

An Efficient Strategy for Design of Prepaid Energy Meter to Control Electricity Theft

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Abstract: *This paper proposes a new procedure to implement a controller based smart prepaid energy meter which can also control electricity thefts. The energy meter makes use of the global system for mobile communication [GSM] network to include the capability of prepaid metering system and remote load control. A prepaid energy meter is installed in every consumer home which makes use of an ARM 7 [LPC 2148] microcontroller to calculate the energy consumed and a server unit is preserved at the service provider side. Mutually the units are well equipped with GSM modem. LCD display is used to display the amount of energy consumed. The user can recharge the meter as per his requirements by sending an SMS to the server. The user needs to make an initial recharge to deal with the issues of unpaid bills and human error in billing which eventually ensures justified revenue collection.*

Keywords- Smart prepaid energy meter, Electricity theft, GSM, SMS.

I. INTRODUCTION

Electrical metering instrument technology has come an extended way from the unique bulky meters with heavy magnets and coils to the current electronic meters. There were many innovations those have ended in length & weight reduction further to improvement in features and specifications. Despite the rapid development in the general public of these sectors in India, just a few traits are made in the energy region. As constrained non-renewable sources are present in our each day lifestyles, strength is one in every one of them which might be utilized in each USA [1]. Electric power is an important useful resource in ordinary lifestyles and a backbone of every industry. As strength is restricted resource its right use and size is very important. In the Conventional metering device to measure energy

consumption the energy issuer corporation hire individuals who visit each residence and file the meter analyzing manually. These meter readings are used for strength invoice calculation and this invoice despatched to purchaser house by using put up. This makes the gadget sluggish and exhausting [2][3]. The human errors can open an opportunity for corruption because of human interventions. So the problems get up inside the billing systems which make them erroneous and inefficient. The availability of wi-fi verbal exchange media has made the change of facts rapid, comfortable and correct. Communication media like the internet, GSM networks, and so forth. Exist anywhere. Wireless meter studying places extra control into the hands of each utility and customers through giving them greater detailed facts approximately strength consumption. This allows utilities to higher regulate the strength deliver. So, faraway & wi-fi meter studying device with pay as you go method is becoming a trend now. Meters can be manipulated to lead them to under-register, correctly permitting energy use without buying it. This robbery or fraud may be risky in addition to cheating [4]. Power companies frequently deploy far flung-reporting meters in particular to allow faraway detection of tampering, and specifically to find out electricity robbery.

The exchange of smart electricity meters is beneficial to prevent energy robbery. A commonplace method of tampering on mechanical disk meters is to attach magnets to the outdoor of the meter. Strong magnets saturate the magnetic fields in the meter in order that the motor portion of a mechanical meter does now not function. Lower electricity magnets can upload to the drag resistance of the inner disk resistance magnets [5][6]. Magnets can also saturate present day transformers or capability transformers in digital meters, though

countermeasures are commonplace. Different nontechnical and technical strategies were proposed inside the beyond to stumble on electricity pilfering. Although periodic inspection can drastically lessen strength robbery such degree calls for big manpower and massive labor[7].

II. RELATED WORK

In paper [1], a new concept of energy meter is discussed where the maximum demand of energy of a consumer is indicated in the meter used by the consumer. After exceeding the maximum demand, the meter and hence the connection is automatically disconnected by an embedded system inserted in the meter itself. Paper[2] presents 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 to existing energy meter by the energy provider. Also, they can monitor the meter readings regularly without the person visiting each house. Paper [3] deals with automatic meter reading and theft control system in energy meter. A current transformer is used to measure the total power consumption for house or industrial purpose. This recorded reading is transmitted to the electricity board for every 60 days once. For transmitting the reading of energy meter GSM module is used. To avoid theft, the infrared sensor is placed in the screw portion of energy meter seal. If the screw is removed from the meter a message is sent to the electricity board. The paper [4] proposes a design of an intelligent energy metering system that can efficiently control the amount of electricity consumed by the user.

