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Embedded Technology for Remote Data Logging, Monitoring and Controlling Using GSM/GPRS

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ABSTRACT: In the world of Embedded System monitoring and control of data or different appliances from remote location in smarter way with least manpower is always a prominent area for research. In this paper modified, simple and cost effective remote data logging controlling and monitoring system using embedded web server is proposed. Use of the mobile phone gave the novelty of distance communication at remote location. The system is very practical in the area served by cell phone data services. With the help of proposed module process automation in industry or home appliances becomes easy because of the power of taking runtime decisions as per the need in the system. Data uploaded on webpage can be accessible from anywhere through internet. Thus the proposed system is suggested for secure remote data logging, controlling and monitoring using web technology.

KEYWORDS: LPC2148 ARM7 Development Board, GSM SIM 800 modem, AT commands, Remote data control.

I. INTRODUCTION

Mobile communication is tremendously enlarging day by day, so that it becomes easy to monitor and control the plant or appliances over a large distance through cellular phone. Global System for Mobile Communication network (GSM) is almost everywhere. Sometimes in critical situations human needs to take runtime decision which is possible using this system. Need of human presence in the vicinity of the plant is reduced. In a similar way system can be controlled and monitored from anywhere, at any point and without worrying about geographical locations. The aim of the paper is to propose a simple, efficient and cost effective password secured system implementation for remote monitoring, controlling and logging of data using embedded arm technology with the GSM web server. With help of data logging concept value of the analog parameters are uploaded at regular interval of time to a common server using GPRS command. And it can be downloaded in PDF format and is saved in local memory for future reference.

II. LITEARTURE SURVEY

The system in [1] monitors and controls the humidity present in the system environment from the remote place and if it crosses a threshold value ARM processor sends an SMS to a concerned authority's mobile phone via GSM network and related authority can control the plant through his mobile phone by sending SMS to GSM modem and in turn to processor and the system is password protected. The system in [2] control of home appliances using GSM technology through android application and android phone using ATmega2560, GSM module and sensors is proposed. The system in [3] intelligent appliances are connected to internet with low cost using webpage; to make communication AVR microcontroller is used. This paper is deploying GM 862 module interfaced with AVR having GPRS/GPS capabilities. The system in [9] proposes a light controller and remote monitoring system based on GSM-Bluetooth technology. This system has simple features which with the minimum power consumption using infrared sensor for controlling lights, fans and other appliances which are controlled using a GSM module via SMS.

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III. PROPOSED SYSTEM

In the proposed system we have configured the advanced and efficient ARM core microcontroller with the GSM SIM 800 module and to different appliances through relay card. Fig.1 shows block diag. of remote data monitoring and control. Programming for the ARM7 in this system is done in embedded c language and IDE used for the programming is KEIL, and the programming of webpage is in html. For the implementation of this system ARM7 development board is used. In this paper we have proposed a system which uses GSM technology for remote monitoring of data. [2] [3], and for data logging it uses GPRS based web technology.

The features of the proposed system are

- We are using ARM7 which gives faster access with more peripherals.
- No need of android application.
- GSM module is available in market, no need of initial set up.
- It requires system dedicated webpage, which is accessible from any device which supports internet.
- Webpage is password secured, to avoid misuse.
- No need of human presence in the system, similarly no need to have dedicated PC in the system.
- Data can be saved in PDF format.
- Controlling action can be performed with the help of webpage.

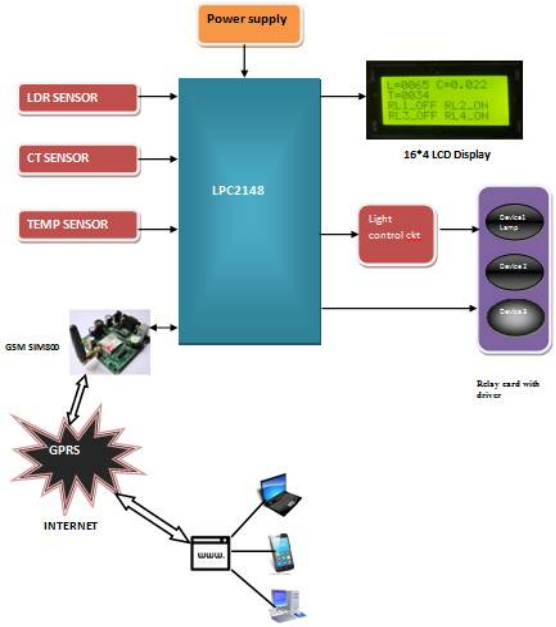

Fig.1: Block Dig of Remote Data Monitoring and Control.

