ISSN:2348-2079

Volume-7 Issue-1

International Journal of Intellectual Advancements and Research in Engineering Computations

GSM based power theft monitoring and controlling system using ARDUINO

Ramraj.B[1], Krishnaraj.C[2], Praveen kumar.T[2], Ravichandran.P[2], Vignesh.P[2]

[1]Assistant Professor, Department of EEE, Nandha Engineering College (Autonomous)
[2]Students, Department of EEE, Nandha Engineering College.

ABSTRACT

Electrical energy is very important for our day today life. When the population increases the power utilization also increases as well as the energy theft is also increases. Utilities in electricity system are destroying the amounts of revenue each year due to energy theft. The newly designed Atmega 328 microcontroller used for energy measurements reveal the concept and working of new automated power metering system but this increased the Electricity theft forms administrative losses due to not regular 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 Atmega328P microcontroller to detect and control the energy meter from power theft and solve it by Relay 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 relay was in order to disconnect the unauthorized supply. A new method is implemented by interspersed the GSM feature into smart meters with Solid state relay to deal with the non-technical losses.

Keywords: ARDUINO, Smart Energy Meter, Power Theft Control, Digital Meter, GSM, Atmega 328 Microcontroller

INTRODUCTION

Now a day with emerging developments in all sectors and growing demands, electricity has become priority for every individual and every organization. The basic concept of power supply includes power generation, power transmission and power distribution to the destinations. According to the World Bank estimates, power theft reduces India's GDP by around 1.5%. A recent study by the NDTV also concluded that 40% of the electricity in India is still unpaid. All of the power generated in the country, around one fourth is either stolen or lost in transmission. These losses can be minimized using the smart meter technology. These are the losses caused deliberately by human beings for the sake of illegal access to the power distribution. Energy theft in India is a serious issue that the country has been trying to dealing with for years. This problem is found not just in the rural areas, but it is also rampant in the cities as well. Even though the Indian government has achieved village electrification in all the villages in India, power theft is something that the government has failed to address adequately.

EXISTING SYSTEM

Energy metering

Energy meters displays kilowatt hour by continuously measuring the instantaneous voltage and current to give energy used in joules. The Electricity meter is electromechanical induction meter and an electronic meter. The electromechanical induction type meter shown figure 1, the total number of rotation of the

Author for correspondence:
Department of EEE, Nandha Engineering College

aluminum disc is directly proportional to the power consumed. The electronic meters shows 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. The system is a single way communication system.

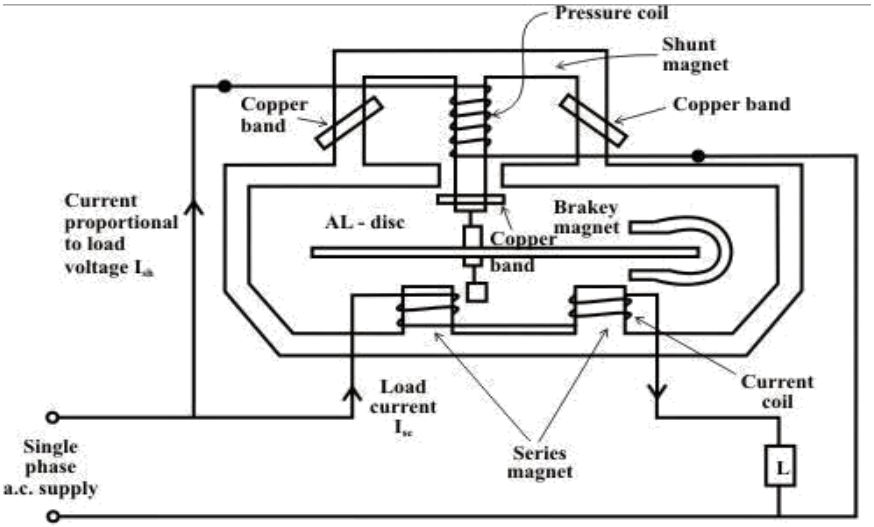

Fig: 1 Electromechanical Meter

Measuring the 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. The electricity meters fixed on consumer's premises and the consumption information is collected by meter reading on their monthly visits to the premises.

