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Design of Intelligent Traffic Visualization Platform Based on Big Data Architecture

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Abstract

With the acceleration of the urbanization process, the urban traffic problems are becoming increasingly prominent. In order to solve the urban traffic problems and realize the sustainable development of urban traffic, this paper designs an intelligent traffic visualization platform based on big data architecture. Platform demand analysis: in view of the existing intelligent traffic data display platform data storage cost, information display form single and poor user experience, this paper designed an intelligent traffic visualization platform, the platform can realize the rapid processing of real-time traffic data and efficient storage, combined with data analysis and visualization technology, to provide users with more intuitive, accurate and real-time traffic data analysis and decision support. Platform architecture design: According to the results of system requirements analysis, this paper designs an intelligent traffic visualization platform architecture based on distributed architecture, which consists of data management module, analysis and computing module and display module. In the data management module, the collection, cleaning and storage of real-time traffic data can realize the efficient storage of large amounts of real-time traffic data; in the analysis and calculation module, the visual processing and analysis of real-time traffic data can realize the understanding and mastery of urban traffic management and decision-making. In the function realization, the platform adopts a variety of advanced technology means to develop and realize. Firstly, the application of distributed architecture adopts the distributed database design architecture based on Spark, the data mining method based on massive real-time traffic data, and the analysis and calculation method based on big data technology. The experimental results show that the intelligent traffic visualization platform designed in this paper can provide more intuitive, accurate and real-time data support for urban traffic management and decision-making.

Keywords

Big data architecture, intelligent transportation, visualization platform, distributed architecture, data analysis, data visualization, data security, platform scalability, platform performance

Introduction

In recent years, with the acceleration of urbanization and the increasing demand for transportation, traffic management and decision-making are facing increasing challenges. The traditional way of manually counting and analyzing traffic data has been unable to meet the needs of modern urban traffic management. With the continuous development and application of big data technology, the intelligent traffic visualization platform based on big data

architecture has become an effective means to solve the problems of urban traffic management and decision-making. This paper aims to design an intelligent traffic visualization platform based on big data architecture to meet the needs of urban traffic management and decision-making. The designed intelligent traffic visualization platform is experimentally validated, and the research results and conclusions of this paper are summarized. The research results of this paper have certain reference value for the relevant research and practice in the field of intelligent transportation, and also provide some useful ideas and methods for the construction and management of smart city.

1. Summary of intelligent transportation and big data technology

1.1 Development course of intelligent transportation

In the stage of traffic information collection, from the 1980s to the mid-1990s, intelligent transportation technology mainly focused on traffic information collection. At that time, the traffic management department began to use computer technology to manage and analyze traffic information, through cameras, electronic police and other equipment to monitor vehicles, realizing part of the intelligent traffic management [1].

Traffic information processing stage, after entering the mid-1990s, intelligent transportation technology entered the traffic information processing stage. With the continuous development of computer technology, communication technology and sensor technology, the intelligent transportation system begins to develop towards digitalization, network and intelligence. Various intelligent traffic systems and equipment such as traffic signal control system, intelligent on-board system, navigation system, road safety monitoring system have been widely used.

Since the 21st century, with the rapid development of Internet of Things technology, cloud computing technology and big data technology, intelligent transportation technology has entered the stage of traffic information sharing and application. Through the application of big data technology, the intelligent transportation system can realize the real-time processing and analysis of massive traffic data, integrate all kinds of traffic information, and realize the real-time sharing and exchange of traffic information, so as to improve the efficiency of traffic management, improve traffic conditions and improve traffic safety.

1.2 Development and application of Big data technology

Big data technology refers to the technology of collecting, processing, storing, analyzing and applying massive, complex and high-dimensional data. In recent years, with the development of the Internet, the Internet of Things, social networks, mobile Internet and other technologies, the scale and types of data have shown an explosive growth trend. In this context, how to use these data to improve social and economic benefits, promote industrial upgrading and innovation, has become an important issue of concern in various fields [2].

Obtain traffic data from multiple data sources, including sensors, surveillance cameras, on-board equipment, etc. Big data technology can help to realize the efficient data acquisition and data access, and ensure the real-time performance and accuracy of the data.

Make data processing and storage. Large amounts of traffic data are processed and stored to support subsequent analysis and application. Big data technology provides the power of distributed computing and storage to process and store massive amounts of data, and ensures the scalability and high performance of the system.

Traffic data need to be analyzed, valuable information and insights extracted and presented visually to users. Big data technologies provide a variety of data analysis tools and algorithms, such as machine learning, data mining, and real-time data analysis, which can help reveal hidden patterns and associations in traffic data.

Make real-time performance and visualization. Intelligent traffic visualization platform needs to monitor and display the traffic status and flow situation in real time. Big data technology can support real-time data processing and visual display, enabling decision-makers to timely obtain up-to-date traffic information and make corresponding decisions.

Through the design of intelligent traffic visualization platform based on big data architecture, traffic managers can better understand and master the operation of the traffic system, so as to optimize traffic flow, improve traffic safety, improve traffic efficiency, and then promote social and economic benefits and promote industrial upgrading. The design and application of such platforms have broad applications in the fields of urban traffic management, traffic planning and transportation.

