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Design of Monitoring System for Aquaculture Environment

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Abstract. In order to strengthen aquaculture monitoring and management, real-time to improve the breeding environment, improve farm income reduce labor intensity, proposed aquaculture environmental monitoring system for wireless networks. The system consists of sensor nodes, base stations, the main controller, routing, consisting of PC and mobile phone users. Through field testing, the system can complete the environment and the waste discharge, and display and comparison of real time data. At the same time, through the replacement of different sensors applied to different environments.

Keywords: sensor node, wireless network, monitoring, environment

1 Introduction

In recent years, with the development of large-scale farming, large-scale farming, is becoming more intensive, modern management techniques of information and automation become increasingly important. A intelligent sensing, remote control monitoring system of the bottom sensors and video surveillance equipment integrated together, will complete "comprehensive perception, wireless transmission, intelligent processing" of information management. At the same time, Users use human machine interface configuration observation of environmental information, the growth status of the animal farms anywhere and anytime. In addition, whenever unusual circumstances scene occurs, the system automatically sends an alarm message[1-2].

By various types of sensor nodes placed in breeding farms, real-time acquisition of farm's environmental parameters, wireless networking technology parameters are transmitted to human Kingview PC interface or the clouds, while the data stored in the SD card. Camera monitoring specific breeding farms, the user can actually get the field of animal growth conditions. Master chip for data analysis, processing, while controlling the venue of the controller, when the index is unreasonable to make the environment when working inside the controller parameter adjustment to a reasonable value. SMS module while the system was added, is allowing users to monitor more blossoms[3-5].

2 Hardware Design

2.1 System Structure

The system is divided into three parts: monitor control section (nodes), data transmission section (wifi), terminal control platform (PC, SMS terminal). Wireless technology will detect and control parts connected together to achieve the purpose of real-time transmission of data, and the data stored in the SD card. Kingview interface makes PC more humanly, real-time data to generate reports, web publishing, automatic alarm[6]. SMS module for remote users can be monitored and controlled via mobile terminals, real-time observation inside and precise regulation of the venue environment at any time, to achieve two-way monitoring and control services. Frame is shown in Fig.1:

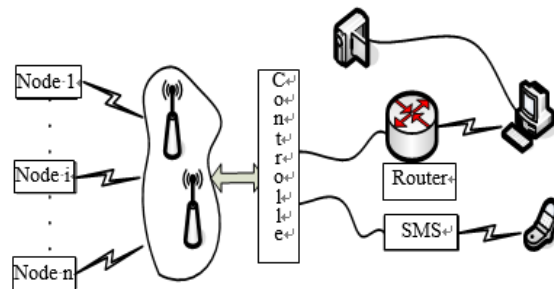


Fig. 1. System topology

2.2 Functions Achievement

- 1) The combination of control system for the farm and internet of things, and the operating mode remote Kingview interface, allows the operator to control environmental indicators breeding farms;
- 2) Record growth environment section animal breeding farms in each period to ensure the quality in farm;
- 3) realize the remote control, as long as the control system is in the same network, it can be controlled at any place worldwide;
- 4) the use of serial communication node can reduce the number of nodes, and the wireless communication between nodes and nodes;
- 5) the use of solar power each node, so that the green agriculture. Enough during the day solar energy into electrical energy for all-weather use system;
- 6) Monitoring livestock and poultry excrement, thus increasing the warning and other functions.

main module functions is shown in Fig.2:

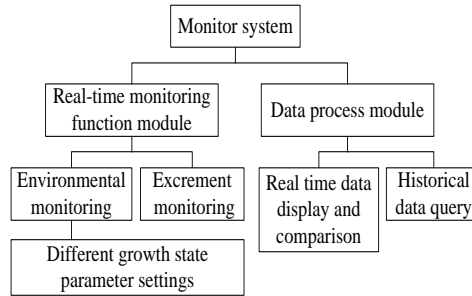


Fig. 2. Monitoring system module

2.3 Master chip

Atmega 2560 is a simple system controller chips of the minimum system. Arduino Mega is a core with ATmega2560 microcontroller board, the group itself has 54 digital I / O input / output terminal (14 PWM outputs), 16 sets of analog inputs, 4 UART (hardware serial ports), using a 16 MHz crystal oscillator. Since Atmega 2560 microcontroller chip is rich in external resources, pins and more simple. Temporarily idle pin can do the follow-up development community. Atmega 2560 smallest single-chip system includes a power supply module, MCU, download the module, reset module, the principle is shown in Fig.3:

