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PREDICTIVE TRAFFIC MANAGEMENT: EXPLORING SOLUTIONS TO TRAFFIC CONGESTION IN ASTANA, KAZAKHSTAN

Abstract. The article explores predictive traffic management solutions for reducing traffic congestion in Astana, Kazakhstan. It examines intelligent transportation technologies, adaptive traffic-light control, machine learning, and reinforcement learning. The authors propose a Predictive Traffic Management System that integrates traffic forecasting, weather conditions, and coordinated control of interconnected intersections. The proposed system will be evaluated through computer simulations using travel time, queue length, vehicle stops, and public transport delays as performance indicators.

Keywords: intelligent transportation systems, traffic congestion, traffic prediction, adaptive traffic-light control, machine learning, reinforcement learning, traffic optimization, computer simulation, Astana.

1. Introduction

I am currently a student with a strong interest in physics and mathematics. This interest has motivated me to explore modern transportation challenges, particularly the causes of traffic congestion and the limitations of conventional road planning. Since analysing transportation systems on a global scale is a complex task, I decided to begin with my own country, Kazakhstan. To narrow the scope of my research, I chose to examine transportation data from Astana and Almaty, two of the country's major cities.

My research focuses on existing traffic-monitoring technologies, intelligent traffic-light control methods, and potential ways to improve traffic management in Astana. Based on this analysis, I propose a Predictive Traffic Management System designed to anticipate congestion and coordinate traffic lights across interconnected intersections.

2. Technologies Used in Intelligent Traffic Management

Several technologies are currently used to monitor traffic conditions and support traffic management.

Computer vision uses image-processing algorithms and artificial intelligence to analyse video footage from road cameras. It can identify vehicles, estimate traffic intensity, measure queue lengths, and assess vehicle speeds. However, its accuracy may decrease during heavy snowfall, rain, poor lighting, or when vehicles obscure one another.

Induction loops are electrical conductors installed beneath the road surface. They detect vehicles through changes in electromagnetic characteristics. These sensors operate reliably under different lighting conditions, but their installation and maintenance require work on the road surface.

Radar sensors use radio waves to detect vehicles and estimate their speeds and positions. They can operate in poor visibility and complement camera systems by providing additional information about vehicle movement.

GPS-based monitoring uses location data from buses, taxis, and other connected vehicles to identify areas with slow traffic and potential congestion. However, it cannot provide a complete picture of traffic conditions because not all vehicles transmit location data.

These technologies provide the information needed for intelligent traffic management. Combining their data can improve the assessment of traffic conditions, although the effectiveness of such integration depends on data availability and system configuration.

Adaptive Traffic-Light Control

Adaptive traffic-light control adjusts signal timings according to current traffic conditions. Unlike fixed schedules, which allocate predefined periods to different traffic directions, adaptive systems use sensor data to respond to changing demand.

For example, if a long queue forms in one direction while another direction has little traffic, the system can adjust green-light durations to distribute time more efficiently.

Another approach is the green wave, which coordinates green signals at successive intersections so that vehicles can travel along a road with fewer stops.

Artificial intelligence can support these methods by analysing traffic intensity, queue lengths, and historical patterns. However, optimising one intersection independently may create congestion elsewhere. Therefore, traffic management should consider the entire network rather than individual intersections.

3. Approaches to Intelligent Traffic-Light Control

Three approaches are particularly relevant to intelligent traffic management: rule-based control, machine learning, and reinforcement learning.

3.1. Rule-Based Control

Rule-based control relies on predefined instructions. For example, a controller may extend a green signal when a queue exceeds a specified threshold.

Its main advantages are predictable behaviour, low computational requirements, and straightforward verification. However, predefined rules may perform poorly when traffic patterns change unexpectedly.

3.2. Machine Learning

Machine learning algorithms identify patterns in traffic data and can predict traffic intensity, queue lengths, and vehicle arrival times. These predictions can then be used by optimisation algorithms to calculate signal timings.

