Prof. K. M. Pimple , Varun M. Fanje, Pankaj A. Patil, Siddharth K. Ganvir / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622
www.ijera.com Vol. 2, Issue 2, Mar-Apr 2012, pp.800-805

AN EMBEDDED WEB SERVER FOR EDUCATIONAL INSTITUTE

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ABSTRACT

In the future pervasive computing environment, people are surrounded by a great multitude of microcomputers that would be embedded in home appliances, factory devices, and so on. It is a better choice for these devices to be embedded a web server. Through this embedded web server users or administrators can access their equipments remotely, and many other things such as maintenance requests can automatically be done. Today very compact Embedded Web Servers are available and allow a wide range of applications. There are a lot of such devices on the market.

This paper describes in detail the implementation of a 16-Bit Embedded Web server based on a 16-bit Micro Controller and an Ethernet LAN Controller. A HTTP server is implemented to enable web based data acquisition and control. A key goal of the present paper is to provide an effective approach of access to traditional equipments that have no Internet interface

Keywords **- Embedded Web Server, embedded web server, microcomputers, Pervasive Computing.**

I. INTRODUCTION

The pervasive computing environments of the near future will involve the interactions, coordination and cooperation of numerous, casually accessible, and often invisible computing devices. These devices, whether carried on our person or embedded in our homes, businesses and plants, will connect via wireless and wired links to one another and to the global networking infrastructure. The result will be a networking milieu with a new level of openness. Otherwise, embedding a web server in a device or sensor allows users to access these devices from anywhere in the world utilizing a standard Internet Browser. New embedded system development platform and embedded web-server technologies are available and make it possible for equipment and sensor manufacturers to quickly develop sophisticated and easy-to-use graphical interfaces for their products. The availability of better tools for building web embedded systems, will further accelerate the pace of new web enabled products that are expected to become the preferred interface standard of the future. Along with simplifying and speeding product interface development, thus reducing costs, a web interface can also greatly extend the capabilities of field devices to provide functions such as: 1) automatically generate maintenance requests, 2) remote diagnostics, 3) remote firmware upgrading, and so on.

Therefore, this paper describes a new application of Embedded Web Server. Various devices can connect & control over internet by this Embedded Web Server. For example, imagine an air-condition has detected an eventual failure condition in its drive motor. The best the current generation of controllers or intelligent devices could do is writing to a log file and display a message on an operator interface to indicate that service was required. Through this use of web services, the air-condition's self-diagnosis of an error condition requiring a replacement motor may trigger a variety of actions within the supportive enterprise. A simple component failure can automatically set into motion a complex series of events (before the customer may even be aware of the problem). That ultimately results in a faster response to the problem and a high degree of customer satisfaction.

Embedded Internet (EI) is a new technology extended from traditional embedded system. 'Embedded' reflects the fact that they are one part of the system and can be embedded into any equipment, machinery and consumer appliance. Functionally it can be a powerful web server or other Internet interface. After embedded this server user can visit their devices through Internet conveniently anywhere at any time.

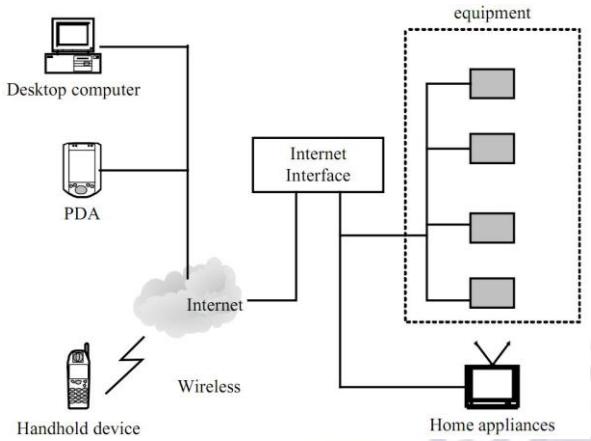

Figure 1: Structure of EI model

Our purpose in this paper is design a mini embedded web server and embedded it to kinds of devices so the different devices that can give user a uniform interface to access through a browser. In fact they only need a browser. It gives a uniform Internet interface to traditional equipments. It can be embedded in any equipment easily even your lamp.

The rest of this paper is organized as follows. In section 2, we discuss the realization of a TCP/IP protocol suite. In section 3 case studies of The Mini Web Server, its implementation & work experience. In section 4 we introduce the hardware description on which we realize the function of the embedded web server. In section 5 working of web server. In section 6 a conclusion is given out.

