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The Design of Intelligent Fungi Training System Based on ZigBee Technology

Ping-ping Xiao[1, a], Chao Wang[1]
[1] School of Electrical Informationline, Changchun Guanghua University, China
[a]286444752@qq.com

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Abstract. Considering the conditions of the environment for the growth of fungi, we designed the intelligent fungi training monitoring system based on ZigBee wireless communication, put forward the design idea and principle circuit for the control factors, and gave the general design plan. With ARM micro controller CC2530 as the core, the system detected the signals of sensors, such as temperature, humidity, light intensity and C02 concentration sensor, and transmitted to CC2530 for data processing. The measurement and control of the fungus culture room were realized. The correctness and feasibility of the system's principle design were verified by extensive experiments.

Introduction

The research content of intelligent fungi is very extensive in the field of environmental monitoring, involving multiple disciplines a variety of scientific theories. It integrated effectively the advanced information technology, data communication transmission technology, electronic sensor technology, electronic control technology and computer processing technology to environmental management system used of plants, established a large range, all-round function, real-time, accurate and efficient integrated monitoring and control system, and realized the intelligent control function of fungi environment.

The Overall Design Scheme

Currently the mainstream network protocols used to design have bluetooth, Zigbee, etc.. For meeting the requirements of wireless transmission stability, power consumption reduction, diversified control, the hardware design of the terminal node and the coordinator used Zigbee cc2530 as the core control chip. Zigbee wireless sensor network had the characteristics with low power consumption, low cost, distributed and self-organization.

The construction mode of the wireless network is diverse, in line with the application of different places. The main network topology structure includes the following three kinds: star network, tree cluster network, mesh network. This system design used the star network structure, and monitored the environmental factors such as temperature and humidity, the concentration of CO2, light intensity and others. Therefore, the system design included the main part: the zigbee terminal nodes, zigbee coordinator, master control system PC, handheld A8 embedded devices. Terminal nodes gathered various environmental factors for the collected fungi; The coordinator gathered all kinds of information within all terminal nodes and time-sharing gathered information transmitting to the PC; PC facilitated visual monitoring display for fungi, and environmental factors can also be artificially controlled directly to the end node; A8 embedded devices can access to PC at any time and realize remote monitoring and control through wireless network. The systematic block diagram was shown in figure 1.

Nutrition supply mainly adopts the model of artificial control. The intelligent fungi culture system involved the main technical parameters of temperature, humidity, CO2 concentration , EC of nutrient value and light intensity. The technical parameters of the intelligent fungus culture system were closely related to the external environment. When a technical parameter in the external environment met the requirements of the training room, it is not necessary to adjust the parameters in the training room. Therefore, the process control system is suitable when selecting the control system. The control system mainly adopted the process control system.

