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GSM Based Automatic Energy Meter Reading System

Chaitali M. Suroshe[1], Neha A. Banokar[2]
Prachi R. Nema[3], Rani G. Balpande[4]
Sneha V. dhamgaye[5], Toshika K. Mendhe[6]
[123456] *UG student*
Department of electronics and telecommunication,
Smt. Rajshree Mulak College of Engg. For women
Nagpur, Maharashtra, India
nbanorkar@gmail.com

Prof. Hina Malik
Assistant Professor
Department of electronics and telecommunication,
Smt. Rajshree Mulak College of Engg. For women
Nagpur, Maharashtra, India
hina.malik184@gmail.com

***Abstract*—**Electricity is one of the basic necessities of human beings and its theft is the biggest and most common problem in India, which causes lots of loss to electricity board. If we can prevent this problem we can save lots of power in future and this is done by using "GSM based automatic energy meter reading system". It includes Arduino, GSM module, LCD display, relay & CT by using this system we can save time, money and as it is automatic system it minimizes human work load as it can monitor the readings without person visiting every house. It provides message by using GSM modem to the user on hourly, daily and monthly basis by the request. Electricity theft and late billing can also avoid using this system. To avoid the energy theft and human error we are introducing an antitheft mechanism. This will contain a microcontroller unit that is Arduino it will continuously read the units of the energy meter and record the energy meter reading in its memory location. This system also uses the GSM module for sending the calculated units of energy meter.

***Index Terms*—**Energy meter, Arduino mini, Global System for Mobile (GSM), Short Message Service (SMS), LCD Display, Relay, Theft Detector

I. INTRODUCTION

Now a day the number of electricity consumers is increasing day by day. An energy meter is a device which is used to measure the consumption of energy of any occupancy, business or an electrically powered device, or other industrial establishment. Digital energy meters preserve their accuracy over a larger current range than the mechanical meter. Presently maintenance of the power is also an important task as the human operative goes to the customer's house and produces the bill as per the meter reading. If the customer is not available, the billing process will be pending and human operator again needs to revisit. Going to each and every customer's house and generating the bill is a difficult operation and requires lots of time. It becomes very hard especially in rainy season. If any customer did not pay the bill, the operator needs to go to their houses to disconnect the power supply. These processes are time consuming and difficult to handle. The energy meter conducts to saving in the overall cost. The GSM based automatic energy meter accommodate energy meter, a GSM modem, a microcontroller (Arduino) and a relay circuit, which is connected between energy meter and load. The digital energy meters also stable over change in temperature, voltage and line frequency. The energy meter is used to measure the real power and convert it into frequency for advance resolution. In digital energy meter gives real power depletion as well as accurate reading. GSM to send SMS to local authorization in case of theft, because GSM has a created in transport layer encryption, which is supported by most network contributor.

II. RELATED WORK

Detailed explanation of related work is explained in this section as follows:

Ashna.k, Sudhish N George, (IEEE 2013) proposed a work referred to as GSM based automatic energy meter reading system with instant billing paper. It presents the design of a simple low cost wireless GSM energy meter and its interconnected web interface. The proposed system replaces electromechanical meter reading methods and it permits remote access to present energy meter. Also they can monitor the meter readings regularly without the person visiting every premise. A GSM modem is used to transmit and receiving data or message for communication between user and service

provider having PC with a GSM receiver at the other end, which contains the database acts as the billing point.

Md. Masudur Rahman, Noor-E-Jannat, Mohd. Ohidul Islam, Md Serazus Salakin (IEEE 2015) proposed a work referred to as Arduino and GSM based Smart Energy Meter for Advanced Metering and Billing System. In this paper they introduced Adriano Uno (microcontroller) for controlling purpose. This work presents a smart energy meter for an automatic metering and billing system. The proposed system can consolidate with micro controller and GSM modem to transmit the data like consumed energy in kWh, generated bill, security services over GSM mobile network such as data can be provided and integrated into existing energy management systems located at industries or organizations to provide the services among the customers without man-power.

