IoT Survey: Architectural Design and Key Technologies of IoT-based Intelligent Transportation

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Abstract. With the rapid development of electronic information and the Internet, transportation based on the Internet of things (IoT) technology is the development trend of the information industry. Planning and designing the future development direction of transportation technology can not only achieve real intelligent transportation, but also promote the development of the IoT industry and improve the social productivity. This paper proposes a unified planning intelligent transportation system based on the IoT technology, and studies the key technologies of IoT under this framework, so as to promote the development of urban traffic management, enterprise internal management, and improved public oriented service through the IoT technology.

Introduction

With the development of Internet of things (IoTs) in recent years, IoT technology and applications are widely used in more and more industries including manufacturing, medical, energy and utilities, transportation and distribution, agricultural technology, and smart cities. With the rapid development of a global Internet and e-commerce, IoT technology plays a crucial role in the whole industry chain from product production to product delivery. At the same time, consumers put forth higher requirements for product timeliness, integrity, and security, which is especially true for the special goods and construction industry. Military supplies, special prescription drugs, fresh food, and chemical products are common goods that are in demand through IoT technology. Effective transportation is the most important factor to deliver these products. Goods necessitate recognition technology such as, vehicle tracking and positioning technology, information transmission technology, and network technology combined with cloud computing, big data, and artificial intelligence (AI) application in conjunction with the current Internet technology to meet these requirements and achieve the true meaning of intelligent transportation.

At present, there are many research advancements on intelligent traffic applications based on IoT technology [1-3]. It is the IoT technology that is accountable for the collection, sharing, and publishing of vehicle data. In transportation platform research, a medium for data gathering and processing framework is presented [4] and a network-management scheme that supports group mobility is proposed. Under this framework, the access delay of vehicle terminals can be optimized, and the network signal cost is reduced [5]. In the aspect of vehicle-terminal connection, a scheme based on the vehicular-connection agent is proposed [6] and a data collection model for vehicular application scenarios is proposed, which can be applied to generate efficient access and management of a large number of mobile terminals [7]. A vehicle video compression-processing model is proposed [8]. In the traffic information service, a modular, scalable-enhanced roadside unit is introduced by the roadside-setting sensors and cameras that include data submitted to the platform in order to carry out speed adjustment and route optimization [9]. An intelligent community-assisted framework for the IoT services is proposed, mainly for the urban road infrastructure management and road-based assistance services [10]. A traffic service system architecture based on GPS (Global
Positioning System) and Android has been proposed to promote the development of public transportation services by publishing real-time information on public transport [11]. An intelligent guard scheme was proposed [12], while an assistant driving scheme was proposed to ensure the safety of vehicle driving through IoT technology [13].

This paper introduces the development of networking and intelligent transportation, and then puts forth the foundation of an intelligent transportation system based on IoT technology in Section II and III. Conclusions and implications are discussed in Section IV.

**Intelligent Transportation Architecture Based on IoT**

The intelligent transportation system based on IoT technology is a modern intelligent transportation system based on a traditional transportation business model and integrated with IoT technology to achieve safety, reliability, and efficiency. The intelligent transportation system is described in detail from the application level to the technical level.

**Intelligent Transportation Scheme**

The main business modes of transportation are task dispatching, fleet driving, destination arrival, loading, transportation to the destination, unloading of goods, and vehicle return to complete the task. In the transportation technology based on IoT, we must successfully locate the vehicle, personnel, and goods. The transportation technology needs include vehicle tracking and positioning, tracking and positioning of goods, real-time monitoring vehicle status, vehicle location, state of goods, and occupant status. In order to ensure the safety, convenience, and efficiency of transportation, the quality and quality of transportation have been improved, as shown in Figure 1.

![Figure 1. Application scene of Intelligent Transportation.](image)

The application scene demonstrates the transportation business model, through the sensor and sensing devices, such as RFID, vehicle location (GPS, BDS), vehicle state (speed sensor, video, liquid level, temperature, and humidity), air condition sensor (temperature, humidity, radiation, and biological data via satellite) the real-time data sent to the operation center, real-time tracking, and analysis of the vehicle. It can monitor the intended destination of the vehicle, the compliance of the route, the state of the vehicle under normal conditions, and the safety of the goods on the vehicle.
Measures should be taken to intervene and deal with vehicles and personnel, such as vehicle disasters, which may involve contacting traffic police and local hospitals. Additionally, situations of illegal operation may involve remote telephone warning and intervention. If the status of goods is abnormal, early warning for the occupants may be necessary. Finally, it may be necessary to assist in an unusual situation according to the needs of the surrounding environment. This technology put forth in this paper ensures all of the aforementioned qualities and that all transportation needs are conducted in a safe, convenient, and efficient state.

Technical Architecture

As shown in Figure 2, the technology architecture of an intelligent transportation system is based on the technical architecture of the IoT, which is composed of the sensing layer, the transmission layer, the support layer, and the application layer.

The sensing layer includes all kinds of information-sensing devices and intelligent-sensing systems, such as vehicle stationary state, speed of running state, fuel consumption and brake, environmental temperature, humidity, wind force, weather, and the state of existence, temperature, radioactivity, and pressure. The transport layer mainly involves IoT gateway, satellite communication network, mobile communication network and wired local area network, which is responsible for data acquisition and transmission of the sensing layer. The support layer is mainly related to physical device servers, data storage, application servers, network devices, and cloud computing. The application layer is mainly the auxiliary decision support and emergency command center for traffic and transportation, and the application of traffic and transportation monitoring, tracking, and processing.

Design of Vehicle Terminal

The early technology of the vehicle networking is mainly based on the bus (BUS) structure of the vehicle network, information transmission through the CAN bus for data transmission, and vehicle OBD interface for vehicle state data collection. These two methods have shortcomings in the actual application process, such as vehicle bus (BUS) network technology structure, and a need to deal with
all kinds of products. Figure 3 shows a typical functional framework for vehicle positioning and monitoring terminals.

The intelligent vehicle terminal is made up of a microcomputer, sensor, gyroscope, BDS module, communication module, front camera, vehicle-mounted camera, display, three degree of freedom acceleration sensor, temperature sensor, liquid level sensor, smoke sensor and CO concentration sensor. The terminal can run on the vehicle safety situation timely reminders and assistance to the driver, while updating the vehicle running time and location. The status of the vehicle and other elements of the pictures and video data facilitate the management of the vehicle in order to avoid or reduce vehicle accidents, and provide timely and accurately understanding of the status of the security as well as initiation of a rapid response when needed. This intelligent device is very practical in transportation, and it can expand the reading of goods' RFID tags, and send this data to the operation center through the 3G/4G network. The state of the goods can be tracked and understood more effectively through this technology.

Conclusion

The continuous progress of modern science and technology and the continuous development of economy and society increase the demand for material goods more and more. Additionally, the quality requirement increases. With the rapid development of e-commerce, logistics will be the bottleneck of the development of e-commerce. How do we effectively solve the bottleneck problem of logistics? Transportation plays an important role. The development of intelligent transportation must rely on the technology of IoT, and science and technology to develop and establish a safe, convenient, efficient, green, and modern integrated-transportation system.

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