

Design of Node in Family's Fire Prevention Based on WSN

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Abstract— At present, wireless sensor network is widely used in sensor technology. While to design the node of WSN which is powerful, good fault tolerance, low power consumption and cheap is essential in wireless sensor network. In this article, A Family's fire prevention method using WSN was described. Which was selectively analysed is the hardware design in sensor node and sink node. At last, we discussed the software flow of this two kinds of nodes.

Keywords — *Wireless sensor network; Family's fire prevention; Sink node; MSP430F1611*

I. INTRODUCTION

Wireless Sensor Network is the Task Oriented network which is composed by several nodes. It synthesized the sensor technology, embeded computing technology, modern network and wireless communication technology, distributed information processing technology and so on. Firstly, each kind of miniature sensor carries on the real-time monitoring to the target information, then it is processed by the embeded computing resource and at last, being transmitted to the remote subscriber is needed. This technology has the very broad application prospect, it is already be used in the national defensive military, animal's habitual observation, the material structure health monitoring, the traffic management, disaster monitoring, and so on. The wireless sensor network is composed of many independent nodes, each one has the independent software and hardware system, moreover it is capable of realizing the data acquisition, processing and transmitting. The node is the basis to construct WSN, whose quality directly influence WSN network's quality. Therefore, to design the node of WSN which is powerful, good fault tolerance, low power consumption and cheap is essential in wireless sensor network.

II. THE COMPOSITION OF WIRELESS SENSOR NETWORK

The wireless sensor network system usually includes certain sensor terminal node, a Sink node and a set of background supervisory system, as described in figure 1. The sensor terminal node has the dual function, it can acquire the local data under the control of the background management software and the Sink node, then transmit the data to the sink node through multi-hop routing, at the same time, forwarding the data of neighbor node. The Sink gathering node is the network's center and has the function of Coordinator and net gate. It is responsible for the network's configuration, management and the data's collection, furthermore, it managers the communication

with the background management software of PC. The background data system is mainly used in collecting the information, transmitting control command, monitoring and controlling the sensor node of wireless sensor network.

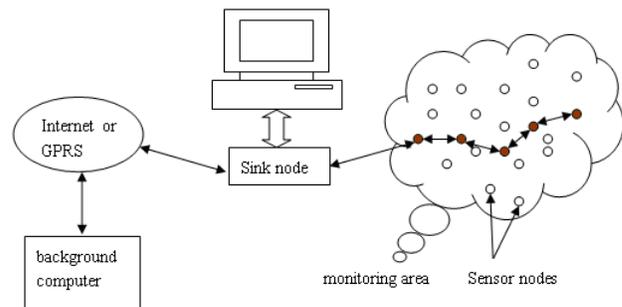


Figure 1. WSN Structure

III. THE NODE'S DESIGN IN FAMILY'S FIRE PREVENTION SYSTEM

In recent years, along with the living standard's enhancement, the family housing area expands unceasingly, the environment is getting better and better, people's housing quality had the distinct improvement, which simultaneously brings inconvenient to the family and plot safety (for example disaster and security prevention). With the development of science and technology, the electronics products developed rapidly. So the family's Fire Prevention system which assures the security appears especially important.

A. The hardware design of sensor node

In general, the sensor node's design includes four parts: Sensor module, processor module, wireless transmission module and power supply module, which is described in figure 2.

In the hardware design, the 16-bit ultra-low power consumption single microcomputer MSP430F1611 produced by TI Corporation is used as processor module. It features five power-saving modes, the low supply-voltage range from 1.8 V to 3.6 V, a 10KB RAM with only 0.2A power consumption in data hold-on mode and a 48 KB+256B FLASH memory which supports online programming and the simulation. The microcomputer's handling ability strong and internal peripheral device is rich. The processor module is responsible to control the operation of entire sensor node, storing the data that is acquired and sent by other nodes. The expanded interface circuit may

connect the external data memory chip or the FLASH chip used as program memory.