S.R.Kurkute, Gopal Girase, Prashant Patil (IJIREEICE 2016) proposed a system referred to as Automatic energy meter reading system using GSM technology. In this paper the Automatic Energy Meter Reading system regularly read the energy meter and calculate total amount of bill at the set dead line and sends the message to service provider. The received data will contain user name, meter ID, total units with paying amount this message maintained at database server which located at service provider department. In this proposed work wireless energy meter reading system is designed to continuously monitor the meter reading and it avoids the human interference provides efficient meter reading and avoid the billing error. It displays the information on LCD for user notification.

V. Preethi, G. Harish, (IEEE 2016) proposed a work referred to as Design and implementation of smart energy meter. In this paper they introduce antitheft mechanism. This paper presents a smart energy meter for an automatic meter reading and billing system. Total meter reading utilized and the corresponding amount will be displayed on the LCD continuously and communicate it to the controlling base station. Communication between user and service provider is done by using Zig-bee. GSM network is used for sending SMS to the local authorities. This meter can work as prepaid or post-paid meter.

III. PROPOSED SYSTEM

The current system of electricity billing is reached at the error level and also time consuming. Fault establish at every stage are due to electro-mechanical meters, human fault while noting down the meter reading, fault while dealing the paid bills and the due bills. GSM based automatic energy meter reading system is a technique which can reduce the problems linked with billing and also reduces the organization of manpower for engaging meter readings. The proposed system consists of digital energy, an arduino (microcontroller), GSM modem and antitheft mechanism. After switching power on the arduino and GSM modem, turn on the relay and fetch the energy meter to load via relay. If any tampering attempt occurs in the metering unit, Arduino turns of the relay, and send the SMS to the service provider. Arduino checks the impulse from energy meter. As it is automatic system it reads the reading and sent it automatically to the user as per reading through the SMS with the help of GSM module. For antitheft mechanism we introducing reed switch on the cap of meter. At the end of the count of 30days or on request by the substation the value is sent to the substation i.e. the receiving with the help of a Transmitter in the GSM Module.

Block diagram:

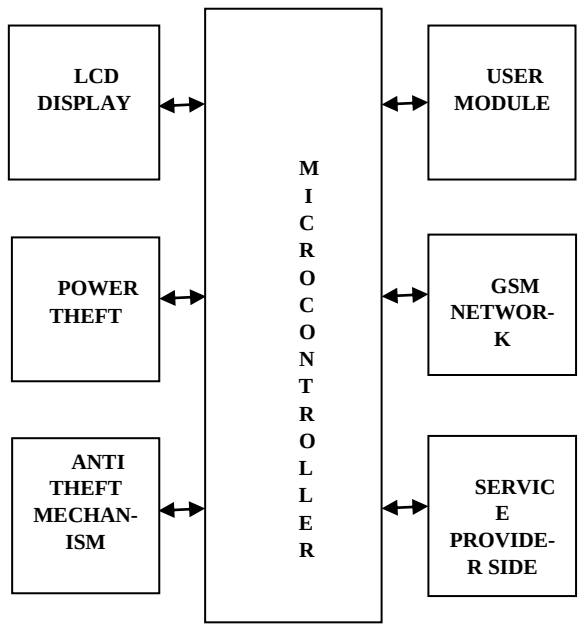

Fig. 1: Block diagram of GSM based automatic energy meter reading system.

a. Energy meter:

An energy meter is a device that measures the amount of Electrical energy supplied to or produced by home or building. The most commonly used energy meter is kilo watt hour meter. Instantaneous power is calculated by taking the product of the Instantaneous current and voltage. This instantaneous power is then integrated against time to give energy used by the consumers. The meters are classified into two basic categories, electromechanical and electronic. The energy consumption is calculated by using the output pulses of energy meter. The load is said to consume 1unit of electricity when the internal counter of microcontroller counts up to 3200pulses.

