Implementation Of Tcp/Ip Ethernet Webservices Based On Arm7

K.Manasa, T.Swapnarani
Electronic and communication engineering
Embedded System (M.TECH)
CMR college of Engineering & Technology (JNTUH), HYD, AP
manasakrishnaes@gmail.com,swapna4aruna@gmail.com

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 ARM7 LPC2148 for embedded Ethernet applications. ARM microcontroller can communicate SPI interface and can transmit data to remote host computer through Ethernet ENC28J60 interface. ARM 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. LPC2148 development board and ENC28j60 will be used to test the built applications.

Keywords-*ARM7;LPC2148, ETHERNET;SPI*

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 intelligent system that has the capability of 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.

ARM7 processor based embedded Ethernet interface web service designed.ARM7 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

between the microcontroller and Ethernet controller is done through SPI.

2.SYSTEM DESIGN

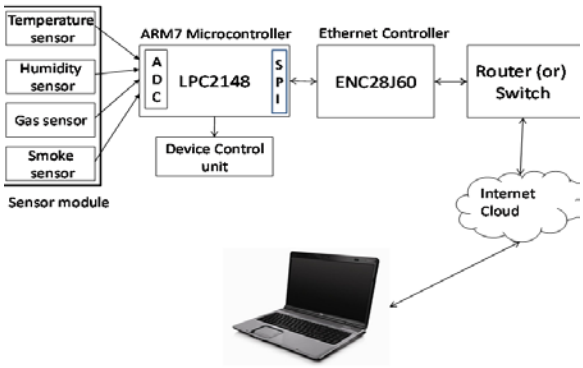


Figure 1.System Structure

The block diagram of the proposed system is shown in the above figure. It is divided into four parts: Sensor unit, ARM processor. Ethernet controller and PC.As in the figure the block diagram of the system consists of sensor unit which is of four sensors. They are temperature, gas humidity and smoke sensors. The second part is ARM7 processor based LPC2148 microcontroller. The third part is Ethernet controller ENC28J60 microchip. It is a standalone Ethernet microcontroller. Finally the last part is a PC in which we can monitor the status of our sensors. The controlling of our status is done by using a telnet. The status of our input is observed on http web page. The web page here is a dynamic web page. In the Ethernet interface module, the collected data are uploaded to a PC via Ethernet interface by using the functions of general purpose operating system and the commands from the host computer are received commands to control the data acquisition system.

3. MODULE DESIGN

A.SENSORS:

1. TEMPERATURE SENSOR

LM35 is a precision integrated circuit temperature sensor whose output voltage is linearly proportional to the centigrade temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. In this work we can see the change in sensor for every 1 degree Celsius. In voltage we can say for every 10mV we can see the change. This sensor working depends on the Ohm's law. Since it is suitable for remote applications we are using this sensor for monitoring and controlling the temperature.

2. GAS SENSOR

MQ-6 is a gas sensor which is high sensitivity to LPG, isobutene and propane and low sensitivity to alcohol, smoke. It gives a very fast response which is stable and has a long life. They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, iso-butane, propane, LNG, avoid the noise of alcohol and cooking fumes and cigarette smoke. The MQ-6 sensor has 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current. Resistance value of MQ-6 is difference to various kinds and various concentration gases. So, when using these components, sensitivity adjustment is very necessary.

3. HUMIDITY SENSOR

To measure humidity, amount of water molecules dissolved in the air of polyhouse environments, a smart humidity sensor module SY-HS-220 is opted for the system under design. The humidity sensor is of capacitive type, comprising on chip signal conditioner. It is mounted on the PCB. The PCB consists of CMOS timers to pulse the sensor to provide output voltage. Moreover, it also consists of oscillator, AC amplifier, frequency to voltage converter and precision rectifiers.. Moreover, it also helps to provide impediment to the noise. The humidity sensor used in this system is highly precise and reliable. It provides DC voltage depending upon humidity of the surrounding in RH%. This work with +5 Volt power supply and the typical current consumption is less than 3 mA. The humidity sensor takes the humidity from the atmosphere as the input and gives electrical signal as the output.

