

Development of an Embedded Web Server System for Controlling and Monitoring of Remote Devices

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ABSTRACT

In today's world Internet is introduced into the control network. It improves the performance of traditional control network and also breaks spatio-temporal restriction. In this paper it is proposed to develop such an Embedded Web Server System in which the four layer TCP/IP protocol will be implemented inside ZigBee Protocol. The article designs an Embedded Web Server which is based on AVR Atmega 32.

Keywords: Embedded Web Server , Zigbee, ASP.Net, AVR, HTTP, CGI, Java.

1. INTRODUCTION

In comparison with PC, the embedded system is greatly improved in stability, reliability and safety etc. The embedded system transplanted web server can be called embedded web server. Through web page released by embedded web server, remote users can obtain the real-time status information and control remote equipments without time and space restriction. This type of Embedded Web Server has many advantages, such as small size, low power consumption, low cost and flexible designed. It's easy to implement, and it is an effective way of leading Internet into embedded system.

2. LITERATURE REVIEW

An Embedded web server which controls and monitors the remote devices has the advantages over the traditional monitoring system which are based on the PC and chip microprocessor.

Remote monitoring system based on chip microprocessor [1]

The chip microprocessor transplanted TCP/IP protocol is configured to an embedded web server which has data collection, storage and communication functions. The method can reduce development cost, but at the same time, it brings some difficulties in functional upgrading and expansion.

PC-based remote monitoring system [1]

PC is the central Part of remote monitoring system. The design can shorten the development cycle with the help of mature development tools on the PC platform. But it has some drawbacks as high cost, unsatisfactory stability and reliability. Moreover in the Client/Server architecture, the maintenance burden on the server would be heavy because some particular monitor software should be installed on each remote monitor terminal. In various Internet applications based on client server architecture, it is better to use embedded WEB server other than PC server for decreasing volume, cost and power consumption.

Remote monitoring system based on embedded web server[1][2]

Through Embedded Web Server System we can connect any electronic device to web server and can get the real time data of devices through the web pages released by the server. The method can overcome the problem of PC based monitoring system.

Proxy Server[3]

The proxy server is usually a PC in which TCP/IP protocols are realized so that it can be connected to the Internet. This method is also called central management or method based on gateway technology, which is the key technology that makes devices connected to the Internet. The devices connect to the proxy server in two ways:

- Devices connect to the pc ports directly, such as RS232, RS485, RF, parallel port, even USB. The technique is convenient to connect the device to the Internet. The development is not difficult. One deficiency of this technique is the limited number of PC ports. When a complex device is controlled, it is not enough to just use the PC ports. When several devices are needed to connect to the Internet, it increases the costs. As a result, this method has not attained popularity.
- Devices connect to PC through special interface card. In this way the device connected to PC need not only gateway but also the corresponding driver. Only after the comment from the user is converted into one identifiable format can it be executed correctly by the driver.

2.1. Protocol Consideration

The TCP/IP protocol is a four-layer protocol system which includes data link, network (including IP protocol), transport (including TCP protocol) and Application Layer. TCP/IP Protocol is implemented for the development of any web server and it is used for wired embedded web server through which devices are connected to the server via Ethernet network. Each layer in TCP/IP protocol has different communication function. Many applications can be implemented based on the TCP/IP protocol, such as HTTP, TELNET, FTP, SMTP, SNMP etc. The key is how to utilize the limited resource of the embedded system to process the information based on the HTTP, SMTP, POP3, TCP, UDP, ICMP, IP and PPP[2]. Thus, the message can be transmitted on the Internet as IP data packet and the data can be browsed in the embedded web page.

2.1.1 HTTP1.0

HTTP engine is the core of any embedded Web Server[1][2][4]. It is used to transfer the web pages from server to the

client.HTTP1.0 are easy to implement but it has some drawbacks .First problem with HTTP 1.0 lacks explicit cache control mechanism. The second major problem with HTTP 1.0 is that each HTTP request requires its own TCP connection. Third is Overload problem at the Web server.