b. Arduino mini:

Arduino is a flexible programmable hardware platform. It is a microcontroller board based on the ATmega328P. It has 32 pins, 8 megahertz frequency, operating at 5V, a sixteen megahertz quartz crystal, a Universal serial bus (USB) connection, a power jack, 6 analog input pins, 14 digital input

output pins and a reset button. It is used for processing and controlling all peripherals connected to arduino. It uses a simplified version of C making it easier to learn program.

c. Optocoupler:

It is an electronic device which is designed to provide Electrical isolation coupling between its input and output. Optocouplers eliminate the effect so electrical noise caused by crosstalk, power irregularities and electrical interferences. It is used to collect the reading.

d. Relay driver:

A relay is an electrically operated switch. Relays are basic Components in a majority of types of electrical and electronic Device .It is also used in power engineering. An overload relay that uses a heating element to detect overloads. Electro-mechanical relay is a high speed device which is insensitive to pulse and high frequency interference and surge voltage. It exhibits a robust Behavior in overload modes and has a satisfactory reset ratio. It helps to on and off the power supply in proposed system.

e. LCD display:

A 16*2 LCD display contains two lines and there are 16 characters per line. Each characteristic displayed by 5x7 pixel matrix. LCD screen is an electronic display module and find wide range of applications. It is very basic module of LCD display and is very commonly used in devices and circuits. This module is preferred over seven segments and other multi-segment LED's display and is very commonly used in devices and circuits. This module is preferred over seven segments and other multi-segment LED's

f. GSM modem:

To send and receive SMS to and from the system GSM Modem is used. It needs AT commands for communicating with the microcontroller. This GSM Modem can accept any SIM card and act just like a mobile phone with its own unique phone number. GSM technology provides the benefit that the system is accessible in remote areas. GSM modem checks the new SMS and read it. If the SMS is "DATA", send data to the specific number. If the SMS is "LINE CUT", turn OFF the relay, so load will disconnect. Again the SMS is "LINE OK" and then turn ON the relay so load will connect.

g. Antitheft mechanism:

Antitheft mechanism for internal theft: As we know that the tempering of energy meter is done by anyone who wants to reduce the electricity bill or less billing especially in industries. In industries machines are used in large amount it causes lot of power get consumed which lead to increase the electricity bill as their monthly bill is in lakhs. To reduce the electricity bill they always try to open the cover of energy meter and try to temper it or burn it at the end of month. To reduce this internal theft we are using a REED SENSOR in the cover of energy meter which senses if anyone tries to open the cover. So, by applying the reed sensor on the cover of energy meter any tempering in energy meter is reduces.

Antitheft mechanism for external theft: For external theft also we are using a limit sensor mounted on isolator. If anyone tries to trip the isolator in that case limit sensor will sense it and arduino will give the information of tripping via message if once it is trapped then it's OK but if it senses more than twice then the power will be cut through relay.

Working:

To reduce all the problems regarding energy meter such as human error, meter reading corruption, time consumption a GSM based automatic energy meter reading system is introduced. It mainly deals with three works i.e. automatic reading the units of energy meter and send the message via GSM network. Another work is to detect the internal theft corresponds to energy meter by using reed sensor in the cover of energy meter. And the third work is to precaution for the external theft by using limit sensor.

If someone tries to open the cover of energy meter for tempering purpose it will detect it and send the message via GSM network that the cover is open. It will also send the units consumed by the energy meter through message to the user and the service provider side by messaging some code which is pre-defined code. By just sitting at the server side, service provider side can easily access the meter reading and can get the acknowledgement of energy theft and also can remotely handle i.e. on or off the power supply of that particular user.