Electricity users can buy the specific amount of energy to use, only when they need it. This is achieved by interfacing energy meter with smart card technology. The system also alerts when the payment was not cleared. Paper [5] presents the development of Automatic Trip Control System for Energy Management using GSM. This system monitors the usage level of electricity of every consumer at all the

time. In excess of electrical energy used by the consumer, the system will give the alerts through an alarm circuit. After the alarm circuit, the consumer has to take an alternative solution to cut-off excess supply from the Electricity Board (EB) to stop alarming.

III. METHOD OF SOLUTION

According to the proposed system a server unit is installed at the power utility side and every user is provided with a consumer unit which is the actual prepaid energy meter. The GSM modem makes use of the GSM network to establish communication between the server units, the consumer unit as well as with the user also. The server unit consists of a microcontroller (ARM 7-LPC2148), GSM modem (SIM 900), 16x2 LCD display. The consumer unit consists of a microcontroller (ARM 7-LPC 2148), GSM modem (SIM 900), 16x2 LCD display, current transformers, potential transformer and relays. The output signal of the current and potential transformers is provided to the in-built ADC of the microcontroller of the consumer unit. The microcontroller calculates the power consumption using the output pulses from the ADC. Fig.1. shows the block diagram of server unit and consumer unit.

In this system the consumer initially needs to send a message to the server requesting to recharge his/her energy meter with the particular number of units. The server unit then sends those particular numbers of units to the GSM modem of consumer unit. As soon as the controller in the consumer energy meter receives a message from GSM modem it activates the relay and connects the power supply line to the load. As soon as the user connects the load the energy consumed is calculated, and amount along with energy consumed is displayed on the LCD display. The microcontroller uses AT command set to communicate with the GSM module. After the consumption of the complete allocated energy (i.e. number of units recharged), the meter automatically disconnects the load from the main power line using the relay until the user recharges his/her meter again. Whenever there is any type of theft, billing irregularity or illegal practices detected at the consumer end the energy meter immediately

disconnects the load from the main supply and reports this malfunctioning to the server by sending a message through the GSM modem. The central authority can take actions against the defendants. Thus this system avoids the irregularities associated with traditional billing system and ensures revenue collection.

Global System for Mobile Communications or GSM is the world's most popular standard for mobile telephone systems[3]. A GSM modem is a wireless modem that works with a GSM wireless network. Global Positioning System is one of the widely used mobile standards. It enables the mobile user to interact all over the world at any time. It is a hardware component that allows the capability to send and receive SMS to and from the system. The communication with the system takes place via RS232 serial port. The GSM module we used is SIM900A module. The SIM900A is an ultra compact, complete Dual-band GSM/GPRS module in a SMT type the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, and Fax in a small form factor and with low power consumption. Short Message Service (SMS) is a text messaging service component of telephone, World Wide Web, and mobile telephony systems. It uses standardized communications protocols to enable fixed line or mobile phone devices to exchange short text messages. Some advanced GSM modems like SIM900A support the SMS text mode. This mode allows you to send SMS messages using AT commands, without the need to encode the binary PDU field of the SMS first. This is done by the GSM modem.

AT commands are used to control MODEMS. AT is the abbreviation for Attention. These commands come from Hayes commands that were used by the Hayes smart modems. The Hayes commands started with AT to indicate the attention from the MODEM. The dial up and wireless MODEMS (devices that involve machine to machine communication) need AT commands to interact with a computer. These include the Hayes command set as a subset, along with other extended AT commands. Besides this common AT command set, GSM/GPRS modems and

mobile phones support an AT command set that is specific to the GSM technology, which includes SMS-related commands like AT+CMGS (Send SMS message), AT+CMSS (Send SMS message from storage), AT+CMGL (List SMS messages) and AT+CMGR (Read SMS messages).