IV. HARDWARE DESCRIPTION

MICROCONTROLLER:

In this system we are using ARM7 LPC2148 microcontroller shown in Fig.2, which is heart of our project. ARM is faster compared to other controllers since it can process 32bit data simultaneously. When we are performing real time operations we need faster processing. In other 8bit controllers like 8051, PIC, AVR data processing is slower as they process 8 bits of data at a time. Also pipelining concept in ARM makes this MCU much faster because, while executing one instruction it can takes other instruction & process them in pipelining queue simultaneously.

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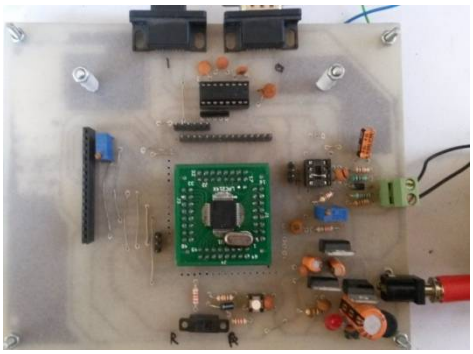

Fig.2: LPC2148 Development Board

- 32 bit ARM7 TDMI core.
- More I/O pins, port0 & port1. More peripherals can be interfaced.
- Built in10 bit ADC with 14 channels.
- 32KB on chip static RAM.
- 512KB Flash ROM with In-System Programming (ISP) and In-Application Programming (IAP).
- Vectored Interrupt Controller.
- Two 32-bit timers, Watchdog Timer, PWM unit
- CPU clock up to 60 MHz, On-chip crystal oscillator and On-chip PLL.
- 128 bit wide interface enables high speed 60MHz operation.

GSM MODULE:

Fig.3: SIM800 GSM Module.

Fig.3 shows GSM digital mobile telephony system. SIM800 operates on 850MHz, 900MHz, 1800MHz and 1900MHz frequency band. It can be used to send and receive SMS or make/receive voice calls. For connecting to internet it can be operated in GPRS mode and can perform many applications for data logging and controlling [3]. Using AT commands the modem can be tested and operated. The GSM modem communicates with any MCU through its serial port.

CT SENSOR:

Current Transformer is a device that steps down primary electric current to a proportional secondary current. Secondary current is decided by turn ratio N1:N2. The generated small current in terms of few mA is passed through a burden

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resistor to generate proportional analog voltage. In this project we are using CT who's N1:N2 ratio is 25Amp: 5 m Amp. Burden resistor is connected to secondary of the CT which converts current to voltage, and value for this resistor is calculated using formula,
Burden Resistor = Vref / Isec (as per the standard ratio).

TEMP SENSOR:
Temp sensor is a device that senses the surrounding temperature and converts it to proportional analog voltage. In this project we are using LM35 temp sensor, this sensor is easy to use & available in reduced cost. LM35 is an integrated circuit whose output voltage in mV is directly proportional to the temperature in degree centigrade and may not require signal conditioning. It has sensitivity of 10mV / ^{o}C. Operating Temperature Range is -55 to 150 ^{o}C.

LDR SENSOR:
Light dependant resistors which are commonly called as photo resistor, which are used to measure the intensity of light. When light falls on LDR its resistance decreases. Its dark resistance is very high. Dark resistance of LDR is high as 1MΩ but when light falls on LDR the resistance is falling down to few KΩ. It is used to control light intensity of bulb according to the ambient light.

SOFTWARE IMPLEMENTATION AND DESCRIPTION:
Required software for the system is developed in embedded c using Keil, then code is compiled and embedded in LPC2148.

ALGORITHM:

1. Power ON
2. Peripheral initialization
3. Sensor initialization
4. Sensor Read
5. Control system convert A to D value
6. Set point check
7. If value is more than the set value
- Send SMS to operator mobile.
- Required control action will be taken.
- Upload sensor reading on URL
- Download Relay Status
- Go to step4,5
8. If value is less than the set value
- Check any SMS or action on webpage is received from operator.
- If not go to step 4,5
- If received, read data from GSM modem
- Decode the data.
- Perform required control action
- Go to step4,5

