The Design of Low Power UHF RFID Reader

Wei Wanhua

Wuhan Donghu University, Wuhan 430212, China

E-mail: 6386997@qq.com

Keywords: mobile robot; obstacle avoidance; RFID; WSN; positioning; path optimization

Abstract: This UHF RFID reader design uses low power consumption chip MPS430F2013 as CPU and CC1100 as RF transceiver. One CC1100 used as transmitter, another used as receiver, two chips can work simultaneously. The size of the design is small, and the power consumption is low. This reader can be widely used in many practical system.

1. Introduction

Ultra High Frequency Radio Frequency Identification (UHF RFID) technology is an automatic identification technology. The basic principle is to use the transmission characteristics of radio frequency signal and space coupling (inductance or electromagnetic coupling) or radar reflection to realize the automatic identification of the identified object. This recognition process does not require manual intervention. It is fast and convenient to operate and can work in various harsh environments. RFID technology has the advantages of non-contact, fast reading, waterproof, anti-magnetic, temperature resistance, long service life, long reading distance, larger storage capacity and data on tags can be encrypted. The UHF RFID has become the core technology of the internet of things and been widely used in many industries.

2. Introduction of the System

A basic RFID system includes tag, UHF RFID reader, antenna and the host computer, the schematic diagram is shown in Figure 1. The reader

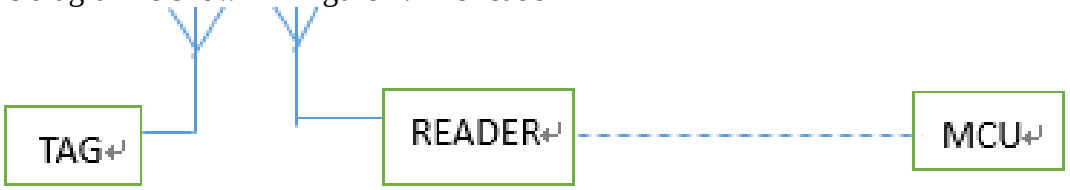

Fig.1. The Consist of the RFID System

It emits a frequency signal from the transmitting antenna, the tag can generate current when it passes near the transmitting antenna, and the energy of the tag is stimulated. The tag transmits the code carried by the transmitting antenna in the tag to the outside. The system receives the carrier signal from the tag by the receiving antenna. The reader demodulates the signal from the regulator and transmits it to the background for the next operation. According to different settings, the main system controls and sends command signals to the executing mechanism. This article introduces a lower power consumption UHF RFID reader system, which based on the MCU of MSP430 and the RF transceiver CC1100. This reader is suitable for various RFID system, it has a wide application prospect.

3. Selection of MCU

Many systems use 8051 series single-chip microprocessors as the system's core, but 8051 series used for the UHF RFID readers has some shortcomings, such as fast signal attenuation, high power consumption, easy to miss and misread due to slow tag reading speed or collision. Considering for

  DOI: 10.25236/iwmecs.2019.071

the above problems, the RFID reader system uses the MPS430 series for the MCU. This series is a high performance 16-bit microcontroller, built-in operating frequency up to 16 MIPS. It usually works in sleep state to save energy. It integrates 10-bit AD, 16-bit timer, watchdog timer, capture comparator, power-off detection, USI communication module (SPI, I2C) and so on. An advanced CPU with analog and digital peripherals with a standard component memory enables MSP430 to process mixed signals.

The design structure is entirely based on low-power operation system. The MCU platform of MSP430 can meet the needs of ultra-low power industries such as metrology, portable instruments and intelligent sensor units. So this system uses the MPS430F2013 as the MCU.

4. Chip Selection of the Transceiver

The RF chip is the RFID reader's core part. It affects the reading and writing distance, the reliability of the tag, and also affects the power consumption of the whole system. CC1100 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication, and wake-on-radio. Its working voltage is from 1.9 V to 3.6 V. It supports four different frequency bands: 315/433/868/915MHz. Programmable output power up to +10 dBm for all supported frequencies; Excellent receiver selectivity and blocking performance; Programmable data rate from 1.2 to 500 kBaud; Frequency bands: 300-348 MHz, 400-464 MHz and 800-928 MHz

The chip supports for FSK, GFSK, ASK, OOK and MSK modulation method. The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data up to 500 kBaud

The energy consumption of CC1100 is very low. 400nA Sleep mode current consumption; Fast startup time: 240us from sleep to RX or TX mode; Wake-on-radio functionality for automatic low-power RX polling; Separate 64-byte RX and TX data FIFOs (enables burst mode data transmission). CC1100 built-in all kinds of functional modules: address decoder, FIFO stack area, modulation processor, clock processor, GFSK filter, low noise amplifier, frequency synthesizer and power amplifier. It requires only a few peripheral components to design a complete system, so it is very convenient to use. In this paper, CC1100 works at 315 MHz, using FSK modulation with data rate of 100 Kbps and channel spacing of 200 kHz. the reader's block diagram is shown as in Figure 2.

