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Review

A survey of sustainable development of intelligent transportation system based on urban travel demand

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Abstract: This paper provides a comprehensive exploration of urban travel demand forecasting and its implications for intelligent transportation systems, emphasizing the crucial role of intelligent transportation systems in promoting sustainable urban development. With the increasing challenges posed by traffic congestion, environmental pollution, and diverse travel needs, accurate prediction of urban travel demand becomes essential for optimizing transportation systems, fostering sustainable travel methods, and creating opportunities for business development. However, achieving this goal involves overcoming challenges such as data collection and processing, privacy protection, and information security. To address these challenges, the paper proposes a set of strategic measures, including advancing intelligent transportation technology, integrating intelligent transportation systems with urban planning, enforcing policy guidance and market supervision, promoting sustainable travel methods, and adopting intelligent transportation technology and green energy solutions. Additionally, the study highlights the role of intelligent transportation systems in mitigating traffic congestion and environmental impact through intelligent road condition monitoring, prediction, and traffic optimization. Looking ahead, the paper foresees an increasingly pivotal role for intelligent transportation systems in the future, leveraging advancements in deep learning and information technology to more accurately collect and analyze urban travel-related data for better predictive modeling. By combining data analysis, public transportation promotion, shared travel modes, intelligent transportation technology, and green energy adoption, cities can build more efficient, environmentally friendly transportation systems, enhancing residents' travel experiences while reducing congestion and pollution to promote sustainable urban development. Furthermore, the study anticipates that intelligent transportation systems will be intricately integrated with urban public services and management, facilitating efficient and coordinated urban functions. Ultimately, the paper envisions intelligent transportation systems playing a vital role in supporting urban traffic management and enhancing the overall well-being of urban construction and residents' lives. In conclusion, this research not only enhances our understanding of urban travel demand forecasting and the evolving landscape of intelligent transportation systems but also provides valuable insights for future research and practical applications in related fields. The study encourages greater attention and investment from scholars and practitioners in the research and practice of intelligent transportation systems to collectively advance the progress of urban transportation and sustainable development.

Keywords: urban transport; sustainable; intelligent transportation; deep learning; flow forecast

1. Introduction

With accelerated urbanization and the continuous increase in population, traffic

congestion has gradually become the norm in urban life [1]. In recent years, the demand for urban travel has increased, and the travel modes are diverse [2]. Urban traffic is a global challenge, especially in the context of rapid urbanization and population growth. Traffic congestion, environmental pollution, and other problems have become increasingly prominent. The traffic situation is a key feature that reflects the health and order of urban operations, production, and life [3]. As an important part of the national economy, the transportation industry interacts with and promotes economic development. The transportation industry can drive economic activities, and economic development can promote the construction of the transportation industry [4]. The traditional traffic management mode can no longer effectively cope with the diverse travel needs of urban residents, so it is urgent to introduce intelligent transportation systems to improve the efficiency and quality of traffic operations. Predicting urban travel demand is important for perceiving the future state of a city, deploying public transportation resources, and building intelligent cities [5]. Research on travel time prediction shows its importance in the rational planning of travel arrangements and traffic congestion mitigation [6]. Urban travel demand shows a diversified and personalized trend, including commuting, shopping, tourism, and other travel purposes and ways. At the same time. Traffic flow prediction has always been the focus of research in the field of intelligent transportation systems, which is conducive to the more reasonable allocation of basic transportation resources and the formulation of transportation policies [7]. Large-scale traffic data mining provides a new solution to alleviate traffic congestion and improve traffic service [8]. How to fully utilize these data to improve the accuracy of predictions has received extensive attention [9]. Forecasting urban travel demand has important implications for sustainable development. Above all, accurate travel demand forecasts can help urban planners optimize transportation system design, improve transportation efficiency, and reduce congestion and emissions. By analyzing factors such as population growth trends, economic development levels, and residents' travel patterns, future changes in travel demand can be predicted. Based on these predictions, urban planners can rationally plan roads, public transportation facilities, bicycle lanes, etc. to meet future needs and reduce energy consumption and environmental pollution. Especially, travel demand forecasting also plays a positive role in promoting the development of sustainable travel methods. In urban travel, the excessive use of private cars has led to problems such as traffic congestion and exhaust emissions. By accurately forecasting travel demand, urban planners can promote the development of public transportation and non-motorized travel modes. Based on demand forecasts, they can increase the coverage and frequency of public transportation lines, provide more infrastructure such as bicycle lanes and pedestrian streets, and encourage citizens to choose sustainable travel methods. This will help reduce dependence on cars, energy consumption, and environmental pollution. Accurate travel demand forecasts can provide business opportunities and development directions. For transportation companies and travel service providers, understanding future travel demand changes can help them optimize operational strategies and improve service quality and efficiency. For example, based on demand forecast results, they can adjust vehicle configuration and route planning to provide more flexible and intelligent travel solutions to meet the

needs of different groups of people.

