



Smart Energy Meter For Superior Metering and Automatic Billing System with Theft Detection

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Abstract: This Energy theft is a very common problem in countries like India where consumers of energy are increasing consistently as the population increases. Utilities in electricity system are destroying the amounts of revenue each year due to energy theft. The newly designed AMR used for energy measurements reveal the concept and working of new automated power metering system but this increased the Electricity theft forms administrative losses because of not regular interval checkout at the consumer's residence. It is quite impossible to check and solve out theft by going every customer's door to door. In this paper, a new procedure is followed based on MICROCONTROLLER to detect and control the energy meter from power theft and solve it by remotely disconnect and reconnecting the service (line) of a particular consumer. An SMS will be sent automatically to the utility central server through GSM module whenever unauthorized activities detected and a separate message will send back to the microcontroller in order to disconnect the unauthorized supply. A unique method is implemented by interspersed the GSM feature into smart meters with Solid state relay to deal with the non-technical losses, billing difficulties, and voltage fluctuation

Keywords— GSM, power theft, Smart meter, Nontechnical losses, power monitoring, tampering, automatic billing

I. INTRODUCTION

Electricity is one of the most important blessings that science has given to mankind. But this energy used by unauthorized person cause losses to utility and also pollutes the environment. Losses in electricity energy sector can come under two sets: technical and managerial. Technical losses of electrical energy are caused due to the functional tendency of the equipment used from generating station to the distributing station. Non-Technical losses are due to lack of utility labor interference periodically. These losses are much higher in developing countries like India. Smart meter is one of the most important devices used in the smart grid (SG). The smart meter is an advanced energy meter that obtains information from the end users' load devices and measures the energy consumption of the consumers and then provides added information to the utility company or system operator. Several sensors and control devices supported by dedicated communication infrastructure, are utilized in a smart The proposed system consists of digital energy meter, an (microcontroller), GSM modem .

Correct and appropriate measuring of power without any error is important in order calculate the total power consumption and then for tariff calculation. In traditional method human power is used to note the energy meter reading for each house and enter the system of regional office. This system is too complicate and need more human power to read the energy meter of each and every house. Human power again used for controlling the load by cut down the power of customer who had not paid the electric bill. To overcome this drawback we are proposing this system in which accuracy increased in meter reading. There is no need of human operator to go to the consumers address to take down the reading extra labour cost is reduced. . The users can be aware of their electricity consumption. The readings recorded can be used by the research and development department.

II. EXISTING SYSTEM: ENERGY METERING

A. Conventional System

Conventional System “Energy meters displays kilowatt-hour by continuously measuring the instantaneous voltage (volts) and current (amperes) to give energy used in joules”. [2] The primary type of electricity meter is the electromechanical induction meter and an electronic meter. In electromechanical induction meter, the total number of rotation of the aluminum disc is directly proportional to the power consumed. Electronic meters show the power consumed, power factor, the reactive power used digitally displayed on LCD or LED display, and also able to send the energy consumed readings to remote places through some communication network. It is a single way communication. In addition to measuring energy used, electronic meters can also record other parameters of the load and supply such as instantaneous and maximum rate of usage demands, voltages, power factor and reactive power used etc [2]. “Traditionally, the electricity meters are installed on consumer’s premises and the consumption information is collected by meter-readers on their fortnightly or monthly visits to the premises.”[2]

Drawbacks of the regular energy meter:

1. Human error cannot be avoided for the manual meter reading. Highly depends on meter reader
2. Always there is no cross checking or recheck of human readers for energy utilization.
3. High chance of stealing and bribery always high to misuse it especially during events.
4. Possibility to change the reading when taking photos of energy meter by using software tools.
5. More number of meter reading employees is extra expenses to the company for hiring them and their expense on traveling too expensive one.
6. Wherever energy meter installed inside the house, which may lead to non-checking of reading due to lock.

B. Proposed System

A smart energy meter works on communication directly with wireless data protocol, so there will be precise reading & there's no necessary for a meter reader to take energy meter reading in consumer premises. Smart energy meters can operate in divergent ways with GSM Module. There are so many different merits of smart energy meter such as:

1. User new smart energy meters send precise reading on a regular interval in sequence about customer’s energy usage to utility (Electricity provider). So the bills will be proper and labor cost is reduced for taking a reading in consumer residents.
2. If the consumer did not pay the energy bill within time, the utility can remotely disconnect the service (line) of a particular consumer and after payment, the service continues to the consumer. So we can avoid sending an employee to cut off energy from the network and again to reconnect their connection.

