Energy Efficient Implementation of Wireless Sensor Network System on Embedded Web Server Using ARM7

Nitin M.Patil
Department of Electronics Engineering
GHRCE, Nagpur, Maharashtra, India

Prof. Pankaj H. Rangaree
Department of Electronics Engineering
GHRCE, Nagpur, Maharashtra, India

Dr. G. M. Asutkar
Department of Electronics & Communication Engineering,
PIET college of Engineering Nagpur, Maharashtra, India

Abstract- This paper proposed an implementation of an independent embedded web server and its integration into a network of wireless sensor nodes. The Embedded Web Server Technology is most evolving technology for Internet devices. In industrial control system one host is connected with several serial devices. The host communicate with each serial device, process data and interact between user and computer. This is feasible only when there are minimum devices and lower transmission rate is required. When serial devices are more and higher transmission rate is required at that time processing is complex and performance of the system is poor. In another condition, if the distance between host and serial devices is more than the required length of wiring increases which drop the communication quality. The data can be access by using mobile phones also. By providing memory card slot data can be save when user is offline.

Keywords – WSN-Wireless Sensor Networks, EWS-Embedded Web Server, Remote monitoring and control

I. INTRODUCTION

The Embedded Web Server Technology is most evolving technology for Internet devices. In many application areas such as telecommunication devices, measuring instruments and lots of consumer electronics uses this technology. In industrial control system one host is connected with several serial devices. The host communicate with each serial device, process data and interact between user and computer. This is feasible only when there are minimum devices and lower transmission rate is required. When serial devices are more and higher transmission rate is required at that time processing is complex and performance of the system is poor. In another condition, if the distance between host and serial devices is more than the required length of wiring increases which drop the communication quality. Due to absence of GSM module user can not access the data using mobile phones. Also when user is offline there is no provision to save the data. We propose a low-power maximum power point tracker (MPPT) circuit specifically designed for wireless sensor nodes. This circuit supply energy to the sensor nodes and energy status information to the node.

II. PROPOSED IDEA

The system which we proposed would not only monitor the plant at remote place but also control the plant. There are three modules of this system. First module calls Remote Node which consists of ARM7 processor, Ethernet Controller. Thirdly, GUI (graphical user interface) on PC where is parameter of plant is monitor and plant is controlled. plant is connected to remote node which will sense or a measure physical quantities using temperature sensor, LPG sensor and relay will control the plant. By using wireless technology, it will transmit data to one Centralized Node. Centralized Node consists of ARM7 processor, Ethernet Controller and to this node all the Remote Nodes send data. This data is then displayed on PC by typing IP address on the GUI. Once logged in, all devices and their current status are displayed. For security purpose two login are provided. One for employer who will only monitor the plant and second for administrator who will not only monitor but also control the plant. The data base is also designed where all the details of measured quantities of plant are stored automatically as reception

of data start. Thus via internet the plant can be monitor and controlled from anywhere in the world. The data can be access by using mobile phones also. By providing memory card slot data can be save when user is offline.

III. SYSTEM OVERVIEW

1. ARCHITECTURE

Industrial system require data acquisition for which ADC is required, DAC is required for embedded control and for data backup SDRAM is required which we will contain entire log details. To communicate with desktop computer industries require modbus protocol so Ethernet control is required. The proposed embedded system uses FLASH and MMC memories for program running and data storage. The BIOS codes, user's codes and the useful data are stored in FLASH memories. RTC data is written on MMC for data logging purpose. As far as the control and acquisition system concerned, the Analog to Digital Converter (ADC) is essential components. The ADCs are applied for data acquisition. A RS-485 serial port is backed up for more widely applications. The LCD controller can be programmed to support different requirements on the screen. LCD is connected to the General Purpose Input/output ports (GPIO) of the microprocessor. The IP address of the system is burned in a serial EEPROM. The Ethernet controller will read the IP address when reset. Ethernet is interfaced to serial peripheral interface of controller.GSM is interfaced as it provides a wireless communication that is message can be sent to particular individual instantly. ON-Chip RTC is configured so that it give real time clock value which is very useful for data logging and data is written on MMC.

