Application analysis of Internet of Things technology in smart transportation

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Abstract: Transportation comes first in economic development. This paper first analyzes the outline of Internet of Things technology and intelligent transportation system, puts forward the application mode of "Internet of Things + transportation", analyzes the advantages and challenges of Internet of Things technology in intelligent transportation, and gives preliminary development suggestions from three aspects of technological innovation, policy management and international exchange, showing the new kinetic energy of China's intelligent transportation.

Key words: Internet of Things technology; Intelligent transportation; And "Internet of Things + transportation" application mode

Economic development, transport first. Connecting production and consumption, transport is an important foundation for maintaining the normal order of people's production and life, promoting the stability of industrial chains and supply chains, and serving the reform and development of the economy and society. As a pioneer in China's modernization, transport has contributed important force to China's economic and social development.

With the development and innovation of information technology, transportation is developing in the direction of informatization and digitalization. This paper first analyzes the outline of the Internet of Things and intelligent transportation, creatively puts forward the application mode of "Internet of Things + transportation", analyzes the advantages and challenges of the Internet of Things technology in intelligent transportation, and gives preliminary development suggestions from three aspects of technological innovation, policy management and international exchanges, demonstrating the new driving force for the rapid development of intelligent transportation in China.

1. Internet of Things and Smart Transportation

1.1 Internet of Things

The origins of the Internet of Things can be traced back to the 1990s, and it is the third revolution in the information technology industry. Since then, after a long period of development, the Internet of Things technology has made great progress and development, and its broad application prospects have been highly concerned.

The Internet of Things (Internet of Things, abbreviation: IoT) is based on the Internet, telecommunications network and other information carriers, so that all ordinary physical objects form an interconnected network, in order to achieve intelligent identification, positioning, tracking and supervision process and technology. People can obtain a broader communication dimension through the application of the Internet of things, that is, from the communication between people and people anywhere and anytime to the communication between people and things, things and things.

There are five major technologies in the Internet of Things, namely radio frequency identification (RFID) technology -- automatic collection, sensor technology -- perception processing, wireless network technology -- Internet of everything, artificial intelligence technology -- analog analysis, cloud computing technology -- "brain" storage and computing.

1.2 Smart Transportation

Intelligent Transportation System (ITS) is a transport-oriented service system based on modern electronic information technology. By making full use of technologies such as the Internet of Things, cloud computing and artificial intelligence, intelligent transportation supports the fields of traffic management, transportation and public travel in all aspects, ensuring traffic safety, improving operation efficiency and management level, and serving smooth public travel and sustainable economic development.

2. Application of the "Internet of Things + transportation" mode

2.1 "Internet of Things + Public transport" to facilitate travel

"Internet of Things + bus" mode uses RFID, sensing and other technologies to monitor and broadcast the location of buses in real time, and realize functions such as curve and route reminder. At the same time, through the intelligent scheduling system, intelligent scheduling of lines and vehicles to achieve intelligent scheduling.

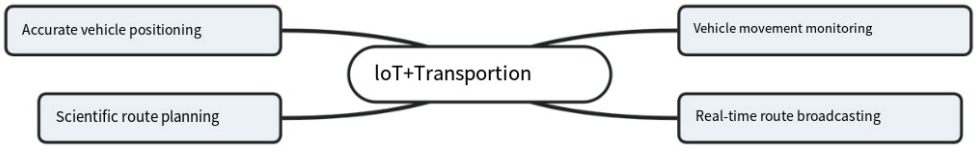

Figure 1 Application of "Internet of Things + Public transport" mode

The "Internet of Things + bus" model can improve the efficiency of the public transport system by reducing delays and waiting times for passengers. Based on the arrival and departure times of buses, information on passenger waiting can be obtained from smart bus stops. Optimising routes avoids congestion and accidents while taking into account real-time traffic conditions. The real-time route presentation of "Internet of Things + public transport" is mainly divided into two kinds. One is the offline electronic bus stop board, which is displayed on the screen or broadcast by voice; The second is the online network platform.