2.1.2 HTTP1.1

HTTP 1.1 has overcome the drawbacks of HTTP 1.0 by adding explicit cache control mechanisms[1][2][4]. HTTP 1.1 allows for a single persistent TCP connection between the browser and the server for multiple HTTP transactions. It improves the performance of Web Server.

2.1.3 RARP

Reverse address resolution protocol is used for converting the physical address to IP address. It is used for static configuration of host. Serious problem with RARP is that the broadcasting is done at the Data link layer i.e. physical broadcast address does not pass the boundaries of the network[3].

2.1.4 DHCP

Dynamic Host Configuration protocol is used for dynamic configuration of host computer. It allows a computer to acquire all the configuration information it needs in a single message. The article present research works in which DHCP LAN configuration system will be connected to the Embedded web server .It overcomes the problem with BOOTP[5].

2.1.5 Directly implementation of TCP/IP

Directly implementation of TCP/IP Protocol[4] on the embedded microprocessor to let the device connect to the Internet. This method does not need operating system, so the required resource is saved. The required quality of the microprocessor is high and the development is challenging.

2.2 Software Consideration

2.2.1 Common Gateway Interface

CGI is the abbreviation of Common Gateway Interface[1][2][8][9]; it is a standard of connecting external application to server. It is a software module in Web server, and it can execute the script stored in the hard disk of the server, and exports dynamic information. Major Drawback of CGI is request processing and result display are executed on web server. That increases the load of web server.

2.2.2 JAVA Applet

Java Applet has some advantageous over CG Java Applet has some advantageous over CGI[1][2].

(1)Java Applet is a dependent java program which is embedded into HTML and interpreted by virtual machine in browser. Its development doesn't matter with software and hardware environment of server.(2) The compile results of Java Applet program 'Bytecode Files' reside on the host machine, only need to download to the target machine. That avoids cross compilation of CGI program.(3)Embedded web server merely exchanges data with Java Applet, but the display task of monitoring web is finished independently by Java Applet on browser. This working mode ensures the load balance between embedded web server and browser.

3. SYSTEM ARCHITECTURE

System architecture of An Embedded Web Server System which controls and monitors the remote devices is presented. The design of Web Server is based on AVR Atmega32 8 bit microcontroller. It has high performance RISC architecture.Atmega32 has a special feature of power on reset. The design is presented with four nodes of Zigbee Module. One node is the server node and the other three nodes of Zigbee module are connected to the remote devices. node one will be connected to the temperature sensor. Node two will be connected to the Sound Sensor and third node will be connected to Light sensor. All the three nodes will collect the real time data of the devices and send it to the server node. Server node will be connected to the computer through the RS232 ports. The User interface will be developed in ASP.Net Web pages. This embedded web server further will be connected to the Personal Computer System. Through the computer user can access, control, and monitor the remote devices.

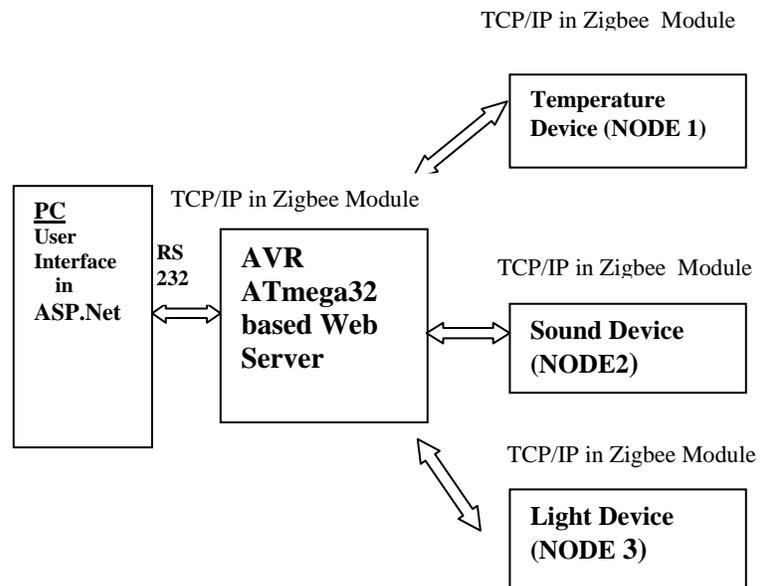


Fig.1.System Architecture of Embedded Web Server System

At each node TCP/IP, a four layer protocol will be implemented in Zigbee module. An HTTP Server will be developed at Personal computer .

