Design of Remote I/O data acquisition system with zigbee

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Abstract- **In the field of modern wireless communication, There are mainly some technologies that provide solutions to the wireless data transmission network, such as: GSM, CDMA, 3 G, Wi-Fi. These solutions make network work with high efficiency and good quality, but still with high Cost. So it was difficulty in popularizing in with low cost and at the circumstance of infrastureless or Infrastructure destruction. According to this situation, in This paper, the key components of the Information Terminal and the wireless receiving modules on the data Collection and wireless transmission network were Designed with the principle of zigbee and 51 Series of single-chip computer as the core hardware, Besides, combining with the current technology on the Wireless Ad Hoc Networks, a short-rang wireless data Sampling and transmission network was putting up, Which provides a low-powered and high-performance? Wireless data communication system, works in the ISM (Industrial Scientific Medical) Band. Then, an available Solution to the wireless data communications was put forward, and this solution was good at stronger real-time Response, higher reliability requirement and smaller data Amount. Through software and hardware debugging and Actual measuring, this system based on our solution had**
Work well, reached the expected goal and been already successfully applied to Wireless vehicle System.

Keywords: - ***Ad hoc, Daq, Zigbee***

I. INTRODUCTION

In modern wireless communication, GSM, CDMA, 3G and Wi-Fi become the mainstream solution of Wireless data transmission network because of their High speed and reliable quality. They also have the Shortcomings of high cost, so wider application would Cause a great waste of resources, and they cannot be promoted in small regional, low speed data Communications. Multi point short range wireless data Collection and transmission network will be the best Solution. The system supports the development of Communication system of peer-to-peer, Point-to-multipoint and multipoint-to-multipoint. Short-range wireless communication can adopt Different network technologies, such as bluetooth, IEEE802.11, and zigbee compared with Long-distance wireless communication network, they are different in the basic structure, the application level, Service range and business (data, voice). The original
Intention of design of short-range wireless Communication network is to provide short distance Broadband wireless access to mobile environment or Formulation of temporary; it is the further Development of internet in mobile environment. The Main advantage of short-range wireless communication Network is lower cost and more flexible use. This paper presents the design proposal of hardware And software of information terminal (machine) and Wireless receiver module of multipoint short-range Wireless data collection and transmission network, which provides a low powered and high performance Wireless data communication system, works in the ISM

II. RELATED WORK

As a point to point multi-mission wireless Communication system, it consists of one central monitoring system and some Multiple Remote Terminal Unit (figure1).In fact; this remote terminal unit is some Kind of removable stations which can communicate with other stations in the process of motion. Furthermore, the CMS communicate with RTU in Bidirectional way. In the next part, some pivotal segment on software and hardware of the information terminal and control Center was designed.

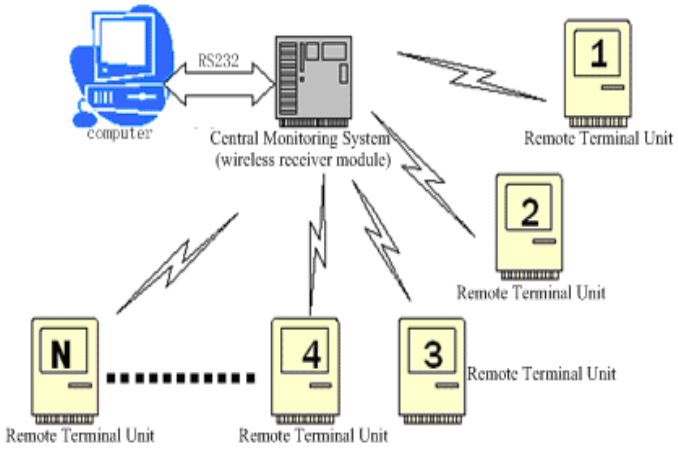
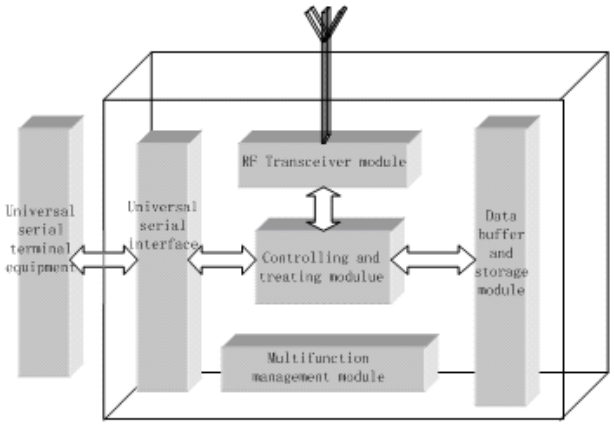


Figure 1. Diagram of reticulate wireless communication system

III. THE HARDWARE DESIGN OF THE SYSTEM

For the sake of the convenience of design, Maintenance and update, design on some hardware Circuit cell and node was divided into some different Module according to functional and electric Characteristic. There are RF Transceiver module [1], Controlling and dealing module, Universal Serial Interface module, data buffer and storage module and Multi functional power management module in the basic Structure (Figure 2).