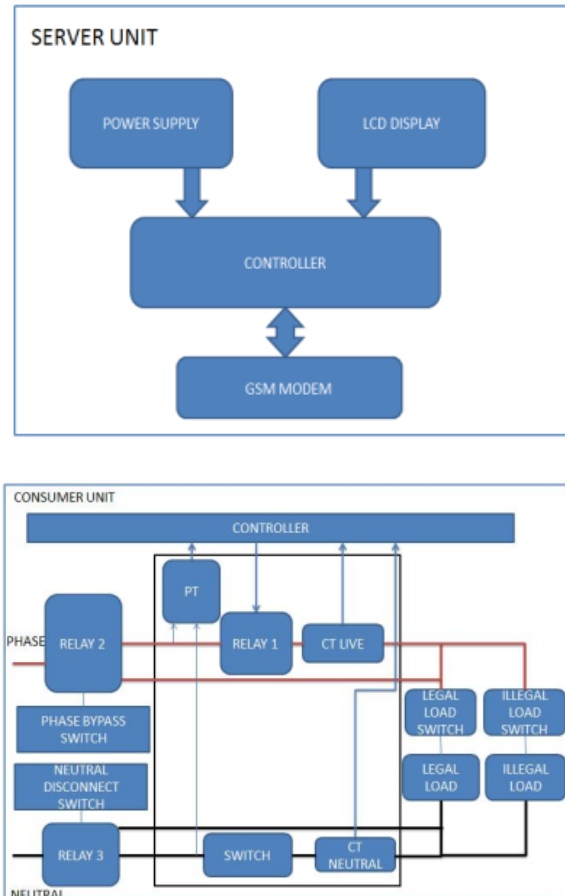


Fig. 1. Block diagram of server unit and consumer unit

Prevention from bypassing of the phase line –

A popular method to bypass conventional meter is shorting the phase line. This type of bypassing of the phase line can be detected with the help of potential transformer PT and the current transformer CT live those are reconnected in the phase line. As soon as the phase line gets bypassed the voltage sensed by PT will be zero and the current sensed by CT live will also be zero amperes. Hence the microcontroller gets intimation and it immediately sends a message to the authorized person of the theft. The authority in charge can take legal actions against the accused user.

Prevention against whole meter bypass –

Bypassing the whole electricity meter is another type of electricity theft. In this case the meter detects no energy consumption. The potential transformer connected detects zero voltage when the whole meter gets bypassed and hence intimates the microcontroller of this particular theft. The meter hence sends a SMS to the authorized person so that the authority in charge can take legal actions against that particular customer.

Prevention against connecting an illegal load –

Electricity theft can also take place by connecting an illegal load. This type of theft is detected by the microcontroller when the current sensed by the current transformer CT LIVE exceeds a specified limit. The microcontroller then actuates the relay to cut the power supplied to the load and sends an alerting message to authority in charge to take legal actions against the consumer.

Prevention from perverting the electricity meter –

The user or professional person can try to open the energy meter and make changes into it, to show low or no power consumption. This also proves to be a major form of electricity theft. To tackle this problem a switch is connected to the proposed energy meter. One terminal of the switch is connected to +3.3V dc supply and the other is connected to the microcontroller. In normal conditions, the switch will be closed and the microcontroller will detect +3.3V at its input pin. If consumer tries to open the energy meter the switch is disconnected and the microcontroller will detect 0V at its input pin. If this occurs, the microcontroller immediately sends a notification SMS to the server and disconnects the load from the supply.

IV. CONCLUSION

This system is beneficial to reduce issues like unpaid bills, billing irregularities, erroneous meter readings and illegitimate payment from customer because of bribed service man. The use of GSM modem facilitates founding direct communication between the server and user end. This system can be a powerful

tool for having efficient use of electricity. Over and done with this system five different forms of electricity theft can be detected and controlled.

