IJFEAT
INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

A REVIEW ON SMART ELECTRIC ENERGY METER

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Abstract

As the population increases, the demand of electricity is increasing day by day. Electricity is become one of our basic need. In household sector, the demand for electricity had increased with the use of different electrical appliances. But the people are unfamiliar about their energy consumption by various appliances until they get the monthly billing status. Thus, there is need of efficient, secured and accurate energy meter which can monitor the energy consumption. An electric energy meter is a key component which measures the amount of electric energy consumption. Traditional energy meter which employed in public sector, only measures the consumption of electricity. In past years, electrical energy was available only at a particular area of plenteous society. As the technology is rapidly growing, the advancement in generation of electrical energy has met the demand of electricity of increasing population. The evolution of electric energy meter is going on from past years to still 21st century. Thus, this review paper presents various types of electric energy meter which is deployed at household, commercial and industrial sector and also on which research is still going. In this paper, study of various energy meters like electromechanical, electronic, prepaid and smart electric energy meter is done.

Index Terms: *Consumption, Electric Energy Meter, Electromechanical meter, Prepaid Meter, Smart Meter, Talking Energy Meter etc.*

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1. INTRODUCTION

Electric Energy has vital role in modern economy. While the global GDP raised from 16254 billion US dollar to 54588 billion US dollar in the year 1971-2012, the primary energy consumption increase from 231440 peta joules to 559818 peta joule in same years [1]. The drastic increase in energy consumption brings many challenges to design secure and accurate energy measuring meter. It has become trend to merge automatic system through wireless application. In early days, delivery of electricity is completely depended on traditional energy meters.

Basically there are two types of traditional energy meter that are electromechanical and electronic energy meter or static energy meter. They only give monthly consumption to the consumer. Electromechanical induction energy meters are used since the 19th century. It gives reading according to the rotation of aluminium disc and results the consumption on analog display. Due to revolving part, wear and tear produced in meter. Hence it does not give accurate reading. Then Electronic Energy Meter comes in picture. Electronic energy meter has no any revolving component so it gives accurate reading by blinking the LED. This meter indicate reverse current, earthed load, phase and watt hour by blinking of LED. It consists of digital display. Electric energy consumption is calculated in KWh (Kilowatt hour). In now-a-days method, monthly one person comes from Distribution Company (DISCOM) at our home to take reading of energy consumption. Due to this human error can occur because he has to take the reading and subtract it from previous reading and then he generate final bill according to unit tariff consumption of consumer. It has no any feature to monitor on energy consumption. This drawback is getting overcome in smart energy meter. Smart energy meter is nothing but electronic energy meter is interfaced with microcontroller and GSM modem. Thus, it transfer and receive the data between consumer and utility companies. It not only measures the consumption but also monitors the consumption and gives the notification via Short Message Service (SMS). It also notifies the consumer about billing status. In microcontroller we can save the consumers bank account details so that bill amount get automatically deducted by prior notification to consumer. To motivate the customers to make

conservative use of electric energy, design of prepaid energy comes in use. In prepaid energy meter, consumers have to recharge it by pre-paying amount. And at zero amount load get dis-connected but due to this emergency need of consumer not get fulfilled.
Following description gives the details about traditional energy meters and smart energy meter. Section 2 discusses the benefits and the modification to make system smarter.

1.1 Electromechanical Energy Meter

Electromechanical Energy Meter operates by counting the rotation of electrically conductive but non-magnetic disc (ferriwheel). The speed of ferriwheel depends on energy consumed by loads. These rotations get convert into respective energy consumption and give the reading on analog meter. Since it involves mechanical parts, mechanical breakdown and defects occur in meter. More chances of manipulation, tampering effect and current theft will be higher. It consists of ferriwheel i.e aluminium disc placed over a spindle between two electromagnets as shown in fig-1 below.