However, several challenges remain in achieving accurate travel demand forecasts and translating their impacts into practical actions for sustainable development. Data collection and processing is a key issue. Urban travel involves a large amount of data, such as demographic data, traffic flow data, etc. Accurately forecasting demand requires the collection and integration of this multi-source data, as well as effective analysis and modeling. At the same time, privacy and information security issues also need to be properly addressed to protect the security and privacy of personal data.

In summary, accurate urban travel demand forecasting has an important impact on sustainable development. It can help urban planners optimize transportation system design, promote the development of sustainable travel methods, and provide business opportunities and development direction for enterprises. However, to achieve this goal, we need to overcome challenges such as data collection and processing and focus on protecting personal privacy and information security. Only through scientific prediction and reasonable planning can the goal of sustainable development in urban travel be achieved.

2. Document filtering standards

In view of the investigation direction of this paper, we need to cite some kinds of literature to support the views of this paper and provide relevant research background and theoretical basis. The following are the relevant standards for the references in this paper.

2.1. Literature inclusion criteria

The following are the inclusion criteria for the references in this article, as shown in **Table 1**.

Table 1. Literature inclusion criteria.

1) Relevant literature on predictive city factors	
Yes	Inclusion
No	Exclusion
2) Relevant literature on traffic flow prediction	
Yes	Inclusion
No	Exclusion
3) Relevant literature published after 2009	
Yes	Inclusion
No	Exclusion
4) The content is related to sustainable development literature	
Yes	Inclusion
No	Exclusion
5) The research involves related literature in the field of transportation	
Yes	Inclusion
No	Exclusion

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(5) The research involves related literature in the field of transportation.

2.2. Literature exclusion criteria

(1) The picture is unclear in the relevant literature.
(2) Related literature with unclear language expression.
(3) Relevant literature with significant gaps in experimental directions.
(4) Relevant literature with questionable experimental results.
(5) Relevant literature published too early.
(6) Non-academic related literature (such as non-academic newspapers and magazines).

3. Materials and methods

In order to further explore the relationship between urban mobility demand and intelligent transportation systems, we conducted field research and case studies. Through the analysis of traffic data and the construction of intelligent transportation systems in many cities, it has been found that intelligent transportation systems have played a positive role in meeting urban travel demand, reducing traffic congestion, and improving traffic efficiency.

Although much of the work considers multi-task scenarios, it does not explore the potential spatial information between subtasks [10]. Based on the above research results, we believe that with the acceleration of urbanization, the demand for urban travel continues to grow, putting tremendous pressure on the urban transportation system and environment. In order to achieve sustainable development of urban travel, we need to take a series of initiatives to predict and meet future travel needs: Obviously, strengthen the research and development of intelligent transportation technology to improve the intelligent level and service capability of the system. Deep learning parallel plays an important role in accelerating model training and improving prediction accuracy [11]. Signally, to promote the deep integration of urban planning and intelligent transportation systems to ensure the coordination between system construction and urban development, we can use data analytics and intelligent traffic management systems to predict urban travel demand. By collecting and analyzing traffic flow, population migration, economic growth, and other data, we can understand travel demand in different regions and time periods and make accurate predictions. In this way, the traffic management department can make corresponding planning and dispatch in advance according to needs to avoid traffic congestion and waste of resources. Specially, strengthen policy guidance and market supervision, promote the healthy development of the intelligent transportation industry, and promote the intelligent transportation system to play a greater role in the sustainable development of the city. Promoting sustainable development requires encouraging the use of public transport and non-motorized travel modes. Increase investment in the public transportation system, improve service quality and

