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Design and Implementation of Oil Separator Room Monitoring System Based on Internet of Things

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Abstract: Based on the IOT technology, the oil separator room monitoring system has been designed and implemented. In the sensing layer, the sensor with ZigBee wireless transmission function is in-charge of the collecting of the parameters around the oil separator. The serial device serves trans-coding and transmit the running data of the separators. Video surveillance system is designed and installed in the separator room in order to to achieve remote visualization management. In the network layer, ZigBee Ethernet gateway receive the information from the sensor, and send it to network switch. On the application layer, the comprehensive operation platform software of oil separator room was designed to summary, process and present the monitoring information, and to realize the man-machine visualization interface of the monitoring system of oil separator room. The system is installed on the ship, and has achieved better results. It has laid a certain practical foundation for the design of the ship engine room of the Internet of things.

Introduction

With the rapid development of automation technology,Automation equipment is used more and more widely in ships.The oil separator has already achieved automatic operation,One button start,timing slag, fault alarm, fault shutdown and other protective measure can also be achieved.Automation technology has reduced a lot work burden of the crew and improved the operation security of the machine.

So far, there are still some disadvantages.

(1)Although the unmanned oil separator room has been realized,but regular inspections are still necessary,and remote video surveillance is not possible.

(2)The engineer on duty only through the extended alarm system can determine the conditions of the oil separator,and the situation in the room can not be observed,In this way, information island formed.

(3)The monitoring and alarming system of the oil separator can only start the alarm program when the system fails,unable to predict in advance, reduce the incidence of failures.

In view of this, this article takes the XX ship's oil separator room as an example, and uses the Internet of things technology to design a comprehensive and intelligent monitoring system.

The Internet of things (IOT) is a new technological revolution developed in the past ten years. It is a technology to realize the connection between things and objects, objects and people.Through various sensing devices, it collects real-time monitoring data, and connects with the network according to the agreed protocol, and displays it remotely to achieve intelligent identification, location, tracking and monitoring of a network.

The theory of Internet of things consists of three layers:

(1)The perception layer: it has all kinds of information acquisition equipment and physical chain. Such as temperature, humidity, liquid level, pressure, flow and other information acquisition sensor.

(2)The network layer: it is mainly responsible for data transmission. Such as Ethernet, Bluetooth, WIFI and other networks.

(3)The application layer: there are all kinds of input and output control terminals. Such as alarm display program, control software and so on.

Design principles

The ship's engine room, there are four types of ALFA LAVAL EPC-50 oil separator, two sets of heavy oil distributor, two lube oil separator, in addition to two steam heating unit.In this paper, the three layer architecture is adopted as the system structure.The system components used in each layer refer to the general technical standards as far as possible. The basic design framework is shown in figure 1.

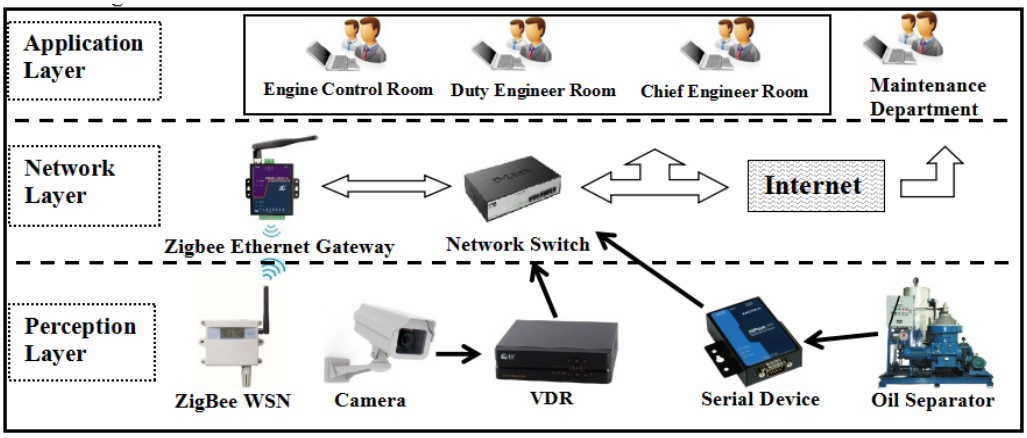

Figure 1 Design principle of monitoring system for oil distributing room

The perception layer

The sensing layer is mainly composed of signal acquisition device and signal input conversion device:

The information acquisition module

This part mainly adopts various sensors with Zigbee wireless communication.ZigBee is a local area network communication protocol based on IEEE802.15.4 standard, which is widely used in Internet of things.Its transmission energy consumption is low, in the sleep standby mode, two 5 batteries can work for a sensor node for 6-24 months.

