

An Advanced Methodology for Automated Power Theft Detection

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ABSTRACT

In countries like India, energy theft is a common problem as the consumers of energy are consistently increasing due to the increase in population[1]. The newly designed Automatic meter reading (AMR) used for energy measurements reveals the concept and working of new automated power metering system but this increased the electricity theft forms because the checkout at the consumer residence is not done at regular intervals[2]. The focus of this article is to create a system which would significantly reduce illegitimate use of electricity and possibility of theft. In this paper, a new technique is adopted which is based on infrared (IR) sensor in conjunction with Microcontroller and Global system for mobile (GSM) module to detect and control energy meter from any kind of tampering and providing details to authorized company. This system continuously monitors the reading and theft detection that can be seen on the Liquid crystal display (LCD).

Keywords-AMR, IR sensor, Microcontroller, GSM (Global System For mobile)

1. INTRODUCTION

The invention of electricity is one of the greatest wonders of science. This mostvaluable gift of science has proved to be a boon to mankind. But the use of this energy by an unauthorized person causes loss. A loss of over 25-30% is faced by the power sector of the country. The main reason is the human element involved in the reading of the meters and also the easy accessibility of the meters to the consumers, a large number of whom tamper with it[3]. A solution to this problem would be done with a set of technologies called automated power theft detection.

A single phase digital energy meter based on a microcontroller is presented in this article. Power theft detection system based on GSM modem provides a cost effective, reliable and interferencefree data transfer between

consumer and authorized company. This paper proposes a detection system of electricity theft made by energy meter tampering.

Digital energy meter, microcontroller, GSM, relay, and LCD are some important constituents of the proposed system. Here we are using an ATmega16 as microcontroller to control the whole mechanism to detect the power theft.

For any kind of meter tampering, the energy meter must be opened. An IR sensor is placed inside the energy meter with LED as a transmitter and photodiode as a receiver. Whenever there is any attempt to open the energy meter, the IR sensor got activated and sends signal to the microcontroller. ATMEGA16 controller sends signal to the relay for isolating/cutting the power supply and GSM sends an alert wirelessly to remote power station.

2. EXISTING SYSTEM

• Electricity Theft Detection Using Magnetic Sensor

In this existing system, magnetic sensors are used to detect power theft. Magnetic sensor is based on Hall Effect, so it is also called Hall Effect sensor. Hall Effect is based on the interaction between an external magnetic field and moving electric carriers. In this existing system, there are some demerits of magnetic sensors. We can conclude that, it can be stated in that approach, in which two or three hall sensors are used, severe technical standard for this application could full fill only with-

- Increased system cost
- A high power consumption
- An inflexible system

The another demerit of the designed meter is sensitive with respect to tampering events, so while tampering continuously indicating tampering which reduced speed of energy calculation which introduce large error. To overcome this demerit, in our project theoretically, once theft detected by the system, relay will cut off the power supply to the load until authority maintenance[4]. Practically, in project we keep a reset button to reset the controller from theft condition to normal condition for showing project work.

• Electricity Theft Detection Using Zigbee

In this existing system the theft is detected when consumer tampers the meter by by-passing it. The fuses at either side of meter are directly connected through a conducting wire hence the meter will be completely bypass that actuates voltage sensor, then the meter tampering signal is given to microcontroller[5].

The main disadvantage of this system is that zigbee is used for wireless communication. The coverage is limited and hence cannot be used as outdoor wireless communication. The transmission rate of zigbee is low. The risk is very high to use it for official private information. It is not a secured system. It is very costly to replace appliances containing zigbee. It requires high maintenance, is very expensive and has less frequency range.

- **Electricity Theft Detection Using Vibration Sensor**

In this system, tampering detection system for electric meter is done by the use of vibration sensor. Vibration sensor is used to detect any changes in the position axis of the meter. Vibration sensor works on vibration measurement[6]. There are many components in vibration measurement which makes it complex. The components of vibration measurement are velocity, displacement, frequency and acceleration.

- **Electricity Theft Detection Using Lever Switch**

In this system of theft detection, at the opening of the meter, a lever switch is used to protect the electric energy meter from theft attempt. The pin of the ARM processor is configured as pull down and the lever switch is connected to interrupt pin. 3.3V is applied to the interrupt pin by the closed switch and the voltage is driven to zero by the open switch. When the meter cover is closed, the switch is normally closed. The interrupt pin turns voltage to 0V as the switch is opened when someone tries to tamper the electricity energy meter. The ARM processor instantly sends AT command to GSM, the GSM then sends the SMS[7]. There is a demerit of lever switch. It is a mechanical switch which is not reliable. If once it is turned on, it would come back in off position manually.

Limitations of Existing System:

- Practical implementation issues
- Lower detection level
- Can be easily tampered
- Complex implementation
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3.PROPOSED SYSTEM

Our proposed approach deals with the tampering detection system for electric meters. If power theft is done, the SMS will be immediately sent to the authorized company to take further action. IR sensor is used to detect theft. The placement of IR sensor is on the screw part of energy meter. Once the meter starts, if any tampering is done, the report will be immediately sent to the authorized company. We use GSM modem to send SMS. Relay cuts the power supply and buzzer turns on. LCD display- "METER TAMPERED". When there is no theft, LCD displays the energy consumed. These are all controlled by the microcontroller. Embedded C is the programming language used here.