Figure 2. Diagram of system basic structure



A. Transceiver Module

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are un avoidable. In the process of sending, the data package should Been Modulated with High frequency and sent to object zigbee Transmitting module, in the process of receiving, The high frequency signal have been demodulated to Original data package through the zigbee receiver module.NRF905 [1] is the key of RF Transceiver moduleWhoserequencyis16MHzCrystalOscillator.NRF90 5can receive the RF signal by Printed Antenna, But this module adopt the external antenna and Filter Circuits in order to improve the receiver sensitivity and Anti-jamming ability.

B. Controlling and Treating module

The controlling and treating module consists of MCU and external circuit, it have two functions: one Made all modules' working under control and harmony; The other function is treating and transmitting the data Got from interface, such as router processing, data Packaging, verification and resenting request. Module's key MCU is 51 MPU, and considering the Industrial function, the WINBOND78LE54 [2] [3] was Applied in this practical experiment because of its good Capability in 8bit CMOS Microprocessor, compatibility with 2.4-5.5V wide voltage electric supply, 256Bytes Embedded RAM, 16KB Flash EPROM and 64KB Addressing space, four 8Bit standard I/O interfaces, one Standard I/O dual serial interface. The Crystal Oscillator frequency of SCM is22. 1184MHz and the electric power is 3.3V to Adapting to zigbee logical level in wireless transceiver Chip. The impending PIN was protected by connecting With VCC to keeping its stability. The specific Connection between MCU and all modules is described below.

CONTACT THE MCU DESCRIPTION MODULE INTERFACE
INTERFACE

RF transceiver
Module
Storage module universal
Interface
Power
Module
P1.0 CSN
P1.1 SCK
P1.2 MOSI
P1.3 MISO
P1.4 PWR_UP
P1.5 TRX_CE
P1.6 TX_EN
P3.2 AM
P3.3 DR
P3.5 CD
P0.0 A0\D0
| |
P0.7 A7\D7
P2.0 A8
| |
P2.7 A15
WR WE
RD OE
ALE C
RXD RO1
TXD Tin1
GND GND
VCC V
CC_OUT_
3.3V

C. Multifunctional Electric Power Management Module

The most remarkable characteristic is compatibility With 8-24V wide voltage electric supply including CMOS

power and TTL power, respectively in 5V and 3.3V, which provided all modules with the suitable and Stable power. Meanwhile, it means so much in energy Source saving because of its electronic switch. The Power supply transfer chip C851414 and AS11173.3 is the primary ingredient in this module. The C851414Made the electric voltage transfer from 8V to 24V, then, The AS-1117-3.3 made it from 5V to 3.3V.Furthermore, suitable filter capacitance and inductance was introduced to make power's ripple characteristic Perfect as possible.

D. Universal Serial Interface Module

The main function of Universal Serial interface Module is connecting universal terminal equipment, Such as signal output equipment or analog collection Equipment with AD transfer. At the same time, it provides entrance to the Computer terminal data Exchange through universal RS232 serial interface.

E. Data Buffer and Storage Module

It has two kinds of function, one is data buffer, the other is data storage, respectively performed by32KByte RAM and16Kbyte EEPROM .Data buffer District supervise buffering some temporary data, suchAstransmitdata, waitingdata. Data storage district Supervise some fixed data memory, such as router data, Local host, local address and some renewed data for Power-off protective.

