



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 5, May 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

ijrset@gmail.com

www.ijrset.com

Automatic Energy Meter Reading and Billing System

Muruganandam Masilamani¹, Sami Khamis Said Khalifa Al-Hinai², Haitham Nasser Salim Said Al-Yahyaai³,
Mohammed Almur Al-Hatmi⁴

Lecturer, Engineering Department, University of Technology and Applied Sciences – Ibri, Sultanate of Oman¹

Bachelor Student, Engineering Department, University of Technology and Applied Sciences – Ibri, Sultanate of Oman^{2, 3 & 4}

ABSTRACT: This paper is about an Automatic Energy Meter Reading and Billing System (AEMRBS) using GSM and microcontroller. In this system the Energy meter reading can be calculated and it will be stored in the electricity distributor database without an assessor's intervention. In such a way that the electricity distributor can access the Energy meter reading frequently by remote access through the GSM based AEMRBS. A GSM module is incorporated in this system with microcontroller and energy meter module. Whenever the customer utilizes the electricity, the live energy will be sent to the cloud server every 30 minutes and it will be recorded in the server. The ThingSpeak cloud server is used for recording the DATA. The customer also can receive the bill from anywhere in the world using the ThingShow mobile application. It is a simple and low cost wireless GSM based AEMRBS.

KEYWORDS: Energy Meter, GSM Module, Arduino Microcontroller, Current Sensor, Voltage Sensor, Real Time Clock (RTC), ThingSpeak and ThingShow.

I. INTRODUCTION

In recent days automation is giving vital role in day to day life. Also utilization of manpower for different work in different environment is difficult, very expensive and more time consuming one. Particularly during the COVID pandemic, taking the energy meter reading by assessors is very difficult and risky. Hence this project Automatic Energy Meter Reading and Billing System (AEMRBS) using GSM is planned to implement. In the existing system different methods used to receive the meter reading, visiting the assessors in person, self-meter reading system, prepaid energy system, etc. It is not convenient, more time consuming, more labour requirements, possibility for error reading, power theft by bypassing the meter and it is disturbance for the user to send the reading every month in the self-meter reading system. Sometime the consumer's door will be closed. Hence the assessor will calculate the bill as per the last month bill or the average of last three month.

The design of a simple low cost wireless GSM energy meter and its associated web interface, for automating billing and managing the collected data globally. This system replaces traditional meter reading methods and enables remote access of existing energy meter by the energy provider. Also they can monitor the meter readings regularly without the person visiting each house. A new interactive, user friendly graphical user interface is developed using Microsoft visual studio .NET framework and C# [1]. A Low Cost GSM based Smart Energy Meter Design: Capable of Demand Side Management and Data Logging. In the design of smart energy meter has been first implemented in software environment and then a prototype model has been developed, which communicates the consumed energy data through GSM network [2]. The GSM Based Energy Meter Monitoring and Load Control has been developed for controlling the load [3], design and construction of A GSM Based Energy Meter developed to send the energy to the web [4]. The GSM module is used for different applications [5-10]. The different automation techniques were demonstrated for different applications [11-15]. In the above mentioned work there is no separate mobile application for the consumers.

The AEMRBS is giving solution for the above said problems. It is a GSM based Automatic Energy Meter Reading and Billing System. Here the energy is calculated using voltage and current sensors value. The calculated energy will be stored in the EEPROM of microcontroller and the same will be sent through the GSM module to the ThingSpeak cloud server and it will be recorded. The bill will be calculated according to the tariff of the respective customer and it will be also sent to the Thing Speak cloud server and also to the customer mobile using the ThingShow app. The proposed system gives the solution to power theft, auto energy recording auto billing and reduction of labour etc.

The Paper is organized as follows. Section I presents the introduction part, Section II describes proposed work, Section III.Explains the methodology Section IV demonstrates experimental results of energy meter. Finally, Section V presents conclusion.

II. PROPOSED WORK

The block diagram given in the figure 1 is represents the Automatic Energy Meter Reading and Billing System (AEMRBS) using GSM and micro controller. The energy meter module consists of a voltage sensor, current sensor, Real Time Clock (RTC), Arduino Microcontroller, LCD display and GSM module. The load is connected with the energy meter module. Initially the power is calculated with the current voltage and power factor. Then the energy will be calculated with power and time. This energy along with the other parameters will be sent to the ThingSpeak cloud through the GSM module.

