Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 05, May -2018

POWER THEFT DETECTION BY USING GSM

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Abstract—*As a part of measure to make electricity accessible to every Indian, to overcome the problem of overbilling, meter tempering and to ensure a cost effective operation, we have introduced the Prepaid Electricity System. The user receives message on their mobile phones about the units they purchased via GSM technology. Mikro C PRO for PIC software is used for controller programming and Proteus is used for simulation purposes. The data was sent through the serial ports to the user energy meter. The PIC microcontroller detected how much units the user have purchased and the relay was switched accordingly. When the units purchased became equal to the units consumed, the relay performed its function by switching off the electricity system. The warning message was sent to user mobile through GSM technology before the disconnection of electricity. Hardware model is also designed using GSM module. The theft detection of electricity also became possible by using this system through which server received the message when users by passed the meter.*

Keywords-*GSM prepaid electricity system; theft detection system; prepaid electricity system*

1. INTRODUCTION

In utility distribution system, electricity metering plays an important role, as it measures the electricity consumption of users and generates bill, which is a source of revenue [1]. Over the years, the Electricity Companies were using the conventional credit metering and billing system which was much time consuming system. It was discovered that this system also faced much problems including incompetent monitoring of consumption, wrong meter reading, unproductive revenue collection and useless energy use. So the scientists started to identify technologies which may become useful and easier for consumers to pay for the services [2]. In the developing countries, electricity theft has raised as a serious problem in power sectors. A great amount of profits lost due to electricity theft. In some countries it has become such a severe problem that the governments are facing losses instead of revenue. Due to this financial loss the shortage of funds occur for investment to expand the existing power capacity and due to which governments become failed to satisfy the ever enhancing demand of electricity [3].

Electric utilities lose large amounts of money each year due to fraud by electricity is vital for our everyday life and a backbone for the industry. Therefore, the concept of the future networks (smart grids) aims to increase the reliability, quality and security of supply for the future. In order to do so, this will also require more information about the operation and the state of the distribution networks. One of the key challenges in the future distribution networks will be the increasing penetration of distributed generation (DG) connected at customers' premises and the shift from the traditional electricity generation concept with dominating large central power plants and unidirectional power flows to more complex power delivery. The operational information will be crucial for the functionality of the future distribution networks and for the distribution network operators (DNO). One of the information sources is going to be the smart metering (SM) infrastructure. Among others, the smart meters should enhance the customers' awareness about electricity. The concept is also going to bring more information to the DNOs. This enables the possibility for the grid operator to analyse the power flows and to detect possible theft of electricity. The problem of illegal electricity abstraction is of interest to the DNOs. The users often violate the law by electricity tampering attempts. In some countries only part of the electricity generated is billed, *inter alia* in India 55% of generated electricity is billed (and only part of the payment reaches the supplier). However, the illegal use of electricity takes place also in European countries. One of the drives for the roll-out of automated meter reading (AMR) infrastructure for the Italian electricity utility (ENEL) was the very endeavour to minimize the non-technical losses (electricity tampering) in their distribution network. The reduction of electricity tampering has helped to justify large investments in AMR and currently Italy is a leading country with high penetration of AMR [1], [2]. The tampering attempts have a variety of forms; they usually take place on meter alone, at a cut out, at meter terminals or on meters' cables. The illegal use is also a serious problem in the Netherlands. The estimated losses due to illegal use represents about 1200 GWh/year and DNOs predict average one electricity tampering attempt at half of the medium to low voltage (MV/LV) substations. Theoretically, the detection of illegal use of electricity should be easily feasible. However, due to the heavy workload on the human resources and large amount of branches in the distribution network, the current methodologies generally focus more on indirect theft detection. Moreover, some of these methodologies are not easy applicable for all customers [3], [4], [5], [6]. The automated detection of the electricity tampering should be an important factor in deployment of the future distribution

networks and in the standardization of SM infrastructure. Therefore, a novel technique is proposed and its experimental results are discussed in the paper. The structure of the paper is as follows: the issue of electricity tampering as an economical problem is addresses in section II. The current practices and experiences with theft detection are presented in section III and the proposed methodology using SM is described in section IV. The requirements on SM and the future distribution stations are highlighted in section V.

2. PROPOSED SCHEME

A smart energy meter works on communication directly with wireless data protocol, so there will be precise reading & there's 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 of smart energy meter such as:

- User new smart energy meters send precise reading on a regular interval in sequence about customer's energy usage to utility (Electricity provider). So the bills will be proper and labour cost is reduced for taking a reading in consumer residents.
- If the consumer did not pay the energy bill within time, the utility can remotely disconnect the service (line) of a particular consumer and after payment, the service continues to the consumer. So we can avoid sending an employee to cut off energy from network and again to reconnect their connection.
- We have connected lever switch for tampering attempt detect. When anyone tries to open the meter cover the button will release and send information to the service provider.
- When the power quality is not maintained from the distribution supply, then the customer equipment can be protected by disconnecting and reconnecting to the supply by SSR.