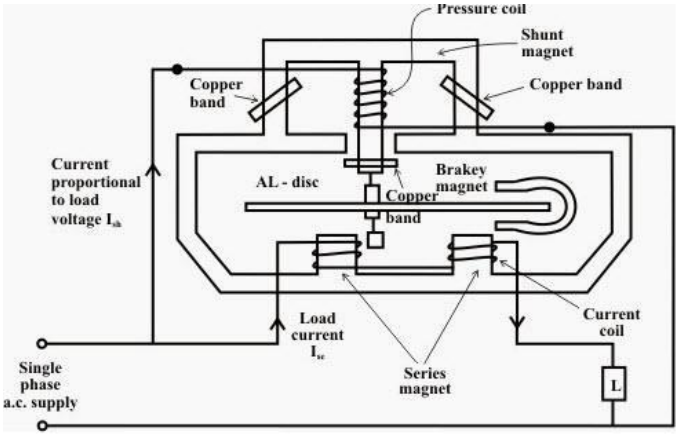

Fig-1: Electromechanical Induction Energy Meter

The rotation speed of ferriwheel is proportional to the power and this power is integrated by using counter mechanism and gear trains. When the driving and braking torque become same, the speed of aluminium disc becomes steady. This type of energy meter is simple in construction and accuracy is less due external fields, rotating part and creeping phenomenon.

1.2 Electronic Energy Meter

Electronic energy meter become substitute for electromechanical energy meter which widely using in residential, commercial and industrial area to monitor the consumption of electric energy. It has high accuracy, high procession and more reliable. It consumes less electric power and starts measuring instantaneously when it gets connected to the load. It indicates consumption of energy by blinking KWh LED means that LED will blink 3200 times in every KWh. It blinks once after consuming 0.1325 watt energy. Interfacing of any software application like microcontroller and supportive network is easy with this type of meter. Smart Energy Meter can be design by connected microcontroller and GSM module with it.

1.3 Comparison of Traditional Energy Meters

The advantages as well as disadvantages of electromechanical and electronic energy meter as shown in table 1.

Table-1: Comparison of traditional energy meter

Types of Meters	Advantages	Disadvantages
Electromechanical	Reliable Measurement	Manually reading
	Simple in construction	Electricity consumed by current coil
		Creep effect
Electronic	More parameters measured besides energy consumption	Security issues
	Two way communication	No provision for tampering
	LCD/LED display	Complex communication circuit require

2. SMART ENERGY METER

In Electronic Energy Meter, digital micro technology is used. So, it is easy to interface electronic devices with electronic energy meter. To overcome drawbacks of traditional energy meter, microcontroller and GSM modem is attached to meter. Thus, in smart energy meter automatic energy consumption reading is possible with the feature of two way communication between consumer and utilities with the help of GSM modem. It will help to convey the consumption and corresponding cost to the respective consumer without human interfere. Smart meter can be again modified to achieve other features by adding other electronic module like buzzer, relay etc. The only two way communications made difference in traditional and smart energy meter. The first formation of smart energy meter was capable of one way communication i.e conveying energy consumption back to the utilities but over a small distance. Then in second formation, meters are capable to transmit data over a long distance [4].
Recent progress in smart energy meter gives the following features:

a) End to End wireless two way communication

b) Energy consumption monitoring and alerting the consumer
c) Large data storage capacity
d) Provision for tampering phenomenon and current theft
e) Detection of faults like earthed fault and its identification
f) Improvement of system security
g) Motivate to consumer to control on energy consumption
h) Regular and precise metering