The main advantage is the ability to account for complex relationships between traffic conditions. However, prediction accuracy depends on the quality of the training data, and accurate forecasts do not automatically guarantee effective control decisions.

3.3. Reinforcement Learning

Reinforcement learning develops a control strategy through repeated interaction with an environment. The algorithm observes the state of the road network, selects an action, and evaluates the outcome using a reward function.

The state may include queue lengths, traffic intensity, and the current traffic-light phase. The reward function can account for delays, queues, and the number of stops.

This approach can help develop strategies for complex traffic situations, but it requires extensive experimentation, careful reward-function design, and testing across different scenarios.

Comparison

These approaches are complementary rather than mutually exclusive. Rule-based control provides predictable decision-making, machine learning supports traffic forecasting, and reinforcement learning can develop strategies for sequential control decisions.

For example, a combined system could use machine learning to predict traffic demand, an optimisation algorithm to calculate signal timings, and an independent controller to enforce safety constraints.

To compare these approaches objectively, they should be tested under the same conditions using the following metrics:

– Average vehicle delay.
– Average queue length.
– Travel time through the selected road section.
– Number of vehicle stops.
– Delays affecting public transport.
– Compliance with safety constraints.

A reduction in delays on a main road, for instance, could increase waiting times on a secondary road. Therefore, the assessment should consider the overall performance of the road network.

4. Analysis of Traffic Conditions in Astana

4.1. Traffic Intensity and Seasonal Changes

Astana experiences considerable traffic pressure due to population growth, an increasing number of cars, and the concentration of employment opportunities in certain areas.

According to a publication by Kazpravda.kz dated December 22, 2025, approximately 437,000 cars were registered in the capital, while incoming and transit traffic added around 90,000 vehicles daily. The highest traffic volumes were reported in the

Esil and Nura districts, near bridge approaches, and along major highways. On certain sections, morning peak-hour traffic intensity reached 4,000–5,200 vehicles per hour.

A study published by Sergek ITS on September 6, 2024, also highlighted seasonal changes in traffic. When comparing the mornings of August 26 and September 2, analysts found that traffic increased significantly on some roads at the beginning of the school year.

On Sarayshyk Street, more than 11,000 cars passed through at 07:00 on September 2, compared with 7,500 a week earlier. Average traffic speed on this section decreased by 20%. Overall, drivers on the studied busy streets needed approximately 30% more time for their journeys.

These findings indicate that traffic conditions depend not only on the time of day but also on seasonal factors. Consequently, effective traffic management should respond to changing demand rather than rely exclusively on fixed schedules.

4.2. Intelligent Transport Systems in Astana

One existing approach is the Intelligent Transport System (ITS), which monitors traffic flows and supports the coordination of traffic-light control.

According to official materials from the Astana Akimat, ITS implementation increased traffic speeds by 18% and reduced average travel time by 20%. Intelligent traffic lights can adjust signal timings according to traffic conditions, helping distribute green time more efficiently.

According to data published in September 2026, 664 traffic-light installations were connected to Astana's intelligent transport system, representing approximately 80% of the total.

However, the number of connected traffic lights does not, by itself, demonstrate the system's effectiveness. Its performance should also be assessed through changes in travel time, queue lengths, and road capacity.

Traffic congestion also depends on factors beyond traffic-light technology. In March 2026, it was reported that changes to the work schedules of government agencies and national companies reduced morning traffic on major highways by 5–10%, while peak-hour traffic speeds increased by approximately 10%.

This example illustrates the importance of considering the broader transport system, including public transport, road infrastructure, and the distribution of journeys throughout the day.

To determine the contribution of intelligent traffic-management technologies, traffic conditions should be compared before and after implementation on comparable road sections, taking into account seasonality, roadworks, and changes in traffic demand.

5. Proposed Solutions to Traffic Congestion in Astana

I identified three potential approaches to reducing traffic congestion in Astana.

1. Construction of transport hubs. The city plans to create nine transfer hubs where drivers can leave their cars and continue their journeys using public transport. This could reduce the number of private vehicles entering the city centre. However, its effectiveness would depend on accessibility, public transport connections, and the locations of the hubs.

