Intelligent Transportation System Planning in the Age of Artificial Intelligence

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***Abstract*—**This paper mainly studies the planning of intelligent transportation system in the era of artificial intelligence. The research content mainly includes: intelligent transportation system implementation mechanism, system application and empirical research. The research conclusion is as follows: First of all, the implementation mechanism and system application of China's intelligent transportation system are constantly improving in both technology and process. Second, Yunnan is the province with the highest public satisfaction of intelligent transportation system. Finally, relevant departments should strengthen the main role of construction, improve the traffic information platform, strengthen data management and enhance technological innovation, and strive to make China's intelligent transportation system development in the forefront of the world.

1 INTRODUCTION

Under the background of continuous urbanization, Urban traffic congestion, pollution and other problems are becoming more serious. It is closely related to People's Daily life and has a certain negative impact on the economic and social development of the city. The limited traffic resources and people's increasing traffic demand form a contradiction With the improvement of people's living standard, the modes of transportation tend to be more diversified. In addition, people pay more and more attention to the value of travel time. Therefore, the traditional urban transportation system has been difficult to meet people's travel needs.

In recent years, the rapid development of artificial intelligence and its deep integration with the transportation industry have provided new solutions for the construction of the transportation system. Intelligent transportation system was first put forward by the United States in the 1960s. And in the late 1960s, it launched the Electronic Road Guidance System, the earliest research project of intelligent transportation System in the world[1]. Subsequently, Japan, South Korea, Singapore and other countries have joined in the study of intelligent transportation. In 1994, the intelligent transportation system was officially recognized as an international term.

Intelligent Transportation System is an advanced social management concept and comprehensive traffic management system, which uses artificial intelligence to manage the matching of traffic supply and demand. It has the characteristics of large-scale, all-round, accurate and efficient, so as to solve the increasingly serious traffic congestion and environmental pollution in cities. S wright pointed out that intelligent transportation is the process of obtaining, analyzing, transmitting and applying traffic information with the help of advanced technology, which provides support for traffic information management. Therefore, high level, high precision and high accuracy of technical methods are needed[2].

In artificial age background, countries around the world have formulated their own development strategies for intelligent transportation systems in line with their national conditions. For example, the Shift2Rail plan proposed by the EU in 2017 and the Smart infrastructure strategy proposed by the UK in 2018. To promote the development of the intelligent transportation system in China, since 2016 the government has issued a series of strategic layout, such as the 2017 "promote the development of intelligent traffic action plan (2017-2020)", committed to making China's traffic intelligent technology take the lead in the world.

2 IMPLEMENTATION MECHANISM OF INTELLIGENT TRANSPORTATION SYSTEM

2.1 The Constitute of Intelligent Transportation System

The ultimate goal of all intelligent achievements is to make human life more convenient and comfortable, the same is true of intelligent transportation, which should adhere to the people-oriented construction concept. The intelligent transportation system consists of four parts: people, vehicles, roads and intelligence.

Human being is the main body of intelligent transportation system, the construction of intelligent transportation system should meet people's needs.

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Various traffic vehicles are carriers. Intelligent vehicles with the ability to "communicate", so that people get the maximum satisfaction of travel.

The future of road infrastructure is smart roads, which are interconnected with smart vehicles.

The premise of an effective intelligent transportation system is the wide application of big data in the era of artificial intelligence, which can realize real-time data collection and analysis and provide information support for traffic operation.

2.2 Overall Implementation Mechanism

The overall implementation mechanism is shown in Figure 1. It is divided into four levels: Data Aware, Support Network, Analysis and Operating Platform and User Demand. These four levels support each other to form a closed loop.