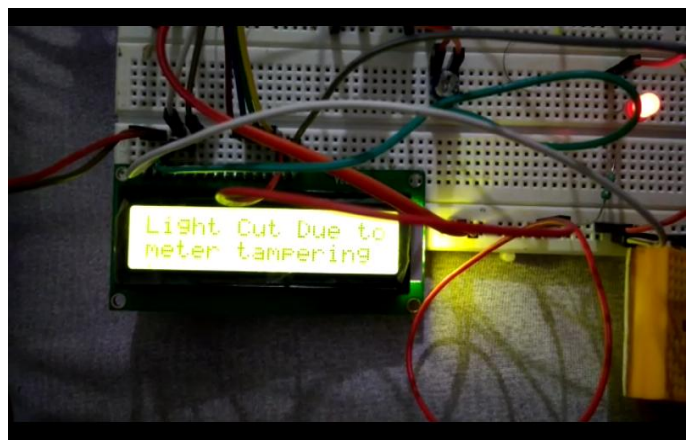

Fig: 2 – figure showing theft detection

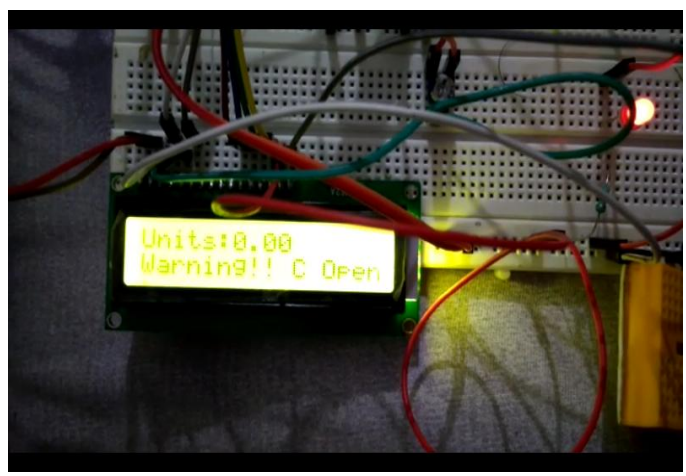

Fig: 3 – figure showing units consumed

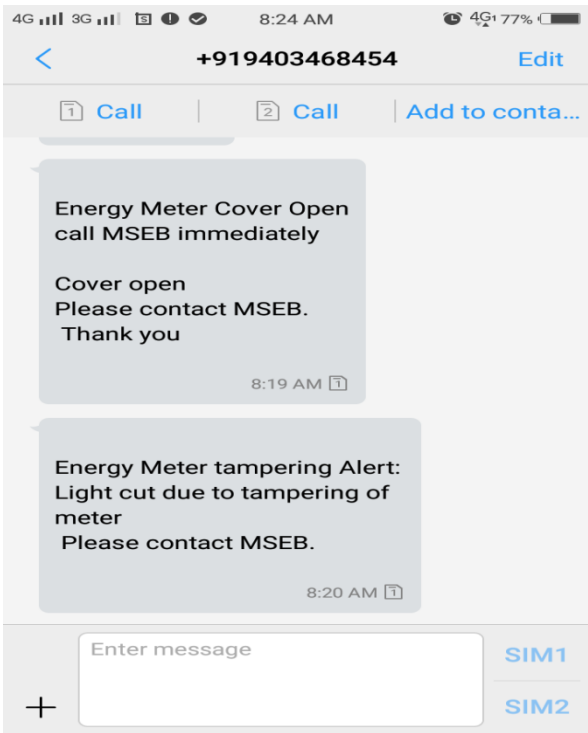

Fig.: 4 - message showing cover open

IV. CONCLUSION

GSM based automatic reading system for advanced metering and billing system is built which is able to read and sent data via wireless GSM technology; however this project needs modification for more reliable and higher degree of satisfaction which we can improve in future. The network strength of GSM module should be too strong so that the communication and network coverage of SIM will be more efficient.

In this modern time, this project is very important. Although overall cost of this project is high but after implementation of this project commercially the cost will be reduced. It saves enough money every month. It will be benefited for us in many ways it reduces human error, human work load, maintenance cost and mainly it detects electricity theft.

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