4. DESCRIPTION OF BLOCK DIAGRAM:

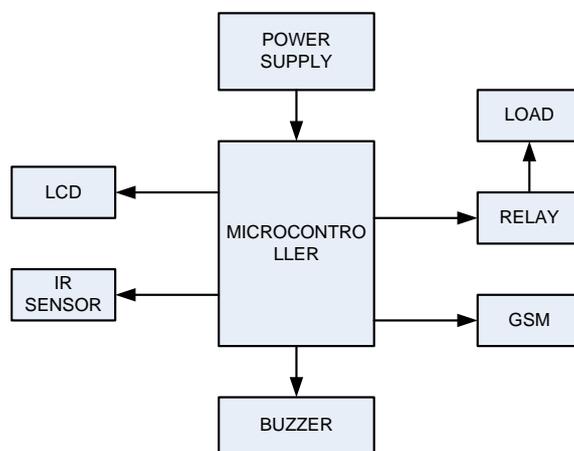


Fig.1. Block representation of proposed configuration

MICROCONTROLLER

The controller ATmega16 is the main part of this project. It controls all the functions. In mega AVR category of AVR family, ATmega16 lies and ATmega16 is a 40-pin IC. In the family of Reduced Instruction Set Computer (RISC), lies AVR, a 8-bit microcontroller. The instruction set of the computer in RISC architecture are not only lesser in number but also simpler and faster in operation.

POWER SUPPLY

We get a desired DC voltage to run the other circuits from a circuit known as power supply. The other components of our circuit require 5V DC but the voltage we get from the main line is 230V AC. To get 12V AC, a step-down transformer is used. 12V AC is later converted to 12V DC using a rectifier. Some ripples are present in the output of the rectifier. It is called as Pulsating DC as it is a DC signal. To remove the ripples and obtain smooth DC, power filter circuits are used. Here a capacitor is also used. The 12V DC is rated down to 5V using a positive voltage regulator chip 7805. Thus a fixed DC voltage of 5V is obtained.

IR SENSOR

When the seal on the energy meter is being tampered by any person, microcontroller receives a signal from the IR sensor and through GSM modem, it would send a message to authorized company. In this, we are using an active IR sensor. Active IR Sensors are the type of IR Sensors that employs an IR source & IR detectors (emitter & receiver). Both an IR source and an IR detector are placed in a single housing in this type of sensors in such a way that light from emitter LED bounces off an external object and is reflected into a detector.. It depends upon the reflectivity of the surface that how much light is reflected into the detector.

It consist of a pair of IR sensors;

- Transmitter
- Receiver

The transmitter transmits the IR signals & the receiver receives the IR signal. In both night and day operation, active IR sensor provides count, presence, speed, and occupancy data.

Global System for Mobile communication (GSM)

Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. The widespread use of GSM throughout the world works as its advantage[8]. Its extensive coverage lies between 35Km to 120Km. The global system for mobile communications allows reliable and efficient data transfer. A fully digital system, security against fraud, enhance privacy, support of short message service (SMS) are the characteristics of GSM. The above circuit describes that in the case of power theft, microcontroller would receive a signal from the IR sensor and through GSM, the microcontroller would send a message to authorized company. This implementation helps to control theft very quickly and easily.

RELAY

Relay is an electromechanical switch. Relays have three main parts- relay coil, movable plunger and contacts. Relay works in two modes, first is normal mode and second is excited mode. There are two contacts in relay, normally open and normally closed. When supply is given to the relay coil, then the magnetic field is induced in the relay coil. Due to magnetic field movable plunger get attracted towards the relay coil. Due to this movement of plunger the contacts gets changed. The normally open contacts turns normally close and normally closed contact turns normally open. To connect and disconnect the supply, a relay is used. When theft is detected, microcontroller gives signal to the relay to cut off the supply to the load.

LCD

The display used in this proposal is 16x2 LCD (Liquid Crystal Display); this means 16 characters per line by 2 lines. When theft is detected, microcontroller sends signal to LCD to display "THEFT DETECTED". When there is no theft in energy meter, the LCD will display energy consumed.

BUZZER

A buzzer or beeper is an audio signaling device. When theft is detected, microcontroller gives signal to the buzzer to turn on. If theft is occurring, buzzer gives an alarm so that quick action is taken against electricity theft.

LOAD

The types of electrical loads are typically divided into three categories:

- Resistive

- Inductive
- Capacitive

Load can be of any type, it can be any home appliances used in our daily life. In this project we are using two bulbs. The bulb is a commonly used resistive load.

