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Design of Beidou Satellite System in Ocean Logistics Real-Time Tracking System

Qian Hao[†], Zhifang Wang[††], and Lele Qin[‡*]

[†]Hebei College of Industry and Technology
Shijiazhuang, P.R. China

[‡]School of Economics and Management, Hebei University of Science & Technology
Shijiazhuang, P.R. China

[††]Polytechnic College, Hebei University of Science & Technology
Shijiazhuang, P.R. China

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ABSTRACT

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In order to ensure the quality and safety of pelagic fish catches in the process of transportation, administrator needs to carry out real-time monitoring and management to the transport and quality status during this period and establish a complete management system. This paper puts forward that the real-time online monitoring of transport location, catches temperature, humidity, PH value and other physical property data can be used during the application process of Beidou System and RFID temperature tags in the cold chain logistics of ocean catches. The system consists of 3 parts, *i.e.* vehicle or vessel tracking, parameter monitoring and data management and analysis. The system applies the technologies such as Beidou, ZigBee and Internet as well as the Java-programming client web page structure and the traditional SSH2 as its code framework. Hence, it realizes the real-time monitoring of whole catches transportation logistics process and makes administrator timely know about the status of catches so as to ensure the product quality. This system can guarantee the quality, safety and transport efficiency of pelagic fish products and provides a support for the building of cold chain logistics system.

ADDITIONAL INDEX WORDS: *Beidou system, ocean logistics, tracking system, real-time monitoring.*

INTRODUCTION

Deep-sea fish is rare, natural, safe, healthy and quality food, and is very welcomed by developed countries like EU, USA, Japan and developing countries like China and India. More and more ocean fishery products are sent onto the human beings' dinning tables. Therefore, cold chain logistics, as a necessary technological guarantee of fishery products' quality and safety in the transport process, are put into use by more and more enterprises. At present, in order to facilitate management and scheduling, a lot of pelagic fishery enterprises are making efforts to build own catches cold chain logistics system to intuitively know about the fish transport status in the process of cold chain logistics. In the traceability system of cold chain logistics, the following modules are required: customer management, catch order management, catch transport status information, visual transport positioning management, *etc*. How to clearly display the position of transport vehicles? How to obtain accurate quality information of catches in the process of transport? These questions are the embodiment of the accuracy and necessity of establishing a cold chain logistics system.

This paper highlights the analysis of Beidou satellite navigation system (BDS), RFID temperature sensor technology and Bluetooth technology's application in this system, and describes a variety of technologies for backend data support. The purpose is to implement real-time logistics monitoring to the catches position and temperature in the process of cold chain logistics, ensure the quality and safety of catches in the process of logistics and facilitate administrator to carry out real-time monitoring at the same time. Besides, the system can make administrator obtain the real-time status and information of catches in the logistics process and help administrator to make timely response to the accidents occurred in the process and establish an information platform.

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*Corresponding author: mr_qin@163.com

APPLICATION OF BEIDOU AND RFID TAGS IN OCEAN LOGISTICS SYSTEM

Due to the particularity of ocean work, the catches must be transported by marine and land transport to the catches market after catching. In order to ensure the quality of catches such as freshness in entire transport process to meet the requirements of the market, the carrier environment needs to be kept consistently in low temperature in the process of marine and land transport. This is pelagic fishery cold chain logistics process, as shown in Figure 1.

OVERVIEW OF BDS AND RFID PHYSICAL PARAMETER MONITORING LABEL

Application of RFID Sensing Tags

In the applications of Internet of Things technology, RFID is one of the most commonly used and key technologies, which can work in any severe environment. Its identification features

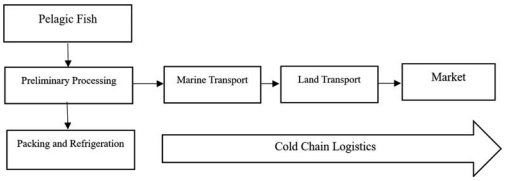

Figure 1. Pelagic fishery cold chain logistics process.

uniqueness and can be done for multiple tags at the same time. The commonly-used RFID tags may store the basic information and data of products but are unable to realize the monitoring of physical properties. Besides identifying the basic information of transport vehicles and transported catches in the pelagic fishery cold chain logistics process, it has an important work, i.e. it needs to make a real-time monitoring to the change of catches temperature, humidity and other physical properties and then upload the data by 4G network or other communication systems. Finally, remote management system conducts unified management and facilitates administrator to make a remote intelligent adjustment of related equipment.

