Construction of Intelligent Logistics System Based on Internet of Things Technology

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Abstract: With the promotion of information technology, the Internet of Things develops rapidly and is gradually applied in all walks of life. Intelligent Logistics has become an inevitable trend in the development of logistics industry. This paper expounds the related concepts of the Internet of Things and Intelligent Logistics, introduces the key technologies in the Internet of Things, and constructs the Intelligent Logistics system based on the hierarchical structure and key technologies of the Internet of Things, so as to promote the sustainable development of Intelligent Logistics.

1. Introduction
In recent years, the Internet of Things has been widely concerned by people, known as the third wave of the world information industry after the computer and Internet. The application of Internet of Things technology can provide certain technical support for the development of China's logistics industry, and further improve the level of logistics management. In this situation, China's logistics enterprises should actively apply the Internet of Things technology in logistics activities, actively explore the construction of Intelligent Logistics system, which plays a positive role in improving the level of logistics service.

2. Internet of Things and Intelligent Logistics

2.1. The concept of Internet of Things
The concept of the Internet of Things first appeared in a book called The Road Ahead which was written by Bill Gates and published in 1995, which put forward the idea of "the Internet of Things". The Internet of Things (IOT) is a kind of information network that connects things, people and things, people and people through various information sensing devices (sensor network, infrared sensors, laser scanners, etc.), bar code and two-dimensional bar code, GPS, etc., according to the agreed communication protocol, and exchanges information through various access networks and Internet, so as to realize intelligent identification, positioning, tracking, monitoring and management. The core of this definition is that every object in the Internet of Things can be addressed, controlled and communicated [1].
2.2. The basic structure of Internet of Things
The technology of the Internet of Things is complex and diverse. Through the analysis of various application requirements of the Internet of Things, it is recognized that the Internet of Things is divided into three hierarchies: perception layer, network layer and application layer. As shown in Figure 1

![Figure 1. basic structure of Internet of Things](image)

2.3. The connotation of Intelligent Logistics
The emergence of Intelligent Logistics is the inevitable result of the development of logistics industry. The emergence of Intelligent Logistics concept conforms to the historical trend, also conforms to the new development trend of automation, networking, visualization, real-time tracking and intelligent monitoring in the development of modern logistics industry, and conforms to the development trend of Internet of Things, big data, Internet and cloud computing. Intelligent Logistics is the process of goods moving intelligently from the seller to the buyer[2]. The whole process includes six basic activities: intelligent storage, intelligent transportation, intelligent distribution, intelligent packaging, intelligent loading and unloading, as well as intelligent acquisition, processing of information. The purpose is to maximize the interests of the sellers, to enable buyers to enjoy the best logistics services. At the same time, it aims to realize the rational allocation of natural and social resources, to reduce energy consumption and protect the environment, to make the logistics reach a state of sustainable development. With all above achieved, a relatively complete Intelligent Logistics management system can be formed.

3. Key technologies of Internet of Things in Intelligent Logistics

3.1. RFID technology
RFID (Radio Frequency Identification) is a technology that uses radio frequency signal to realize contactless information transmission through spatial coupling (alternating magnetic field or electromagnetic field) and achieves the purpose of identification through the information transmitted. When the items are loaded with RFID tags, the reader sends RF signals of a certain frequency through the transmitting antenna. When the items with RFID tags enter the working area of the transmitting antenna, the RF signals can automatically identify the items and obtain the relevant information of the items. This technology is easy to operate and can identify multiple targets automatically and quickly. It is one of the most widely used and core technologies in the Internet of Things[3].

Nowadays, RFID is widely used in logistics system and plays an important role in logistics management. On the one hand, there are standardized codes stored in RFID tags. Different codes represent different item information, and the reader distinguishes the target objects through the
identification code. On the other hand, RFID tags can also store real-time dynamic information of objects. The information can be updated in real time by connecting to the network. The reader can identify the information data of objects, and realize the functions of data transmission and query.

3.2. Sensor technology
The Internet of Things can make inorganic objects perceive the physical world, and this purpose is mainly realized by sensors. Sensors are the basis for objects to perceive the physical world, which determines the accuracy and authenticity of the original information. According to the standard of China, the sensor is defined as the device which can sense the object to be measured and convert it into the signal which can be used to transmit according to certain rules. The sensor consists of sensitive elements, conversion elements, signal conditioning and conversion circuits. In Intelligent Logistics, sensor technology and sensor network are very important. They can not only cooperate with RFID system to track the location, temperature, route and other information of objects, but also realize the cognition of the given environment through the network. Therefore, sensors are the bridge between the real world and the information world.

