The Design of CC1101 Wireless Sensor Module Based on RTOS

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Abstract

The wireless sensor module is the foundation of Internet of Things (IOT) bottom node, the wireless sensor module mainly completes the data acquisition, the intermittent type work, uses the battery power supply generally, must have the extremely low power loss. This article through an example for designing the wireless sensor module completes data acquisition, aimed at its low power loss request, defining the technology used in hardware design.

Key words: Wireless; Sensor; Low power loss; Embedded

INTRODUCTION

Wireless sensor network is one kind of new networking, this technical collection information gathering, transmission and processing together, with rapid development internet of things (IOT), the wireless sensor network has the extremely widespread application prospect. The wireless sensor module is the node, is the network core part, the wireless sensor module completes the data acquisition work generally, the intermittent working, uses the battery power supply, therefore the wireless sensor module power loss more or less will be very important for designing. This article takes an actual wireless sensor module as an example, explained how to use some technologies in the module hardware circuit design.

1. SYSTEM DESIGN

1.1 System Function Requirement

In greenhouse, needs to gather many kinds of crops production the outside essential factor, the wireless sensor module design goal is gathering temperature, humidity parameter and so on wireless nodes in the greenhouse. This node should include following function:

● Gathering soil temperature, air temperature, outdoor temperature, irrigation water temperature and so on many kinds of temperature data.

● Gathering soil moisture, air humidity, outdoor humidity.

● Gathering carbon dioxide (CO_2) density.

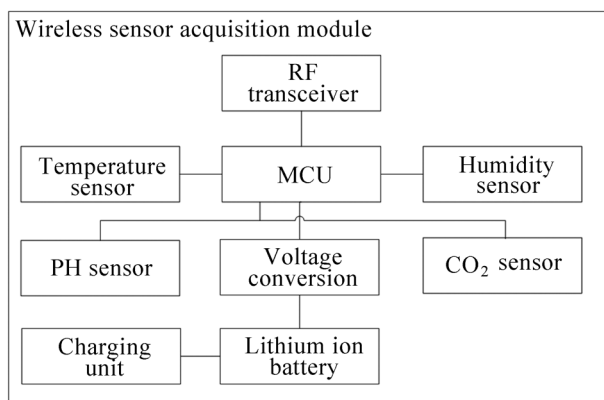● Gathering illuminance.

● Gathering soil PH value.

Figure 1
Hardware Structure Flowchart

The module based on the lithium ion rechargeable battery power supply, can charge, charges once can continuous working more than 1 month.

The wireless data transmission distance is bigger than 100 meters.

1.2 System Structure

System structure design diagram as shown in Figure 1.The system is composed by the MCU unit, radio frequency, receiving & dispatching unit, sensor unit, supply voltage transformation unit and charge unit. All of the units use the low power loss part. Regarding the units consumes more electricity, such as MCU and the radio frequency receiving and dispatching unit uses has the dormancy function part. Wireless sensor module MCU uses STC Corporation the STC11L04 chip, the radio frequency receiving and dispatching unit uses TI Corporation the CC1101 chip. The system usually is at the dormant state, the main engine sends out when awakens the order, the system is awakened, completes gathering and the data transmission work, then enters the dormant state. Reducing the system power consumption greatly. The system software designed according to C51, based on RTOS structure.

2. HARDWARE CIRCUIT DESIGN

2.1 Supply Voltage Transformation

System based on the lithium ion rechargeable battery power supply, the lithium battery working voltage is between 3.6-4.2V, MCU, the wireless module and the sensor working voltage is 3.3V, the lithium battery voltage need transformation, through the voltage stabilization, the transformation is the 3.3V voltage, supplied for system. The transformation chip uses MAX1759, this chip has the

widely working voltage, simply exterior electric circuit connection, the working efficiency high etc. characteristic, and is suitable for the voltage transformation. The circuit diagram as shown in Figure 2.
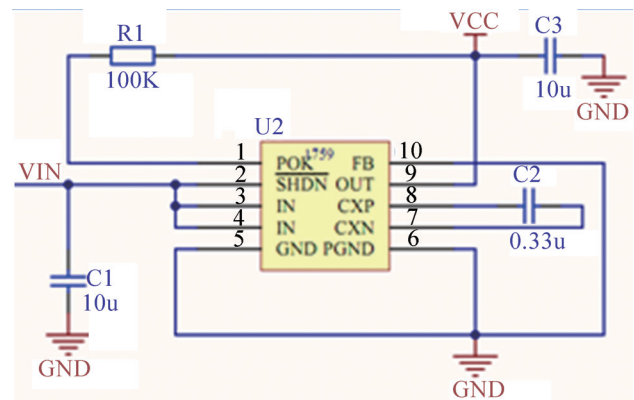

