International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 04 | Apr-2016 www.irjet.net p-ISSN: 2395-0072

Internet of Things (IOT) Based Energy Meter

[1]Gobhinath.S, [2]Gunasundari.N, [3]Gowthami.P

[1]Asst. Professor, Dept of EEE, Sri Krishna College of Engg & Tech., E-mail: gobhinaths@skcet.ac.in

[2, 3] UG Scholars, Dept of EEE, Sri Krishna College of Engg & Tech.,

---

Abstract: The Existing domestic Energy meter reading systems universally exist many problems, such as difficulty in construction, too narrow bandwidth, too low rate, poor real time, not two way communication quickly etc. To solve above problems, this paper uses the wireless technology for Automatic Meter Reading system. A proposed method provides the communication between the Electricity Board section and the consumer section using Internet of things (IOT) for transmitting the customer's electricity consumption and bill information that is calculated using ARM7 microcontroller [1]. The power fluctuations are monitored using the voltage sensor and current sensor are fed to the microcontroller which indicates it to the Electricity Board. Depending on the power generation, the house hold devices are controlled automatically. From Electricity Board section the information regarding the bill amount and payment are communicated to the consumer via Global System for Mobile communication [4]. The power and billing information is continuously transmitted by the use of Internet of Things and monitored by the Electricity Board section. Whenever there is power theft identified can be sent from the Electricity Board section to cut the supply to the customer.

Keywords: Internet of things, ARM7 microcontroller, Energy meter and Global System for Mobile.

I. INTRODUCTION

Embedded systems and Real Time Operating systems (RTOS) are two among the several technologies that will play a major role in making these concepts possible [2]. A large number of people are already depending on operating systems for real time applications, these 'eyes in the sky' are now going to make an impact on our everyday lives in a more significant manner. Embedded systems are pre-designed without connections and operate as per the required task. But in operating systems instruction is design-oriented. These systems are basically platform-less systems. Embedded systems are the unsung heroes of much of the technology we use today the video game we play, or the CD player or the washing machines we use employ them. Without an embedded system we would not even be able to go online using modem [3].

Almost every car that rolls off the production line these days makes use of embedded technology in one form or the other; most of the embedded systems in automobiles are rugged in nature, as most of these systems are made up of a single chip. No driver clashes or 'systems busy' conditions happen in these systems. Their compact profiles enable them to fit easily under the cramped hood of a car. These systems can be used to implement features ranging from adjustment of the suspension to suit road conditions and the octane content in the fuel to antilock braking systems (ABS) and security systems. Embedded systems are designed to do some specific task, rather than be a general-purpose computer for multiple tasks. Some also have real time performance constraints that must be met, for reasons such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs.

Embedded systems are not always standalone devices. Many embedded systems consist of small, computerized parts within a larger device that serves a more general purpose. For example, the Gibson Robot Guitor features an embedded system for tuning the strings, but the overall purpose of the Robot Guitar is, of course, to play music. Similarly, an embedded system in an automobile provides a specific function as a subsystem of the car itself embedded systems are designed to do some specific task, rather than be a general-purpose computer for multiple tasks [5]. Some also have real time performance constraints that must be met, for reasons such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs.

II. ENERGY METER

The conventional mechanical energy meter is based on the phenomenon of "Magnetic Induction". It has a rotating aluminium Wheel called Ferriwheel and many toothed wheels. Based on the flow of current, the Ferriwheel rotates which makes rotation of other wheels. This will be converted into corresponding measurements in the display section. Since many mechanical parts are involved, mechanical defects and breakdown are common [3]. More over chances of manipulation and current theft will be higher.

Electronic Energy Meter is based on Digital Micro Technology (DMT) and uses no moving parts. So the EEM is known as "Static Energy Meter" In EEM the accurate functioning is controlled by a specially designed IC called ASIC (Application Specified Integrated Circuit). ASIC is constructed only for specific applications using Embedded System Technology. Similar ASIC are now used in Washing Machines, Air Conditioners, Automobiles, Digital Camera etc [4].

