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Research and Application of The Internet of Things Based on Big Data in Intelligent Transportation

Aozhe Niu

Beijing Royal School, Beijing, 102209, China

ABSTRACT
Doing a good job in intelligent transportation can effectively help cities improve their transportation problems.The Internet of Things can better obtain information on various devices.Such as cars, radar, etc.Doing these well can make people's travel faster and more convenient. Most research focuses on parts related to highways, such as transportation, while fewer people pay attention to people's daily travel, such as smart transportation in cities.I think there is still some lack of research on people's daily travel, so this topic is studied.

KEYWORDS
Big data; Internet of Things; Intelligent transportation

1 Introduction

Since the 21st Century, various regions in our country have begun to plan and construct intelligent transportation. After integrating the Internet of Things technology, intelligent transportation can utilize a variety of sensor devices to extract various types of information generated during urban traffic management, and use multiple technologies such as big data and artificial intelligence to conduct in-depth processing and analysis of massive traffic information, ultimately significantly enhancing the intelligence level of intelligent transportation. Second, promote the arrival of the era of the Internet of Everything in the transportation sector. In the 5G era, the Internet of Everything will be well applied in various industries and fields. The Internet of Things technology is the foundation of the interconnection of all things. After being applied in intelligent transportation, it can provide a basic environment for the interconnection of all things and promote the arrival of the era of the interconnection of all Things in the transportation field.

2 The current application status of big data in intelligent transportation

The Intelligent Traffic System (abbreviated as ITS) is also known as the Intelligent Transportation System. It is the effective and comprehensive application of advanced science and technology (information technology, computer technology, data communication technology, sensor technology, electronic control technology, automatic control theory, operations research, artificial intelligence, etc.) in transportation, service control and vehicle manufacturing, to strengthen the connection among vehicles, roads and users. Thus, a comprehensive transportation system that ensures safety, enhances efficiency, improves the environment and saves energy is formed [1].

2.1 Traffic flow prediction

A large amount of traffic flow data can be collected in real time through sensors, cameras and GPS devices deployed in the road network. For example: Congestion warning, which informs drivers in advance of upcoming traffic jams and helps them choose other routes. Signal light optimization: Dynamically adjust the duration of traffic lights based on predicted traffic flow to reduce waiting time and unnecessary stops. Public transportation regulations stipulate that public transportation departments can reasonably arrange schedules based on the predicted number of passengers to avoid overcrowding or waste of resources.

2.2 Traffic condition monitoring

Big data technology is of vital importance for traffic condition monitoring. It can collect, process and analyze data from multiple sources in real time, helping traffic management departments to promptly grasp road condition information, optimize traffic flow, and enhance road safety and efficiency. For instance, dynamic signal control adjusts the duration of traffic lights based on the current traffic flow, reducing waiting time and enhancing traffic efficiency. Accident response and management: Once a traffic accident occurs, the system can quickly locate the accident site and send an alert to relevant departments. Traffic police will also arrive at the scene immediately to handle the situation and suggest detour

routes for nearby drivers. Emergency evacuation guidance: In the event of natural disasters or other emergencies, real-time traffic data is utilized to plan the best evacuation routes to ensure the safe evacuation of personnel [2].

2.3 In terms of easing traffic congestion

Big data plays a crucial role in alleviating traffic congestion in intelligent transportation systems. By collecting, analyzing and applying multi-source data, traffic bottlenecks can be effectively identified, traffic flow can be optimized, and the efficiency of the overall transportation system can be improved. For instance, dynamic signal control automatically adjusts the duration of traffic lights based on the current traffic flow, reducing waiting time and enhancing traffic efficiency. During peak hours, extend the green light duration on main roads and shorten the red light duration on secondary roads. Route planning and navigation services provide drivers with real-time traffic information and the best detour suggestions, disperse traffic flow and avoid concentrated congestion. Intelligent navigation applications can recommend the fastest driving route based on the current traffic conditions. Public transportation priority strategies have been implemented, including the use of dedicated bus lanes and signal priority measures, to encourage more people to choose public transportation for their trips and alleviate the traffic pressure caused by private cars. Shared mobility, promoting shared bikes, electric bikes and carpooling services, especially to replace private cars in short-distance travel and reduce road occupancy. Parking management optimization, through the intelligent parking lot management system, guides drivers to quickly find available parking Spaces, reducing the additional traffic volume caused by searching for parking Spaces. The event response mechanism enables the system to quickly locate and notify relevant departments in the event of a traffic accident or other emergency, and simultaneously push detour information to surrounding vehicles to prevent secondary congestion [3].