3.3. Cloud computing and big data
At present, there is no universal definition of big data. Big data scientist John Rauser mentioned a simple definition: "big data is any huge amount of data that exceeds the processing capacity of a computer." It is generally believed that big data has four dimensions: volume, variety, value and velocity. Cloud computing is a new leading information technology, which can realize super-computing and mass storage capacity. The combination of big data and cloud computing can realize the storage and analysis of massive data, and effectively manage large-scale parallel computing server cluster. In the Intelligent Logistics system, big data and cloud computing are used to provide real-time items dynamic information, security information and logistics information query services for the service objects in all aspects of logistics, so as to realize the visible, controllable and traceable tracking management of the whole logistics process and provide high-quality logistics services for customers.

3.4. M2M technology and management platform
M2M (machine to machine) refers to the transmission of data from one terminal to another. It is a way of realizing intelligent and interactive communication between machines by means of wireless communication. M2M can provide customers with comprehensive information solutions. Logically, M2M system is divided into three areas, including terminals, network and application[4]. Intelligent Logistics based on M2M technology and management platform can realize a variety of information requirements, including real-time monitoring, real-time tracking, real-time control and real-time scheduling, so as to realize the route planning, vehicle scheduling and other services in the logistics process.

4. Construction of Intelligent Logistics system based on Internet of Things technology
The four key technologies of the Internet of Things RFID, sensor network, M2M system framework, cloud computing and intelligent information devices are constantly updated and upgraded, which is the core power to promote the rapid development of the Internet of Things. With the continuous innovation and development of the Internet of Things, the Internet of Things has the characteristics of comprehensiveness of perception, reliability of information transmission and intelligence of information processing. These characteristics just provide the key technical support for the formation and development of Intelligent Logistics, and further promote the development of logistics informatization, digitization and intelligence.

4.1. Design of perception layer
The role of perception layer is to upload user information, employee information, management
information, commodity information and other information that may be involved in the Intelligent Logistics platform, such as personnel, goods and environment, to the database or server through the Internet of Things technology. The perception layer of Intelligent Logistics system is mainly composed of data acquisition layer and access layer. The data acquisition layer mainly uses the sensor, bar code, RFID tag and other facilities and equipment with acquisition function in the Internet of Things technology, and inputs the offline item information to the mobile device or PC through the sensor technology, bar code identification technology, RFID technology and so on. Then, through the network upload function in the access layer, the mobile network, wireless network or wired network are used to transmit to the global Internet of Things. As shown in Figure 2

![Access Layer Diagram]

Figure 2. Construction of perception layer of Intelligent Logistics system

4.2. Design of network layer

The network layer is the bridge between customers and background data, the link between the major components of logistics information system, and the basis of information sharing and real-time communication. It mainly includes two parts: network transmission platform and application platform. The two platforms can be unified as information integration platform. Through the use of network convergence, mobile communication and other technologies, the network transmission platform connects the logistics management information systems together, and accesses the logistics information network to provide technical support for the timely, unimpeded and efficient transmission of information. The application platform includes an information integration platform that can store, analyze and process information data uniformly and a security platform with open interface. As shown in Figure 3
4.3. Design of application layer

The application layer includes field subsystem, vehicle subsystem, logistics enterprise subsystem and Industry management subsystem. Field subsystem is distributed in roads, warehouses and stations, which is used for information collection and provides physical facilities and management system for information exchange with Industry management subsystem and logistics enterprise subsystem. Vehicle subsystem is composed of relevant devices installed on the vehicle for receiving, sending and collecting information. Its main function is to exchange information between the vehicle and the data center. There are some differences in the business systems of logistics enterprises under different logistics modes. From the perspective of supply chain, the logistics enterprise subsystems are the various systems in the logistics functional system. Industry management subsystem is mainly defined from the perspective of relevant government departments, transportation hub and industry management. This system has more functions to fulfill, and it needs to form information interaction with enterprises and departments that have intersection with the operation of logistics enterprises, such as transportation management department, logistics transfer points, airport, station, railway, bank, insurance, tax and etc.. As shown in Figure 4.

Figure 3. Construction of network layer of Intelligent Logistics system

Figure 4. Construction of application layer of Intelligent Logistics system
5. Conclusion
The research on Intelligent Logistics in China is relatively lacking, and the research on the systematization of Intelligent Logistics needs to be strengthened. At present, the Internet of Things is in the stage of rapid development. In order to realize the full application of the Internet of Things in Intelligent Logistics, it is necessary to continuously give full play to the advantages of the Internet of Things, combine with a number of technologies, improve the current situation of logistics management, gradually improve the Intelligent Logistics system, and promote the sustainable development of Intelligent Logistics. According to the basic structure of the Internet of Things, this paper initially builds the framework of Intelligent Logistics system from three hierarchies: perception layer, network layer and application layer. There are still many elements in the construction of the system that need to be improved, such as the construction of Intelligent Logistics function system and Intelligent Logistics support system, which need to be gradually improved in the process of follow-up research.

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