Smart meter

In this existing system GSM technology is implemented for transmitting the information about power usage to the supplier. System is not designed to prevent the electricity thefts happening in the current scenario. This system senses only the power usage and sends the bill message to the user via GSM. Existing system block diagram is shown in Fig 2. This does not prevent the electricity theft as much as possible. The proposed system gives solution for the existing problems like power theft, wastage of energy and transmission line fault that are faced by the authorized power suppliers.

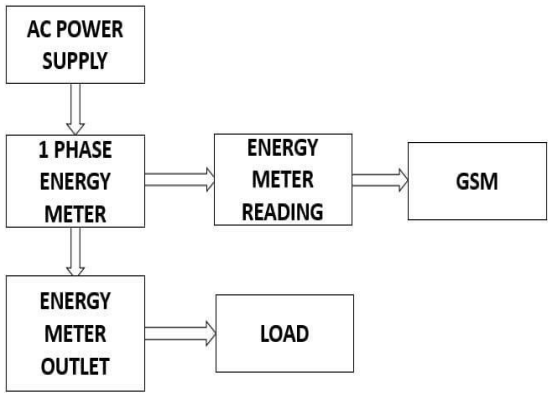

Fig: 2 Block Diagram of the existing system

Existing system drawbacks

- The energy theft can be found out only by using the energy meter reading.
- Human error cannot be avoided for the manual energy meter reading.
- No cross checking or recheck of human reading for energy meter.
- High chance of stealing and bribery always high to misuse it especially during events.
- Possibility to change the reading when taking photos of energy meter by using software tools.
- More number of meter reading will cause extra expenses to the company for hiring employees and their expense on traveling too is an expensive one.
- Wherever energy meter installed inside the house, which may lead to non-checking of reading due to lock.

PROPOSED SYSTEM

In the proposed system the manual work is replaced with automatic meter reading with GSM. In the proposed system, if the energy meters incoming & outgoing energy differs the supply will shut down for the particular energy meter. If the theft has detected the message will send to the particular mobile number of the respective substation with the complete details of the service. Once the system gets shutdown the meter is not able to recover, without RESET the meter by the superior of the particular substation. The next enhancement of energy meter is to make it smart enough to detect any theft and to communicate with energy supplier and user wirelessly via GSM technology. Extra features, i.e. a wirelessly controlled system using GSM technology that enables the user and supplier to communicate with the meter via SMS and with power theft detection, scheduled load shedding and monitoring capability. The proposed system consists of digital energy meter, an Arduino (microcontroller), GSM modem and solid state relay. Once the power is fed to Arduino and GSM module connect thus the energy meter to load. Then display the current data. Arduino checks the readings from voltage and current sensor i.e. PT and CT respectively. If there is any difference in value between CT's connected in input phase and output phase then Arduino turns OFF the relay sends SMS to the service provider. Also, this Arduino helps the utility for power disconnection on the occasion of when power theft. From customer and supplier point, this is a benefit to monitoring their daily/monthly consumption and power theft.

