

# Tcp/ip based multi-device programming circuit using arm

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## ABSTRACT

Nowadays both embedded internet technology and network of computers widely used in domestic home applications as well as in industrial production. Numbers of internet users are widely using embedded technology and computer network for their applications by using the system remote monitoring and control of embedded devices. The proposed system is to program multiple devices connected to ARM LPC2148 using embedded internet technology. With the help of SPI interface ARM microcontroller can transmit data to remote host computer through Ethernet ENC28J60 interface. Programming/controlling through host computer can be done by sending and receiving packets to devices connected to ARM processor. ARM is a standalone web server which provides controls for various input and output transducers. The monitoring of transducers and status of different devices can be done through web page(s). Using TELNET service, remote devices connected to ARM can be control. ARM LPC2148 development board and Ethernet ENC28J60 will be used to test the build applications.

**Keywords – Ethernet ENC28J60, ARM7, LPC2148, SPI**

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## I. INTRODUCTION

Embedded system has the capability of controlling, monitoring and processing. It includes microcontrollers, sensors, ASIC, FPGA, etc. Examples of embedded systems are security system, entertainment system and automatic environmental system. Embedded system has capability to store programs on ROM. Communication is an additional feature of any embedded system. In embedded system communication can be via WI-FI, Bluetooth, Ethernet cables or GSM. TCP/IP protocol is mostly used for digital communication. Web service enables interactions of a machine over network. To build ubiquitous internet, allowing web services on embedded systems is certainly among development trend in near future and it is an intelligent system which has capability of controlling, monitoring and processing.

The TCP/IP protocol mostly used for the networks and internet all over the world. With embedded Ethernet it is possible to monitor remotely the status of embedded system using a web browser or sending alert when a service is needed. Embedded system has the human-computer interaction and performance of network. Nowadays powerful microcontrollers are used as parts of office and home appliances. By integrating web servers to intelligent devices will help in controlling such devices over Internet and also create user interfaces for them in the form of web pages. As the cost of web-based interfaces is low, they can be used to provide infrastructure for design of simple and user friendly interfaces for household and Industrial appliances. Another advantage is web page based interface is easier to change, when needed, as compared to hardware interface.

ARM7 LPC2148 processor based embedded Ethernet interface are web service designed. ARM7 LPC2148 processor does not have onboard Ethernet module so to interface with PC we are using ENC28J60 stand alone Ethernet controller, which is 28 pin, 10 BaseT controller. This Ethernet controller minimizes the complexity, board space and also cost is less. In this interfacing between Ethernet controller and microcontroller is done using SPI.

## II. SYSTEM DESIGN

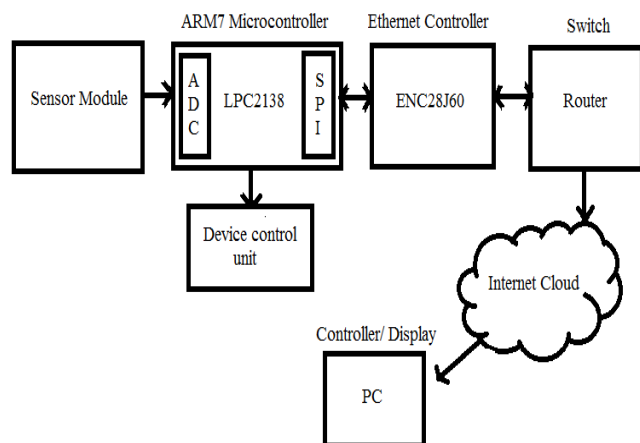


Fig1. Proposed block diagram of system

The block diagram of the Ethernet web services based on ARM7 system is shown in the above figure.

It is divided into four parts:

- Sensor module
- ARM processor
- Ethernet controller and
- PC

As in the figure 1 the block diagram of the system consists of sensor unit which is of different types of sensors. The second part is LPC2148 microcontroller from ARM7 processor family. The third part is ENC28J60 Ethernet controller which is standalone Ethernet controller. The last part is host computer in which we can monitor status of sensors which are connected to the processor. Controlling of the status is done by using a telnet protocol. Status of the input which is given is observed on the http web page. In this web page is a dynamic web page. In Ethernet interface module ENC28J60, the data collected are uploaded to computer through Ethernet interface by using general purpose operating system and commands from host computer are received commands which are used to control the data acquisition system.

