Library Temperature and Humidity Remote Control System Based on Micro Controller Unit

Na Li, Yonggang Tang
Department of Mechanical and Electronic Engineering, Suzhou University, Suzhou Anhui, 234000, China
E-mail: 94115399@qq.com

***Abstract*—This thesis has designed a remote control system which takes Micro controller Unit AT89S51 as the core for library temperature and humidity.The system consists of temperature and humidity data acquisition, wireless transceiver, Micro controller Unit and PC data display modules. The system can detect and control temperature and humidity of library remotely in real time, avoid the traditional manual labor tedious, and contribute to the storage of paper documents.**

Keywords-AT89S51; SHT11/15 automatic sensor; nRF401 wireless data translator; mperature/humidity controller for library

I. INTRODUCTION

The literature protection workers have dedicated to study suitable temperature and humidity for the storage of materials and paper documents for a long time. Temperature and humidity not only have some serious direct impacts on paper documents, such as strength, deformation and aging, but also cause many to indirect damages because of light, acids, harmful gases, worm and bacterium [1]. Experience of library work proved more appropriate temperature to protect the books is14 ~ 20℃, and humidity is 50% to 65% [2].

Monitoring of temperature and humidity in library is a key link in the storage of paper documents. Thus, the thermocouple, platinum resistance as temperature and humidity sensor is widely used. In these cases, the method of using wired connection to collect and transmit signal is common. Though it meets the purpose of measuring temperature, there are many problems as follows, complex cabling, high cost of maintenance, inflexible application, etc. Remote control system based on nRF401 set up easy, no cabling, low cost, it overcomes the shortcomings of the wired system [3].

II. SYSTEM DESIGN

The system consists of temperature and humidity data sensor, wireless transceiver, micro controller and computer data display. Data collection and transmitting are completed by micro controller AT89S51 as the core of the master, monolithic intelligent humidity/temperature sensor as the slave, and nRF401 as wireless data transmission module. The wireless receiver module receives data and transmits to micro controller, which would send data to the computer through the parallel port, then, data is processed and displayed by computer. At the same time, the micro controller judges the temperature and humidity and drives real-time implements, such as heaters, humidifiers, and ventilation window to adjust temperature and humidity in library. The system block diagram is shown in Fig. 1.

The hardware circuit design [4]is the core content of the entire system. The hardware design of the system includes control unit AT89S51, SHT11/15 monolithic intelligent temperature/humidity sensor as the acquisition part, nRF401 as wireless communication transceiver chip and PC host computer.

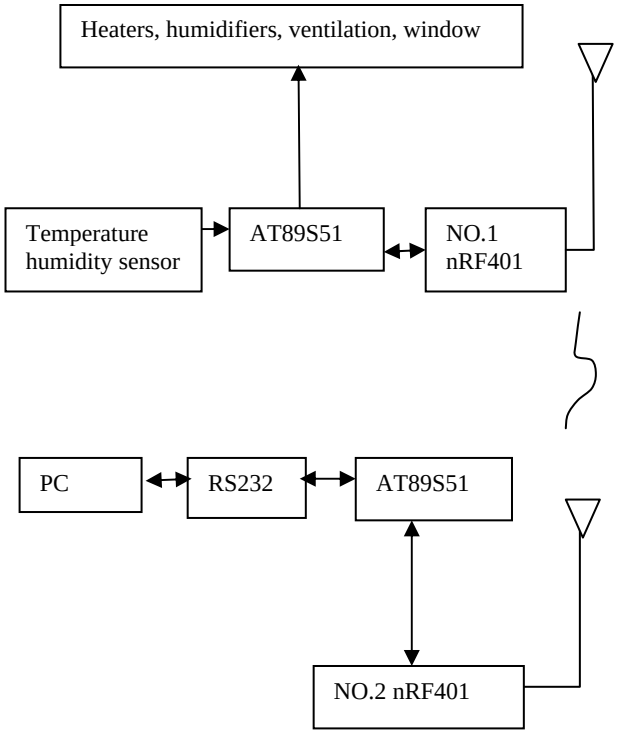

Figure 1. System design

III. HARDWARE CIRCUIT DESIGN

A. the AT89S51 Micro Controller

This design uses AT89S51 micro controller produced by Atmel Corporation. It is a kind of high-performance CMOS 8-bit micro controller with 4K bytes of FLASH memory, four 8-bit programmable parallel I/O ports, two programmable 16-bit timer and interrupt system with five interrupt sources. Powerful microcomputers AT89S51 can provide cost-effective solution to many embedded control applications.

