

# GSM Based Smart Energy Meter with Theft Detection and Fault Identification

S. Sivaram

**Abstract:** This paper presents a GSM based smart energy metering system which will replace 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 and the bill is automatically SMS to each user and if the bill is unpaid within the load can be turned off by the service provider. This system will prevent the illegal usage of electricity before the meter and also find out the line fault location without any human control.

**Keywords:** smart energy meter, GSM, SMS, AMR, PC.

## 1. Introduction

Global energy crises are increasing every moment and everyone has the attention towards more and more energy production. Hence a lot of new technology has been introduced to satisfy the user demands. Apart from efforts to meet growing demand, automation in the energy distribution is also necessary to enhance people's life standard.

The traditional method of electricity billing system involves meter readers to periodically visit every house to take readings. There are many issues related to this method such as taking wrong readings, lack of meter readers, and houses in very remote areas, meters in inconvenient location and so forth.

Many technological advancement have been carried out and one such method is automatic meter reading (AMR). Here the Energy Meter sends the recorded power consumption of a household in the certain interval of time to a wirelessly connected network, which could be a personal computer (PC) or central server of power distribution companies.

As the technology increases, the power theft is also increasing which will affect the economy of our country. Power consumption and losses have to be closely monitored so that the generated power is utilized in a most efficient manner.

Development of advanced electronic meter with tamper protection prevents the electricity stealing inside the meter. Hence now the theft of electricity occurs before the meter by tapping the existing lines. Therefore the meter will not count the actual energy consumption. As a result of this, it is necessary to design an energy meter with the function of detecting electricity-stealing before the meter.

The customer needs power without any interruption. Therefore fault identification and rectification needs more attention and will increase the cost. Hence if our meter does that function, then we can rectify the fault within short time with less cost expenditures.

This paper proposes a smart energy metering system which periodically updates the energy consumption details in the data base of the substation. By using GSM, it sends the bill to the user through SMS and disconnects the load automatically

when the user fails to pay the bill. It also monitors the energy available in each pole and the energy consumed by each user. Thus the energy theft and energy meter bypassing can be monitored by this meter. As it monitors the energy available in each pole, it will be easier to find the fault locations and the type of fault. Hence the accuracy can be improved, power theft can be stopped and fault can be rectified.

## 2. Functional Block Diagram

Figure 1 shows the block diagram of proposed system. Here the energy meter module consists of energy measurement IC AT7751, ATmega8 microcontroller, IR receiver and a relay. This module will measure the energy consumed by each user.

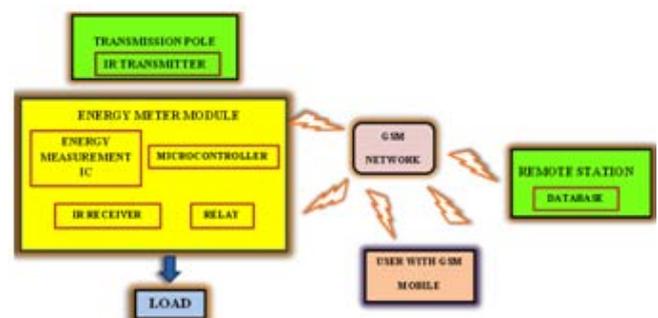


Figure 1: Block Diagram

In the consumer pole, there will be a transmitter and sensors. Sensors will measure the voltage and current values at the pole and the details are transmitted to the energy meter module through infra-red transmitter.

This measured energy consumption details of the user and the pole energy will be transmitted to the service provider's data base through GSM. In the service provider's database, the pole energy and the user energy will be compared and the energy consumed bill by each user will be send to the customer through SMS.

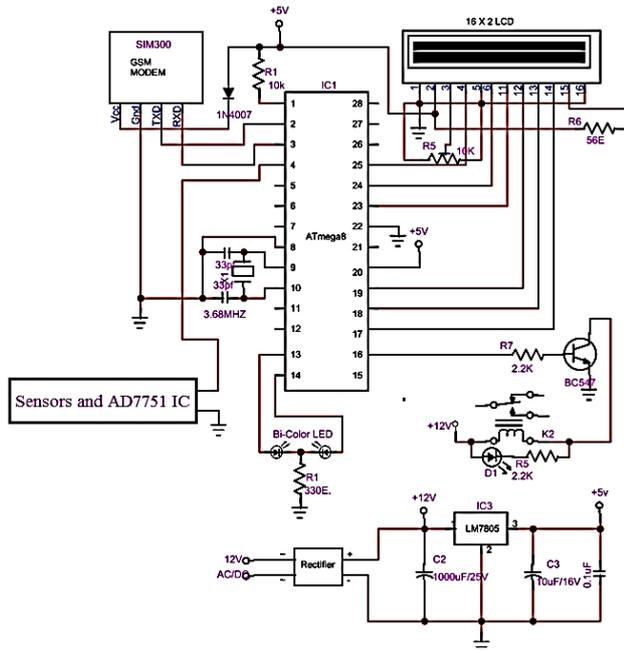
If the bill is not paid by the user the service provider will disconnects the load automatically by tripping the relay through GSM. After paying the bill, immediately the load is connected by the service provider without delay.

During theft condition, the pole energy mismatch from the user consumed energy. Therefore the database will produce alarm and give information regarding the locations and theft

details. Hence service provider can take actions against the illegal user.

The database will have all the pole data's. Hence it will be easier to find the location of fault and the type of fault. Therefore it will be easier for the service provider to rectify the fault with in the limited time.

### 3. Circuit Diagram



**Figure 2:** Circuit Diagram of proposed system

Figure 2 shows the circuit diagram of GSM based smart energy meter. It is usually an electronic device that records consumption of electric energy in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing. Smart meters enable two way communications between the meter and the data base of the service provider.

