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Smart Energy Metering and Power Theft Control using 8051 & GSM

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ABSTRACT
Project aims in meter reading consumed by each home through SMS without visiting the customers home every month for billing. Digital energy meter is replaced by smart energy meter. Leakage of electricity due to tapping can be detected through energy meter. If energy meter is tapped by the customer then a SMS is sent to the electricity board. Based on the electricity consumed in each home bills are prepared as per the latest tariff and bill to be paid is sent through SMS, If customer fails to pay the bill within the scheduled time then warning message will be sent. Even after warning message if customer fails to pay the bill power supply will be detached for the particular customer home and same message is sent to the customer. Sensors are used in between the spindle of the energy meter with the help of opto-coupler. For every rotation the pulse is generated and the same signal is sent to the microcontroller. The microcontroller keeps the track of the meter reading. The microcontroller is interfaced to the GSM modem for communication purposes like reading the meter, information about tapping and to detach the power.

Keywords: GSM, Power theft, Smart meter, Power monitoring, Tapping, Billing.

I. INTRODUCTION

A Smart Energy Meter system based on GSM is presented in this paper. Microcontroller can be used to monitor and record the meter readings. In case of customer defaulter, no need to send a person of utility to cut off the customer connection. Utility can cut off and reconnect the customer connection by short message service (SMS). Furthermore, the customer can check the status of electricity (load) from anywhere. In this system energy meter readings are being transferred with the help of GSM.

This system enables the electricity department to collect the meter reading every month without the meter reader visiting customer house. This can be done with the help of microcontroller unit which continuously monitors and records the energy meter reading from its permanent memory location.

II. EXISTING SYSEM

Existing energy meters are of electromechanical induction type and electronic meter type. In electromechanical induction meter, the total number of rotation of the aluminium disc is directly proportional to the power consumed.

Electronic meter shows the consumption of power, power factor, the reactive power used and it is digitally displayed on LCD or LED display. It is a single way of communication.

In existing system, there are no possibilities to stop or minimise the power theft.

III. PROPOSED SYSTEM

A smart energy meter works with communicating 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. The merits of smart energy meter are as follows:

- ✓ 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 bill payment, the service will be provided to the consumer. So sending an employee to cut off energy from the network and reconnecting can be avoided.
- ✓ Lever switch is connected for detection of tampering. When anyone tries to open the meter cover the switch will be released and same information is sent to service provider.
- ✓ When the power quality is not maintained from the distribution station, then the customer equipment can be protected.

The proposed system consists of digital energy meter, a(microcontroller), GSM modem and SSR. After switching power on the microcontroller and the GSM modem, turn on the SSR and connects the energy meter. Then read the EEPROM and display the current data. Microcontroller 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 phase and neutral line then microcontroller 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, this is a benefit for monitoring their daily/monthly consumption, voltage fluctuation .

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IV. SYSTEM ARCHITECTURE

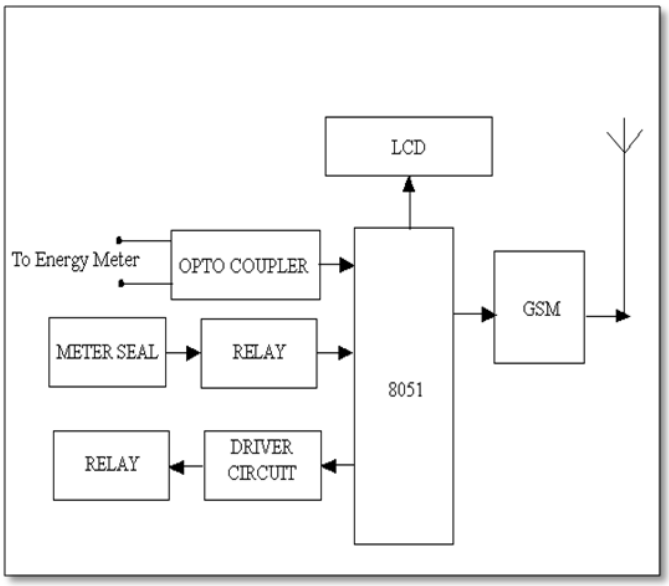

Figure 1. System Architecture

a. DIGITAL ENERGY METER

The output of digital energy meter is fed to the opto-coupler to pin number 1 and 2. For each rotation a pulse is generated in the digital energy meter. This pulse makes the LED to glow in the opto-coupler. When the LED glows the light falls on the phototransistor. Phototransistor conducts and low pulse is generated, which is then applied to microcontroller (89s52). Now the microcontroller reads the pulses coming from the Digital Energy Meter and displays the unit readings on the LCD interfaced to the microcontroller.

b. OPTO-COUPLER

MCT2E is an optocoupler integrated circuit in which light emitting diode drives a phototransistor. They are also known as optoisolators since they separate two circuits optically. These are used to couple two circuits without any ohmic contact. They allow one of the circuits to switch another one while they are completely separate. The first circuit is connected to LED while the other circuit with the phototransistor. The isolation ensures that no damage occurs in either of the circuits while the other one has a fault. An opto coupler is analogous to a relay which isolates two circuits magnetically. They differ with relays in the sense that they are smaller in size and allow fast operation. MCT2E's are commonly used in interfacing an electronic circuit to produce pulse to the microcontroller.