IV. SYSTEM SOFTWARE DESIGN

The realization of system performance depends on Its effective and reasonable software control. TheDesignofthissoftware is on the basis of the hardware Environment to development a wireless network Protocol that have functions as data transmission, Avoiding conflict, the retransmission when error occurs, And overtime retry, in order to achieve the design goal. The entire network is composed of a host and many Scattered terminals, each terminal must have a wireless Transceiver node (this system adopts nRF905single-chip RF transceiver), any nodes of the entire Wireless network has a unique identified address which is composed of an unique identified terminal. For Convenience's sake, each terminal wireless transceiver Node addresses of the actual system is set by ourselves (4 bytes).In order to improve the reliability of the system; the protocol is designed as stop-wait mode. In data link layer, the send process is roughly as follow. Firstly, the data sources send a connection request to the dataVI.Conclusion targets, and it will transfer data after the data sources respond. Then wait for response from data target after each transmission. If the response is correct, another transmission will start. After all the data transmission is done, the data source will send a request to release channel resources, the transmission is finished when the response from the target is received. The receive process is as follow: the data target will receive data after give a response to the source, and will give an effective or ineffective response, until receive a Demolition request. Then, save the data and send a Response to end the entire process. Whether the function of system can realize and stays table depends on the rational programming of the software. After various considerations and assumptions, we design the software as the module that is presented in Figure 3, so as to make the system achieve better efficacy and adaptability. Figure 4 is demonstrating the software flowchart of the Control Centre (host), while Figure 5 is information terminals (terminal). We will

FOCUS ON SOME CRITICAL PART OF THE MODULE.

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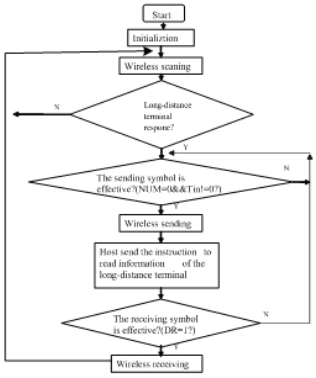

Figure 4. Software of control center (host)

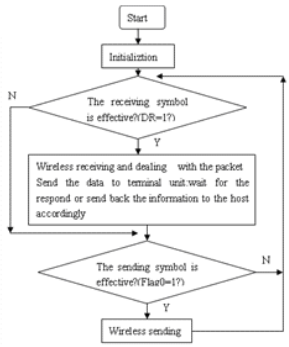

Figure 5. Software of Information Terminal

V. SYSTEM TESTING

Because communication between any two nodes may be tested through point to point, in this system Testing Process, communication model between node A and node B is a good example for testing

Schematic diagram, just like figure 6.

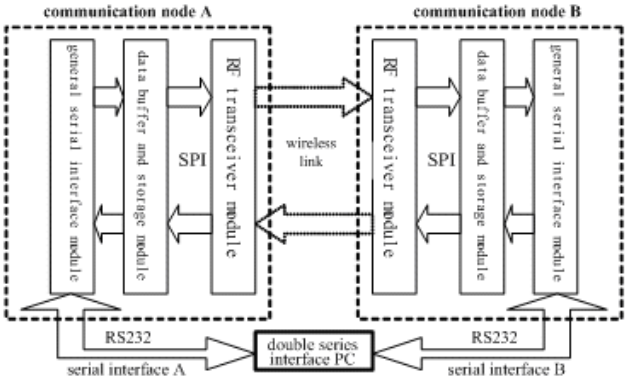

Figure 6. Schematic diagram of system testing

Closed-loop testing circuit is put up throughPCwithdouble serial ports and two RS232 ports and communication node A and B. On one terminal, data was sent through serial port testing auxiliary tool “serial port assistant V2.2”, onheother terminal, returning data is monitored. Data is sent through PC’s serial portA, RS232 port, then data buffer and finally wireless transceiver module successively. However, the process of data receiving was SPI serial, data buffer, then RS232 port, finally PC. In t in this paper, allow-powered and high-performance wireless data communication system were designed with the principle of transceiver zigbee and 51 series of single-chip computer as the core hardware. An available solution to the wireless data communications was put forward, and this solution was good at stronger real-time response, higher reliability requirement and smaller data amount, which is widely applied various fields such as data communications, environmental monitoring and security Guard System. We believe that integrated and intelligent Communication Protocol is realized after software design is refined and improved further. He testing process, digital oscilloscope was also used to monitor the data transfer of communication node a, node B, RS232 port and SPI port. In the following Section, information from MOSI/SCK and MISO/SCK Was analyzed to verify the system’s Correctness. As a waveform of wireless sending data, figure7 demonstrate some relations among efficient data, address information and synchronous clock in wireless ending process. Because the receiver address must be design at end by the transmit terminal, 4 byte address require to be sent after sending packet.