It consists of voltage and current sensors to convert the power to signals. These signals are given to AD7751 IC, which produces the energy pulses. The generated pulse is given to atmega8 microcontroller which calculates the energy consumption details and displays in LCD display. It also sends this data to GSM modem, which transmit the data to the service provider database.

The service provider monitors the data for billing. When the user fails to pay the bill, the service provider disconnects the load by tripping the relay.

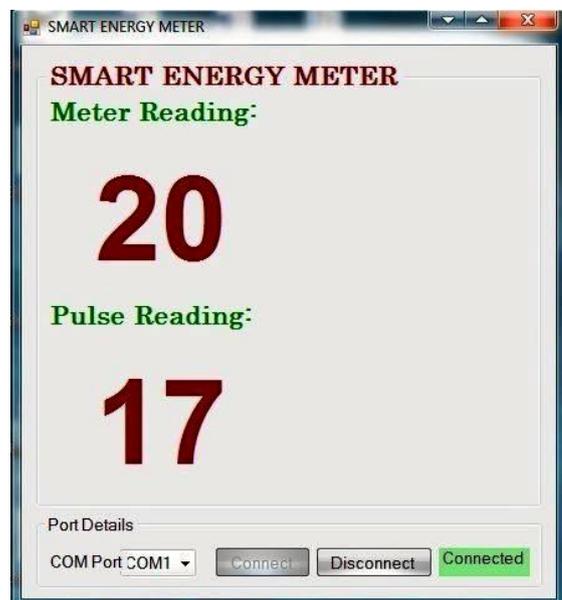
### 4. Hardware and Results



**Figure 3:** Hardware Photo

Figure 3 shows the hardware snapshot of proposed GSM based smart energy meter. Due to unavailability of IC AD7751, a digital energy meter is used. The purpose is only to produce energy pulses.

Figure 4 shows the database at the service provider. For simplicity now it shows only the energy consumption details of a single user.



**Figure 4:** PC Display

Figure 5 shows the SMS send to the consumer. It shows the energy consumption details only. By proper development in database, we can send the bill along with energy details.

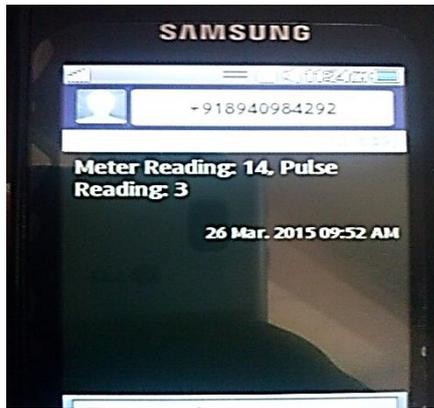


Figure 4: Consumer SMS

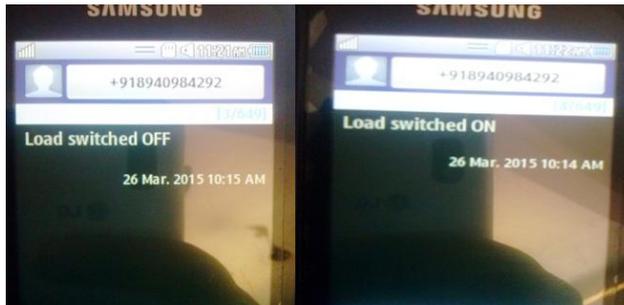


Figure 6: Load Condition SMS

Figure 6 shows the SMS send to the consumer after the disconnection or connection of load. The service provider can disconnect or connect the load from the station itself. When the user fail to pay the bill with in the given time, the service provider will disconnects the load and an SMS is send to the user. After the bill payment, immediately the load is connected and then also an SMS is send to the user.

## 5. Conclusion and Future Scope

This system will have high accuracy since human interaction has been minimized. The generated bill is available as SMS at the time of generation itself and if the user is registered he can pay the bill through internet. Future works will include the development of energy measuring circuit at the pole of transmission line. This can identify the power theft locations and also the fault location and its type.

## References

- [1] A.Molderink, V. Bakker, M. G. C. Bosman, J.L. Hurink, G. J.M. Smith, Management and Control of Domestic Smart Grid Technology, IEEE Transactions on Smart Grid, vol.1, 2010.
- [2] Yujun Bao 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.
- [3] LvZhi-an, Yanping Xiao, "Design and development of an intelligent anti-steal-electricity-power instrument," Electronic measurement technology, 2006, Vol. 29, No. 5, pp. 93-95.
- [4] ZhengDezhi, Wang Shuai, "Research on measuring equipment of single-phase electricity-stealing with long-distance monitoring function," Aviation Research Foundation, 2009, Vol. 27, No. 9, pp. 978-981.

- [5] B. S. Koay, S. S. Cheah, Y. H. Sng, P. H. Chong, P. Shum, Y. C. Tong, X. Y. Wang, Y. X. Zuo and H. W. Kuek, "Design and implementation of Bluetooth energy meter", *Proceedings of the 4th International Joint Conference of the Conference of the ICICS*, vol. 3, pp. 1474-1477, Dec, 2003.
- [6] P. A. V. Loss, M. M. Lamego, G. C. D. Sousa and J. L. F. Vieira, "A single phase microcontroller based energy meter", *Proceedings of the IEEE Conference of the IMTC*, vol. 2 pp. 797-800, May, 1998.
- [7] K. Li, J. Liu, C. Yue and M. Zhang, "Remote power management and meter-reading system based on ARM microprocessor", *Proceedings of the Conference on CPEM*, pp. 216-217, June, 2008.