Smart Meter Billing and Power Consumption Monitoring System using Arduino Microcontroller

Swati Khokale, Patil Kaveri, Patil Nikita

Department of Information Technology,
Sandip Institute of Technology and Research Center, Nashik,
Savitribai Phule Pune University, Maharashtra.
swati.gawand@sitrc.org, kaveripatil127@gmail.com, patilnikita912@gmail.com

Abstract—The technology of e-metering (Electronic Metering) has gone through rapid technological advancements and there is increased demand for a reliable and efficient Automatic Meter Reading (AMR) system. Now days, large amount of electrical power is consumed daily both domestically as well as industrially and energy meters are meant to calculate the consumed energy to facilitate the billing according to the consumption. An employee of Electricity board that is reader travels for a long distance and take reading manually to prepare the bill. The number of electricity consumer is increasing in great extend. Traditional manual meter reading was not suitable for longer operating purposes as it spends much human and material resources going to each and every consumer house and generating bill is a laborious task and require lot of time. Errors may get induced at some stage of billing like errors with electromechanical meter, human reading errors and also while processing the bills. There are many cases where the bill is paid and then is shown as due amount in the next bill. Manual operator can not find unauthorized connection or Mal practices carried out by consumer to reduce or stop meter reading/power supply.

To overcome this pitfalls proposed system introduces new methods for reducing manpower and save the time and also reducing the electricity frauds. Smart meter will be connected to web server through Internet. Smart meter consist of Arduino microcontroller, Relay, Counter, Socket, etc. Arduino port is use to control power consumption and relay will operate the socket. Counter will count power unit. Power supplier will deduct the bill of electric meter through consumer registered bank account which will be optional for those people who don’t have their bank accounts.

Index Terms—Automatic meter reading (AMR), Arduino Port, Electronic Meter(E-Meter) Relay, Counter.

I. INTRODUCTION

An electricity or energy meter is a device that measure the amount of electrical energy consume by a residence, business or an electrically power device. In the traditional system of electrical meter a person from electrical department has to go each house and take the reading from each house’s meter which is time consuming and also need lot of manpower. The scope of the project work is to introduce advanced technology in electrical meter that means in this project work produce the meter reading by power supplier within an area, and Power supplier can also deduct bill of electric meter through his or her registered bank account. For this system, consumer should register their account detail. so that the payment will be deduct from the consumer bank account on time. Hence this meter can be called as electric smart meter. This types of meter communicate directly with your energy supply either via wired connection. Smart meter can be install at each and energy house, where the state electricity department going to supply the conventional energy. With the help of project work lot of manpower can be reduced and power supply can be controlled.

In this proposed system, we are supposed to connect electrical meters of each and every house to the system which will be monitored by a person of electricity department. This person can monitor power energy of each house and also he can do bill payment of each house meter by deducting corresponding amount by consumer bank account. The consumer should register their bank account details to the system.

II. REVIEW OF LITERATURE

The estimated idea of this paper is useful for smart city concept. The survey up till now, energy meter reader goes to every premise and takes reading manually then issues the bill. But in this system, there may be error possible and not provide reliable meter reading. To overcome this drawback, this paper idea of prepaid energy meter is introduced. You have to pay first then only use can use electricity.

In this paper[1],AEMR System can provide message at hourly, daily and monthly by the request. This is proposing for reducing the manpower, reading collection time, theft of electricity also avoids late bill payment. It is more efficient that conventional billing system. Similarly in this paper[2], design of an electric energy meter for long distance data information transfers which based upon GPRS, but this system can’t be implement so easily because the regular use of GPRS is still a dream of common man. This paper presents an implementation methodology for wireless automatic meter reading system incorporation the widely used GSM/GPRS network. The system includes a microcontroller, which transmits the power consumption values periodically, via an existing GSM/GPRS network, to a master station.

In [3], technique used for prepaid scheme using smart meter included the embedded system and GSM for sending and receiving the SMS through GSM network. Here they establish a communication network between the consumer and service provider using GSM. The objective is to minimize the queue at the electricity billing counters and to retrieve the electricity
automatically. It also addresses about various debugging tools such as Keil 4 Vision. In [4] the author provides prepaid energy meter using an AT89S52 micro-controller has been introduced. The prepaid energy meter is based on pay first and then use it”. An LDR (light dependent Resistor) circuit counts the amount of energy on the LCD. they proposed and designed a prepaid energy meter using two micro-controllers AT89S52 and AT24C02 from ATMEL family which gives high performance, power efficiency or design flexibility. A relay system has been used which shut down or disconnect the energy meter.

