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Intelligent Transportation Planning and Construction in the Era of Big Data

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Abstract: Intelligent transportation planning has become increasingly important in the era of big data. By utilizing big data technology, traffic flow can be measured and managed more effectively. This leads to transportation planning that is more scientific and provides people with more convenient travel options. In this paper, the role of big data technology in intelligent transportation planning is analyzed. Subsequently. a path towards intelligent transportation planning is proposed, laying the foundation for intelligent transportation development.

Keywords: Big data era; Intelligent transportation; Planning; Role; Construction path

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1. Introduction

To ensure the smoothness of urban traffic and reduce traffic pressure, it is necessary to make full use of big data technology to conduct intelligent analysis and simulation of urban traffic conditions and plan intelligent transportation. The software and hardware facilities of big data technology should be leveraged to enhance the modernization and advancement of intelligent transportation, ensuring technical support for the sustainable growth of the urban transportation environment. It can ensure intelligent and accurate traffic operation. Therefore, it is necessary to make full use of big data methods to improve the efficiency of transportation planning.

2. Application of intelligent transportation in the context of the big data era

2.1. Traffic flow monitoring

Big data technology enables the collection of traffic-related information, including real-time traffic line speed, traffic volume, congestion status, and more, using surveillance cameras, sensors, and other monitoring equipment. Real-time monitoring of these information is helpful to understand the needs of the transportation field. Better traffic monitoring results can be achieved by transmitting and processing these data to the server. By combining historical data with real-time data analysis, it becomes possible to predict traffic flow patterns,

analyze traffic operation modes, and forecast future traffic operation data [1]. These forecast data will help the transportation department make better road planning to avoid large-scale traffic congestion. Big data technology plays a vital role in traffic planning, providing a reference for traffic signal adjustment and alleviating traffic congestion problems. At the same time, scientific planning and adjustment of roads can help balance the load of urban highways and play an important guiding role in regional transportation planning [2].

2.2. Improving travel experience

Applying big data technology in urban transportation planning improve travel experience. Big data technology allows for the integration of information, including people's travel times and preferences, enabling a better understanding of travelers' needs and population mobility. This information can then be used to formulate transportation plans that enhance the quality of transportation services. By recording various location information on mobile devices, the common travel methods of the people can be better understood. Analyzing people's travel modes and frequencies can offer valuable insights for optimizing public transportation routes and increasing the capacity of public transportation services. Furthermore, big data technology's analysis of people's travel times can provide insights into the travel time patterns of the general population, allowing for a more accurate assessment of urban traffic congestion during morning and evening rush hours. This information is valuable for developing effective traffic management strategies and alleviating traffic congestion.

2.3. Realizing intelligent management

The application of big data technology in intelligent transportation is conducive to improving intelligent traffic management capabilities and ensuring the smoothness and safety of traffic operations. Big data technology gathers location data from vehicles and pedestrians, providing the transportation department with insights into real-time traffic conditions. Analyzing this data allows for the identification of traffic congestion and enables adjustments to route planning and traffic signal optimization, ensuring smoother traffic flow. At the same time, big data analysis is also conducive to collecting traffic violations and traffic accidents, understanding which road sections in traffic operations are high-risk sections and prone to safety hazards, and taking effective improvement measures [3]. For example, traffic signal signs can be installed in areas with high accident rates as a warning for motorists and pedestrians. Illegal behaviors in traffic operations, such as running red lights, speeding, etc., can also be monitored to reduce the probability of unlawful driving.

3. Intelligent transportation planning and construction strategies in the era of big data

The utilization of big data technology can help optimize the transportation management model, establish an intelligent transportation operation network, provide guidance for various transportation planning, alleviate traffic congestion, and reduce traffic accidents. When combined with other technologies, it enables the creation of a traffic operation model for real-time traffic operations monitoring and contributes to the healthy development of transportation [4].

3.1. Strengthening network architecture

The Internet of Things (IoT) is the foundation for constructing urban intelligent transportation networks. It can accurately locate transportation operation facilities, monitor various facilities, fully use artificial intelligence (AI) and big data means, and strengthen the optimization of general technologies and underlying infrastructure platforms. The application of IoT technology can be in the form of communication networks, big data, VR

technology, and cloud computing. Information collection and transmission are achieved through remote monitoring, intelligent management, and communication coordination. Through analyzing infrastructure, traffic operation conditions, and transportation services, specific traffic application scenarios are formed, which are beneficial to autonomous driving and closed-area monitoring. Besides, the accuracy of transportation positioning can be improved through big data technology and ensure data processing efficiency [5].