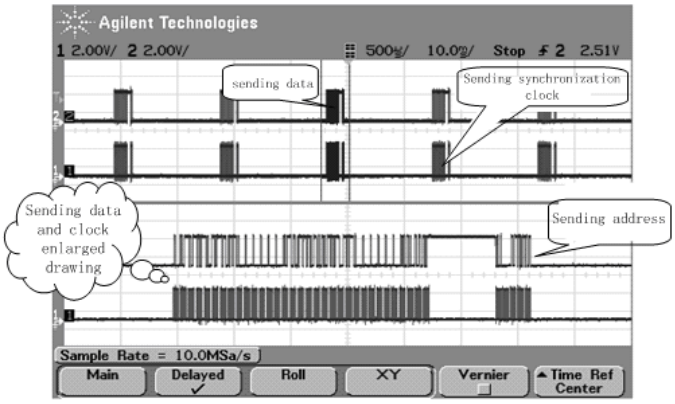

Figure7.Relation diagram of efficient data, address information and synchronous clock in wireless ending after headdress was confirmed, the wireless receiver began to pick up and send out the effective data, distilled address information. The relationship between effective data to be received and synchronous clock was showed in figure8.

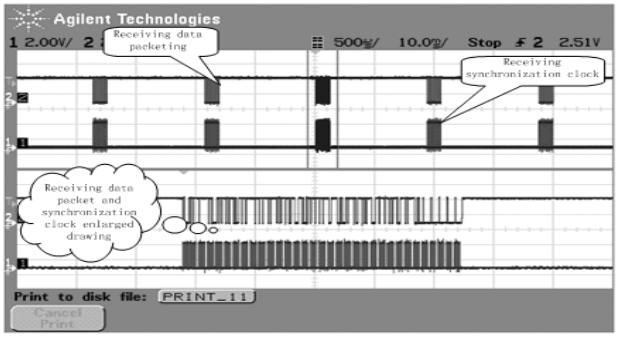

Figure8. Relation diagram of efficient data and synchronous clock in wireless receiving in figure 9, some relationship between the data packet to be sent and to be received is demonstrated. They distribute in well proportioned interval, which make the frame synchronization, avoid packet to be lost and wrong as possible, which means the most balanced and stable situation for the wireless data Transceiver. Figure 9 Comb relation diagram of wireless sending and receiving In the stability test, we have run the uninterrupted random transceiver experiment on system for one week, dead computer, packet loss and packet wrong have never happened.

ZIGBEE ARCHITECTURE

The IEEE 802.15.4 standard and Zigbee wireless network technology are ideal for the implementation of a wide range of low cost, low power and reliable control and monitoring applications within the private home and industrial environment. The working model of the IEEE 802.15.4 and Zigbee is illustrated in Figure 6.9.

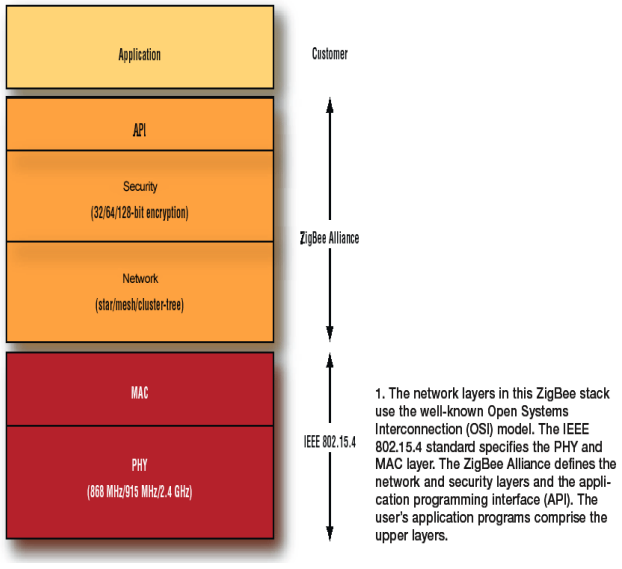

Fig: 6.9 Zigbee Architecture

In the Zigbee architecture, the PHY layer and MAC layer are based on the IEEE 802.15.4 WPAN standard. Zigbee defines the NWK and APS layers. The software and hardware vendor will provide the software stack with appropriate tools to allow an OEM to create applications, which are added to the APL. The Physical (PHY) layer and Medium Access Control (MAC) layer are based on the IEEE802.15.4 PAN standard. This includes the actual radio hardware. Above the MAC and PHY are the Network (NWK) and application layers defined by Zigbee.

VI. CONCLUSION

In this paper, a low-powered and high performance wireless data communication system was designed with the principle of zigbee and 51 series of single-chip computer as the core hardware. An available solution to the wireless data communications was put forward, and this solution was good at stronger real-time response, higher reliability requirement and smaller data amount, which is widely applied various fields such as data communications, environmental monitoring and security Guard System. We believe that integrated and intelligent Communication Protocol is realized after software design is refined and improved.

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