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Exploration of intelligent monitoring technology for the operation status of large port loading and unloading machinery equipment

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Abstract

This article takes the large-scale loading and unloading machinery equipment and intelligent monitoring technology in ports as the research This article takes the large-scale loading and unloading machinery equipment and intelligent monitoring technology in ports as the research object, with the goal of rational use of intelligent detection technology. It conducts research from two dimensions of intelligent monitoring technology content and implementation, and elaborates on five technologies: Internet of Things, BP neural network, signal acquisition, data It conducts research from two dimensions of intelligent monitoring technology content and implementation and elaborates on five technologies: Internet of Things, BP neural network, signal acquisition, data transmission, and data processing; Based on the example exploration method and focusing on the operation status of equipment and actual monitoring Based on the example exploration method and focusing on the operation status of equipment and actual monitoring needs, the system development is completed using intelligent monitoring technology. The system structure and software composition are discussed. Finally, through testing and verification, the system can eliminate blind spots in equipment monitoring, realize the value of intelligent monitoring technology, and effectively improve the operability of the system. technology, and effectively improve the operability of intelligent monitoring technology for the operation status of large port loading and unloading machinery equipment. The system can eliminate blind spots in equipment monitoring, realize the value of intelligent monitoring technology, and effectively improve the operability of intelligent monitoring technology for the operation status of large port loading and unloading machinery equipment.

Keywords: Port; Large scale loading and unloading machinery and equipment; Operating status; Intelligent monitoring technology

1. Introduction

Large mechanical equipment is the "heart" of port handling production. With the booming development of China's port business, loading and unloading machinery and equipment towards digitalization, automation, high efficiency, large-scale direction of development, the operation state is more complex, although the intelligent monitoring means have long been used, but due to the problems in the operation of the intelligent monitoring technology can be operated at a low level, resulting in a limited effect. In order to ensure the reliable operation of the equipment, it is also necessary to combine the actual monitoring needs and the operation of the loading and unloading equipment, the development of a high degree of adaptability of the intelligent monitoring system, to realize the advantages and functions of intelligent monitoring technology. In this regard, this paper explores how to use intelligent monitoring technology to monitor the operation status of large-scale port handling equipment from the practical application level.

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2. Port large-scale loading and unloading machinery and equipment operation state intelligent monitoring technology content analysis

2.1. Internet of Things (IoT) technology

At present, the country is focusing on building smart ports and generally realizing the application of the Internet of Things (IoT). In the Internet of things through the Internet will be loading and unloading machinery, cargo and other physical objects and virtual network connection, realize the information on the interconnection and interoperability, can real-time monitoring port large-scale loading and unloading machinery and equipment. The use of the Internet of things to carry out monitoring can implement the man-machine-to-man coordinated control mode, to ensure fully automatic collection and storage, endless transmission of data, so that the monitoring personnel to obtain accurate results of the fixed inspection, time and content.

2.2. BP neural network

BP neural network grasps the operating state data of large loading and unloading machinery and equipment, learns the laws and rules therein, and outputs the results closest to the desired output value. The use of BP neural network can accurately assess the equipment operation problems, the use of the process of using its key, output, implied three functions, to complete the learning and training, neuronal cell measurement, deviation analysis, and automatically output the regulation of the management rights and thresholds[1] . Based on daily continuous learning, measuring the average deviation of equipment operation, checking the accuracy, evaluating the optimal control shift caused by the state of the equipment in the work, accurately judging the shortcomings during the operation, and improving the accuracy of the inspection.

2.3. Signal Acquisition Technology

Port large-scale loading and unloading machinery and equipment monitoring is a long-term, uninterrupted work, the need to always understand the operation of the equipment, diagnosis of faults, the monitoring results and the detailed operating parameters of the equipment summary, the overall situation of the equipment to make a judgment, the process of signal acquisition. Port commonly used acquisition technology has the following forms: one-time acquisition, according to the real needs of a one-time acquisition of a sufficient number of relevant data and information; fault signal acquisition, tracking the collection of equipment operation, the ability to continue to collect all the signals of the equipment operation, the main identification of fault signals, abnormal signals; automatic, random sampling technology, the collection of signals that change when the equipment fails or according to the fixed operating cycle of mechanical equipment Timed collection of signals.

2.4. Data transmission technology

Port loading and unloading equipment operation generates massive data, in order to ensure that the application of intelligent monitoring technology to meet the needs of port large-scale loading and unloading machinery and equipment efficient positioning, tracking, monitoring, the use of big data transmission technology to support the realization of efficient, reliable and safe transmission program. Big data transmission can use parallel transmission, compressed transmission, acceleration algorithms, improve transmission efficiency, and automatically increase security measures for the network layer, transmission layer, application layer, improve transmission reliability. Combined with fiber optic network and Internet of Things, it can reduce the impact on data quality and transmit equipment operation data to port data center in real time.

2.5. Data processing technology

Data processing technology refers to the processing center to receive the transmission of data, the state of the equipment signal analysis, different types of signals have different processing methods, often using cloud computing technology for real-time processing for subsequent data analysis, data mining, optimization of the monitoring program to provide a data base.