## III. MODULE DESIGN

### A. SENSORS:

#### 1. TEMPERATURE SENSOR

LM35 is integrated circuit temperature sensor. The output voltage of this is proportional to centigrade temperature. The LM35 temperature sensor has an advantage over other linear temperature sensors which are calibrated in °Kelvin,

as user is not required to subtract larger constant voltage from the output to obtain Centigrade scaling. In this we can easily see changes in sensor for every 1 degree Celsius. In the voltage we can say that for every 11mV we can see the changes. This working of sensor depends on Ohm's law. As it is suitable for the remote applications, we are using this temperature sensor for controlling and monitoring the temperature.

#### 2. HUMIDITY SENSOR

For humidity measurement, the amount of water molecules dissolved in air of polyhouse environment, smart humidity sensor SY-HS-220 is taken for system which is under design. The humidity sensor is capacitive type, including on chip signal conditioner. It is mounted on the Printed Circuit Board (PCB). PCB consists of CMOS timers to pulse sensor and to provide the output voltage. Additionally, it also consists of AC amplifier, oscillator, precision rectifiers and frequency to voltage converter. It also helps to provide the impediment to noise. Humidity sensor used in this is highly precise and reliable. The humidity sensor provides DC voltage which is depends on humidity of the surrounding in RH%. It works with +5 V supply and typical current consumption almost less than 3 mA. The humidity sensor takes humidity from the environment as input and gives electrical signal as output.

#### 3. SMOKE SENSOR

In this we are using smoke sensor MOC7811. MOC7811 is slotted opto isolator, with photodiode and IR transmitter mounted on it. This is used as a positional sensor switch. It has four legs. Two legs for diode and two for the transistor, four legs are collector, emitter, cathode and anode. Both are inbuilt and no external connection is required but current limiting resistance is required.

### B. SPI INTERFACE:

SPI is serial peripheral interface which is used when very few I/O lines are available. But for doing this the communication between two or more than two devices must be very fast and easy to implement. SPI interface allows serial communication between two or more devices at very high speed and also easy to implement. SPI is four wire serial bus protocol. It contains MISO, MOSI, SCLK, SS wires. It also supports full duplex communication. It has multiple slaves and single master. It is best suited for point-to-point streaming data. SPI interface is synchronous protocol. For synchronization, the clock signal is provided by the master. Clock signal controls when data change and when it is valid for the reading.

As SPI interface is synchronous protocol and it has clock pulse including data. RS-232 and the other asynchronous protocols do not use clock pulse, but data must be timed accurately. Since it has a clock signal, the clock can be varied without disrupting the data. The data rate will change along with the changes in the clock rate. It makes SPI interface ideal when microcontroller is being clocked imprecisely, such as by RC oscillator. Serial peripheral interface is for transferring processors data serially to the Ethernet controller.

### C. PROCESSOR MODULE:

It is the core part of system design in which ARM processor family chip LPC2148 is used to complete complex operation. LPC2148 processor is based on 32/16 bit ARM7TDMI-S CPU with the embedded trace support and real time emulation, which combines microcontroller with the embedded high speed flash memory mainly ranging from 32 kB to 512 kB. Due to small size and low power consumption, LPC2148 processor is ideal for the applications where the miniaturization is the main requirement, such as point-of-sale and access control. Blend of serial communications interface which is ranging from USB 2.0 Full Speed device, SPI, SSP to I<sup>2</sup>Cs, multiple UARTs, and on-chip static RAM of 8 kB up to 40 kB, makes these devices well suited for protocol converters and communication gateways, voice recognition, soft modems and low end imaging, provides high processing power and large buffer size. Numerous 32-bit timers, 10-bit DAC, single/dual 10-bit ADC(s), PWM channels and 45 fast general purpose IO lines with up to 9 edge/level sensitive external interrupt pins which make these processors suitable for industrial control.

