pilot projects in Tashkent indicate that AI-based smart cameras and traffic control systems are positively influencing road discipline, reducing congestion, and improving safety without solely relying on fines or penalties. The expansion of AI-powered pedestrian monitoring and adaptive traffic lights—alongside the newly established AI Traffic Situation Center—represents a promising direction for modernizing urban transportation in Uzbekistan.

Overall, AI offers not just technological efficiency but also societal benefits by making roads safer, reducing traffic jams, and ensuring more responsive and adaptive transport infrastructure. Expanding AI integration across more intersections and transport hubs is expected to play a vital role in improving urban mobility and road safety in the coming years.

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