ARDUINO BASED AUTOMATIC ENERGY METERING FOR CONTROL OF POWER THEFT

Ebanazer pravin S
Asst Professor, Department of Electrical and Electronics Engineering,
St. Mother Theresa Engineering College, Vagaikulam, India

Packia Jerome jegaraj A
UG Student, B.E, Electrical and Electronics Engineering,
St. Mother Theresa Engineering College, Vagaikulam, India

Mike Jonathan S
UG Student, B.E, Electrical and Electronics Engineering,
St. Mother Theresa Engineering College, Vagaikulam, India

Abstract— Consumers usage of electricity increase in country like India as the population increases. Energy theft is a major problem in growing countries. This destroys the amount of revenue each year due to energy theft. As the regular checkout at the customers residence is quite impossible always. There are always chance of improper power reading and other problems. In this paper a new procedure is used based on the MICROCONTROLLER Atmega 328p to detect and control the energy meter from power theft and solve it by remotely disconnecting and reconnecting by using SSR. The SSR act by the instruction given from the microcontroller. The power is measured by the current sensor and the voltage sensor, they act as CT and PT respectively. The microcontroller gets the power readings from them and sent to the consumer and service provider. A unique method is implemented by interspersed the GSM into smart meters with SSR to deal managerial losses, billing difficulties and voltage fluctuation difficulties

Keywords- Atmega 328p, automatic billing, GSM, MICROCONTROLLER, Power theft, Smart meter, SSR.

I.   INTRODUCTION

Electricity is one of the blessings of the modern world thatscience hasgiven to theWorld[1]. This energy if used by unauthorized Persons cause loss to the utility and also pollute the environment. Losses comes Under two bases. They are technical and managerial. Managerial losses due to improper labor interference periodically and lack of concentration. Technical losses are due to improper functional tendency of the equipment used in the measurement.

The proposed method consists of digital energy meter, an Arduino processor, GSM modem, SSR and power supply. After the power is supplied to the Arduino and GSM, connect the SSR in between the load and energy meter. Current sensors and voltage sensor act as CT and PT which is used to measure the power. Arduino checks the value from current sensor and voltage sensor. SSR will disconnect the supply if instruction given by Arduino. If there is overvoltage problem or power theft found by the Arduino then only it sends the signal to the SSR which will disconnect the supply.

II.   EXISTING SYSTEM: ENERGY METERING

A.   Conventional system

The power measurement method used electromechanical meter and electronic meter. In the electromechanical meter the total number of rotation if the power consumed is directly proportional to the power consumed. In the electronic meter, it shows the power consumed, power factor and the reactive power used by consumer using digital display on LCD or LED. It is also capable of send the energy

readings to other places by some form of communication. In addition to that the electronic energy meter can be used to record other parameters of the load and supply such as voltages, power factor, reactive power, instantaneous and maximum rate of usage demand of power.

The power measurement method traditionally is the electricity meters are usually installed on the consumer's premisesand the power usage is measured by the meter reader labors on monthly basis. The utility billing is yet unavoidable in the world as for concern post-paid energy meter [2].

The current scenario slightly as govt of India has announced strictly that after May 2018 AMR must not be used and smart energy meter must be installed. This increases the efficiency of the energy meter. For instance, a utility person might not read the correct value of the total energy consumed that isdisplayed on the energy meteror may intentionally give lower value than exactly read one [3]

Drawbacks of regular energy meter:

- Mainly depends on meter reader
- Human error cannot be avoided
- No chance of cross checking or recheck of human readers
- High chance of stealing and bribery always high to misuse it especially during events
- Possibility to change the readings
- More number of employees is required is extra expense to the government
- When meter is installed inside the home, there may be chances of non-checking of reading
- The consumer does not receive the energy bill as per regular interval of his due date

B. Proposed system

A smart energy meter works on communication directly with wireless data protocol, so there will be precise reading. There is 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.

