

# Development Status of Intelligent Traffic Management System

Rui Wu<sup>1,\*</sup>

<sup>1</sup> School of Traffic & Transportation, Chongqing Jiaotong University, Chongqing 400074, P. R. China

\* Corresponding author

**Abstract:** The intelligent traffic management system is the most important part of the intelligent traffic system. The research and analysis of the development status of the intelligent traffic management system can provide a research basis for its future development. This paper studies the three subsystems of the intelligent traffic management system: the intelligent traffic monitoring system, the By comparing the research methods used by scholars in different time periods for intelligent information service systems and signal control systems, it is found that with the application of technologies such as the Internet of Vehicles, big data, Internet of Things, and deep learning, the level of intelligent traffic management system management is constantly rising.

**Keywords:** Intelligent traffic management system; monitoring system; information service system; signal control system.

## 1. Introduction

With the rapid development of urbanization, urban road traffic problems are becoming more and more serious. Traditional traffic management methods are no longer able to meet the complex and changeable traffic demands. Intelligent traffic management has become an important means for cities to solve urban traffic problems. Intelligent traffic management system uses advanced communication and computer technology to realize a series of efficient and intelligent management of real-time traffic monitoring, traffic signal control, traffic guidance, traffic optimization analysis, etc. It is a necessary tool for future urban traffic management, and it is also a hot spot for scholars and technicians.

## 2. Concept and Function of Intelligent Traffic Management System

### 2.1. Intelligent traffic management system concept

Intelligent traffic management system refers to the use of intelligent traffic system technology and methods to establish an advanced traffic control, traffic management and traffic decision-making system for traffic management departments. Intelligent traffic management system is the most important part of intelligent transportation system, and also the important basic part of urban intelligent transportation system. Since the world's major cities began to build networked signal control systems in the 1970s, many large and medium-sized cities have formed an urban intelligent transportation integrated management system with signal control system as the core. Meanwhile, countries and regions with relatively developed expressways have also formed intelligent traffic management systems covering expressways. Faced with problems such as large traffic scale, diverse transportation modes, and traffic congestion, traditional manual traffic management is bound to fail to meet functional requirements. With the development of communication technology and computer technology, intelligent traffic management system is the development trend of traffic management.

### 2.2. Basic Functions

1) Integrate traffic information from different channels

Information is the foundation of a complete and efficient traffic management system, and it is a powerful means for traffic management system to analyze and judge road conditions and implement road traffic control and control. Therefore, in order to accurately obtain various types of real-time traffic information, it is necessary to establish a sharing system (data warehouse) that can collect and store these information.

2) Release various traffic information

Timely and accurate release of traffic information to traffic participants (including pedestrians, drivers, traffic management personnel, etc.), system management personnel and other third parties (including public security, fire, medical, municipal, etc.) is one of the main purposes of establishing an intelligent traffic management system. The above-mentioned departments or personnel use relevant information and data to cope with various traffic situations. Adopt corresponding strategies to manage their own traffic behavior, and then improve the operation of the whole traffic management system.

3) Intelligent traffic incident detection

Using the achievements of artificial intelligence, machine vision and image processing with considerable development trend, it can automatically realize traffic jam detection, parking detection, retrograde detection, pedestrian intrusion detection, spill detection, smoke detection, illegal line integration detection, illegal U-turn detection and other events. Finally assist managers to make decisions and relieve traffic pressure.

## 3. Intelligent Traffic Management System Subsystem

Intelligent traffic management system is a system system composed of multiple subsystems, including road transport monitoring system, information release system, signal control system, etc., through the system to achieve real-time traffic flow monitoring, traffic signal priority control, guiding the

role of vehicles, the ultimate goal is to better traffic operation services.

### 3.1. Traffic monitoring system

Traffic monitoring system is one of the subsystems of intelligent transportation system, which plays an important role in vehicle detection and traffic flow statistics, illegal behavior identification, traffic incident warning, escape vehicle tracking and so on. It has important economic and social significance to alleviate the increasingly serious traffic congestion and facilitate the mass travel. As the core technology of intelligent traffic monitoring system, vehicle detection and tracking technology plays a vital role in the construction of intelligent traffic

At present, the detection of vehicle targets is mainly divided into two categories. One is the traditional image processing methods, such as the use of inter-frame difference method, background difference method and other methods to process vehicle target images. For example, Yao Lin[1] et al. used three consecutive frames to extract foreground vehicle targets on the basis of inter-frame difference method, and further realized vehicle target detection effectively through binarization operation and combined with vehicle rigid structure model. The other is the use of neural networks for vehicle target detection, such as: He Kaiming[2] and others propose the method of Spatial Pyramid Pooling (SPP) to reduce the number of forward propagation. By cascading the shallow to deep multi-layer features of the network, the network can achieve good results through one feature extraction.

