

# Arm Based Wireless Energy Meter Reading System ALONG with POWER on/off CIRCUIT

V V Rajesh Parvathala, T Venkateswarareddy, N V G Prasad

**Abstract:** *In this paper we discuss about wireless energy meter reading system along with power on/off circuit. It is a simple system which is used for measuring electrical bills through wireless communication and sends the information regarding consumed power & also send the dead line for paying of electrical bill and the system also having the power on/off circuit used to disconnect the power supply to energy meter by using wireless technology when the consumer fail to pay the electrical bill. Disconnecting the power supply through proper selection of switch located at the control unit. System also sends an acknowledgement to consumer regarding status of the system. Wireless energy meter reading system developed with ARM7 Processor, wireless communication network and other peripheral circuits.*

**Keywords:** *wireless meter reading system, zig-bee, GSM, ARM7 processor.*

## I. INTRODUCTION

With the rapid developments in the Wireless communication technology by the use of microcontrollers, there are many improvements in automating various industrial aspects for reducing manual efforts. The traditional manual Meter Reading was not suitable for longer operating purposes as it spends much human and material resource. It brings additional problems in calculation of readings and billing manually. Now-a-days the number of Electricity consumers is increasing in great extent. It became a hard task in handling and maintaining the power as per the growing requirements. Presently maintenance of the power is also an important task as the human operator goes to the consumer's house and produces the bill as per the meter reading. If the consumer is not available, the billing process will be pending and human operator again needs to revisit. Going to each and every consumer's house and generating the bill is a laborious task and requires lot of time. It becomes very difficult especially in rainy season. If any consumer did not pay the bill, the operator needs to go to their houses to disconnect the power supply. These processes are time consuming and difficult to handle. Moreover, the manual operator cannot find the Unauthorized connections or malpractices carried out by the consumer to reduce or stop the meter reading/power supply. The human error can open an opportunity for corruption done by the human meter reader. So the problem which arises in the billing system can become inaccurate and inefficient.

**Manuscript received on December, 2012.**

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The availability of wireless communication media has made the exchange of information fast, secured and accurate. The digital implementation caused the rapid utilization of devices such as computers and telecommunication devices. Communication media like the internet, GSM networks, etc exists everywhere. Wireless meter reading puts more control into the hands of both utilities and consumers by giving them more detailed information about power consumption [1]. This allows utilities to better regulate supply. So, remote wireless meter reading system and management kinds of network technologies has become a trend now. In the work presented here, a technique has been developed to read electricity meter readings from a remote server automatically using the existing GSM networks [3] for cellular phones. This technique can be applied for gas or water meters as well. The meters send the meter readings like kilo-watt-hour (kWh), voltage, current, bill, etc. by SMS to a central server. The central server then stores the information in database for analysis and sends the bill to the customer mobile phone. The SMS based data collection can be done very quickly and efficiently. Data can be collected after any desired time interval such as hourly, daily, weekly, or monthly basis. As there is no human intervention in the entire process, there is no chance of human error and corruption. In the extremely bad weather conditions like heavy snow, rain, storm, etc the system will not hamper on collecting data as long as GSM networks are stable. The development cost of the SMS based remote meter will be higher than conventional meter but the electric supplier revenue will increase in the successive months because it will eliminate the possibility of corruption done by the customer or as of a reader. Remote meter can be used in residential apartments and especially in industrial consumers where bulk energy is consumed.

## II. SYSTEM ARCHITECTURE

Basic design of the system is designed for measuring electrical bill wirelessly & sends the information regarding bill to consumer & gives the status of the energy meter. The message sends data regarding the amount paid for the consumption & deadline for the paying bill, depends of the payments the electrical bill, the system checks whether pay the bill or not, when the consumer failed to pay the within time, then the system disconnect the power supply wirelessly to energy meter by selecting proper switch located at control unit.

Basically system has 3 sections, Meter section, control unit section & mobile unit.

