

Design of a Prepaid Power Meter with Communication facility based on GSM Network

Rohit Nargotra¹, Ritula Thakur², Dr. S. Chatterji³, Ankur Mahajan⁴

^{1,4}M.E. Student, ²Assistant Professor, ³Professor and Head

^{1,2,3,4} Department of Electrical Engineering, NITTTR Chandigarh

¹rohitnargotra07@gmail.com, ²ritula_21@yahoo.com, ³chatterjis@yahoo.com, ⁴ankurmahajan786@gmail.com

Abstract: Prepaid power meter is a new concept in the measurement of electricity consumption on periodic basis. This method of measurement and data collection discards the conventional method of taking the meter reading manually. Though the prepaid energy meter displays the number of electrical units consumed by the user at the load centre but on the other side, there is an urgent need to develop a system which will transmit the units consumed by the individual user to the power development department (PDD). This paper reports the design of a prepaid power meter which will be able to communicate based on GSM network; for the transparency between the user and the PDD. The GSM Automatic Power Meter Reading System (GAPMR) consists of an energy meter connected with the compatible microcontroller, a display device and compatible software to capture, transmit and maintain the record of the electricity consumption data of a particular user.

Keywords: Automatic Meter Reading, Digital Power Meter, GAPMR, Global System Mobile

I. INTRODUCTION

Electricity, since its invention, has always been one of the fundamental requirements for any modern civilization and its development. It is now the heart of any property, whether it is residential, commercial or industrial. Thinking for a while, it can be imagined how deep electricity goes through our lives. Factories, mills, laboratories, commercial institutions, traffic, communication, household, etc. are just few examples on the present situation of Electricity Empire.

Since beginning, research and development in the field of electrical energy has been concentrated on its generation, transmission, distribution, protection and line losses, etc. But, in all the generations of electrical power technologies, no significant changes in measuring methods of electricity

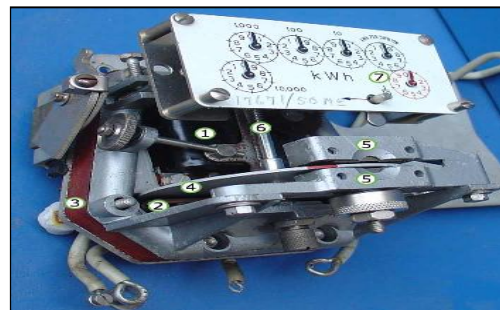


Fig. 1. A conventional power meter in its shape and functionality. The conventional meters are shown in Fig. 1.

consumption were noticed. Power meter remains the very basic and traditional



Fig.1 Conventional Power Meters of two different types

But the scene turned far different in the last few years particularly from the last decade of the last century. Main causes for this, are envisaged as:

Resources necessary to produce electricity particularly fossil fuels are depleting rapidly.

Electricity consumption is increasing in geometrical progression.

Demand for electricity is also increasing many folds.

Increase in the commercial losses.

In India commercial losses are about 25% to 30% which are about 24% more as compared to developed nations. These commercial losses affects the country's economy and leads to the foundation of the third world.

In view of the increasing demand of the electricity and commercial losses, a new field of research and development has emerged in the form of metering technology. The objectives of metering technology are not limited merely to measure the consumed units of the electricity but far above. In India under Electricity Act its becomes mandatory to install electronic meters but the biggest cons of this meter is that they are not incorporated with communication facility which gives a fair chance to the consumers to go for power theft, as they are not regularly monitored by the service providers. This paper deals with the design of a communicable prepaid power meter based on GSM which will not only increase the transparency between the end user and the service provider (PDD) but also play a vital role in the reduction of commercial losses.

II. CONVENTIONAL METERING SYSTEMS

Electrical meter reading is still done manually in India. In the normal practice, meter readers visit every meter location periodically and enter the meter reading manually. These readings are then analyzed with the previously read values and result is recorded into the customer consumption register which is further maintained in the utility computer [1][2]. Cost of the consumed energy during the latest cycle can thus be calculated. In some cases where consumption rationalization strategies are followed, the consumer is charged for the energy units in proportion to his/her total consumption. Energy measurement by the traditional manual methods is in use since the commercialization of electric

power. But with the advent of new technologies, more complex electric networks, ever increasing number of consumers, huge Transmission and Distribution losses [3] and increasing scarcity of electric power, following drawbacks of manual metering work have become more prominent:

Human error and negligence in meter reading.

Long gap between two successive meter readings, making it extremely difficult to prepare an exact load profile of the consumer and the group of consumers.

Absence of any data collection for the purpose of energy auditing, planning and forecasting.

Instantaneous consumption of a particular locality is not easy to find out.

Tempering with metering system remains unnoticed.

III. DEVELOPMENT IN METERING TECHNOLOGY

With the passage of time and also need, conventional meters have undergone change in shape and design. Electromechanical induction meters have gradually been replaced by electronic and digital meters [4]. In India, it has become mandatory to use the electronic meters in all new installations. Commercial and Industrial institutions are required to get digital meters installed in their premises. Although the Indian Government makes it mandatory to install digital meters but still the conventional method of noting meter reading is in practice.