For example,the RFID temperature tags adopted by this system are made on the basis of the common RFID electronic tags by joining temperature sensor which can monitor the temperature such as ZWTTTH1002 temperature and humidity RFID sensing tags. In the process of transport, the RFID temperature tags can make a real-time monitoring of temperature information of catches, and transmit information to the RFID reader by wireless transmission way according to the time set, and upload the information by ZigBee, WiFi, etc. Therefore the reader can convert digital information received to easily identifiable information every once in a while, and then pass into the backend database for recording. When the temperature and humidity exceed the threshold, the system will signal in time, making it convenient for administrator to adjust and for computer to adjust automatically, as shown in Figure 3. The RFID temperature tag integrates RFID electronic tag and temperature sensor technology, making it possible to not only identify the catches but also collect their temperature information in real time and transmit the information to backend monitoring system through the circuit network. The application of RFID temperature tags in cold

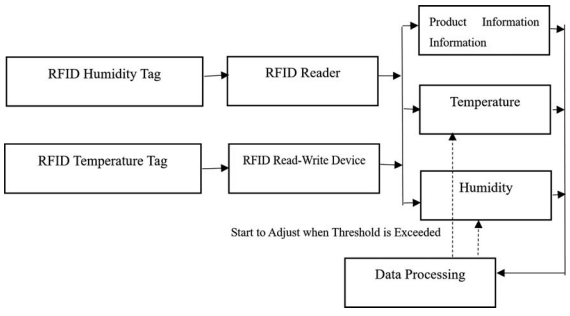

Figure 2. Flow chart of RFID data collection & control.

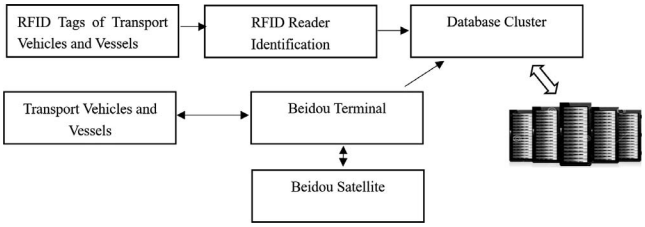

Figure 3. Applications of Beidou and RFID tags in real-time tracking system.

chain logistics system of ocean fishery guarantee real-time status information of catches can be transmitted to cold chain logistics system accurately, which makes it convenient for administrator to monitor and trace the subsequent information of catches.

REALIZATION OF SYSTEM

Positioning of Transport Carrier

In the cold chain logistics process, transport positioning and transport route are a very important link. By understanding the geographic location information and the transport route information of transport carrier, administrator may make remote monitoring conveniently and avoid the catches to be failed to transport to the destination due to the occurrence of unknown accident to the carrier. BDS and GPS are the most widely used navigation systems in the world. This system adopts Beidou system and applies it to pelagic fishery cold chain logistics by combining with Beidou system and RFID tags. It makes the process more intelligent and more transparent for management:

(1) Identification

At present, in order to facilitate the management, a lot of ocean fishing and transport vehicles are labeled with their own "identity mark", which indicates basic information such as the name of fishing vessel and the company they belong to. By adopting RFID system, relevant information of company and goods can be read in real time, and information can be transmitted back to the backend database to identify the source of catches. At the same time, land vehicles are also equipped with the same identity tags, which indicate the information of carrier, vehicle and transport volume and so on. It facilitates the subsequent recipients to identify the identity and avoid quality and safety disputes caused by inconsistent information received at the earlier stage.