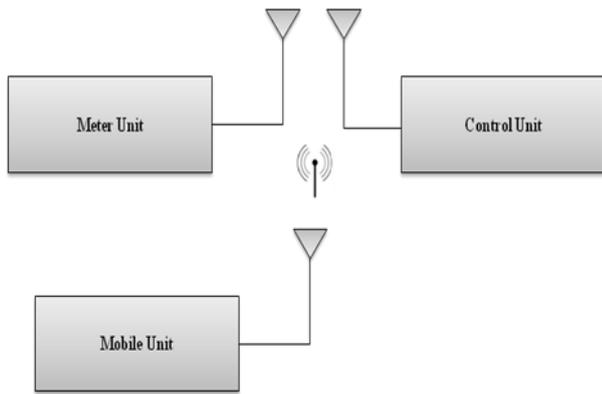


Figure1. Basic Block Diagram of Wireless Meter Reading System

Basically system consisting of two hardware units

### A. Meter unit:

Meter unit is a consisting of ARM 7 processor LPC2148, zigbee module, energy meter, relay& opto-coupler and it is shown in figure2

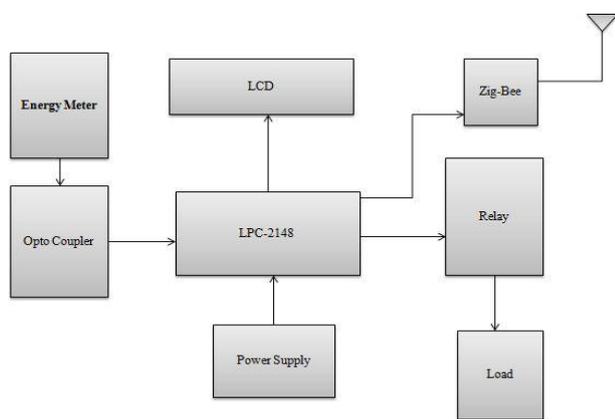


Figure2. Meter Unit

### B. Control Unit

Control unit is a consisting of ARM 7 processor LPC2148, zigbee module, GSM module and 3 switches (STATUS switch, ON switch, OFF switch) and it is shown in figure3

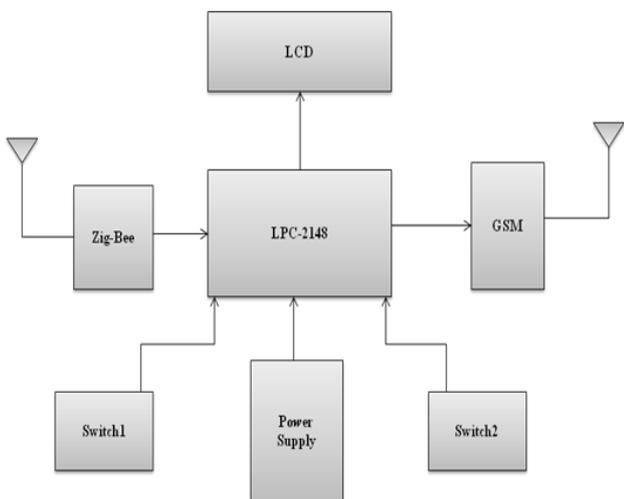


Figure3. Control Unit

## III. SYSTEM HARDWARE

The basic hardware components used in the Project are shown below in figure.2

- A. ARM7- LPC2148 Microcontroller
- B. Energy meter
- C. GSM Modem
- D. Relay control unit
- E. Power Supply

### A. ARM7 (LPC 2148) Microcontroller

ARM stands for Advanced RISC Machines. It is a 32 bit processor core used for high end applications. The LPC2148 microcontrollers are based on a 16- bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine the microcontroller with embedded high speed flash memory ranging from 32KB to 512KB. ARM (Advanced RISC Machine)

- 1) T – The Thumb 16 bit instruction set
- 2) D – On chip debug support
- 3) M – Enhanced Multiplier
- 4) I – Embedded ICE hardware
- 5) S- Synthesizable

A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate [4]. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. The LPC 2148 microcontroller is shown in figure.4.