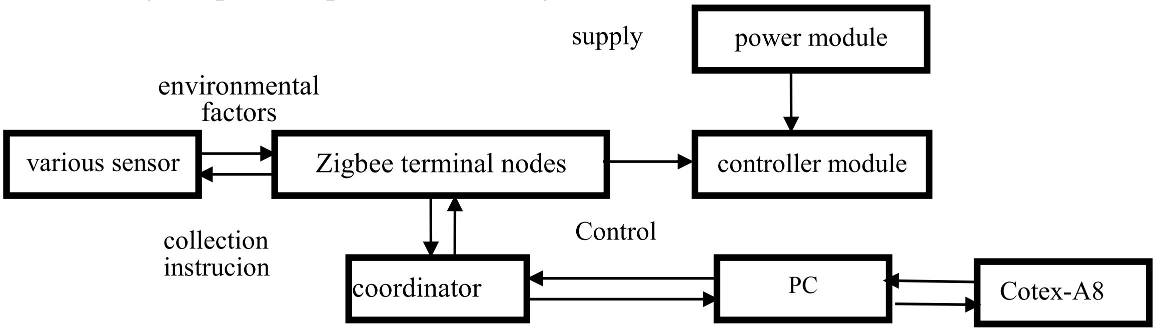

Fig.1 The systematic block diagram

The intelligent fungus culture system also included the controller, the executive device, the power supply module and so on. The controller mainly used the PLC system with the switch quantity control as the special length, and also can carry on the PID loop control of the continuous process. The actuators mainly included fan, wet curtain, motor of moving sunroof, mobile shading motor, various actuator of the heating system, and the execution component of the irrigation system. The upper computer set the configuration, connected with the controller to monitor the data in real time, collected and collated the data and changed the parameters online. The upper computer can be connected with PLC through serial port. Of course, wireless communication can also be adopted, with corresponding communication protocol. We can develop APP to wake up remote monitoring by phone and modify parameters.

Hardware design scheme of intelligent fungus system

The main control equipment of the system includes upper computer and embedded system. The upper computer made it easy to monitor the bacteria environment in real time, the embedded system was easy to carry, and the wireless communication is adopted.

DC motor drive module. This design adopted double H bridge high power drive chip. According to the current and voltage of the system, the electric current and other parameters of the motor in the start-up process, the power chip was used. At the same time, taking into account the stability of the motor in the actual operation, PWM was adopted to speed control. During the operation of the motor, the motor "crawling phenomenon" caused by the unstable signal was eliminated, which made the motor run smoothly. At the same time, it eliminated the impact caused by inertia at startup.

Soil moisture detection module. The module used the AD conversion device to convert the analog signals detected by the soil humidity sensor to the digital signal that can be identified by the single chip microcomputer, and send the signals to single chip microcomputer through the I2C bus (the Integrated Circuit). Single chip microcomputer based on signal to decided whether to irrigation. This module used the FC-28 soil moisture sensors, which used electromagnetic pulse principle to measure the apparent dielectric constant of the soil according to the electromagnetic wave propagation in a medium frequency, thus soil volumetric water content was obtained.

Power module. The power supply of the intelligent system was 15V DC and 220V AC. Sufficient voltage can be provided. At the same time, in the aspect of hardware, in order to prevent the output voltage is too high, we had adopted two voltage regulator tube at the end of the output power to ensure the voltage stability of two PWM speed regulating channels and avoide speed interference caused by power, so as to maintain the stable operation of the machine.

Roller shutter and photoelectric sensor module. When the temperature reaches the set value, the dc motor drived the roller shutter machine. At the same time, during the motion of the roller shutter machine, when the photoelectric sensor detected the motion of the roller shutter machine to the limit position, it sent a stop signal to the single chip, and the shutter machine stopped moving. When the signal was not received, the output of NPN photoelectric sensor was high level. When the external signal was collected, the output was low level.

System Test

The module adopted five ZigBee module, a ZigBee module as the coordinator (call other node to realize data collection and intelligent control node devices) and 4 child node (within the child nodes were collected fungus degrees, CO2 concentration, outsiders monitoring, fire alarm function, and include the control system for the intelligent device), as shown in figure 2.

1. The system took PC as a server with a coordinator through the USB serial port connected to the PC, and the coordinator itself through the wireless transport protocol connected to several wireless terminal node, no dead Angle of real-time monitoring indoor environmental factors to achieve real-time control and adjust the training coordinator of indoor equipment test results, as shown in figure 3.

