

Design of a Wireless Sensor Network node based on STM32

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Abstract—The characteristics and the design factors of wireless sensor network node are talked in this article. According to the design factors of wireless sensor network, this article will mainly point out the design of wireless sensor nodes based a Cortex-M3 Microcontroller STM32F103RE chip. And the wireless communication module is designed with a CC2430 chip. Our wireless sensor node has good performance in our test.

Keywords- Wireless sensor network; Design of sensor node; STM32F103RE; CC2430.

I. INTRODUCTION

The wireless sensor network is a collection of information collection, information transmission, information processing in an integrated intelligent information systems by cheap micro sensor nodes deployed in the sensing area. It is a formation of a Ad-Hoc network through wireless communication, with a low-power, low-cost, distributed, self-organization, rapid deployment, anti-strong survivability^[1].

With the rapid development of wireless sensor network in various areas, a lot of design of sensor nodes in different functions and performance had been shown. This article will show a method to design a wireless sensor node based on STM32F103RE microcontroller and CC2430 radio frequency chip.

II. SYSTEM HARDWARE DESIGN

A. WSN Node Design

The WSN node based on STM32 and CC2430 chip is consist of microcontrol-ler unit, CC2430 transceiver, power manageme-nt unit, sensor unit and UART unit, as shown in figure.2.

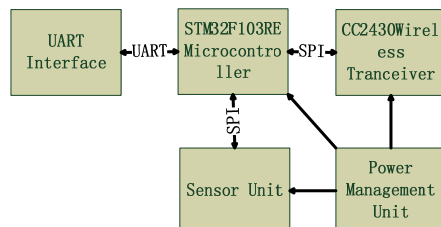


Fig.2 System block diagram

The system can acquire the characteristic signals of the environment, and transmit or receive external RF signal through the CC2430. The microcontroller controls the data reception, processing, storage, packing the calculated simplify data and send the data to the sink node through the network.

B. Hardware Connection between Microcontroller and CC2430

The communication and control between the microcontroller and the CC2430 use a standard SPI bus^[2,4]. SPI(Serial Peripheral Interface)is a four-wire synchronous serial interface designed by Motorola, because of the powerful hardware, its software code is relatively simple, allows the microcontroller to have more time to deal with other things. Generally less pin package such as FLASH, EEPROM, ADC, clock chip have a SPI interface. SPI is a synchronous, full-duplex, fast communication interface bus, and only four pins on the chip, and provides a convenient connection mechanism to save the chip pins, and also saves PCB layout area. STM32 series microcontroller also supports SPI interface, its function is very powerful, and is also very easy to implement, the microcontroller can achieve the control of CC2430 by six lines, as shown in Figure.3. In order to facilitate the communication and control between the microcontroller and CC2430 chip, a auxiliary line is added between the two chips, when necessary, to establish some of the necessary communication between the microcontroller and CC2430 chip.

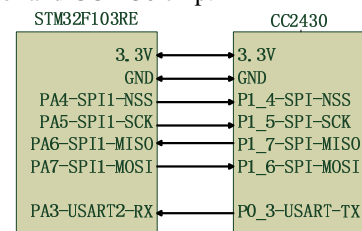


Fig.3 The hardware connection between STM32F103RE and CC2430 chip

III. SOFTWARE DESIGN

A. The Software Design of Microcontroller

The software design include the initialization of a range of peripherals and sensor, data processing and storage, CC2430 communication, the PC serial communication. Figure.4 shows the flowchart of the main program of the

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microcontroller. As can be seen, the entire microcontroller software design mainly includes the following sections:

- Initialize basic Peripherals: This part initialize the microcontroller minimum system, including initialization of the system clock, the peripheral clock initialization, interrupts initialization, serial communication initialization, timer initialize. These basic initialization have a lot mature program to refer.
- Initialize peripherals: This part is the initialization of some peripheral devices, including Flash, sensors, CC2430 RF chip etc. Initialization of the peripheral devices, including the I / O port initialization, clock initialization, SPI communication initialization. As mentioned above, CC2430 is a 51-core, supporting ZigBee protocol, wireless RF chip. So for the microcontroller, CC2430 initialization relates only to the initialization of the interconnected SPI interface.
- Timer interrupt function processing: The design uses a timer fixed periodic interrupt to read the sensor data. In the interrupt function the data is processed and saved, then transferred between the CC2430 chip.

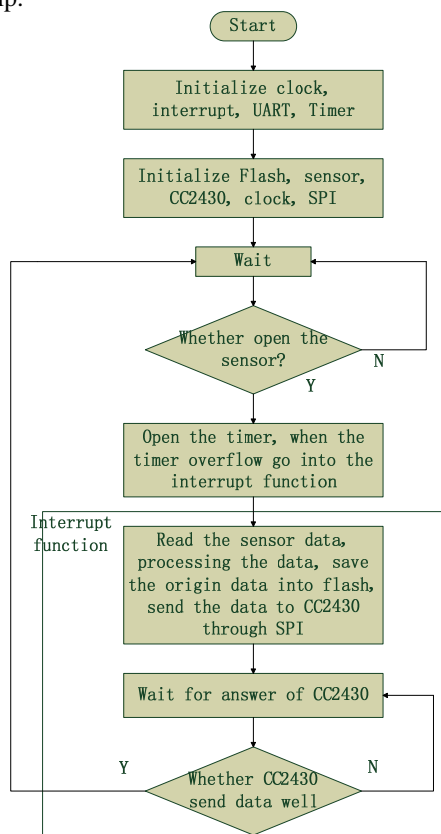


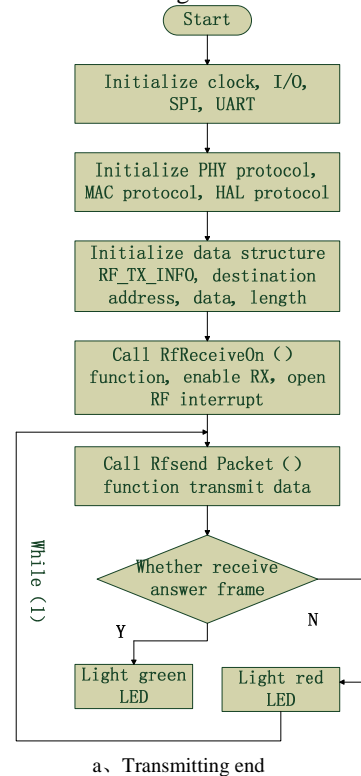
Fig.4 The program flowchart of the microcontroller

