Research of Embedded Web Data Acquisition System based on ZigBee Technology

Jun Xiong
Hunan Police Academy, 410138, China

Abstract. ZigBee technology can promote working efficiency and reduce the instrument cost. This article analyzes the implementation scheme of embedded Web server. Then, it researches the design and implementation of ZigBee technology and the system software in IAR development environment and other aspects. Moreover, this article supports parts of specific implementation. Hope this article can provide some references and suggestions for the relevant staff.

1. Introduction
The current data acquisition system mostly apply in the system of high efficiency and long distance. People research less in the data acquisition system with low efficiency and short distance. However, the data acquisition system of low efficiency usually applies in agricultural production, industrial production and medical equipment. The embedded Web service equipment has been the popularity of the current embedded system application. The popularization of information technology and computer technology supports possibility of embedded system. We build the embedded Web data acquisition system based on the ZigBee technology. It will promote the working efficiency, reduce the equipment cost and simplify the system research and maintenance. Users can inquire the data by the computer browser and they can realize the communication between system and the communication equipment by connecting GPRS equipment.

2. Principle introduction of ZigBee technology
ZigBee technology is one wireless communication technology of short distance data with unified standard. It combines with four layers. The first layer is physical layer, the second layer is MAC layer, the third layer is network layer and the forth layer is the application layer. The protocol target of physical layer and MAC layer is the protocol target of IESS series. The network layer is confirmed by ZigBee technology alliance. The application layer researches and applies with the users requirements. Figure 1 is the protocol combination of ZigBee technology.

![Figure 1. Protocol combination of ZigBee technology](image)
Combine with the protocol target of IESS series, we can divide the ZigBee technology into 3 parts of the working frequency band. The first part is 850MHz, the second part is 900MHz and the third part is 2.2DHz. In the frequency band 2.2DHz we can set 15 channels, which is free for the industry, agriculture and medical treatment. Users can apply for the application. In this frequency band, the data transfer efficiency is 245bit/s. This article sets up the data transport of the system nodes in this frequency band. In the frequency band 850MHz we can set up 9 channels with 45bit/s transport efficiency. In the frequency band 900MHz we can set up 2 channels with 15bit/s transport efficiency.

ZigBee equipment is one kind of low efficiency equipment. The data transport efficiency is about 2.5dBm and the communication distance is 45m with the ability of detection and identification. The wireless communication technology application is carrier sensing of multipoint access or collision avoidance. It will avoid the wireless carrier collision. Moreover, it is important to build the perfect response communication system in order to protect the data transport reliability.

We can set up one segment key to insure the data security and confidentiality of the ZigBee equipment during the transportation. We take the simplified criterion as the principal thing of the ZigBee technology frame. When we finish the mission of each layer, the upper layer need to service it and insure the service among each layer through interfaces.

3. Implantation scheme of the embedded Web server

Central control unit of the Web server in the data acquisition system usually built by ARM. CC2530 and acquisition nod can realize the data communication and achieve the data transportation through Internet technology. Data acquisition node uses to transport the obtained data into data acquisition, quantification and coding through convertor ADC. Then the coded data will be transported to the micro-processing equipment and transported through wireless. When the Web server receives the data, it will process them.

We generally choose CC wireless network RF for the wireless network RF and select embedded industrial chips of S3C type for the chips of micro-processing equipment. We can display and analyze the obtained data and control the data of each unit appropriately.

4. System design and implementation

4.1. IAR development environment

The main function to use IAR embedded IDE (integrated development environment) is supporting all the ARM processing equipment, which include coding equipment, project management equipment, translation equipment, connection equipment and the adjustment equipment. IRA embedded IDE (integrated development environment) has inner code optimizer that can support different types of chips and form the series of program code with simplicity and reliability.