Video signal input and conversion module

This part mainly uses the hard disk video recorder to convert the analog signals collected by the video monitoring equipment into digital signals and send them to the Ethernet.

Operation data acquisition module of oil distributor

The main principle is that the serial port server is installed on the RS-232 port reserved in the control panel of the oil separator, and the monitoring data of the oil separator is connected with the Ethernet to realize the data collection of the oil separator.

The network layer

The network layer is mainly composed of industrial grade ZigBee, Ethernet gateway and network switch.ZigBee Ethernet gateway is mainly used to receive data sent by sensors and remote control sensors, so as to realize the docking and transmission between ZigBee wireless network and Ethernet. Data collected by each sensor are collected and converted into digital signals to be sent to Ethernet.

The application layer

The application layer mainly consists of the PC terminal which is located in the centralized control room, the engine room, the engine room and the remote company depot. Based on the design of communication protocol and software operation platform, the data of each sensor node is

aggregated, managed and processed, and the call and display of each type of data in the oil engine room are realized.

The hardware design

The hardware involved in this system includes ZigBee sensor, information acquisition module, video monitoring module, operation information collection module of oil distributor and Ethernet network hardware module.With the rapid development of Internet of things technology, many technology companies can supply supporting products and provide corresponding software service support. The hardware standard of the system is selected as far as possible.

Zigbee sensors and information acquisition module

Depending on the monitoring requirements, the types of wireless sensors are configured as shown in figure 2:

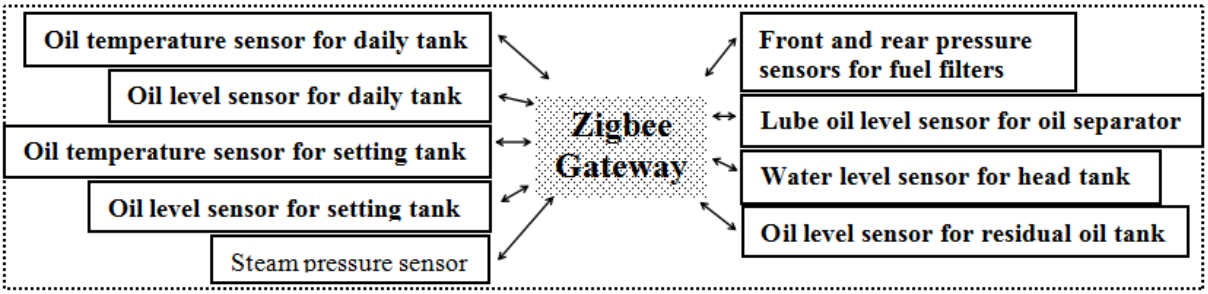

Figure 2:Wireless sensor configuration diagram

The temperature sensor

Temperature sensor select model JWB-CW2000, the sensor by 3.6V lithium battery power supply, anti-interference ability is strong, you can set the sensor points, and can automatically network. The temperature measuring range is -30 ~100℃, the measurement accuracy reaches ± 0.5℃, and the wireless transmission distance is greater than 200 meters.

The pressure sensor

The pressure sensor used in model JYB-KB-CW2000, the measuring range of the sensor can be adjusted in the range of 0~35Mpa, the measurement accuracy below 0.5 grade, measuring the medium temperature of -20℃~60℃, by the pressure pipe connection can make its range extended to -200℃~500℃.