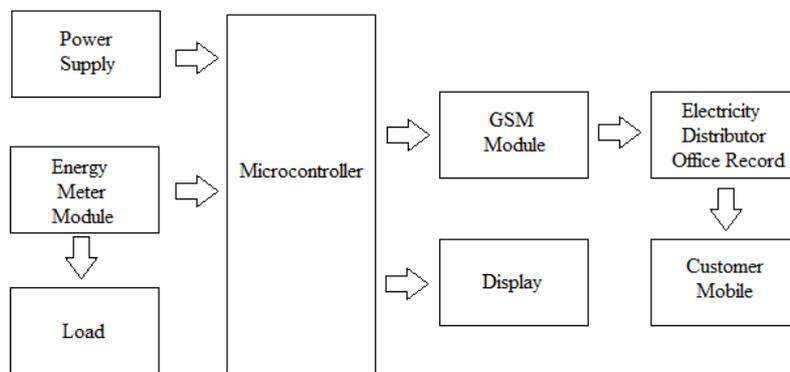


Fig.1. Block Diagram of proposed system

III. METHODOLOGY

The energy is calculated using the voltage and current sensors. ZMPT101B is the AC voltage sensor used to sense the AC voltage. It is a single phase AC transformer based active output voltage mutual inductance module build with this sensor. It has series of high-precision voltage transformer and high-precision operational amplifier. It can able to measure the input of 0 to 250 volt AC supply voltage. It contains an onboard Precision Micro-Voltage Transformer, high-precision on-board operational amplifier circuit; it will measure the precise value of sampling and proper compensation and other functions. The output of this sensor is sinusoidal voltage DC component of 5V to 30V. Figure shows the voltage sensor ZMPT101B. The Voltage Sensor ZMPT101B is shown in figure 2.



Fig.2. Voltage Sensor ZMPT101B

The ZMCT103C 5A-5mA Current transformer is used for sensing the current. It is a high precision micro current transformer and it will sense the AC current accurately using the current transformer. It will measure the input current of 5A and it will give the output of 5mA corresponding to the 5 ampere input meaning that it is working with the ratio of 1000:1. This current transformer has high galvanic isolation, high accuracy and good consistency. It can be mounted on the PCB easily by soldering the two legs. There is a burden resistor of 100 ohms is used to sense the current in terms of voltage. The Current Sensor ZMCT103C 5A-5mA is shown in figure 3.



Fig.3. CurrentSensor ZMCT103C 5A-5mA

The power factor is calculated using a separate Arduino Nano microcontroller. The calculated power factor is given to the Arduino mega main board for calculating the energy. The single phase AC power is calculated using the voltage, current and power factor. Then the Energy is calculated by multiplying the time with the AC power.

IV. EXPERIMENTAL RESULTS

The energy is calculated almost for every millisecond. The calculated Energy will be stored in the EEPROM of Arduino Mega Board. Every millisecond the new energy will be calculated and it will be added with the existing energy in the EEPROM storage. The calculated parameters will be lively displayed in the 20X4 LCD display. The live date and time also will be displayed in the LCD using the RTC DS1302. All the calculated parameters such as voltage, current, power, power factor, energy and cost will be validated with standard meter reading and the developed smart energy meter is providing accurate result. All these parameters will be sent to the cloud server and it will be updated every 30 minutes.

