A Review Paper on Automatic Energy Meter Reading System

Nitesh Rawat[1], Bhuvesh Yadav[2], Sonia[3] and Neha[4]

[1,2,3,4]Electronics and Computer Engineering Dronacharya College of Engineering, Gurgaon, M.D. University, Rohtak

Abstract—*The existing systems are either an electronic energy meter or an electro-mechanical meter which are currently in use is limited to record up to kWh units. The kWh units recorded by meter readers monthly, on foot which need to be processed by a meter reading company. For processing the meter reading, company needs to link each recorded usage data to the particular account holder and then determine the amount owed by means of the specific tariff in use. On basis of various platforms researchers proposed many system for Automatic Meter Reading (AMR). There are various wire-based AMR systems like Power Line Carrier (PLC) and Telephone Line Network (optical/ cable) and wireless AMR systems such as E-metering systems based on GPRS, Bluetooth, GSM. Design of an Electric Energy Meter for long-distance data information transfers which based upon GPRS, but this system can't be implemented so easily because the regular use of GPRS is still a dream to the common man. A GSM based Energy meter with instant billing facility is introduced is efficient, but still the problem of missing SMS will degrade the accuracy and performance. A more reliable and user friendly system by creating web portal for multiple access using the advanced Visual studio .net frame work which will manage the data efficiently even if there is loss of SMS. It makes the design different from the previous proposals and also increases the throughput. The GSM/GPRS channel is a very useful means of communication as sending data as SMS turns out to be a very handy tool, due to its good area coverage capability and cost effectiveness.The front end web portal is User friendly and any employee with minimum knowledge of computers can work on this software. Employees can read the meter by sitting in their office.*

Keywords: *Automatic Meter Reading System (AMRS), GSM, PIC, Short Messaging System (SMS), Visual Studio.NET*

1. INTRODUCTION

At present, most of the houses in India have the traditional mechanical watt hour meters and the billing system is not automated [1]. At the end of each month a person from the electricity board goes to every house and takes the meter reading manually. These meter readings are used for electricity bill calculation and this bill sent to consumer house by post. Customer goes to electricity department for paying this bill amount. But in this technique we are required great number of persons for reading the meters. The procedures of sending the bills to customer are very laborious and cumbersome. But a new technology is named Automatic Meter Reading System is discuses. Apart from being a boom,

AMR wipes out all the cons of conventional systems. Automatic Meter Reading System is a sophisticated system which allows companies to collect the reading without visiting the site. AMR include various technology for data collection such as power line communication, Zig-bee, Radio Frequency (RF Method) and GSM network but GSM network is best among this technology
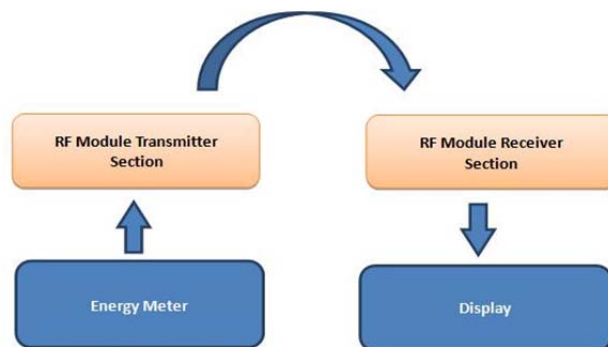

Fig. 1: Block diagram of Energy Meter reading system

The Energy meter data acquisition system with wireless communication is presented in this paper. The proposed method is based on wireless communication with use of a RF Transceiver and GSM module. The power consumption is measured with digital energy meter in terms of units and then the power measurement readings are transmitted with use of RF transmitter from energy meter to the center node which contains a RF receiver and GSM module as Data Forwarder. The GSM module will forward the data to the end utility office. So the whole proposed method will work in two type of communications. First short distance wireless communication with use of RF Transceiver from energy meter to the center node. Second will be for long distance wireless communication from center node to the end utility office with use of GSM module. All the hardware and software based details are described in the paper. The system has many significant advantages such as, wireless communication, low power consumption devices, Accuracy, Large coverage area. The power consumption data are received at the end where they are stored and used for future references and customer

billing system. The front end web portal is User friendly and any employee with minimum knowledge of computers can work on this software..