3. SYSTEM ARCHITECTURE

The system architecture of Arduino and GSM based smart energy meter is shown in the Fig. 1. 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. Ardui no and GSM based smart energy meter can be divided into several parts as Energy Meter IC, LCD, Arduino, GSM modem, Relay, Optocoupler, Lever switch, Display Unit and Power Supply Unit etc. Power Supply Unit etc.

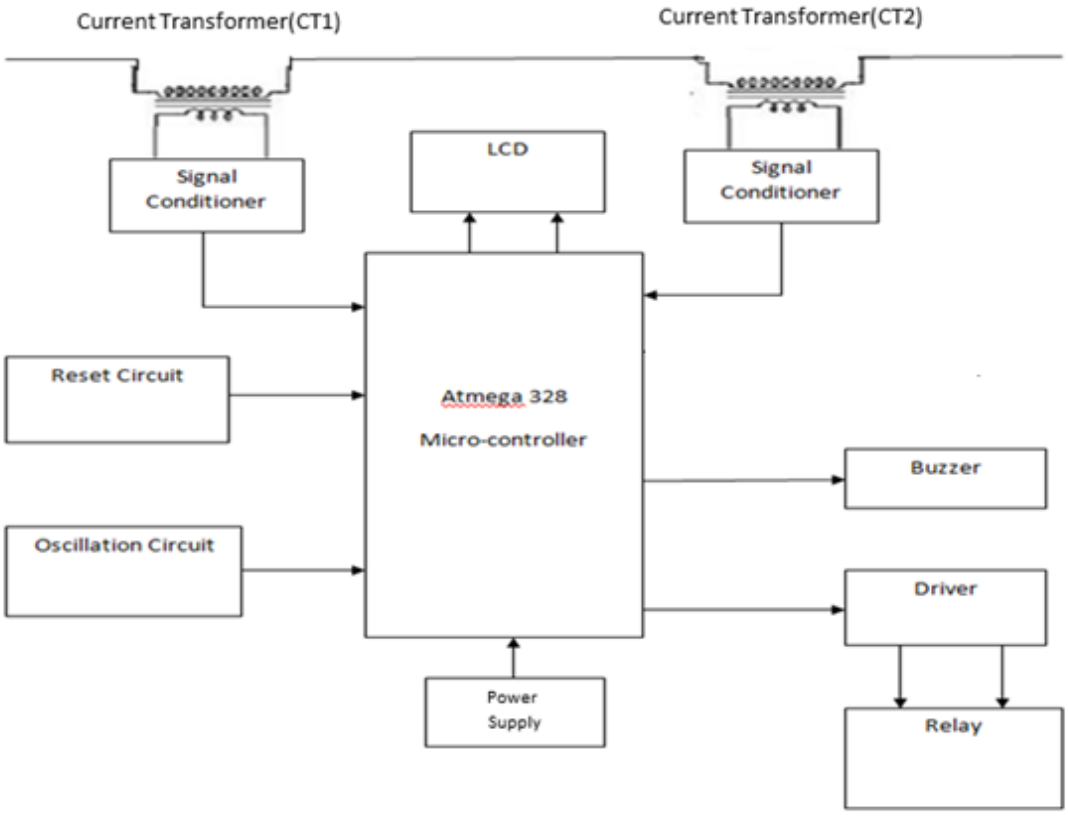

Fig-1: Architecture Diagram

Potential transformers are also called as voltage transformers. It is fundamentally step down transformers very accurate turn's 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.

Fig.2: Voltage Transformer

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Fig.3: Solid State Relay

To connect and disconnect the supply a relay is used. To blown away the various disadvantages for the electrical relay, alternative relay type called a Solid State Relay or (SSR) can be established which is a solid state contactless, pure electronic relay. "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 triac's. The electrical partition between the input control and the output load voltage is adept with the optocoupler type Light Sensor."[3] However, being a semiconductor device they must be anchored onto perfect heat sinks to avoid expected output switching semiconductor device from overheating.

Fig.4: MICROCONTROLLER Atmega328P

"The high-performance Atmel picoPower 8-bit AVR RISC-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 registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART"[4]

Fig-5: GSM Module

"GSM/GPRS module establishes communication among a computer & GSM-GPRS system. Global System for Mobile communication (GSM) is a structural design used for mobile cellular communication in most of the countries. GSM modems possess together with power supply and communication interfaces (like RS-232, USB etc) for the computer. The MODEM is the soul of such modules is Sim900A-RS232" [5]

