

# Embedded Web Server Based Automation

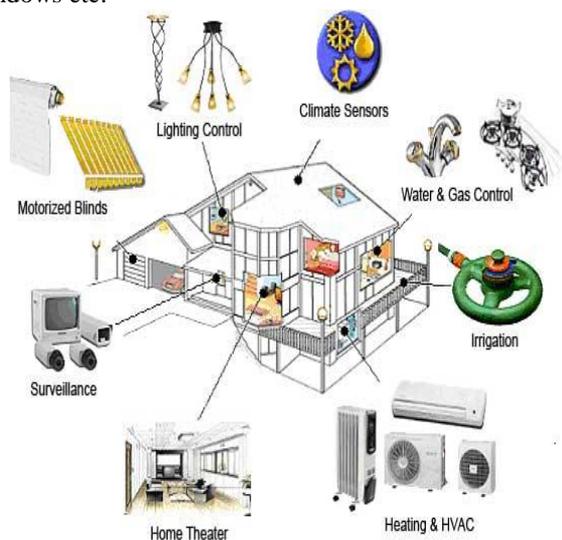
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**Abstract**— Instead of PC based servers; ARM processor based servers are becoming trend of today's market. Cost reduction is achieved using ARM processor along with Ethernet module as Embedded Web Server. Idea is utilized for monitoring and controlling maximum no. of either home appliances or industry devices. Without using a computer, Ethernet module can communicate to the owner of the overall system, who is able to manage appliances from any location outside. This server provides a powerful networking solution and enables web access for automation and monitoring of different systems. For industry automation, instrumentation and household devices control, this is an optimized solution. System home page can be accessed using web browser. Operational status of the appliances can be observed and changed in case of necessity. This paper proposes development of low cost system for above purpose. Different sensors installed at working place help in sensing real time environmental conditions like temperature, light, humidity etc.

**Index Terms**— ARM, Monitoring, Automation, Embedded Web Server, DACs

## I. INTRODUCTION

Web server hosts a web site and provides reliable services for any requesting client. Any general purpose web server is composed of some kind of operating system, fast processor, special purpose hardware, large amount of memory, running applications and few web pages [5] etc. Such web servers are developed using general purpose computers. They use different kind of operating systems such as NT, Unix, Linux Windows etc.

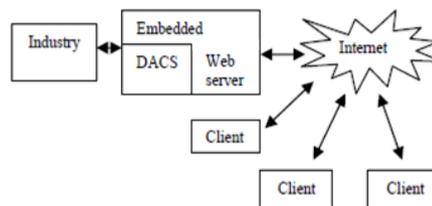


**Fig. 1. Different Devices Connected For Automation**

Such systems apply typical client-server architecture where, the client accesses the server through the LAN router and the Internet. Client sends the request to the server. This request is processed by the router to connect to the Internet. The web

processes the request made and finally connects to the desired web server. Requested data is sent to the client. An embedded web server is a microcontroller including software and application code to monitor and control the systems. Microcontroller or ARM processor is an integral part of an embedded network and create a way for easy controlled activities of any device from any remote location. Such servers designed using very low resource usage, are highly reliable, portable and secure systems.

## II. ARCHITECTURE



**Fig. 2. Embedded Web-Server Architecture**

A web server can be embedded in a device to provide remote access for various appliances located at home or industry. The embedded system stores static and dynamic information about industry machineries, systems and provides the same to web browsers on demand. Such type of web server is called an Embedded Web Server. This server is an ARM processor with Ethernet module containing system software and application code for overall automation process. Embedded web servers are integral part of an embedded network. Fig. 2 shows concept of data acquisition system with embedded web server on a single chip module. This is a single hardware which contains program with portable ARM processor. ARM processor is the responsible part for measuring signals and controlling the devices remotely. Measurements can be done with DACs and the data are shared with clients through embedded web server. The system is completely designed to manage all the tasks such as measuring signals, conversion of signals, data base updates, sending HTML pages to client and communicating with owner of the system using authentication password etc.

