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Research on Big Data Acquisition and Application of Cold Chain Logistics Based on Artificial Intelligence and Energy Internet of Things

Research on Big Data Acquisition and Application of Cold Chain Logistics Based on Artificial Intelligence and Energy Internet of Things

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Abstract. In view of the information islands and energy consumption problems exposed in the big data of cold chain logistics, the research on the big data collection and application system of cold chain logistics based on artificial intelligence and energy Internet of Things is proposed, and the "four in one" cold chain is constructed. Logistics engineering management technology system, and use big data to analyze the national cold chain logistics data real-time early warning and monitoring platform, open up the logistics information chain, realize the system of logistics system energy consumption predictable, logistics information can be traced, realize cold chain logistics system and public service information Effective docking, realize data sharing and information sharing in the industry, rationalize resource allocation, and realize low-carbon green development of cold chain logistics.

1. Introduction

Cold chain logistics means that fresh produce such as meat, poultry, aquatic products, vegetables, fruits, and eggs are harvested (or slaughtered and harvested) from the place of origin, and are always at a suitable low temperature in the processing, storage, transportation, distribution, and retail of products. A special supply chain system that maximizes food quality and quality, reduces wear and prevents pollution under controlled conditions [1]. In the current rapid development of information communication technologies such as the Internet of Things, big data, and cloud computing, the rapid growth of cold chain logistics has been promoted through integration with other new technologies. “Big Data” has become a hot word in the cold chain logistics industry, and its value in researching big data is huge, especially when big data is integrated with the Internet of Things. The mining and collection of cold chain logistics big data can improve the operational efficiency of cold chain logistics, optimize resource allocation, and reduce energy consumption, which coincides with the development of contemporary green ecological economy.

2. Introduction to key technologies

2.1. Internet of Things technology
As the intersection of embedded technology, network technology and software technology, Internet of Things technology is defined as the use of infrared sensors, radio frequency identification, GPS and other communication technologies to connect the item terminals to the communication main network according to a certain protocol, thereby exchanging information. A network that implements intelligent interaction [2]. It is generally believed that the IoT structure can be divided into three levels: the sensing layer, the network layer and the application layer [3]: the sensing layer mainly includes metering sensing devices; the network layer includes the network protocol stack and its software and hardware implementation; and the application layer includes centralized Or a distributed cloud computing platform and user application software, etc., is the part of the "object" that directly interacts with the user.

The Internet of Things communication protocol is divided into an access protocol and a transmission protocol. The access protocol mainly refers to the protocol for communication between the underlying sensing layer devices, such as ZigBee. The transmission protocol is based on the TCP/IP protocol of the Internet, and the data is exchanged for the application layer. The common IoT transmission protocol is the MQTT protocol. MQTT adopts a "push" mechanism to alleviate the burden of short-term concurrent receiving of data requests by the server, providing three kinds of quality of service, enabling asynchronous and efficient communication between the device and the remote system in a resource-constrained network [4]. The protocol, its network structure is shown in Figure 1.