According to the author[5], proposed a system which measures the current consumption unit through IR sensor unit. The receive photo diode is placed used to find no. of rotation. To reduce unit given for specific user ARM processor is used. By using Wireless Body Area Network the users links the devices through their body and nearby devices. According to the author[6], they proposed mobile based electricity billing system to collect, process and notify consumer about consumption. The proposed solution uses involving mobile technology, over a solution which uses mobile application to handle a company’s day today work. Customer interaction with the company is improved and customer can easily view their current electricity uses using their mobile phone.

III. Methodology

Smart Meters are electronic measurement devices used by utilities to communicate information for billing customers and operating their electric systems. The main task of the smart meter is to measure the power consumption. It is possible to control power supply using Electric smart meter. The electric smart meter consist of monitoring power supply by a person, online billing system, etc. To implement this system arduino microcontroller, relay, socket is used. Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures kits for building digital devices and interactive objects that can sense and control the physical world. Arduino microcontroller is used to do the mathematical calculations to measure the power units. The proposed system state that the system will be connected to the web server through Internet and the desktop system will also connected to the home meter because of that power supplier can easily monitor power unit of home or industries Hardware model uses a arduino port to control the power consumption. Relay is an electrically operated switch which will operate socket. Power supplier can also deduct bill of electric meter through his or her registered bank account. For this system, consumer should register their account detail. so that the payment will be deducted from the consumer bank account on time.

If suppose any customer don’t have their account in bank then he or she can also pay bill in billing office. The data regarding consumer payment and power supply which is provided to consumer home will stored in database server. If consumer did not pay electricity bill on time then supplier will cutoff or switch of the electricity from server only.

A. Relay

We know that most of the high end industrial application devices have relays for their effective working. Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working.
B. Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board.

C. Socket

Sockets are devices that allow electrically operated equipment to be connected to the primary alternating current (AC) power supply in a building. Electrical plugs and sockets differ in voltage and current rating, shape, size and type of connectors. The types used in each country are set by national standards, some of which are listed in the IEC technical report TR 60083. Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC.[1] The scope of IEC TR 60083 states: The report only contains systems for which standard sheets have been published in a National Standard, which may be a National Standard of the country itself or any other IEC member country.

IV. ADVANCED ENCRYPTION STANDARD (AES)

The more popular and widely adopted symmetric encryption algorithm likely to be encountered nowadays is the Advanced Encryption Standard (AES). It is found at least six times faster than triple DES. A replacement for DES was needed as its key size was too small. With increasing computing power, it was considered vulnerable against exhaustive key search attack. Triple DES was designed to overcome this drawback but it was found slow. AES is an iterative rather than Feistel cipher. It is based on substitution-permutation network. It comprises of a series of linked operations, some of which involve replacing inputs by specific outputs (substitutions) and others involve shuffling...
bits around (permutations). Interestingly, AES performs all its computations on bytes rather than bits. Hence, AES treats the 128 bits of a plaintext block as 16 bytes. These 16 bytes are arranged in four columns and four rows for processing as a matrix.

Unlike DES, the number of rounds in AES is variable and depends on the length of the key. AES uses 10 rounds for 128-bit keys, 12 rounds for 192-bit keys and 14 rounds for 256-bit keys. Each of these rounds uses a different 128-bit round key, which is calculated from the original AES key.

V. AES ANALYSIS

In present day cryptography, AES is widely adopted and supported in both hard-ware and software. Till date, no practical cryptanalytic attacks against AES has been discovered. Additionally, AES has built-in flexibility of key length, which allows a degree of future-proofing against progress in the ability to perform exhaustive key searches.

However, just as for DES, the AES security is assured only if it is correctly implemented and good key management is employed. In this algorithm, we will discuss the different modes of operation of a block cipher. These are procedural rules for a generic block cipher. Interestingly, the different modes result in different properties being achieved which add to the security of the underlying block cipher. A block cipher processes the data blocks of fixed size. Usually, the size of a message is larger than the block size. Hence, the long message is divided into a series of sequential message blocks, and the cipher operates on these blocks one at a time.

VI. CONCLUSION

The proposed system will provide secure and efficient way for electricity measurements. In the existing system meter reading is done by manual process and it is the wastage of time and it causes more manpower. But the proposed system provides many features than the system that have been previously used. It will reduce manpower by using automatic reading of power consumption units and also reduces the time. This system monitors the flow of power consumption therefore there no chances of electricity frauds. Arduino microcontroller is used to monitor and control the flow of electricity. This method possible to solve the problem of manual process of billing system. Proposed system will provide the smart and secure infrastructure.

REFERENCES


