ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

An ISO 3297: 2007 Certified Organization *Vol. 3, Special Issue 3, April 2014*

International Conference on Signal Processing, Embedded System and Communication Technologies and their applications for Sustainable and Renewable Energy (ICSECSRE '14)

Organized by

Department of ECE, Aarupadai Veedu Institute of Technology, Vinayaka Missions University,

Paiyanoor-603 104, Tamil Nadu, India

GSM Based Automatic Energy Meter System with Instant Billing

[1]E.Moni Silviya, [1]K.Meena Vinodhini, [2]Salai Thillai Thilagam.J.
Final year Students, Department of Electronics and Communication Engineering,
Aarupadai Veedu Institute of Technology, Vinayaka Missions University, Paiyanoor Chennai 603 104, India[1]
Associate Professor, Department of Electronics and Communication Engineering,
Aarupadai Veedu Institute of Technology, Vinayaka Missions University, Paiyanoor Chennai 603 104, India[2]

Abstract— In this paper, we propose a system which measure the current consumption unit through IR sensor unit. The IR transmitter is placed in the rotating unit of the EB meter. The receiver photo diode is placed in a certain place which is used to find no of rotation. By getting the number of rotation we get the current consumption. After getting the current consumption the ARM processor will reduce the unit given for specific user. The unit here is taken as numeric value. If the unit is reduced to minimum value it will intimate the user through alarm and LCD unit. If the user wants to add more units for him, he has to send a message to EB section. From the EB section the required value will be sent to the ARM controller through GSM modem. From the obtained value the ARM will increment the unit in the memory. Thus recharge process is done quickly with less manual interactions. Our system may be applied in Industrial control, medical system and access control.

Keywords— Communication, GSM modem, LCD, Energy meter.

I. INTRODUCTION

AN A wireless local area network (WLAN) links two or more devices using some wireless distribution method and usually providing a connection through an access point to the wider Internet. This gives users the mobility to move around within a local coverage area and still be connected to the network. By using Wireless Body Area Network the users links the devices through their body and nearby devices. From the recent development in low power Wireless Sensor nodes in WBAN, the applications are categorized into two as Medical and Non medical. In medical applications the vital data's are transferred through this wireless network which is used in prevent the occurrence and treat the diseases.

II. LITERATURE SURVEY

Subhashis Maitra (Oct 2008) In this paper, a new concept of energy meter will be discussed, where maximum demand of energy of a consumer will be indicated in the meter used by the consumer. After exceeding the maximum demand, the meter and hence the connection will automatically be disconnected by an embedded system inserted in the meter itself. According to the maximum demand, the consumer will purchase a cash-card of amount depending on the consumption of energy and after the full consumption, the consumer again has to purchase another cash-card or recharge the same and thus the hassle related to go to the billing office, to stand in a long queue and to submit the bill, can be avoided. Also this system helps to eliminate the draw backs of billing management system, such as to take the reading from the meter, to create the bill, to print the bill, to send the bill to the proper address and to collect the amount for the bill [6].

T El-Djazairy, B J Beggs and I F Stewart (Jun 1997)
This paper presents the results of an investigation which show that the development of the GSM network as a low cost, global carrier of digital telecommunications signals provides exciting opportunities for novel applications such as the handling of power system metering and load management telemetry. As the use of GSM for telephony becomes more widespread, it is inevitable that costs will be driven lower, and it is also inevitable that this medium for the transfer of telemetry data

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will become very important to the electricity supply industry in the next few years. One major issue which will require to be addressed as this development takes place is the security protection of data being transferred, particularly in the radio link paths of the network.[7]

Li Kaicheng, Liu Jianfeng, Yue Congyuan, Zhang Ming: (Jun 2008) A power load management system based on ARM-7 microcontroller and GPRS is presented in this paper. The proposed system consists of electronic KWH meter, intelligent management terminal (IMT) and management centre. The intelligent terminal is sued to acquire information from KWH meter, control the energy-consuming device and communicate with management centre via GPRS network. How to implement the IMT by using ARM-7 microcontroller and GPRS telecommunication module is discussed in detail. Also the software design of the terminal with high performance embedded real-time operating system muC/OS-II is presented in this paper.[8]

