



Smart Electricity Billing System

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Abstract: Electricity metering and billing is a periodic process in our daily life, but also it has few disadvantages like each, and every meter must be read manually, trust issues on some meter readers and bill/meter tamper. To overcome this, here is a proposed idea where the consumed power is calculated within the meter and the data is sent to the electricity department and the customer. This system uses a Arduino, GSM module, and LCD. The Arduino is used to perform the power consumption calculation, sending the data through GSM module and write data to LCD display. The proposed system continuously monitors the amount of power consumed and then generates the total electricity bill of that month. The billing details is sent to the customer and displayed on the LCD display. If the payment is delayed it adds up the fine to the electricity bill. This system reduces manpower where each meter must be read and can be notified the customer at the correct time, which avoids penalty to the customer.

Keywords: Energy meter, Power, Customer, Tamper, Payment.

1. INTRODUCTION

The project "SMART ELECTRICITY BILLING SYSTEM" is a humble attempt to eliminate the waste of time in taking a meter reading and to reduce the human efforts. The current procedure regarding the billing process for electricity is not a fully automated system. It involves manual process from the time. The meter reader starts reading the meter until the system is updated with the current reading. A meter reader visits the house, does the meter reading, and then manually calculates the amount by considering the units consumed from home. To overcome these problems, we must introduce the smart electricity billing system. The system consists of an Arduino, GSM module, LCD display and a relay switch.

The system Arduino continuously reads the energy meter, and the GSM transmitter transmits the information wirelessly to the GSM receiver which is connected to the computer at the EB Office. If the user pays the bill on time the power supply will be provided to the user without any interrupt. If the user fails to pay the bill the power supply to the user will be cut. Power management system is introduced in which during normal mode user can consume the amount of power he/she requires, but during the restriction mode only limited amount of power supply is given to the customer.

The service provider for energy still uses conventional methods for getting the energy consumed by individual customer. This system automatically reads the energy consumed and sends it to the service provider using the existing short message service SMS. The billing process of electricity consumption which we are using at present is very long process and requires lot of manpower. For overcoming all the difficulties present in this system we are introducing fully automated billing process. Two GSM modems are used one connected to electric meter and another connected to PC present in office of electricity board. The PC is the computer which consists of all databases such as meter reading, bill amount, due amount, last date for bill payment. GSM modem consists of SIM cards possessing unique number. User interface consists of LCD which displays the power consumed and amount of bill to be paid. User also consists of a mobile phone through which bill details can be communicated to the consumer. Bill can be paid just by recharging through the mobile.

The proposed system overcomes the disadvantages of the existing system such as errors which occurs due to manual meter reading, high manpower consumption etc. The proposed system has advantage of power disconnection and power reconnection. The power management system is introduced in which during the restriction mode only limited amount of power supply is provided to the customer, which reduces the scarcity of power during the period of power demand.

The current procedure with regard to the billing process for electricity is not a fully automated system. It involves manual processes from the time the Meter reader starts reading the meter until the system is updated with the current reading. A meter reader visits a house, does the meter reading, and then manually calculates the amount considering the units. To overcome problems with this manual approach a few solutions are identified.

In this project, the idea of a smart electricity billing system using an ARM-7 microcontroller has been developed. This concept provides a cost efficient manner of electricity billing. The present energy billing systems are discrete, inaccurate, costly and slow. They are also time and labor consuming.” This system measures the power consumption through IR sensor unit. After getting the power consumption the ARM processor will detect the unit pulse and the unit will be converted as per our currency based on government tariff values and displayed on LCD screen for specific user. Smart electricity billing system also reduces the error made by humans while taking readings to a large extent and there is no need to take reading in it. According to the power consumption, the amount will be displayed on LCD screen. A relay system has been used which shut down or disconnect the energy meter and load through supply mains when the consumer doesn't pay his bill within the given time. Buzzer and LED's are used for indicating the payment of the bill by the user. Keywords--Energy meter, GSM technology, Microcontroller ARM-7(LPC2148). There are many problems in metering and billing processes like the going of meter reader to each customer meter to manually take the meter reading, the probability of the non-existence of the customers at their houses during that time, the lack of integrity and credibility of some of the meter readers, the safety (especially in Iraq) and the outback areas represent a huge drawback cannot be neglected. In other hand, the in service classical energy meter type (generally induction type) suffers from well-known measuring errors. The above problems result in a two significant points, waste of much money due to the large number of employees (meter readers) and the weakness in electricity management which results in lack in electric power.