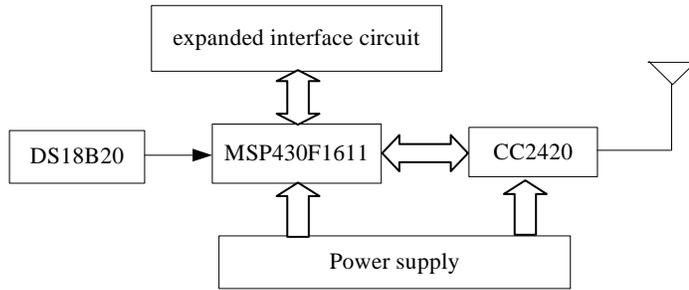


Figure 2. The sensor node structure

Digital temperature sensor DS18B20 is applied in sensor module, because only a port line is used to realize full-duplex communication with the processor.

The wireless transmission module uses wireless receiving and transmitting module CC2420 which is low power consumption and is responsible for wireless communication with sink node, exchanging control information and receiving or transmitting acquired data. It uses battery or voltage-stabilized source as power supply.

The power-supply module provides the energy for the operation of sensor node. In the node design, the CR2032 button battery is chosen to supply power for the entire node, which can be able to provide approximately the 200mAh energy when the voltage is bigger than 2.8V. So it may give the appropriate operation voltage for various modules. The hardware connection diagram between MSP430F1611 and CC2420 is shown in Figure 3.

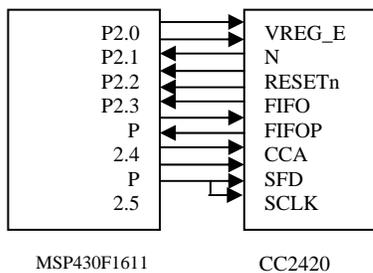


Figure 3. The hardware connection between MSP430F1611 and CC2420

In the diagram, the processor's UCLK pin provides the clock frequency, STE pin controls the synchronization of data receiving and transmitting and CSn pin must be set to low level when the data exchange starts. MOSI and MISO are the data output and the input pin respectively. The level of SFD pin is set to be high at the starting frame's arrival time, then the following data is continues to be transmitted and received until the data transfer process ended. If the address- recognized function enables, but recognition defeat, the SFD pin will reduce to the low level immediately. The data transmission and receiving time information can be gotten through the connection between

P2.5, the pin of the processor and SFD. Connected with the CCA pin, the processor is able to achieve the signal to remove the channel estimation. FIFO and FIFOP are related with RXFIFO(storing for received data), the pin of CC2420. When the data is in RXFIFO FIFO becomes the high level, until RXFIFO is empty. Thus, by reading the FIFO pin's level, the processor may judge whether CC2420 has the received data. When the data, that has not been read in RXFIFO, exceeds the limit maximum(set by the program), the FIFOP pin turns to be high level. But, when the CC2420 address- recognized function enables, only until the address is distinguished successfully, the FIFOP pin plays its role. This is to prevent the processor from reading these invalid data before the completing of CC2420 address recognition.

When RXFIFO overflows, FIFO will become the low level, at the same time, FIFOP will become the high level. Therefore connection with the FIFO pin and the FIFOP pin lets the processor know when to read data. RESETn pin is used to reset the chip and VREG_EN pin is used to enable the voltage regulator of CC2420, which can generate the needed voltage of 1.8V. So CC2420 may enters the normal work condition. The communication of CC2420 is accomplished by single-pole antenna or PCB antenna.

B. The hardware design of sink node

If the sensor network wants to exchange the internal information with the external network, the sink node is essential. It receives the data from the sensor nodes, and carries on the verification to confirm the accuracy of the data, in addition, adds the specific data frame in order that the external network can distinguish the data we transmit, then the data is sent to PC and the monitors through internet. In the other hand, the sink node also receives the information through external network, which can be distinguished. In the next step, the information is analyzed and turned to the command and data that can be recognized by this network.