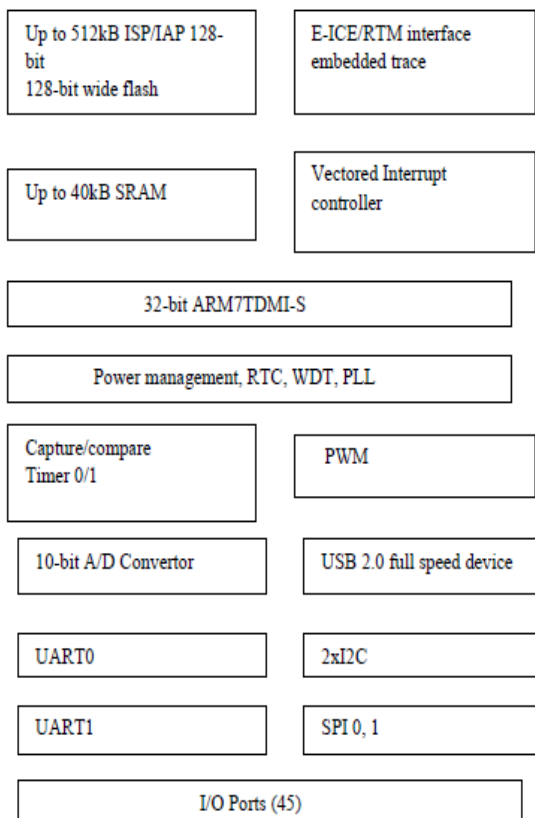


Fig 2. LPC2148 Block Diagram

#### D. ETHERNET MODULE

The ENC28J60 Ethernet module is stand-alone Ethernet controller with standard Serial Peripheral Interface (SPI). Ethernet module is designed to serve as an Ethernet network interface for any of the controller equipped with the SPI. ENC28J60 Ethernet module exhibits all the IEEE 802.3 specifications. It contains RJ45 socket with integrated transformer and activity light. This Ethernet module allows connecting a particular embedded device in a network. It works with any processor operating at 3.3 volts or 5 volts. The circuit board of Ethernet module contains all required

components for Ethernet controller, a 3.3 volts voltage regulator and RJ45 jack with an integrated transformer and built in the link and activity LEDs for the connection to an Ethernet LAN. The microchip provides a driver for the ENC28J60 Ethernet module and a TCP/IP stack containing an HTTP web server. Web pages are stored in internal and external EEPROM. The ENC28J60 Ethernet module which is designed to operate at frequency of 25MHz with a crystal connected to OSC1 and OSC2 pins. The ENC28J60 Ethernet module doesn't support automatic duplex negotiation. If this module is connected to an automatic duplex negotiation enables the network switch or an Ethernet controller, the ENC28J60 Ethernet module will be detected as half-duplex device. To communicate in the Full-Duplex mode, the ENC28J60 Ethernet module and remote node (router, switch or Ethernet controller) must be manually configured for the full-duplex operation.

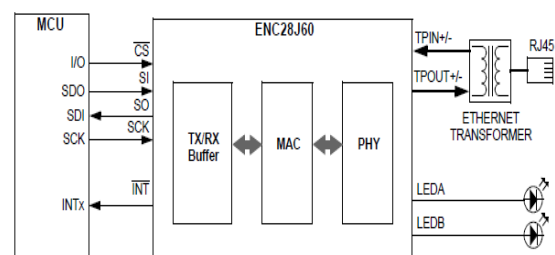


Fig 3. Typical ENC28J60-Based Interface

#### IV. SOFTWARE REQUIREMENTS

##### A. KEIL ARM

µVision is software development platform that combines robust and modern editor with a project manager and make facility tool available. µVision integrates all the necessary tools needed to develop embedded applications containing macro assembler, C/C++ compiler linker/locator, and a HEX file generator. µVision Debugger and IDE is the main part of Keil development tool chain and it has additive features that help the programmer to develop embedded applications very quickly and successfully. The Keil tools are simple to use and they help you to achieve your design goals in a timely manner.

##### B. FLASH MAGIC

The Flash Magic is loaded being performed it means that other applications that necessary to use COM Port, debugging tools, can be used while Flash Magic is Windows software that allows easy access to all ISP features provided by the devices. It gives a clear and simple user Under Windows; only one of the applications may have access to the COM Port at particular time, thus by preventing other applications from using COM Port. Then to download the hex file into the processor board we can use a programmer called flash magic tool.

#### V. CONCLUSION

To control and monitor the sensors data with the help of SPI interface to the network, embedded Ethernet interface based on ARM LPC2148 processor is designed. Here TCP/IP protocol is used which is used to define set of rules to enable all computers to communicate over all the networks,

showing how data should be shipped, addressed, packaged, routed and delivered to the right destination. The application layer protocol (Telnet) is used to control the applications. Telnet protocol is user command and a dependent TCP/IP protocol for accessing remote computers. By using telnet, another user can access someone else pc remotely. On the web, Telnet and HTTP protocols, allow to request some specific files from the remote computers. This design widely used in monitoring the remote data and controlling the system in family as well as industry.

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