II. TCP/IP PROTOCOL SUITE

EMBEDDED SYSTEM USUALLY CONNECTED WITH DEVICES THROUGH NETWORK, SUCH AS RS232, RS485, CAN AND SO ON. BUT THESE NETWORKS HAVE THE LIMITED OF DISTANCE. MORE AND MORE USERS HAVE THE REQUIREMENT OF REMOTE CONTROL. INTERNET IS A LARGEST LOGIC NETWORK AND ANYWHERE ON THE EARTH IS CONNECTED ON IT, SO TRANSACT CONTROL INFORMATION THROUGH INTERNET IS A GOOD IDEA. NOW THE PROBLEM IS HOW TO CONNECT THE EMBEDDED SYSTEM ON INTERNET? THERE ARE TWO FEASIBLE METHODS: ONE IS CONNECT THE DEVICE WITH A PC, BECAUSE PC CAN CONNECT TO INTERNET AND DEVICES EASILY SO ALL INFORMATION CAN TRANSFER THROUGH THIS PC; ANOTHER METHOD IS TO REALIZE ALL NETWORK PROTOCOL IN DEVICES CHIP. I THINK THE LATTER IS A PREFER METHOD. PC IS HUGER THAN SOME EMBEDDED DEVICE AND EXPENSIVE THAN DEVICE SO THE FIRST METHOD IS NOT REALISTIC. TCP/IP PROTOCOL SUITE IS ESSENTIAL TO INTERNET APPLICATIONS. THERE ARE SEVEN LAYERS IN INTERNET STRUCTURE. IN EVERY LAYER THERE ARE LOTS OF PROTOCOL TO ACHIEVE THE SPECIALLY FUNCTION. THE INTERFACE OF EACH LAYER IS CLEARLY AND STANDARD.

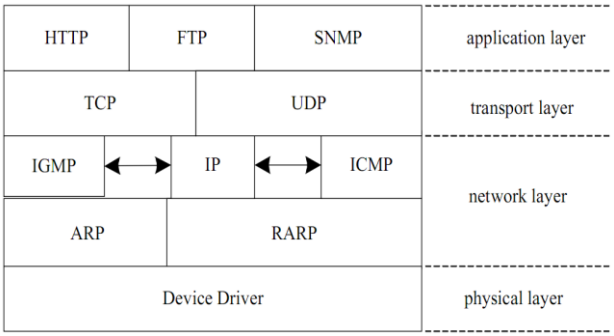

Figure 2: TCP/IP suite structure

A microcontroller with an embedded TCP/IP stack called an "Embedded Web Server" sends pages over a physical layer connection to a remote computer with a browser. The computer with the browser could be in the same room or on the opposite side of the globe. The browser reads the HTML formatting and displays a page in the browser window. The user can send data to the Server stack through a form on the web page, the form data is sent over the physical connection and is received by the TCP/IP stack in the remote microcontroller. The Server's stack then passes the submitted data to user code in program memory in exactly the same way that parameters are passed to a subroutine. The Server's application code then takes action over it and manages the system connected to Server I/O pin.

But not all the protocol in the TCP/IP suite is necessary for the Embedded Internet application. It is essential to filter out protocols that have to be supported in this embedded web server. Today's browsers can perform a myriad of tasks, the core task is receiving the data in an HTTP protocol packet and rendering the data, via appropriate formatting, in the browser area so that it can be read and understood by the user. WWW is the user-friendly interface, in which that image, formatted text, video, and audio are available. Users can access their equipment from any browsers. So TCP and HTTP is the basic need. In some special case user maybe prefer to use UDP protocol so we reserved UDP, ARP, RARP and ICMP as the basic function. In application layer some protocol just like SNMP and FTP is complex and seldom used in Embedded Internet applications so these protocols can be take off from the embedded Internet kernel.

Thus, the TCP/IP stack used in device was reduced specifically for embedded applications, with priority placed on performance and reduced code size. In comparison with a standard STREAMS based stack, the thin TCP/IP stack proved to be excellent and much smaller.

Simplicity and versatility were a major concern when designing thin TCP/IP configuration. It is designed to be uncomplicated, straightforward, and flexible. Using a TCP/IP connection, the web server is accessed over the Internet by a web browser to provide a graphical window into embedded devices. The web server generates web pages that are graphically displayed in the web browser. The server and the browser communicate via the HTTP protocol. The web server can be complemented with the embedded file system and the TCP/IP network utilities (such as TFTP server). Web files can be downloaded via TFTP tool to embedded device by the file system.

III. CASE STUDY: THE MINI WEB SERVER

The goal of this embedded web server is link to device and appliances, the small size of allow that it can embedded into any little appliances. We have built several applications using this mini web server here we present an example of application that allow users to control and monitor the state of various equipments in Educational institute. On the basic level we connect the water tank level controller system & automatic generator ON/OFF system. We connect water level sensors and maintain the water level in a tank. It sends the quantity of water and shows in a graph. The auto generator ON/OFF system activated when the sudden power failure. Sensor senses the failure of power and stars the generator with in a fraction of seconds. The failure of power doesn't affect the working of Web Server due to the provision of battery back-up system. All these activities are stored in a memory in the form of table.