III. BLOCK DIAGRAM

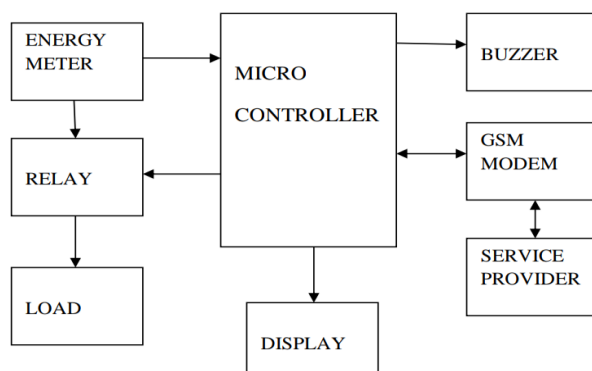


Fig No.1 Proposed Block Diagram Of System

The system architecture of Microcontroller and GSM based smart energy meter is shown in the Fig. 1. The energy consumption is being calculated using the energy meter IC and Microcontroller. In order to prevent a power theft, detection program is present in the Microcontroller. Microcontroller and GSM based smart energy meter can be divided into several parts as Energy Meter IC, LCD, GSM modem, Relay, Display Unit and Power Supply Unit etc. Figure shows the block diagram of the system.

Microcontroller input is effectively interfaced to energy meter which measures the energy consumption and display on the LCD .The reading of energy meter is send to service provider by sms via sms loaded gsm modem .Relay detects the power theft by balancing current method and send information to the service providet agency and microcontroller disconnect load and interrupt the power supply of the consumer

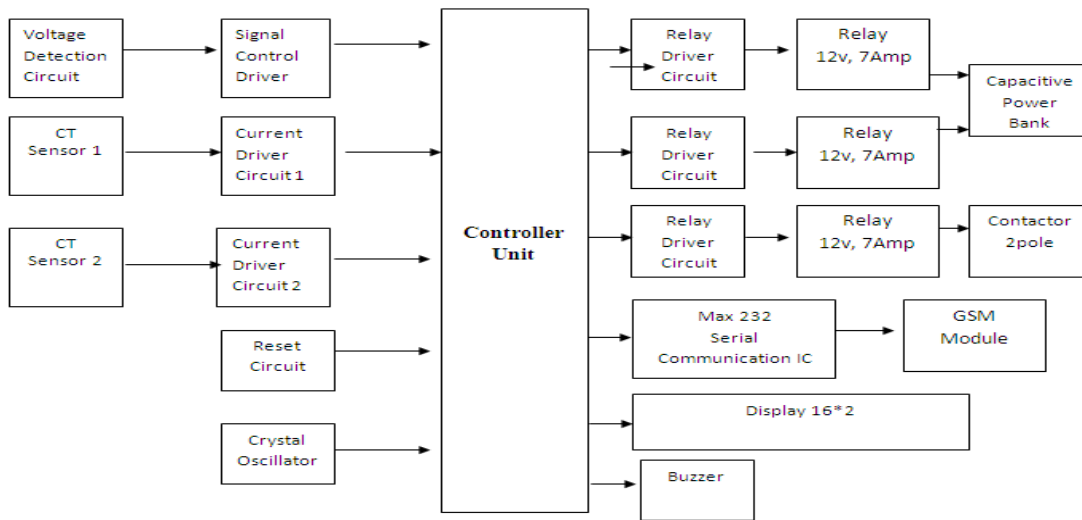


Fig No.2 Detail Proposed Block Diagram Of System

IV. ACTIVE POWER AND ENERGY CALCULATION

Active Power

Figure 3.4 shows active power calculation process. Real power of each phase is accumulates. It can be accumulates in the corresponding watt-hour register. AWATTHR, BWATTHR, or CWATTHR are the Watt-hour register. metering IC has 16 bit watt hour register. By changing accumulation mode setting the input energy register also changed

