

Research on Distributed Monitoring System of Freshwater Fish Growth Environment Based on GPRS and Modbus

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Abstract

In recent years, the quality and safety events of aquatic products always affect people's nerves, and people's awareness of quality and safety of aquatic products is constantly strengthened. Through analyzing the collecting information of each link of freshwater fish, using IOT and GPRS remote transmission technology, the water temperature, PH/ORP, dissolved oxygen and other data of freshwater fish growing environment are collected into the EDA9017 module. The system is based on the Modbus protocol and sent to the data center by GPRS DTU in TCP/IP way, The data center converts the data into the corresponding PH/ORP、water temperature, dissolved oxygen and other values by unzipping the DTU package, parsing the DTU package.

1. Introduction

With the rapid development of industrialization, urbanization and the improvement of living standard, Engel's coefficient generally shows a downward trend. Consumption of cereals and tubers has been decreasing, while consumption of animal products, including aquatic products, has been increasing [1]. Over the past 30 years, world-wide production of aquaculture for food has grown by nearly 12 times, at an annual rate of 8.8 per cent. Freshwater fish dominated is 56.4 percent in 2010. The varieties of silver carp, grass carp, carp, carp and crucian carp are all in the top 10 of the world freshwater fish production, and their circulation and consumption situation have a significant impact on the circulation and consumption of world aquatic products.

However, in recent years, the quality and safety events of aquatic products always affect people's nerves, and people's awareness of quality and safety of aquatic products is constantly strengthened [2]. Therefore, it is urgent to strengthen the monitoring and management of aquatic product safety, especially aquatic product production environment.

At present, most of the aquatic production methods in China are mainly traditional aquaculture, mainly using manual operation, the manpower input is relatively large, the lack of scientific management means [3], and the degree of modernization is low, which leads to the low output value of fishery. With the development of modern fishery technology, intelligent fishery culture has become a new type of fishery culture model which breaks the disadvantages of traditional culture. Through the application of IOT technology, it can realize the data collection, intelligent analysis and processing of fishery production links [4], and achieve the goal of environmental measurable, production controllable, disaster early warning. The implementation of the project is of great practical significance.

2. System Structure Design

Based on the current use of Internet of things technology, wireless sensor network technology, communication technology and other technical means to build a freshwater fish quality information collection platform to achieve the acquisition and recording of important information on the growth environment of freshwater fish[5]. Freshwater fish growth

environment monitoring system mainly monitors the PH/ORP, water temperature, dissolved oxygen and other parameters of freshwater fish production areas. In the manufacturers, the growth environment monitoring system can easily understand and grasp the environmental conditions of freshwater fish[6], for consumers, the growth environment monitoring can not only truly see the data of freshwater fish breeding site, but also reflect the authenticity of the growth quality of freshwater fish.

The connection of freshwater fish growth environment distributed monitoring system based on GPRS and Modbus is shown in Figure 1. The system adopts distributed transmission, GPRS DTU sends and receives related control commands through GPRS network and remote data management center. The data transfer between GPRS DTU and analog data acquisition module is carried out by RS485 communication mode[7]. Analog data acquisition module and each environment sensor are connected by signal line, which connects the signals of various sensors into transmitters to the input end of the AD interface of the data acquisition module. when the whole system is actually running, the sensor transmitter generally outputs 4-20mA current or 0-5V voltage. after ITEA encryption, the sensor reading is read and converted to the actual corresponding sensor reading by Modbus protocol in the network data center. The data flow of the from top to bottom and from bottom to control according to the relevant control commands.

