Application of GPRS in The Remote Monitoring of the Greenhouse

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Abstract. This paper introduces a remote monitoring system through GPRS in view of that some greenhouses are remote and scattered. The system uses ARM11 as the center of data processing, realizes the remote monitoring of environmental factors in the greenhouse. Data processing center and remote monitor terminal work in Browser/Server mode, save the spending, and improve its extensibility.

1. Instruction

In order to exploit the agricultural resources and to promote the greenhouse's efficiency, it is completely significant to apply modern computer technology and wireless communication technology to the greenhouse production. Modern greenhouses develop towards internet, intelligent and automation, while some greenhouses locate in remote geographical positions which are far away from residential area with bad communication conditions.

The growing wireless communication technology has been used in greenhouse monitoring system. Here are a few examples, he greenhouse environment monitoring system based on ZigBee, temperature, humidity, light ventilation environment intelligent control system based on ZigBee, Design of Greenhouse environment monitoring system based on the technology of ZigBee, etc. However, there is a universal problem existing among the prevalent wireless communication technology: their communication distance is too short. Zigbee, for example, just permits a 10-20 meters-long. So in this paper, the GPRS net is used in greenhouse control for its advantage in remote communication to make up the deficiency in other communication patterns.

2. System Structure

System includes three parts: user monitoring terminal, data processing center, collect and execution nodes. These nodes gather the environmental factors in greenhouse and send them to processing center, and receive the control commands. Data processing centre analysis and processing the data of the greenhouse, and sends it to the monitoring terminal through GPRS. The monitoring terminal realizes the observation and control of the factors in greenhouse. The whole structure chart of the system is shown if Fig.1.

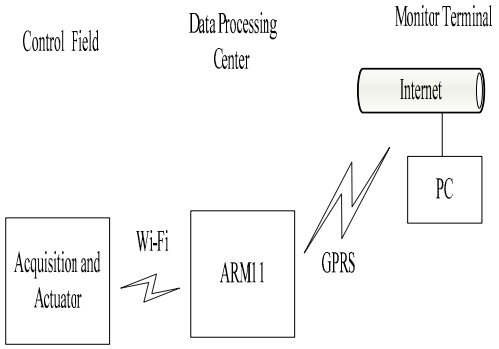


Fig.1 Whole structure chart of the system

The monitoring terminal is a computer in the laboratory, so in order to communicate with the embedded devices through GPRS, must configure it with an outside IP address. Using Dreamweaver to develop the monitoring interface, and install the Apache server and SQLite database, so the people can query the history data. Data processing center works in client mode and

monitoring terminal works in server mode, so the people can monitor multiple data processing centers.

3. System Hardware Structure

Because of the greenhouse environment is complex, when design the data processing center need to consider several aspects:

(1) Memory and processing speed. Because the data processing center needs to receive the data and the user's control instructions, the data interaction is frequent, a higher memory and processing speed is necessary.

(2) Intelligent control. Without human intervention, the center can automatic adjust the factors through the default value. Based on the two considerations, this system uses S3C6410 as MCU, and its memory is 256M, processing speed is very fast. The Hardware structure of data processing center is shown in Fig2.

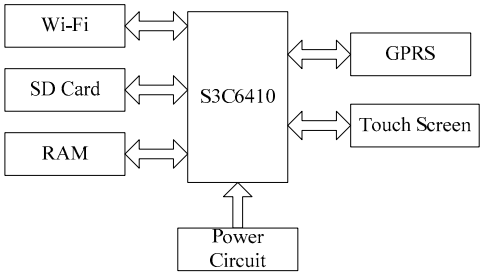


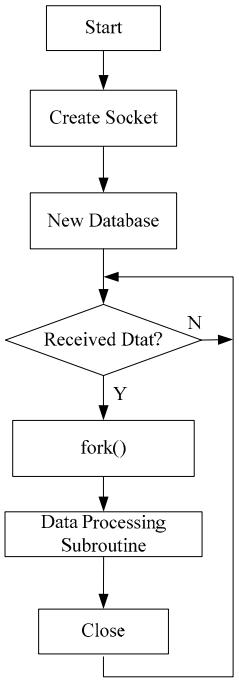
Fig.2 Hardware structure of data processing center

S3C6410 via a serial port connect a GPRS module which installed a SIM card. The GPRS mode is GTM-900C, embedded TCP/IP protocol stack, and support the AT instruction set. This module communicates with the Internet through network communication, and it interacts with the S3C6410 through a serial port. After received data, generate a serial port interrupt, S3C6410 responses the interrupt and executes the correct program.