3.2. Mining travel data

In the era of big data, traditional transportation distribution methods face challenges in meeting the needs of large-scale transportation development. Big data technology allows for the collection of various information, including vehicle location, dwell time, and recurrence frequency, through signal collection. With this data, it becomes possible to infer traffic operation conditions, evaluate project travel impacts, and analyze traffic operation characteristics. An origin-destination (OD) matrix can be formulated to gain insights into people's travel patterns. This can involve the analysis of daily traffic volume distribution and the study of the movement of people and vehicles across different regions. Data sources for this analysis may include sources like public transportation card swipes and mobile phone signals. For example, suppose it is found during the survey that the proportion of people travelling by car in a particular area is significantly higher than that of public transportation. In that case, it can be determined that there is a congestion problem in this area. Subsequently, the cause of the congestion can be analyzed, and corresponding solutions can be formulated and taken promptly. Analyzing data such as bus card swipes and bus positioning allows us to comprehend passenger flow at various stations during public transportation operations. It also helps in identifying the operational characteristics of public transportation, exploring the development potential of public transit, and optimizing the public transportation operation network [6]. Through dynamic mining and tracking investigation of transportation data, we can understand the operating status and passenger flow of transportation, laying the foundation for accurate transportation planning. For instance, when planning a specific road section within the city, an analysis of road traffic prediction results reveals issues such as overlapping traffic peaks in that area, which can potentially lead to traffic congestion. As a result, it is necessary to clear the congested road sections, expand the connecting channels between the central area and the crowded locations, and increase the proportion of non-motorized lanes.

3.3. Mobile navigation guide

Intelligent transportation planning under big data technology provides travelers with more effective travel guidance. Travelers can use big data and AI to plan their trips more efficiently [7]. For example, mobile navigation provides practical guidance for transportation planning and can give travelers precise advice and services.

Mobile navigation can enable a dynamic voice broadcasting mode, connecting travelers with traffic updates and providing travel route reminders along with road condition alerts. For example, a popular mobile application called Amap provides pedestrians with accurate traffic information and ways. It can form a variety of route planning navigation, which is conducive to providing more precise guidance for travelers and vehicle operations. This can lead to the optimization of bus trips, providing more precise vehicle operation information, enhancing vehicle planning efficiency, and promoting the implementation of intelligent transportation solutions.

3.4. Intelligent parking system

As the number of vehicles per household increases, parking problems have become more apparent. To address this problem, an intelligent three-dimensional parking system can be created to ensure the market-

oriented development of parking equipment. Intelligent parking is the main development direction of traffic parking systems, which aims to solve parking difficulties [8]. One approach involves establishing an intelligent parking system platform and creating a parking space database through big data analysis. This database would encompass parking resources across various areas, such as shopping malls, hospitals, hotels, businesses, and communities. The platform would also employ sensors to identify parked vehicles and gather data on parking location, duration, and vehicle details. An automated parking system would then provide drivers with real-time information on parking space availability, fee rates, and reserved parking options, allowing them to conveniently locate, assess, and reserve parking spaces based on their preferences and requirements. This service approach not only simplifies parking for drivers but also assists them in selecting the most efficient parking route, opting for a more suitable parking spot, and steering clear of unnecessary detours or traffic congestion due to parking issues [9]. In addition, a three-dimensional parking lot can be built to ensure the rationality of the parking lot location. Integrating data from intelligent transportation infrastructure, we can gain insights into vehicle congregation points and spatial distribution. This information enables the construction of three-dimensional parking facilities in congested traffic and densely populated areas. A three-dimensional garage can be formed by constructing a parking lot, using intelligent storage methods and electrical systems to build parking devices and equipment that can move horizontally and vertically.