Figure 2
Power Voltage Conversion

2.2 Charging Circuit

System selects the lithium battery capacity is 3000mAH, when the battery electrical energy exhausts, may carry on the charge operation.The charging circuit inputs the 5V power source, the master control chip selects CN3052A, this is a section commonly used 500 mA single-node lithium battery charge chip, this chip is charged by constant voltage and constant current, the chip/battery has the functions with temperature protection and battery control lamp. Electric circuit as shown in Figure 3. In Figure 3: D3 is the battery control lamp, resistance R17 can control the charging current, has used the 5.6K resistance. The formula is as follows:

$$Ich = 1800V/5600 = 322 \text{ mA}.$$

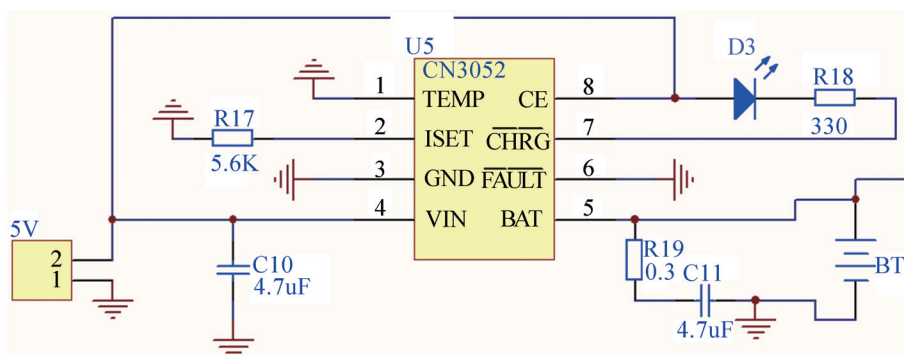Regarding the 3000mAH lithium battery, when a full charge need approximately for 12 hours.

Figure 3
Battery Charging Circuit

2.3 MCU Electric Circuit

Micro controller chip is selected STC11L04 by STC Corporation, this chip working voltage 3.3V, has the dormancy model during power off condition, the electricity consumes the electricity to be smaller than 0.1μA when power-off. The MCU electric

circuit is shown in Figure 4. In the Figure 4, D1 is the work instruction, when normal work, the light glitters each second 1 time; when battery capacity insufficiency, the light glitters each second 2 times; when breakdown, the light glitters each second 3 times.

2.4 Battery Voltage Examination

Lithium ion rechargeable battery has been extremely sensitive regarding the electric over-discharge, the system has established the battery voltage examination electric circuit, carries on the examination to the lithium ion rechargeable battery terminal voltage, control system whether continues to work. This information also can pass on upper monitor. Examines electric circuit as shown in Figure 5. The electric circuit based on precision comparator LM258, composes 2 to return stagnates the comparator, separately uses in the examination which the battery low pressure and exhausts. Comparator electric circuit does not work during the system is on dormancy state.
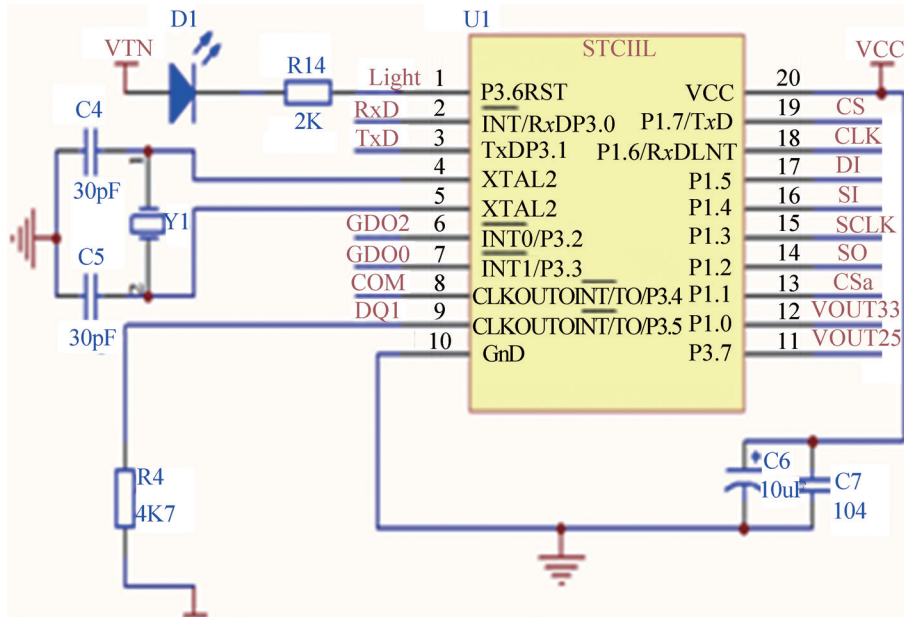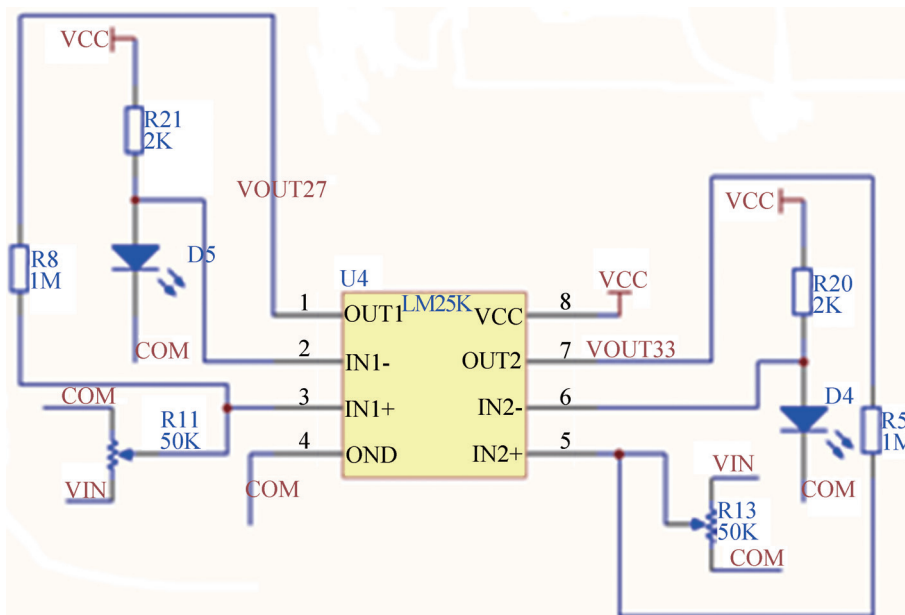