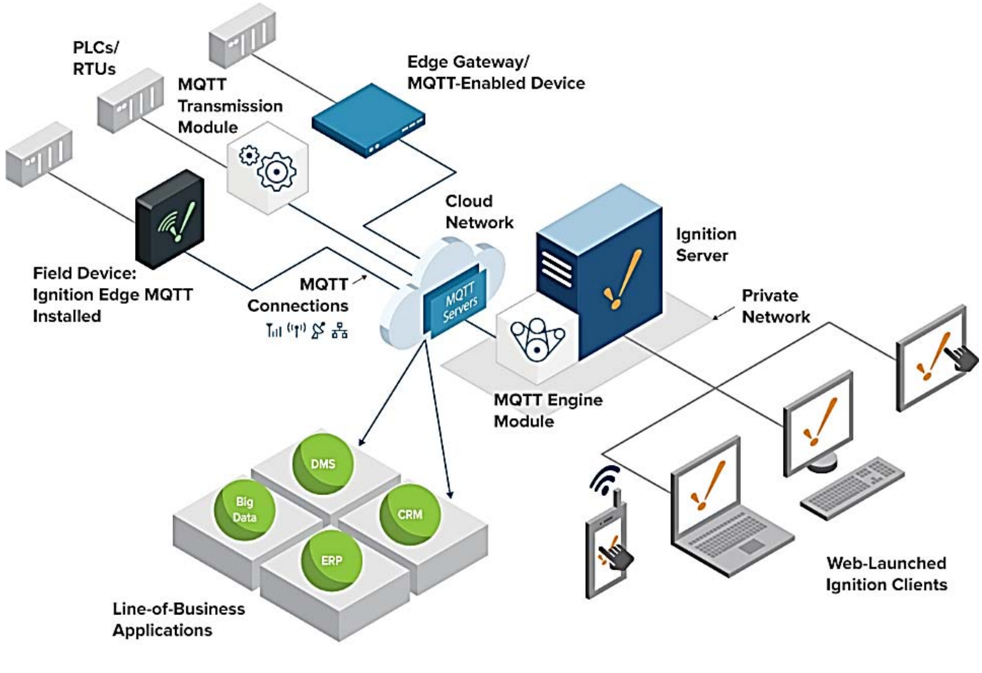

Figure 1. The hub-and-spoke network structure of the MQTT protocol

2.2. Big Data Technology
Big data is a large and complex data set, so the use of traditional data processing applications is not enough to handle these huge amounts of data. Carefully analyze big data that is most relevant to your business. Before analyzing the data, there are two main steps: collecting data and supporting APT storage methods. Big data is inseparable from the Internet of Things, and the Internet of Things has a

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great impact on big data analytics. These data need to go through the intake and storage phases before the analysis phase. The data of the Internet of Things needs to be managed through different frameworks.

3. Cold chain logistics big data acquisition and application function system

3.1. Demand Analysis

With the rapid development of modern information technology, especially the extensive application and embedding of big data, artificial intelligence, Internet of things and other technologies, the logistics activities are presented in an associative, interconnected and intelligent way, which can provide real-time monitoring of cold chain logistics. Location services, data analysis and mining, risk warning, precise control, improved performance and enhanced food safety.

3.2. Overall structure of the system

3.2.1. Logistics Center Operation Module. Through the module, the cold chain logistics product information data collection and the monitoring environment parameter setting are completed; the information data collection and monitoring system configuration is completed; the current monitoring information of each monitoring point is displayed in real time, and the trend trend diagram of important parameters is drawn. Through this module, the operator can also initialize the monitoring hardware parameters in the system, and can choose to close unused monitoring points and monitor the running status of each monitoring point monitoring device.

3.2.2. Agent Module. The module is the core of the entire cold chain logistics system. It includes components such as management agent, decision agent, communication agent, monitoring agent, and execution agent. This module is responsible for real-time monitoring and intelligent control of logistics products, and drawing waveforms for monitoring environmental changes. The management agent is responsible for the supervision, control and management of the entire system, and coordinates and schedules the work between other agents. Therefore, it is represented by a hybrid logical agent.

3.2.3. Fault Alarm Module. When a certain indicator exceeds the normal value during the running of the system, an automatic alarm is generated to generate a log file; when the monitoring device fails, a fault signal is issued, or the controller is out of control, the monitoring system issues an alarm display to automatically store the alarm data.

3.2.4. Big Data Analysis Module. Based on the big data characteristics of food safety, Hadoop and MapReduce system architecture, based on NoSQL data management technology, hive is used for ETL data processing, including data acquisition, data processing, data analysis, data presentation and application modules.