2.2 “Internet of Things + Logistics” smart logistics

As a pillar industry of national economic development, logistics industry needs to achieve further growth, meet the increasing demand for logistics, and realize smart logistics, depending on the comprehensive application of Internet of Things technology. The application of the “Internet of Things + logistics” model is mainly concentrated in the following four aspects:

1. Product traceability: In the pharmaceutical, food and other industries, the “Internet of Things + logistics” model plays a huge role in goods tracking, identification, inquiry, information collection and management, providing a guarantee for product quality and safety.

2. Visual supervision: Based on GPS, RFID, sensing and other technologies, accurate identification of objects and comprehensive collection of information, to achieve real-time accurate positioning of vehicles in the logistics process, logistics visualization development.

3. Intelligent distribution: Based on RFID, sensing and other Internet of things technology to establish intelligent control of logistics operations, automated operation network, to achieve the automation of logistics distribution center. The use of data fusion to monitor the distribution process, when encountering special circumstances, automated driving technology can be used to remotely control and even take over the logistics vehicle to solve the problem of driver fatigue driving.

4. Smart supply chain: The “Internet of Things + logistics” model upgrades the logistics support system of smart logistics and smart supply chain to meet the large number of personalized needs and orders generated under the rapid development environment of e-commerce and intelligent manufacturing, helping enterprises to more accurately predict customer needs and realize the wisdom of the entire supply chain.

2.3 “Internet of Things + high speed” smart line unimpeded

In order to implement efficient traffic management, many countries around the world are implementing intelligent transport systems powered by industrial intelligence to improve road safety and performance by reducing traffic impacts related to driving, traffic congestion and wasted time during traffic jams.

In view of the problems such as heavy traffic lane congestion at toll stations, limited resources that make it difficult to expand the number of toll lanes, and special situation handling of lanes that affect traffic efficiency, the intelligent development model of “Internet of Things + high-speed” is proposed. Through the toll lane system cloud, ETC pre-transaction, lane facilities all things interconnection, special situation after the intelligent disposal, toll island intensification and other programs, improve the highway traffic efficiency and intelligent level. Relying on the perception technology and network technology of the Internet of Things, the data resources of the expressway toll system are used in intelligent applications such as road network monitoring, driving behavior analysis, toll inspection, unmanned driving, and vehicle-road collaboration. It will build an intelligent comprehensive management and control platform integrating monitoring, scheduling, control, emergency response and service, and realize the beautiful vision of “viewing the whole area with one screen and understanding the whole process with one brain”. We will promote the digital and intelligent development of expressways.

2.4 “Internet of Things + traffic lights” efficient road network

Traditional traffic lights mainly through mechanical control and timing control, there will be uneven time distribution to reduce the efficiency of the intersection. “Internet of Things + traffic lights” mode through inductive control and adaptive control, the intersection installation of radar devices, real-time monitoring of the intersection of the number of vehicles, vehicle distance and speed, while monitoring the number of pedestrians and external weather conditions, dynamic control of the traffic light signal, improve the intersection vehicle traffic rate, reduce the traffic light empty time, and ultimately improve the bearing capacity of the road.

“Internet of Things + traffic light” mode in addition to automatic adjustment of traffic light time, but also according to the actual situation and demand to add some auxiliary functions, such as alarm function. The system detects that the congestion at the intersection is aggravated, and combined with historical data, intelligently determines whether the cause of the congestion is accidental, and immediately issues an early warning if there is an anomaly. The traffic police receive the alarm and go directly to the scene to investigate and solve the problem.

3. Advantages and challenges of “Internet of Things + Transportation”

3.1 Advantages

3.1.1 Great prospects

Intelligent transportation system development has great prospects, with the intelligent transportation market size estimated at $31.26 billion by 2023 and expected to reach $43.41 billion by 2028, growing at a compound annual growth rate of 6.79% during the forecast period (2023-2028). The increase in traffic volume, government initiatives aimed at reducing the impact of greenhouse gas emissions, the increase in urban projects as well as the increase in megacities, urbanization and population all drive the market growth.