The enthusiasm of these applications includes:

Safety has been enhanced. Meanwhile, continuous monitoring of the driver's behavior patterns can also promptly detect abnormal actions and prevent potential dangerous events. In addition, when an emergency occurs, the rapid response mechanism relies on efficient information transmission channels, which also cannot do without the support of powerful background data analysis capabilities.

The travel information service is convenient. The mobile application or website interface provided for ordinary citizens integrates the latest traffic information from multiple channels, including but not limited to bus and subway schedules, live traffic condition pictures, and estimated time required to reach the destination, enabling people to flexibly plan their travel routes based on actual situations and improve travel efficiency.

3 The current application status of internet of things technology in intelligent transportation

3.1 Current domestic development status

In recent years, China has made remarkable progress in the development of intelligent transportation, and domestic research mainly focuses on the following three aspects:

(1) Intelligent traffic control: China has conducted in-depth research and practice in urban traffic signal control, traffic guidance, and public transportation optimization. By introducing advanced algorithms and technologies, the efficiency and accuracy of traffic control have been enhanced.

(2) Intelligent vehicle technology: China has made significant breakthroughs in autonomous driving technology, intelligent connected vehicle technology, and in-vehicle intelligent devices. Among them, autonomous driving technology has moved from the laboratory stage to the actual road testing stage.

(3) The application of big data and artificial intelligence in the transportation sector: In China, big data and artificial intelligence technologies are utilized to mine and analyze transportation data, providing more accurate data support for transportation decision-making. For instance, through big data analysis, urban traffic flow can be predicted, providing references for traffic planning and dispatching [4].

3.2 Current development status abroad

Compared with the development in China, the popularization of intelligent transportation in foreign countries started earlier. Therefore, the current research on intelligent transportation in foreign countries mainly focuses on artificial intelligence. The following are some of the research priorities in foreign countries:

(1) Driverless cars: Currently, many countries have begun research on driverless technology, such as the United States, Japan, and Germany. Some companies have already completed commercial operations of driverless cars. Such as Tesla in the United States.

(2) Intelligent bus system: In some European countries such as the UK, where buses have introduced big data analysis

and advanced sensor technology, they can better monitor bus vehicles and conduct real-time dispatching of these buses, thereby enhancing the efficiency and reliability of buses.

4 Analysis of the application of internet of things based on big data in intelligent transportation

The intelligent transportation system in our country is still not perfect, and many things are still in their infancy. But the foundation of the transportation system lies in the establishment of infrastructure. As a result, a large number of enterprises have participated in the development of the intelligent transportation industry. However, the problem that has emerged is that there are numerous brands, the products are chaotic, and the quality is difficult to guarantee. Products related to the intelligent transportation field include mobile phones, GPS navigation products, and in-vehicle satellite navigation products. Among those involved in these products are large enterprises such as state-owned enterprises and central enterprises.

The application of the Internet of Things (IoT) based on big data in intelligent transportation is gradually changing our understanding and management methods of transportation systems. By connecting objects in the physical world to the Internet and using the massive data generated by these objects for analysis and decision support, we can achieve a more efficient, safer and more environmentally friendly urban transportation system [5]. The following is a specific analysis on this topic:

4.1 How do Internet of Things (iot) devices collect traffic data

Internet of Things (iot) devices such as sensors, cameras and other smart terminals can continuously collect a large amount of information about traffic conditions from the environment, including but not limited to vehicle location, speed, direction, road conditions, etc. These data are then transmitted to the cloud or edge computing nodes for initial filtering and preprocessing. For instance, in intelligent transportation systems, video image recognition technology and intelligent positioning systems can be employed to monitor the conditions on the roads.

Real-time monitoring and early warning

The processed data can help build a comprehensive and accurate traffic situation map, enabling the traffic management department to grasp the overall dynamics in the first place. For potential problems such as traffic accidents or abnormal congestion, the system can respond quickly through pre-set algorithm models, issue alerts and take necessary measures to mitigate the impact. In addition, the smart zebra crossing based on Internet of Things (iot) technology can monitor the behavior of pedestrians and vehicles in real time, predict potential risks, and send early warning information to users through AI smart hardware products.