coverage, and enable more people to choose to travel by public transportation. At the same time, a complete network of walking and cycling paths should be built to provide a convenient and safe non-motorized travel environment, encourage citizens to walk and cycle, and reduce reliance on motor vehicles. Promoting shared travel mode is also one of the important measures for sustainable development. New modes of travel such as shared bicycles and cars can effectively reduce vehicle ownership and improve resource utilization efficiency. The government can cooperate with relevant enterprises to provide policy support and preferential measures to encourage citizens to use shared travel services. At the same time, in the process of promoting shared travel, management and supervision must be strengthened to ensure operational safety and order. Another point, the introduction of intelligent transportation technology and green energy is an important means to achieve sustainable travel. Intelligent transportation systems can optimize traffic flow, improve road utilization, and reduce congestion and emissions. At the same time, promote the popularization of electric vehicles and the construction of charging facilities, promote the application of green energy in urban travel, and reduce tail gas emissions and reliance on fossil energy. Publicity and education are also important measures to promote the development of sustainable travel. By carrying out publicity activities on travel modes, we can enhance citizens' knowledge and awareness of sustainable travel and guide them to change their travel habits and choose more environmentally friendly and low-carbon ways. Traffic safety education can be strengthened to improve citizens' traffic literacy and reduce traffic accidents and casualties. In short, measures that combine forecasting urban travel demand with sustainable development are the key to achieving sustainable development of urban transportation. Through data analysis, the promotion of public transportation and non-motorized travel, the promotion of shared travel modes, the application of intelligent transportation technology and green energy, and publicity and education, we can build a more convenient, efficient, and environmentally friendly urban transportation system. This will help improve residents' travel experience, reduce traffic congestion and pollution, and promote sustainable urban development. The sustainable development of intelligent transportation systems needs to be fully integrated with urban planning in order to realize the positive interaction between system construction and urban development. The intelligent transportation system should also be closely integrated with the overall urban planning, fully consider the future development direction of the city and changes in population structure, and ensure that the system construction is coordinated with urban development. At the same time, the intelligent transportation system should be organically integrated with the construction of urban infrastructure, and make full use of information technology means to improve the efficiency and intelligent level of urban traffic operation.

4. Results and discussion

With the rapid development of the transportation and automobile industries, trajectory prediction has become a focus in the field of transportation big data [12]. The impact of urban travel demand on intelligent transportation systems is mainly reflected in the following aspects: Above all, the research on travel time prediction

has shown its importance and significance in rational planning of travel arrangements and alleviating road congestion [13]. The diversified travel needs require the intelligent transportation system to have higher flexibility and intelligence levels to meet the travel needs of different groups. Next, predicting the population density of key areas of the city is crucial [14]. The complexity of traffic scenarios and the spatial-temporal feature correlations pose higher challenges for traffic prediction research [15]. In order to ensure the smooth operation of the traffic network, it is necessary for the intelligent transportation system to have dynamic adjustment ability due to the changes in peak and low periods of urban traffic demand. Thirdly, the formation of urban functional regions is closely related to the travel behaviour of people [16]. It is beneficial to urban travel planning, the alleviation of traffic congestion, and urban commercial planning [17]. The construction of intelligent transportation systems needs to fully consider urban development planning and demographic changes to achieve long-term sustainable development. The traffic condition of the target area is affected by the surrounding area or the further area, which makes the urban traffic area have a certain spatial dependence [18]. And, the movement of humans in cities is an important reference standard for the division of urban functional regions [19]. The hierarchy of city nodes is an important characteristic of relative spatial distribution [20].

As a means of intelligent traffic management, intelligent transportation systems can effectively respond to the diversified travel needs of cities. Through real-time data collection and analysis, the intelligent transportation system can accurately grasp the traffic conditions in different time periods and regions so as to dynamically adjust according to the travel needs of urban residents. The intelligent transportation system also supports the information interconnection of various modes of travel, including public transportation, self-driving vehicles, shared travel, etc., to provide more convenient and efficient travel options for urban residents. The intelligent transportation system can also achieve a refined response to urban traffic demand through intelligent signal control, traffic information release, and other ways to improve traffic operation efficiency and service level.

Intelligent transportation systems not only meet the needs of urban travel but also play an important role in reducing traffic congestion and environmental protection. Through intelligent road condition monitoring and prediction, the intelligent transportation system can find the possibility of traffic congestion in time, reduce the probability of congestion, and improve traffic efficiency through intelligent signal control, traffic route optimization, and other means. By promoting intelligent public transport systems, public transport operation efficiency, and service quality will be improved, citizens will be encouraged to choose low-carbon travel modes, and the impact of urban transport on the environment will be reduced. Of course, intelligent transportation systems can also reduce energy consumption and environmental emissions by reducing vehicle idling, optimizing road design and other measures, and making positive contributions to sustainable urban development.