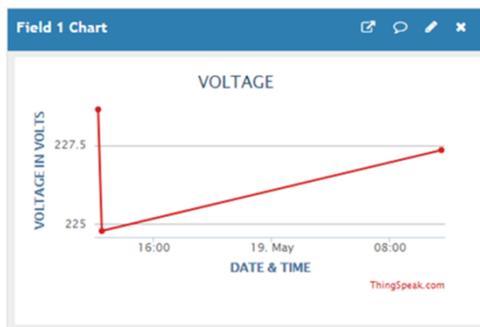


Fig.4. Graphical representation of Voltage

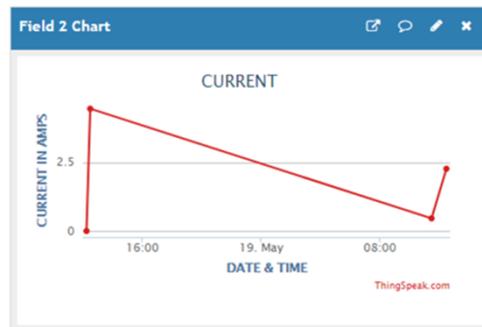


Fig.5. Graphical representation of Current

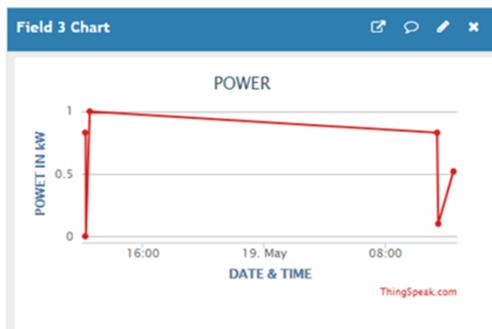


Fig.6. Graphical representation of Power

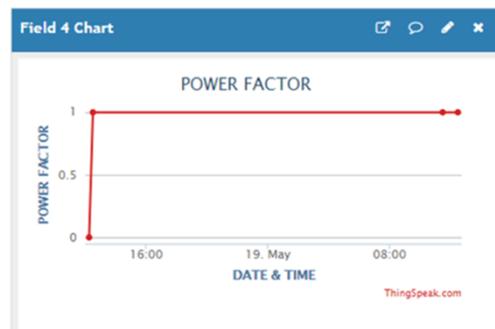


Fig.7. Graphical representation of Power Factor

For the IoT application GSMSIM900A is used for data transfer and the ThingSpeak cloud is used for DATA recording. Here there is an Ooredoo Sim Card is used for the GSM module for transferring the data to the ThingSpeak cloud. The same ThingSpeak recorded parameters can be viewed from the mobile application called ThingShow. Hence the Smart Energy Meter all the parameters can be viewed in the ThingSpeak website and also the mobile application ThingShow. The graphical representation of recorded DATA voltage, current, power, power factor, energy and cost in ThingSpeak Cloud is shown in figure 4, 5, 6, 7, 8 and 9 respectively.

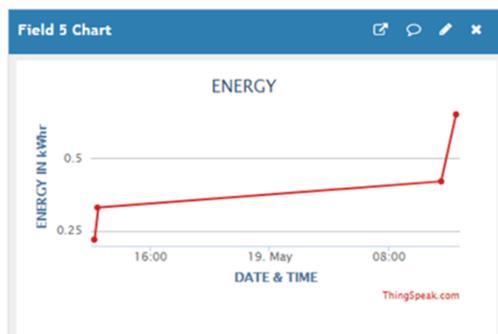


Fig.8. Graphical representation of Energy



Fig.9. Graphical representation of Cost

V. CONCLUSION

The Automatic Energy Meter Reading and Billing System Using GSM and Low Cost Microcontroller have been developed as per the initial objectives. This project will calculate the energy of all type of loads. Here the power factor is calculated without using complex hardware circuit; hence the overall hardware circuit is simple and compact. The calculated parameters such as voltage, current, power, power factor, energy and cost are initially displayed in the LCD display. All these parameters are sent to the ThingSpeak cloud; here all the data were recorded. The electricity distributor can view the individual customer's utilized energy and other parameters any time from the cloud server without any assessor's intervention. The consumer also can see their daily usage of electricity and all other parameters including billing cost, time to time from anywhere in the world using the ThingShow mobile application. The smart energy meter parameters were calibrated with the standard meter and verified all the parameter with the existing standard meter, the developed smart energy meter is showing accurate result, more over all the parameters can be viewed from anywhere in the world.

ACKNOWLEDGEMENT

This research project was funded by The Research Council (TRC) – Sultanate of Oman. We acknowledge The Research Council (TRC) – Sultanate of Oman, for funding this project. Also, we express our sincere gratitude to the Dean, Head of the Engineering Department, Head of Electrical Section of the University of Technology and Applied Sciences – Ibr, Sultanate of Oman for their constant encouragement and continuous support.