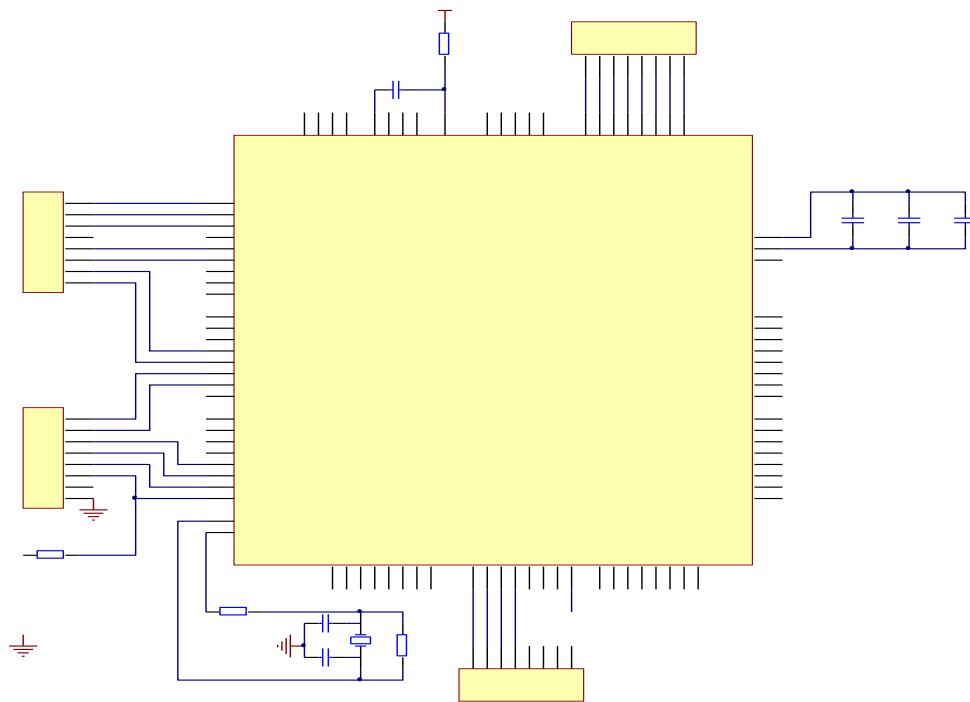


Fig. 3. Schematic of main chip

2.4 2.4G Wireless communication

2.4G Wireless module implements the data transmission between nodes. The module with low power consumption, transmission speed and other little choice wireless serial communication module, communication distance up, meets the design requirements of the system.

WLC_24L01 is a wireless transceiver module based on the Nordic Semiconductor of Nrf24L01. The module integrates all RF related functions and devices, users need only a simple configuration registers through the SPI interface, which can realize communication, reducing the user of the wireless product development cycle. Fig.4 is the interface circuit between the module and MCU.

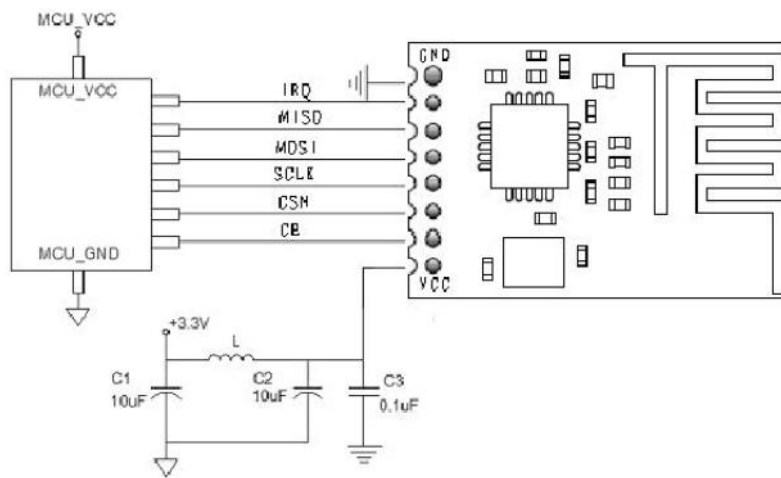


Fig. 4. Interface circuit

2.5 Sensor nodes

According to the detection system environment, different sensors may be suitably selected nodes, such as temperature sensors, humidity sensors, light sensors, ammonia sensors, CO₂ sensors, H₂S sensors. Wireless sensor node system block diagram[7-8] is shown in Fig.5.

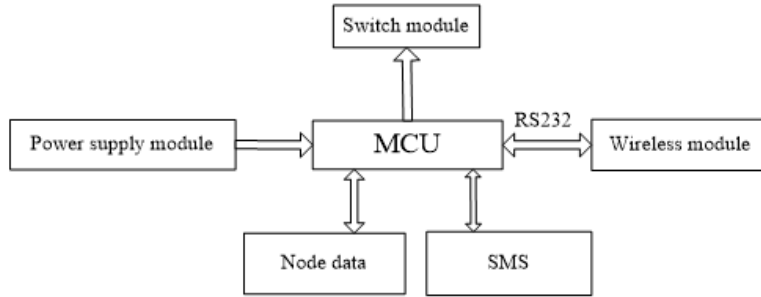


Fig. 5. Block diagram of wireless sensor node

3 Software Design

3.1 Serial to Ethernet configuration

By entering RM04 configuration interface: work mode selection Serial to Ethernet, network protocol select TCP server, remote IP does not work as a server, the server to open port TCP listening port serial parameters set here according to the needs of our users set the baud rate 9600, 8 data bits, parity bit NONE, 1 stop bit. We do not enable network parameters DHCP configured static IP: 196.168.11.254, submit configured so that Ethernet has been constructed[9].

