An Embedded Web Server

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Abstract: As computer networks and embedded Internet technology rapid development of embedded systems in industrial production and daily life have been widely used. Embedded real-time operating system and dedicated hardware structure of Internet users around as long as you can at any time, any place using the system remote monitoring and control of embedded devices. The proposed system is Implementation of TCP/IP Ethernet web services on AVR for embedded Ethernet applications. AVR microcontroller can communicate SPI interface and can transmit data to remote host computer through Ethernet ENC28J60 interface. AVR acting as a standalone web server, with controls for various input and output transducers. The web page(s) will allow monitoring of traducers and status of the different devices. Remote device we can control through TELNET service. AVR development board and ENC28j60 will be used to test the built applications.
Key words-EthernetATmega328P,RJ45.

1. INTRODUCTION

Embedded system is an intelligent system that has the capability of processing, monitoring and controlling. It may comprise of Sensors, Microcontrollers, FPGA, ASIC, etc. It typically has a specialized function with programs stored on ROM. Examples of embedded systems are automatic environmental systems, security systems, and entertainment systems. An added feature in any embedded system is its ability to communicate. The communication can be via Bluetooth, WI-FI, GSM, or Ethernet cables. The TCP/IP protocol is a widely used standard for modern digital communication

Web service is a common internet application that enables interactions of machine over a network. As to establish a ubiquitous internet, enabling web services on embedded systems is certainly among the development trend in near future and it is an processing, monitoring and controlling. The TCP/IP protocol plays the major role for the internet and networks worldwide. Monitoring remotely the status of our embedded system using a web browser or sending an alert whenever a service is needed, all these are made possible with embedded Ethernet. As the embedded system it has the performance of network and human-computer interaction. Powerful microcontrollers are used as parts of most home and office appliances of today. Integrating web servers to these intelligent devices will aid in controlling such devices over the Internet and also creating user interfaces for them in the form of web pages. Assigning multiple functionalities to a single button help manufacturers economize user interfaces but, this makes them more complicated. Since the cost of web-based interfaces is considerably low, they can be used to provide the infrastructure for the design of simple and more user friendly interfaces for Industrial and household appliances. Also, a web page based interface is much easier to change, when needed, as compared to a hardware interface.

AVR processor based embedded Ethernet interface web service designed.AVR processor doesn't have inbuilt Ethernet module so to interface with the PC we are using a microchip ENC28J60 stand alone Ethernet controller, which is a 28 pin, 10BaseT controller. It minimizes the complexity, board space and the cost is less. Here interfacing

2 ENC28J60 PERFORMANCE ANALYSIS

Ethernet as a cheap, efficient Internet access method, has been very widely used. The TCP / IP protocol stack is embedded into the microcontroller, using Ethernet controller MCU access to the Internet and data transmission. The client browser, the user can browse these embedded devices, dynamic information, and also can be achieved with the system's interactive features.Traditional embedded system development, the choice of an independent Ethernet controllers, such as the RTL8019, AX88796L, DM9008, CS8900A, LAN91C111 such as are for the personal computer systems

ISSN: 2278 – 909X

designed. These devices are not only complex, bulky and high cost. ENC28J60 is a Microchip Technology has introduced a 28-pin stand-alone Ethernet controller. Ethernet controller on the market most of the package are more than 80 pins, while the IEEE 802.3 protocol ENC28J60 line with only 28 pins, both provide the corresponding functionality, but also greatly simplify the related design, reducing the space. In addition to technical advantages, for some there are restrictions on the size of small embedded devices, the use of ENC28J60 is the best option.

ENC28J60 is composed of seven main functional modules:

1. SPI interface: to serve as the primary controller and the communication channel between ENC28J60.
2. Control register: used to control and monitor ENC28J60.
3. Dual-port RAM buffer: for receiving and sending data packet.
4. Preferred device: When the DMA request transmit and receive modules, the right to control access to buffer RAM.
5. Bus Interface: SPI receive through the data and command parsing.
6. MAC (Medium Access Control)modules : implementation in line with IEEE802.3 standard MAC logic.
7. PHY (physical layer) modules: the simulation of the twisted-pair data on the encoding and decoding.

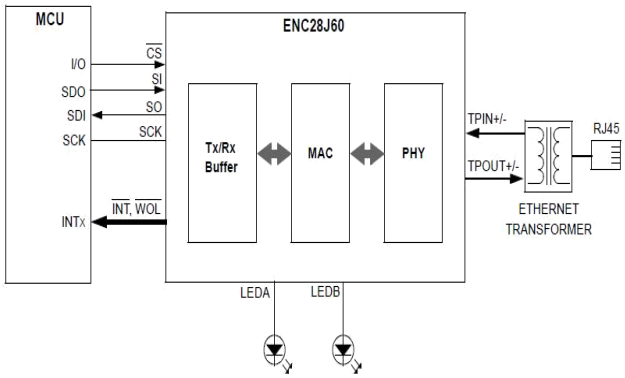
ENC28J60 working voltage is 3.3V, easily integrated into 5V systems, SPI of the CS, SCK, and SI input and RESET pin can withstand 5V voltage. When the SPI and interrupt inputs from the ENC28J60 on a CMOS output driver, through a one-way level converter. LEDA and LEDB pins to support the automatic reset when the polarity detection, in these two pins to pull current lit LED. When a system reset, ENC28J60 will detect the connection LED.