Stability is another important parameter for this web server. When more than one user access the web server the kernel of Server must can deal with different task at the same time, if the robust of the kernel is weak the web server maybe power down. For the purpose of testing we do another experiment, from different computer access the same Server and catch the package of Server using package catch tool. This test lasted for 24 hours and the result of testing give out in Table

Table 1: Reliability Performance of Server

ICMP	TCP	ICMP LOST	TCP LOST
86400	207360	0	0

From above data sheet we can concluded that this web server is steady and good performance to control remote devices. Though the transfer speed is low but the complexity of the web server is released. This manner fit for the design purpose of EI.

IV. HARDWARE DESIGN

The design consists of two main components namely, a 16 - bit Micro Controller and an Ethernet Controller. The 16 - hit Micro Controller used in this design has 60KB of flash memory and 2KB of RAM. The Micro Controller also has six general purpose input/output ports of which three ports are used for interfacing with the Ethernet Controller and the rest are left for application development The Ethernet Controller chosen for this design has a highly integrated design, which reduces the amount and cost of external components, and has a very easy to handle bus interface. The supply voltage compatibility with the Micro Controller is another benefit. The following sections describe in detail the interfacing between the Micro Controller and the Ethernet Controller and also about the hardware design.

A. Interfacing to the Ethernet Controller

The most interesting thing in this design is the connection between the Ethernet Controller and the Micro Controller. The Ethernet Controller can operate in three different modes: I/0 space, Memory space, and as a DMA slave. All of these modes have their special advantages and disadvantages. For this design, the I/O space operation mode is the best choice. This is the default mode and is always enabled in the Ethernet Controller. The high point of this design is that of utilizing the full resources of the Ethernet Controller by configuring it in 16 - bit mode of operation. A 16 -bit width data bus is used to interface with the Micro Controller.

The Ethernet Controller in I/O mode is accessed through the 16-bit I/O ports that are mapped into 16 registers. To access them, a 4-bit address bus width is used. There are also two control lines used, IOR (I/O Read) and IOW (I/O Write). These signals are active-low and indicate whether there is a read or a write access in progress. These control signals are initiated by the Micro Controller. The Micro Controller places a valid I/O address in the address bus and drives one of the control lines (IOR, IOW) to low, so that data transfer over the data bus can take place.

B. Circuit Description

The Block diagram shown in the figure gives an overview of the interconnection between

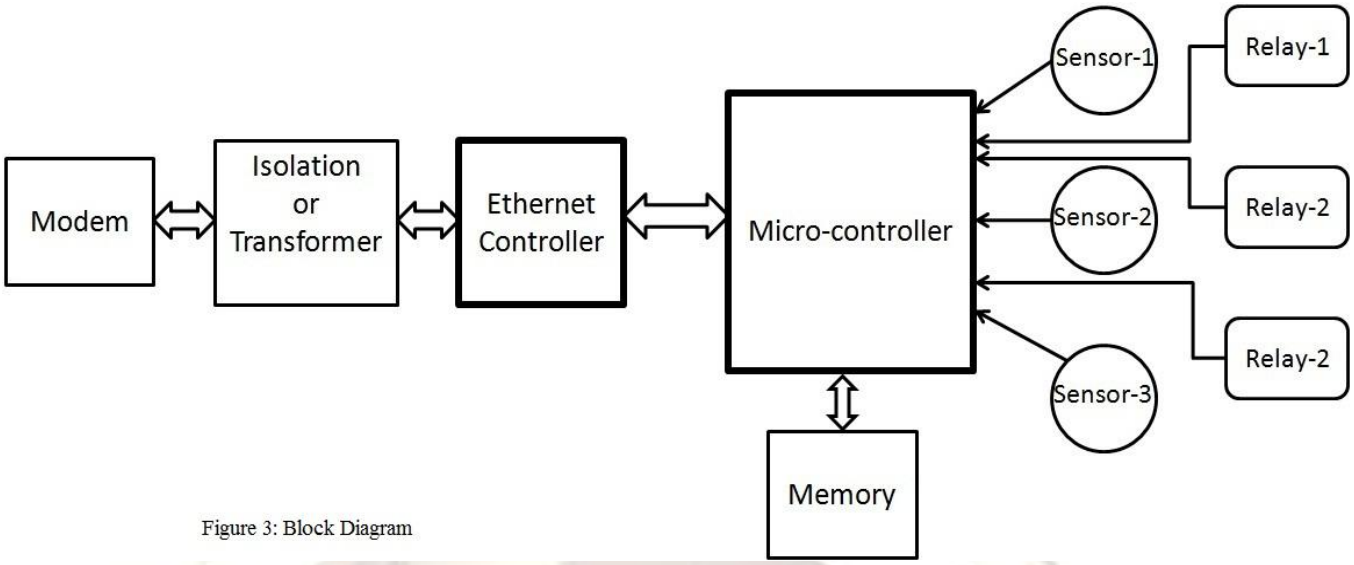

Figure 3: Block Diagram

various devices in the design. The resources of the Micro Controller are used in such a way that simultaneous processing of information from the various sensors and also to send/receive data over the internet via the Ethernet Controller is made possible. The full 16- bit operation of both the Micro Controller and the Ethernet Controller ensures no queuing up of data received from the internet. This is also complemented by the high speeds at which both the devices operate.