In addition to ASIC, analogue circuits, Voltage transformer, Current transformer etc are also present in EEM to "Sample" current and voltage. The 'Input Data' (Voltage) is compared with a programmed "Reference Data' (Voltage) and finally a 'Voltage Rate' will be given to the output. This output is then converted into 'Digital Data' by the AD Converters (Analogue- Digital converter) present in the ASIC [7].

The Digital Data is then converted into an "Average Value". Average Value / Mean Value is the measuring unit of power. The output of ASIC is available as "Pulses" indicated by the LED (Light Emitting Diode) placed on the front panel of EEM. These pulses are equal to Average Kilo Watt Hour (kWh / unit). Different ASIC with various kWh are used in different makes of EEMs. But usually 800 to 3600 pulses / kWh generating ASIC s are used in EEMs. The output of ASIC is sufficient to drive a Stepper Motor to give display through the rotation of digits embossed wheels. The output pulses are indicated through LED. The ASIC are manufactured by Analogue Device Company. ADE 7757 IC is generally used in many countries to make EEMs. ADE 7555 / 7755 ASIC maintains the international standard CLASS I IEC 687/ 1036 [3].

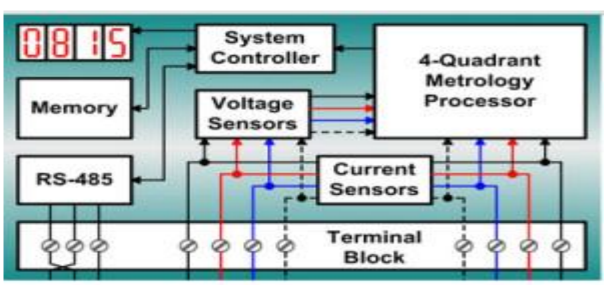


Fig.1 Energy meter functional block

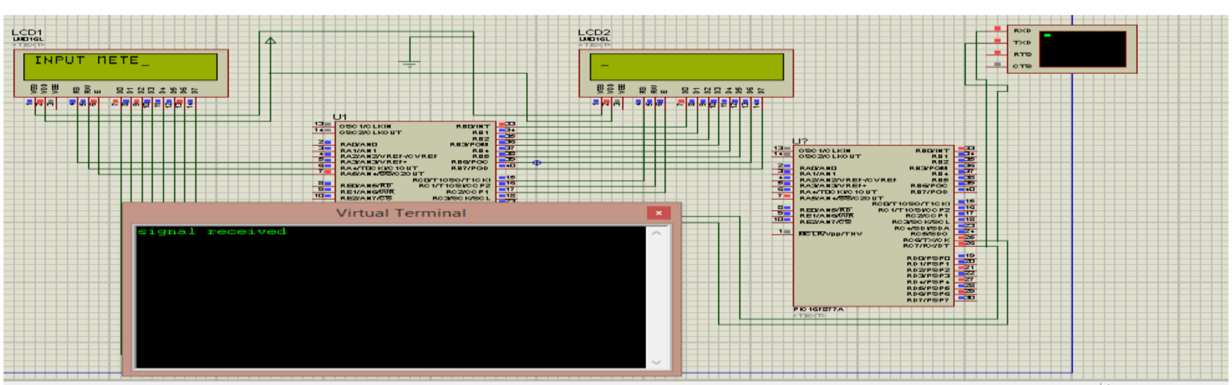
III. PROPOSED SYSTEM

Since IOT is cost effective compared to SMS, monitoring of energy meters at lower cost is made possible. Daily consumption reports are generated which can be monitored through Android application and/or web portal. Also, android users can pay their electric bills from their android application [4].