4.2 The operation of an intelligent traffic management system based on big data and the Internet of Things

The combination of big data and Internet of Things (iot) technologies has brought many changes to intelligent transportation management systems. Through real-time data collection, analysis and application, this system can significantly enhance traffic efficiency, reduce congestion, improve safety and optimize resource utilization Real-time monitoring and early warning: By using video image recognition technology and intelligent positioning systems to monitor road traffic conditions in real time, an alarm will be issued immediately and corresponding measures will be taken once any abnormality is detected. Predictive maintenance, through long-term tracking of infrastructure performance parameters, predicts potential failure points, arranges maintenance work in advance, and avoids service disruptions caused by unexpected problems. Personalized services, based on users' travel habits and personal preferences, provide customized information services, such as recommending the most suitable travel time and route, and even participate in the urban planning process. Collaborative cooperation is achieved among different departments (such as traffic management departments, public security departments, environmental protection departments, etc.) to realize data sharing and collaboration. In addition, when applied in daily life, the intelligent traffic management system can monitor and predict traffic flow, keep track of traffic conditions in real time, predict traffic flow within a certain period in the future, and take measures in advance to alleviate congestion. Dynamic signal control automatically adjusts the duration of traffic lights based on the current traffic flow to optimize the traffic efficiency at intersections. Route planning and navigation services provide drivers with the best route suggestions, helping them avoid congested sections and disperse traffic flow. Event response and emergency handling: Quickly locate traffic accidents or other emergencies, notify relevant departments and push detour information to nearby vehicles. Public transportation optimization: Adjusting bus routes and schedules based on real-time data to enhance operational efficiency and service quality [6].

4.3 Application efficiency of big data and the Internet of Things in intelligent transportation

The application of big data and the Internet of Things in intelligent transportation has greatly enhanced the efficiency of the transportation system and improved the quality of urban traffic management. Real-time monitoring and dynamic adjustment: Internet of Things devices such as cameras and sensors can capture traffic condition information in real time, including vehicle speed, traffic volume, road occupancy rate, etc. These data are transmitted to the cloud or edge computing nodes for processing and analyzed in combination with historical data to provide immediate decision support. For instance, dynamically adjust the signal light time based on the current traffic situation to reduce unnecessary waiting time. Event response and early warning: When traffic accidents, road construction or other emergencies are detected, the system can immediately issue an alarm and notify relevant departments to take action. At the same time, detour suggestions are sent to drivers in the affected areas to avoid creating new congestion points. Predictive maintenance prevents facility failures: By monitoring the condition of infrastructure (such as Bridges, tunnels, traffic lights, etc.) and using big data analysis to predict the occurrence of potential problems, it arranges maintenance and repair work in advance to prevent service disruptions caused by sudden failures and ensure that transportation facilities are always in the best condition [7].Personalized travel services, intelligent navigation and route planning: Based on the user's starting point and destination as well as real-time traffic conditions, it provides each user with personalized and optimal route recommendations, avoiding congested sections and saving travel time [7]. In addition, different types of transportation options can be provided based on users' preferences, and customized information services can be offered. According to users' travel habits and personal preferences, relevant travel tips and service information, such as weather forecasts and updates to public transportation schedules, can be pushed to enhance user experience satisfaction. Public transportation optimization and schedule scheduling optimization, with the help of a big data analysis platform, can not only optimize the existing bus route layout and service schedule, but also flexibly adjust the frequency of trips according to actual demand to meet the needs of passengers during peak hours and reduce the empty load rate. Data integration and sharing, cross-departmental collaboration, to achieve data intercommunication and sharing between traffic management departments and other relevant departments (such as public security, environmental protection, meteorology, etc.), jointly addressing complex traffic challenges [8]. For instance, under adverse weather conditions, the transportation department can promptly adjust traffic control measures based on the early warning information provided by the meteorological department. Enhance traffic safety by leveraging Internet of Vehicles technology to monitor drivers' behaviors, such as speeding and fatigued driving, and promptly issue warnings or automatically take deceleration measures to ensure driving safety [9].

5 Challenges and policies faced by the internet of things based on big data in intelligent transportation

Although the application of big data and Internet of Things (IoT) technologies in intelligent transportation has brought many benefits, it also faces a series of challenges.

Firstly, there are challenges in data privacy and security. Collecting and processing large amounts of personal data may lead to the risk of privacy leakage, and at the same time, data transmission may also be subject to hacker attacks. Solution: Implement strict data encryption standards to ensure the security of data during transmission and storage. Use anonymization and de-identification techniques to protect user privacy and reduce the exposure of sensitive information. Establish and improve a data access control mechanism, and only authorize necessary personnel to access specific data.

Secondly, there are challenges in data quality and standardization. Data formats from different sources are inconsistent and may contain noise or errors, which can affect the accuracy of data analysis. The solution is to establish unified data standards and interface specifications to promote interoperability among different systems. Apply data cleaning and preprocessing techniques to remove noisy data and fill in missing values. Introduce automated tools for data verification and quality monitoring to ensure the consistency and reliability of the data.

