

Explore the Application of Internet of Things Technology in Cold Chain Logistics System

Mei 'e Xie

School of Business Administration, Wuhan Business University, Wuhan430056, China

Abstract

Cold chain logistics is an important part of modern logistics system. The introduction of Internet of things technology into fresh cold chain logistics can realize the automation and informatization of the whole process of cold chain logistics, and greatly improve the operation efficiency and economic benefits of the whole logistics. This paper first introduces the domestic research on the Internet of things technology, then expounds the concept and architecture of the Internet of things, and introduces several key Internet of things technologies in detail. Finally, the paper summarizes the specific applications of Internet of things technology in storage management, transportation management and sales and distribution management in the cold chain logistics system.

Keywords

Internet of things technology, cold chain logistics, logistics system.

1. Introduction

In recent years, with the rapid development of logistics industry, the total demand for cold chain logistics has reached 180 million tons. Despite the growing demand for fresh products, the circulation rate of fresh agricultural products is still at a low point, and the low cold chain circulation rate leads to the high corrosion rate of fresh agricultural products. The refrigeration effect of fresh products is insufficient, the transportation equipment is backward, and the low proportion of cold chain in the whole process leads to the occurrence of "chain breaking". In addition, at the level of information system management, China still lags behind other countries. The rapid development of the Internet of things provides an opportunity to solve the current problems of cold chain logistics. Cold chain logistics based on Internet of things technology can track the transported products in real time and reduce the loss of logistics information in the supply chain. Therefore, the application of Internet of things technology to the construction of cold chain logistics system of fresh agricultural products will help to solve the current problem of "chain breaking" in cold chain logistics, and is of great significance to ensure the quality and safety of fresh agricultural products and stabilize the price of agricultural products.

2. Research Status

In recent years, with the rapid development of Internet of things technology and its comprehensive application in the process of cold chain logistics, the problems faced by China's cold chain logistics have been effectively solved. Many scholars in China have conducted comprehensive research on this aspect, and the representative research points are:

Feng Jia (2017) first determined the model design objectives in the construction of the cold chain logistics model of urban fresh agricultural products based on the Internet of things, and then constructed the cold chain logistics model of urban fresh agricultural products based on the Internet of things from the network layer, perception layer and application layer respectively. The economic benefits of implementing the cold chain logistics system of urban fresh agricultural products based on the Internet of things are analyzed from the perspectives

of enterprises, consumers and society. Zhu Geng (2017) in "Research on terminal distribution mode based on Internet of things technology", aiming at the problems of competition and cooperation among node subjects in the process of terminal collaborative distribution operation, constructed the joint decision-making model and the evolutionary game model of collaborative cooperation in collaborative distribution, established the decision-making model of Internet of things technology upgrading and transformation in the state of non cooperative game, cooperative game and cooperative game coordination decision-making, and verified the model through an example.

Chen Changbin and Tao an (2020) "Research on the application of Internet of things technology in cold chain logistics of fresh agricultural products", and Wang Chenran (2019) "Research on intelligent cold chain logistics system of agricultural products based on Internet of things technology", it can be seen that there are many constraints affecting the development of cold chain logistics of agricultural products, which can be roughly divided into two categories, one of which is management and institutional factors: including logistics organization status, logistics management system, and awareness of cold chain logistics of agricultural products. The second is the scientific and technological factors, mainly considering the logistics facilities and technology application, pointing out that the main problem of cold chain logistics is the lack of the application of advanced cold chain logistics information technology. Nowadays, China's logistics industry is developing faster and faster, especially the informatization of logistics enterprises is constantly improving. Under this background, the demand for the application of automatic identification technology in the logistics industry will continue to increase.

3. Architecture of Internet of Things

The concept of Internet of things was proposed in 1999. It uses wireless identification and other information sensors as well as the Internet to connect all objects, so that they can be intelligently managed and identified. The core and foundation of the Internet of things is the Internet, but it is extended to things, between which information can be exchanged. In the application of logistics system, RFID technology is used to replace bar code identification, so as to achieve the purpose of intelligent management of logistics system. The Internet of things integrates radio frequency identification, infrared sensors, GPS and other sensors, links the Internet with objects according to relevant protocols, and provides information exchange and identification for intelligent reading, positioning, tracking, monitoring and management.

The IOT technology system includes various sensors, cloud networks, intelligent devices, radio frequency identification, information sensors, etc. they connect various objects in the form of electronic tags through IOT and other networks to achieve the purpose of accuracy, reliability, comprehensiveness and intelligence. The Internet of things is mainly divided into three layers: perception layer, network layer and application layer, as shown in Table 1.