The presented paper provides an excellent solution (Automatic electrical energy billing) to the problems mentioned above where the system has been designed based on the use of energy smart meter to read electrical energy consumed to get an accurate reading. Then the energy meter reading is sent to the control center in the electricity department based on GSM/SMS technology. The system in the electricity department receives readings and makes processing operations on them and extracts the bill that must be paid by the customer. The system also sends a message to the own customer mobile phone which contains the current bill, due bill, and total bill every two months (according to Iraqi regulations) have to be paid. In addition, the system has the ability to print out a hard copy of the customer bill. Finally, the proposed system has the ability of automatic power outage if the customer refrains or delays for certain time in paying the bills by means of an SMS message.

All the mentioned problems would be reduced if the metering and billing operations are proceeding by an automatic manner. So the solution is to design a wireless digital energy metering and billing system. This system is introduced in the present project. The presented system consists from two parts. The first part is a GSM smart energy meter containing from microcontroller Arduino UNO type, Arduino energy shield, Arduino GSM Shield, current transformer (C. T) to measure load current, voltage transformer (V. T), relay and LCD. The GSM smart meter calculate the watt hour consumed units digitally with high accuracy, storing these units in Arduino EEPROM, displaying on LCD and send them to the power distribution utility center (PDUC) via SMS. These operations were programmed in C++ language of Arduino IDE.

2. LITERATURE SURVEY

T El-Djazairy, B J Beggs and I F Stewart (Jun 1997) This paper presents the results of an investigation which show that the development of the GSM network as a low cost, global carrier of digital telecommunications signals provides exciting opportunities for novel applications such as the handling of power system metering and load management telemetry. As the use of GSM for telephony becomes more widespread, it is inevitable that costs will be driven lower, and it is also inevitable that this medium for the transfer of telemetry data.

P.K. Lee and L.L. Lai, Fiee (Jun 2007) In this paper, the authors discuss the way to adopt the cost effective GPRS applications. Although there have been lots of theories and concepts on the GPRS applications but the real applications applying to a large network, distributed power generation or building energy/power distribution monitoring are limited. The authors focus the application of the GPRS to this on-line system application and the techniques. A practical scheme is proposed and its use to real-life system will be introduced. A practical implementation for a wireless GPRS on-line Power Quality Monitoring System will be illustrated. Results and benefit to the end users in some practical applications will be discussed.

3. PROBLEM STATEMENT

The old manual system was suffering from a series of drawbacks. Since whole of the system was to be maintained with hands the process of keeping maintaining, and retrieving the information was very tedious and lengthy. The records were never used to be in a systematic order. There used to be lots of difficulties in associating any particular transaction with a particular context. If any information was to be found it was required to go through the different registers, documents there would never exist anything like report generation.

There would always be unnecessary consumption of time while entering records and retrieving records. One more problem was that it was very difficult to find errors while entering the records. Once the records were entered it was very difficult to update these records. In present, work done in the electricity board is performed manually which is a great headache for the department. The reason behind it is that there is lot of information to be maintained and must be kept in mind while running the business. For this reason, we have provided features present system is partially automated (computerized), existing system is quite laborious as one must enter same information at three different places.

Following are some problems observed in those energy meters which should be rectified:

- Meter reading and other related tasks like bill payment are performed by many staff i.e., large number of employees are

required, and an expansive number of staff is utilized for meter reading, and they are used for other related assignments like bill payment.

- Billing errors due to carelessness of meter readers during meter reading and sometime billing estimation.
- Careless usage of electricity by consumer who is unaware of its cost.

4. OBJECTIVES

The main objective of the project is

- To detect the energy meter tampering and to notify the concerned authority.
- To reduce the man power required for meter reading/billing system.
- To send the notification to the customers about the amount of power consumption and tariff through mobile application.