BLOCK DIAGRAM

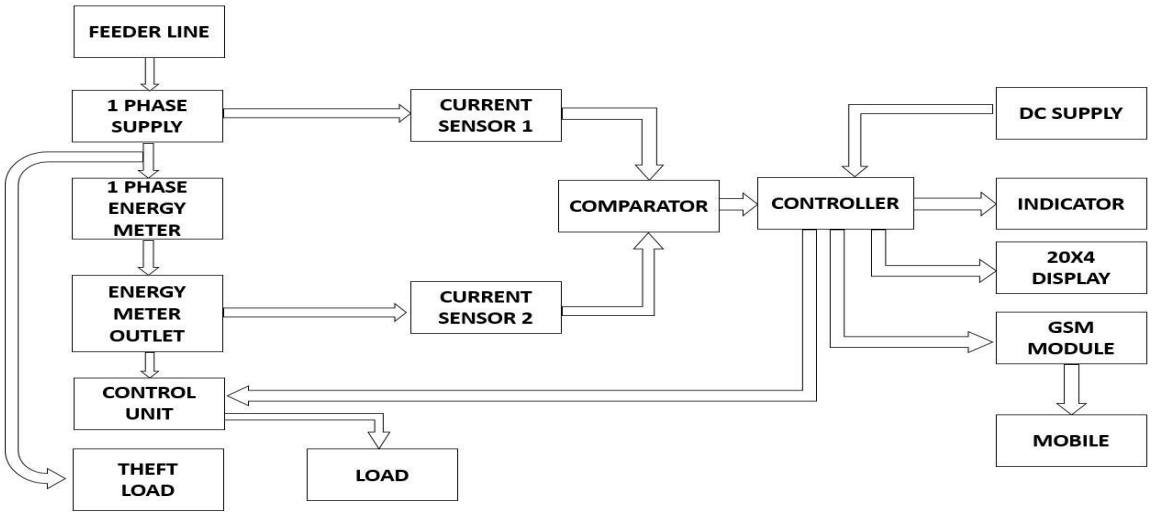

Fig: 3 Block Diagram of the proposed system

The block Diagram containing Power supply unit, ATMEGA 328P, 20x4 LCD display, Global System for Mobile Communication, Current sensors, Relay circuit, Energy Meter. The Block diagram of the Power theft monitor and controller of proposed system is shown in the figure 3.

A power supply is connected to electronic device that supplies electric energy to an electrical load. Various microcontrollers offer different kinds of memories. EPROM, EEPROM, FLASH etc.., are some of the memories of which FLASH is the most recently developed. Technology that is used in AT mega 328P is AVR family, so that data is retained even when the power is switched off. AT mega 328P microcontroller Programming and Erasing are other features.

GPRS and GSM Modules are one of the commonly used communication modules in embedded systems. A GSM GPRS Module is used to enable communication between a microcontroller and the GSM / GPRS Network. The GSM stands for Global System for Mobile Communication and GPRS stands for General Packet Radio Service. A GPRS GSM MODEM comprises of a GPRS GSM Module along with some other components like communication interface power supply and some indicators. With the help of this communication interface, we can connect the GPRS GSM Module on the GPRS GSM MODEM with an external computer. GPRS/GSM / Modules allow microcontrollers to have a wireless communication with other devices and instruments. Microcontrollers Wireless communication system opens up with a wide range of applications like Medical Assistance Home Automation Systems, Disaster Management, E – Commerce Vehicle Tracking, Online Banking, etc. Before going in to the details about the GSM/GPRS Module, we will first see a few basic things like GSM, GPRS, MODEM, Module and System.

A LCD display is a flat panel display, video display electronic or visual display that uses the light modulating properties of liquid crystals. The light does not emitted by the liquid crystals directly .A liquid crystals are available to display arbitrary fixed images or images which can be displayed or hidden, such as preset digits, words, and 7-segment displays are used in digital clock. The basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

The solid state Relays are electrically controlled switches. Relay type, a coil pulls in an armature when sufficient coil current flows. Many varieties are available including “latching” and “stepping” relays; the later provided the cornerstone for telephone switching stations, and they’re still popular in pinball machines. Solid state Relays are available for dc or ac excitation, and coil voltages from 5 volts up to 230 volts are common. A Current sensor or Hall Effect sensor is a device that detects electric current in a wire, and generates a signal proportional to that current. The sensor is generated signal could be analog voltage or current or even a digital output. The analog signal can be then used to display the measured current in an ammeter, or can be stored for further analysis in a data, or can be used for the purpose of control.

POWER THEFT CONTROLLING

Power thefts can never be totally eliminated in our country. In the very efficient system of some countries like Japan, Europe and United States efforts have devised different methods compulsory to reduce power thefts to acceptable levels. The first step in electricity theft reduction is to find and investigate theft problems. There are many methods for reducing power thefts in a community including but not limited to: (1) Technical Engineering Methods (2) Managerial Methods (3) System Changes etc. [11].