B. Single-chip Intelligent Temperature/Humidity Sensor SHT11/15

This design uses monolithic intelligent temperature/humidity sensor SHT11/15 produced by Sconsirion company in Switzerland. SHT11/15 is widely used in HVAC, automotive, consumer electronics, automatic control and other fields. As a slave, SHT11/15 is connected with the host micro controller. The connection requires only one port line which could achieve communication between microprocessor and SHT11/15. The temperature range of SHT11/15 is － 40 ℃ ～ ＋ 123.8 ℃ with an accuracy of ± 0.1°C. Measurement range of relative humidity is from 0% to 99.99% with an accuracy of ± 2% RH and resolution of

0.01% RH [5]. Fig. 2 shows the detection system of SHT11/15 and micro controller.

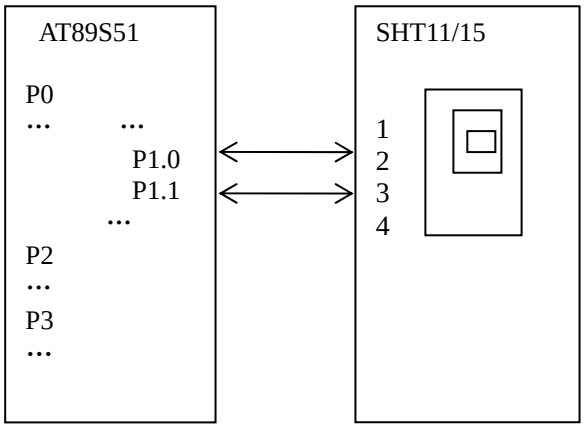

Figure 2. SHT11/15 and micro controller

C. *Wireless Transceiver nRF401.*

The nRF401 chip produced by Nordic Company in Norway does not need debug components, and it is low power consumption, so it is convenient to use [6]. nRF401 has three modes as sleep, accept and launch, which are choose by the states of pin PWR_UP and pin TXEN. Serial communication port DIN, DOUT are connected with serial communication ports P3.0, P3.1. Pin CS is used to select the operating frequency. The connection between nRF401 and AT89S51 is shown in Fig. 3.

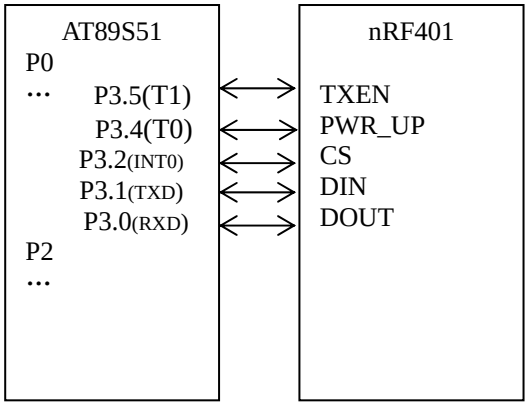

Figure 3. nRF401 and micro controller

D. *Receive Part of PC Host Computer.*

This section includes a wireless receiver module nRF401, single-chip, level shifting, and PC. After receiving data by No.2 nRF401, MCU processes the data, which is send to NO.1 nRF401, so as to achieve controlling library temperature and humidity by relay. In this system, nRF401 uses TTL level, however serial communication protocol RS-232 uses negative logic level. In order to achieve matched level between them, the design uses the MAX232 as level translator [7]. The PC complete the organization and processing of data, send data transfer command to lower computer. At the mean time, PC receives data from lower computer, and displays data. Fig. 4 shows the receive part of host computer.

This section includes a wireless receiver module nRF401, single-chip, level shifting, and PC. After receiving data by No.2 nRF401, MCU processes the data, which is send to NO.1 nRF401, so as to achieve controlling library temperature and humidity by relay. In this system, nRF401 uses TTL level, however serial communication protocol RS-232 uses negative logic level. In order to achieve matched level between them, the design uses the MAX232 as level translator. The PC complete the organization and processing of data, send data transfer command to lower computer. At the mean time, PC receives data from lower computer, and displays data. Fig. 4 shows the receive part of host computer.

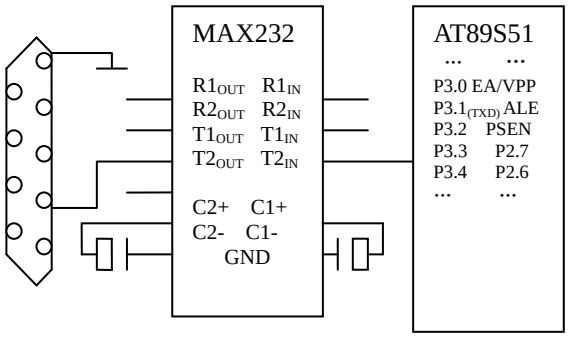

Figure 4. Receive part of host computer

IV. SOFTWARE DESIGN OF THE SYSTEM

The communication between AT89S51 and SHT11/15 has three parts, SHT11/15 initialization, SHT11/15 identification and data exchange. The wireless transceiver is achieved by nRF401, which could be set states by PWR_UP and TXEN. If PWR_UP = 1, TXEN = 1, it is normal sending state, while PWR_UP = 1, TXEN = 0, it is normal receiving state. Flow chart of acquisition module and transceiver module is shown in Fig. 5.