1.3 Application status of Big Data in the field of intelligent transportation

Big data technology can analyze and mine the historical traffic data, establish the road condition prediction model, and realize the prediction [3] of the future traffic conditions. Through road condition prediction, it can help traffic management departments to formulate reasonable traffic control plans in time, optimize traffic organization, and alleviate traffic congestion. Through the analysis and mining of the historical traffic accident data, the traffic accident prediction model can be established to realize the prediction of the future traffic accidents. The traffic administrative department may strengthen the traffic safety management according to the forecast results and take effective measures to avoid the occurrence of traffic accidents. Big data technology can analyze and process the traffic data in the traffic signal control system, and realize the intelligence of the traffic signal control. Through the real-time traffic data analysis, the intelligent traffic signal control system can adjust the traffic signals in time, optimize the traffic capacity at the intersection, and alleviate the traffic congestion. Through the analysis and mining of the data of different traffic modes (such as buses, private cars, taxis, etc.), the travel characteristics and behavior habits of different traffic modes can be understood, the design and organization of traffic modes can be optimized, and the travel efficiency can be improved.

Through the analysis and mining of historical traffic data, the road condition prediction model can be established, and the future traffic conditions can help the traffic management department to formulate reasonable traffic control plans, optimize the traffic organization and alleviate traffic congestion. Researchers have worked extensively in this area, using big data technologies and machine learning algorithms for traffic prediction and congestion identification.

Through the analysis and mining of the historical traffic accident data, the traffic accident prediction model can be established to realize the prediction of the future traffic accidents. The traffic administrative department may strengthen the traffic safety management according to the forecast results and take effective measures to avoid the occurrence of traffic accidents. Researchers have carried out related research, using big data technology and statistical analysis methods to predict the probability and location of traffic accidents.

Big data technology can analyze and process the traffic data in the traffic signal control system, and realize the intelligence of the traffic signal control. Through the real-time traffic data analysis, the intelligent traffic signal control system can adjust the traffic signals in time, optimize the traffic capacity at the intersection, and alleviate the traffic congestion. In this regard, researchers have proposed various traffic signal optimization algorithms and strategies based on big data.

Traffic mode optimization and travel efficiency improvement. Through the analysis and mining of the data of different traffic modes (such as buses, private cars, taxis, etc.), the travel characteristics and behavior habits of different traffic modes can be understood, the design and organization of traffic modes can be optimized, and the travel efficiency can be improved. Big data technologies can be used to identify associations and interactions between traffic patterns and to provide decision support to improve the overall performance of traffic systems.

Current research efforts have mainly focused on developing more efficient and accurate big data analysis algorithms and models to cope with the complexity and scale of traffic data. At the same time, with the further development of Internet of Things technology and sensors, intelligent transportation systems can obtain more real-time data, providing more opportunities and challenges for data-driven traffic management and decision-making. Therefore, the researchers are also exploring how to better integrate big data technology, Internet of Things technology and artificial intelligence technology to further improve the efficiency and reliability of intelligent transportation systems.

2. Intelligent traffic visualization platform design

2.1 Platform requirements analysis

Platform demand analysis first needs to clarify the requirements of data collection, including data type, data quantity, data collection frequency, etc. In the intelligent traffic visualization platform, the data to be collected mainly includes traffic flow, vehicle speed, road condition information, weather information, vehicle GPS information, etc. The frequency of data acquisition needs to take into account the real-time data performance and the data storage cost [4].

Intelligent traffic visualization platforms need to collect multiple types of data to obtain comprehensive traffic information. This includes traffic flow data, vehicle speed data, road condition information, weather information, vehicle GPS data, etc. Different types of data are of great significance for traffic management and analysis, so the

platform needs to be able to collect and integrate multiple types of data sources. The amount of data a system faces is usually very large because it needs to cover the vast road network and vehicle traffic. Platform design needs to consider the ability to process and store large-scale data to meet the performance requirements of the system. This may require techniques of distributed storage and computing to support high throughput and parallel processing of data.

The frequency of data acquisition is crucial for the monitoring and prediction of real-time traffic status. The acquisition frequency should balance the real-time performance and the data storage cost as required. Some data may need to be acquired in real time, while others can have a lower acquisition frequency. Platform design needs to consider how to adjust the frequency of data collection according to the importance and real-time requirements of the data.

Intelligent traffic visualization platform need to ensure that the collected data has good quality and accuracy. This includes data completeness, consistency, and accuracy. Data quality management is an important aspect of platform design and may involve technologies such as data cleaning, exception detection and error correction to ensure the provision of accurate and reliable traffic information. Since traffic data involves the privacy information of individuals and vehicles, the platform design needs to consider the protection of data privacy and security. This includes security measures such as data encryption, access control, and authentication to ensure that sensitive data is not accessed and abused by unauthorized people.

Platform demand analysis plays an important role in the design of intelligent traffic visualization platform based on big data architecture. Clarifying the requirements of data collection, including data type, data quantity, data collection frequency, etc., can provide guidance for platform design to ensure that the system can effectively collect, process and analyze traffic data, so as to achieve better traffic management and decision support.