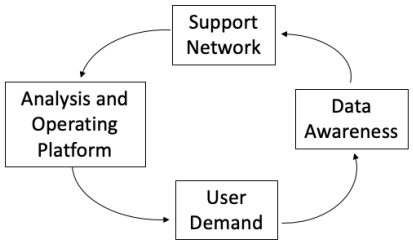

Figure 1. Implementation Mechanism Diagram

2.2.1 Data Awareness: To get the data. The data of each traffic section is collected by various technical means as the basis for further analysis. The main acquisition methods include monitoring, infrared sensing, magnetic field sensing and so on. Sensor technology is mainly used in vehicle detection, which is one of the most basic technical means. It can obtain the traffic flow, speed, running track, road occupancy and other basic data.

2.2.2 Support Network: To transmit information. It mainly includes wired and wireless modes. At present, 5G communication network is widely used and can be applied in many scenarios, including the field of intelligent transportation. Using 5G network to realize the transmission and storage of traffic information will greatly improve the speed, and provide stable network support for the construction of intelligent traffic system.

2.2.3 Analysis and Operating Platform: For data analysis and operational management. The data obtained in the first two steps enter into the analysis and operation platform, which screens valuable information from a large number of traffic data and conducts data collation, classification and extraction. Then the sorted data is transmitted to the operation management platform to provide users with the information they need.

2.2.4 User Demand: According to the different needs of users to provide the corresponding services. For travel service demand, the system provides real-time traffic condition query, congestion level prediction, traffic travel guidance, intelligent parking and other application services. For daily transportation, the system provides such services as expressway, ETC, smart bus and smart subway. For administrative personnel public security governance, intelligent traffic system also launched the corresponding intelligent monitoring, incident tracking, electronic police system to help law enforcement.

3 Intelligent Transportation System Application

3.1 Population Distribution and Travel Needs Analysis System

The data of urban population distribution plays an important role in studying the traffic demand and making traffic planning. GPS technology can well realize basis data acquisition. In terms of fine-scale data, Min Xu et al. employed land cover, building address, and housing price data, and high-resolution stereo pair remote sensing images to simulate fine-scale urban population distribution. It is of great significance in transportation route design and travel demand analysis[3].

For the prediction of traffic demand, scholars in academic research mainly build network models based on economic principles for analysis. Li Meiling et.al(2017) based on the gravity model of the spatial interaction between population and economy, established an intercity passenger flow demand forecasting model for urban agglomerations. And the example shows that the model is suitable for traffic volume prediction[4]. Wu Dingjie et.al(2020) construct the space-time map attention network, study and predict the spatial and temporal distribution of travel demand and road traffic flow based on urban points of interest[5].

In practical applications, many Internet platform companies have launched "traffic brain" intelligent systems. Based on big data, machine learning and cloud computing, the platform can collect information on urban population distribution and activities. It further analyzes the real needs of drivers and passengers and their travel habits, and forecasts the demand of users' destinations and regions by using such technologies as intelligent ordering and supply and demand forecasting, in order to provide people with the best choice.

3.2 Electronic Toll Collection(ETC) System

Electronic Toll Collection(ETC) is a toll collection method using electronic information technology. It uses the computer network technology, can carry on the background settlement processing with the bank, causes the vehicle to pass through the road bridge toll station does not need to pull over to be able to pay the road bridge fee. It greatly improves the capacity and efficiency

of the lane[6]. ETC system mainly includes toll stations, data communication network, section management center, settlement and payment center, etc. Its core technology is automatic recognition technology, used to identify vehicle license plate and other information, so as to grasp the vehicle dynamics[7].

ETC technology was introduced into China in the mid-1990s. Due to the small number of cars in China at that time, toll stations were not crowded, ETC technology did not have great advantages. However, with the rapid development of China's social economy, in 1998, the Joint Research Institute of the Ministry of Transport of China began to study and promote ETC technology projects. The research and formulation of China's ETC system was launched in 2002, and the ETC standard was implemented in 2007[8]. Since January 1, 2020, ETC lanes at tollbooths have taken up more than 70% of the total area. The average length of congestion has been reduced by 10% compared with the same period in 2019, and the average speed of traffic has increased by 13% compared with the same period in 2019, providing great convenience for people to travel.