4. PERFORMANCE ANALYSIS

4.1 Programing

```
// EmonLibrary examples openenergymonitor.org, Licence GNU GPL V3
#include <LiquidCrystal.h>
// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(3, 4, 5, 6, 7, 8);
#include "EmonLib.h"                   // Include Emon Library
EnergyMonitor emon1;                   // Create an instance
EnergyMonitor emon2;
int tr=9;
int buz=A5;
void setup()
{
pinMode(tr,OUTPUT);
pinMode(buz,OUTPUT);
Serial.begin(9600);
lcd.begin(16, 2);
// Print a message to the LCD.
lcd.print("Welcome CSMSS");
emon1.current(0, 111.1);             // Current: input pin, calibration.
emon2.current(1, 111.1);
delay(2000);
lcd.clear();
lcd.print("Guided BY:");
lcd.setCursor(0,1);
lcd.print("Prof.C.V.Rahane");
delay(2000);
}
void loop()
{
digitalWrite(buz,LOW);
digitalWrite(tr,HIGH);
emon1.current(0, 11.1);
double Irms = emon1.calcIrms(1480);  // Calculate Irms only
emon1.current(1, 11.1);
double Irmss = emon1.calcIrms(1480);
float diff=Irmss-Irms;
lcd.clear();
lcd.begin(16, 2);
lcd.print("I1=");
```



```
lcd.print(Irms);
lcd.print("I2=");
lcd.print(Irmss);
lcd.setCursor(0,1);
lcd.print("P=");
lcd.print(Irmss*250);
delay(2000);
if(diff>=0.50)
{
lcd.clear();
lcd.print("Sending SMS.....");
digitalWrite(tr,LOW);
digitalWrite(buz,HIGH);
Serial.println("AT+CMGF=1");
delay(1000);       // delay in between reads for stability
Serial.println("AT+CMGF=1");
delay(1000);
Serial.println("AT+CMGF=1");
delay(1000);
Serial.println("AT+CMGS=\"+919503041644\""); //set the phone number
//SendMessage("+919970979603","Sir, Your Water tank LEVEL is FULL and so The Moter is kept OFF
Thank YOU      From Automatic Water LEVEL Controller");
delay(1000);
Serial.println("Attention Power Leakage Noticed in Your Distribution Line");
delay(500);
// Serial.println(26,BYTE);
Serial.write(26);
delay(5000);
lcd.clear();
lcd.begin(16,2);
lcd.print("making Call.....");
Serial.println("ATD9503041644;");
delay(16000);
}
}
```

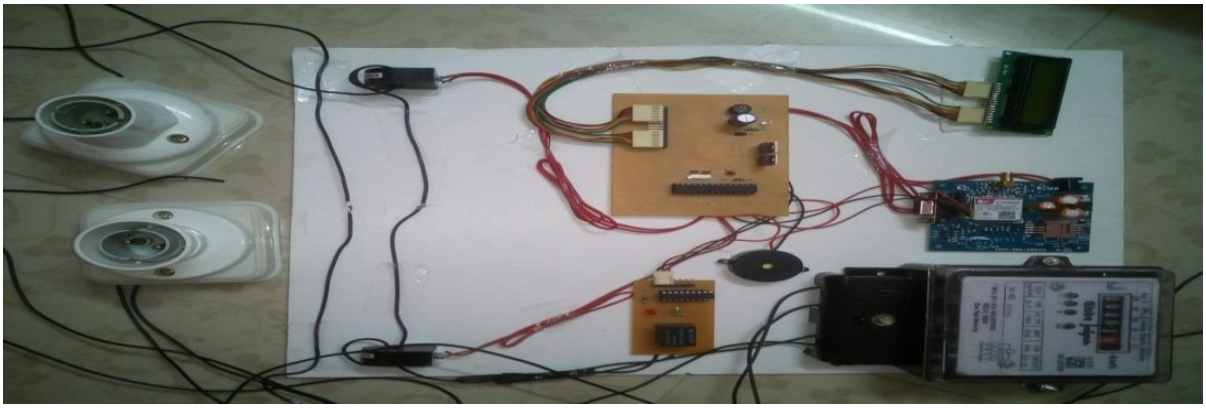

Fig 6 Actual Model with Control Circuit

5. SYSTEM SCOPE

A. Advantages:-

- This method will reduce the energy wastage and save a lot of energy for future use.
- We can detect the location from where the power is being stolen which was not possible before.
- Real time theft monitoring
- The system consumes very little power for its operation.
- System operation is independent of time (24 hours functioning).

B. Limitations:-

- Wide range of frequencies is required to facilitate large number of users. To overcome this, carrier levels can be changed from region to region.
- Presently, it requires a power supply (230 V) for the operation, but a small battery with automatic charging facility can be provided in real time.
- Cannot determine who is stealing, but even no other existing system is capable of doing this.
- If implemented on a large scale it may take lot of time and manual input.

C. Applications :-

- The system can be incorporated for almost all types of users.
- The concept is well suited especially for villages and interior areas.
- It can be implemented in malls where huge amount of power is wasted.
- It can also be implemented in schools and collages

6. 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 labor work and human error in the distribution system and also protect the consumer equipment.

Theft detection based prepaid electricity system is designed. On the other hand customers get rid of over billing and wrong meter reading problems. The primary preferred standpoint of our undertaking is that electric supply organization gets most extreme income for the power gave by this innovation and robbery location is likewise conceivable. Accordingly this innovation ought to be actualized in such Countries where income gathering and power thefting are significant issues.

7. FUTURE SCOPE

- The project model reduces the manual manipulation work and theft.
- The government saves money by the control of theft in energy meter and also
- More beneficial for customer side and the government side.
- Cost wise low when compared to other energy meter without automatic meter reading and theft control.
- This method will reduce the energy wastage and save a lot of energy for future use

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