Table 1: IOT architecture

Arrangement	Parts
Perception layer	Electronic labels, Card readers, Cameras, Infrared sensors, Shelves, Parking lot sensors, Human body sensors
Network layer	Wired network (local area network \ private network \ private line network), Internet, Wireless network (4G\5G\WLAN\WiMAX)
Application layer	Intelligent medicine, Food traceability, Environmental monitoring, Public safety, Intelligent logistics, Telemedicine, Intelligent life

4. Key Technologies of Internet of Things

Internet of things technology includes radio frequency identification (RFID), infrared induction technology, global positioning system (GPS), laser scanning technology, communication technology, Internet technology (Internet), geographic information system (GIS) and other related technologies.

4.1. Sensing technology

In the Internet of things, sensors undertake the task of data acquisition. It is the nerve end of the Internet of things to "perceive" the whole world. Sensors are devices or devices that sense and detect some parameter information of objects, such as temperature, humidity, pressure, size, composition, etc., and convert these parameter information into transmissible signals (such as voltage) according to the conversion rules.

4.2. Wireless communication technology

General wireless communication technologies include mobile communication 4g/5g technology, WiMAX, WiFi, Bluetooth, ZigBee, Lora, Nb IOT, RFID, etc. The advantages of RFID technology lie in a variety of transmission distances (the reading radius ranges from centimeter to kilometer), good penetration (the information in the packaging box can be read directly), no wear, no contact, anti pollution, high efficiency (multiple labels can be identified at one time), etc.

4.3. Data analysis and processing technology

Data analysis and processing technology is to summarize the material parameter information through network transmission, conduct in-depth analysis and processing of a large amount of data, excavate useful laws and conclusions from a large amount of data, and provide the conclusions to decision-making users through charts and other forms. Artificial intelligence (AI) and intelligent management technology can promote the intellectualization and automation of data analysis to replace manual decision-making and management.

4.4. Network communication technology

Communication is information transmission and communication between people, people and things, things and things through some kind of disconnection and behavior; Network communication refers to the information transmission and exchange between terminal devices through computer network.

5. Specific application of Internet of things technology in cold chain logistics system

The application of the Internet of things in the cold chain will lead to the intellectualization of cold chain transportation, that is, intellectualization of management, visualization of logistics and transparency of information, so that the cold chain can create more value. Manufacturers, logistics providers, sellers and consumers in the cold chain industry can obtain the situation of perishable goods anytime and anywhere through various terminals that can access the Internet without paying any cost, and enjoy the changes in security and timeliness brought about by the Internet of things technology.

5.1. Application in warehouse management

In the cold chain storage center, RFID technology can realize the automatic registration of commodities without manual inspection or scanning bar codes, which is faster and more accurate, and reduces the loss of agricultural products. The application of Internet of things technology can realize the visualization of distribution and the timely and accurate scheduling

of agricultural product transportation vehicles, so as to improve transportation efficiency and avoid invalid transportation as far as possible. The temperature tag can be used to provide temperature monitoring, so as to realize the dynamic perception and monitoring of on-board agricultural products and the quality and safety of agricultural products in transit. At the same time, the application of the Internet of things can realize the dynamic grasp of the inventory of each cold storage and the transportation volume in transit, so as to make scientific transportation decisions, fundamentally improve the rationality of transportation, and realize the effective circulation of agricultural cold chain logistics. In short, the application of the Internet of things will promote the visualization of the whole warehouse, maximize the storage quality, realize the storage safety, realize the automatic adjustment of storage conditions, and improve the efficiency of storage operation management.

5.2. Application in transportation management

The application of IOT technology in logistics transportation monitoring system includes but is not limited to vehicle tracking, route planning and navigation, information request, emergency assistance, etc., which can track and manage vehicles and goods in transportation to achieve reasonable planning. By maximizing the utilization of GPS monitoring, we can reduce the total investment and cost of the logistics and transportation industry. The application scenario of Internet of things technology in transportation management is shown in Figure 1