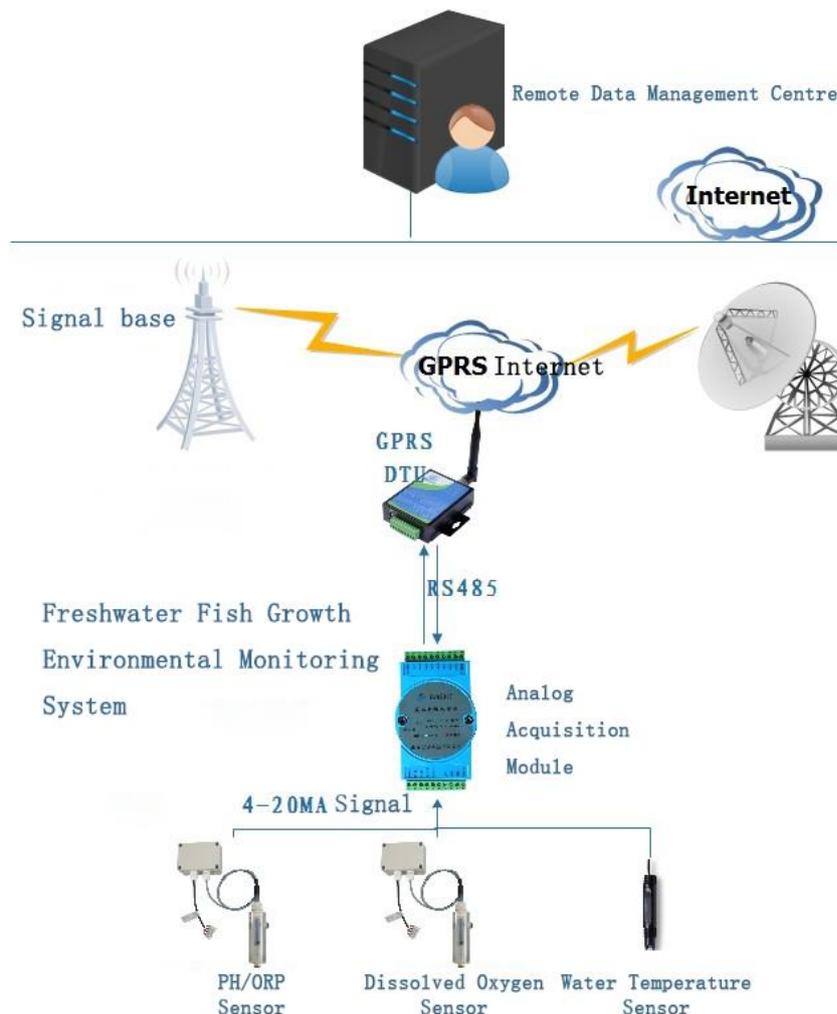


Fig 1. Architecture of Freshwater Fish Growth Environment System

The monitoring of freshwater fish growth environment is mainly composed of three parts: PH/ORP sensor and electrode, dissolved oxygen sensor, water temperature sensor and so on,

and GPRS DTU data transmission part, which is composed of transmission medium, and contract, and data processing composed of data analysis in the data center.

3. Hardware and Software Design and Data Processing

Freshwater fish growth environment monitoring system is a remote acquisition system based on GPRS wireless network. The hardware structure block diagram of the data acquisition terminal is shown in figure 3.1, and the hardware of the data acquisition terminal is modularized.