2.2 Platform architecture design

In the design of intelligent traffic visualization platform based on big data architecture, platform architecture design is one of the cores [5] to realize the platform functions. Data collection, the platform needs to collect a large amount of traffic data, and to process and store these data. Data collection needs to consider the data type, collection frequency, data source and many other factors. The platform can use sensors, monitoring equipment, vehicle GPS and other ways to collect data, while the data needs to format and preprocess the collected data. For data processing, the platform needs to use the big data processing framework to process the collected data, including data cleaning, data conversion, data calculation, data summary and other links. The platform can use big data processing frameworks such as Apache Spark and Flink for data processing, while considering the real-time performance and accuracy of data processing. Data storage, the platform needs to use a distributed storage system to store and manage the processed data. The platform can use Hadoop HDFS, Apache Cassandra and other distributed storage systems for data storage, and also needs to consider the capacity, scalability, data security and other requirements of data storage. Data analysis, the station needs to use data analysis tools to analyze and mine the processed data to provide more in-depth traffic data analysis and decision support. The platform can use Python, R and other data analysis tools for data analysis and mining, while considering the efficiency and accuracy of data analysis. Data visualization, the platform needs to use data visualization tools to visualize the processed data, so that users can understand the traffic data more intuitively. The platform can use Tableau, Power BI and other data visualization tools for data visualization display, and also need to consider the requirements of visualization effect and real-time performance.

2.3 Platform module implementation

The implementation of the data acquisition module requires the configuration and deployment of the data acquisition equipment and sensors according to the platform architecture design and the data acquisition requirements. Data also need to be formatted and preprocessed to facilitate subsequent processing and storage. The realization of the data acquisition module needs to consider the stability and reliability of the equipment and sensors, and ensure the accuracy and real-time of the collected data [6]. The implementation of the data processing module needs to configure and deploy the data processing framework according to the platform architecture design and the data processing requirements. At the same time, it is necessary to write data processing programs to clean, transform, calculate, summarize and other links of the collected data. The implementation of data processing module needs to ensure the speed and accuracy of processing, while considering the requirements of real-time and stability. The implementation of the data storage module requires the configuration and deployment of the distributed storage system according to the platform architecture design and the data storage requirements. At the same time, it is necessary to split and

backup the storage system to ensure the reliability and scalability of the data. The implementation of data storage module needs to consider the requirements of data storage capacity and performance, and ensure the security of data storage. The implementation of the data analysis module requires the configuration and deployment of the data analysis tools according to the platform requirements analysis and the data analysis requirements. At the same time, it is necessary to write data analysis programs to analyze and mine the processed data, so as to provide more in-depth traffic data analysis and decision support. The implementation of the data analysis module needs to consider the efficiency and accuracy of the analysis, and ensure the reliability of the analysis. The implementation of the data visualization module needs to configure and deploy the data visualization tools according to the platform requirements analysis and the data visualization requirements. At the same time, it is necessary to write a data visualization program to visualize the processed data, so that users can understand the traffic data more intuitively. The realization of data visualization module needs to consider the effect and real-time of visualization, and ensure the reliability of demonstration.

3. Conclusion

The design of the intelligent traffic visualization platform needs to consider many types of data, such as traffic flow, vehicle speed, road condition information, weather information, and vehicle GPS data. The platform shall be able to collect and integrate these data sources and provide comprehensive traffic information support. The design should deal with large-scale data volumes, with distributed storage and computing techniques to support high-throughput and parallel processing. Data acquisition frequency should balance real-time and storage cost. Data quality management includes integrity, consistency, and accuracy, with data privacy and security protection. The platform architecture design involves the implementation of data acquisition, processing, storage, analysis, and visualization modules, including configuration and deployment of acquisition equipment, selection of processing framework, configuration of distributed storage systems, and configuration and deployment of data analysis and visualization tools. The design of intelligent traffic visualization platform based on big data architecture is a complex system engineering involving many aspects and links. Through the review of intelligent transportation and big data technology, the design of big data architecture, the demand analysis of intelligent transportation visualization platform, platform architecture design and platform module implementation, this paper proposes a feasible intelligent transportation visualization platform design scheme.

References

[1] Huang Jiazhen, Yang Fangyuan. The practical path of big data technology in intelligent transportation [J]. Digital technology and applications, 2020, (8):67-68

[2] Wang Jifeng, Sun Tianqi. The application research of big data technology in the field of intelligent transportation [J]. Traffic Information and Safety, 2017 (01): 14-19.

[3] Lu Xiaoguang, Zhao Jiaqi. Urban traffic visualization study based on big data [J]. Science and Technology Information, 2018, (19): 221-222.

[4] Wang Zhengyang, Jiang Jinlong. Processing and analysis of intelligent traffic information based on big data [J]. Computer Science, 2017 (04): 121-123 + 129.

[5] Wang Jing, Wang Baijuan, Chen Lijiao, et al. Design and implementation of Yunnan Chashan Geographic Information System based on big data [J]. Modern electronic technology, 2022, 45(16):75-79.