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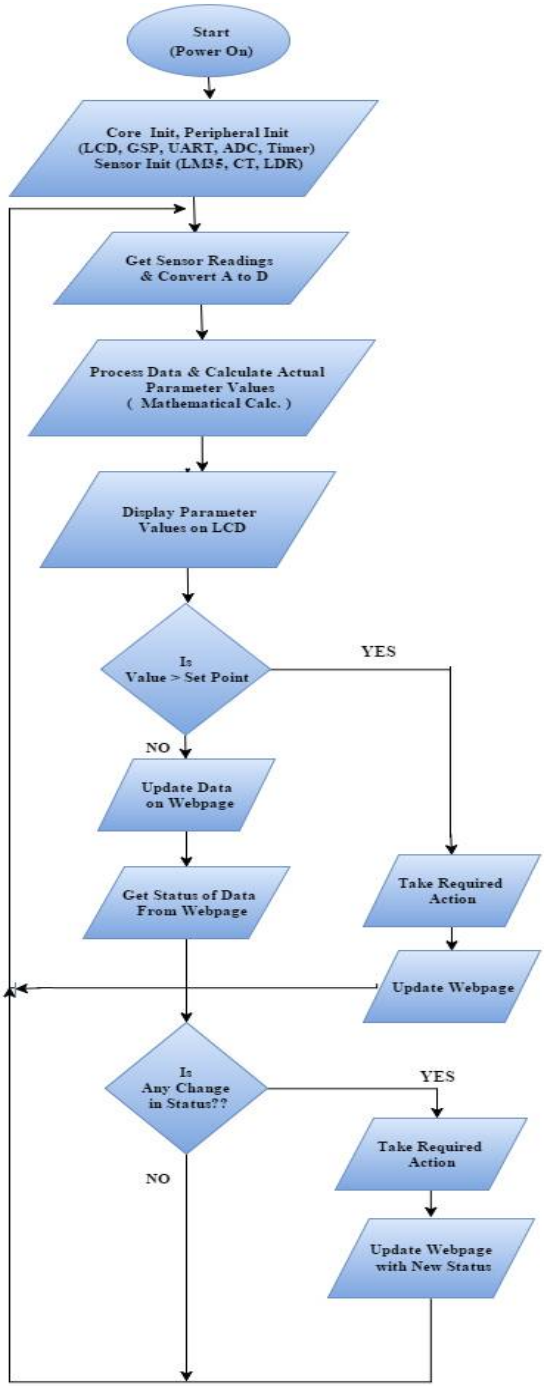

Fig.4: Flowchart of remote monitoring and data logging

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V. RESULT AND DISCUSSION

In this section we will discuss about the results of our proposed system. This system is designed for monitoring and controlling of diff parameters like temp, light, current from remote location using GSM technology as shown in Fig.5. All the time we can monitor current status of our system with the dedicated webpage. Similarly if it needs any control action like change in threshold value, ON / OFF the devices can be done through webpage and also via text message. Fig.4 shows the flowchart of the system. Here we can save data in PDF form, which is saved either in mobile phone or in the PC for later reference.

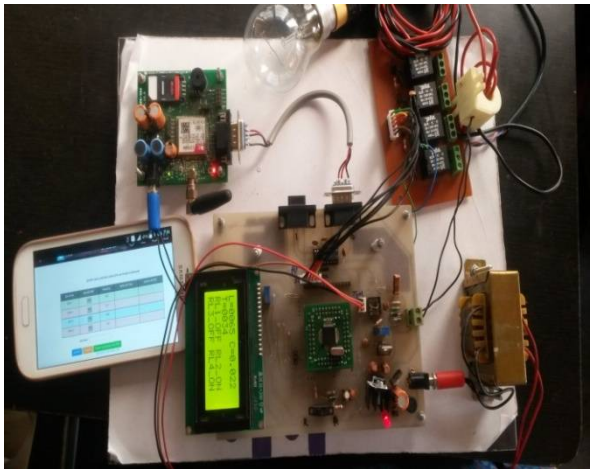

Fig.5: LPC2148 with SIM800 interfaced with peripheral devices along with webpage.

Sensors continuously read values and sends data to microcontroller. After processing microcontroller will update data on webpage, controller is continuously comparing the incoming value with the set point value. We have set a threshold value for an application if that value is crossed according to that controller will ON/OFF particular application. On other hand application which is used to modulate light intensity is driven by PWM. We don't need to check webpage repeatedly, no need to send text message for maintaining set point. As exceeding set point condition for different application may come several times in a day, which may result in continuous attention on mobile and can cause irritation. When query is sent requesting about the status of system, then only I will get text message about the current status of the system.