Then, there are technical integration and compatibility challenges. There is a lack of compatibility between various hardware devices and software platforms, making it difficult to achieve seamless integration. The solution promotes the formulation of standards within the industry and encourages the adoption of open standards and technical frameworks. Develop middleware or API gateways to bridge different systems and services, enhancing the flexibility and scalability of the overall system [10].

In addition, there are challenges in user acceptance and participation. The public's acceptance of new technologies varies, and some people may be reluctant to cooperate due to concerns about the inconvenience or privacy issues they bring. The solution is to enhance publicity efforts, popularize relevant knowledge, and eliminate misunderstandings and concerns. Design user-friendly interfaces and service processes to enhance users' sense of trust and satisfaction.

Finally, there are the challenges of system reliability and fault tolerance. Intelligent transportation systems must have

high availability and fault tolerance to deal with various unexpected situations. The solution is to build a redundant backup mechanism to ensure that services can be quickly restored when key components fail. Regularly conduct pressure tests and emergency drills to enhance the system's ability to withstand pressure and response speed. By solving the above-mentioned problems, the intelligent transportation system based on big data and the Internet of Things can be further improved, thereby more effectively improving urban traffic conditions and enhancing the quality of life for residents.

6 Conclusion

In conclusion, in the face of various challenges encountered by the Internet of Things based on big data in the field of intelligent transportation, we need to adopt a comprehensive approach. We should not only attach importance to technological innovation but also take into account institutional design and the construction of social consensus, so as to jointly promote the sustained and healthy development of this emerging industry. The government plays an indispensable role in this process and needs to fulfill the dual functions of a guide and a service provider to contribute to the construction of an intelligent society. The intelligent transportation in cities has a wide range of applications and a large audience. The application of intelligent transportation in cities has a huge impact on people's lives, so the degree of intelligence is also very important. To this end, we can start from the public transportation cards in a city, build a more complete one-card system, and increase the convenience of People's Daily travel. For instance, in terms of public transportation such as buses, subways, and taxis, a single public transportation card can be used, or the fare can be automatically deducted through the facial recognition account.

By comprehensively applying technologies such as barcodes, IC cards, GPS, GIS, video surveillance, and wireless communication, dynamic perception of the operational status of transportation vehicles and the goods they carry can be achieved. Combined with corresponding software, monitoring and intelligent dispatching of transportation elements can be realized, optimizing transportation organization and enhancing transportation efficiency and safety. The Internet of Things technology based on big data has brought unprecedented opportunities to the field of intelligent transportation. It not only promotes technological innovation, but also drives social progress and development. However, while enjoying the convenience, we should also clearly recognize the challenges existing therein and actively seek solutions to achieve the sustainable development goals. With the continuous evolution and improvement of technology, it is believed that more exciting application scenarios will emerge in the future. Data not only transforms the traditional transportation management model but also lays a solid foundation for building a more intelligent and humanized urban transportation system. In the future, with the application and practice of more advanced technologies and concepts, it is believed that intelligent transportation will embrace a broader space for development.

References

[1] Li Wenyan. Design and Application of Intelligent Transportation System Based on Internet of Things and Big Data Technology [J] China Telecommunications Industry,2025,(02):77-80.

[2] Wang Guiling, Wang Qiang, Zhao Zhuofeng, et al. Internet of Things Big Data Processing Technology and Practice [M]. Publishing House of Electronics Industry :2017, 09:245.

[3] Wang Yangyang. Application of Real-time Big Data Processing Technology in Smart Internet of Things [J]. Information and Computer, 2020,37 (03):72-74.

[4] Xu Huafen, Yuan Jiangting, Meng Guangxue. Design and Implementation of Intelligent Transportation System Based on Internet of Things [J]. Journal of North China Institute of Science and Technology,2021,18(01):96-100.

[5] Wen Tianji. Analysis and Design of Intelligent Transportation System Based on Internet of Things [J]. Contemporary Economy,2017,(02):94-95.

[6] Su Yahui. Design and Implementation of Intelligent Transportation Information Collection System in the Internet of Things Environment [D] PLA Information Engineering University,2014.

[7] Lu Ming. Research on the Application of Internet of Things Technology in the Context of the Big Data Era [J]. Shihezi Science and Technology, 2024,(03):32-33.

[8] Ye Cheng. Application of Internet of Things Technology in Intelligent Transportation [J]. Transport Manager World,2023,(24):55-57.

[9] Wang Wenhui, Zeng Yunrui, Wu Xiao. Analysis of Intelligent Transportation Strategy Based on Internet of Things Big Data [J]. Electronic Technology,2023,52(06):96-97.

[10] Yue Jianren. Research on the Application of Big Data Technology in Intelligent Transportation Management [J]. Investment and Cooperation, 2021,(02):175-176.