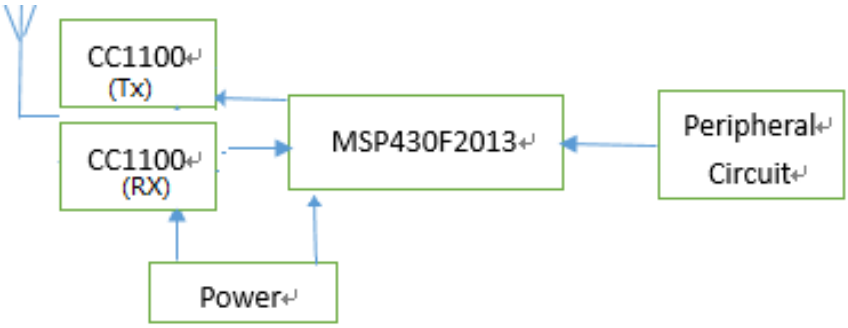

Fig.2 Reader's Basic Principles

CC1100 chip can't send and receive signals at the same time. In the design of radio frequency circuit, two CC1100 chips are used to send and receive data, one for data transmission and the other for data reception.

5. The Design of the Interface

CC1100 has 20 pins and can be configured through four-wire SPI compatible interfaces (data line: SI and SO, clock line SCLK, enabling line CSn) to write and read data at the same time. CSn can be connected to an IO port to simulate timing, while the other three pins are connected to the SPI interface of MCU. By reusing SI, SCLK and CSn pins on the SPI interface, the main state of

the communication can be performed through a simple three-pin control, the three states are: dormancy, idleness, RX and TX.

Each byte on the SPI interface is equipped with 1/8 read/write, 1/8 burst access bits and 6/8 bits address. SPI interface adopts synchronous serial communication mode. CSn pin is responsible for chip selection. When CSn is 0, SPI interface can transmit data, cannot transmit data at 1. The main functions of SI and SO pins are to realize digital input and output. SCLK is a synchronous clock pin. It can write data when the clock signal rises and read data when the clock signal falls.

6. Software Design

MCU is the control center of the reader, the reader's basic function can be implement through the MCU's control program. The software of the system is developed based on the platform of IAR Embedded Workbench, the program is written in C language. MCU coordinates the work of each module and control the communication protocol. Its working flow is shown in the Figure 3.

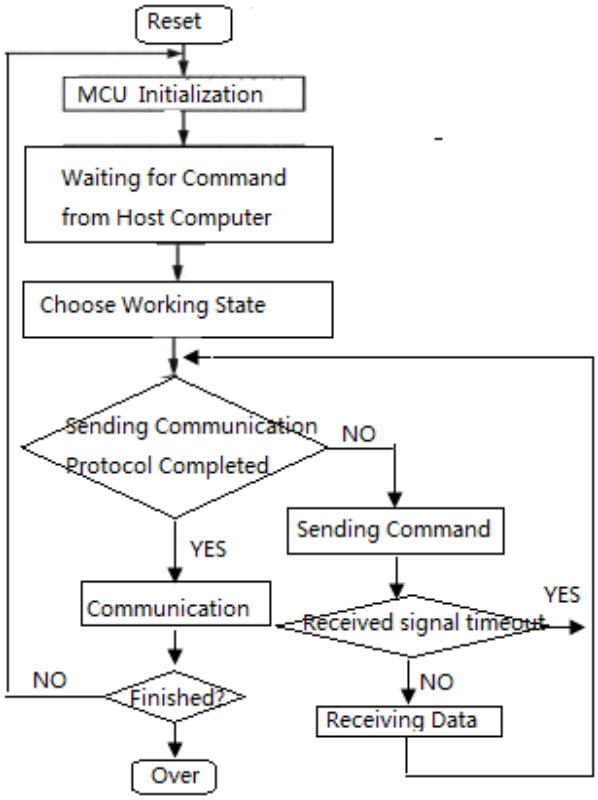

Fig.3 The flow chart

7. Conclusion

Because of the use of low power chips, the whole design can work with low power consumption. This design has strong applicability and can be widely used in logistics management, warehousing, library and many other systems. It has broad application prospects in many fields.

Acknowledgement

The work was supported by the the Youth Fund of Wuhan Donghu University with the project number 2017dhzk003 and the project name *Research and Design of UHF Radio Frequency Identification System Front End*.

References

[1] Wang Minglei. Design of Active RFID Label Based on MSP430F2012 and IA4420[J].

Electronic Products World, 2006(11):1191-1195.

[2] Guo Lixia. Design of Wireless Temperature and Humidity Sensor Node Based on MSP430F2012 and CC1100[J]. Electronic and Packaging, 2010,8(17):69-71.

[3] Wang Mingming. SOC Design of UHF RFID Reader [J]. Industrial Control Computer, 2018, 6(31):33-37.