Analysis of Aquaculture System based on Internet of Things Technology

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Abstract: This paper designs a set of aquaculture intelligent management system, which integrates IoT technology and aquaculture technology, and collects information on dissolved oxygen, pH and water temperature through sensors distributed throughout the pond. The signal is amplified and conditioned and uploaded to the main controller via ZigBee wireless communication technology. The main controller of the system is an industrial control computer. The computer system is loaded with a human-computer interaction system written in JAVA language, which leads the operation of the entire management system. After receiving the uploaded data, the received data can be displayed, stored and analyzed in real time, and the control command is given according to the calculation result, and then sent to the lower computer (PLC) via the wireless communication system, and the lower computer controls the corresponding the ground equipment moves to complete the adjustment of the water quality factor and achieve the purpose of intelligent management.

1. Introduction

With the continuous expansion of the demand for aquatic products, the domestic aquaculture industry has developed by leaps and bounds. The traditional farming methods can no longer meet the needs of the market. Informationization, intelligence and scale have become the development direction of aquaculture technology. Internet of Things technology is a revolution in the development of information technology. It connects all the items to the Internet and realizes the technology of intelligent identification management. Domestic Internet of Things technology has been listed as one of the five emerging strategic industries in the country, and is widely used in industrial production, smart home and transportation industries. In this study, IoT technology is applied to aquaculture. The dissolved oxygen, pH and water temperature of each pool are collected by sensing devices distributed in the water. The data collected by ZigBee wireless communication is used to receive the data. After the data, the prepared human-computer interaction system displays, stores and analyzes the received information data in real time, and runs the control program to give the corresponding control commands, and sends the control commands to the host computer PLC, which controls the pool. Adjust the action of the device and finally achieve the purpose of automatic operation. At the same time, in order to achieve portable management, the corresponding mobile app server was also developed. The results show that the system can easily and efficiently adjust the water quality factors to achieve the design goals.

2. System hardware structure

The data acquisition module is mainly responsible for collecting various water quality parameters (water temperature, dissolved oxygen and pH). The hardware design of the front-end acquisition module is shown in Figure 3. First, the signals collected by each sensor device are converted into stable analog signals by the conditioning circuit, then converted into digital signals through analog-to-digital conversion, transmitted data through the serial port and ZigBee, and finally transmitted to the server through wireless communication technology. .

The core of the data acquisition module is the sensor, and the accurate acquisition capability is the basis for the effective operation of the entire system. Because it is soaked in water for a long time, the sensor is easy to adhere to impurities in the water, which affects the accuracy of the

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collection and damages the service life of the sensor. Therefore, the sensor is equipped with a corresponding protective device. The device mainly has two functions of transmission and flushing, and realizes the function of automatic water discharge and water inlet of the sensor probe by controlling the positive and negative rotation of the motor; controlling the electromagnetic valve to complete the function of washing and moisturizing.

The front-end execution module mainly receives the control commands and data given by the host computer by the ZigBee module, and then sends it to the PLC through the serial port RS232. The PLC runs the control program, controls the action of the front-end device, executes relevant commands, and reaches the control purpose. The coordinator module is the backbone of the entire system. It not only uploads the received front-end data to the server, but also sends the control commands given by the server to the lower-level PLC. The ZigBee module is connected to the server via the RS232 serial port and transmits data using the Modbus protocol.

The research aquaculture intelligent management system uses ZigBee technology to build a wireless communication system. In the communication system, ZigBee adopts a star topology configuration network, and the sensor end, the host computer and the front end actuator connected to the ZigBee module are used as ZigBee nodes in the topology. The wireless communication system is shown in Figure 6. Sensors such as temperature, dissolved oxygen and pH, and the front controller PLC are used as terminal devices in the ZigBee network, and the server acts as a coordinator. In the system, the upper computer transmits information through the ZigBee wireless communication system and each sensor, receives and displays the data collected and transmitted by each sensor in real time, and sends instructions to the PLC through the ZigBee wireless communication system, and reads the PLC to send to the upper computer about the working status of each device. The information is displayed on the display unit.