P.K. Lee and L.L. Lai, Fieee (Jun 2007)
In this paper, the authors discuss the way to adopt the cost effective GPRS applications. Although there have been lots of theories and concepts on the GPRS applications but the real applications applying to a large network, distributed power generation or building energy/power distribution monitoring are limited. The authors focus the application of the GPRS to this on-line system application and the techniques. A practical scheme is proposed and its use to real-life system will be introduced. A practical implementation for an wireless GPRS on-line Power Quality Monitoring System will be illustrated. Results and benefit to the end users in some practical applications will be discussed.[5]

H.G.Rodney Tan,C.H. Lee,V.H.Mok (Dec 2007)
The development of a GSM automatic power meter reading (GAPMR) system is presented in this paper. The GAPMR system is consists of GSM digital power meters installed in every consumer unit and an electricity ebilling system at the energy provider side. The GSM digital power meter (GPM) is a single phase IEC61036 standard compliance digital kWh power meter with embedded GSM modem which utilize the GSM network to send its power usage reading using short messaging system (SMS) back to the energy provider wirelessly. At the power provider side an ebilling system is used to manage all received SMS meter reading, compute the billing cost, update the database, and to publish billing notification to its respective consumer through SMS, email, Web portal and printed postage mailing. A working prototype of the GAPMR system was build to demonstrate the effectiveness and efficiency of automatic meter reading, billing and notification through the use of GSM network.[2]

III. PROJECT ANALYSIS

Our project consist of the hardware components that contain the following units. Is power supply unit, Microcontroller Unit, sensor unit, communication unit, display unit, Alerting unit, Driver unit, Software unit.They are shown in figure1,2,3 that are given in the bottom.

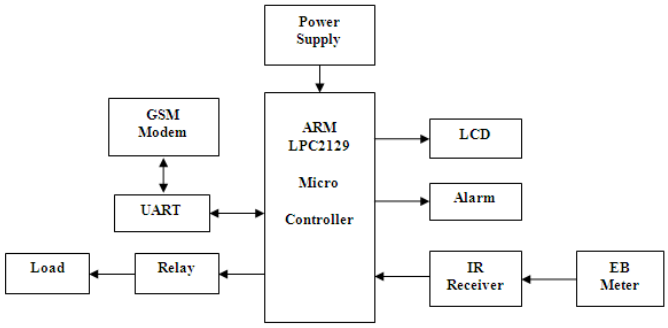

Figure 1.Home section block diagram

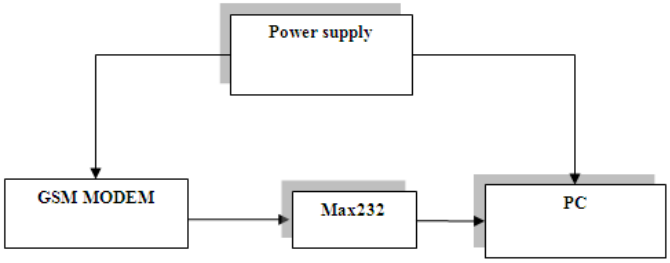

Figure 2. EB section block diagram

Figure 3.Mobile section block diagram

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Power Supply Unit

The supply of 5V DC is given to the system which is converted from 230V AC supply. Firstly, the step down transformer will be used here for converting the 230V AC into 12V AC. The microcontroller will support only the DC supply, so the AC supply will be converted into DC using the bridge rectifier. The output of the rectifier will have ripples so we are using the 2200uf capacitor for filtering those ripples. The output from the filter is given to the 7805 voltage regulator which will convert the 12V DC into 5V DC. The output from the regulator will be filtered using the 1000uf capacitor, so the pure 5V DC is getting as the output from the power supply unit. Here we are using the PIC microcontroller which will be capable of getting the supply of 5V DC so we have to convert the 230V AC supply into 5V DC supply.

Micro controller unit

In the micro controller unit we are going to use ARM LPC2129 microcontroller which is used to sense the values from the sensors and will transfer to the monitoring section regarding the situation. In the sensing part Analog to Digital conversion is done internally in the controller. The controller will get the location detail of the node using GPS receiver. The controller also converts the data to serial communication for wireless data communication through GSM/GPRS modem.

Sensor unit

The sensor unit consists of IR LED and IR Receiver. The LED is placed in the moving unit in the meter. The receiver gets the IR signal for the whole rotation of the moving unit which has the LED.

Communication unit

GSM Modem is a communication technology in which it is used to transmit the message from the monitoring section to the control section. Whenever there are any abnormalities in the sensors or for certain period of time, the microcontroller is used to transmit the data to the monitor section.

Display unit

LCD

The display unit is mainly achieved by the 16X2 LCD. A liquid crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals (LCs). LCs does not emit light directly. The monitored data from the patient is viewed in the display.