2. BRIEF HISTORY

The Automated Meter Reading (AMR) was first conceived in 1962 by AT&T, but this experiment was not successful. After successful experiments, AT&T offered to provide phone system-based AMR services at $2 per meter. The price was four times more than the monthly cost of a person to read the meter-50 cents. Thus the program was considered economically unfeasible. The modern era of AMR began in 1985, when several major full-scale projects were implemented. Hackensack Water Co. and Equitable Gas Go. were the first to commit to full-scale implementation of AMR on water and gas meters, respectively.

In 1986, Minnegasco initiated a 450,000-point radio-based AMR system. In 1987, Philadelphia Electric Co., faced with a large number of inaccessible meters, installed thousands of distribution line carrier AMR units to solve this problem. Thus, AMR is becoming more viable each day. Advances in solid-state electronics, microprocessor components and low cost surface-mount technology assembly techniques have been the catalyst to produce reliable cost-effective products capable of providing the economic and human benefits that justify use of AMR systems on a large, if not full-scale, basis.

The primary driver for the automation of meter reading is not so much to reduce labor costs, but to obtain data that is otherwise unattainable. Many meters, especially water meters, are located in areas that require an appointment with the homeowner. Gas and Electricity tend to be more valuable commodities than water, and the need to offer actual readings instead of estimated readings can drive a utility to consider automation. While early systems consisted of walk-by, and drive-by AMR for residential.

Remote meter reading (or AMR) system refers to the system that uses a communication technique to automatically collect the meter readings and other relevant data from utilities gas meters, without the need to physically visit the gas meters. The development AMR technology has catapulted meter data to center stage of the utility business plan.

3. BENEFITS OF AUTOMATIC ENERGY METER READING SYSTEM

The automatic energy meter reading technology is very useful in many applications. By using AMR technology we can accommodate a lot of benefits. Some benefits of AMR are as follow-

A. Electrical Company Benefits
- Smart automated processes instead of manual work.
- Accurate information from the network load to optimize maintenance and investments.

- Customized rates and billing dates.
- Streamlined high bill investigations.
- Detection of tampering of Meters.
- Accurate measurement of transmission losses.
- Better network performance and cost efficiency.
- Demand and distribution management.

B. Customer Benefits
- Precise consumption information.
- Clear and accurate billing.
- Automatic outage information and faster recovery.
- Better and faster customer service.
- Flag potential high consumption before customer gets a high bill.

4. SYSTEM DESIGN

A. Proposed System
The proposed System can be divided into main four sections. Fig. 1

- Meter Reading System
- Wireless Communication for Short Range
- Wireless Communication for Long Range
- Data Collection and Storage

These four sections combined can give a better solution for smart metering application. The main idea behind keeping the center node is to minimize the hardware used for the installation on every meter. The RF transceiver used is CC2500 of very low cost and reliable for short range communication. CC2500 is installed on every energy meters and those end nodes will be sending data statistics to a center kept another CC2500 receiver which is called center node. Now from the center node a GSM module is connected to the CC2500 RF Transceiver. This will forward the meter reading data to the other end with long distance.

Thus only RF transceivers are installed on every energy meters instead of GSM modules as described in the proposed system. This will lower the cost of overall system. The microcontroller used in the proposed system is of ultra low power consumption[25]. The center node between the different end nodes will be working on battery supply in most of the cases so that is most important that the center node requires minimum amount of power. This will increase the lifetime of the node.
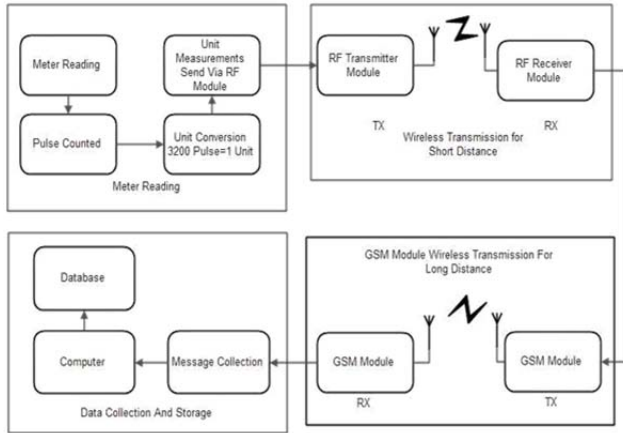
Fig. 2: Block Diagram of Proposed System