4 Empirical Analysis

The Research Group of Beijing Jiaotong University organized "Questionnaire on Satisfaction with The Construction of China's Transportation Power". The survey covered 31 provinces (cities) and autonomous regions in China and was conducted from December 18, 2019 to January 12, 2020. A total of 4,000 questionnaires were issued, and a total of 2,911 valid questionnaires were recovered, with an effective rate of 72.8%. One of the questions is: Do you think your city's intelligent transportation system can provide useful information about bus and tram status and real-time location? Intelligent transportation system includes electronic station sign, website, mobile phone client and other aspects. Through descriptive statistics on this question and score results based on extenics, it can be seen that people's attitude towards the intelligent transportation system of their province.

4.1 Descriptive Statisticsn

Figure 2 shows the results of the survey, showing people's attitudes towards whether the smart transportation system in their city can provide useful information such as bus and tram operation status and real-time location. It can be seen that the majority of respondents believe that the smart transportation system in their cities can basically provide practical information, accounting for 48%.

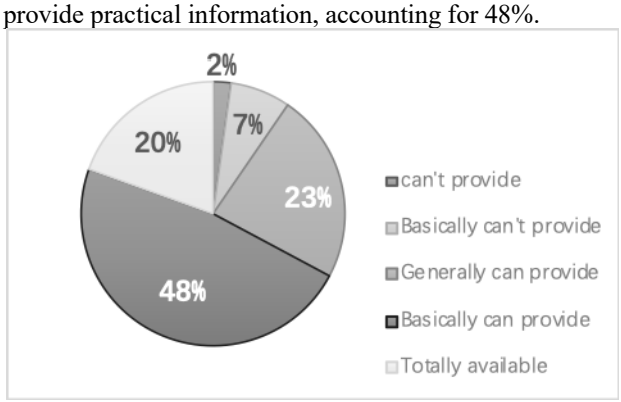

Figure 2. Descriptive Chart

4.2 Extenics Calculation Process

- Identify the classical domains and node domains.
- Determine the evaluation element.
- Determine the weight coefficient.
- Determines the value of the index's correlation function.
- Determine the correlation degree and conduct comprehensive evaluation

The whole process is calculated by MATLAB software.

4.3 Comprehensive Evaluation Results

The results of extenics calculation are shown in Table 1. It can be seen that the top five provinces are Yunnan, Guangxi, Hebei, Zhejiang and Jiangsu. From the perspective of China's regional division, the following trends are mainly presented: the western region is seriously polarized, the eastern and central regions perform well on the whole, and the research on intelligent transportation system in the northeast region needs to be strengthened.

TABLE I. Satisfaction Ranking Table

Ranking	Provinces	Score	Ranking	Provinces	Score
1	Yunnan	67.50	17	Xinjiang	64.01
2	Guangxi	66.56	18	Shaanxi	63.95
3	Hebei	66.27	19	Sichuan	63.93
4	Zhejiang	65.88	20	Ningxia	63.69
5	Jiangsu	65.80	21	Guizhou	63.68
6	Beijing	65.49	22	Heilongjiang	63.63
7	Shanghai	65.42	23	Hainan	63.21
8	Guagndong	65.37	24	Liaoning	62.91
9	Nei Mongol	64.73	25	Qinghai	62.81
10	Hubei	64.55	26	Jiangxi	62.76