The monitoring object of the system is aerial traffic video taken by drones, which helps to expand the monitoring scope, improve the efficiency of traffic control, and realize the monitoring and analysis of urban road traffic flow, speed and abnormal parking. Jinshasha et al. [3] found that multi-target tracking algorithm can be better applied to intelligent traffic monitoring scenarios by comparing tracking speed and tracking accuracy. Li Zhenxiao [4] et al. proposed a multi-vehicle tracking algorithm based on detection to achieve real-time and accurate tracking of multiple vehicles.

The traditional vehicle detection technology and tracking technology need a lot of manual participation, which has the disadvantages of high labor intensity, poor real-time performance and high labor cost. The target detection and tracking method based on computer vision is gradually applied to intelligent traffic monitoring system. With the rapid development of deep learning algorithm, its superiority in complex scenes has gradually replaced the traditional algorithm. In recent years, more scholars have combined vehicle detection algorithm and tracking algorithm to monitor the traffic situation, which is now a research hotspot of scholars, and also the development direction of future traffic monitoring system.

### 3.2. Traffic information service system

Traffic Information Service System (TISS) is an important part of ITS, TISS is mainly for public travelers, using wireless and wired communication means, In the form of text, voice, graphics, video and other forms, it provides real-time and dynamic traffic information related to travel, so that travelers can obtain various relevant information such as road traffic situation, required time, best transfer mode, required cost and destination at any time during the whole travel process, so as to guide travelers to choose the appropriate transportation

mode, travel route and departure time. Complete the travel process in the most efficient and convenient way [5].

Traffic information service system is mainly composed of four parts: traffic information collection, transmission, processing and service. Yang Xiaoli [6] et al. analyzed the traffic information characteristics, research status and system structure under the big data of the Internet of vehicles, studied the processing and release of traffic service information, and studied the technical architecture and big data application framework of the information service platform of the Internet of vehicles in the big data environment, so as to formulate reasonable plans according to the needs of travelers. He Jing [7] et al. analyzed the characteristics of big data and the background of road traffic big data, summarized the information service content under this background, and proposed the traffic big data information service architecture based on the Internet of Things to guide information release and service. Through the search of CNKI and the summary of the above literature, it is found that there have been few researches on intelligent transportation information service system in the past two years, but more before 2019, and after 2015, they mainly focus on the application of vehicle networking and big data in the construction of intelligent transportation service information platform. The development prospect of intelligent information service system centered on traveler's demand.

### 3.3. Intelligent signal control system

The intelligent traffic signal control system can reduce the total delay of vehicles and improve the operation efficiency of road network by adjusting the timing scheme of signal lights reasonably. At present, Chinese scholars' research on urban road traffic control technology mainly focuses on the control of traffic signals. How to realize intelligent control of traffic signals is an important direction of ITS research in our country.

Tan et al. [8] studied the intelligent traffic signal control system and established a model using fuzzy computing technology to realize the intelligent control of traffic lights, and the system could be realized under different traffic conditions. DiFebbraro et al. [9] studied the application of Petri net (PN) model to traffic management, and the results showed that the control of intersection signal lights could be realized according to the establishment of a reasonable model, thus realizing the role of traffic control.

Compared with traditional signal control methods, with the support of a variety of new technologies such as online car hailing and the Internet, it is no longer limited to the system's own collection, and is based on the integration analysis of multi-source and multi-dimensional big data that can be obtained anytime and anywhere at low cost. At the same time, with the transplantation of new technologies such as cloud computing, edge computing, machine learning and neural networks, the system can no longer rely on complex data models with many formula variables and harsh boundary conditions in modern control theory, and can be directly driven by big data intelligent decision control and iterative learning of traffic signals. Through the application of new technologies such as the Internet of Things, the Internet of vehicles, and mobile Internet, traffic signal control has gradually changed from traffic response to traffic demand pre-guidance, and traffic information active service, truly realizing the efficient allocation and coordination of traffic elements such as people, vehicles, roads, and controls in the

whole time and space.

## 4. Conclusion

In the early stage of construction, the intelligent traffic management system was restricted by the basic supporting technology and supported by traditional information and communication technology means to achieve preliminary information collection, data analysis, automatic control, command and dispatch, information service and other functions. At that time, the amount of information collection was limited, the communication speed was restricted, and the control method was simple. But it also plays an important role in automatic signal control, information services, emergency traffic and so on. In recent years, cloud computing, big data, Internet of Things, mobile Internet, artificial intelligence and other technologies have been gradually introduced into intelligent transportation systems and gradually play an increasingly significant role in some scenarios. Big data analysis algorithms, AI algorithms, and deep learning improve data analysis capabilities, which can promote urban intelligent traffic management systems to maximize their value, provide more scientific and reliable support for traffic management decisions, and strive to provide better services for people while improving management efficiency

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