REFERENCES

1. Subhashis Maitra “Embedded Energy Meter- A New Concept To Measure the Energy Consumed By A Consumer And To Pay The Bill” 978-1-4244-1762-9/08 ©2008 IEEE.
2. Salai Thillai Thilagam, J, E. Moni Silviya, K. Meena Vinodhini, “GSM Based Automatic Energy Meter Reading System with Instant Billing” International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering [IJAREEIE], Vol. 3, Special Issue 3, April 2014.
3. P. Rakesh Malhotra, Dr. R. Seethalakshmi, “Automatic Meter Reading and Theft Control System by Using GSM”, International Journal of Engineering and Technology [IJET], Vol 5 No 2 Apr-May 2013.
4. Athira. P. M, D. Jeslin Jeniba, “Electricity Theft Control Using Smart Prepaid Energy Meter”, International Journal on Applications in Electrical and Electronics Engineering, Volume 1, Issue 3: March 2015.
5. S. Sukhumar, P. Mukesh Aravind, L. Manivannan, P. Naveen Kumar and N. Suthanthira Vanitha, “GSM based Automatic Trip Control System for Energy Management” International Journal of Innovative Research in Science, Engineering and Technology [IJIRSET], Vol. 2, Issue 12, December 2013
6. Nabil Mohammad, Anomadarshi Barua and Muhammad Abdullah Arafat, “A Smart Prepaid Energy Metering System to Control Electricity Theft” Proceedings of 2013 IEEE International Conference on Power, Energy and Control (ICPEC).
7. Maninderpal Singh, Er. Varun Sanduja, “Minimizing Electricity Theft: A Review”, International Journal of Advance Foundation and Research In Science & Engineering (IJAFRSE) Volume 1, Special Issue, 2015.

8. M.Leelavathi, K.Aswini”SMART ENERGY METER WITH READING INDICATION USING GSM”, International Research Journal of Engineering and Technology (IRJET), Volume: 02 Issue: 02, May-2015

9. ShailajaKumari, V. Dara, M.Veda Chary, “Pre-paid Remote Energy Meter monitoring and Overvoltage Protection through Electricity usingGSM Network”, International Journal of Science, Engineering and Technology Research (IJSETR) Volume 2, Issue 9, September 2013.

10. S.Sukhumar, P.MukeshAravind, L.Manivannan, P.Naveen Kumar and N.SuthanthiraVanitha,“GSM BASED AUTOMATIC TRIPCONTROL SYSTEM FOR ENERGY MANAGEMENT”, International Journal of Innovative Research in Science,EngineeringandTechnology,Vol. 2, Issue 12, December 2013.

11. DammindaAlahakoon, Member, IEEE and Xinghuo Yu, Fellow IEEE, “Smart electricity Meter Data Intelligence for Future Energy Systems:A Survey”, IEEE TRANSACTIONS ON INDUSTRIAL INFORMATICS,2015.

12. S.Ezhilaraus, Raju, K Venkatesh, M Varatharaj, “An Enhancement of Prepaid energy Meter Using Smart Card and GSM Module Techniques”,International Journal of Research in Electronics-IJRE,vol:02,issue:03,2015.

13. SaiKiranEllenki, Srikanth Reddy G, Srikanth Ch, “An Advanced Smart Energy Metering System for Developing Countries”, InternationalJournal Of Scientific Research And Education IJSRE Vol 2 Issue 1 Jan. 2014.

14. Athira.P.M, D.JeslinJeniba, “Electricity Theft Control Using Smart Prepaid Energy Meter”, International Journal on Applications in Electricaland Electronics Engineering Volume 1: Issue 3: March 2015, pp 16-20.

15. K.Sheelasobanarani, S.Dineshraj, B.Dhanraj, K.Manickam, K.Karthhikraja, “An Integrated Prepaid energy Meter using GSM”, InternationalJournal of

Industrial Electronics and Electrical Engineering, ISSN: 2347-6982 Volume-2, Issue-5, May-2014.

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