3.5. Creating a data link system

Through the construction of a digital collection system, the intelligent transmission system can be strengthened, an intelligent and digital transportation system can be formed, the goal of building a powerful transportation country can be achieved, and the value of intelligent transportation can be enhanced. In the comprehensive planning of intelligent transportation, the data link should be fully leveraged to perform precise assessments and intelligent analyses of the transportation system using AI and big data. This involves the integration and diagnosis of the data link [10]. In this way, a multi-dimensional and multi-level traffic impact model can be form to make accurate judgments to promote the intelligent operation of urban traffic. At the same time, an intelligent transportation analysis report can be made to conduct an in-depth analysis of urban traffic congestion and its causes. By integrating collection and transmission systems, precise control of traffic operations and effective avoidance of congestion problems can be achieved, embodying the value of intelligent transportation operations. The integrated advancement of intelligent digital systems maximizes the utilization of data links, establishing an information collaborative development mechanism that enhances the effective fusion of road and pedestrian elements, resulting in a novel service model. In the event of traffic congestion, video technology is employed for identification, enabling swift assessments of road conditions and traffic flow. This is complemented by intelligent applications and vehicle navigation systems that bolster the identification and dissemination of traffic information. This collective approach enhances the efficiency of intelligent traffic management and ultimately contributes to improved travel conditions for pedestrians and drivers.

3.6. Adopting edge computing model

Edge computing refers to using intelligent devices and other technologies to realize information storage, calculations, etc., to form a complete network management and service model. The application of edge computing is based on the system's edge nodes and AI edge computing, developing high-efficiency processing of computing units and high-resolution video data analysis. The device can be connected to cameras and microwave radars to identify lanes, traffic lights, traffic signs, etc. It can be connected to the cloud platform to obtain corresponding traffic information. The related information can also be edited and set through the

computing unit, and the information transmission can be completed using the communicator. Compared with the traditional central computing model, edge computing can be combined with data collection terminals for data analysis. It does not need to transmit all data to the central server to form a unified processing model, which improves the operating efficiency and computing power of servers and processors to ensure the safety of system operation.

3.7. Simulated annealing algorithm

The application of big data in intelligent transportation can use simulated annealing algorithms to improve traffic lines' management efficiency and diversion. Traffic diversion is an integral part of transportation planning, which is beneficial to alleviating traffic pressure and balancing traffic load. The simulated annealing algorithm can simulate and search the spatial state of traffic, form a more scientific traffic diversion model, avoid deadlock in the design of some traffic planning lines, and obtain a more optimized traffic diversion effect. Bus line design is an integral part of public transportation services. Using the simulated annealing algorithm, bus lines can be optimized, including the layout of line routes and the operation frequency of public transportation. Through the objective function, we can understand the performance of various solutions in the line design scheme and form the optimal strategy. In addition to traffic diversion and line design, the simulated annealing algorithm is also beneficial to the optimization of various combinations in traffic planning. For instance, through the optimization of traffic signal placement, bus route configurations, and parking lot layouts, we can devise solutions to abstract issues. This process simplifies the challenges associated with bus route operations and enables the selection of optimal solutions from a range of transportation design alternatives.

3.8. Combining big data with artificial algorithms

Intelligent transportation planning and design can combine big data and artificial algorithms to ensure the scientific nature of transportation system design. Using artificial algorithms, such as genetic algorithms, traffic operation conditions are simulated to construct traffic models. Various factors and circulation processes within traffic are optimized to formulate the most rational traffic planning scheme. This enhances traffic operation efficiency and mitigates issues related to traffic congestion.

4. Conclusion

In summary, intelligent transportation is the development trend of urban transportation, improving transportation efficiency and allowing pedestrians to plan their trips more conveniently. Using big data technology in intelligent transportation provides more accurate information for transportation planning and design. The IoT, cloud computing, and artificial intelligence can be used to understand traffic status in real-time and reasonably build traffic roads, public transportation lines, and shifts based on traffic operating patterns and traffic conditions. At the same time, services can be extended based on the current transportation development situation, and a more scientific and convenient travel plan can be formed to address issues such as mass travel and parking, providing a reference for the healthy development of urban transportation.

Moreover, the intelligent traffic management system can create real-time data models, enhance dispatching decisions, and boost the efficiency of the transportation system. It can establish multi-modal traffic operation guidelines, employ big data techniques to coordinate and integrate various transportation modes, strategically plan travel routes, optimize traffic organization, and enhance the overall traffic environment.

Disclosure statement

The author declares no conflict of interest.

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