3. System software structure

The system software is mainly composed of the upper computer software and the lower computer software. The lower computer software has been solidified in the PLC program memory. After receiving the data and instructions of the upper computer, the corresponding front-end equipment is controlled to adjust the water quality factor. Figure 7 shows the fish pond real-time monitoring platform, which can be divided into five modules: 1 real-time display module for dissolved oxygen, water temperature and pH of fish pond; 2 system parameter setting and alarm module; 3 switching module for operation mode; 4 device status Display and manual control module; 5 lift (sensor protection module) timing settings. First, the host computer sends a query for the water quality parameter to the collection end of a fish pond. After receiving the correct information, the system first determines whether the water quality parameter sampling data is within the upper and lower limits set by the system. If it is out of range, it is judged to be abnormal. If the dissolved oxygen (DO) is 9.5 mg / L, it exceeds the upper limit set by the system, its status is abnormal, and a warning is issued to remind the user; if the data is normal, the system will dissolve oxygen. The information on pH and water temperature is displayed on the interface in real time. The operation mode of the system is divided into automatic and manual. If the system works in the automatic state, the system will analyze and calculate according to the received information and the set control parameters, and give the control command; if the system works in the manual state, it will wait for the manual. When the control command is issued, it is generally only switched to the manual operation state in special cases such as an alarm. Normally, the system works in the automatic running state, and when it is in the automatic state, the feeding machine and the lifting machine work regularly. As shown in the figure, “Area 5” is to set the lifting time of the elevator. At the end of the time, the sensor is pulled out of the water surface (input Rinse and wash in water).

The system test is divided into two steps: online monitoring system testing and online control testing. The online monitoring system mainly completes the monitoring of water quality parameters, and the online control completes the adjustment of water quality parameters based on the collected water quality parameter information. The online monitoring system completes the water quality parameter collection, data uploading and real-time display function of the upper computer, and is

mainly composed of a water quality parameter acquisition system, a wireless communication system and a host computer human-computer interaction system. The water quality parameter acquisition system mainly completes the collection of dissolved oxygen, water temperature and pH. The system has its own liquid crystal display function at the information collection end. Accurate water quality parameter collection is the basis for efficient operation of the system. In order to ensure the correctness of the collected data, this study will compare the information collected by the acquisition system with the reference data; in order to ensure the accuracy of the dissolved oxygen sampling signal, this study will compare it with the imported high-precision dissolved oxygen measuring instrument (reference sensor The sampling results are compared; in order to test the stability of the communication system and the host computer human-computer interaction system, the data displayed in real time by the upper computer monitoring interface is also compared with the former two. The test procedure is to first insert the dissolved oxygen sensor probe and the reference sensor probe into the water in the same area, and then collect and compare the two within one hour, and record every 10 minutes.

Comparing the readings of the dissolved oxygen sensor with the reference readings, the readings of the two are basically the same, the maximum error is 0.1 mg / L, and the control accuracy can be met within the allowable error. At the same time, the upper computer reading and the sensor reading are completely consistent, indicating that the wireless communication system and the host computer human-computer interaction system work stably and reliably, and the entire monitoring system can complete the water quality parameter collection and display tasks in real time, accurately and stably. The online control test is mainly that the upper computer calculates and analyzes the collected water quality information through the control algorithm, and forms a control command and sends it to the PLC. The PLC controls the front-end equipment to achieve the purpose of adjusting the water quality parameters. In this paper, the dissolved oxygen is taken as an example for field testing. The test object is a water aquaculture extension station in Jiangmen. There are 2 large ponds and 4 small ponds in the aquaculture site. The fish cultured in the fish ponds are Bangui and Koi, which have higher requirements for dissolved oxygen, generally 5 Above mg / L, the optimum value is 6 mg / L. The set reference value of the system is 6 mg / L, and the test time is 24 h. Table 2 shows the dissolved oxygen data obtained by the test.

4. Conclusion

This research applies the Internet of Things technology to the aquaculture industry and develops a complete set of aquaculture intelligent management system. The system has accurate data collection, stable data communication uploading, simple image of human-computer interaction system, convenient operation, complete functions and adaptability. Strong. The results show that the system can continuously and accurately monitor the environmental factors of the pool and realize the automation and intelligent goal of pool culture.

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