

Application and Future Development of Big Data Technology in Intelligent Transportation Systems

Yuhe Yang

Information and Computational Science, Beijing Information Science and Technology University,
Beijing, 102206, China
1292166259@qq.com

ABSTRACT

In this research plan, we employ a literature review approach to summarize the current state and development trends of big data technology in intelligent transportation systems. By collecting and analyzing relevant literature from both domestic and international sources, we organize case studies of big data applications in intelligent transportation systems. This allows us to analyze the shortcomings of existing research and identify the challenges that will be faced in future development. Additionally, we can propose future research directions and key focuses. Through this research, we hope to provide valuable assistance for future studies in this field.

KEYWORDS

Big Data Technology; Intelligent Transportation Systems; Traffic Management

1. INTRODUCTION

1.1. Research Background

In recent years, with the acceleration of urbanization and the increase in the number of vehicles, urban traffic problems have become more apparent. Traffic congestion, frequent traffic accidents, and environmental pollution are issues of widespread public concern. As a critical solution to these problems, Intelligent Transportation Systems (ITS) require our utmost attention. The rapid development of big data technology now provides robust support for ITS. By collecting, processing, and analyzing real-time data, big data technology can offer precise decision-making support for traffic management.

1.2. Research Significance

Intelligent Transportation Systems utilizing big data technology can achieve real-time monitoring and analysis of traffic accidents and road conditions, thereby improving traffic management efficiency, reducing congestion, and minimizing pollution. Additionally, these systems can transmit relevant information to the public through various applications. Studies have shown that the operation of autonomous taxis supported by existing big data technology can significantly enhance traffic efficiency and reduce travel costs, ultimately saving public travel time. Furthermore, the application of big data technology in traffic accident prediction and emergency response helps improve traffic safety levels and reduce accident rates. Therefore, researching the application and development of big data in ITS not only aids in the advancement of higher-level technologies but also contributes to

reducing daily traffic congestion, decreasing the occurrence of traffic accidents, and optimizing the allocation of parking resources.

2. LITERATURE REVIEW

2.1. Domestic Research Status

In related domestic literature, scholar Yan Xinpeng and colleagues introduced the current status and challenges of intelligent transportation systems in China. Their research on major cities like Beijing and Shanghai, where intelligent traffic management platforms have been deployed, revealed that collecting traffic data through video surveillance, sensors, and vehicular networks enables real-time analysis and reporting, thereby improving traffic operation efficiency [1].

Scholar Han Weiyu focused on the short-term traffic flow prediction methods for a certain city. The research analyzed the current road traffic conditions and the issues faced in traffic flow prediction in the city. A set of indicators was developed to meet the short-term traffic flow prediction needs of the city. Real traffic flow data from urban roads in the city was collected. On this basis, a short-term traffic flow prediction model for the city was first constructed using Gradient Boosting Decision Trees (GBDT), and a series of parameter optimizations were performed to achieve the best model fit. Building upon this model, the relationship between roads was analyzed and modeled based on their interconnections [2].

In the field of intelligent parking, scholar Luo Hao designed five functional modules for parking, with the Internet of Things (IoT) remote control and active infrared beam as the core technologies. By using "parking space reservation" to lock in available parking spots in advance, this system disperses parking pressure, solving the issue of difficult parking. It maximizes the utilization of urban parking resources, making it easier for citizens to park and find their cars, while also reducing traffic pressure. The application of this system has significantly improved the utilization of urban parking resources [3].

Wang Langtao and other scholars addressed the complex issues of unmanned large-scale parking control systems by proposing an intelligent automatic parking control system based on machine vision and big data. This system enables license plate recognition and fingerprint recognition to complete information collection and matching. Parking and retrieving vehicles are handled by a control module, while a display module shows various statuses and intelligently calculates the required parking fees. The system uses 3D printing technology to replicate urban parking lots, and testing has resolved issues such as difficulty in finding cars and long parking and retrieval times in large parking systems, greatly improving the utilization efficiency of parking spaces [4].

Scholar Xu Wei, in his research on the emergency traffic warning system in Yunnan Province, found that there is a need to optimize the countermeasures for highway traffic accident emergency management. In terms of prevention and preparedness, it is essential to improve the traffic accident emergency management system and enhance the support for emergency forces and equipment. For monitoring and early warning, an efficient intelligent system platform should be established, with a focus on strengthening the monitoring of hazardous materials transport vehicles and improving the warning mechanisms [5].

Scholar Guo Yue elaborated on the current state of research, development trends, and policies related to intelligent vehicles both domestically and internationally. He highlighted the achievements of researchers in object detection based on machine vision and selected the FAST algorithm for this purpose, optimizing it further. The principles of camera calibration and distance measurement were studied and analyzed, leading to the proposal of a new target distance measurement algorithm based on coordinate transformation. He introduced the principles of neural networks and proposed a new optimized FAST feature point detection algorithm for vehicle targets, achieving good target

recognition results and laying a foundation for improving the accuracy of target distance measurement. A risk warning system was established using MATLAB 2016b to provide early warnings for front risk targets. Experiments were conducted to verify the effectiveness and accuracy of target detection and distance measurement, as well as the designed driving risk warning system, proving that the proposed target detection and distance measurement methods are feasible and the designed risk warning system is accurate and effective [6].