2. A winter traffic-management algorithm. This system would account for snowfall, ice, visibility, vehicle speeds, and road conditions. When conditions deteriorate, it could

adjust traffic-light timings and recommend alternative routes. However, its effectiveness would depend on the accuracy of weather and road-condition data.

3. A chain-reaction congestion prevention system. This approach would predict how congestion at one intersection could affect neighbouring intersections and coordinate traffic lights across several road sections. Its main limitation is its dependence on reliable traffic data and accurate predictions.

Each approach addresses a different aspect of the problem. However, I propose combining the second and third approaches into a single concept: the Predictive Traffic Management System for Astana.

6. Proposed Predictive Traffic Management System for Astana

The proposed system would combine weather-aware traffic control with the coordination of interconnected intersections. Its main objective would be to anticipate changing traffic conditions, reduce unnecessary stops, and prevent congestion from spreading across the road network.

An initial version could be investigated through computer modelling before investing in additional infrastructure or equipment. However, the availability of suitable data and compatibility with existing systems would need to be verified.

The system could be developed in four stages.

Stage 1: Data Collection

Collect available data on vehicle speeds, queue lengths, traffic intensity, weather conditions, and time of day. Initially, the study could focus on several interconnected intersections in Astana.

Stage 2: Model Development

Build a simplified computer model of the selected intersections. The model would represent traffic flows between them and allow the effects of different traffic-light timings to be examined. Where sufficient data are available, it could also account for weather-related changes in traffic conditions.

Stage 3: Algorithm Development

Compare conventional traffic-light control with a predictive algorithm that accounts for traffic forecasts and weather conditions.

Both approaches should be tested under identical traffic scenarios. The predictive algorithm would aim to reduce queues and unnecessary stops while preventing congestion from spreading to adjacent intersections. Mandatory safety constraints would remain in place.

Stage 4: Verification of Results

Evaluate both approaches using the same performance metrics:

– Average travel time.
– Average queue length.
– Number of vehicle stops.
– Delays affecting public transport.
– The spread of congestion between intersections.
– Compliance with safety constraints.

The tests should cover normal traffic conditions, peak-hour demand, and adverse winter weather.

If the predictive system consistently outperforms conventional control across these scenarios without creating unacceptable delays elsewhere, the results would support further investigation. Nevertheless, successful simulations would not prove that the same improvements could be achieved in a real city. Further validation and controlled testing would be required.

7. Conclusion

Traffic congestion in Astana and Almaty is a complex problem that cannot be solved solely by expanding road infrastructure. The analysis suggests that more effective transportation management requires the integration of real-time data, predictive models, and adaptive traffic control. Although existing intelligent transportation systems have the potential to improve traffic flow, their effectiveness depends on how accurately they respond to changing traffic conditions, weather, and road capacity.

To address these challenges, I propose developing a Predictive Traffic Management System for Astana that combines traffic data collection, congestion forecasting, and adaptive control of interconnected intersections. By comparing different optimisation methods through computer simulations, it would be possible to identify which approaches could reduce travel delays, shorten queues, and improve the overall efficiency of the road network. Particular attention should also be given to winter conditions, when snow and ice can significantly affect traffic flow and road safety.

Ultimately, this research highlights the importance of applying mathematical modelling and engineering principles to real-world transportation challenges in Kazakhstan. Further analysis and simulation are needed to evaluate the proposed system and determine its practical feasibility. Such an approach could provide a foundation for developing more efficient, adaptive, and reliable urban transportation systems.

References:

1. https://kazpravda.kz/n/o-zagruzhennosti-dorog-vyskazalsya-akim-astany/
2. https://sergek.com/ru-news-article/sergek-its-osen-probki
3. https://www.gov.kz/memleket/entities/astana/press/news/details/434161?lang=ru
4. https://astanatimes.com/2026/09/kazakhstan-expands-digital-road-safety-measures-as-astana-traffic-grows/
5. https://vlast.kz/gorod/68765-kak-v-astane-resaut-problemu-s-probkami.html

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