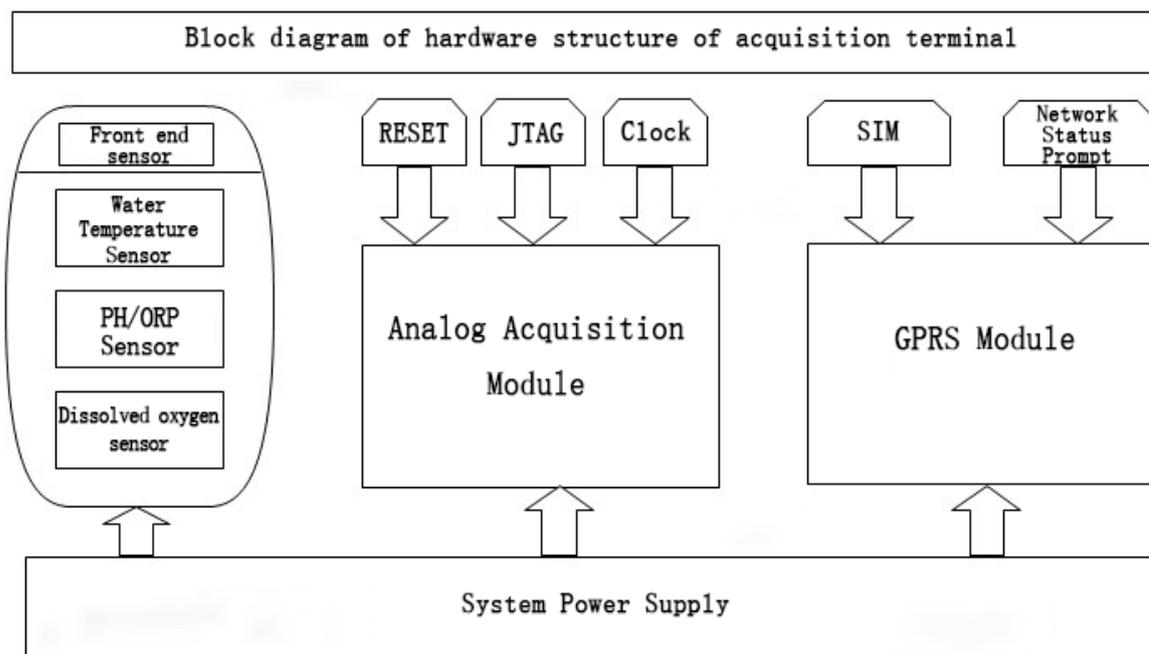


Fig 2. Structure chart of acquisition terminal hardware

3.1. Hardware Design

Freshwater fish growth environment monitoring system is mainly composed of the following four parts: data acquisition sensor, microcontroller, GPRS module, power module [8].

(1). Data acquisition sensors. There are many environmental parameters for the quality, safety and growth of freshwater fish in Dongting Lake. Physical, chemical and biological water quality parameters are generally selected when evaluating the degree of water pollution. These include: turbidity, transparency, color, smell, taste, water temperature, PH value, dissolved oxygen(DO), trace amount of harmful chemical elements, pesticide and other inorganic or organic compounds, number of Escherichia coli, bacterial content, etc. Here, three kinds of sensors are designed to collect dissolved oxygen, water temperature and PH/ORP, values in the growing environment, respectively.

(2). Microcontroller. This system adopts the eda9017 analog quantity acquisition and measurement module, the acquisition signal adopts the rs485 bus mode, the communication protocol is the Modbus-RTU protocol, controls the sensor signal acquisition[9], the reception and the GPRS module to connect the network, the data transmission.

(3).GPRS module.This system chooses LETRUE Company as the GPRS communication module, plus SIM card interface circuit, network status indicator circuit and so on. MCU connects with the LQ-8110 through serial port and performs network communication operation by sending Modbus instructions.

(4). Power module. The system needs to provide 24 v DC voltage, water temperature sensor working voltage is DC 24 v, analog input module working voltage is DC 8~30 v, GPRS DTU working voltage is DC 10-30 v.

3.2. Data Transmission

At the data transmission end of the monitoring system, GPRS communication mode is mainly used. GPRS communication has the advantages of wide coverage, convenient use, no wiring, low cost, fast transmission rate, and can connect Ethernet and Internet seamlessly. As a result, GPRS communication is widely used in wireless data communication. GPRS communication module, generally composed of GPRS module, sim card, power conversion, RS232/RS485 interface and simple control circuit, its internal generally encapsulates the PPP dial protocol and the TCP/IP protocol stack. GPRS DTU schematic block diagram is shown in figure 3.6. essentially, DTU and data processing centers establish socket connections. DTU is the socket client and the data processing center is the server side of the socket. Socket connection is divided into TCP protocol and UDP protocol, the same protocol should be used by the DTU and center, which is generally configured with configuration software. It can be seen as a combination of microprocessor and GPRS modem. The function is to realize the transmission of serial port data on GPRS communication network and Internet, and the actual work is to convert serial port data into TCP/IP packets for transmission. To improve the integrity and stability of freshwater fish growing environment information monitoring system, reduce the design task and shorten the product research and development cycle, this design selected LETRUE LQ8110E as the communication module GPRS remote transmission. LQ8110eE provide transparent data transmission channels together with the interface equipment of the data center to form a user-specific data network. Features are: support for access to centers based on domain names and IP addresses, and support for multicenter data transfer in a fully transparent manner. Built-in watchdog with abnormal lifting. Adopt a variety of judgment and error correction mechanisms to ensure the long-term stable operation of the DTU.