2.2. International Research Status

In related international research, Germany's studies in the field of intelligent transportation have achieved efficient traffic data collection and analysis through large-scale vehicular network technology experiments. Scholar Schmidt and colleagues researched Germany's intelligent traffic signal control system and applied big data technology to achieve dynamic traffic flow regulation, significantly reducing traffic congestion. This provides feasible intelligent traffic control solutions for other countries [7].

On the other hand, Takeyoshi Imai's research explored the progress in integrating autonomous driving technology with big data in Japan. By utilizing LiDAR, sensors, and real-time planning with high-definition maps, efficient dispatch and route planning of autonomous vehicles were achieved. This provided a route planning method that other regions can reference, and the study also discussed the local applications in Japan [8].

In the article by Anton Finogeev and colleagues, a system is proposed for proactive monitoring and forecasting of road traffic accident risks based on the influence of external factors. To address issues in traffic warnings, an experimental method was developed to analyze and predict changes in road transport infrastructure, enabling the prediction of destructive events under external influences. This system can determine, assess, and predict the dynamic factors affecting the likelihood of accident risks, depending on the current situation on the monitored road sections. The monitoring system is implemented using a multi-agent approach, involving the integration of multiple fields, and experiments have shown that it can significantly improve the success rate of predictions [9].

3. METHODS

3.1. Literature Collection and Organization

Using authoritative academic databases such as CNKI and Google Scholar, I conducted a comprehensive literature search to collect and analyze research on the application of big data technology in intelligent transportation systems. I used keywords like "big data," "intelligent transportation systems," and "traffic management" to ensure a broad and precise search scope. Through this search, I gathered a large number of research papers related to the field.

In the initial screening process, I selected studies on the application of big data technology in the transportation sector from different countries and regions. This approach ensured that the selected literature had broad representation. I carefully filtered out high-quality papers that were highly relevant to our research area to ensure the depth and breadth of the study.

By conducting detailed literature reviews and categorizing the findings, I was able to comprehensively analyze and summarize the existing research outcomes. This helped me to gain a deep understanding of the specific applications and development trends of big data technology in intelligent transportation systems. Reading and analyzing these high-quality research papers helped me grasp the current research status. Additionally, it allowed me to think about the practical application prospects of big data in intelligent transportation. Combining the existing research results will be beneficial for further exploring innovative applications of big data technology in traffic management in future studies.

3.2. Case Analysis

I conducted an in-depth analysis of intelligent transportation system application cases in typical cities both domestically and internationally. Through detailed case studies, I summarized the successful experiences and best practices of various cities in implementing intelligent transportation systems. For example, in Yunnan and some cities with many highways, there is a need to monitor and control transport vehicles. In cities like Beijing, where there are clear regulations, traffic dispatch must consider relevant laws and regulations.

I carefully studied the various experimental methods reported in different literature within the same field and proposed practical improvement suggestions based on the actual situations of these cities. To ensure the practicality and feasibility of the suggestions, I considered the specific conditions and relevant laws and regulations of each place. By comparing the research focus in the same field domestically and internationally, I identified suitable methods for deploying intelligent transportation systems.

Through this integrated analysis, I hope to provide valuable references and guidance for other cities in constructing intelligent transportation systems. This can not only help scholars conduct more in-depth research in this field but also offer theoretical guidance to regions willing to deploy intelligent transportation systems. The goal is to achieve comprehensive deployment of intelligent transportation networks in the future.

3.3. Comprehensive Evaluation

After completing the literature review and categorization, I conducted a detailed analysis to identify the strengths and weaknesses of existing research. Using methods from studies in different regions, I evaluated the effectiveness of big data technology in traffic management based on current data. This process highlighted successful experiences and identified existing challenges.

I carefully analyzed and compiled the data needed for future research to provide a solid foundation for subsequent studies. By identifying areas for improvement, I aim to give clear direction for future work. Addressing the technical obstacles in current research and pinpointing urgent issues will help guide future research and prioritize solving key problems in developing intelligent transportation technology.

The goal of this evaluation is to provide clear guidance for future research, helping both academia and practical fields achieve innovation and progress in traffic management. By analyzing existing research and future needs, I hope to offer valuable references for future studies and promote the application of big data technology in intelligent transportation systems, making everyday life easier for people.

4. CONCLUSION

Through existing research both domestically and internationally, it is evident that intelligent transportation systems and big data technology can significantly enhance traffic efficiency and safety. Big data technology enables dynamic regulation, which effectively mitigates traffic accidents and congestion. For example, networked traffic signal adjustments can control traffic flow at specific times, sensors and dynamic cameras can facilitate autonomous driving on real-time maps, and centralized parking space information can be published on application platforms to alleviate parking difficulties for citizens. These examples highlight the vast development potential of big data in intelligent transportation platforms. However, research in Germany and Japan indicates that privacy issues and technological complexity need urgent attention. Future advancements should not only focus on technical breakthroughs but also prioritize user privacy protection by implementing relevant policies and regulations to safeguard data security and prevent issues arising from data breaches.

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