Circuit diagram

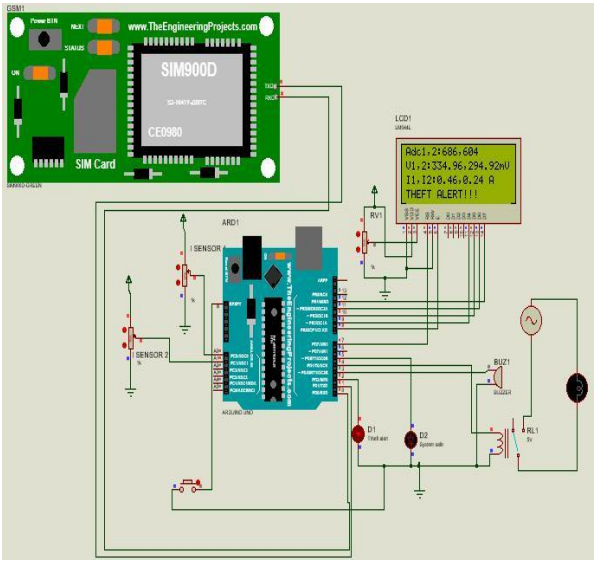

Fig: 4 Circuit Diagram of the proposed system

Nowadays, electricity theft is being done in such a fashion that there is no current entering the energy meter and due to which the energy meter does not count the units being utilized by the consumer. The Circuit Diagram of Power theft monitoring and controlling of proposed system is shown in the figure 4.To reduce such type of electricity theft we have used two identical Current sensors to measure and detect the current leaving and entering the meter. If both the values are different from each other beyond threshold value, then it is detected by the microcontroller as a sign of theft and the electricity supply will be disconnected and at the same time the signal is sent to the energy supplier company via SMS and is displayed. Arduino Uno 328P is used in this work along with other required hardware like power supply required for GSM. With the capability to perform multiple tasks at a very high conversion rate. A GSM module is used in the proposed design to communicate between the meter and utility and consumer. A 20x4 LCD (Liquid Crystal Display) is another efficient and low power consumption component of the equipment interfaced with the Arduino used in this work. It is an electronic-modulated device filled with liquid crystals and arrayed in front of a light source. The LCD displays the values of current, voltages and ADC value and notifications of power theft.

DATA FLOW DIAGRAM

Fig: 5 Data flow diagram of the proposed system

GSM (Global System for Mobile communication) is a digital mobile network that is widely used by mobile phone users in Europe and other parts of the world. Is show in figure 5.Data flow diagram of proposed system GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies: TDMA, GSM and code-division multiple access (CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 megahertz (MHz) or 1,800 MHz frequency band [6-10].

GSM, together with other technologies, is part of the evolution of wireless mobile telecommunications that includes High-Speed Circuit-Switched Data (HSCSD), General Packet Radio Service (GPRS), Enhanced Data GSM Environment (EDGE) and Universal Mobile Telecommunications Service (UMTS).

PROPOSED THEFT CONTROL FLOW CHART

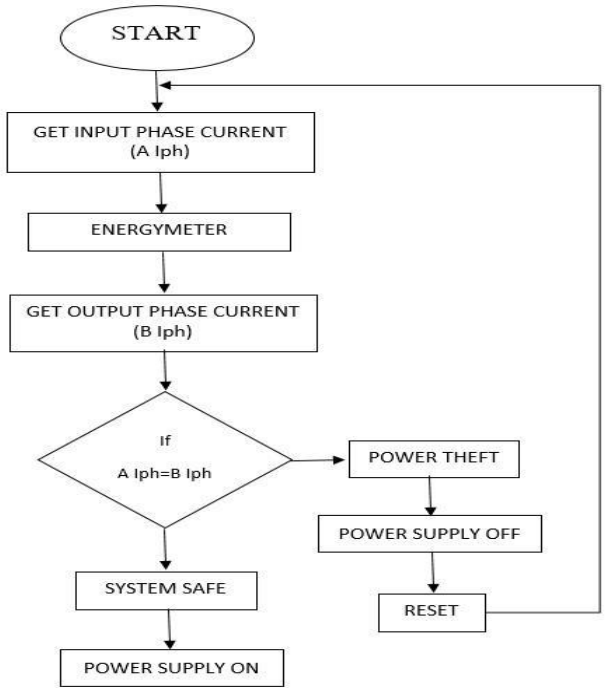

Fig: 6 proposed theft control flow chart

The current sensor A Iph was connected with input AC power supply. The readings were noted. The AC power supply is connected to the energy meter. In energy meter output side, the current B Iph was connected. The readings were noted. The two current sensor value was compared by Arduino. If the two readings are the same (A Iph=B Iph) the system is safe. The power supply is ON. The relay will control the load side. If the readings are varied the theft was detected. Then the power supply is OFF with the help of the relay. The relay is connected to the load side. The GSM module will send the message to the EB office and the message was sent to the supplier with service ID. Now the system is reset by help of the RESET button and it work normally [1-5].

