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 whichcan 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 isinstalled in every consumer home which makes use of an ARM 7[LPC 2148] microcontroller to calculate the energyconsumed and a server unit is preserved at the service provider side. Mutually the units are well equipped with GSMmodem. LCD display is used to display the amount of energy consumed. The user can recharge the meter as per hisrequirements by sending an SMS to the server. The user needs to make an initial recharge to deal with the issues ofunpaid 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 magnetsand coils to the current electronic meters. There were many innovations those have ended in length & weightreduction further to improvement in features and specifications. Despite the rapid development in the general public of thesectors in India, just a few traits are made in the energy region. As constrained non-renewable sources are presentin 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 inordinary lifestyles and a backbone of every industry. As strength is restricted resource its right use and size isvery important. In the Conventional metering gadget to measure energy consumption the energy issuer corporation hireindividuals who visit each residence and file the meter analyzing manually. These meter readings are used for strength invoicecalculation and this invoice despatched to purchaser house by using put up. This makes the gadget sluggish and exhausting [2][3]. Thehuman errors can open an opportunity for corruption because of human interventions. So the problems get up inside the billingsystems which make them erroneous and inefficient. The availability of wi-fi verbal exchange media has made thechange of facts rapid, comfortable and correct. Communication media like the internet, GSM networks, and so forth. Existsanywhere. Wireless meter studying places extra control into the hands of each utility and customers through giving themgreater 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. Thisrobbery or fraud may be risky in addition to cheating [4]. Power companies frequently deploy far flung-reporting metersin particular to allow faraway detection of tampering, and specifically to find out electricity

robbery. The exchange of smartelectricity meters is beneficial to prevent energy robbery. A commonplace method of tampering on mechanical disk meters is to attachmagnets to the outdoor of the meter. Strong magnets saturate the magnetic fields in the meter in order that the motor portionof a mechanical meter does now not function. Lower electricity magnets can upload to the drag resistance of the inner diskresistance 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 forbig 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 isprovided with a consumer unit which is the actual prepaid energy meter. The GSM modem makes use of the GSMnetwork to establish communication between the server units, the consumer unit as well as with the user also. Theserver unit consists of a microcontroller (ARM 7-LPC2148), GSM modem (SIM 900), 16x2 LCD display. Theconsumer 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 providedto the in-built ADC of the microcontroller of the consumer unit. The microcontroller calculates the power consumptionusing 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 energymeter with the particular number of units. The server unit then sends those particular numbers of units to the GSMmodem of consumer unit. As soon as the controller in the consumer energy meter receives a message from GSMmodem it activates the relay and connects the power supply line to the load.

As soon as the user connects the load theenergy consumed is calculated, and amount along with energy consumed is displayed on the LCD display. Themicrocontroller uses AT command set to communicate with the GSM module. After the consumption of the completeallocated energy (i.e. number of units recharged), the meter automatically disconnects the load from the main powerline using the relay until the user recharges his/her meter again. Whenever there is any type of theft, billing irregularityor illegal practices detected at the consumer end the energy meter immediately disconnects the load from the mainssupply and reports this malfunctioning to the server by sending a message through the GSM modem. The centralauthority can take actions against the defendants. Thus this system avoids the irregularities associated with traditionalbilling system and ensures revenue collection.

Global System for Mobile Communications or GSM is theworld's most popular standard for mobile telephone systems[3]. A GSM modem is a wireless modem that works with aGSM wireless network .Global Positioning System is one ofthe widely used mobile standards. It enables the mobile usersto interact all over the world at any time . It is a hardwarecomponent that allows the capability to send and receive SMSto and from the system. The communication with the systemtakes place via RS232 serial port. The GSM module we usedis SIM900A module . TheSIM900A is a ultra compact, complete Dual-band GSM/GPRSmodule in a SMT type the SIM900A delivers GSM/GPRS90011800MHz performance for voice, SMS, and Fax in asmall form factor and with low power consumption.Short Message Service (SMS) is a text messaging servicecomponent of telephone, World Wide Web, and mobiletelephony systems. It uses standardized communicationsprotocols to enable fixed line or mobile phone devices toexchange short text messages. Some advanced GSM modemslike SIM900A support the SMS text mode. This mode allowsyou to send SMS messages using AT commands, without theneed to encode the binary

PDU field of the SMS first. This isdone by the GSM modem.