4. System Software Design

Because the data processing center complete the main job, the next will mainly introduce the data processing center. The software design of it is mainly process the data in the greenhouse and the user commands.

In order to prevent the system blocked when calling a function, it takes process invocation mechanism. At the same time improves the maintainability of the program. The program flow chart of data processing center is shown in Fig3.



Fi.3 Program flow chart of data processing center

The processing and remote transmission of data is mainly completed by data handler program. The data processing subroutine is shown in Fig4.

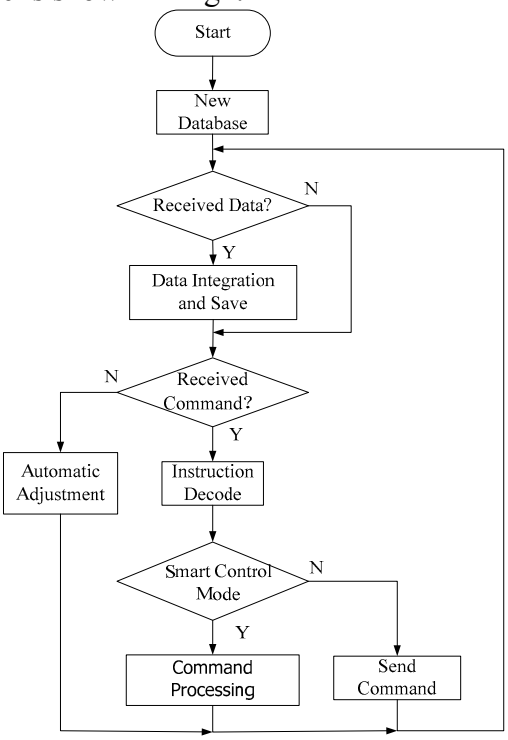


Fig.4 Data processing subroutine

It analyses the data, decodes user commands, determines the control mode, sends the correct adjustment commands.

After received the data, the data processing subroutine saves the data of each nodes in the database, and sends to the user after process it.

It should be pointed out that it must call a function to reset the data store when it receives data or sends data through GPRS module to avoid data error.

The communication between the data processing center and the remote monitor terminal mainly use TCP transport protocol and Socket communication mechanism. There are two main types of transport protocol: one is TCP protocol, and the other one is UDP protocol. UDP provides

connectionless communication, cannot guarantee that the packet is sent to the destination address. But TCP is a connection-oriented, based on the communication protocol of byte streams. For their delay characteristic, TCP is longer than the UDP. But the TCP protocol can ensure the receiving terminal receives the byte streams from the sender correctly, provide reliable communication service for the application.

In this system, in order to ensure the actuators act accurately, using the TCP protocol transmits temperature and humidity data and user control commands.

But in practical application, it always has many clients send a connection request to only one server, so this will need to use the multiplexing mechanism. A solution is using non-blocking sockets, the server check each state of the socket circularly, once there have data then receive and process it.

After call fork () function to create the child process, there are two different return values:0 and a process number. For the child process, the return value is zero; for the parent process, the return value is the child process number. It means that after create the child process, the program is executed twice: execute the child process first then execute the father process. So after the process of data processing is completed, it should close the child process in the father process, to ensure that the program execute circularly.

5. The Analysis of System Test Results

The results of data processing center is shown in Fig5.

Fig.5 Results of data processing center

In the figure is the setting value of the temperature decoded in data processing center, “35” is the setting value, ‘1’ is the identifier of the temperature data. After received commands, Data processing subroutine decodes it, and compare ‘’35” with the temperature saved in the database, then according to the result of comparison send the reduce humidity instruction ‘TC’ and raise temperature instruction ‘TO’ to every nodes.

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