Non-android users can monitor and pay their bills online. The system is more reliable and accurate reading values are collected from energy meters. Live readings of the energy meter can be viewed through Android application. Also, the readings can be viewed online. The human intensive work is avoided and all the values are maintained in the central server. The communication medium is secure and tampering of energy meters can be identified easily. If an error occurs in the system, the value in the central server will not be updated. Once the value updated crosses the threshold time, the server can determine that something is wrong in the system and can report the engineers in EB. Thus, identification of error becomes easier. Since the values are stored in the central database, the reports are made accessible from anywhere in the world. Also, the server is online 24x 7 [4].

A. Advantages of the Proposed System

The users can be aware of their electricity consumption. The human work of collecting readings by visiting every home at the end of every month can be avoided by generating Electricity bills automatically. Theft of electricity can be avoided by tamper proof energy meters. The errors in the system can be identified quickly



III. SYSTEM DESIGN

The designed energy meter includes a simple energy meter, a GSM modem (SIM-900), An ARM7 LPF 2129 (master controller), 8051 microcontroller (measure electric pulse), web portal with database and android app installed in user's mobile [5]. The system can be divided into 2 parts: The project is mainly divided into 2 modules: (a) Hardware design (b) Web Server interface design

A. Hardware Design

Internet of things (IOT) is the main method of communication between the energy meter and the web server. IOT, being a 2.5G mobile technology, is available all over the world. It is also ideally suitable for data transfer over an always on-line connection between a central location and mobile devices. The cost is per kilobyte of data transferred, in comparison to SMS where the cost is per message. The reading information from the energy meter in real time is uploaded to a central database via IOT [5]. Each user of the system may access this information via the Internet.8051 microcontroller is interfaced with energy meter and PIC 18F4550 which acts as the master controller through RS-232. The receive pin of RS-232 of PIC is connected to the transmit pin of RS-232 of 8051. The transmit pin of RS-232 of PIC is connected to the receive pin of RS-232 of SIM900 module.8051 microcontroller monitors every pulse of the energy meter. It sends the measured reading to PIC 18F4550 every time the value is changed. PIC 18F4550 gets the reading from 8051 and then communicates with SIM900 through AT commands and transmits the reading information through IOT to the central server.

From fig 3 we can see, when user try to tamper meter, the theft detection unit detects theft and it sends theft detected information to Tx PLC through μc, which is then displayed on windows virtual terminal of the service provider using Rx PLC [5].

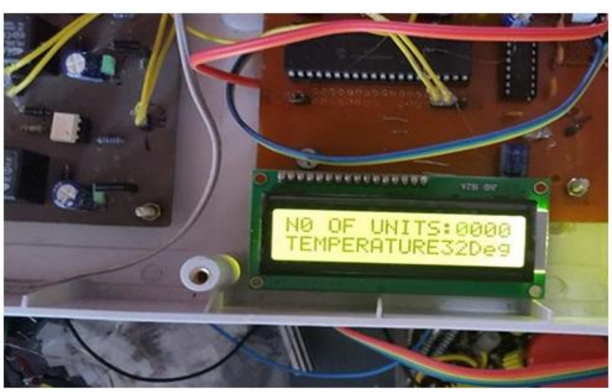


Fig.3 LCD display of IoT energy meter No. of units consumed.

B. Web Server interface design

The pulse for every unit from the energy meter is monitored using 8051 microcontroller. This monitored value is sent to the PIC controller which acts as the Master. For every 30 seconds, the PIC controller tries to send the value received to the central public server through IOT using GSM Modem [6].