## III. WORKING OF SYSTEM

Sensor inputs are connected through signal conditioning circuits to ARM Controller. It processes on these signals (conversion from analog to digital) and then parameter values are stored in the memory. Status of the working devices or appliances is decided on the basis of stored values. Relays can be operated ON or OFF to change the status of devices as per

our requirement. By comparing the standard values of parameters to be tested, further status of devices is decided. Thus purpose of automation works. For controlling the devices using web browser, owner of the system has to access the webpage and change the settings. Software code will be written in Embedded C for all actions. It will be transferred to processor using serial port. Serial port is interfaced using driver/receiver interface. Sensed data is processed by microcontroller and continuously provides feedback to the website. Ethernet module plays an important role in transferring web pages to the client. Web page code is designed in HTML and uploaded on server using Ethernet module and TCP/IP address.

#### IV. ETHERNET MODULE

The Ethernet specification (IEEE 802.3) has evolved over the last number of years to address higher transmission rates and new functionality. For this project selected Ethernet module is WIZ810MJ. This network module includes W5100 (TCP/IP hardwired chip, include PHY), MAG-JACK (RJ45 with X'FMR) with other glue logics. It can be used as a component and no effort is required to interface W5100 and transformer. The WIZ810MJ is an ideal option for users who want to develop their Internet enabling systems rapidly. WIZ810MJ consists of W5100 and MAG-JACK.

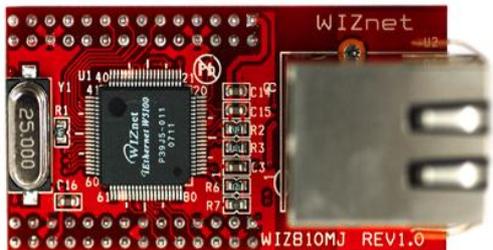


Fig 3: Ethernet Module

##### A. Ethernet Specifications

- TCP/IP, MAC protocol layer : W5100
- Physical layer : Included in W5100
- Connector : MAG-JACK(RJ45 with Transformer)
- RJ-45 Connector RDA - 125BAG1A
- Input Voltage : 3.3V Internal Operation and 5V Tolerant I/Os
- Power Consumption : 10/100 base T : Max 185mA (3.3V)

##### B. Features

- Supports 10/100 Base TX
- Supports half/full duplex operation
- Supports auto-negotiation and auto crossover detection
- IEEE 802.3/802.3u Complaints
- Operates 3.3V with 5V I/O signal tolerance
- Supports network status indicator LEDs

- Includes Hardware Internet protocols: TCP, IP Ver.4, UDP, ICMP, ARP, PPPoE, IGMP
- Includes Hardware Ethernet protocols: DLC, MAC
- Supports 4 independent connections simultaneously
- Supports MCU bus Interface and SPI Interface
- Supports Direct/Indirect mode bus access
- Supports Socket API for easy application programming
- Interfaces with Two 2.0mm pitch 2 \* 14 header pin

#### V. WEB SERVER CONFIGURATION

Complete implementation of an HTTP Web Server in an ARM7 microcontroller is possible. The website pages are stored inside the program space of the ARM7 microcontroller. Web server includes pages to be delivered to the browser. Using any standard web browser on any PC you can access the web pages displaying information about temperature, light intensity etc. Uploading any changes to present data into flash memory is possible and it allows to change the status of any device connected into the system. The web server implements different protocols such as ARP, IP, IGMP, TCP, UDP, HTTP for overall operation. Initially the server is configured by entering IP address to the Ethernet module and tested for the working using ping command. Now the embedded web server is responding to the clients. Request is made to embedded web server, by typing the IP address of the server in the client's browser. This request is taken by the OS of the client and given to the LAN controller of the client system. The LAN controller sends the request to the router which processes and checks for the system connected to the network with the particular IP address. If the IP address entered is correct and matches to that of the server, a session is established and a TCP/IP connection is established. Web server starts sending the web pages to the client.

#### VI. CONCLUSION

With the rapid development of the field of industrial process control and the wide range of applications of network, intelligence, digital distributed control system, it is necessary to make a higher demand of the data accuracy and reliability of the control system. This embedded ARM system can adapt strict requirements of the data and parameters in such a way that it is utilized to control and automate all present systems. Their function, reliability, power consumption, and remote access are taken care by the existing system and can be expanded to suite some additional features. This system can be widely applied to electric power, petroleum, chemical, metallurgy, steel, transportation, Electronic & Electrical industries, Automobiles and so on. The designed system can be expanded for controlling more no. of devices and same can be tried out for wireless communications using GSM, GPRS, Zigbee etc.



ISSN: 2277-3754

ISO 9001:2008 Certified

International Journal of Engineering and Innovative Technology (IJET)

Volume 2, Issue 9, March 2013

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