In the design of sink node, how to communicate between node and computer must be considered. Microprocessor MSP430F1611 has internal UART, therefore it is very easy to realize serial communication with computer. The MAX3221 is used to realize the transformation between TTL level and RS232 level. The current temperature value is displayed in the LCD, when the temperature exceeds the limiting maximum, MSP430F1611 will drive the acousto-optics alarm circuit to warn. The hardware connection between MSP430F1611 and MAX3221 is described in Figure 5.

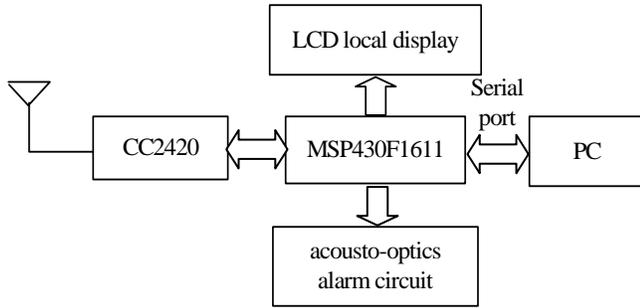


Figure 4. The sink node structure

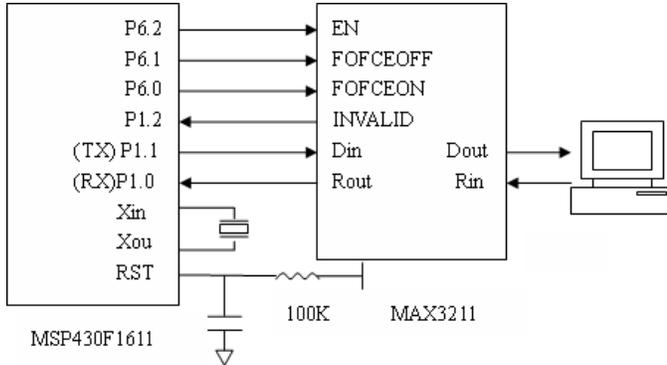


Figure 5. The hardware connection between MSP430F1611 and MAX3211

IV. THE SOFTWARE DESIGN OF THE NODE

A. The software design of the sensor node

In this step, the initialization of each module in the processor as well as CC2420 is completed and then the sensor node will send ready signal to the sink node. The acquired temperature data is transmitted to the sink node through CC2420 until the sensor node receive the answering signal. After all the data transmission is finished, the processor will enter the sleep state, simultaneously starts the timer and the interrupt. If the timing time is over, this data acquisition process is finished. Software flow is shown in Figure 6.

B. The software design of the sink node

The sink node receives the acquired temperature data from the sensor node, and then the data will be compared with the limiting maximum. If it exceeds the limiting value, the local alarm circuit will be driven. The temperature data is also be sent to PC. The node positioning algorithm is run on the computer to find the node's position. In the specified time, if the signal from the sensor node can not be detected, the processor enters the sleep state. Software flow is shown in Figure 7.