Figure 4. LPC 2148 Microcontroller

Due to their tiny size and low power consumption, LPC2148 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus 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 [5], 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 suitable for industrial control and medical systems.

### B. Energy meter

Energy meter module is composed of ADE7757 which is energy metering IC with integrated oscillator and load and which produces the analog signal can be converted into digital signal and that digital signal in the form of pulses and ADE7757 outputs average real power information [11] based on the load. These outputs are interfaced with the LPC2148. One of the feature in ADE7757 to enhance the

capability of this work is having a power supply monitoring circuit on the VDD supply pin of the ADE7757. Due to this, proper device operation [6] is achieved at power up and power down modes. High degree of immunity to false triggering from noisy supplies is attained due to built in hysteresis and filtering operations in power supply monitor of the ADE7757.



Figure 5. ADE 7757 Energy meter

Depending on the data received from the energy meter Module, it sends information of the user meter to remote place through wireless communication module. In addition to that, the same information is sent to the user through LCD.

### C. GSM Modem

The Communication Module consists of GSM Modem. It is used to transfer the data of the user meter from LPC2148 controller to remote station by GSM wireless module [7]. The serial communication with the modem is full duplex 8 bits, no parity, 1 stop bit and at 115200 bauds. We have used Subscriber Identification Module (SIM) in the modem.



Figure6. SIMCOM 300 GSM modem

Specifications:

- 1) Tri-Band GSM/GPRS 900/1800/1900 MHz
- 2) Supply voltage range is 3.4V to 4.5V
- 3) Low power consumption
- 4) Operating temperature is -20°C to +60°C
- 5) Serial interface and debug interface
- 6) LCD interface
- 7) Keypad interface
- 8) Antenna connector and antenna pad

### D. Relay Control Unit

Relay control unit is used to shutting off the electric power supply when the due date is over. Whenever the user pays the bill the electric power supply is resumed by the relay module. The relay is driven by the LPC2148 controller. The user can monitor power consumption details on LCD. Controller of the Wireless meter reading system [8] is a 32bit ARM7 CPU (LPC2148). The system communicates with the remote station through communication module. Depending on the information received from the remote station, the LPC2148 can control the Relay module to shut off or resume the electric power supply.

## III. IMPLEMENTATION AND RESULTS

Basic design of the system is designed for measuring electrical bill wirelessly & sends the information regarding bill to consumer & gives the status of the energy meter. The message sends data regarding the amount paid for the consumption & deadline for the paying bill, depends of the payments the electrical bill, the system checks whether pay the bill or not, when the consumer failed to pay the within time, then the system disconnect the power supply wirelessly to energy meter by selecting proper switch located at control unit.

Basically system has 3 sections, Meter section, control unit section & mobile unit.

Control unit is a consisting of ARM 7 processor LPC2148, zigbee module, GSM module and 3 switches (STATUS switch, ON switch, OFF switch)

Meter unit is a consisting of ARM 7 processor LPC2148, zigbee module, energy meter, relay. The entire operation of the system will do from control unit by proper selection of the switches. When switch 1 is selected then the system reads the energy meter reading in terms of number of units wirelessly through zigbee modules & then electrical bill is measured for corresponding number of units consumed by the energy meter & sends the information regarding the electrical bill will be sent to consumer mobile through GSM module message consisting of information regarding electrical bill & the deadline for the payment of the bill. When the consumer fails to pay the electrical bill in time then the power supply to energy meter will disconnect wirelessly by proper selection of switch & then the status of the energy meter sent to the consumer.

## IV. CONCLUSION

In the present work wireless meter reading system is designed to continuously monitor the meter reading and to shut down the power supply remotely whenever the consumer fails to pay the bill. It avoids the human intervention, provides efficient meter reading, avoid the billing error and reduce the maintenance cost. It displays the corresponding information on Mobile for user notification.

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