ENC28J60 all the memories are a way that a static RAM, the memory type of Ethernet buffer, respectively, control registers and PHY registers. ENC28J60 control registers used for configu-ration, control and status access, through the SPI interface to read and write these control registers directly. Ethernet buffer contains an Ethernet controller for use to send and receive storage space. Host controller can use the SPI interface, the capacity of the storage space program. PHY registers used for PHY module configuration, control and status of acquisition, not through the SPI interface to directly access these registers. Access Ethernet network module using the ENC28J60 program compared to other programs, the module is extremely streamlined. Microcontrollers that do not open the bus, although the possibility of using simulation of a parallel bus connections to other Ethernet controllers, but no matter from an efficiency or performance, not as good as with the SPI interface, or using general-purpose I / O port simulation SPI interface ENC28J60 to program.

3. OVERALL ARCHITECTURE

The proposed system complies the architecture depicted in As shown in the figure, the overall architecture can be split in two main parts: a local network and a remote controlling one. Through this network we intake the voltage deviations. Voltage variations can affect all the interconnected devices. The acquisition device, which acts as a transducer, is connected to the channel and it produces an analog voltage proportional to the voltage phase. Then this voltage is sent and it is converted into a digital signal in order to be encapsulated into an RJ-45 Ethernet frame. Using this serial bus, the transducer is connected to an embedded web server implemented using the ENC28J60 (10 Mbits Ethernet controller) produced by Tuxgraphics, whose description will follow in the next sections. The embedded web server is connected to the Internet by a RJ-45 connector physically

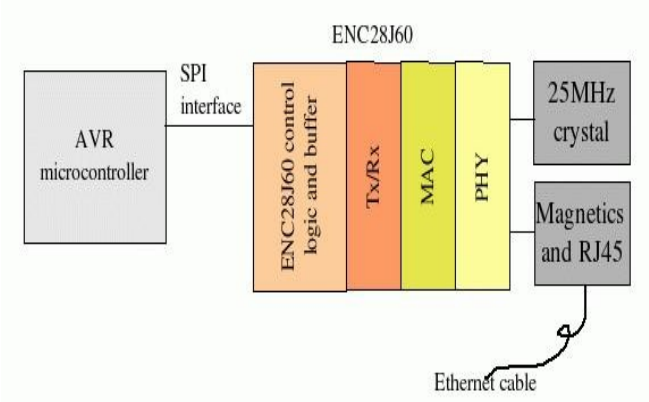
ISSN: 2278 – 909X



4. Implementation

The web server was realized using the Tux graphics AVR Ethernet. The Ethernet module is depicted in Fig. The AVR is based on an 8-bit RISC processor with 25 MHz clock. Depending on the specific type of the modules,

also processor with a different clock can be used. The operating voltage of this Processor is of 5V. They have 3.3V CMOS compatible serial ports, too. So, these modules can be easily connected to SPI (Serial Peripheral Interface) and I2C (Inter Integrated Circuit) devices. Referring to the memories, the ATmega 328P has a 512kB flash memory, 512kB program execution SRAM, 512kB data SRAM. The operating code data can be stored permanently into the flash memory using an AVR USB500v2 programmer. The ENC28J60, Ethernet controller chip. It has Tx/Rx, MAC and PHY in one small chip. The Schematic block diagram of the AVR controller along with the Ethernet controller is as show in the Fig.



We have generated a cross compiler for ubuntu v9.04.The operating code written is then stored into the flash and it is executed when the module is powered on. Tuxgraphics AVR module has not an Operating System: in this way the boot time is very short because it has the only commit of loading the operating code. Finally, the operating code sets the file system and manages the network protocols and the network access. Our application using IEEE 802.3 (Ethernet) only. Referring to the higher levels of the TCP/IP stacks, the language C manage both TCP and UDP connections and a wide range of application level protocols, such as HTTP, SMTP, and FTP. More information about the module description, including the processor and the I/O of the development board can be found

5. Web Server Pages

This section addresses the web pages design. The proposed prototype has embedded server pages that are stored into the flash of the embedded web server. The employed web pages are both static and dynamic. Static HTML pages are used in order to view contents that do not change, providing only an informational view, while dynamic pages are used to manage data that can vary. The dynamic update is performed using

CGI functions that will be explained in next section. Specially, the developed prototype includes the following pages:

1) Home Page
2) Status and Control

This file is very useful to detect also the duration of each event in order to provide the right classification among the power quantities. Other settings can be made by a web form that can be accessed only by the designer/manufacture. It contains several settings: the automatic refresh time (default 5second).

This section covers the realized prototype test. So, using the screenshots coming from the developed application we will show how it is possible to use the proposed data acquisition system for a controlled channel. For that we have to reach the embedded web server by typing its address into the web browser (for example we tested the prototype in a LAN, where the server has the

ISSN: 2278 – 909X

10.0.0.40 address). This produces the login form of Fig. 4. During the programming stage we set the credentials of the authorized users. After a successful login it is possible to reach the home page of the Heater status/control page Basically it addresses to all the other contents of the application.

6. CONCLUSIONS

A remote controlling systems/Heater control based on embedded Web server is designed for Industry application, in this paper. The system adopts Browser/Server mode and control the remote Heater/Motor. Therefore, remote users can control and manage the operation using a Web browser over the internet. It has advantages of small size, longer work time and stable performance. It is applicable to a variety of fields such as industrial control, medical, instrument etc. Further the same system can be used in alarm system for a building or area network, depending upon IP's, static or dynamic.

Because of interfacing of an electromechanical relays AC applications can also be controlled by any PC in the LAN. The electromechanical relays are specially used to seperate two different circuits operating at two different power supplies. The low cost is also one of the features of this system as compared with other systems in the network the system we designed is very low cost effective.

The new program an be easily downloded into the microcontroller by using ISP programming feature of microcontroller.

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ISSN: 2278 – 909X