The above is the introduction of the microcontroller program flow, then we will talk about the transmitting and receiving ends of the CC2430 software design.

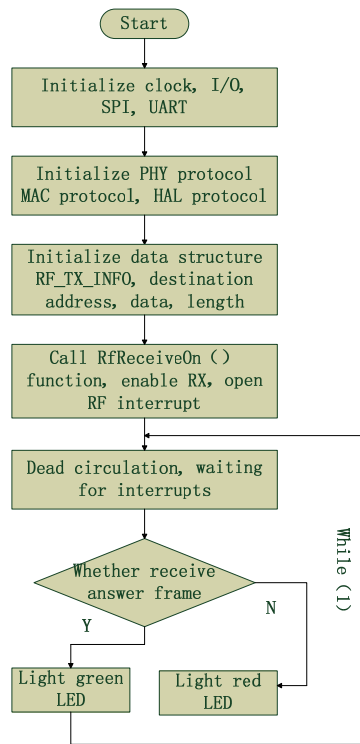
B. CC2430 Transmitting and Receiving Ends Software Design

In this paper, the Z-Stack2006 ZigBee protocol stack provided free by TI is chosen as the CC2430 development platform, greatly simplifying the application development process. The design only needs to add CC2430 and microcontroller SPI communication control part on the basis of the Z-Stack, and the CC2430 software design can be achieved^[3].

In order to increase the capacity of the ZigBee wireless sensor network as well as to solve an important energy supply problems in sensor networks. The design uses a operating mode wake-up based on demand. This model can significantly save the power consumption of the sensor nodes, reducing the probability of collisions when the information reported to extend the life of the network. Figure.5 shows a flowchart of a program for CC2430 transmitting and receiving ends. The CC2430 chip's program includes the following sections:



a、Transmitting end



b. Receiving end

Fig.5 The program flowchart of CC2430 chip

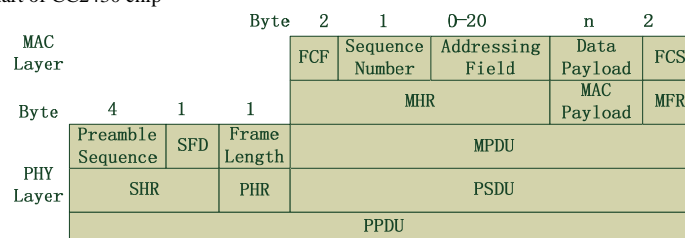


Fig.6 Standard data frame format

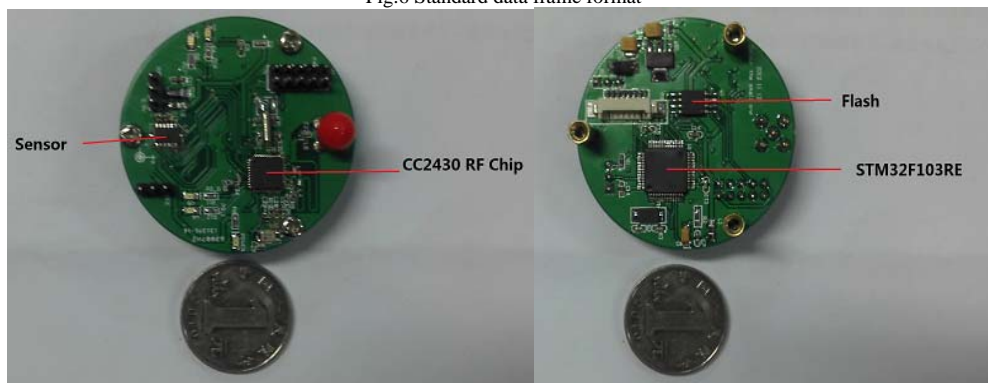


Fig.7 The physical picture of the wireless sensor node

IV. CONCLUSION

The authors summarize the existing research results. Elaborate the wireless sensor network node design based on STM32F103RE and 2.4GHz radio frequency chip CC2430. In the test, the sensor node is sensitive to the

The wireless transmitting data processing: Transmitting data processing includes getting the processed data from the microcontroller via SPI interface, packaging the data into a standard data frame and sending by RF^[5]. Following is the program code of the transmitting side, Figure.6 shows a standard data frame format.

- The wireless receiving data processing: Receiving data processing is mainly used to detect the CC2430 chip RF buffer when there is data present in this register the standard data frames are read out, and the sensor data are extracted from the standard data frame.
- Initialize basic peripherals: The CC2430 chip need a effective initialization before communication. Initialization process includes: initialize the system clock, initialize the I / O port, initialize the SPI interface, initialize the UART interface. These basic initialization has a lot mature program to refer.

Now, the CC2430 transmitting and receiving end program design is completed. Microcontroller and CC2430 chip program were burned into its Flash, to complete the design work of the entire network node, Figure.7 shows the physical picture of the wireless sensor node.

environment and transmit the information to the terminal PC to meet the requirements of wireless sensor networks.

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