3. Port large-scale handling machinery and equipment running state intelligent monitoring technology realization scheme

3.1. Overview of examples

A port consists of resource-specific output port, dry bulk port, production berths more than 50, the maximum can receive and discharge 150,000 tons of ships, the port large-scale loading and unloading machinery and equipment types, mostly in continuous operation, want to use intelligent monitoring technology to monitor and detect the fixed loading and unloading equipment, mobile loading and unloading equipment, the equipment oil situation. As expected, the fixed equipment monitoring adopts B/S, C/S technology, combined with virtual simulation technology, network technology, data processing technology, etc. to form a stable system, comprehensively monitor the main function of all devices of the equipment, real-time monitoring of the subsystems of the transmission of the lifting capacity, limit switches, motor current data, and it should be able to accurately determine the location of the fault, combined with the information in the database to analyze circuit diagrams problems. Find a solution to the fault, automatically analyze the cause of the fault, and form a fault report[2] .

Mobile equipment monitoring needs to rely on the GPS terminal system to realize, the equipment operation will be transmitted to the terminal, so that the monitoring personnel to master the equipment location, speed, engine status and other data, should be done all-weather monitoring; and need to connect the system with the loading and unloading of machinery and equipment communication interface, monitoring the operation of the equipment to ensure that the occurrence of faults, can grasp the form of the fault, type, severity of the information.

Oil monitoring system needs to grasp the physical and chemical properties of the oil, determine the lubrication status of the device, in order to prevent failures; monitoring of oil grinding problems, without disassembling the components of the equipment under the premise of judging the engine, reducer and other lubricating components of the oil system in the absence of particles; in addition, we must consider the oil monitoring of a large number of text, pictures of data generated by the impact on the monitoring system operating efficiency, to ensure that the system can meet the daily monitoring The system should be able to meet the daily monitoring requirements.

Based on the above monitoring needs, a comprehensive data collection platform for multiple concurrency and high heterogeneity should be developed to remotely collect the operating conditions of key large-scale loading and unloading machinery and equipment in ports in real time and automatically summarize and analyze them.

3.2. The basic structure of large-scale loading and unloading machinery and equipment running state intelligent monitoring system

According to the results of port monitoring demand analysis, it is determined that the intelligent monitoring system consists of the following levels: the data acquisition layer is equipped with wireless transmission device and time accumulator to collect real-time operational data during the operation of equipment; the network transmission layer is equipped with 5G/GPRS fiber-optic network with the main function of transmitting data; the system application layer is responsible for the integration of classified maintenance content details, storage and analysis of the maintenance equipment ledger and plan, and the summary of equipment The system application layer is responsible for integrating the details of classified maintenance contents, storing and analyzing maintenance equipment ledgers and plans, summarizing equipment warranty records, and mastering detailed information of warranty, maintenance and time accumulator; the terminal system application layer masters the real-time information of equipment operation status through the wireless transmission device and time accumulator, and obtains the equipment positioning information based on the 5G/GPRS technology, which can be displayed on the Web terminal and mobile terminal, and supports the management of terminals[3] . The massive data storage in monitoring relies on MsSQL database server, forming a data storage layer with permanent storage and efficient management functions.

3.3. Large-scale loading and unloading machinery and equipment running state intelligent monitoring system software realization

3.3.1. Planned maintenance of equipment records

The system is a typical parent-child hierarchical structure, which establishes a dictionary tree of the corresponding path of data acquisition, allowing unified management and query records. First add the equipment, select the corresponding type, obtain the information through the data acquisition path, click on the scheduled maintenance can view the details of the information, and jump to the details of the maintenance information page, to provide the specific need for equipment maintenance time, content and other information.

3.3.2. Classification maintenance details

The monitoring system collects fixed, mobile loading and unloading equipment and oil and fluid system operation, and also displays the maintenance of each type of equipment in a categorized manner, clicking on the categorized items can summarize the maintenance data information of a certain type of equipment at the same time, and clicking on any of the equipment, you can jump to the details page, displaying the maintenance of the components, and displaying the component situation information in chronological order, and clicking on the page of new, modified can rectify the component information. Click Add or Modify on the page to rectify the component information. Next to the name of each component, click to enter another detail page, presenting maintenance inspection items, inspection methods and other information, and also set up a new function, you can add maintenance component type information, each category of component maintenance part information[4] .

3.3.3. Detailed information of the accumulator

Located in the data acquisition layer of the monitoring system, the totalizer is an important device responsible for collecting data, which can scan the loading and unloading equipment in the responsible range to obtain detailed information about the equipment and transmit the data to the server side by relying on the wireless transmission tool. It should be added to the monitoring system and a detail information page should be added, which can be clicked to get the real-time running status information of the totalizer and display the running time category of the totalizer under different dates.