AT commands are used to control MODEMs. AT is theabbreviation for Attention. These commands come fromHayes commands that were used by the Hayes smart modems.The Hayes commands started with AT to indicate the attentionfrom the MODEM. The dial up and wireless MODEMs(devices that involve machine to machine communication)need AT commands to interact with a computer. These includethe Hayes command set as a subset, along with other extendedAT commands. Besides this common AT command set,GSM/GPRS modems and mobile phones support an ATcommand set that is specific to the GSM technology, whichincludes SMS-related commands like AT+CMGS (Send SMSmessage), AT+CMSS (Send SMS message from storage),AT+CMGL (List SMS messages) and AT+CMGR (Read SMSmessages).
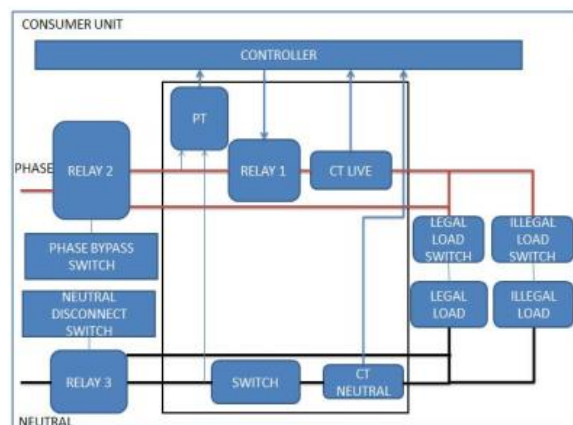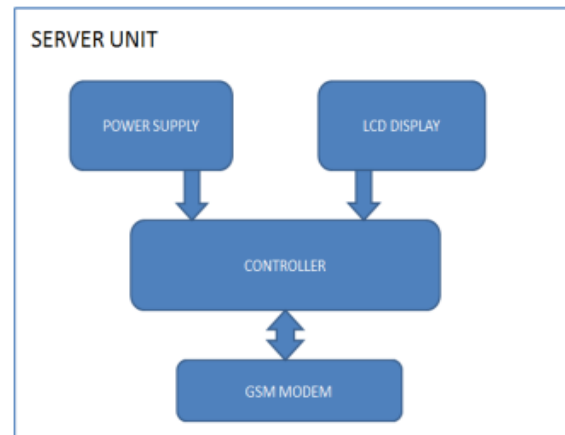
Fig. 1. Block diagram of server unit and consumer unit

Prevention from bypassing of the phase line –

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

Prevention against whole meter bypass –

Bypassing the whole electricity meter is another type of electricity theft. In this case the meterdetects no energy consumption. The potential transformer connected detects zero voltage when the whole meter getsbypassed and hence intimates the microcontroller of this particular theft. The meter hence sends a SMS to theauthorized 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 detectedby the microcontroller when the current sensed by the current transformer CTLIVE exceeds a specified limit. Themicrocontroller then actuates the relay to cut the power supplied to the load and sends an alerting message to authorityin 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 powerconsumption. This also proves to be a major form of electricity theft. To tackle this problem a switch is connected tothe proposed energy meter. One terminal of the switch is connected to +3.3V dc supply and the other is connected tothe microcontroller. In normal conditions, the switch will be closed and the microcontroller willdetect +3.3V at its input pin. If consumer tries to open the energy meter the switch is disconnected and themicrocontroller will detect 0V at its input pin. If this occurs, the microcontroller immediately sends a notification SMSto the server and disconnects the load from the supply.

IV.   CONCLUSION

Thissystem is beneficial to reduce issues like unpaid bills, billing irregularities, erroneous meter readings and illegitimatepayment from customer because of bribed service man.The use of GSM modem facilitates founding directcommunication between the server and user end.This system can be a powerful tool for having efficient use ofelectricity.Over and done withthis system five different forms of electricity theft can be detected and controlled.

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