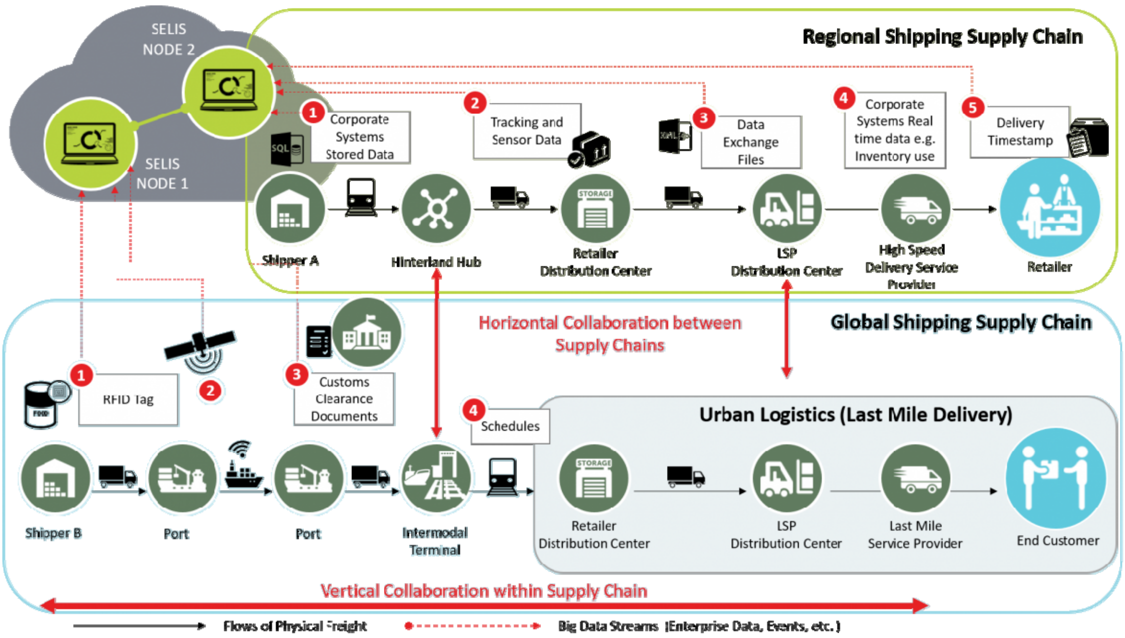

Figure 2. System big data monitoring and acquisition system design

(1) Data acquisition: not only includes routine monitoring of foodborne disease surveillance data, food pollutant monitoring data, cold chain temperature and humidity and other structured data, but also remote sensing data related to food safety environmental pollution, food safety public opinion monitoring data, etc. Unstructured data; breakthroughs in the “fences” and “islands” of data from agriculture, quality inspection, industry and commerce, and health, to achieve “liquidity” and “availability” of data.

(2) Data processing: Using the respective advantages of RDBMS and NoSQL, using the form of mixed storage of structured and unstructured data, mutual compensation for defects, achieving flexible and efficient purposes.

(3) Data analysis: Using spatial statistical analysis methods to explore the correlation between various impact factors and various food safety risks, establish a multi-factor influence model, and use complex network technologies to intrinsic associations and interactions are explored and modeled to construct a complex network model of multiple impact factors. Based on a unified space-time framework, based on the complex correlation between impact factors and food safety risks, a multivariate impact factor is established. Spatio-temporal reasoning models, etc [3-4].

(4) Data presentation and application: Application GIS transmits the food safety incident scene information back to the data center display, and displays the real-time data change situation and related resource distribution in the basic space geographic image visually, through spatial distribution analysis and time. Historical curve analysis, buffer analysis, shortest path analysis, etc., the time and space distribution of events and development trends, decision-making, early warning and forecasting.

3.3. Big Data Acquisition Algorithm

The coordination and cooperation between the modules is expressed by algorithms. It includes both the behavior of a single module and the behavior of cooperation by multiple modules. It uses the transfer function to realize the information exchange between each module. The problem-solving process and the data acquisition process in the multi-module system adopt a cooperative algorithm. There is a task that can be divided into n subtasks, which are executed by n tasks respectively. The execution time of the task is limited to a certain time window area, and all tasks completed outside this area have to pay extra cost. A task execution Agent j contains three important indicators (A_j, B_j, P_j), where A_j is the cost required for task j to complete before the time window, B_j is the cost required for

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task *j* to complete after the time window, and P_j is executed. The time required for task *j*. The time window for completing the total task is *[t-a, t+a]*, where *2a* is the window size, *t* is the best completion task time, and *t* value is to be determined. Solving the appropriate scheduling scheme through the scheduling module minimizes the extra cost of performing the task. Its objective function is expressed as follows [5].

$$S = \sum \left[A_j \cdot q\left(t\text{-}a\text{-}t_j\right) + B_j \cdot q\left(t_j - a - t\right)\right] \tag{1}$$

Where t_j is the completion time of task *j*. Each of these task completion times is assumed to be the start time of the common completion task time window. As a task completed in the time window in this scheduling, it selects the minimum value of the objective function value among the *n* sub-problems as an optimal value of *S*, and determines the optimal solution of *S*. The algorithm is solved as follows:

Step 1: $q\left(x\right)=\begin{cases} 0 & X<0 \\ 1 & X>0 \end{cases}$:, there is an expression:

$$\left(j \in L\right), f=\sum_{j=1}^{n} S_j \tag{2}$$

Step 2: (Removing the set after i), and solving the corresponding maximum number of tasks completed on time can be regarded as a 0-1 backpack problem.

$$\begin{aligned} & max \sum\nolimits_{j\in L_i} S_j X_j \\ & s.t. \sum\nolimits_{j\in L_i} P_j X_j \le 2a \qquad X_j \in \{0,1\} \left(j \in L_i\right) \end{aligned} \tag{3}$$

Optimal solution T_i And stipulate $f_i=\sum_{j=1}^{n} S_j\text{-}Si\text{-}T_i$.