4.2. Linux kernel transplantation

The current Linux kernel transplantation has two types: board level transplantation and chip level transplantation. The board level transplantation means the Linux can support the corresponding processing equipment that we only need to adjust the hardware. The chip level transplantation means the Linux cannot support the corresponding processing equipment and we need to operate kernel transplantation with the equipment. The applied Linux in this article includes the transplantation package of S3C and ARM processing equipment. We can use u-boot the download data into the target board and operate it. Figure 2 is the development process of Linux kernel transplantation.
4.3. Transplantation and establishment of Web service under Linux

There are three types of Web service equipment under Linux. The first one is Httpd, the second one is Boa and the third one is Thttpd. Thttpd cannot support CCL and its authentication. Moreover, it has minimal performance and is the simplest type of embedded Web service equipment. HTTP and Boa can support CCL and its authentication with high efficiency. Here we suppose the embedded service equipment only needs some simple websites, then we can use httpd and Web service equipment. If the embedded service equipment need to transport and exchange the data with users, we need to use HTTP and Boa Web service equipment. Usually, the system will use Boa Web service equipment as the embedded service equipment based on the simple system, high efficiency, good compatibility and strong function. Compare with HTTP, Thttpd costs much more resources than Boa, even both of the two types support CCL. Through gateway interface under the Web environment, users’ data can be transported to Web service equipment. Then the Web service equipment will select the relevant working progress to realize the data processing. After that, the processed data will be sent to the user with the web page.

4.4. Embedded database under Linux

Database uses for data storage and research. The embedded database has the basic characteristics of the original database. However, they have differences in essence. The original database uses engine-type drive and the embedded database use program drive. The embedded database has small capacity which only cost dozens of KB after the programming. Moreover, the embedded database can easily transport data into the embedded equipment. There has various equipment are compatible with Linux database. SQLite is the most popular system that the system can select SQLite as the embedded database based on the own characteristics.

4.5. Web Data acquisition implementation of the embedded gateway

In the first place, we build one Ad hoc Network in the embedded gateway and take the continuous testing. We can judge the network application based on the testing. If the network is applicable, we should connect the nodes and power. Then, it will automatically connect the network and transport the data by sensors. ZigBee gateway can transport the data in the wireless network through serial port 1 then into the embedded platform. The embedded platform will store the data into SQLite database. Finally, we can access the SQLite database by computer technology.

5. Conclusion

This article emphasizes on researching the embedded Web data acquisition system based on ZigBee technology. ZigBee wireless network is the basement and the terminal to realize the data acquisition and realize the system design through the data acquisition. Combine the embedded system characteristics of strong reliability, low consumption cost and less maintenance will realize the network remote operation and data maintenance. It can reduce the communication cost, promote the sensor network sensitivity with further application in the future.
Reference
[1] Wang Zheng-wan, Li Yuan-ying. Research and application of embedded Web data acquisition system based on ZigBee technology[J]. Electronic Design Engineering, (3):144-147, 2016
[2] Sun Jing-lin, Xu Feng, Zhao Ming-zhong. Collection system design of temperature and humidity data based on ZigBee technology[J]. Modern Electronics Technique, (21):163-164+168, 2011
[3] Xu Wen-zheng, Yu Jun-qi. The Embedded Wireless Gateway Design Based on ZigBee Technology for Energy Data in Large Public Buildings[J].Building Energy Efficiency, (2):38-41, 2012
[4] Zhang Li-li, Xu Yong, Sun Kai-yu. Development of wireless data acquisition system based on ZigBee technique[J].Experimental Technology and Management,(5):139-142,2012
[5] Zhong Wei-sheng, Shi Zhong-hua, Liu Lu-ren. Application of Embedded Web Server in Remote Daa Collecting System[J]. Instrument Technique and Sensor,(9):103-104+110,2012
[6] Gong Xian-chuang, Yang Wei-fa, Yang Dai-cai, Chen Ning, Xie Cong-gang. Design and Implementation of Wireless Meteorological Data Acquisition System Based on ZigBee Technology[J].Meteorological Science and Technology , (4):607-611,2015
[7] Han Cai-ning, Liang Xin-yue. Application of remote data acquisition system based on embedded web servers[J]. Microcomputer Application,( 10):21-22+28+4,2009
[8] Yang Peng-wei, One method of low-power Zigbee data collection. Science & Technology Vision, (5),142-143,2015
[9] Chen Xi-mei, Industrial Instrumentation Wireless Data Acquisition System Based on ZigBee, Industrial Control Computer, 22,p.1-2,2011