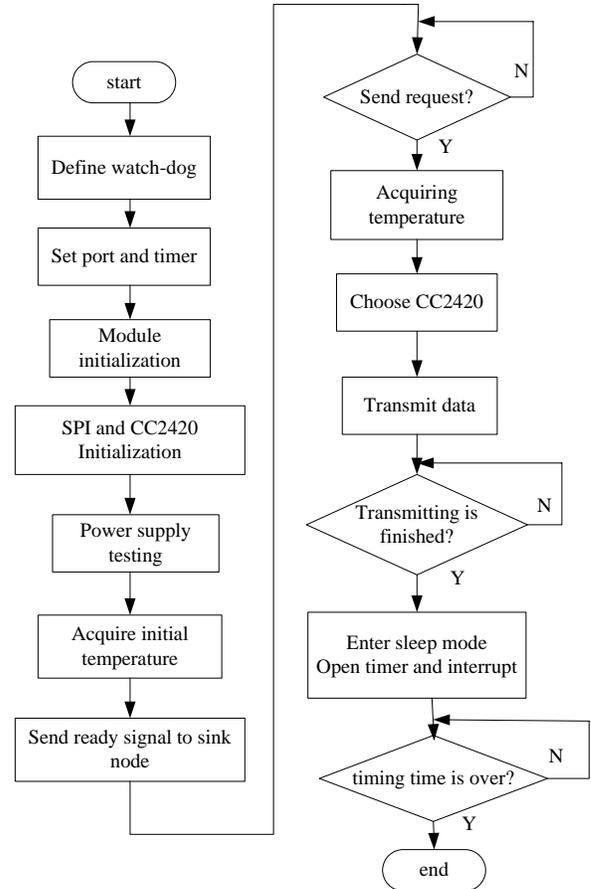


Figure 6. The sensor node Software flow

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REFERENCES

- [1] Zhang Kai, Liu Zhiqin, "Hardware design of sink node in monitor of vehicles' off-gases system of WSN-based" *Computer Engineering and Design*, vol. 31, no. 7, pp. 1469-1472, July 2010.
- [2] Wu Jian, Yuan Shenfang, "Design and implementation of a general node for wireless sensor network", *Chinese Journal of Scientific Instrument*, vol. 27, no. 7, pp. 1120-1124, September 2006.
- [3] Dong-Sun Kim, Seung-Yerl Lee and Tae-Ho Won, "A Wireless Sensor Node Processor with Digital Baseband based on Adaptive Threshold Adjustment for Emotional Lighting System", *IEEE Transactions on Consumer Electronics*, vol. 52, no. 4, pp. 1362-1367, November 2006.

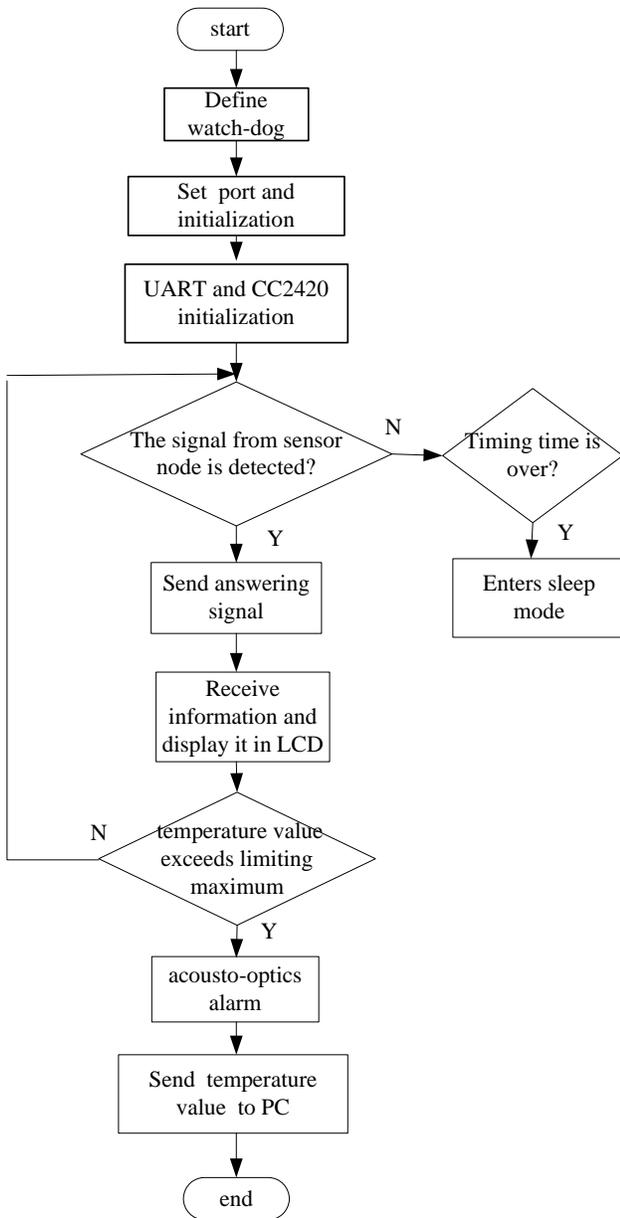


Figure 7. The sink node software flow