# Research on Remote Monitoring System for Construction Machinery

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**Abstract:** In view of the current domestic and foreign development situation of the remote controlling and monitoring construction machinery industry, puts forward the design idea of remote monitoring system for engineering machinery equipment in this paper. The design method of the overall framework of the system is studied, and the key technologies involved in the system implementation process are discussed. The system software architecture is divided into four main functional modules: system management, vehicle controller, GPS terminal and information management center. The system is oriented to many types of engineering machinery equipment. This paper analyzes the user management content and equipment monitoring interface in detail, and the management of equipment monitoring information and the implementation steps of dynamic display are designed. The system has strong universality, and has an important reference for similar remote monitoring system research.

**Keywords:** Construction machinery; Remote monitoring system; GPS

## 1. Introduction

Construction machinery is the essential construction equipment necessary for the construction of various infrastructures. During the period of China,s "Twelfth Five-Year Plan", with the increase of the national investment in the infrastructure field, the construction machinery industry has entered a stage of rapid development and has rapidly developed into a major producer of construction machinery. Under this background, it is imperative to use information technology to perform the long distance information for production, management and after-sales service of mechanical equipment. It is of great practical significance to study the remote monitoring system of construction machinery. Along with the country's requirements for safe operation of site equipment continue to increase, there is an urgent need for a remote monitoring system to monitor the equipment and keep track of the current operating conditions of the equipment.

## 2. Overall Design

The remote monitoring and controlling terminal is the core part of the remote monitoring system of construction machinery. It is distributed on each construction machine and is responsible for receiving satellite positioning information from the system and deciphering the position, speed and direction of the construction machinery.

### 2.1. System principle and composition

The remote monitoring system of construction machinery uses neural network algorithm, GPS and other technologies to realize remote tracking, remote debugging, real-time online monitoring, fault alarm and maintenance, expert diagnosis and other functions of remote engineering machinery, which effectively improves the remote monitoring of construction machinery. Management and maintenance level. As shown in Figure 1.

The remote monitoring system of the construction machinery is connected to the remote information processing center by means of the mobile base station, and the remote information processing center is connected to the monitoring management platform through the wired network, thereby realizing remote control of the engineering machinery and equipment. At the same time, the construction machinery equipment can realize real-time tracking, track playback and regional management of the equipment through self-positioning, providing data support for the application of the monitoring management platform.


**Figure 1. Login interface**

### 2.2. Vehicle controller

The controller is one of the three core technologies of engineering machinery, which directly determines the performance of the product. The vehicle controller, as the brain of engineering machinery, mainly realizes the work performance status detection, feature information extraction, data real-time transmission and receiving remote monitoring center control instructions of engineering machinery equipment, providing physical support for remote real-time monitoring and fault diagnosis of engineering machinery.

In addition to the conventional engine, hydraulic, and rotary control of the construction machinery, the on-board controller can also collect various data during the operation of the mechanical equipment in real time, and transmit it to the system monitoring center for safety analysis and fault diagnosis. It can receive various commands issued by the monitoring and management center, and control the actions of various actuators, such as the most common remote lock, to realize remote control of construction machinery.

### 2.3. GPS terminal

As a data transmission tool, the GPS terminal transmits the collected data to the information processing center through the wireless network and Ethernet for data processing. The GPS terminal is composed of a microprocessor, a power module, a module, a communication module, a vehicle data acquisition module, a vehicle control module, and a peripheral interface.

### 2.4. Information processing center

The information processing center is the core and "brain" of the whole system. It is the transit station of communication and the center of data analysis and processing. It includes communication protocol analysis, business processing and logic judgment, as well as construction machinery health status assessment, prediction and early warning and fault diagnosis. . Its components mainly include communication module, data analysis module, fault diagnosis module, short message transceiver module, SMS alarm module, data storage module, etc., and can also provide WEB service management functions.

The construction machinery remote monitoring system design equipment access volume is 20,000 units, carrying real-time supervision of all equipment of the company. A large number of devices concurrent access and concurrent data processing and storage are system design challenges. To solve this problem, the system uses a combination of hardware load balancing and software load balancing.

The information processing center is the core of the business processing of the whole system. It adopts cluster technology and consists of multiple servers. It is the bridge between the terminal and the remote monitoring and management platform. It is responsible for receiving job information, alarm information and location information collected from the vehicle controller or sensor. The analysis and processing are performed, and the commands issued by the remote monitoring management platform are forwarded to the terminal and then forwarded to the on-board controller to realize real-time control of the vehicle, and data classification analysis, service processing, logical storage and the like are implemented.

## 3. Monitoring Management Design

For the device owner and user, it is hoped that the monitoring system can view the working status of the device in real time, and the query and statistics functions can be used to analyze the running status of the device in the recent period.

### 3.1. Real-time information monitoring

The real-time information monitoring module mainly completes the real-time information display of the device, and when the alarm information appears, the user can be prompted in a prominent position, so that the device owner can find the problem in time and reduce the unnecessary loss caused by the device failure.

#### 3.1.1. Monitoring process design

Because the security of the data is high, the client does not want to lose data during the monitoring of the device. Therefore, the communication thread of the client and the communication thread of the lower computer adopt the TCP mode. When the server receives the data of the lower computer, it needs to find in the communication thread of the client whether there is a customer monitoring the device.