REFERENCES

- [1] Ashna.k, Sudhish N George. "GSM Based Automatic Energy Meter Reading System with Instant Billing" 2013 International Mutli Conference on Automation, Computing, Communication, Control and Compressed Sensing (iMac4s), 22-23 March 2013.
- [2] RanaAsad Ali1, MudassirHussain and TahirMahmood, "Low Cost GSM based Smart Energy Meter Design: Capable of Demand Side Management and Data Logging" 2018 3rd International Electrical Engineering Conference (IEEC 2018) Feb, 2018 at IEP Centre, Karachi, Pakistan
- [3] Darshit S. Patel, H.B. Patel, "GSM Based Energy Meter Monitoring and Load Control", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 04 Issue: 03, Page(s): 360-363, Mar -2017
- [4] Olanrewaju-George Babatunde, "Design and Construction of A GSM Based Energy Meter", Department of EEE, School of Engineering and Engineering Technology, ModibboAdama University of Technology, Yola, May, 2014
- [5] M.Muruganandam,A.MaswoodhurRahman, "Simulation and Implementation of Loop Based Bank Locker Security System Using Cost Effective Microcontroller and GSM Module" Published in International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 8, Issue 9, September 2019. Pages: 2175-2181. ISSN (Print): 2320 – 3765
- [6] MaswoodhurRahman Abdul Wahidh and MuruganandamMasilamani, "Experimental Verification of Three Mode Controller for Home Appliance Using Wireless Technology, IIUM Engineering Journal, Vol. 22, No. 2, 2021, <https://doi.org/10.31436/iiumej.v22i2.1618>.

- [7] Muruganandam, M, Thangaraju I and Madheswaran, M. “Simulation and Implementation of an Embedded Hybrid Fuzzy Trained Artificial Neural Network Controller for Different DC Motor” Published in International Journal of Engineering and Technology, Vol. 6, Issue 1, pp. 315-332 February 2014. ISSN:0975-4024 (Online) p-ISSN: 2319-8613.
- [8] Sreejith.S, Indra Gandhi, DhanalakshmiSamiappan and Muruganandam.M, “Security Constraint Unit Commitment on Combined Solar Thermal Generating Units using ABC Algorithm” Published in International Journal of Renewable Energy Research, Page(s) 1361-1372, Volume 6, Issue 4, 2016 ISSN:1309-0127.
- [9] P Ranjitha, V Dhinesh, M Muruganandam, “ Soft Switching with Cascaded Transformers to Drive the PMDC Motor” Published in International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Volume 4, Issue 2, Pages 787-794, Feb-2015. ISSN (Print): 2320 –3765 ISSN (Online):2278 –8875.
- [10] R PavithraPriya, N Sivaraj, M Muruganandam, “ A Solution to Unit Commitment Problem with V2G Using Harmony Search Algorithm” Published in International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Volume 4, Issue 3, Pages 1208-1214, March-2015. ISSN (Print): 2320 –3765 ISSN (Online):2278 –8875.
- [11] I.Thangaraju, M.Muruganandam, and M.Madheswaran, “Performance Analysis and Experimental Verification of Buck Converter fed DC Series Motor Using Hybrid Intelligent Controller with Stability Analysis and Parameter Variations” Published in Journal of Electrical Engineering and Technology, Vol.10 Issue No.2, March-2015, Page(s) 518-528. ISSN(Print) : 1975-0102, ISSN(online) : 2093-7423.
- [12] J Vinoth, T Muthukumar, M Muruganandam, “ Implementation of Distributed Maximum Power Point Tracking for Partially Shaded PV Systems” Published in International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Volume 4, Issue 2, Pages 702-709, Feb-2015. ISSN (Print): 2320 – 3765 ISSN (Online):2278 –8875.
- [13] P.Arivazhagan, B.Deepan, M.Muruganandam, S.Saravanan, “Power Sharing Optimization between GridandMicrogrid With Multiple Distributed Generators” Published in International Journal of Innovative Research in Science, Engineering and Technology, Volume 4, Special Issue 6, Page (s) 1462-1470, May 2015, ISSN(Online) : 2319 – 8753, ISSN (Print) : 2347 – 6710.
- [14] S.Sindhuja, K.Madumathi, M.Muruganandam, S.Saravanan, “Improving the Stability of a Two Bus System Using Shunt Active Filter” Published in International Journal of Innovative Research in Science, Engineering and Technology, Volume 4, Special Issue 6, Page (s) 1344-1351, May 2015, ISSN(Online) : 2319 – 8753, ISSN (Print) : 2347 – 6710.
- [15] R.Bashkaran, M.Vijayaraghavan, M.Muruganandam, S.Saravanan, “Improving the Stability of DFIG-Based Offshore Wind Farm Using a STATCOM” Published in International Journal of Innovative Research in Science, Engineering and Technology, Volume 4, Special Issue 6, Page (s) 1338-1343, May 2015, ISSN(Online) : 2319 – 8753, ISSN (Print) : 2347 – 6710.



INNO SPACE
SJIF Scientific Journal Impact Factor

**Impact Factor:
7.512**

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details