A. Power Measurement

The power measurement of the energy meter is done with the 5V operated AD7751 Energy meter IC and 3.6V operated MSP430G2553[25] microcontroller in terms of pulse counting as shown in the block diagram of Fig.2.The whole setup was tested with 100W bulb and the results are also shown in the later sections.
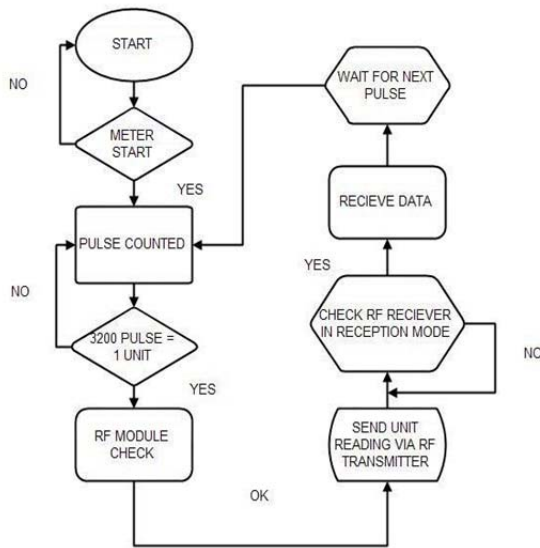

Fig. 3: Prototype setup Data Transmission between CC2500 and MSP430G

B. Data Transmission for Short distance with CC2500 RF Transceiver

The 3.6V power operated RF Transceiver CC2500 used is of very low cost and with good accuracy and enough coverage area for the data transmission between the energy meters to the center node connected with ultra-low power operated MSP430G2553 microcontroller.

C. Center node (CC2500 with SIM300 based GSM module

On reception of the meter reading packet at the center node the 20 pin out of 8 pins connected to microcontroller CC2500 will receive in reception mode and extract the meter address and reading data from the packet. According to the meter address the reading will be forwarded through the SMS with the use of GSM module. With the use of UART of MSP430G2553 the GSM module is given AT command for sending the message which contains the meter reading. With easy use and wide spread network of GSM network, it gives very good result for long range communication.

5. CONCLUSION

In this work an automatic energy metering device is described which allows the visualization of power consumption of electrical devices like a TV or washing machine in real time. The current system enables residents to have an immediate overview about the actual and short term history power consumption. Future work will include developments towards automatic and remote control of devices. A further approach could be that once a day accumulated data is sent from the household to the energy provider. This gives the energy provider the opportunity to better calculate the needed.

REFERNCES

[1] K V Murthy, M S Kamath, basic circuit analysis, 1st edition, A Jaico Book Publication, 2002, ISBN 81-7224-771-9

[2] Rob van Gerwen, Saskia Jaarsma and Rob Wilhite, KEMA, "Smart Metering" July 2006

[3] H.G.Rodney, Tan IEEE, C.H.Lee and V.H.Mok, IEEE "Automatic Power meter Reading system using GSM Network" .Proceeding of the 8th international Power Engineering Conference (IPEC-07) 2007, pp: 465-469.

[4] A. Abdollahi, M. Dehghani, and N. Zamanzadeh , "SMSbased reconfigurable automatic meter reading system," .IEEE International Conference on Control Applications (CCA 2007), Oct, 2007, pp. 1103 - 1107.

[5] L. Cao, J. Tian, and D. Zhang, Networked Remote Meter-Reading System Based on Wireless Communication Technology, Information Acquisition, 2006 *IEEE International Conference*, pp. 172176, 2006.