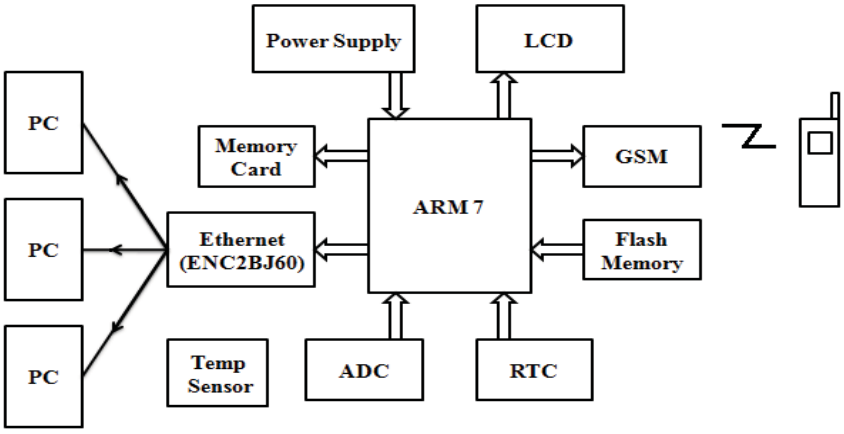

Figure 1- Block diagram of Proposed Architecture

2. *GSM MODULE:*

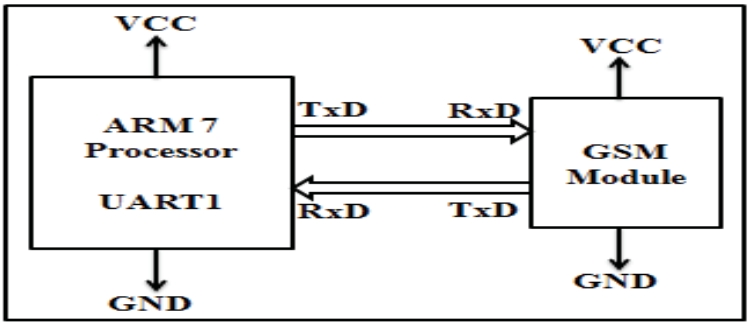

Figure 2- Interfacing of GSM and ARM7

Global System for Mobile communications (GSM) is the almost popular wireless standard for mobile phones in the world. GSM module allows transmission of Short message service (SMS) in TEXT mode and PDU mode. The proposed design uses SIM 300 GSM module in text mode. This design uses SIM300 GSM module that provide 900/1800/1900MHz Tri-band for VOICE, SMS, DATA, and FAX. This module operates on AT command over TTL interface. AT command is an abbreviation for Attention command that is recognized by GSM Module. This abbreviation is always used to start a command line to be send from TE (Terminal Equipment) to TA (Terminal Adaptor).

3. ETHERNET MODULE:

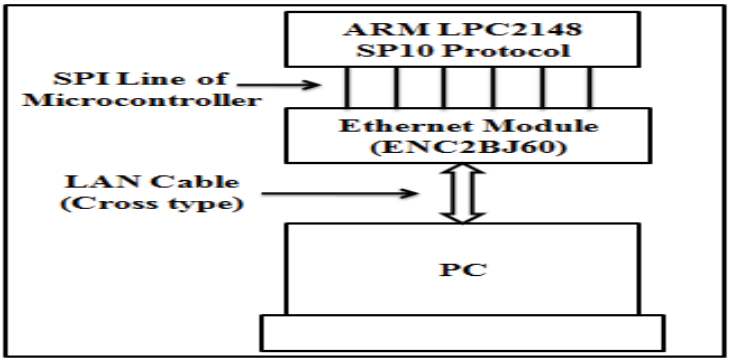

Figure 3- Interfacing of Ethernet with ARM7

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 incorporates a number of packet filtering schemes to limit incoming packets. It also provides an internal DMA module for fast data throughput and hardware assisted checksum calculation, which is used in various network protocols. Communication with the host controller is implemented via an interrupt pin and the SPI, with clock rates of up to 20 MHz. Two dedicated pins are used for LED link and network activity indication. With the ENC28J60, two pulse transformers and a few passive components are all that are required to connect a microcontroller to an Ethernet network. The embedded system in which field signal values are displayed on Web page or collected into control center in real-time through RJ-45 with Embedded device (equipped with SPI support) on to a network.