The Micro Controller forms the central part of the design wherein the respective Sensors are connected to it to perform the necessary functions. The Analog circuitry around the Ethernet Controller mainly consists of the isolation transformer and LEDs to indicate the status of the network link.

V. WORKING

It will let you house your own web site with possibly hundreds or even thousands of pages, all in a little box connected to the internet via your modem/router. You don't need a computer to operate and house a website - this little box does it for you and it can be accessed from anywhere around the world, at any time, even from a mobile phone which has a web browser. In fact, it is a complete web server - so we've called it Web Servers.

Everyone knows that web servers normally involve big, expensive, powerful computers with large memory, large hard disks and exotic software, don't they? Well, that is the normal approach but now it doesn't have to be. In fact, you don't even need a computer! Web Servers can do it all. Even better, it does not have a hard disk, uses practically no power and costs not much at all. Web Servers is just a small PC board (single- sided, no less) with a micro controller, an SD/MMC card reader and not much else. In fact, it involves a total of just three ICs and a 3-terminal regulator. Why has a memory card? This is the "Eureka!" feature: SD/MMC cards are used in the majority of digital cam- eras and they can pack a huge amount of memory for very little cash; we've an SD/MMC memory card to store the data and website. And it just grew from there. Having thought of the memory card as the bulk memory for the project and realizing just how cheap it was, the potential uses seemed to grow enormously. We are sure readers will come up with a host of different uses let's also be realistic. We need to describe how this Web Servers project works, how it connects to the intern and all the necessary know-how that this requires . There is a lot of jargon to be digested and understood but when we have finished describing Web Servers in considerable detail, we are sure that you will see the potential.

Web Servers presents a great learning opportunity for anyone interested in creating a personal website it will be great for schools, too. Project it lacks some features like server side scripting and encryption, for example, although for most applications, this won't be a problem. Its main advantage is that it is considerably simpler, cheaper and easier to set-up than a more powerful web server. In fact, if you have already gone through the set-up procedure for connecting a broadband modem to your computer, this project should not be any more challenging. Remote monitoring in most basic applications, control up to four digital outputs, The FTP (file transfer protocol) server allows you to store and retrieve files from a remote location and also allows you to manage your website remotely. In addition, you can use it to back-up files off-site or transfer files (both text and images) to a remote location The memory card can actually be an MMC, SD or SDHC card (up to 32GB). The website can include dynamic content that's constantly updated - you

will get emails from Web Servers -Protocol) client within the Web Servers.

In practice, the "Toggle" buttons Network time service if this address changes. By using this service, you can log into the web server using a domain name rather than its IP address (an IP address is numerical and all devices connected to the internet, such as your modem, have an IP address}. This is necessary as the public IP address can change if your modem is turned off for some time, so you might not always know what it is.

Earlier design and a PlC micro controller it came as a pre-built module and stored its web pages in an onboard EEPROM chip. Because the data was stored in an EEPROM, the website was limited to 64 kilobytes. Even so, it did allow remotely using dynamic web pages and had configurable I/O pins) output. By contrast, our new design can store much more complex web pages. Another advantage of the new design is that it implements simple file permissions through HTTP (Hypertext Transfer Protocol) authentication. This means that you can set a user name and password to access the whole website or just certain pages. You can also restrict access to certain files, based on the file extensions. The earlier design lacked a method of restricting access to its web pages and so its onboard website was completely open to the public. Finally, the Web Servers is highly configurable and can be set up to work with almost any Ethernet network Connectors on the back of your modem. Ethernet is a standard which is used .to transmit data over a local network or to the internet via a modem.

VI. CONCLUSION

We have introduced the general design concept of the mini embedded web server and the policy of TCP/IP, especial the TCP, whose goal is to allow easy access to and exploitation of remote equipment. This mini web server gives the common devices an Internet interface and gains a good performance. It can be used broadly in industry, medical, and other fields, more important it can bring us a new home life& helps in an offices. With the mini web server embedded, we will begin to see the application of computing technologies in settings where they are unusual today's device and appliance networking in the home; faithful capture of scientific experiments in the laboratory and automated full-time monitoring of patient health.

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