HARDWARE RESULTS

Figure 7 explains the hardware snapshot of power theft monitoring and controlling system.

Fig: 7 Hardware snapshot

Figure 8 explains the hardware snapshot consumer side (System safe)

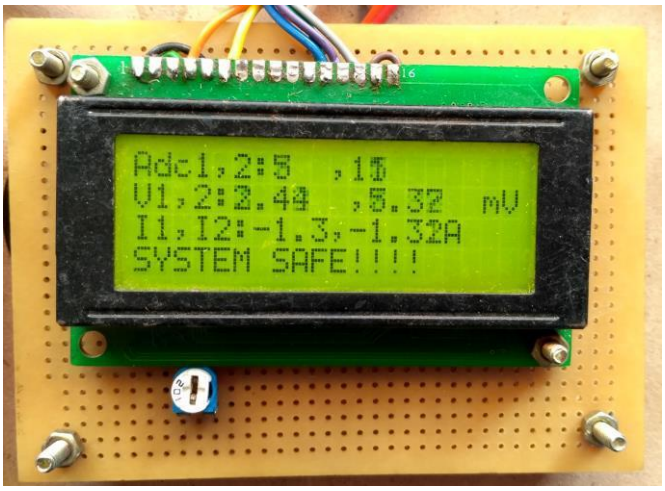

Fig: 8 Hardware result of consumer side (System safe)

Figure 9 explains the hardware snapshot consumer side (Theft alert)

Fig: 9 Hardware result of consumer side (Theft alert)

CONCLUSION

This paper has the combined hardware advantage for both utility and the customer. Arduino, and GSM stationed Energy Meter for power theft detection, and voltage and current variation is built which is able to read and send data via wireless protocol using GSM technology through GSM modem, capable of managing and controlling the supply to that meter with Relay. In the case of power theft, defaulter meter line cutting/joining labor system is reduced. Power consumption, power quality, and its accuracy can be monitored by the consumers directly in their mobile. This process will reduce the labor work and human error in the distribution system and also protect the power theft.

REFERENCE

[1]. Electricity Theft Detecting Based on Density- Clustering Method, IEEE transaction, Kedi Zheng1, Yi Wang1, Qixin Chen1, and Yuanpeng Li2, 2017.

[2]. Distribution Line Monitoring System for the Detection of Power Theft using Power Line Communication, IEEE, Alwin Vinifred,Christopher, Guhesh Swaminathan, Maheedar Subramanian,PravinThangaraj, 2014.

[3]. Electricity Theft Detection Using Smart Meter Data, IEEE, Sanujit Sahoo Censio,Daniel Nikovski,Toru Muso and Kaoru Tsuru.2015.

[4]. Electricity Theft Detection in Low Voltage Networks with Smart Meters Using State Estimation, 2016 IEEE, Chun-Lien Su, Wei-Hung Lee Chao-Kai Wen.

[5]. Electricity Theft Detection and Localization in Grid-tied Microgrids, IEEE ,Muhammad Tariq, Member, IEEE, and H. Vincent Poor, Fellow, IEEE.2016.

[6]. Electricity sector India, En.wikipedia.org/wiki/theft of electricity

[7]. Parul ranjan, Namitha Mehra, T.A.More, Shipad Bokand, " Wireless design for power theft monitoring", International journal of computer technology and electronics engineering (IJCTEE) volume 2, Issue 2.

[8]. Vrushali V.jadhav, Soniya S. patil, Rupali V.Rane, Swati R.Wadje. "Wireless power theft detection", International journal of electronics, communication $ Soft computing science and engineering 2(1), ISSN: 2277-9477.

[9]. Daniel Nikovski, Zhenhua Wang, Alan Esenther, Hongbo Sun, Keisuke Sugiura, Toru Muso, and Kaoru Tsuru, " Smart meter data analysis for power theft detection".

[10]. Nikhil P. Wandhare, "Automatic load balance and theft detection system", International journal of application or Innovation in engineering & management (IJAIEM) ISSN 2319-4847, RATMIG 2013.

[11]. Amarnath.R, Kalaivani.N, Priyanka.V, "Prevention of power theft using IED," Global humanitarian technology conference (GHTC), IEEE, volume, 2013.