3.1.2 Comprehensive precision

The “Internet of Things + Transportation” model utilizes connected mobile devices to ensure real-time data communication and remote access for real-time data management of driver activity, optimized routes, fuel consumption analysis and other reasons. Through the multi-sensor fusion of cameras in different directions, lidar and millimeter-wave radar, the “Internet of Things + traffic” mode can collect data in real time and transmit and analyze it, timely grasp traffic conditions and changing trends, and realize comprehensive monitoring of all aspects of the traffic environment. The data, with its high precision and spatial and temporal resolution, can provide more accurate indicators such as traffic flow, air quality and noise level, and provide scientific basis for decision makers.

3.1.3 Comprehensive consideration

Iot technology can synthesize data from multiple sources. In addition to the data collected by sensors and devices, it can also be combined with data from other data sources (such as traffic cameras, social media, mobile apps, etc.) for comprehensive analysis. By integrating and analyzing information from different data sources, the “Internet of Things + transportation” model can provide a more comprehensive understanding of the situation of the urban traffic environment and provide more precise information for decision-making.

3.2 Challenges

3.2.1 Data Privacy and Security

"Internet of Things + Transportation" is a networked system. In order to ensure data security and privacy protection, strict data protection policies and technical measures are required, and a security management system is required for real-time identification, analysis and early warning of security threats to ensure the automatic and safe operation of the control system.

3.2.2 Device interoperability

Device interoperability is a challenge in the iot environment and it involves different types and brands of sensors and devices. In order to achieve seamless integration and data sharing, uniform standards and specifications are needed to facilitate interoperability between devices.

3.2.3 Data intelligence processing capability

A large amount of traffic environment data generated by the Internet of Things technology requires efficient artificial intelligence technology and cloud computing technology to store, transmit, process and analyze, to ensure the timeliness, accuracy and reliability of the data, to support the management and decision-making of intelligent transportation, and to realize the maximum potential and value of the "Internet of Things + transportation" model.

3.2.4 Sustainability and cost

The deployment and maintenance of the "iot + transportation" model requires a large number of sensors and devices, which requires a lot of resources and costs, while also taking into account factors such as energy consumption and environmental impact.

4. Development Suggestions

4.1 Technological innovation

The first is to improve and innovate the sensor technology, and constantly improve the perception ability and the accuracy of data acquisition; Secondly, it is necessary to strengthen the processing and analysis of big data and develop more efficient and intelligent data processing algorithms and tools; In addition, the Internet of Things technology should be integrated with other data sources, such as traffic signal data, vehicle global positioning system (GPS) data, social media data, etc. And finally, to enhance the compatibility between different iot devices and systems, to achieve seamless integration and sharing of data.

4.2 Policy management

In order to achieve a better application of the "Internet of Things + transportation" model, first of all, it is necessary to establish and improve relevant policies, regulations and regulatory mechanisms, standardize the use and protection of data, and supervise and manage the application of Internet of Things technology; Secondly, it is necessary to guide healthy competition, encourage data sharing, strengthen cooperation and exchanges among relevant parties, and improve the overall efficiency of the intelligent transportation environment. In addition, it is necessary to train and introduce talents in related fields, improve the technical level and application ability of professionals; Finally, encourage scientific research institutions, universities and enterprises to carry out innovation and experimental projects to promote the innovative development of Internet of Things technology in smart transportation.

4.3 International exchanges

In the process of developing the "Internet of Things + transportation" model in the future, it is of great significance to strengthen international cooperation and exchange of experience. Through cooperation with other countries and regions, they can learn from their successful experience and advanced technologies to accelerate the application and development of their own iot technology in urban traffic environmental monitoring.

5. Conclusions

The Internet of Things is the core foundation of building intelligent transportation system, and it is also an important way to realize the intelligent development of traffic. Through the application of the "Internet of Things + transportation" mode, intelligent identification, intelligent monitoring and object tracking of equipment can be realized, providing a new way for operation and maintenance decision-making. The "Internet of Things + transportation" mode can realize the real-time linkage between various elements on the road, realize the comprehensive processing of all information resources, promote the intelligent development of the entire transportation system, and alleviate congestion, inefficiency, accidents and other conditions. We look forward to seeing more intelligent "Internet of Things + transportation" mode put into actual operation in the near future, bringing greater benefits and convenience to the transportation system.

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