A. HARDWARE CLK RATE:

MODULE	ON-CHIP PROTOCOL	CLK RATE
GSM	UART 1	9600BPS
MEMORY CARD	SPI 0	62.5KHz
ETHERNET (ENC28J60)	SPI 0	2MHz
TEMP SENSOR	ADC 0	1MHz

IV. IMPLEMENTATION

The heart of the system is a real-time kernel that uses preemptive scheduling to achieve multitasking on hardware platform. The previous sections dealt with µC/OS_II porting to the application desired. This section deals with the implementation of hardware and software. Depending on the required application the number of tasks may vary. Porting of µC/OS-II we can perform simple tasks like Temperature sensor (i.e., ADC), 16x2 LCD (i.e., degree to Fahrenheit), UART (i.e., sending msg through GSM), Ethernet (i.e. to communicate with desktop PC) MMC (i.e., memory card for data backup).

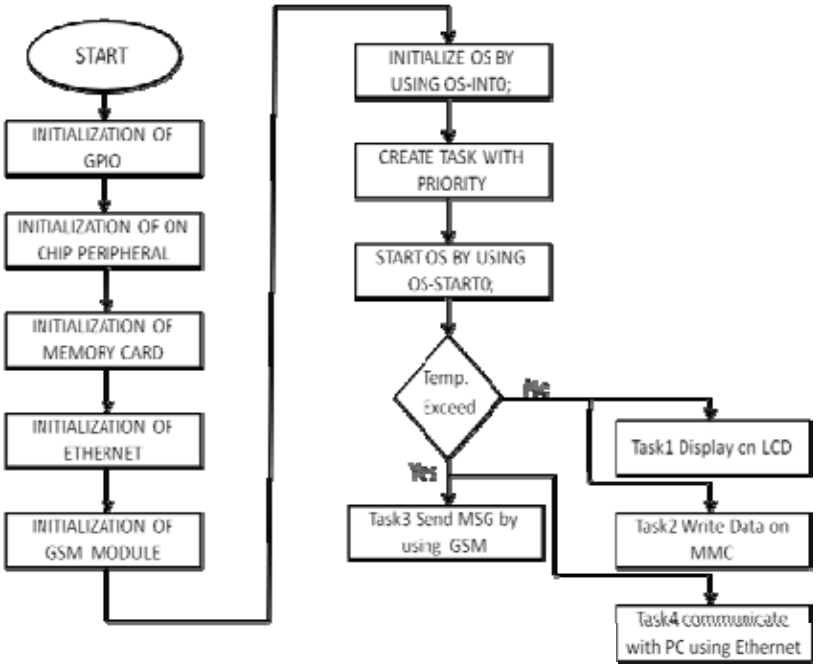

Figure 4 - Flow chart of Hardware & µC/OS_II implementation

V. SOFTWARE

Keil IDE is used for implementation. Keil IDE is a windows operating system software program that runs on a PC to develop applications for ARM microcontroller and digital signal controller. It is also called Integrated Development Environment or IDE because it provides a single integrated environment to develop code for embedded microcontroller. Keil µVision4 IDE (Integrated Development Environment) is a Windows based front end for the C Compiler and assembler. KeilµVision4 is used for writing embedded C programs. Embedded C is a high level language, which includes many aspects of the ANSI (American National Standard Institute) C programming language. Standard libraries are altered or enhanced to address the peculiarities of an embedded target processor.