(2) Carrier Positioning

In order to avoid the loss of monitoring objects in the pelagic fishery cold chain logistics and subsequent monitoring problems, real-time positioning monitoring is required for the transport carrier. BDS terminal installed on the transport carrier can transmit the position information to the terminal of monitoring center through the satellite in real time and display the status and trails of transport. In case of emergencies such as the change of transport destination, administrator and intelligent management software can accurately find the location of transport carrier on the monitoring platform,

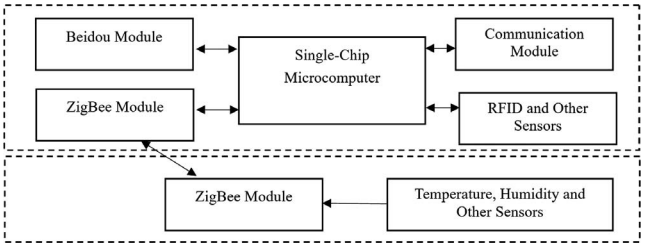

Figure 4. Design chart of mobile terminal.

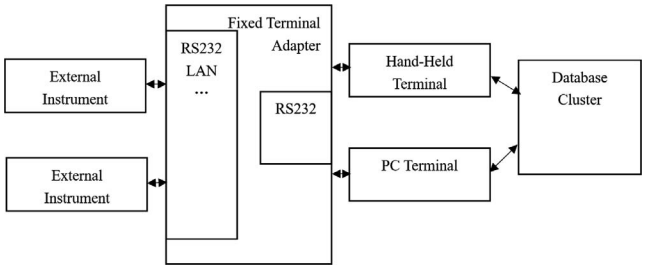

Figure 5. Structural chart of fixed terminal.

achieve accurate scheduling and others by instant message contact through Beidou satellite. The details are shown in Figure 3.

Design of Vehicle and Vessel Tracking

The tracking and recording part is mainly distributed on the catches carrier of transport vehicles. The tracking and recording part is mainly the mobile terminal, which collects the real-time status of catches in the whole process through the sensors. Mobile terminal includes main control module, Beidou module, ZigBee module and communication module. Each catches encasing-carrier is equipped with a principal part of mobile terminal, which composes of main control module, Beidou module, ZigBee module and communication module. While, there might be many collection modules which are separated from the principal part and are distributed on various places of catches carrier. The main control modules are mostly single-chip microcomputers, which use the STM32F405RG single-chip microcomputer of ST Company as the microcontroller to open 8 channels and complete the classification and packing of various data. Beidou module uses SKG09D, which is mainly responsible for receiving Beidou signals as well as sending and receiving instant messages. Since ZigBee protocol features large capacity, strong compatibility and convenient increase or decrease of nodes, ZigBee module is responsible for the communication between the principal part and the data acquisition module. The data acquisition module mainly collects the temperature and humidity of catches carrier in real time. Specific collection frequency depends on the actual situations. See structural chart in Figure 4.

Parameter Monitoring

Parameter monitoring can be conducted in 2 ways: batch monitoring of relay station and real-time monitoring of mobile terminal. Batch monitoring of relay station is mainly carried out through comprehensive monitoring on catches manually or by instruments. After that, the fishery products will be cleaned up or relevant items will be added to adjust the products and their environment. Finally, the information data will be transmitted to the data management center by means of network transmission, and processed by the management information. In addition, it can facilitate the management of product transactions by inputting the name of relay station, relevant information of inspection personnel and operation personnel, and adjusted information. The comprehensive parameter monitoring includes the data generated by external instrument monitoring and manual input, and the data transmission is processed separately. The comprehensive parameter monitoring is mainly conducted by fixing the external monitoring instrument of terminal interface and connecting to PC equipment for manual control. For example, the oxygen capacity and PH value of catches carrier can be tested, and the temperature, oxygen capacity and PH value can be adjusted according to the system prompts. The comprehensive parameter monitoring can detect the water quality and selectively clean the catches carrier according to the feedback data. Fixed terminal is the extension of mobile terminal. Its interface mainly includes RS485, RS232 and LAN. The computer terminal also allows manual data input, and finally the data is packaged together and transmitted to the data management center through the network. The real-time monitoring of mobile terminal is conducted through RFID tags, PH sensors and other equipment for real-time data collection, and completes the data upload through the ZigBee protocol. Besides, it will start or stop related equipment according to the system information decision.