3.1 Zigbee Communication Module

ZigBee wireless communication module is main part of the proposed architecture .In Zigbee Module a TCP/IP will be implemented . AVR Atmega32 is used as microcontroller. RF transceiver is the core of ZigBee device. Any ZigBee device should have a RF transceiver [6]. RF transceiver is different from general wireless transceiver for broadcasting in the respects of small size, low power consumption, support for battery-powered devices. RF transceiver is mainly responsible for modulation, demodulation, sending and receiving of signal. Microcontroller connects with the RF transceiver through the SPI bus. It is mainly used in RF signal processing, control,

coordinating all parts of the device and communicating with external devices through the serial port. ZigBee module also includes memory, crystal, antenna and serial ports (SPs) as shown in Fig. 2. When a ZigBee network node requests joining ZigBee WSN, it can set its own channel same with ARM microprocessor's channel and provides the correct authentication information. Similarly, when a ZigBee node requests to leave the ZigBee WSN, it only needs to request to the AVR ATmega 32 microcontroller. The AVR ATmega32 controls the node's leaving or joining the network.

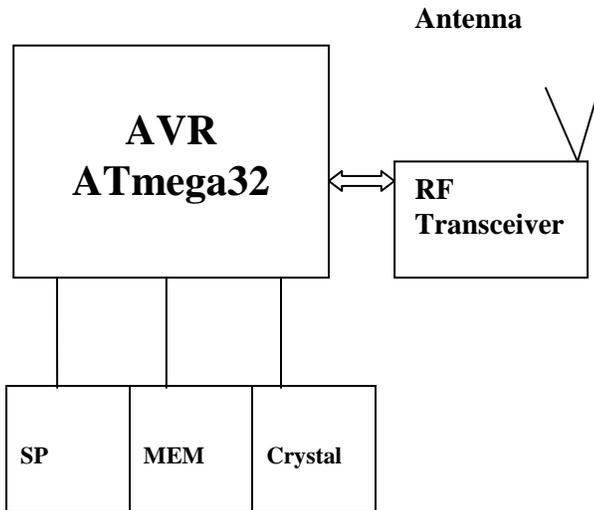


Figure. 2, Zigbee Communication Module

3.2 ASP.Net

ASP.Net is language independent. .Net is the ease with which it allows the exchange of data between various software applications. .Net proves to be useful when applications stored on remote systems have to communicate with each other through standard internet protocols like XML, SOAP. In this research design the front end will be developed in ASP.Net language through which user can access the information about the remote devices which are connected to the Web Server. The .Net improves the speed of communication between devices and web server.

3.3 Implementation of TCP/IP in Zigbee Communication Module

ZigBee protocol a five layer model, offers unique advantages for wireless applications, including low-cost radios, mesh networking. Zigbee Module is a basis in standards, and low power consumption. But with a technology this new, realizing a successful ZigBee implementation requires understanding its architecture and operation, assessing design options at the chip and module level, and weighing practical considerations relative

to specific application needs. Implementation of TCP/IP in Zigbee Module for connecting the remote devices to the Embedded Web Server will overcome the drawbacks of TCP/IP implementation.

4. CONCLUSION

In this paper an Embedded Web Server system design is proposed through which devices are connected via Zigbee Communication Module. The work proposed the TCP/IP protocol implementation in Zigbee Module. The design will overcome the drawbacks of Java Applet. In place of Java Applet ASP.Net will be used for development of user interface. User can control, monitor, and diagnose the problem with the remote devices.

5. REFERENCES

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