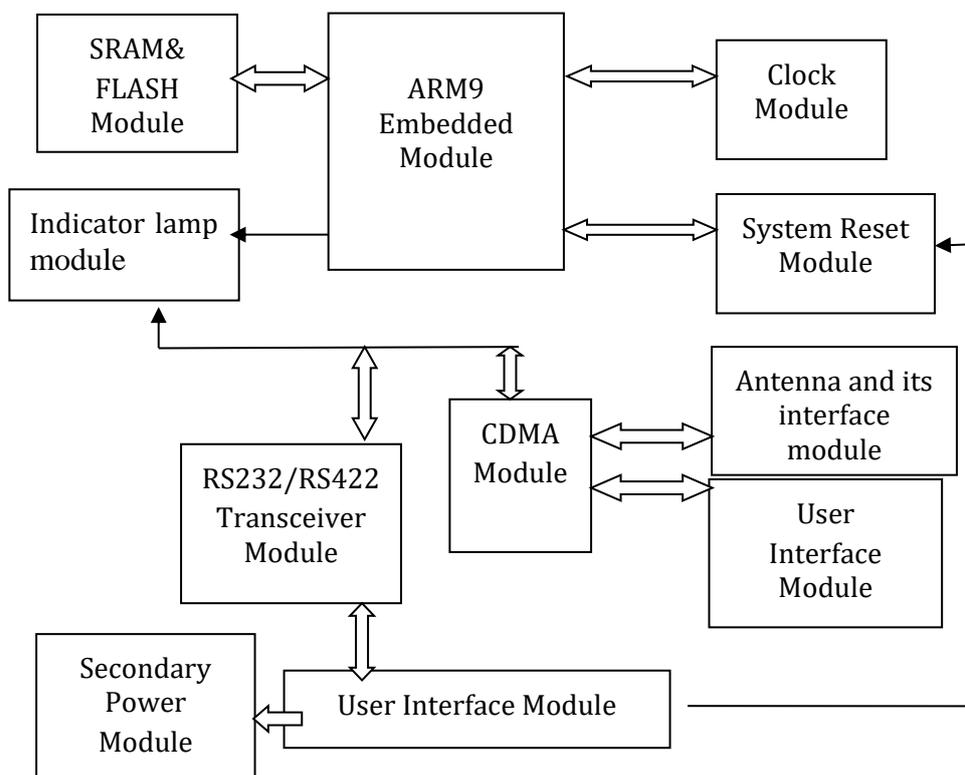


Fig 3. Schematic of GPRS DTU

The workflow of GPRS data transmission is: after the IP address (or domain name `www.nxp-nfc.com`) and port number of the center are configured to the DTU, the user equipment of the field acquisition point (PH/ORP sensor, water temperature sensor, dissolved oxygen sensor) connects the 4-20mA sensor signal to the analog input module of the field acquisition point. EDA9017 is connected to the GPRS DTU terminal through the rs232 or rs485/rs422 interface. The data sent by the user serial port device is encapsulated by the network protocol through the internal embedded processor of the GPRS DTU terminal and sent to the data center through the GPRS wireless network. The DTU is first registered to the mobile network after powering up, and then sends the request package that establishes the socket to the mobile, which sends the request to the Internet. The server-side software of the center establishes the connection after receiving the request and sends the reply information.

The growth environment data center mainly processes and displays the information of PH/OPR, water temperature, dissolved oxygen and other sensors sent to the data center by GPRS packet. The system is based on the Modbus protocol and sent to the data center in a TCP/IP way. The data center converts the data into the corresponding values of PH/ORP, water temperature, dissolved oxygen and so on by unpacking the DTU package, parsing the package.

3.3. Software Design

The data acquisition system's bottom-up data transmission process: after receiving the acquisition command sent GPRS the remote data center, the analog data acquisition module will turn on the A/D conversion function, collect the data of various sensors, then package the collected information according to the specified protocol rules, transfer the packaged data packets to the gateway GPRS support node GGSN through the GPRS network, and then send the data frames to the remote data center through the internet, namely growth environment monitoring system. the device management interface after its login is shown in figure 3.8.

The data management center then parses the data and converts the sent data into the corresponding values on the web page according to the Modbus protocol. As far as this system is concerned, the Modbus protocol is set with 03 function code, using analog probe, and the register is 40001.

The analog data acquisition module sends the sensor data collected in the field to the GPRS DTU, then GPRS DTU and converts the data into a TCP/IP packet to the GPRS network, which can GPRS DTU send the TCP/IP packet to the growth environment data center through the domain name correspondence. Growth environment data center using `c#` development completed. The TCP/IP packets collected from the internet are acquired by the growth environment data center, and the collected data TCP/IP packets are restored to the collected data through the program. The monitoring center processes the data according to the established protocol data format, removes the packet header, the tail and the check bit, then extracts the sensor data and displays it on the web interface according to the predetermined data conversion.

4. Summarize

This project proposes a distributed monitoring system for freshwater fish growth environment based on GPRS and Modbus. At present, there are hundreds of species of freshwater fish products in China, and 113 species of freshwater fish in Guangdong alone. This system selects the turtle that people contact more in daily life as an example, carries on the research to the fresh water fish growth environment in Guangdong area, combines the data monitoring, the collection and the fresh water fish growth process, and through the cloud service technology, causes its each link to form a benign data closed loop of monitoring and control, can well conform to the industry development demand, has the potential huge economic benefit and the broad market prospect.

Acknowledgments

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