The design of breeding district soil information wireless acquisition system

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Abstract: In order to solve backwardness information acquisition technology and cable transmission way, a breeding district soil information acquisition wireless system based on GSM/GPRS and ZIGBEE network was proposed on request of intelligent sense modern precision agriculture. The system composed of two parts which were data collection module and handheld device; data collection module consisted of End-device CC2430 and SHT11 sensor which obtained the temperature data and humidity data of the breeding district soil information. The handheld device used LPC1769 processor as core of main CPU which composed of LPC1769 core microprocessor, CC2430 coordinator, TFT_PQ2.4 touch screen, SD card as well as peripheral circuits. The main CPU (LPC1769) was the ARM Cortex-M3 core processor of NXP, the handheld device instituted by LPC1769 could collect and monitor breeding district soil environmental information using the touch screen through ZIGBEE wireless network communication way. The collected data might store in the SD card which could be searched through GSM by remote people. The hardware configuration and software implementation were detailed description in this paper.

The introduction

Food production is indispensable to mankind, China's big population base, however, due to soil degradation, arable land is shrinking. In order to improve the food production, to improve food production equipment, through the high-tech equipment for crop to get the environment information (such as soil, temperature, humidity, etc.)^[1], to improve the quality of breeding. Through the information collected, breeders to find reasons to plot yield difference, take reasonable control measures, according to the needs of the crop irrigation fertilization measures.

Agricultural environment mainly include soil information, atmospheric conditions, atmospheric temperature and humidity, the soil is the basis of crop development and growth, soil condition directly affects the growth of crops. Soil moisture test mainly contains the following categories^[2-6]:

(1) drying weighing. This method is the highest accuracy of soil moisture detection method. Use twice the weight difference before and after drying to detect soil moisture content. The method is simple in principle and high precision. But time-consuming, laborious detection speed is slow.

(2) the electrical measuring method. Principle is the use of water and some parameters of electronic components the relationship between the indirect determination of soil water content. This system USES this approach.

(3) the method of nuclear technology. The X-ray attenuation law, for example, high measuring precision, but due to the rays, radioactive, impossible job.

The system saves manpower and material resources and financial resources, but also greatly save the time of access to information.

overall system architecture

Wireless acquisition system includes: main CPU LPC1769 and peripheral circuit, TFT_PQ 2.4 color LCD screen, ZIGBEE coordinator module, ZIGBEE wireless acquisition module. This system uses the ARM CPU LPC1769, as the core of the system control chip. Using sensors for data acquisition [7], with the data transmission on the GPRS connection by LPC1769 and dial the telephone, and information feedback in the form of short messages ^[8-9]. Compared to the ^[10-11] cable transmission system, this system through the UART mode and CC2430 coordinator to communicate, CC2430 router by ZIGBEE network transmit collected data to the coordinator, finally transferred to the LPC179, soil in all parts of the community information will be stored in the SD card in the TXT file. Main chip LPC1769 will return to command, and process information by the coordinator will command back to the terminal node control pump irrigation.

LPC1976 and ZIGBEE wireless acquisition

ZIGBEE wireless network and LPC1769 through UART connection, LPC1769 by receiving ZIGBEE coordinator sent data, by the ZIGBEE network transmission ^[12] command control sensors to collect information.

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wireless network design coordinator

ZIGBEE coordinator is responsible for establishing and start in the network, the establishment of network flow chart. First system initialization, configuration ZIGBEE devices as the coordinator, chosen by the software channel, distribution, PANID, short address, set up network, receiving other nodes access request, to apply for the net node distribution in short address, send a response. Waiting for the receiving node to send data.

the design of the wireless network terminal nodes

Terminal node part is the lowest layer of the network, it is a sensor acquisition node. Soil temperature and humidity, light intensity will be collected by the terminal nodes and sent to the coordinator, again by the coordinator to LPC1769, displayed in TFT_PQ2. 4 color LCD screen. Main collection of soil temperature and humidity parameters in this system, sensor SHT11 soil parameters, the sensor's internal structure as shown in figure 1, the typical circuit is shown in figure 2.

Figure 1 SHT11 internal structure

Figure 2 data acquisition principle diagram

System initialization, manual configuration for the terminal nodes, send access request, received a request to confirm the coordinator to send, sensor nodes to join the network success, will be sent to the data collected the coordinator. ZIGBEE terminal nodes only responsible for sending and receiving data, so the terminal nodes can enter a dormant state, awakened by vibration internal crystal oscillator.

LPC1769 with GPRS SIM300 communication

Method using UART communication with SIM300 LPC1769, three-wire system, two signal lines and a common ground. SIM300 integrates the complete rf circuit and baseband processor of GSM, to provide users with a fully functional system interface. This system can be through hand-held devices to make calls, send a short message to breeders, convenient community breeding base of the selection and comparison. It's communication mainly by the AT command.

The application of TFT_PQ2. 4 and SD card

TFT module for LCD display control adopts ILI9325 chips. There are four ILI9325 bus interface: i80 MPU interface system, VSYNC interface, SPI interface, RGB interface. This system adopts i80 MPU interface, it is parallel transmission mode. ILI9325 LCD controller supports up to 256 k color, 18 or value. By adopting the working style of 8 bits of data transmission color value for each time, three times slower. In order to speed up the show, with 65 k color mode, as shown in figure 3.

Figure 3 65 k transmission mode

Touch screen adopt XPT2046 chip. LPC1769 processor through direct I/O port operation to interact with touch screen, read the touch screen information and UART serial port information. Infinite loop structure is used in the system the main function of six event query: waiting for touch screen buttons, accept UART interrupt, to process the information received, the update time, alarm information detection and data logging. Liquid crystal display is given priority to with LPC1769 control chip. the system of information task feedback on the LCD screen, the screen has nine modules function of its execution steps are shown in figure 4.

Figure 4 touchscreen program flow chart

system experimental results

LPC1769 handheld devices for breeding soil environment for on-site inspection, Sensor nodes will be collected by soil temperature, soil humidity wireless sending to handheld devices for display. Then such as time, temperature and humidity data records in the SD card. Table 1 for ZIGBEE values, this system can be used for breeding work.

the conclusion

This paper implements the plot breeding soil information wireless acquisition system design, this system has a large network capacity, self-organization, self-healing capability, characteristics of plug and play, all-weather and stable operation, without human intervention. and this system development is simple, high maneuverability, low power consumption, simple and stable, etc.

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