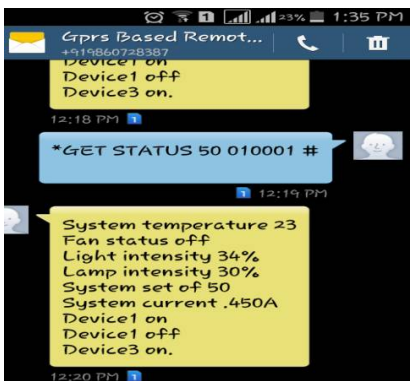

Fig.6: SMS sent and received regarding status

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From Fig.6 we can analyze the status of the devices i.e. which device is presently ON or OFF, it's current intensity etc. Similarly we can set the threshold value by sending text message to the system.

SERVER CONFIGURATION:

Fig.7 & Fig.8 shows the initialization and configuration of the server, values from the Arm development board are uploaded at regular interval in the common server.

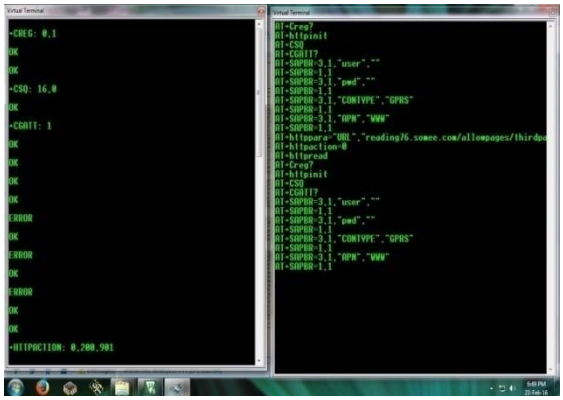

Fig.7: Initializing Server

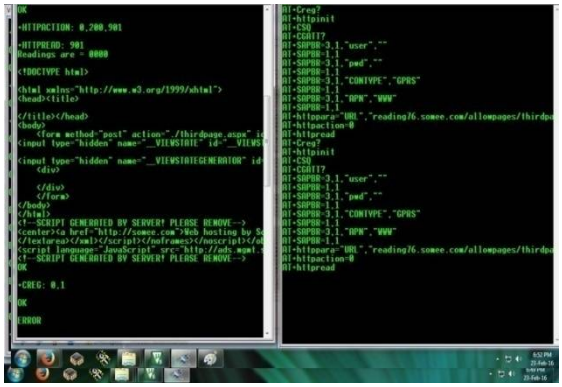

Fig.8: Initializing Server

Below fig.9 shows webpage of the system dedicated website, which gives clear idea about monitoring and control of the devices from remote location, this webpage can be opened from any type of browser data is saved in PDF format for future reference.

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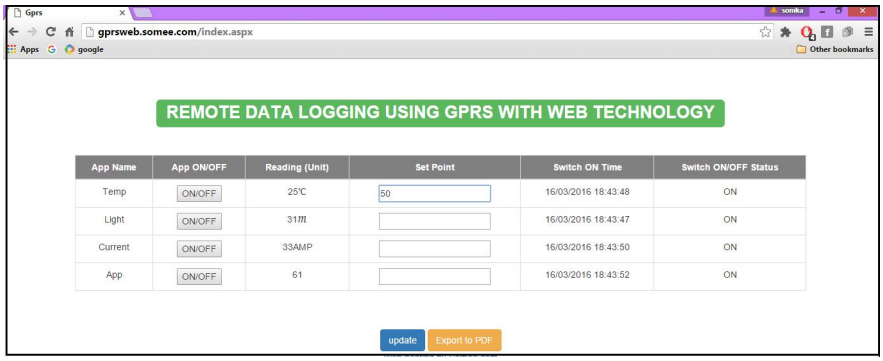

Fig.9: Webpage of the system.

VI. CONCLUSION

Through this project we can remotely ON/ OFF a particular device as well as we can control threshold value for an individual device. The proposed system is tested as a standalone embedded system using LPC2148 ARM development board, GSM module, Sensors and control circuitry for Industrial process control or for home appliances. The proposed system is low cost, with easier access and this system can be customized and extended for various types of analog sensors. The advantages of the proposed systems are: (1) Runtime action can be taken from an operator if needed. (2) Using GPRS network we reduce initial set up cost and time. (3) Using GSM network which is present even in rural areas extends the mobility of the operator. (4) Any modification can be made to the code in very less time. (5) We are using LPC2148 which results in high speed operation. (6) Using webpage we can monitor and control the system. Changes in set point can be done very effectively. (7) Data is saved in PDF format which can be read from Smartphone and PC. (8) Reduces the cost of manpower as there is no need of human to be present in the system.

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