Open Configuration software, create a new project in the "Device" option, select the communications port (free to choose a serial number as long as the actual serial interface and can not), and communication (MODBUS (Ethernet via the "Device Configuration Wizard" NIC)). Then enter the port address 196.168.11.254, it should be noted that if the virtual IP Ethernet module and PC must be in the same LAN, if the WAN must be fixed IP. New data variables, the same variables and attributes required to address the corresponding element. Communication in the picture elements and data dictionary variable corresponds to good when using different devices and data variables whenever a different port mappings on the line.

3.2 System Algorithms

The system uses incremental PID algorithm. Read node data back to the data processing whether the comparison satisfies a predetermined value, if it satisfies the use of PID algorithm for automatic control, the controller compares the acquisition value and the setting value and issue the command, and then sent to the node allows the controller work . The principle is the following formula(1):

$$\begin{aligned} \Delta u(n) &= u(n) - u(n-1) \\ &= K_p [e(n) - e(n-1)] + K_p \frac{T}{T_i} e(n) + K_p \frac{T_D}{T} [e(n) - 2e(n-1) + e(n-2)] \end{aligned} \quad (1)$$

Algorithm process is shown in Fig.6:

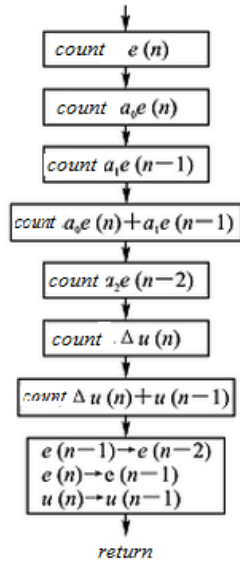


Fig. 6. Algorithm process

4 Results and Discussion

4.1 Test Results

In the system debugging process we determined the drinking water tank, light intensity, the concentration of ammonia, carbon dioxide concentration, room temperature, the solution temperature. The following data is testing laboratory simulation data made by the various indicators line chart: Fig.7 shows raw and spectra after pretreatment respectively.

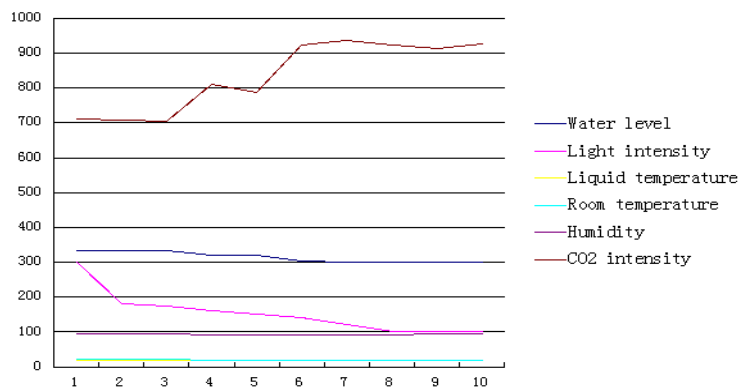


Fig. 7. Conventional and spectra after pretreatment

4.2 Discussion

In the system, monitoring device and execution unit in the entire operation of the system to achieve a friendly communication with users of wireless data transmission. At the same time, by detecting the data analysis, the system can detect changes in the environment in real time, and timely feedback to the user. Since the control system uses a PID algorithm in the software design process, so it has the following characteristics

- 1) use incremental PID control algorithm such that a given value is not mutated, but there is a certain inertia delay of slow variables, so the system has a certain adaptability and stability;
- 2) incremental algorithms do not need to accumulate, accuracy problems after the calculation error, the calculation of the amount of control less affected;
- 3) incremental algorithm is derived from the incremental control, it will not affect the overall operation of the system.

5 Conclusions

By testing system is stable, and another set of system test data, test data accurate rate of 98%, to achieve the desired results. While highlighting the control principle in control process (PID incremental control algorithm), such as: regulation, adjust the water level of light intensity and so on. The system is stable, easy to control, simple. System is small, low cost choice in favor of SMEs. The sample source of catering waste oil in the research is limited and cannot completely represent diversity and complexity of catering waste oil. In addition, the law breakers usually add catering waste oil to qualified edible vegetable oil according to a certain proportion, and then sell the fake oil, therefore, it needs to further collect representative adulterated samples in the future.

- 1) twenty-four hours of uninterrupted real-time acquisition, display various environmental parameters within breeding sites, including: light intensity, temperature, humidity, carbon dioxide concentration and ammonia concentration;
- 2) camera monitoring breeding farms circumstances;
- 3) PC interface configuration king collected real-time display of environmental parameters, making statements;
- 4) When any abnormal when an alarm, the system automatically send control commands;
- 5) automatic timing system for the phone to send environmental parameters, and you can use SMS to send control commands to the system.

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