

Intelligent Monitoring System on Refrigerator Trucks Based on the Internet of Things*

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Abstract. Refrigerator transportation is an important part of cold chain. Aiming at monitoring the temperature and humidity inside the refrigerator trucks, and managing information of the the refrigerator trucks internal. At the paper, there is a design of an intelligent monitoring system based on the Internet of thing, realized monitoring temperature and humidity inside the refrigerator trucks and the intelligent cargo identification, and tracking the location of refrigerator trucks real-time in the entire transportation process by using advanced RFID technology, the sensor technology and the wireless communication technology.

Keywords: Refrigerator Trucks, Internet of Things, Intelligent Monitoring, RFID.

1 Introduction

With the continuous development of society, people pay more and more attention on the food safety in daily life, especially fruit, dairy and meat food's preservation problem. In the food cold-chain process, the transport process of refrigerator trucks is an important segment to ensure food safety. In this segment, the temperature and humidity conditions within the refrigerator trucks, the state of door switch and the location of refrigerator trucks must be real-time monitored.

The Internet of things is a combination of the Internet and all kinds of information sensing devices such as radio frequency identification devices (RFID), infrared sensors, global positioning systems, laser scanners, etc. Meanwhile, it based on the simple RFID technology and combined the existing network technology, database technology and middleware technology to form a huge network including lots of networking reader and countless mobile labels. This technology is widely used in intelligent transportation, environmental protection, public security, peace household,

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intelligent fire, industrial monitoring, and many other areas, which greatly improved the social intelligence and automation level.

Applying the Internet of things technology in refrigerator trucks' transportation can track the position of refrigerator trucks and monitor the temperature and humidity etc real-time, and monitor the whole transport process intelligently to improve transport efficiency.

The paper is based on the concept of thing networking, and used the advanced RFID technology, humidity sensor technology, door switch monitoring device, GPRS/GPS technology, wireless communication technology and the Internet to form a remote monitoring intelligent system for the refrigerator trucks. The remote intelligent monitoring system based on this networking technology can have a real-time monitoring of the temperature and humidity, gate switch state, cargo information and the location of refrigerator trucks, all that make the whole monitoring process reach informatization.

2 Intelligent Monitoring System Design Scheme

Because of the refrigerator trucks' wide transportation range and some are still in areas with bad environment, which causes management difficulties in the process of transportation. The transport goods are mostly fresh meat, fruit, vegetables and dairy products, cold drinks, health food, which need high requirement of environment. Combined with the characteristics of transportation process refrigerator trucks above, this paper puts forward refrigerator trucks remote intelligent monitoring system based on the Internet of things. The system adopts modular design, and be constituted by multi-point temperature and humidity acquisition module, the door switch monitoring device, RFID module, monitoring module in trucks, GPRS/GPS module, wireless network, remote monitoring center, and so on. The system composition diagram was as shown in Figure 1. This system relies on advanced content networking technologies and combines existing technology to achieve real-time and accurate monitoring purposes. The temperature and humidity acquisition module constituted by high performance temperature and humidity sensor can be used to read the temperature and humidity conditions data within the refrigerator trucks real-time. In order to measure more accurate temperature and humidity data, more temperature and humidity acquisition modules can be placed in the box according to actual needs. The door switch is used to monitor the monitoring device switch state in the process of goods transportation to avoid goods loss. Through advanced RFID technology, labeling goods with electronic tag, entering relevant information on goods labels and putting RFID reader beside the box, the RFID reader senses induction cargo information when the goods loading or unloading. The temperature and humidity data, the door switch state and the RFID information are all sent to the refrigerator cockpit monitoring module screen through the RS485 bus to accessory personnel check and management. And the refrigerator tracks position is located and tracked by the GPS satellite, and returns its positioning information with temperature and humidity data, door switch state and cargo information to monitoring center through GPRS network

and the Internet. Using intelligent analysis software on the remote monitoring center terminal to display refrigerator trucks temperature and humidity data, door switch state and cargo information real-time to locate and track the location refrigerator trucks to implement intelligent monitoring management and make the whole system constitute a real-time, intelligent thing networking[2].