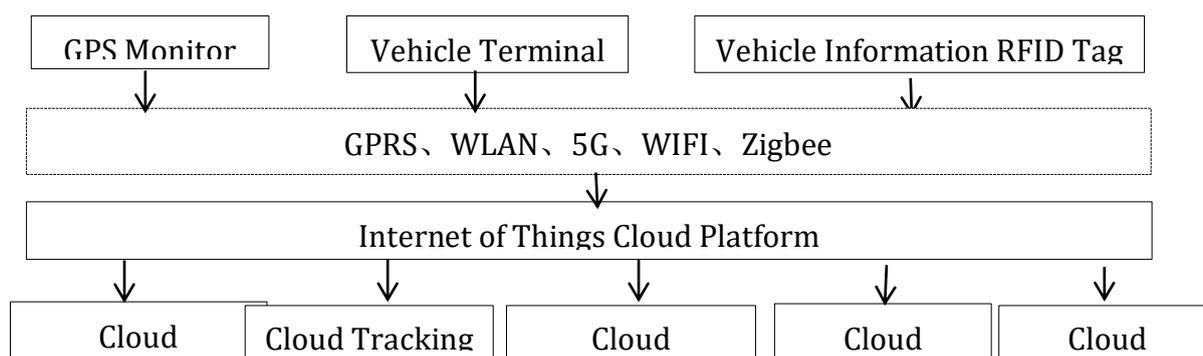


Figure 1: Application of Internet of things technology in transportation management

5.3. Application in sales distribution management

RFID technology in the Internet of things is introduced into the sales store, which can read the temperature information of the frozen area in real time, and feed these information back to the supermarket management department to ensure that the temperature of the frozen area is within a certain control range, so as to ensure the freshness of fresh food. Moreover, when the consumer pushes the shopping cart through the exit equipped with RFID reader after shopping, the reader can recognize the type, quantity, amount and other information of agricultural products in the shopping cart at one time. The computer display screen will display the total amount of the customer's consumption, and then the customer will pay and leave. The supermarket's sales system will automatically update immediately, recording all the information of agricultural products sold and sales volume for inclusion in statistics.

In the distribution process, the Internet of things technology is applied to clarify the type, quantity and destination of goods to be transported. According to the distance of optional routes, traffic conditions, etc., the optimal or better loading scheme and transportation plan are selected through the Internet of things system. Once the management personnel calculate the most effective logistics route, the scheduling and instruction information will be sent to the driver through the logistics transportation system, The driver receives information and executes instructions through the on-board communication system to ensure the safety, efficiency and accuracy of the transportation process.

6. Conclusion

Internet of things technology can realize the visual monitoring and tracing of the whole process of cold chain logistics, so as to effectively improve the efficiency of cold chain logistics operation, avoid excessive losses of goods in the logistics operation process, reduce logistics costs, and improve social and economic benefits. The application of the Internet of things in the cold chain will realize the intellectualization of cold chain transportation, that is, intellectualization of management, visualization of logistics and transparency of information, so that the cold chain can create more value. The application of Internet of things technology integrates key technologies such as RFID, GPS and QR code, and is widely used in all links of transportation management, warehousing management and distribution management of fresh fruits and vegetables, agricultural products and drugs in cold storage, which has played a positive role in promoting the development of cold chain logistics in China.

Acknowledgements

This paper is supported by project of The National Social Science Fund of China (18BJY138) and 2022 China logistics society, China Federation of logistics and purchasing(2022CSLKT3-137).

References

- [1] Zhu Qin Analysis on the development of cold chain logistics of fresh agricultural products and Its Countermeasures [J] Foreign trade and economic cooperation, 2019 (3): 39-40
- [2] Chen you, Chen Changbin, Tao an Research on the application of Internet of things technology in cold chain logistics of fresh agricultural products [J] Value engineering, 2020,39 (20): 129-132
- [3] Wang Chenran Research on intelligent cold chain logistics system of agricultural products based on Internet of things technology [D] Yunnan University of Finance and economics, 2019
- [4] Yang Xiaoyan Design and research of logistics management system based on RFID technology [J] Journal of Fuyang Normal University: Natural Science Edition, 2021,38 (3): 61-66
- [5] Wu Jiahui, Wang Jingwen, Liu Tianmu Analysis of problems and Countermeasures in the development of cold chain logistics of fresh agricultural products [J] National circulation economy, 2019 (20): 29-30
- [6] Zhang Qian, Du Sisi Application of automatic identification technology in modern logistics [J] Strait science and technology and industry, 2020 (7): 46-48
- [7] Celal Çeken and Dini Abdurahman. Simulation Modeling of An IoT Based Cold Chain Logistics Management System[J]. Sakarya University Journal of Computer and Information Sciences, 2019, 89-100.
- [8] Run T. Research on Optimization of Cold Chain Logistics Distribution Path of Fresh Agricultural Products[C]. Voronezh, Russia, 2019.