PC

PC is connected with the MAX232 to the microcontroller the data received by the GPRS modem is given to the microcontroller. Through the microcontroller the data will be transmitted to the PC and the data will be monitored in PC in hyper terminal.

Alerting Unit

Buzzer will produce the beep sound to alert the user when the power theft occurs.

Driver unit

Here the relay driver is used to drive the load. Relay is an electromechanical switch which acts as an interface between the microcontroller and the load.

Software Unit

Software is used to compile the coding of the desired application for the corresponding embedded system.

KEIL uvision4

This is the embedded C compiler which is compatible for the ARM microcontroller to compile the code. Keil Software makes C compilers, macro assemblers, real-time kernels, debuggers, simulators, integrated environments, and evaluation boards for the 8051, 251, ARM, and XC16x/C16x/ST10 microcontroller families.

GIVEN INPUT AND EXPECTED OUTPUT

Given Input:

230V, 5A, 50 Hz AC Supply

Expected Output:

12V, 500mA- 1A, DC Voltage

Microcontroller Unit

Given input:

It receives the input from the IR receiver and over load sensing unit.

Expected output:

It sends the remaining pre defined units into text message format and sends it to the GSM modem.

Sensor unit

IR sensor

Given input:

The IR sensor needs of 5V dc power supply

Expected output:

ON\OFF pulse, which changes as per the LED input is the output Communication unit

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GSM Modem
Given input:
The serial text format data from the microcontroller is the input
Expected output:
Transmission of wireless packets to the network is the output.

Driver unit
Motor driver
Given input
The 5v trigger is given from microcontroller.
Expected output
The load gets disconnected from the supply..
MAX 232
Given Input:
The input to MAX 232 is the information in TTL Level.
Expected Output:
The output of the MAX 232 is the same information in RS232 level.
Display Unit
LCD
Given Input:
The text from the microcontroller indicating the device status is given as input to the LCD.
Expected Output:
The received text is displayed on the LCD.
E section,

IV. GENERAL DESCRIPTION

The LPC2119/2129/2194/2292/2294 are based on a 16/32 bit ARM7TDMI-STM CPU with real-time emulation and embedded trace support, together with 128/256 kilobytes (kB) of embedded high speed flash memory. A 128-bit wide internal memory interface and a unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb Mode reduces code by more than 30% with minimal performance penalty.

With their compact 64 and 144 pin packages, low power consumption, various 32-bit timers, combination of 4-channel 10-bit ADC and 2/4 advanced CAN channels or 8-channel 10-bit ADC and 2/4 advanced CAN channels (64 and 144 pin packages respectively), and up to 9 external interrupt pins these microcontrollers are particularly suitable for industrial control, medical systems, access control and point-of-sale.

Number of available GPIOs goes up to 46 in 64 pin package. In 144 pin packages number of available GPIOs tops 76 (with external memory in use) through 112 (single-chip application). Being equipped wide range of serial communications interfaces, they are also very well suited for communication gateways, protocol converters and embedded soft modems as well as many other general-purpose applications.T

FEATURES
16/32-bit ARM7TDMI-S microcontroller in a 64 or 144 pin package, 16 kB on-chip Static RAM, 128/256 kB on-chip Flash Program Memory (at least 10,000 erate/write cycles over the whole temperature range). 128-bit wide interface/accelerator enables high speed 60 MHz operation, External 8, 16 or 32-bit bus (144 pin package only), In-System Programming (ISP) and In-Application Programming (IAP) via on-chip boot-loader software. Flash programming
takes 1 ms per 512 byte line. Single sector or full chip erase takes 400 ms, Embedded ICE-RT interface enables breakpoints and watch points. Interrupt service routines can continue to execute whilst the foreground task is debugged with the on-chip RealMonitor software, Embedded Trace Macrocell enables non-intrusive high speed real-time tracing of instruction execution, Two/four interconnected CAN interfaces with advanced acceptance filters, Four/eight channel (64/144 pin package) 10-bit A/D converter with conversion time as low as 2.44 ms, Two 32-bit timers (with 4 capture and 4 compare channels), PWM unit (6 outputs), Real Time Clock and Watchdog, Multiple serial interfaces including two UARTs (16C550), Fast I2C (400 kbits/s) and two SPIs™, 60 MHz maximum CPU clock available from programmable on-chip Phase-Locked Loop, Vectored Interrupt Controller with configurable priorities and vector addresses, Up to forty-six (64 pin) and hundred-twelve (144 pin package) 5 V tolerant general purpose I/O pins. Up to 12 independent external interrupt pins available (EIN and CAP functions), On-chip crystal oscillator with an operating range of 1 MHz to 30 MHz

Two low power modes, Idle and Power-down.