3.3.4. Equipment maintenance request function

Intelligent monitoring system based on BP neural network analyzes the equipment update and maintenance needs, you can apply for updating and maintenance, this kind of maintenance and updating is a non-scheduled matter, you need to fill in the application form. Click New on the corresponding page, a new maintenance application form will appear, fill in the maintenance department, the name of the equipment, the type of failure and the basic information about the equipment, the maintenance order is generated.

3.3.5. Maintenance of equipment and its dispatch

After generating the maintenance order, the system will automatically start the function of selecting and dispatching workers to the maintenance department to dispatch the order, and after determining the maintenance personnel, it will establish the connection between the maintenance order and the information of the maintenance personnel, and send the content of the maintenance order to the maintenance personnel, and their Web terminals or mobile terminals will receive the text alert information, and they will be able to understand the details of the maintenance order by clicking on the view details, and will ask the maintenance personnel to complete the maintenance and the repair in the time specified by the maintenance order. update work within the time specified in the maintenance order. The system will automatically generate the dispatch records, each record has a single number column of equipment maintenance, should be consistent with the maintenance order, completed by the maintenance personnel to fill in the dispatch order, the system will automatically backfill the corresponding maintenance equipment name, to avoid information asymmetry.

3.3.6. Maintenance of equipment and its records

The system also automatically collects equipment maintenance data, monitors the maintenance process, and provides feedback on the changes in the equipment after repair. In order to avoid missing key information, the system will automatically collect and save the details of the equipment maintenance information, but there are also many details of the maintenance information, such as the site conditions, need to be filled in by the maintenance staff after the repair by clicking on the Add button to describe the text, pictures and other forms of description. Equipment maintenance and its process record content is also used for maintenance effect assessment, the system has a permission control function, allowing only those who have the authority to start the assessment function, view the maintenance process information, click on the "Maintenance Results Assessment", the assessment of the contents of the prompts can not be assessed twice, not assessed will appear in the input box, click on the results of the assessment to save, the assessment can be exited from the system after completion. Click on the evaluation result to save it and then exit the system after the evaluation.

3.4. Intelligent monitoring system performance test of large-scale loading and unloading machinery and equipment operation state

Determine the hardware facilities, the realization of the monitoring system software features at the same time, but also on the overall performance of the system to test, to determine whether the system monitoring effect to meet the expected demand. The test consists of two elements:

3.4.1. Sensor Acquisition Data Performance Testing

The accuracy test of sensor data acquisition is carried out in the form of real sampling, the sampling frequency is 50Hz, the sensor balance beam position is in the no-load state, and the sensor display value is adjusted to 0 before the test. after the test starts, load 1kg and the state is stable, make the balance beam hold the load for 120s, unload the weight, and after the state is stable, load 2kg, and similarly wait for the state to be stable, hold the load for 120s, and unload the weight of 2kg. Unload the weight, follow the above steps to continue loading 3kg, hold the load for 120s and count the results of the three loads, based on the theoretical value, the minimum value, the maximum value to calculate the average value, the absolute error, the relative error. The test results show that the influence of different weights on the load of the sensor balance beam is less than 3%, and the maximum relative error occurs when the load is 2kg, but it does not exceed 5%, which meets the accuracy requirements.

3.4.2. Content integrity testing of collected data

The data integrity test is not installed in the routing device, the use of the end point device and coordination device to complete. First, choose a suitable test location, which requires no metal obstacles and openness in the surrounding area. The linear distance of the device is controlled at 30m, and during the test, the transmission power is 4.5dB, the channel is 2.405GHz, the upload period is 1s, and 1000P upload packets are sent, and two sampling frequencies are set up in total, 20Hz and 50Hz, and the test is conducted five times under each adopted frequency. Finally, RSSI is used to complete the signal quality measurement, and the lower absolute value of the measurement result indicates the higher signal strength. Test results show that the sampling frequency of 20Hz when the data byte preservation is complete, the transmission did not occur in the loss of bytes, RSSI measurement average value of -51dB; sampling frequency of 50Hz when the byte loss occurs, the transmission of 61,000 data bytes of the average packet loss of 0.16%, the RSSI measurement average value of -76dB, the transmission of strain experiments are in the low-frequency band. Therefore, in the open environment, the sampling frequency of 20Hz when the integrity of the collected data to meet the measurement requirements. After two tests to verify that the intelligent monitoring system can effectively serve the equipment operation status data collection, eliminate the blind spot of equipment operation monitoring, and avoid the correct judgment of the equipment operation status due to the lack of information at the technical level.

4. Conclusion

In summary, intelligent, efficient and reliable monitoring is the basis for guaranteeing the stable operation of port large-scale loading and unloading machinery and equipment, which has a significant impact on the economic development of ports. However, improving the intelligent level of monitoring is not blindly superimposed intelligent monitoring technology, need to combine the specific monitoring needs of the equipment combination of technology, development and adaptive system to realize the value of the technology, so as to ensure that the equipment monitoring is operable, access to comprehensive, reliable equipment operation data, to protect the equipment, available to provide data support, and then provide technical support to protect the port loading and unloading production and high efficiency.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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