But in Smart Energy Meter research is still progressing. Smart Meter gives information of energy consumption to the consumer via SMS. But every time it is not possible to consumer to check the message. For user friendly interaction, Talking Energy Meter is design in such a way that consumer will get voice alert. Talking Energy Meter consists of arduino microcontroller, voice module and GSM module. Arduino IDE software is used for designing the talking energy meter. It uses Embedded C language for programming purpose. Talking Energy Meter is very economic than existing system. It is used to alert the consumer in case of over usage when it goes beyond the pre-set limit in programming of microcontroller. As we know the tariff rate of electricity consumption varies according to the unit consumption, so this meter helps the consumer to alert their unit consumption. In voice module, recording is done in any language (for e.g. English, Marathi Hindi) so that it will be helpful to common people in society. For e.g., if consumer is setting limit of 90 units then it will alert the consumer when 90 units get consumed and alert will be like "Over Consumption". This meter can also alert the consumer when over voltage and over current comes from utility, in order to protect the loads. This system is need to design to help the consumer to monitor the energy consumption and protect them from extra charges which occurred due to minor change in unit consumption and affect the bill at high rate. It will benefits to consumer and government too. Block Diagram of talking energy meter is shown in fig. 2.

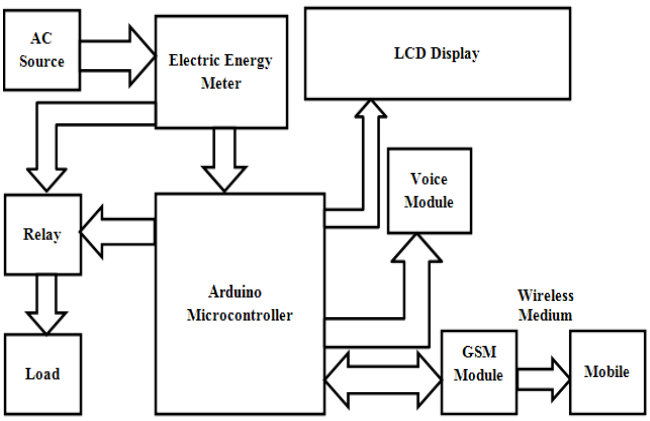

Fig-1: Block Diagram of Talking Energy Meter

An AC source is given to the electric energy meter and load is connected to the arduino microcontroller via relay. Voice module, GSM module and LCD display are connected after the arduino. Arduino Microcontroller requires 5 V DC supply. The energy value once taken from the energy meter is digitized with the help of microcontroller. The GSM module is used to send the information of daily energy usage and its bill to the consumer via SMS. The cost value for the corresponding energy value is determined and predefined cost value is set in programming for which the consumption level increase is notified to the consumer. A relay is connected with the arduino and the load which is used to protect the load while overloading condition. As this meter gives the voice alert too, helps the blind and illiterate people to know their consumption of electricity. By adding voice module, smart energy is modified to Talking Energy Meter.

2.1:BENEFITS OF SMART ENERGY METER

Application of smart energy meters in public sector has many benefits are summarized from above review in following table-2.

Table-2: Benefits of Smart Energy Meter

Stakeholder	Benefits
Utility Companies	Reduced customer complaints
Billing Service	Improved billing accuracy, No involvement of human
Security	No tampering and creeping
Customer Service	Help to know the updates of their consumption, more accurate and timely billing, reduced metering cost

3. CONCLUSION

Energy Meter plays vital role in measuring electrical energy consumed by consumers for their daily activities. In India, at rural area still electromechanical energy meter are using. Thus, this review paper gives information of various electric meter and benefits of smart energy meter discussed. Energy Meter will become smarter and more flexible by adding electronic modules with it. From this review paper, it is conclude that Smart Energy Meter and Talking Energy Meter are very accurate and precise at energy reading, billing and security. Creeping phenomenon is reduced to zero level. It also monitors and alerts the consumer about their usage and billing status. In this way, these meters help the consumer to keep their bill down and make them aware about their consumption by SMS and voice alert.

ACKNOWLEDGEMENT

We express my gratitude and indebtedness to our guide Mr. M. D. Ghatole, Assistant Professor, Electrical Engineering department, who has been constant source of guidance and inspiration in preparing this review paper. We express our sincere gratitude towards H.o.D., Mr. B. S. Rakhonde, and Assistant Professor whose constant help and encouragement helped us to complete this paper. I am grateful to Dr. L. P. Dhamande, Principal for his encouragement and support in relevant matter. We also thankful to all the staff members of Electrical Engineering department, whose suggestions helped us to complete this work.

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