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Processor wake-up from Power-down mode via external interrupt, Individual enable/disable of peripheral functions for power optimization.The ARM LPC2129 is given in the figure4 in the bottom.

DUAL POWER SUPPLY

- CPU operating voltage range of 1.65V to 1.95V (1.8V +/- 8.3%).
- I/O power supply range of 3.0V to 3.6V (3.3V +/- 10%)

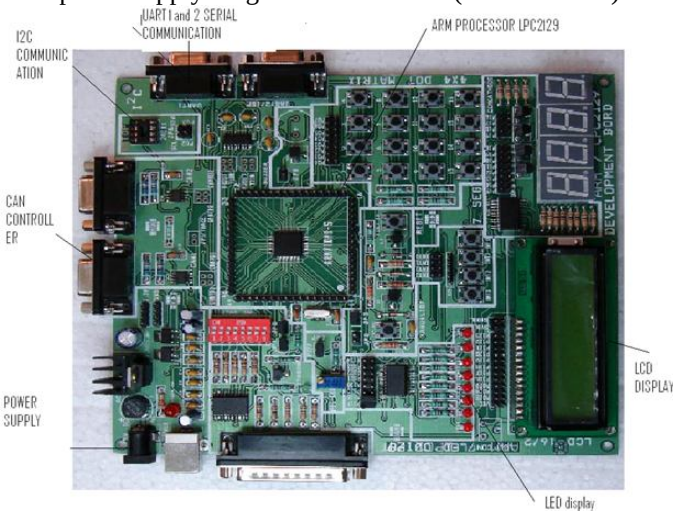

Figure 4.Advanced Risk Machine(ARM LPC2129)

3.2 APPLICATIONS

Industrial control, Medical systems, Access control, Point-of-sale, Communication gateway, Embedded soft modem, General purpose applications.

ARCHITECTURAL OVERVIEW

The LPC2119/2129/2194/2292/2294 consists of an ARM7TDMI-S CPU with emulation support, the ARM7 Local Bus for interface to on-chip memory controllers, the AMBA Advanced High-performance Bus (AHB) for interface to the interrupt controller, and the VLSI Peripheral Bus (VPB, a compatible superset of ARM's AMBA Advanced Peripheral Bus) for connection to on-chip peripheral functions. The LPC2119/2129/2194/2292/2294 configures the ARM7TDMI-S processor in little-endian byte order.

AHB peripherals are allocated a 2 megabyte range of addresses at the very top of the 4 gigabyte ARM memory space. Each AHB peripheral is allocated a 16 kilobyte address space within the AHB address space.LPC2119/2129/2194/2292/2294 peripheral functions (other than the interrupt controller) are connected to the VPB bus. The AHB to VPB bridge interfaces the VPB bus to the AHB bus. VPB peripherals are also allocated a 2 megabyte range of addresses, beginning at the 3.5 gigabyte address point. Each VPB peripheral is allocated a 16 kilobyte address space within the VPB address space

The connection of on-chip peripherals to device pins is controlled by a Pin Connection Block. This must be configured by software to fit specific application requirements for the use of peripheral functions and pins.LCD Moniror is given in Figure5 in the bottom.

Figure 5.LCD Monitor

V. RESULTS AND DISCUSSION

In our Approach we design a system with IR sensor and GSM technology. Instead of this we can use SPI metering IC which will provide more parameters. By using three phase IC MCP3909 we can extend to the three phase supply.

VI. CONCLUSION

In this paper,Various electronic meters have been developed and are still being developed. However the use of GSM in this particular system provides numerous advantages over methods that have been previously used. Data transmission is charged at standard SMS rates, thus the charges are not based on the duration of data transmission. The cost efficient transmission of readings ensures that power consumption values can be transmitted more frequently to a remote station. The implications of being able to transmit readings more often are that energy utilities will be able to generate timely bills, better understand energy demand patterns, manage meter failures more efficiently and manage fraud better.

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ACKNOWLEDGMENT

The author is thankful to the Dean and Head of the Department, Electronics and Communication Engineering ,Aarupadai Veedu Institute of Technology,Vinayaka Missions University, Chennai for providing research facility and valuable suggestions for this work.

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