The liquid level sensor

In order to measure the liquid level, we use the type of plug-in ZigBee level transmitter for AL208 type armoured, by the high performance silicon piezoresistive pressure sensor as the measuring element, and the liquid level height is proportional to the hydro-static pressure measurement, and the signal acquisition analog signal into ADC digital signal, then the signal is sent to the the data acquisition center through the Zigbee transmission module.

The ZigBee Ethernet Gateway

Here, we use the model for Guangzhou Zhiyuan electronics Limited by Share Ltd R & D and production of ZBNET-300C-U, the device can be achieved on the ZigBee sensor data acquisition and control, and do not need to develop two times can be quickly ZigBee Ethernet local area network access. At the same time also support all kinds of development environment, such as VC, C#, Lab, view, LINUX and so on, so as to facilitate functional expansion.

The video monitor module

The camera model is DS-2CE16F5P-IT5, with high resolution and clear and delicate image.It has more mature matching software and is easy to install.DVR uses DS-7916N-E4/16P, which supports the preview, storage and playback of 5 million pixel HD network video, and has 2 RJ45 Ethernet interface, so it is easy to realize network remote operation.

The operation information collecting module for oil distributor

We connect the serial port server with the RS-232 communication which was interface reserved on the main board of the oil distributor control board.And then, it sends the monitoring data of the oil distributor to Ethernet, and realizes the connection with the PC port through the network switch.We choose the Netcom-400L series of serial server, it embedded TCP/IP protocol stack, with a variety of configuration mode and working mode.

The Ethernet network hardware module

We use the IES-2206 Industrial Ethernet switches, the 3.3V DC power supply, can be in -20℃ to 75 ℃ within the scope of work, installation of industrial grade protective shell, can adapt to the harsh environment of the ship site requirements.

Software design

The software design of ship oil distribution room mainly refers to the interface software design of the application layer monitoring platform and the communication protocol design between the hardware modules.

Application layer monitoring platform interface software design

The main function of the computer monitoring platform is to manage the monitoring units.The data collected by the sensors in the sensing layer are transferred to the PC monitoring platform via LAN, and the monitoring platform is responsible for analyzing, storing and displaying the received data as well as the man-machine interface.

Communication protocol design

The communication protocol mainly includes perception layer, Zigbee sensor network and data conversion protocol, RS-232 port to RJ45 serial port communication protocol.Through the development kit provided by the manufacturer, we can easily convert the above data.

Test

We perform the following tests on the system as follows:

Zigbee sensor test:

Firstly, we test the temperature rise of heavy oil daily tanker and settling tanker, and find that the system reaction time is delayed by 2S, and the error range is not more than±2℃.Secondly, we increase the pressure of the steam heating box and the outlet of the settling tank, and find that the pressure sensor reacts quickly and the error is no more than ±0.02Mpa.Thirdly, we carry out liquid level experiment on sedimentation cabinet, daily use cabinet, high water tank, residuum tank,and separator lube oil tank. We found that the level sensor basically meets the experimental requirements.

The running test of oil separator:

We start the test on the oil separator and find that it can realize the real-time transmission of the operation data. We deliberately set up the operation fault and found that the alarm unit is normal.

The video surveillance equipment testing:

We test the video surveillance device and find that the monitor is clear, the transmission is basically without delay, and the storage and playback function is normal.

Conclusion

The system has been tested on a ship,The duty engineer only need to operate a computer in the room, and will be able to know all operation data of the separator room.He was able to make an advance control operation, reduce the incidence of errors, and achieved very good results.Of course, There are still has some insufficient, such as the development of this stage can only be monitored on the oil separator room, can not achieve remote control, or even intelligent control.Next, we are going to perfect the remote control system and explore the intelligent control database to realize the intelligent automatic control of the oil distributing room.

References

[1]Cong Shan.Room Environment Monitoring System Based On IOT[D].Nanjing:Nanjing University of Posts and Telecommunications, 2014.

[2]Huiju Wang.Fire monitoring system based on Internet of things technology[D].Suzhou:Soochow University,2012.

[3]Tao Hai,Hu Tao,BoLin ,Zhaoyong Li,Qianyi Song.Design of an intelligence system base on Internet of things[J].Experimental Technology and Management,2013,30(7):103-108.