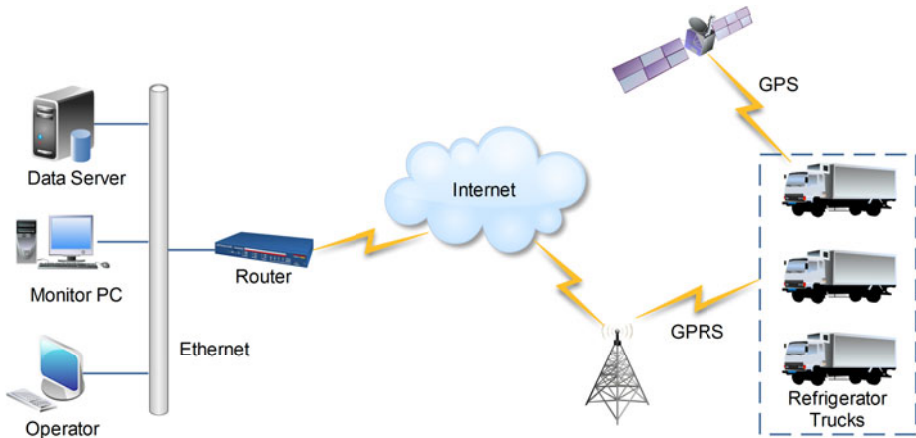


Fig. 1. Monitoring System Framework of Refrigerator Trucks

3 The Monitoring Center Inside the Refrigerator Trucks

The refrigerator temperature and humidity acquisition module, the door multi-points monitoring device and RFID reader switch, GPRS/GPS module and monitoring modules in trucks together can be regarded as the monitoring center inside the refrigerator trucks. System composition diagram is as shown in Figure 2. The temperature and humidity data, the door switch state and cargo information read in the box are sent to the cockpit monitoring module through the RS-485 bus. At the same time, returning positioning information to determine the location of refrigerator trucks, temperature and humidity data, door switch state and cargo information and refrigerator location information displayed real-time in monitoring module on the LCD panel through GPS satellite. And the alarm device on monitoring module automatic send out a warning message to accessory personnel and remote monitoring center to let the accessory personnel make corresponding processing when the trucks temperature and humidity data beyond the preset numerical cap or lower than lower limit. The refrigerator trucks also have installed SOS switch. When meeting special events, as long as people press emergency switch, the remote monitoring center will know that this refrigerator need assistance. While monitoring module intrucks read all information on the refrigerator trucks, the information also is sent to remote the monitoring center by GPRS module.

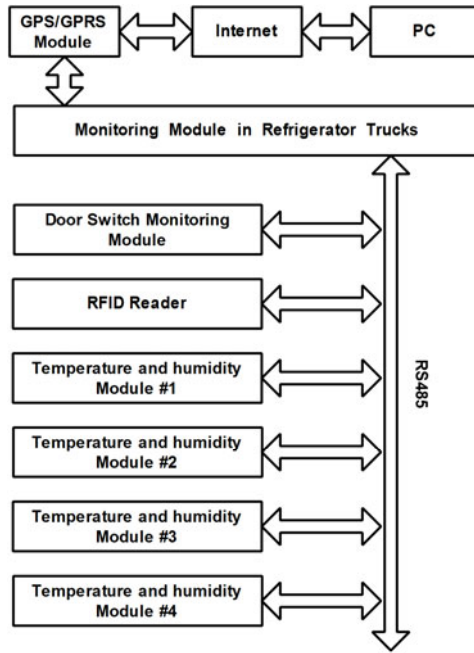


Fig. 2. Monitoring System of Refrigerator Trucks

3.1 Temperature and Humidity Acquisition Module

Temperature and humidity acquisition module is used to read the temperature and humidity in refrigerator. For the temperature and humidity acquisition module using STH10 High-performance and humidity sensor has characteristics of fast response time, high data collection precision and big acquisition range, all make it meet the trucks' testing environment condition requirements of refrigerator in the transport process. In order to measure more accurate data, we install multiple temperature and humidity acquisition module to collect multi-point temperature and humidity in the trucks, meanwhile. The data collected by each module is sent to the monitoring center inside refrigerator trucks by RS485 bus.

3.2 The Door Switch Monitoring Module

In order to avoid the goods loss caused by the door's abnormal switch in transport process, we need to do a real-time monitoring of the switch state of the trunk door. The door switch condition monitoring device uses hall sensor to probe refrigerator door's switch state, to record the related information of time and location when the trunk door switch every time ,and always transmit the key information to the remote monitoring center at any time .

3.3 RFID Module

The RFID commonly known as the electronic tag, is a simple wireless system. This system is consisted by a reader and a lot of tags, which is an important part of the Internet of things technology and widely used in information exchange, detecting and tracking on goods. Using the technique, the system posted tag in the cargo, and input the tag number, goods related information to the label. When loading or unloading goods, the goods will be recognized in the box by the RFID reader installed beside the door. The information read from the label would be sent to the remote monitoring center through the transmission control module on RS485 bus. So the people of remote monitoring center can understand the situation of the cargo inside the trucks by viewing the data at any time.

4 Remote Monitoring Center

The monitoring center inside refrigerator trucks can connect to the remote monitoring center through wireless communication network and Internet. The database server, the monitoring center and monitoring terminal together compose the remote monitoring center, which can monitor refrigerator trucks real-time. Using the intelligence analysis software to design humanized monitoring interface to output the data from monitor terminal and display every refrigerator trucks' data real-time, such as alarming, processing, recording, printing and determining the location of per refrigerator trucks. Meanwhile, the remote monitoring center monitor the cargo information of loading and unloading, record the loading, unloading time and cargo information to ensure cargo's safety conditions in transport process. If the refrigerator trucks have not in normal operation in the process of transportation, the remote monitoring center alarms prompt, which made the whole system accomplish intelligence, and information monitoring.

5 Conclusion

The refrigerator trucks intelligent monitoring system which put forward by this paper was based on content networking technology. And combined with advanced RFID technology, sensor technology and wireless communication technology, etc. to realize purposes such as monitoring the transport process intelligently, improving the refrigerator trucks' transport efficiency, preventing the deterioration of goods in transit, and avoiding the loss of goods during transportation, and so on.

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