- User new smart energy meters send power reading on a regular interval in sequence about customers energy usage to electricity provider. The bills will be proper. Labor cost is reduced.
- If the consumer did not pay the energy bill within time, it remotely disconnect the remotely disconnect the service of a particular consumer and after payment, the service continues to the consumer. So, we avoid sending an employee to cut off energy from the network and again to reconnect their connection.
- We have connected lever switch for tampering attempt detect. When power disturbance occurs, SSR disconnect and re connect the supply

The proposed system consists of digital energy meter, an Arduino GSM modem and SSR. After switching power on the Arduino and the GSM modem, turn on the SSR and connects the energy meter to load via SSR then read the EEPROM and display the current data. Arduino checks the readings from voltage and current sensor a PT and CT respectively. By incorporating microcontroller in to protective relays there are more flexible and remote operations are possible, like by shutting down the equipment under fault conditions with the help of radio communication [4].
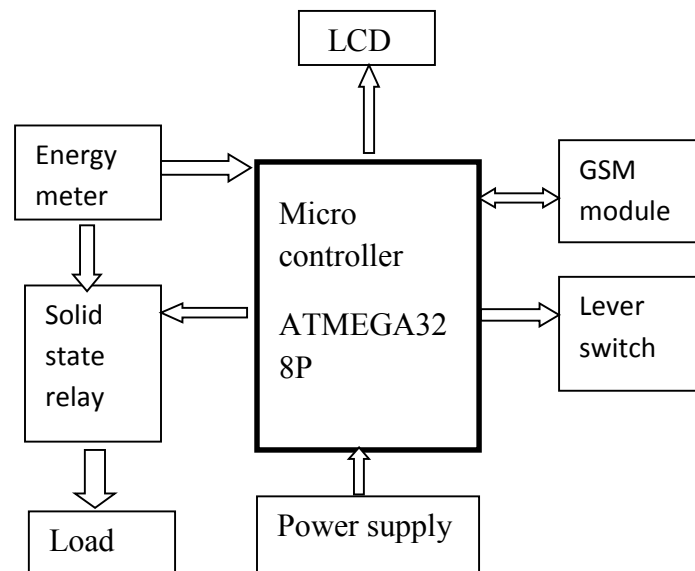
Figure.1   Block diagram of smart energy meter

If there is any difference between CT's connected in phase and neutral line then Arduino turns OFF the relay and sends SMS to the service provider. Also, this Arduino helps the utility for power disconnection when the bill is not cleared by the customer. From customer point of view their monthly usage will be updated properly with their bill. SSR will be used as a protection from over voltage and voltage fluctuations in the power system. The Smart energy meter consists of three main parts

1) Voltage and current measurements

2) Power factor measurements

3) GSM portion. [5]

III.   SYSTEM ARCHITECTURE

The system architecture of Arduino and GSM based smart energy meter is shown in the fig. the energy consumption is being calculated using the energy meter IC and Arduino. In order to prevent a power theft, detection program is present in the Arduino. Arduino and GSM based smart energy meter IC, LCD, Arduino, GSM modem, relay, opt coupler, lever switch, display unit and power supply unit etc. Potential transformers are also called as voltage transformers. It is usually step-down transformers with very accurate turns ratio. A standard measuring device used to measure the change in high magnitude to lower voltage for step down transformer. It works in technique with more number of primary turns and less number of secondary turns. Higher value voltage and current cannot be measured directly. so we need one voltage sensor and two current sensors for the proposed system.

The term Personal Communication Services (PCS) refers to a wide variety of wireless access and personal mobility services provided through small terminals with the goal of enabling communications at any time, at any place and in any form [7]. Here the PCS is achieved by the usage of GSM

Figure.2 12V distribution transformer

To connect and disconnect the supply a relay is used. To blow away the various disadvantages for the electrical relay, alternative relay type called a solid-state relay or SSR can be established which a solid state contactless, pure electronic relay.

Figure.3 SSR – 40A

"The SSR is completely an electronic device which has no moving parts with its design. The mechanical contacts have been replaced with power transistors parts, thyristors or triacs. The electrical partition between the input control and the output load voltage is adept with the opt coupler the Light Sensor [6].

However, being a semiconductor device, the must be anchored onto perfect heat sinks to avoid expected output switching semiconductor device from overheating.
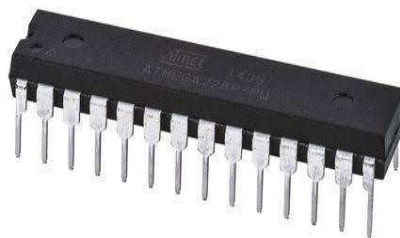

