

Advanced in Control Engineering and Information Science

Design of Remote Environment Control System of Intelligent Network Henhouse Based on ARM9

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Abstract

In order to improve the level of automation about the traditional small henhouses, a set of remote environment control system of intelligent network henhouse is designed by combining ARM and ZIGBEE network technology with traditional henhouse construction in this paper.

This system took the S3C2440 of ARM9 microprocessor as the core, and Linux system as development platform to realize data collection and transmission through the ZIGBEE wireless sensor network, so that culturists can remote control and monitor the facilities and indicators in the henhouse simply through broadband network, the labor intensity is greatly reduced and the working efficiency is raised

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Keywords: intelligent henhouse; embedded web gateway; ARM9, ZIGBEE; wireless sensor network

Introduction

The suitable environment can give full play to the potential egg production on layers.

enhance the resistance of layers and reduce diseases, then directly affect the production efficiency of raising layers..

Nowadays, with the rapid development of Chinese breed Poultry, there are a large number of laying hens specialized culturist in rural areas.

Due to farmers generally lack adequate fund and appropriate field, when building the henhouses, they always didn't built a new one, but reformed an old house which they had built. Most these henhouses are provided with simple facilities and the automated level is low, Lack of the ability of monitor and control the henhouse environment which severely restricted the production of eggs. Therefore, enhancing the automation and specialized level of regulating equipment's of the small henhouse were imperative.

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In order to obtain these indicators, culturists had to frequent flit in and out the henhouse. Thus the nonrefrigerated chance is increased, layers rest is influenced and it also would be against heat preservation indoor, which increases managers' workload, labor costs and decrease the management efficiency.

With the development and popularization of the embedded technology, the monitor equipments with MCU as master controller gradually appeared in some henhouses, the monitoring of indicators such as temperature and humidity was realized. But due to MCU realizing function is limited, the remote monitoring can't be realized. On the basis of the current MCU have achieved monitoring indicators, such as temperature, the ZIGBEE and WEB programming technology combined with the ARM technology in this paper. Using more advanced ARM9 controllers in the Linux development platform transplanted Web server called Boa as an embedded Gateway, and a wireless sensor network is built with ZIGBEE technology to develop a set of smart network henhouse environment control system for culturists. Users can simply remote control and monitoring the facilities and indicators in the henhouse only through broadband network.

1. The whole system solutions and function

1.1. The whole system solutions

Several small henhouses in Dongjianshan village Chanshan town Donggang city Liaoning Province China are taken as test objects in this paper. The henhouse building standards were with windows, cages. Chicken sources were all in the 19-72 week laying period HY-LINE VARIETY BROWN in Shenyang CHIA TAI LIVE STOCK CO., LTD, appropriate temperature range was needed 13 to 25 °C, relative humidity was 60-65% and also considered technology feasible, economy applicable problems. The design of smart network henhouse environment control system is based on the ARM9 S3C2440 microprocessor and embedded LINUX operating system production, on the basis of the current MCU have achieved monitoring indicators, such as temperature, focused on the ZIGBEE and WEB programming technology, combined with the ARM technology, developed wireless network to realize the remote monitoring and control.

The sensors collected data in the henhouse site, then transferred the data to the terminal system through wireless network. After the terminal processed, Computer is taken as the medium to put the real-time data to the web, at last, the users can remote control to henhouse through the web.

1.2. System function

The specific features of the intelligent network henhouse remote environment control system include: Electric control: it can control electric light to switch, timing. If henhouse had machine equipments such as dung scraper, it also can under control. Environmental information collection: it can collect henhouse environmental temperature, humidity information. Automatic alarm: when it found the henhouse environmental temperature and humidity beyond the limitation, It would automatic alarmed, and informed the culturists. Remote control: users can remote control and inquires the henhouse. through Internet

2. System hardware design

2.1. Embedded gateway circuit

Controller is the core of the embedded gateway and Microprocessor adopt samsung's ARM9 processor (S3C2440), S3C2410 is chosen as control core in this task, because S3C2440 is a high-performance 32-bit processor , its highest frequency can achieve 400MHZ and provide strong data processing ability, Meanwhile it had a complete set of general system peripherals resources, such as LCD controller, touch screen and IIS bus, SD card interface, additional components are not required which reduced the overall system cost, and provide the low prices, low power consumption, high-performance small micro-controller solutions for general type application ,at the same time , the complexity of the circuit design is reduced.

If we want to transplant Linux operating system and support required application software, we should configure the 256MB NAND Flash and 64MB SDRAM and develop the necessary interfaces such as ZIGBEE module interface and network card interface. Buzzer was used to provide alarm function.

2.2. ZIGBEE networking module circuit and sensors

ZIGBEE technology is a new type of wireless, short, low power network communication technology, which has so many technological advantages, such as low complexity, low power consumption, low cost, high efficiency and high reliability and its network coverage area is so much wide.It works in the 2.4 GHz - 2.5 GHz ISM free microwave section with strong anti-jamming and equipment contact function. It is able to identify the full realization of 1500m and the transmission rate can be up to 10M bit / s .Thus, application of the technology to solve systems remote transmission problem is the best choice.The chip called CC2430 as ZIGBEE networking module is adopted in this paper. The chip is Chipcon ‘s latest rf transceiver which complied with 2.4 CIEE administers standard integrated ZIGBEE rf, memory, and micro controller. It is together with the sensor module to make up wireless sensor network node .Sensors included temperature and humidity sensor, called SHT11,light sensor, called TSL2561

3. System software design

3.1. Software system structure

The entire system took ARM9 microprocessor as the core, which supports C language and assembly language and mixed them to program. Bottom driven is programmed by assembly language and remains C language interface to outside, human-computer interaction used Linux embedded real-time operating system. One hand to support TCP / IP protocol and can provide WEB services, so that allowed culturists through external Internet access it. On the other hand through ZIGBEE technology to build Wireless sensor network, which can real-time send and receive the data.