Step 3: If $f_i<f$ then let $i=i^*, f_i=f$.

Step 4: If $i<n$, set $i+1<1$, go to step 2; if $i=n$, the optimal value is *f*.

Step 5: $L_i^*=L\backslash\left\{i^*\right\}$, solve the corresponding *0-1* knapsack problem:

$$\begin{aligned} & max \sum\nolimits_{j\in L_i^*} S_j X_j \\ & s.t. \sum\nolimits_{j\in L_i^*} P_j X_j \le 2a \qquad X_j \in \{0,1\} \left(j \in L_i^*\right) \end{aligned} \tag{4}$$

Step 6: Determine the solution to the optimal completion task:

$$t = P_i^* + \sum_{j\in V_{22}} P_i + a \tag{5}$$

The minimum loss f of the system obtained by equation (3); the optimal time window position determined by equation (5) is the area $\left[P_i^* + \sum_{j\in V_{22}} P_i, P_i^* + \sum_{j\in V_{22}} P_i + 2a \right]$ with the length of *2a* centered on the optimal completion task time *t*; the numbered set of the task scheduling order in the system is in turn Yes: $V_{21} \rightarrow \{ i^* \} \rightarrow V_1 \rightarrow V_{22}$. For each task within the collection, there can be different execution order schemes, which has no effect on the loss of the system.

4. Cold chain logistics big data application effect

4.1. Promote real-time dynamic feedback of product information

The corresponding distribution products in the cold chain logistics impose extremely strict requirements on the distribution conditions, and the temperature and humidity and the light will affect the loss of the products. However, if the logistics enterprise installs the temperature and humidity, the light sensor in the cold chain car, and transmits the information data to the remote service center, combined with the historical data, the optimal temperature, humidity and illumination for storing the part of the product are obtained, thereby achieving the purpose of reducing the loss of the product. In addition, the terminal on the transportation vehicle forms a contact with the logistics enterprise server via the mobile communication system to carry out information data transmission and reception, and the logistics enterprise or the fleet management personnel can realize convenient access to GPS and related real-time data, such as the driving direction of the vehicle and the driving time of the vehicle. Information such as product loading and unloading conditions, driver braking times, and driver acceleration times provide great convenience for carriers and shippers to know the product transportation situation in real time, help to find relevant responsible parties, and also release the cold chain car in time. Effective instructions to achieve the goal of reducing product losses [6].

4.2. Promote the optimization and adjustment of the application strategy

In the big data environment, logistics companies do not need to effectively analyze logistics information data, and ensure the efficiency and accuracy of data analysis. The application of big data technology allows managers to make decisions, no matter what problems they face. The system can integrate real-time incremental data, combined with data analysis methods to obtain effective and timely answers, highlighting the reliable data value advantage in cold chain logistics. At the same time, the most important factor in the cold chain logistics is timeliness. Because the products involved are more special, the products can show significant seasonal differences, which will increase the cost and risk of logistics enterprises to a certain extent. The big data technology can rely on the effective analysis of the existing data information to optimize and adjust the internal and external factors and marketing plans faced by the logistics enterprises. The logistics enterprises can also monitor the distribution process in real time according to their actual conditions. Obtain information data of their own needs, such as transportation routes, management and maintenance costs, etc., further reduce the frequency of failures, shorten the distribution route, and reduce costs.

5. Conclusion

In the context of artificial intelligence and the Internet of Things, cold chain logistics companies form big data thinking and actively respond to the enormous challenges brought by big data. Internet of Things technology extends the traditional information communication network to the broader physical world of cold chain logistics. In recent years, the research results of related Internet of Things technologies have emerged. When the technology develops to a certain extent, the application model will become more and more mature, the application scope will become more and more extensive, and the application power will become stronger and stronger. In the future, combining artificial intelligence and the Internet of Things, we will be able to achieve the “ideal path for dispatching cold chain logistics and distribution”, “promoting real-time dynamic feedback of product information”, “building a sound standardization system, and promoting standardization of product production and circulation”. Promote the optimization and adjustment of the application strategy and other data monitoring and application functions to maximize the benefits of cold chain logistics transportation.

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