VI. RESULT

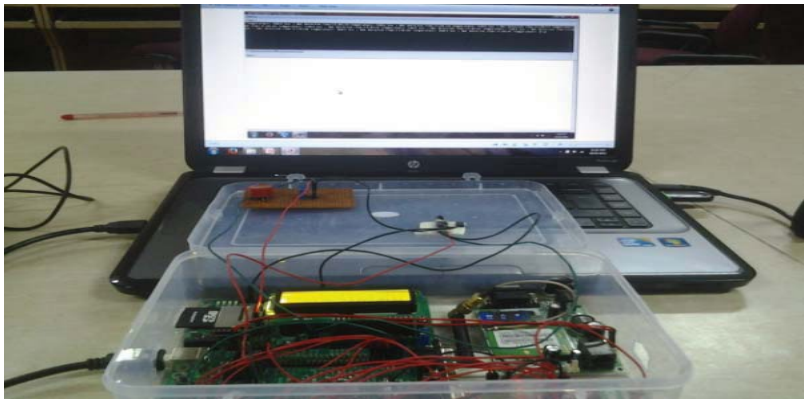

Figure 5 - Hardware Interface

Figure 5 shows complete hardware interfaced with ARM7.GSM module and Ethernet controller is interfaced with the ARM7.Gas sensor and Temperature sensors are connected at the ADC port of ARM7.When temperature value is bellow the limit it will show on the display and simultaneously it will store the same value in memory card.

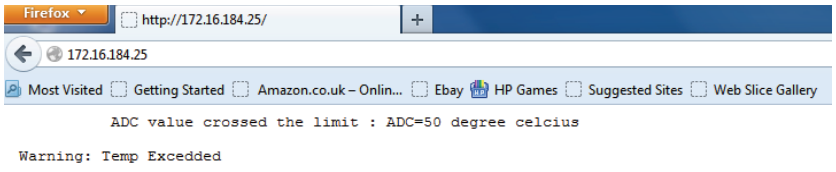

Figure 6 – Ethernet Data log on PC

Figure 6 shows data coming from the Ethernet. By entering IP address an authorize person can access the sensors data. When ADC value crossed the limit then it will display the warning message of 'Temp. Exceeded'.

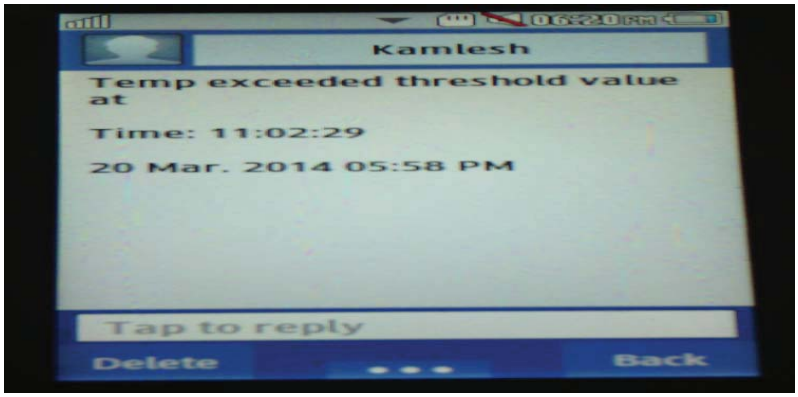

Figure 7 – Message send from GSM module to the user

When temperature value cross the limit it will shows the information on computer through Ethernet connection and simultaneously it will send the message of same information to authorize mobile no. using GSM module. When an authorize person got the information of exceeded temperature is able to take some action to control temperature.

VI. CONCLUSION:

The Design of ARM based industrial embedded system using RTOS offers necessary mighty functions to developing fast and efficient an application. The system can be used to perform real-time controls where there have standard electrical interface. High precision data acquisition can be realized by the embedded system as well. Using the Ethernet port of the embedded system, networked control and acquisitions can be achieved through an industrial Ethernet LAN. The hardware and software provide a platform for diverse control and acquisition applications, including industrial process controls and factory automations. Since the embedded system is able to deal with Multi-Tasks and can run operation systems, field operations, supervisions and managements can be done by the lower embedded devices, hence the upper PC or workstation in the industrial LAN will do fewer works, which lowers the concentration degree of the whole system. This enhances the reliability of the control and acquisition system and reduces the risks. In addition system uses GSM Module for long distance communication and MMC card for data backup.Thus the embedded system is compact system that is useful for industrial applications.

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