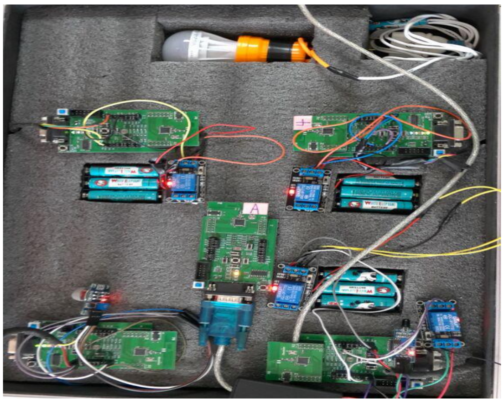

Fig. Intelligent mold control node

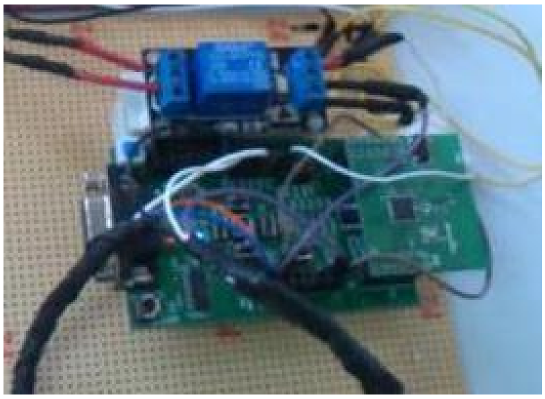

Fig. The coordinator

2. The wireless terminal node was connected to the control module, the terminal node received the control instructions of the coordinator, and the terminal node sent instructions, so that the control module operated to regulate the environmental factors in the training room.

3. The content of mobile phone display was encrypted by PC machine and transmitted to the mobile phone terminal. The decryption of mobile phone would cultivate indoor environmental factors, and displayed it on the mobile phone terminal, so as to achieve real-time monitoring and train indoor environmental factors. The test effect of the embedded main control system on the mobile phone was shown in Figure .

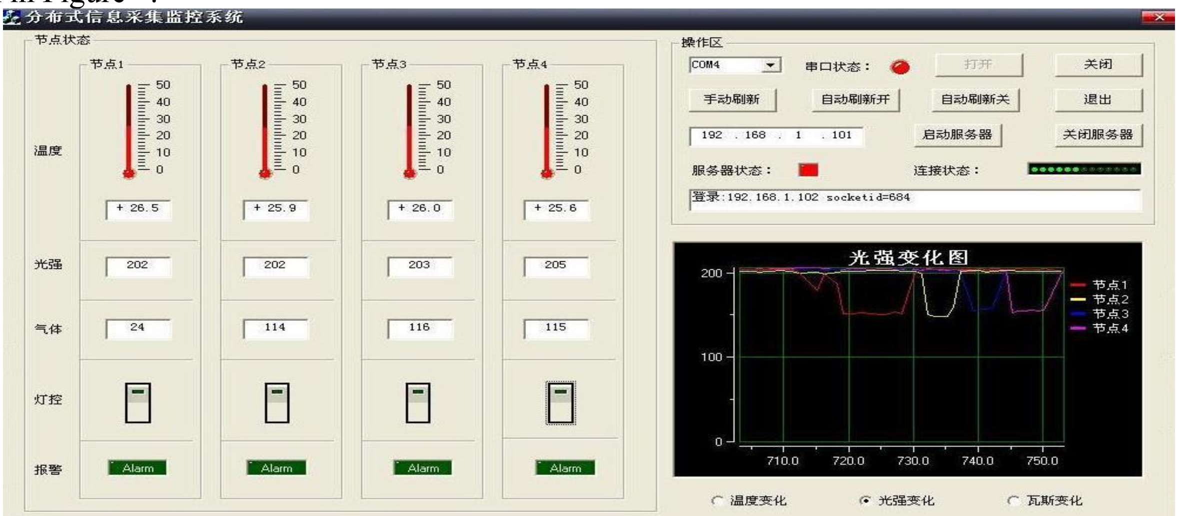

Fig. The test effect diagram of upper computer interface

4. The coordinator would develop indoor environmental factors through the USB serial line real-time transmission to the PC terminal, and the PC page showed the environment factors of indoor culture to realize the real-time monitoring of fungi culture environment. The fungus had been in a suitable growth environment. The test results of the software upper computer interface were shown in Figure 7.

Fig.8 The test results of mobile terminal interface program

Conclusion

The system developed a intelligent fungi culture system used sensor technology, serial communication technology, and micro controller technology through the step by step a cumulative. After the test, the intelligent fungi culture system could accurately monitor and control the temperature and humidity, realized the function of automatic gating and fire protection, and the working process was stable and reliable. The accuracy of indoor environment factor index of fungus was improved, and the indoor environment of fungus was monitored more precisely.

Acknowledgements

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