When the system receives the real-time information of the device non-alarm, it searches the client thread whether there is a customer monitoring the device, if so, sends real-time data to the client, and then stores the data; if no customer monitors the device , then directly save the library. When the system receives the real-time information of the device alarm, if there is an administrator online, it will send it directly to the administrator; once again match the user to which the device belongs, then find the user among the client threads, if there is, send it directly, and then save the library. Operation; if there is currently no customer online, then directly save the library.

#### 3.1.2. Implementation of monitoring system

The real-time monitoring interface of the system is shown in Figure 2. Through the main interface, the

customer can easily understand the current running status of the device.

**Figure 2. Real-time monitoring interface**

The main interface can be divided into the following sections:
Monitoring device selection list area: All the devices currently managed by the customer are displayed in the list on the left side of the main interface of the system, and the customer can select the device to be monitored according to his own needs.
Monitoring tab page: The right interface of the main interface of the system displays the real-time information of the device currently monitored by the customer. Because the information of the device is generally large, it is difficult to display completely in a tab page, so the system dynamically customizes according to the customer. The number of tab pages is displayed in real time.
Alarm information list: The alarm information is the content that the customer cares more about. Therefore, as long as the alarm information is generated by the device managed by the customer, the server will send the alarm information to the client, and the client will display the alarm information in the list. . In order to ensure that the customer does not lose the alarm information, the alarm message will always appear in the list box as long as the customer does not process it.

### 3.2. Information query process design

The historical information query function is mainly used to query the historical records of various parameters of the device and obtain the historical operation data of the device. The technical personnel use the data analysis tool to scientifically predict the possible failures. In order to make the data display more intuitive, users can print the data out of the report, or analyze the historical data by curve drawing.
Because different types of device types have different data types, you can only query the historical data by device ID number or device type. The specific implementation steps are as follows:
The time period in which the customer first selects which way to query and query. When the selection is completed, the data type of the device type is obtained by the first communication with the server. After obtaining the data type of the device, the receiving list box is dynamically initialized according to requirements; After the initialization of the list box is completed, the historical data sent from the server side is received one by one, and then filled into the list box one by one. The customer can cancel at any time during the process of receiving data according to the requirements;
After the data is received, the customer can print the data into an Excel report and draw a historical information curve, which is more intuitive to analyze the information of the device during this period.

### 3.3. Alarm function design

When an alarm message appears during the operation of the device, the system records the alarm details so that the device administrator can better maintain the device.
The specific implementation steps of the alarm statistics are as follows:
The user selects the type of statistics. Users can count the content they care about according to their needs. They can perform statistics on a certain device or statistics on alarms of all devices.
The time range in which the user determines the statistics. The dialog box of the statistics list first initializes the query time range of the time control. In order to avoid unnecessary misoperations during the selection process, the scope of the time control is set.
When the statistic type and time range are determined, the client starts to receive the alarm information data sent from the server, and then fills the alarm information data one by one into the alarm statistic list.

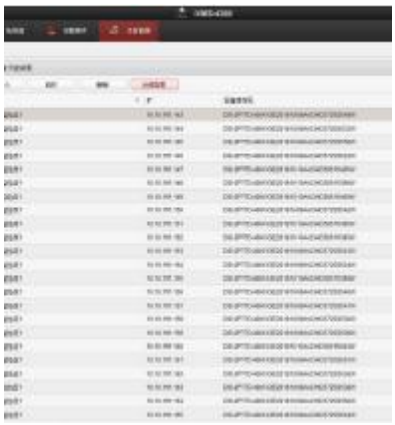

**Figure 3. Query result display**

In order to highlight the importance of the alarm information, when the system receives the alarm information sent by the lower computer device, the client immediately issues an alarm voice prompt to the user. The client receives the alarm information sent by the server, fills this record to the forefront of the alarm

list, and records the type of the alarm information and the specific time of triggering the alarm information.

## 4. Summary

The engineering machinery remote monitoring system can monitor the working parameters, operating status, alarm information and fault information of the field equipment in real time, and can issue commands to remotely control the engineering machinery equipment, and can also perform fault diagnosis and data statistics to provide users with Smart service. The whole system is developed based on mature software and hardware technology. It has entered the trial operation stage and has a good running condition, which has achieved the expected goal as a whole. The remote monitoring system of large-scale construction machinery and equipment as an extension of the functions of engineering machinery equipment is of great significance for the subsequent maintenance and equipment management of engineering machinery equipment.

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## References

[1] Yang Yang, Chen Jin, Zhang Jie. Design of Remote Monitoring System for Engineering Machinery based on GPRS. Industrial Instrumentation Automation. 2014, (4).

[2] Zhang Bin. The Remote Monitoring System of Construction Machinery Based on GPRS/GIS. Hunan University. 2015.

[3] Wu Weiguo. Research on Remote Monitoring System for Construction Machinery. Construction Machinery and Equipment. 2007, (5).

[4] Wan Qing. Remote Monitoring System for Construction Machinery. Hubei University. 2013.

[5] Li Yuhe. Design of a Remote Monitoring System for Construction Machinery. Construction Machinery and Equipment. 2007, (4).

[6] http://www.chyxx.com/industry/201606/426395.html

[7] Huang Lugao. Research & Development about Management System for Construction Machinery"s Remote Monitoring. Shanghai Jiao Tong University. 2008.

[8] http://www.sohu.com/a/215421254_661286

[9] Peng Xi. Study on Remote Monitoring System for Construction Machinery based on Big Data. Internet of Things Technologies. 2014, (01).

[10] Long Tan. A Remote & Wireless Data Acquisition and Monitoring Systemin Engineering Machinery. Mechanical Science and Technology for Aerospace Engineering. 2011, (3).