3.2. The software design of the embedded gateway

Embedded gateway adopted modularization design scheme , which consists of hardware driver layer, the operating system layer, network protocol layer and application layers as shown in figure 1.Hardware driver layer described ZIGBEE module driver in the gateway node ,the operating system layer

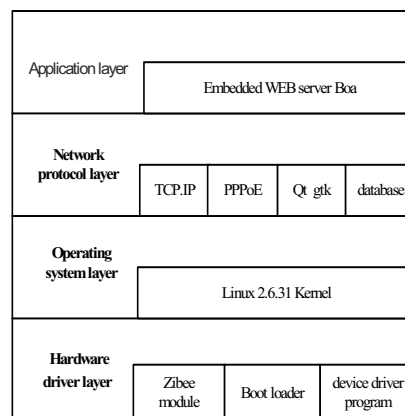


Figure 1 embedded gateway structure

transplanted ARM--- Linux real-time operating system kernel;Network protocol layer transplanted ZIGBEE protocol stack and application layer transplanted embedded Web server software called Boa on the Linux kernel.

There are three main tasks: structuring embedded system development platform, established embedded WEB server and transplanted embedded database.

3.3. Design of ZIGBEE networking software

Networking software design includes sensor data acquisition and wireless communication software. Sensor data acquisition adopts I2C protocol and wireless communication adopts ZIGBEE technology

Software design is focused on wireless communication in this paper. ZIGBEE system structure includes four layers: the physical layer (PHY), the medium access control layer (MAC), network layer (NWK) and the application layer(APL). “IEEE802.15.4”standard defines the bottom two layers: the physical layer (PHY) and the medium access control layer (MAC), ZIGBEE alliance provides the network layer(NWK) and the application layer (APL) framework design, the processor chip CC2430 chosen in this paper can achieve ZIGBEE stack architecture.

Program flow chart of the wireless sensor network shown in Figure2, procedure is initiated CC2430 firstly, after the protocol stack, Start o send signals which join the network, then wait for the primary response.If join the network successfully,The LED on the sensor nodes where temperature, humidity and light intensity data are acquired will be light and assign 16-bit network address. If failed, the LED will not be lighted.

When join the network, temperature, humidity and light intensity collection node is timing acquisition data and sent to the coordinator

Program loop calls function “SendData () ”

timing acquires temperature value, then put data packing and send to embedded gateway, at the same time to receive a response.

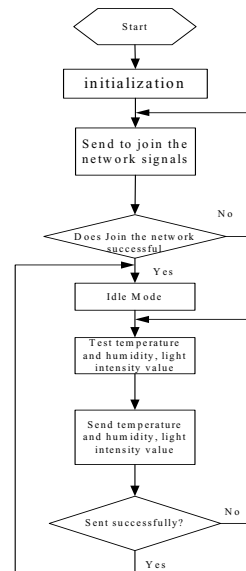


Fig.2 wireless sensor network node flow chart

4. System function test

So far, system modules are already running smoothly,Now we take a whole testing on system .When

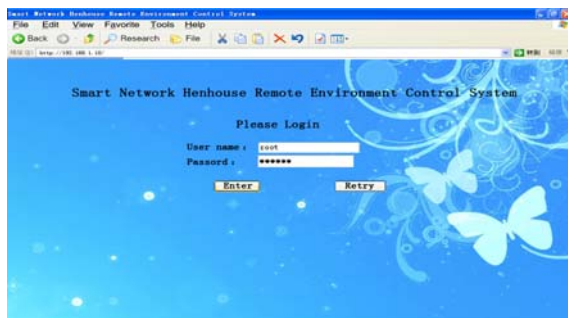


Fig.3 user login window



Fig.4 Smart Network Henhouse Remote Environment Control Systemmaster control window

culturists log in through the IP , First they will enter user verification interface, as shown in figure 3. culturists 'user name and password is stored in embedded database, Only authenticated users can smooth login system.

After Users' rights are authenticated,they can enter the system home page as shown in figure 4 below. culturists can read the contents of the home page or according to their own needs to take related operations

Through the main control interface, Culturists can see the current henhouse time, temperature, humidity and light intensity value, conveniently,and make judgment based on these values to remote control automation equipments in the henhouse.

Meanwhile, the system are also set limit to each index, when these data beyond the limit values, it would alarm to remind culturists attention. since each henhouse has different automation equipments which are not the same as system provide complete.So we should according to different henhouses to install different remote remote control device. The henhouse which Figure 7 is no dung scraper and pumping automation equipment,So we can only control the lights and tempering ventilation equipment

Conclusion

Along with our country breed Poultry have been expanding ,the intelligence and automation of the henhouse demands are higher and higher,The design of intelligent Network Henhouse Remote Environment Control System adopts powerful ARM9 processor, embedded gateway is built in Linux system, meanwhile choosing economical practical ZIGBEE technology to establish wireless sensor network.

Finally culturists can remote monitoring and control henhouse through the Internet . The test results show that system performance is stable and reliable and it can better meet the control requirements of time, temperature, humidity and light intensity values' real-time and accurate control.The study in this paper has very important significance for further study and promote of intelligent henhouse environment control technology.

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