

Design and Development of Energy Meter using GSM

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ABSTRACT

Power theft is the biggest problem in recent days which causes lot of loss to electricity boards. In countries like India, these situations are more often, if we can prevent these thefts, we can save lot of power. Electrical power theft detection system is used to detect an unauthorized tapping on distribution lines. Implementation part of this system is a distribution network of electrical power supply system. This project aims at developing a system which helps in monitoring the readings from an energy meter and controlling the switching of energy meter. This system also has tamper switch, which helps in illegal removing of energy meter cabinet and alerts the authorities in the form of text message. This also sends data to householder in real-time with tamper alert status too.

Keywords: Arduino UNO, power theft detection, energy meter, GSM, LCD, buzzer, relay.

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 occurs 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. 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 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 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 number 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 smart metering infrastructure. Therefore, a novel technique is proposed, and its experimental results are discussed in the paper.

2. PROPOSED METHODOLOGY

With the electric industry undergoing change, increased attention is being focused on power supply reliability and power quality. Power providers and users alike are concerned about reliable power, whether the focus is on interruptions and disturbances or extended outages. Monitoring can provide information about power flow and demand and help to identify the cause of power system disturbances. One of the major challenges in energy meter in recent time is the detection and elimination of electricity theft. However, the previous theft control system is manual. That is moving from house to house in monitoring the power. Other than the loss of revenue to the utility provider, power theft also has adverse effects on consumers and society. It is difficult to obtain data which identifies specific locations where power theft is occurring. A Revenue Assurance and Audit Process are composed of macro functions to detect and analyse revenues involved in illegal consumption of electricity. Periodic inspection of illegal connections involves a lot of labour and strain for vigilant officials. In this project, GSM module is used to transmit the information about power theft to utility company. The main aim of this work is to use the GSM network alongside reducing theft and losses. This also can be used to disconnect the power supply to the house in case of electricity theft. In case of tampering, it can immediately send signal to the central server of the utilities. Another advantage of the GSM is that it enables the utility engineers efficiently plan for network expansion while delivering power to the customer. The controlling device is a Microcontroller. GSM modem, Relay, LCD, tamper switch and energy meter are interfaced to Microcontroller. The microcontroller is programmed such that it sends the energy readings to the authorities by sending simple SMS to the system. It helps controlling the energy meter along with tampering proof facility. The readings are displayed on LCD. The Microcontroller is loaded with intelligent program written using Embedded 'C' language. The modules in the project are:

- GSM modem for establishing communication between system at house and electricity department.
- Energy meter which continuously gives usage details.
- LCD to display current reading of meter.
- Relay to disconnect the power in case of non-payment of bill.
- Buzzer to alert theft detection.

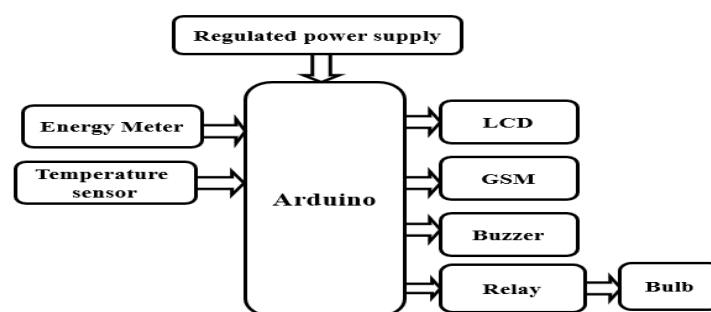


Figure 1. Block diagram of proposed system.

Advantages

- It reduces the manual manipulation work and theft.
- The government saves money by the control of theft in energy meter and 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

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

3. HARDWARE DESCRIPTION

3.1. LCD

LCD is liquid crystal display technology works by blocking light. Specifically, it is made of two pieces of polarized glass that contain a liquid crystal material between them. A backlight creates light that passes through the first substrate. It is used for display purpose.

3.2. Buzzer

A buzzer or beeper audio signalling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

3.4. GSM

A GSM modem is a remote modem that works with a GSM remote system. A remote modem acts like a dial-up modem. The fundamental distinction between them is that a dial-up modem sends and gets information through a settled phone line while a remote modem sends and gets information through radio waves.

4.1. Arduino

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button. Arduino can be used to communicate with a computer, another Arduino board, or other microcontrollers. The ATmega328P microcontroller provides UART TTL (5V) serial communication which can be done using digital pin 0 (Rx) and digital pin 1 (Tx). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The ATmega16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. There are two RX and TX LEDs on the Arduino board which will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328P also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus.

4. CONCLUSIONS

The design, simulation and construction of a GSM-based power theft have been achieved. It has covered various forms of electricity theft which include unaccountability of servicemen, irregularities of billing leading to a reduction of funds by the utility companies has also been achieved as this work

prevents one on one contact between the end user and the workers. With remote monitoring of the meter reading and sending SMS, whenever there are abnormal readings, in the customer electricity meter, the developed system may able to help Utilities to reduce the incidences of household electricity theft. An automatic circuit breaker can be integrated into the unit to remotely cut off the power supply to the house or consumer who tries to indulge in power theft. This system design mainly concentrates on single phase electrical distribution system.

Automation of the customer billing system has been achieved as the meter keeps track of the consumer's load on a timely basis. This design, therefore, removes the manual reading of meters with its attached consequences of time-consuming system and bill manipulation which affects the company while adding higher bills to the consumer. The work also revolves around the automatic disconnection and connection when the recharge is low or high respectively and extra cost due to reconnection can also be removed

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