Figure 4
MCU Circuit

Figure 5
Battery Voltage Detection Circuit

2.5 Wireless Receiving and Dispatching

Module Wireless receiving and dispatching module uses the CC1101 chip by TI Corporation, electric circuit as shown in Figure 6. Between CC1101 and MCU through the SPI main line connection, MCU to the CC1101 initialization establishment, the order transmission, data receiving and dispatching all carries in the SPI main line. The CC1101 GDO0 pin connects MCU outside to

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interrupt INT1, when the CC1101 changed the state or be awakened, sends out the interrupt request to MCU, the MCU operating procedure according to the corresponding operation.

2.6 Temperature Sensor

In order to simplifying the electric circuit, the system uses single main line temperature sensor DS18B20 to complete the temperature examination. DS18B20 is a kind of numeral temperature sensor which DALLAS Corporation produces, with 3 pin TO-92 and small volume package form; The temperature survey scope is between -55~+125℃, programmable is 9~12 A/D transformation precision, the temperature measurement resolution can reach to 0.0625℃. Can connect on the simple root main line reaches 8 chips, simplified the electric circuit connection greatly. MCU chip the 9th foot DQ1 is to connect the DS18B20.
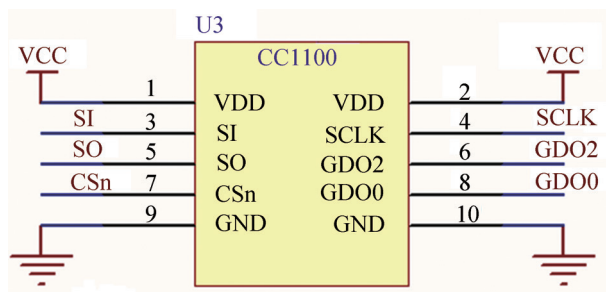

Figure 6
Wireless R-T Module Circuit

SUMMARY

Networking technology is in the embedded area of technology new hot spot in our country, the wireless sensor module with low power loss advantage can obtain the widespread application key strong point. In the article designs the wireless sensor module, has the structure simply, the cost inexpensive, the technology matures, the power loss low characteristic. The article introduced realization wireless sensor module the design method, to development personnel who designs the wireless sensor module, has the actual reference value.

REFERENCES

Hao, H. H. (2012). Data acquisition system for greenhouse based on wireless sensor network. *Electronic Design Engineering, 20*(1), 70-73.

Ju, J. W. (2012). Design of software system based on RTX51 embedded real time operating system. *Journal of Sichuan University of Science & Engineering: Natural Science Editton, 25*(1), 74-76.

Ju, J. W., & Wang, L. Y. (2008). Realization for an effective approach to online simulation of MCU. *Journal of Sichuan University of Science & Engineering: Natural Science Editton, 21*(2), 51-53.

Wang, L. Y., & Ju, J. W. (2008). Implementation of MCU mixed calling between C51 and ASM. *Journal of Sichuan University of Science & Engineering: Natural Science Editton, 21*(3), 57-59.

Zhang, Y. M., Yang, C., Ma, L., & Wang, K. F. (2012). Design method of wireless s ensor network node with low power consumption. *Computer Engineering, 38*(3), 71-73.

Zheng, G. H., Xu, Z. B., & Qiu, Y. L. (2012). A low power wireless sensor node design. *Fujian Computer, 2,* 39-41.