4. SMOKE SENSOR

In this work we are using a smoke sensor MOC7811.MOC7811 is a slotted Opto isolator module, with an IR transmitter & a photodiode mounted on it. This is normally used as positional

sensor switch (lima switch).Actually it has four legs. 2 legs for diode and 2 for transistor, the four legs are cathode, anode, collector and emitter. Both are inbuilt, no external connection required. Of course, current limiting resistance is required. Operation is very simple.

B.SPI INTERFACE

SPI is used when few I/O lines are available. But to do so communication between two or more devices must be fast and easy to implement. It allows serial communication between two or more devices at a high speed and is reasonably easy to implement.SPI is 4 wire serial bus protocol. It contains MOSI, MISO, SS, SCLK wires. It supports full duplex communication. It consists of multiple slaves and single master. It is best for point-to-point streaming data. SPI is a Synchronous protocol. The clock signal is provided by the master to provide synchronization. The clock signal controls when data can change and when it is valid for reading. Since SPI is synchronous, it has a clock pulse along with the data. RS-232 and other asynchronous protocols do not use a clock pulse, but the data must be timed very accurately. Since SPI has a clock signal, the clock can vary without disrupting the data. The data rate will simply change along with the changes in the clock rate. This makes SPI ideal when the microcontroller is being clocked imprecisely, such as by a RC oscillator.

C.PROCESSOR MODULE

Processor module is the core part of the design, in which the ARM chip LPC2148 is used to complete the complex operation.LPC2148 microcontroller is based on a 32/16 bit ARM7TDMI-S CPU with real time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. Due to their tiny size and low power consumption, LPC2148 is ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. A blend of serial communications interface ranging from a USB 2.0 Full Speed device, multiple UARTs, SPI, SSP to I^2Cs, and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers particularly suitable for industrial control

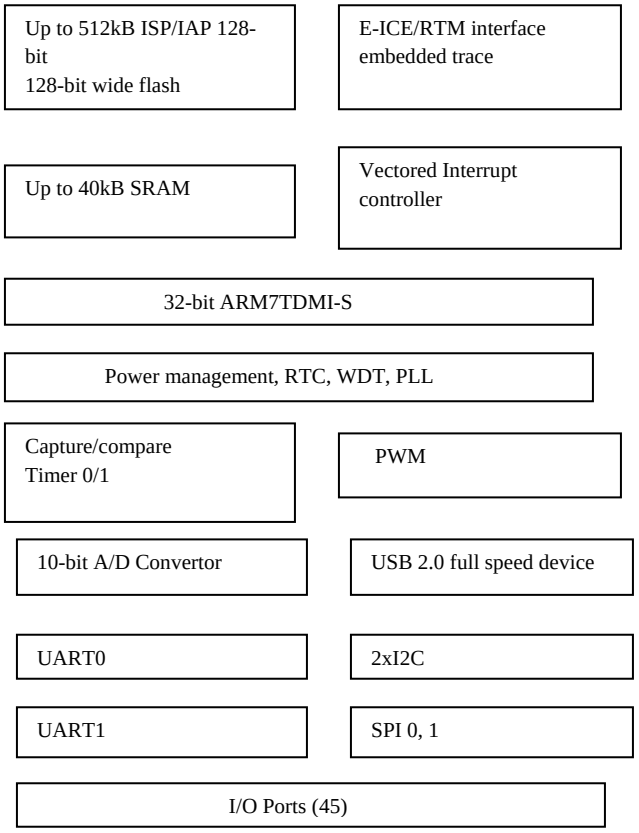


Figure 2:LPC2148 BLOCK DIAGRAM

D.ETHERNET MODULE

The ENC28J60 is a stand-alone Ethernet controller with an industry standard Serial Peripheral Interface (SPI). It is designed to serve as an Ethernet network interface for any controller equipped with SPI. The ENC28J60 meets all of the IEEE 802.3 specifications. It includes a RJ45 socket with activity lights and integrated transformer. This Ethernet module enables to connect a particular embedded device onto a network. It works with any microcontroller operating at 3.3v or 5v.The circuit board includes all required components for the Ethernet controller, a 3.3v voltage regulator and a RJ45 jack with integrated transformer and built in link and activity LEDs for connection to an Ethernet

local area network. Microchip provides a driver for the ENC28J60 and a TCP/IP stack including an HTTP web server. Web pages are stored in external and internal eeprom.This firmware is written in C. The ENC28J60 is designed to operate at 25MHz with a crystal connected to the OSC1 and OSC2 pins. The ENC28J60 does not support automatic duplex negotiation. If it is connected to an automatic duplex negotiation enabled network switch or Ethernet controller, the ENC28J60 will be detected as a half-duplex device. To communicate in Full-Duplex mode, the ENC28J60 and the remote node (switch, router or Ethernet controller) must be manually configured for full-duplex operation.