ADVANTAGES OF PROPOSED SYSTEM

- Real time implementation is possible
- Lesser complex design
- High accuracy
- Low power consumption
- Flexible system

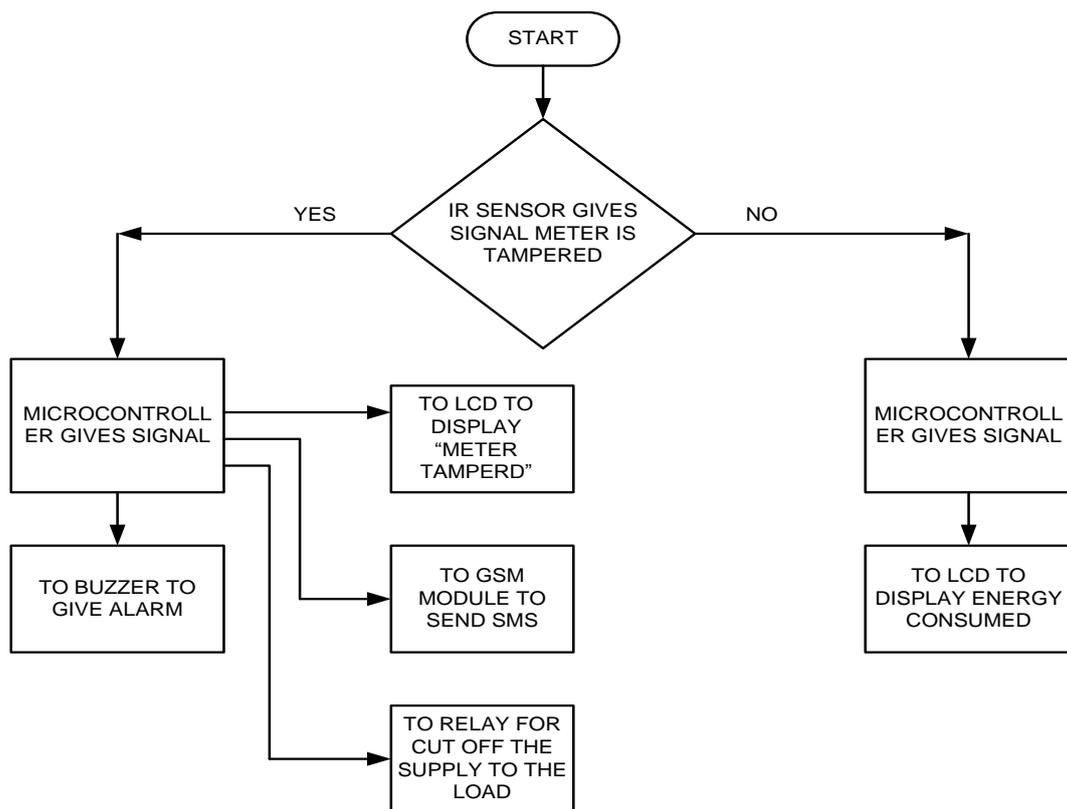


Fig. 2. Flow chart of the proposed system

5.HARDWARE IMPLEMENTATION:

The hardware implementation of power theft detection is to design such a system which will automatically detect the theft using IR sensor. Microcontroller is used to control all the functions. IR sensor senses the power theft and gives the signal to the ATmega16.

Then microcontroller gives signal to GSM, relay, LCD and buzzer.

- GSM modem sends SMS to authorized company.
- Relay cut off the power supply.
- At the same time buzzer turns on indicating that theft detected.
- LCD displays “METER TAMPERED” at the time of theft.

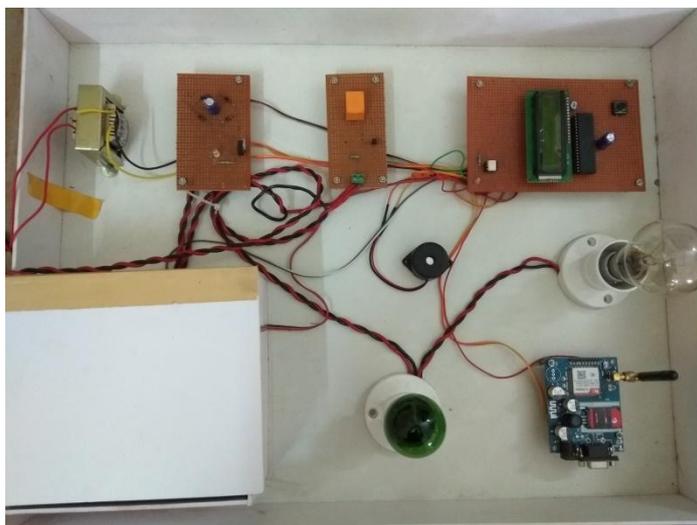


Fig. 3. Hardware implementation of the system

6. CONCLUSION

The proposed system sends instant alert to the authorized power supplier when there is any kind of meter tampering detection. This system model would reduce the manual manipulation work and electricity theft. Use of GSM modem in this system provides an added advantage of wireless communication. The use of IR sensor in place of mechanical liver system, vibrational sensor or magnetic sensor is definitely a new approach to reduce the complexity and cost of the system. This system will help the government to reduce electricity theft and thereby increasing their revenue and power quality of the grid. The manufacturer cost is marginally greater than the existing system but when it will be implemented commercially then the cost will reduce significantly by two to three times.

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