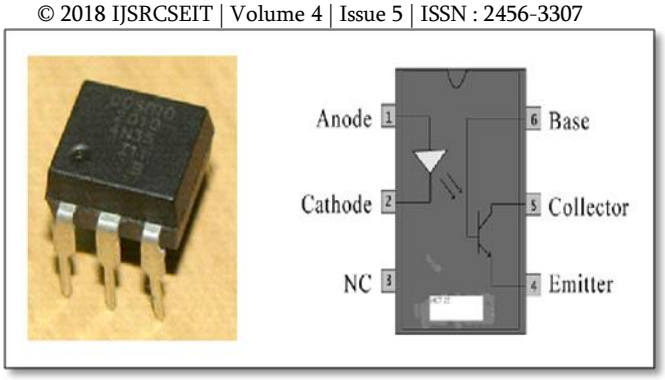

Figure 2. Opto-Coupler

c. MICROCONTROLLER

Microcontroller is the central component which controls all the activities like reading data from the card and displaying information on LCD(Liquid Crystal Display), controlling the door. In order to do all the activities a program (sequence of instruction) must be written for the microcontroller. This program is called firmware. In order to execute the program, Microcontroller requires basic configuration like 5V regulated power supply, clock, and reset circuit.

16*2 (2 line of 16 character) LCD is used for displaying status. It provides easy user interface. It needs to initialize before displaying data. This initialization is done by Microcontroller.

ATMEL AT89S51 is used in the project. This particular microcontroller is chosen because following features.

1. 4K Bytes of In-System programmable flash memory.
2. Compatible with MCS®-51 Products
3. 4.0V to 5.5V Operating Range
4. Fully Static Operation: 0 Hz to 33 MHz
5. 128 x 8-bit Internal RAM
6. 32 Programmable I/O Lines
7. Low cost.

d. DRIVER CIRCUIT

ULN2003 is a high voltage and high current Darlington array IC. It contains seven open collector Darlington pairs with common emitters. A Darlington pair is an arrangement of two bipolar transistors.

ULN2003 belongs to the family of ULN200X series of ICs. Different versions of this family interface to different logic families. ULN2003 is for 5V TTL, CMOS logic devices. These ICs are used when driving a wide range of

loads and are used as relay drivers, display drivers, line drivers etc. ULN2003 is also commonly used while driving Stepper Motors. Stepper Motor interfacing is done using ULN2003.

Each channel or Darlington pair in ULN2003 is rated at 500mA and can withstand peak current of 600mA. The inputs and outputs are provided opposite to each other in the pin layout. Each driver circuit also contains a suppression diode to dissipate voltage spikes while driving inductive loads.

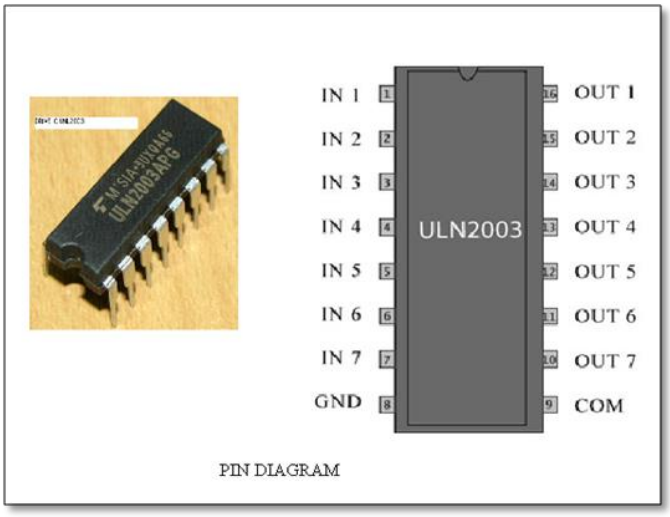

Figure 3

Here in this project relay is driven with the help of driver IC.

e. GSM MODEL

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a microcontroller or computer, this allows the microcontroller or computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS as well as for control applications using GSM.

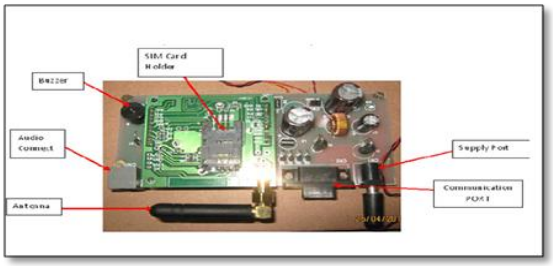

Figure 4. GSM modem

f. HARDWERE USED

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- Power Supply 9V&5V DC: 7809 and7805
- Micro controller: AT89S52-Atmel
- LCD : (Liquid crystal display) 2 x16
- GSM Modem
- Energy meter
- Driver circuits
- Meter seal sensing circuit
- Relays

g. SOFTWARE USED

- Keil compiler
- ISP flash programmer

V. APPLICATIONS

1) To centralize and monitoring the electrical energy meter reading.
2) Tapping of electricity can be prevented.
3) Economy of electric supply board can be increased.
4)Cut the power to home from EB itself, if the bill is not paid

VI. ADVANTAGES

- We can save manpower.
- Taping of electricity can be detected and message is transmitted to substation
- If seal of the meter is opened, it transmits message to the substation
- Time can be saved.
- Economy of electric supply board can be increased.
- In the manual system if the door is locked the bill cannot be calculated.

VII. CONCLUSION

This paper has the hardware advantages for both utility and customer. Microcontroller, SSR, and GSM combined energy meter used for smart metering, power theft detection. Capable of managing and controlling of supply to that meter through SSR. 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 consumer on their mobile. This process will reduce the labor work and human error in the distribution system and also protect the consumer equipment.

VIII. REFERENCES

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