Fig. 2 Digital meter being used in Jammu & Kashmir

IV. BLOCK DIAGRAM OF PROPOSED SYSTEM

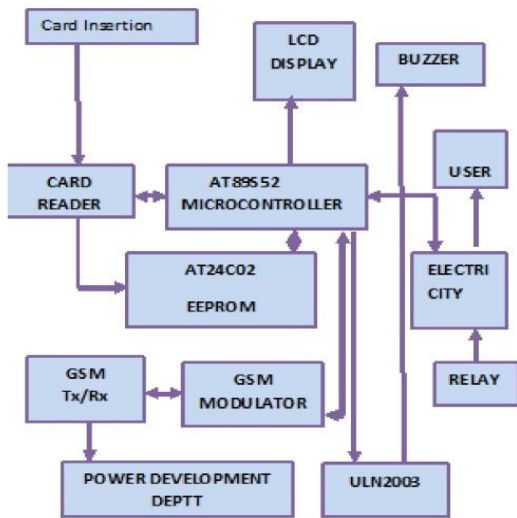


Fig. 3 Block diagram of the proposed metering system

A scheme of Electricity billing system called Prepaid power meter can facilitate in improved cash flow management in energy utilities and can reduce problems associated with billing consumer living in isolated area and reduces deployment of manpower for taking meter readings. Every consumer can buy a smart card (EEPROM IC) with a password stored inside it using MC program. When the consumer inserts a smart card into the card reader which is connected in power meter with tariff indicator kit, the card reader will read the stored information and delete the

V. SYSTEM ARCHITECTURE

The proposed system consists of several remote meters and a central server system as shown in Fig.3. The remote meters which are placed at load centers exchange information with the server using GSM network.

information from the EEPROM IC (smart card) using the MC program. This is done in order to ensure that the smart card cannot be used by others. According to the power consumption the amount will be reduced.

When the amount is over, the relays will automatically shutdown the whole system. Microcontroller AT89S52 acts as the primary controller. The primary controller collects information from energy meter as well as from the smart card which is IC AT24C02 (EEPROM chip). Smart card gives information about the limitation of units. The energy meter reading is compared with the smart card information by the primary controller. Depending on the result, the primary controller will activate the buzzer if the credit is low and the Controller will trigger the Relay if the credit goes very low. Once the Relay is triggered, the electricity Supply will be cut. The supply will start again only when the meter is recharged with enough credit.

This Scheme will allow the user to consume electric power judiciously and there is also a GSM modulator which receive the data from the microcontroller about the energy consumed by the user and this data is then transmitted to the PDD by GSM transmitter. At the service provider end there is a software which keep keen eye on the consumption of the every user and also generate a command in case of the power theft detection which in result reduces the commercial losses.

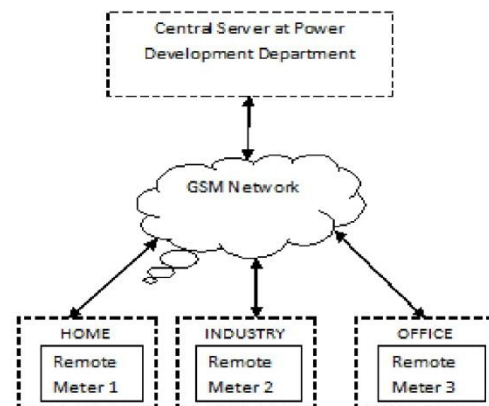


Fig. 4 The Remote Metering System

VI. CONCLUSION

Prepayment systems have been proposed as an innovative solution to the problem of affordability in utilities services. In spite of being a popular system in European and African countries, the use of such mechanisms remains controversial. Among the main arguments in favor of its dissemination are the advantages concerning lower costs of arrears, running costs and finance charges for the service provider and the better allocation of resources it implies for users. The arguments against prepaid meters are based on the higher cost of the technology and the possibility of self-disconnection of low-income users. The monopolistic power distribution market in Asia is gradually transforming into a competitive marketplace. Differentiation in service is going to be the key competitive factor to improve market share in the deregulated power markets. Prepaid meters with their advantages over conventional ones are likely to help power distributors to differentiate and offer value-added services to consumers.

Encouraging consumers to opt for prepaid meters on a voluntary basis and offering tariff or non-tariff incentives to those consumers who prepay their power charges, would help the utilities to implement this system.

REFERENCES

- [1] Syed khizar Ali Zaidi,Hura Masroor,Syed Rehan Ashraf and Ahmed Hassan, "Design and Implementation of Low Cost Electronic Prepaid Energy meter", Proceedings of the 12th IEEE International Multitopic Conference, December 23-24, 2008,pp548-552.
- [2] Stebbins Wayne L, "New concepts in Electrical Metering for Energy Management",IEEE Transactions on Industry Application,Vol.22, March/April 1986.
- [3] Application note ,Atmel,AVR465:Single phase Power/Energy Meter with Temper Detection.
- [4] Doraswam Anand, "A case for Electronic Electricity Meter in India",Energy for Sustainable Development ,Vol.N0.2,July,1995.