5. METHODOLOGY

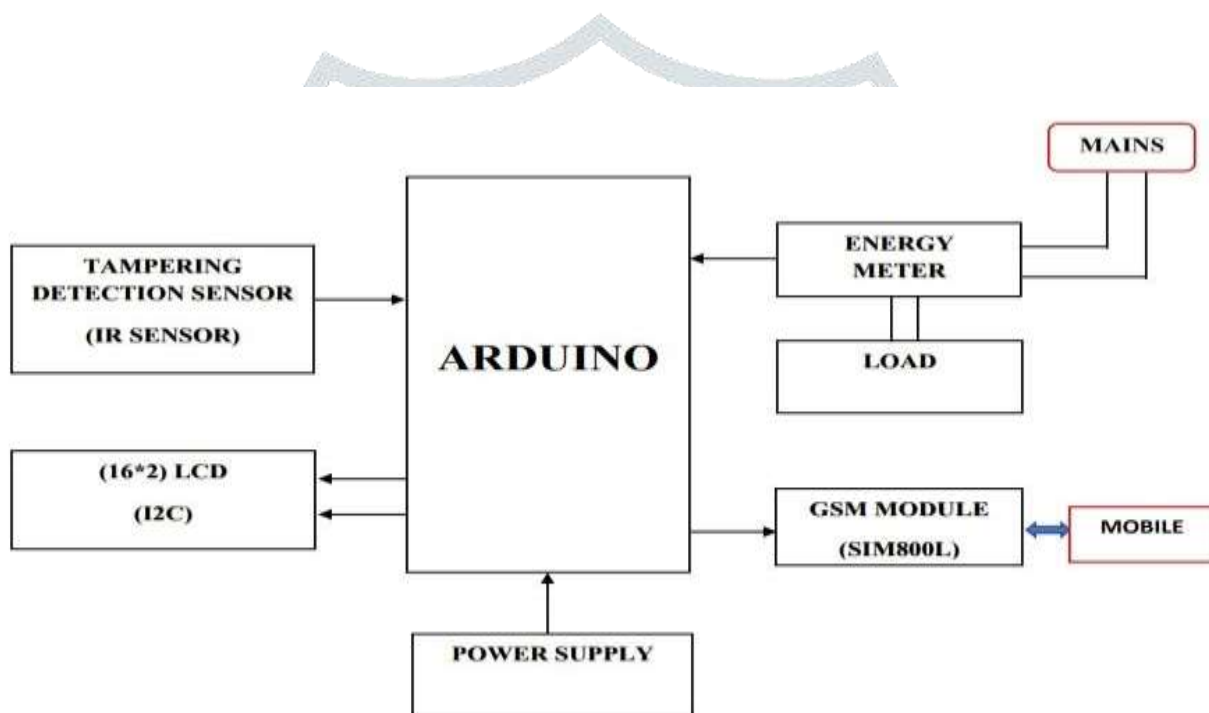


Fig.5.1: Block Diagram of Smart Electricity Billing System.

- The electricity is consumed, the electricity bill is generated, the generated bill can be seen in our smart phone as well as on our LCD.
- The system consists of the bulb, where the bulb is used as load.
- IR sensor, GSM module, energy meter and power supply are connected to the Arduino pin.
- The integration of the Arduino and GSM provide the meter reading system with some automatic functions that are predefined.
- GSM module transmits the data like consumed energy in Kwh, generated bill, security services.
- The bill will be generated for total count of load

6. RESULTS AND DISCUSSIONS

In this system monthly electricity billing system has been developed. The use of GSM module provides lot of advantages over the previously used billing method. This system is mainly applicable at home.

The final output of the Smart electricity billing system is the energy meter was tested by using an electric light bulb of 100 watts that draws current consumption up to 1mA without backlight. The supply voltage is 230 V. First, a wattmeter was used to measure the power consumed by the load. Then energy consumption was measured after every 10 seconds. Total 5 pulses occurred at every 10 seconds in energy meter. The computed energy consumption is read from the LCD. The messages sent or received by the user and electricity department.

6. ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- Real time and Accurate billing information.
- Reduced Disputes due to billing errors.
- Useful for energy conservation and reduces fraudulent consumption.
- Better and faster customer service.
- More intelligence to business planning
- The user is not bound to pay excesses amount of money; user must pay according to their requirement. It can reduce problems associated with billing consumer living in isolated areas and reduce deployment of manpower for taking meter readings.
- Improve our awareness of energy consumption.

DISADVANTAGES

- Billing system fails if no GSM Network coverage.
- Charges may be applicable for network use.

7. APPLICATIONS

- By using this system, the customers can easily check their monthly electricity bills.

8. CONCLUSION

In the proposed SEM using GSM would go a long way in making people conscious of the amount of energy they spend and help to conserve the conventional depleting resources. The automation of billing system eliminates human involvement hence more accurate and reliable. The implementation of time of-day billing can control the usage of electricity on consumer side to avoid wastage of power which helps in reduction of energy generation costs. The introduced Prepaid Billing System minimizes the Electricity theft in a cost-effective manner. Automation of meter reading also gives the information of total load used in a house on request at any time as well as to make consumers to keep track of energy usage. It sends a SMS alert to energy provider company whether a person using more than specify limit of load. The use of a web-service developed at load Centre has made it possible to overcome the computational complexity of smart meters currently used on the market.

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