Figure.4 AVRRISC-based microcontroller

"The high-performance Atmel picopower 8-bit AVRRISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purposes I/O lines, 32 general purpose working three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART [8]
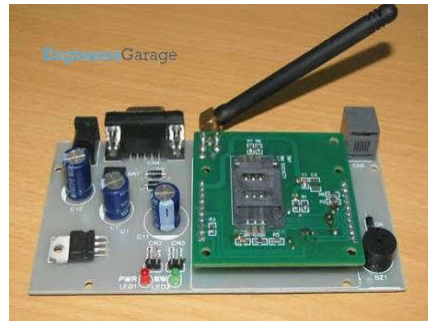
Figure.5 Prototype model

GSM/GPRS module establishes   communication among a computer & GSM-GPRS system. System for Mobile communication (GSM) is a structural design used for mobile cellular communications in most of the countries. GSM modem possesses together with power supply and communication interfaces for the computer. The MODEM is the soul of such modules.

IV.   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 in no energy measured in the meter [9]. A major feature of smart energy meter is that utility company can cut off and reconnect the connection of energy of any user with the help of SMS without sending the person to perform the task manually [10]
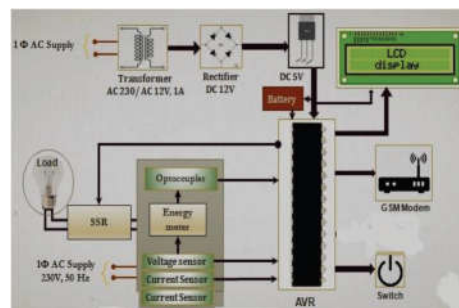

Figure.6 Circuit diagram of smart energy meter

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 centre through GSM modem. Lever switch provided to detect the physical disturbance such as tampering given to the smart meter. To track down the unauthorized loads tapped before the meter is beyond the scope of this proposed concept.

V.   SOFTWARE REQUIREMENT

Arduino programs are used to write in any programming language with a compiler concept that produces executable binary machine code. Atmel afford an improvement of this environment for proposed system's

microcontrollers, AVR studio and the newer Atmel studio. The Arduino development using project with IDE works on cross platform application concepts in Java. IDE isauseful for beginner of any programming languages. Arduino programmer called as sketch. Arduino library most useful to add many readymade predefined inputs to our project. It supports c and c++ using special organize code

"A typical Arduino C/C++ sketch consists of two functions that are compiled and liked with a program stub main () into an executable cyclic executive program:

Setup (): is used for initializing settings which run one time at the start of a program.

Loop (): is used to run the same function multiple times till the board powers off." [11]

VI. CONCLUSION

This paper is the combined hardware advantage for both utility and the customer. Arduino, SSR, and GSM stationed Energy Meter for smart metering, power theft detection, and voltage 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 through SSR. In the case of power theft, defaulter meter line cutting/joining labour 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 labour work and human error in the distribution system and also protect the consumer equipment.

VII. REFERENCE

[1]. S.Visalatchi and K.Kamal Sandeep "Smart Energy Metering and Power Theft Control using Arduino and GSM," proceedings of the 2017 *2nd International Conference in Technology(I2CT).*

[2]. Vinu V Das, "Wireless Communication System for Energy Meter Reading" *International Conference on Advances in Recent Technologies in Communication and Computing 2009.*

[3]. K.Ashna, Sudhish N George, "GSM Based Automatic Energy Meter Reading System with Instant Billing" *978-1-4673-5090-7@2013 IEEE.*

[4]. Sarfaraz Nawaz Syed, S.Radhika and M.N.Sandhya Rani(2015) "Differential Current Protection of Transformer using Arduino with Voice Alert" *International Journal of Innovatins in Engineering and Technology (IJIET).*

[5]. H.M.Zahid Iqbal, M.Waseem, Tahir Mahmood, "Automatic Energy Meter Reading using Smart Energy Meter," proceedings of*International Conference on Innovation in Information Technology (IIT)2012.*

[6]. Vanishree K Rao, Sri G N Madhu," GSM based Energy Meter Reading and Billing" proceeding of *International Journal of Science and Billing, Volume 5 issue 8, August 2016.*

[7]. Nabil Mohammad, Anomadarshi barua, Muhammad Abdullah Araft, "A Smart prepaid energy metering system to control electricity theft" in proceeding of *International Conference on Power, Energy and Control(ICPEC), vol.562, no.565, pp.6-8, Feeb.2013.*

[8]. Tarek Khalifa, kshirasagar naik and Amiya nayak "a survey of communication protocols for automatic meter readings "in*IEEE communication surveys and tutorials, vol3, no2, second quarter 2011.*