11	Shanong	64.43	27	Tianjin	62.69
12	Hunan	64.43	28	Jilin	61.71
13	Shanxi	64.28	29	Tibet	61.34
14	Fujian	64.28	30	Anhui	61.15
15	Chongqing	64.25	31	Henan	60.58
16	Gansu	64.05			

a. Data Sources: Author calculation

Take Yunnan province, which ranks number one. Yunnan province has been laying out its intelligent transportation system since 2011. And "Colorful Yunnan, Intelligent Travel System" was launched in 2014, to improve the information construction in the field of transportation. It mainly covers four systems: urban travel, intercity travel, urban service and travel information. It has a comprehensive range of services, timely and efficient information updates, and can provide travelers with a quality travel experience. In November 2018, Yunnan province became the first region in China to use the "ETC+ non-sensory Payment" high-speed payment mode. The number of daily active users reached 200,000 in one week, bringing new high-speed experience to travelers. In 2019, Yunnan Road Network Toll Collection Management Co., Ltd. and Huawei Technologies Co., Ltd. conducted in-depth cooperation. It is committed to building a smart transportation research laboratory, innovating smart systems and improving smart transportation solutions.

4.4 Existing Problems

First of all, there are information islands and certain security risks in data acquisition. Traffic big data is the foundation of intelligent transportation system. However, the current data acquisition system standards are not unified, which results in the failure of comprehensive integration and sharing of data from enterprises, governments and other aspects, resulting in fragmented distribution of data and low utilization efficiency. Moreover, the matching degree between hardware and software of intelligent transportation system is increasingly high and more complex, so how to evaluate the reliability and security of infrastructure such as software system still needs to be improved.

Secondly, in terms of data support, there are deficiencies in the in-depth mining and analysis application of comprehensive traffic information data at present. Most of them are only based on the analysis of the data itself, and most of them are based on historical experience, without sufficient in-depth integration of information resources across fields, industries and departments, which cannot provide complete theoretical support for future traffic decision-making.

Finally, the lack of flexibility in data-based information services makes it difficult for the public to get a good service experience.

5 Conclusion and Suggestion

5.1 Conclusion

This paper mainly studies the planning of intelligent transportation system in the era of artificial intelligence. mainly from three aspects: implementation mechanism of intelligent transportation system, application of intelligent transportation system and empirical research. At present, China's smart transportation is developing rapidly, and the government, enterprises and other relevant departments attach great importance to it. However, it is still in the early stage, and there are many aspects to be improved in the implementation mechanism and system application.

As for the satisfaction of the masses, it can be seen from the questionnaire that most people agree with the effectiveness and functionality of the intelligent transportation system in their provinces, among which Yunnan, Guangxi, Hebei, Zhejiang and Jiangsu rank high in satisfaction. From the perspective of China's regional division, the following trends are mainly presented: the western region is seriously polarized, the eastern and central regions perform well on the whole, and the research on intelligent transportation system in the northeast region needs to be strengthened.

Therefore, the following Suggestions are proposed for the planning of China's intelligent transportation system:

5.2 Suggestions

5.2.1 Strengthen the construction of subject: On the one hand, the government, as a public policy maker, should actively develop regional differentiated top-level design of intelligent transportation. In addition, the construction of intelligent transportation system requires the government to take the lead, cooperate with relevant departments, clarify the key points and difficulties in the system construction, and formulate corresponding solutions to make the project be implemented. On the other hand, vehicle suppliers should pay attention to the combination of data and technology to make the data play a full role.

5.2.2 Improve the traffic information platform: First of all, relevant departments should realize the comprehensive informatization of traffic services, construct a diversified traffic information service system,

and optimize the service quality of traffic trips, so as to meet the personalized service needs of travelers. Also, relevant departments should strengthen cooperation to build a comprehensive transport information platform. It can provide real-time information, including transport, online car-hailing, rental, rescue and other service information.

5.2.3 Strengthen data management: In terms of data systems, the relevant units should strengthen security protection, record and monitor the data source, data application, data modification and other processes, to prevent data loss, damage due to malicious attacks. In terms of management personnel, the security awareness of direct management personnel should be emphasized to ensure the safety of all hardware and software facilities.

5.2.4 Enhance intelligence traffic technology innovation: Relevant units should grasp the development trend of modern information technology to adapt to the market demand of intelligent transportation development. And the ability to innovate independently is critical. The key technical problems in the field of transportation need to be solved to break through the bottleneck problems.

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