Data Management and Analysis

Data management and analysis is mainly carried out by taking the data server and transaction process server as its core, and links through the cable network and wireless network. The server receives data from wireless and network communication at the same time. Data management and analysis is basically around the discovery, extraction and process of data, the use of models and generation of decision information.

Tomcat is a core project in the Apache Software Foundation's Jakarta Project, developed by Apache, Sun, and other companies and individuals. Tomcat Server is a free and open source Web application server which belongs to lightweight application server. It is widely used in small and medium-sized systems and applies to the occasions where there are not so many concurrent access users. It is the best choice for developing and debugging JSP programs. Therefore, Tomcat is used as the Web service software to receive data from the network, and Oracle database is used as the database to receive data.

The data received by the data management center can be classified into mobile terminal data, fixed terminal data and

web client data. After receiving the data of real-time mobile terminal, it is temporarily stored in the cache. The data enters into the database after cleaning. Fixed terminal data is stored directly in the database. If data comes from the Web client-end, server will extract data from a database or internal storage (For viewing the real-time data, it just needs to extract data from internal storage; for viewing the historical data or to draw a chart, just extract data from the database) according to user's requests. Corresponding page or chart will be generated by the Web service software, and then be sent to the client end through the network.

The whole structure of web page showed on the client end is mainly divided into application layer, business layer and data layer. Application layer is mainly responsible for providing interface for users and meeting the users' requirements for data, map, data analysis, decision support and other services through the man-machine conversation on the interface. It can also complete man-machine interaction and upload relevant information to the server. Business layer is also called business logic layer layout. In the web server, it is mainly responsible for receiving uses' requests from the application layer, performing different operations based on the algorithms and models already set by the system, classifying the requests, and performing different operations or sending requests to data layer according to the requests. Data layer is the layer where the DBMS is located, which is mainly responsible for accepting the requests from the business layer, completing the access to the database, filtering the data according to conditions of the requests, and then feeding back the selected data.

The web page structure of client end is programmed with Java, and the code framework uses traditional SSH2. SSH is an integration framework of struts+ spring+ hibernate which is a relatively popular open source framework of Web application program. The system of SSH integration framework is divided into four layers according to functions: presentation layer, business logic layer, data persistence layer and domain module layer. This system is used to help developers build Web application programs with clear structure, good reusability and convenient maintenance in a short time. Struts is used as the whole fundamental framework of the system, which is responsible for the separation of MVC. The model part of Struts framework is responsible for controlling business skip and using Hibernate framework to provide support for the persistence layer. Spring is responsible for managing Struts and Hibernate. In the design of the system, Struts2 is responsible for the linking between the front end and the business layer, Spring is responsible for the whole business logic, and Hibernate is responsible for the linking between the database and the business layer.

CONCLUSIONS

This paper proposes combining the Beidou system with RFID temperature sensor technology and using RFID temperature tag and RFID read-write device to make a real-time temperature monitoring in the process of catches transport,which will ensure the quality safety of the catches. And Beidou vehicle terminal can position the location of transport carrier when abnormal events occur to the carrier. It is available to make remote communication with administrator through the satellite communication function. Theoretically, the combination of the two is indispensable, which can make it convenient for administrator to make online monitoring and improve the intelligent management level of pelagic fishery cold chain logistics. As a result, it can provide sufficient guarantee for the complete construction of pelagic fishery cold chain logistics system.

Along with the combination of modern information technology and pelagic fishery, the development of pelagic fishery has become more and more intelligent, and the information that usually can't be seen directly such as the work status also becomes "transparent", which enhances the safety and improves the efficiency of fishery products sale. Therefore, in the future development of pelagic fishery, the combination of Beidou and related technologies of Internet of Things will become closer and closer, and the application scope will become wider and wider.

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