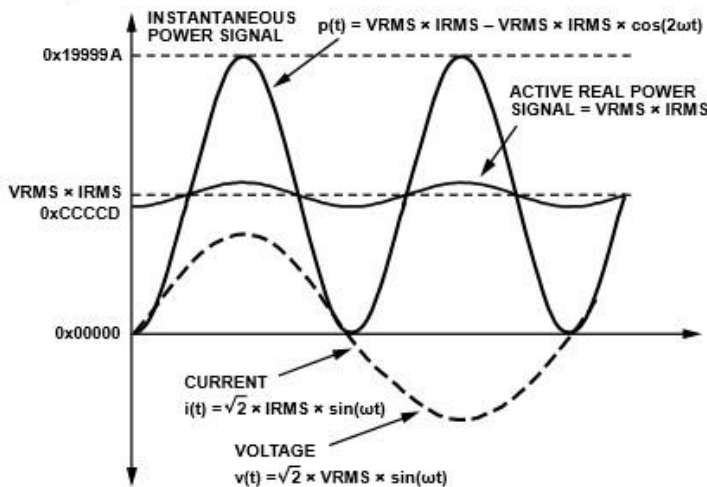


Figure 3 Active Power Calculation

P is the real power. Instantaneous Power can be calculated as bellow:

$$v(t) = \sqrt{2}V_{rms}\sin(\omega t) \tag{1}$$

$$i(t) = \sqrt{2}I_{rms}\sin(\omega t) \tag{2}$$

$$p(t) = V_{rms}I_{rms} - V_{rms}I_{rms}\cos(2\omega t) \tag{3}$$

Where, $i(t)$ = Instantaneous Current $p(t)$ = Instantaneous Power ω = Angular Frequency

$v(t)$ = Instantaneous Voltage I_{rms} = Root Mean Square of Current

Then average power is calculate by following equation:

$$P = \frac{1}{nT} \int_0^{nT} p(t)dt \quad (4)$$

Active power is calculated by multiplying of voltage and current waveforms. The obtaining waveform is known as instantaneous power signal $p(t)$. When instantaneous power is calculated at that time dc component is present in each phase.

By using Low Pass Filter (LPF2) DC component is removed. Then average real power is obtain on each phase.

The relationship between power and Energy can be expressed mathematically as

$$Power = \frac{dEnergy}{dt}$$

When active power is integrate over a time, then energy is calculated.

$$Energy = \int p(t)dt$$

V. HARDWARE IMPLEMENTATION



Conventional single phase energy meter use one current sensor and voltage sensor to estimate the KWhr consumed by the electrical load by the product of current and voltage. During unauthorized tapping in the lines then any of these sensors gives zero value and certainly the product of voltage and current will also be zero resulting in no energy measured in the energy meter. . By connecting one more current sensor with solid state relay with minimal variation in the energy meter helps to track down power theft, connect/disconnect the supply. A constant 5V DC supply given to Microcontroller and LCD unit. Communication will be connected between microcontroller and utility center through GSM modem. Lever switch provided to detect the physical disturbance (tampering) given to the smart meter. To track down the unauthorized loads tapped before the meter is beyond the scope of this proposed concept

CONCLUSION

The system designed reduces the efforts of manual data collection of energy meter. Also, data which is received at service provider side is easy to manipulate for bill generation and other such tasks. With this system we can collect the reading as well as control the supply, the customer can be informed of current meter reading, bill for current cycle, status of the line and other parameters to the customer with message. The technology used in energy meter is expanding to the power distribution transformers. So that it can cut the power supply from anywhere in case of any emergency or maintenance, find areas with power distribution failure. Smart metering system is useful to both utility provider and consumers. thus reduce human effort in meter reading and this method is very economical and time saving.

REFERENCES

- [1] Wireless Electricity Theft Detection System Using Zig Bee Technology” Virendra Pandey Simrat Singh Gill, Amit Sharma³ 1(EC, final year), 2(Assistant Professor), 3 (Assistant Professor) MIT, MORADABAD.
- [2] “Theft detection and smart metering practices and expectations in the Netherlands” P.Kadurek, Student member, IEEE, J. Blom, J. F. G. Cobben, W. L. Kling, Member, IEEE1
- [3] Electrical Power Theft Detection and Wireless Meter Reading presented by Sagar Patil, Gopal.IJRSET Vol,Issue 4 ,April 2013
- [4] Sandip Kumar Singh,Ranjan Bose, Anupam Joshi,“Energy Theft Detection in Advanced Metering Infrastructure”, IEEE, 2018, pp529-534.
- [5] Maha Aboelmaged,Yasmeen Abdelghani, MohamedA .Abd El Ghany, “Wireless IOT based metering system for energy efficient smart cites”, International conference on microelectronics,29,2017,pp 1-4.
- [6] Anitha.k, Anitha. V,“Smart energy meter surveillance using IOT”, international conference on power,energy,control and transmission system,2018,pp 186-189.

