Smart Electricity Billing System

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ABSTRACT

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 labour 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)

I. INTRODUCTION

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. ‘Smart Meter’\textsuperscript{1} and ‘Java Based Meter Reading System’\textsuperscript{2} are some of the solutions. But they are not much sufficient, because the initial cost is very high.

II. 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, IEEE (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 an 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.

H.G.Rodney Tan,C.H. Lee,V.H.Mok (Dec 2007) The development of a GSM automatic power meter reading (GAPMR) system is presented in this paper. The GAPMR system is consists of GSM digital power meters installed in every consumer unit and an electricity e-billing system at the energy provider side. The GSM digital power meter (GPM) is a single phase IEC61036 standard compliance digital kWh power meter with embedded GSM modem which utilize the GSM network to send its power usage reading using short messaging system (SMS) back to the energy provider wirelessly. At the power provider side an e-billing system is used to manage all received SMS meter reading, compute the billing cost, update the database, and to publish billing notification to its respective consumer through SMS, email, Web portal and
printed postage mailing. A working prototype of the GAPMR system was built to demonstrate the effectiveness and efficiency of automatic meter reading, billing and notification through the use of GSM network.

III. ADVANTAGES OF PROPOSED METHODOLOGY OVER EXISTING METHODOLOGY

The present power usage reading is made manually by moving to the consumer locations. This requires large number of labor operators and long working hours to accomplish the task. Manual billing is sometimes restricted and delayed by bad weather conditions. The printed billing also has the tendency of getting lost. Smart electricity billing system has been proposed as an innovative solution aimed at facilitating affordability and reducing the cost of utilities. This drawback is reduced by using a smart electricity billing which is based on the concept “Get your electricity bill in your currency daily”. The present system measures the power consumption with the help of power measurement circuit and fed to the ARM controller through IR sensor. After getting the power consumption values the ARM processor will calculate the bill amount according to the present tariff values and displays to the user. The information also provided to the electricity department and to the user using GSM technology for bill payment purposes.

IV. SMART ELECTRICITY BILLING SYSTEM

Smart electricity billing system is a technique which is cost efficient and can reduce problems associated with billing and also reduces deployment of manpower for taking meter readings. Smart electricity billing system has many advantages both from suppliers as well as consumer’s point as follows:-

- No bill production
- No bill distribution
- No further actions such as disconnections
- Customer responsible for disconnection
- Load and demand side management
- Limit load
- Load based
- Time based
- Pay to suit your income status
- Daily, weekly, monthly budgeting
- Show true cost of consumption
- Reduce consumption when income is tight-- make money
- No billing errors

V. BLOCK DIAGRAM OF SMART ELECTRICITY BILLING SYSTEM

Figure: 1 shows the block diagram of prepaid energy meter is shown in fig. (i). It consists of microcontroller LPC2148, buzzer, relay, single phase energy meter, MAX232, IR sensor circuit, LCD display.

Figure: 1

HARDWARE IMPLEMENTATION

A. Power Supply Unit:

The supply of 5V DC is given to the system which is converted from 230V AC supply. Firstly, the step down transformer will be used here for converting the 230V AC into 12V AC. The microcontroller will support only the DC supply, so the AC supply will be converted into DC using the bridge rectifier. The output of the rectifier will have ripples so we are using the 2200uf capacitor for filtering those ripples. The output from the filter is given to the 7805 voltage regulator which will convert the 12V DC into 5V DC. so, the pure 5V DC is getting as the output from the power supply unit.

B. Microcontroller unit:

In the microcontroller unit we are going to use ARM LPC2148 microcontroller which is used to sense the values from the sensors and will transfer to the monitoring section regarding the situation. The controller also converts the data to serial communication for wireless data communication through GSM modem.

C. Sensor unit:

The sensor unit consists of IR LED and IR Receiver. The LED is placed in the moving unit in the meter. The receiver gets the IR signal for the whole rotation of the moving unit which has the LED.

D. Communication unit:

GSM Modem is a communication technology in which it is used to transmit the message from the
monitoring section to the control section. Whenever there are any abnormalities in the sensors or for certain period of time, the microcontroller is used to transmit the data to the monitor section.

**E. Display unit LCD**

The display unit is mainly achieved by the 16X2 LCD. A liquid crystal display (LCD) is a flat panel display, electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs does not emit light directly. The monitored data from the patient is viewed in the display.

**VI. ENERGY CALCULATION AND ENERGY METER STANDARDS**

Energy is the measure of how much work has been required over a known period of time. We are using a light bulb as a load with a 100W rating which consumes 100 watts of active power in order to create light (and heat). First of all a wattmeter is used to measure the power consumed by the load by using the equation. The frequency across 100 W load obtained during an experiment is $F = 0.5 \text{ Hz}$ And

$$P = 100 \times X \div 0.5$$

$$P = 200 \times X$$

Where X: is the frequency of pulses that is produced by the energy meter.

1 watt sec = 1 kW sec/1000

$1 \text{ watt sec} = 1 \text{kWh/} (1000 \times 3600)$ Therefore

Energy = P * Sec/ (1000 *3600)

<table>
<thead>
<tr>
<th>Indian Standard No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS:13776-1999 read with latest amendments</td>
<td>Specification for AC static watt hour meter for class 1 &amp; 2</td>
</tr>
<tr>
<td>IS:5133-1969 (Part II)</td>
<td>Specification for boxes for the enclosure of electrical accessories</td>
</tr>
<tr>
<td>IS:9000</td>
<td>Basic environmental and other Testing for Electronic &amp; Electrical Items</td>
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<tr>
<td>IS:11791</td>
<td>Specification for engineering plastic</td>
</tr>
<tr>
<td>IS: 11000</td>
<td>Resistance to heat &amp; fire</td>
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**VII. FLOW CHART**

The entire procedure will be shown in this flow chart Figure: 2. Here Dt means date in that particular month. From the initialization step to continue step all the messages will be send to the user, If the tariff value changed by the government that will be updated by the electricity department and If any person tries to open the meter it will be detected by the controller and sends the message to electricity department. All this messages are sent by using GSM technology.

**VIII. SOFTWARE REQUIREMENTS FOR SMART ELECTRICITY BILLING SYSTEM**

The system software is implemented by C language. The developed code is edited, compiled and
debugging by Keil Microvision and the code has been dumped by using flash magic software.

IX. RESULT

The final output of the Smart electricity billing system is shown in the figure: 3 The energy meter was tested by using an electric light bulb of 100 watts that draws current up to A. The supply voltage was 230 V. First of all 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 are shown

X. CONCLUSION

The paper is intended to present an overview of Smart electricity billing system, which can control the usage of electricity on consumer side to avoid wastage of power. Smart electricity billing system is a concept to show the consumer electricity in units and in your currency daily.

1. The users are not bound to pay excesses amount of money, users have to pay according to their requirement.
2. It can reduce problems associated with billing consumers living in isolated areas and reduce deployment of manpower for taking meter readings.
3. Smart electricity billing system is more reliable and user friendly.

From all these we can conclude that if we implement this Smart electricity billing system then it can become more beneficial.

REFERENCES