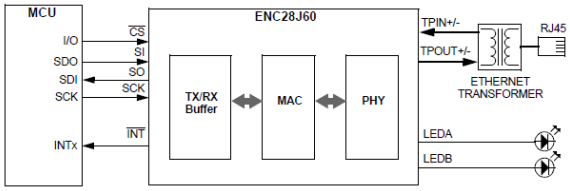


Figure 3 : Typical ENC28J60-Based Interface

3.SOFTWARE REQUIREMENTS

A.KEIL ARM

µVision is a window-based software development platform that combines a robust and modern editor with a project manager and make facility tool. It integrates all the tools needed to develop embedded applications including a C/C++ compiler, macro assembler, linker/locator, and a HEX file generator. The µVision IDE and Debugger is the central part of the Keil development tool chain and has numerous features that help the programmer to develop embedded applications quickly and successfully. The Keil tools are easy to use, and are guaranteed to help you achieve your design goals in a timely manner.

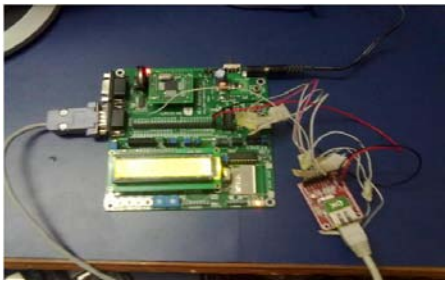
B.FLASH MAGIC

Flash Magic is loaded being performed. This means that other applications that need to use the COM Port, such as debugging tools, may be used while Flash Magic is Windows software from the Embedded Systems Academy that allows easy access to all the ISP features provided by the devices Flash Magic provides a clear and simple user Under Windows, only one application may have access the COM Port at any one time, preventing other applications from using the COM Port. Flash Magic only obtains access to the selected COM Port when ISP operations are being performed. This means that other applications that need to use the COM Port, such as debugging tools, may be used while Flash magic is loaded. To download the hex file into the microcontroller board we use a programmer called flash magic tool.

4. TESTING THE DESIGN

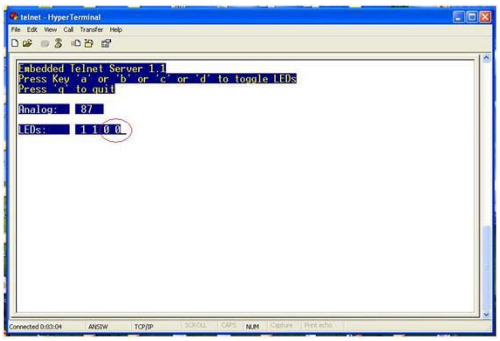
After the software and hardware have been completed the generated codes are compiled and downloaded to the target system for testing. The codes include hardware system start-up code, general purpose operating system, Embedded C.In this system PC is used to monitor the status of the transducers.IP address and subnet mask are set in both computers to know that the communication between them is in the same network. When the IP address of host is given as input by ping command, the result shows that the Ethernet is connected between the computer and ARM7.

Hardware unit



Webpage

Telnet Control unit



5. DISCUSSION AND CONCLUSION

In order to monitor and control the sensors data with SPI interface to network, a embedded Ethernet interface based on ARM processor is designed. Here TCP/IP is used which defines a set of rules to enable computers to communicate over a network, specifying how data should be packaged, addressed, shipped, routed and delivered to the right destination. Here telnet is used to control the application. Telnet is user command and an underlying TCP/IP protocol for accessing remote computers. Through telnet, an administrator or another user can access someone else's computer remotely. On the web, HTTP and Telnet protocols, allow to request specific files from remote computers. This design can be widely used in remote data monitoring and controlling the system in industry as well as family.

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