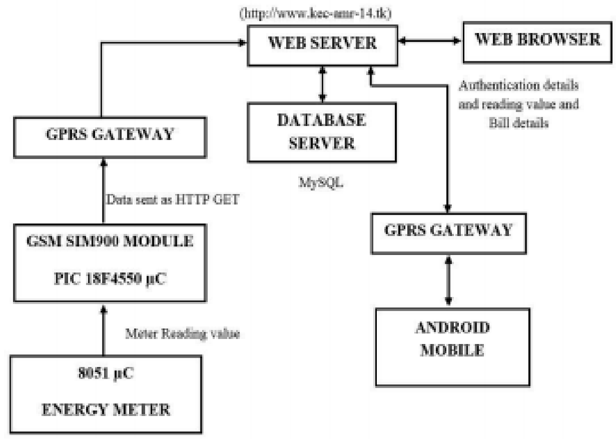


Fig 4. Block diagram of webserver design

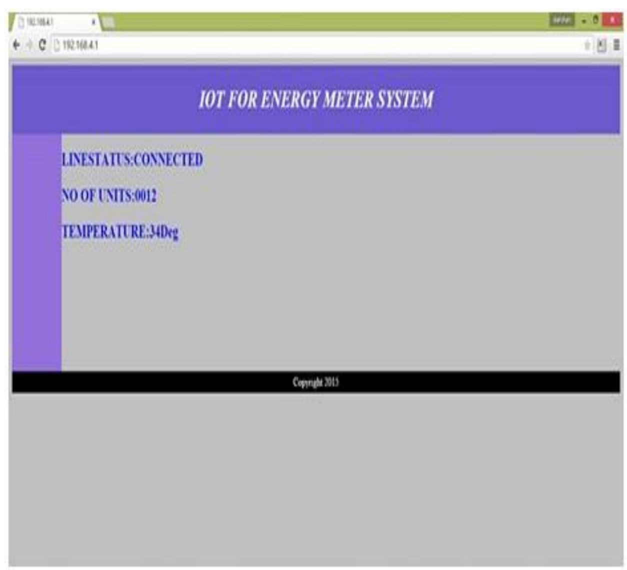


Fig 5. IOT Energy meter Webpage

IV. APPLICATIONS

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

A. *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 [6]. Th e 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 Figure6 in the bottom

Fig.6 . LCD Display

V. CONCLUSION

The GSM output format has been analyzed.ThePIC-16F877A Microcontroller the operations were studied and it is programmed and the system working model was developed in order to accomplish the objective. "The IOT based Energy meter" saves the customer's time by making them work "leaner". The operation of the calculating the power cost is simple and doesn't involve delays. Instead of using DAQ which is very costly in this project PIC (16F877A) microcontroller along with serial communication has been used to interface with the virtual terminal[5].

The IOT based Energy meter for calculating cost and displayed in LCD has been achieved using MPLAB and PIC 16F877A. The power cost is send through serial communication to the Virtual terminal constructed in PROTEUS. This project can therefore enlighten management about wasted time, and unnecessary trips, book keeping and billing because it gives an accurate accounting of units driven because the prevention of malpractice.

REFERENCES

1. YujunBao and Xiaoyan Jiang, "Design of electric Energy Meter for long-distance data information transfers which based upon GPRS", ISA2009. International Workshop on Intelligent Systems and Applications, 2009.
2. Ashna.K and Sudhish N George, "GSM based automatic energy meter reading system" IEEE Wireless commuincations, 2013.
3. Philip Garner, Ian Mullins, Reuben Edwards and Paul Coulton. "Mobile Terminated MS Billing - Exploits and Security Analysis" New Generation. Proceedings of the Thirdlnternational Conference on lnformation Technology: New Generations (ITNG'06) -Vol. 00 200, 10-12 April 2006, Las Vegas, Nevada, USA, pp. 294 - 299.
4. N. Papadoglou and E. Stipidis (1999) "Short message service link for automatic vehicle location reporting" Electronics Letters 27th May 1999 Vol. 35 No. 11, pp. 121-126.
5. Vivek Kumar Sehgal,Nitesh Panda, NipunRaiHanda, "Electronic Energy Meter with instant billing",UKSim Fourth European Modelling Symposium on Computer Modelling and Simulation.
6. N. Papadoglou and E. Stipidis (1999) "Short message service link for automatic vehicle location reporting" Electronics Letters 27th May 1999 Vol. 35 No. 11, pp. 121-126.
7. TanmoyMaity and ParthaSarathi Das, "Intelligent online measurement and management of energy meter data through advancedwireless network" IEEE Wireless communications ,2011.