SUMMARY

Library temperature and humidity remote control system has some advantages as follow:

(1) This system has simple structure, flexible temperature control and accurate testing.

(2) The monolithic intelligent temperature/humidity sensor SHT11/15 is the acquisition part, which simplify the circuit structure.

(3) Wireless Transceiver nRF401 does not need debug components, and it is convenient to use.

(4) PC host computer provides man-machine interface and user-friendly reading.

(5) Software design uses C language which has many advantages, such as good portability, well-structured, fast development and certain value in use.

(6) The system achieve remote controlling of library temperature and humidity, and it is very convenient to access other sensors, scalability of function is good.

REFERENCES

[1] Beijing library protection study group, Library Build, Vol. 03, 1994, pp. 25. (In Chinese)

[2] Library of Hebei technology university, Documents Preservation Research, Vol. 01, 1996, pp. 24. (In Chinese)

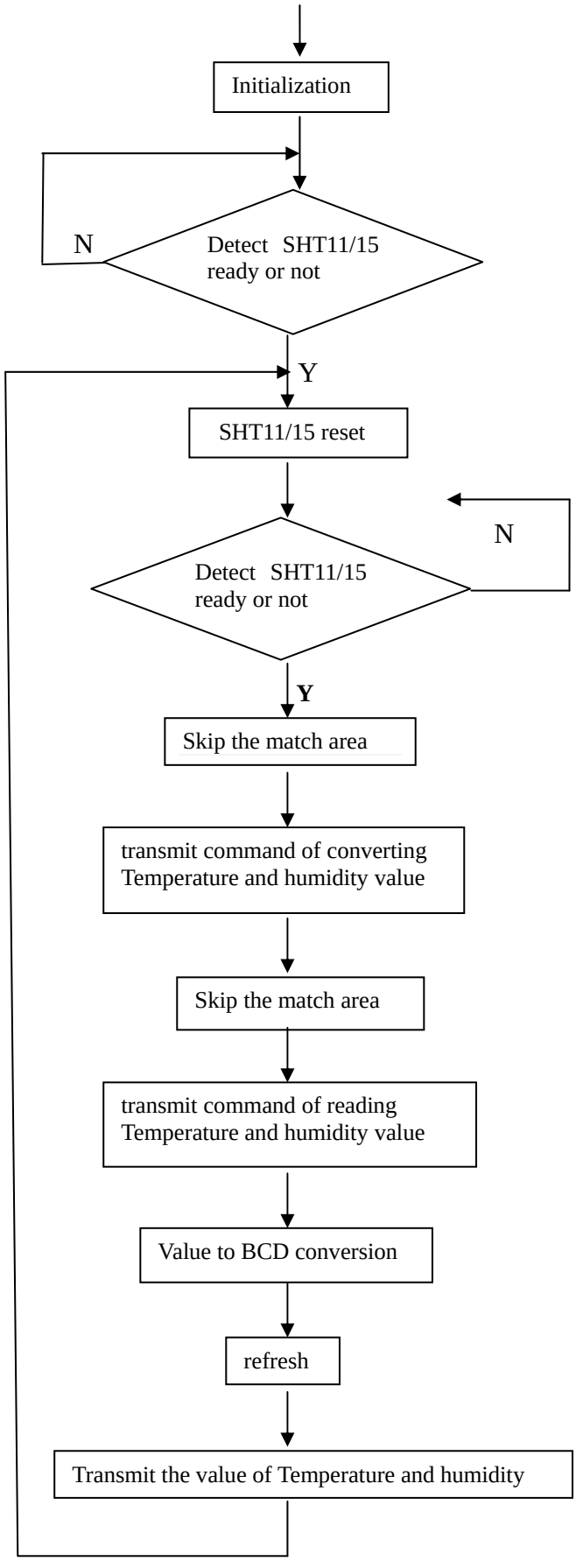

Figure 5. System design acquisition module program flow chart

[3] Beijing library protection study group, Library Build, Vol. 03, 1994, pp. 25. (In Chinese)

[4] Library of Hebei technology university, Documents Preservation Research, Vol. 01, 1996, pp. 24. (In Chinese)

[5] Z.X. Li, L.N. Xu and Y.G. Li, Hubei Agricultural Sciences, Vol.48, 2009, No. 12, pp.3143. (In Chinese)

[6] D.Y. Zhang, The Principles and Control Technologies of MCU. Fudan University Press, China, 1996. (In Chinese)

[7] T. Wu: Automatic Monitoring and Wireless Control System of Temperature and Humidity in Warehousing. Nanjing Technology and Engineering University Press, China, 2007. (In Chinese)

[8] J.J.Wang, Q.Zhang, Electronic Test, Vol.9, 2008, pp. 83. (In Chinese)

[9] K.M. Wu: Principles and Applications of CAN Bus. Aeronautics and Astronautics University Press, China, 1996. (In Chinese)