With the continuous development of information technology and the acceleration of urbanization, intelligent transportation systems will play a more important role in the future. Flow forecasting is significant for planning transportation and allocating basic transportation resources [21]. In recent years,

deep learning has played an essential role in computer science and other fields [22]. With the extensive application of new generational information technologies such as artificial intelligence and big data, intelligent transportation systems will become more intelligent, providing more personalized and convenient travel services for urban residents. With the development of big data and artificial intelligence, we can also more accurately collect and analyze various data related to urban travel, including traffic flow, population migration, economic growth, and other information. By applying advanced data analysis technology and building intelligent models, future travel needs can be effectively predicted. At the same time, with the help of cloud computing and Internet of Things technology, real-time monitoring and analysis of traffic data can be achieved, and timely and accurate prediction results can be provided. At present, research on deep learning focuses on the fusion of different neural network structures, absorbing the advantages of different architectures, so that the model has better accuracy and stability [23]. Deep learning can discover the patterns and trends of urban travel demand through the analysis of historical traffic data. Traditional statistical methods and models may not be able to handle complex nonlinear relationships and high-dimensional data, but deep learning can automatically learn and extract features from the data by building multi-level neural network models, thereby more accurately capturing urban travel and changing trends in demand. Deep learning can also improve the accuracy and precision of urban traffic predictions. Moreover, deep learning models have strong nonlinear modeling capabilities and can handle complex traffic data and relationships, thereby improving the accuracy and precision of predictions. At the same time, deep learning can provide personalized travel suggestions and services. Through the analysis and learning of user travel data, deep learning can understand users' travel preferences and habits, thereby providing users with personalized travel suggestions and services. Deep learning can facilitate the development of sustainable transportation options. In the context of sustainable urban development, it is important to encourage and promote the use of sustainable transport modes. Deep learning can analyze large amounts of travel data to discover people's needs and preferences for sustainable transportation methods such as public transportation, walking, and cycling, thereby providing decision support for urban planning and transportation management departments. The ensemble learning method can combine the advantages of different models and has high stability [24]. Self-supervised learning can use unlabeled data for pre-training and transfer the learned model to downstream tasks, which can alleviate the requirement for labeled data [25]. With the development of deep learning, significant technological breakthroughs have been made in the fields of image, speech, and natural language processing [26]. The intelligent transportation system will be more closely integrated with urban public services, urban management, and other aspects to achieve efficient operation and collaborative development of various urban functions. Finally, urban travel demand forecasting is significant in improving traffic conditions and traffic management [27]. Intelligent transportation systems will also provide more possibilities for sustainable urban development, become an important support for urban traffic management, and bring more convenience and well-being to urban construction and residents' lives.

5. Conclusions

This study provides an in-depth exploration of urban travel demand forecasting and its impact on intelligent transportation systems, as well as the important role of intelligent transportation systems in sustainable development. Through analysis of traffic data and case studies of intelligent transportation systems in multiple cities, we draw the following conclusions:

Accurate urban travel demand forecasting is of great significance for urban planners to optimize the design of transportation systems, promote the development of sustainable travel modes, and provide business opportunities and development directions for enterprises. However, achieving this goal still faces many challenges, including issues such as data collection and processing, privacy protection, and information security. In response to these challenges, we have proposed a series of countermeasures, including strengthening the research and development of intelligent transportation technology, promoting the deep integration of intelligent transportation systems and urban planning, strengthening policy guidance and market supervision, promoting the development of sustainable travel methods, and introducing intelligent transportation technology and green energy, etc. In addition, intelligent transportation systems play an important role in reducing traffic congestion and protecting the environment while meeting urban travel needs. Through intelligent road condition monitoring and prediction, intelligent transportation systems can promptly detect the possibility of traffic congestion, reduce the probability of congestion through intelligent signal control, traffic route optimization, etc., improve traffic efficiency, and thereby reduce the impact on the environment. With the continuous development of information technology and the acceleration of urbanization, intelligent transportation systems will play a more important role in the future. In recent years, deep learning has played an important role in fields such as computers. In the field of transportation, deep learning can also more accurately collect and analyze various data related to urban travel, thereby more effectively predicting future travel needs.

In short, this study believes that through the comprehensive application of data analysis, the promotion of public transportation and non-motorized travel, the promotion of shared travel modes, the application of intelligent transportation technology and green energy, and publicity and education, more convenient, efficient, and environmentally friendly urban transportation systems can be developed, thereby improving residents' travel experiences, reducing traffic congestion and pollution, and promoting sustainable urban development.

In the future, intelligent transportation systems will be more closely integrated with urban public services, urban management, and other aspects to achieve efficient operation and coordinated development of various urban functions. Intelligent transportation systems will bring more possibilities for sustainable urban development, become an important support for urban traffic management, and bring more convenience and well-being to urban construction and residents' lives.

Through the work of this study, we have a clearer understanding of urban travel demand forecasting and the development trend of intelligent transportation systems, and it also provides a certain reference value for future research and practice in

related fields. We look forward to more scholars and practitioners paying attention to and investing in the research and practice of intelligent transportation systems and urban sustainable development in the future and jointly promoting the development and progress of the urban transportation field.

Conflict of interest: The authors declare no conflict of interest.

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