

Arduino Based Smart Prepaid Energy Meter using GSM Technology

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Abstract— In this system a smart energy meter is installed in every consumer unit and a server is maintained at the service provider side. Power utilities in different countries especially in the developing ones are incurring huge losses due to electricity theft. Both the meter and the server are equipped with GSM module which facilitates bidirectional communication between the two ends using the existing GSM infrastructure. Pilferage of electricity can be substantially reduced by incorporating the proposed measures along with the prepaid metering scheme. Legal actions against dishonest consumers can also be taken in this system. The accurate metering and billing of actual energy consumed by consumers is integrated to commercial management of an electric utility. Power utilities in different countries especially the developing ones are incurring huge losses due to electricity theft. The electrical grid in most of the developing countries has inefficiencies in different areas such as transmission and distribution, power quality, grid reliability and system protection.

Key words: Microcontroller, Prepaid Meter, GSM Networks, SMS, Smart Energy Meter

I. INTRODUCTION

This project provides the facility of measuring the consumption of electricity and continuously monitoring the unit of consumption of electricity by the meter and includes security theft of electricity. The electricity theft has as a serious problem in power sectors especially in the developing countries. Electricity theft includes fortify meter to show a low meter reading, take electricity bypassing a meter, billing irregularities and unpaid bill. A huge amount of earnings is lost due to electricity theft. In some countries this is so grave that governments are incurring losses instead of revenue. In some cases government has to provide allowance to fonts for investments to maintain a reasonable price of electricity. Different non technical and technical method was initiated in past to detect electricity theft. Non technical methods may include inspection of the customers with suspicious load profile. Although regular inspection can substantially reduce theft, such measure require large manpower and huge labor. Such effort also fails in most cases due to the dishonesty of the staffs. Some of the technical ways to detect theft are use of central observer meter at dishonesty of the staffs. Some of technical ways to detect meter tempering are use of central observer meter at secondary terminal of distribution transformer, harmonic generator, genetic support vector, achiness, extreme learning machine and power line impedance technique. Electricity meter are typically calibrated in billing units, the most common one being the Kilowatt hour [kWh]. Periodic readings of electric meters establish billing cycles and energy used during a cycle, the cycle generally extending for a month.

II. RELATED WORK

A smart energy meter based prepaid electricity distribution system has been proposed by (Yadav, Sharma 2015). It consists of an energy meter, ARM7 microcontroller board, GSM module, EEPROM, keypad and LCD display. Here, one has to purchase a scratch card of required amount and enter its serial number into the system using keypad and LCD display.

The authors (Hiware, Bhaskar, Bombale & Kumar 2013) have been proposed a scheme where it consists of wireless meter, server, PIC microcontroller, three 8 bit ports, one 6 bit and one three bit port so total 33 I/O lines, ADE 7757, 8 KB of program memory and 368 data memory.

The authors (Jubi, & John 2013) have been proposed a scheme where it consists of consumers hold credit and then use the electricity until the credit is exhausted. If the available credit is exhausted then the electricity supply is cutoff by a relay.

The authors (Islam, Mamun 2015) have been proposed a scheme it developed the EDU, where consist of Microcontroller Atmega32, Energy Metering IC ADE7755 and LCD display is used to display the balance amount.

This paper presents the prepaid energy meter is technique which is cost efficient and can reduce problem associated with billing and also reduces deployment of manpower for taking meter readings (Deepakumar, Latha 2015). The energy meter consists of a microcontroller (ATmega 32), energy measuring chip (ADE7751), GSM module, MAX232, LCD display and a relay.

III. PROPOSED METHOD

In this system of prepaid electricity scheme various researchers have done work on various techniques. But on keeping in mind the present scenario, we have tried to develop a new system which uses prepaid electricity and work on smart meter for better uses and control the electricity.

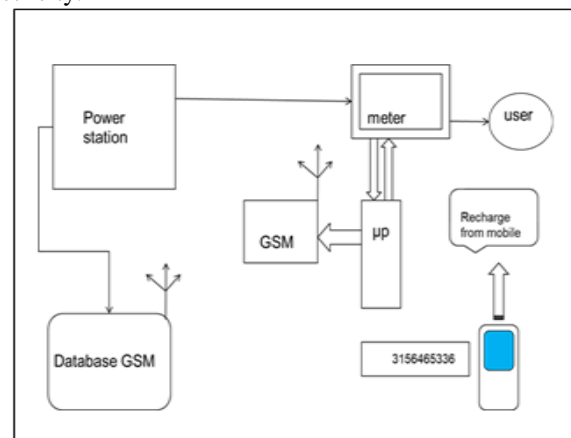


Fig. 1: Block diagram of prepaid electricity billing scheme

The system implements the prepaid electricity billing scheme using GSM, and embedded system. The objective of providing easily the electricity by recharge meter save lot of time, money, human power and save electricity and control consumption of electricity of consumer.

The system is comprised of three phases, in the first phase the user send a request for electricity through SMS, in second phase service provider receive SMS and perform matching function and in third phase in service provider recharge the meter.

Embedded system means microcontroller is the interface of meter and GSM modem. So that it continuously monitors electricity consumption. In this complete approach communication established between power station, meter and user using a GSM modem

IV. RESULTS

This approach controls the uses of electricity consumption. All the functions are completely based on embedded system and GSM modem. Complete implementation is divided into three phases:-

- 1) Complete setup for service provider.
- 2) Complete setup for consumer.
- 3) User.

Figure 5.1 shows complete setup for service provider. It includes a GSM modem to send and receive. RS232 serial port is used, it is used for serial data transmission. Serial communication established between service provider and user using MATLAB. MATLAB (Matrix Laboratory)



Fig. 2: Setup for service provider

In this approach we have performed the improvement of smartness of normal meter. This step shows interfacing of microcontroller and GSM modem. So that apply this scheme to improve the smartness of normal meter. Figure 1.3 is showing working mode of meter. Complete setup is including the normal meter interfacing with microcontroller, GSM modem, LCD and electricity consumption component. LCD is used to the consumption of electricity.

This figure shows recharge SMS of meter from service provider by sending the SMS to meter. LCD display the service provider recharge successfully.

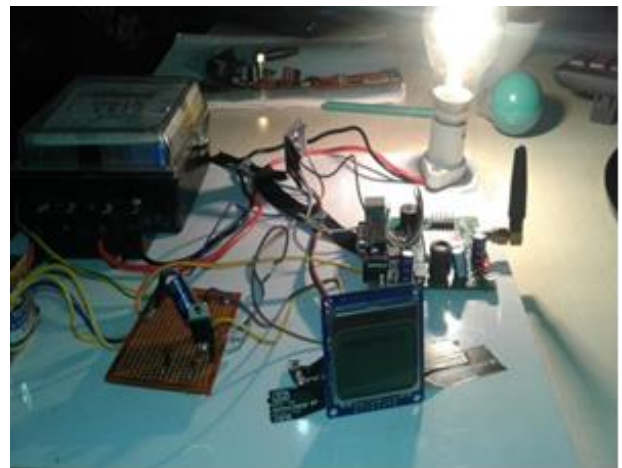


Fig. 3: Setup during electricity consumption in consumer side

It is experimentally observed that this method gives better values than previous methods. Comparison of cost of GSM shown in form of graph in figure 1.4 (X axis having GSM and Y axis having corresponding cost of those parameter.

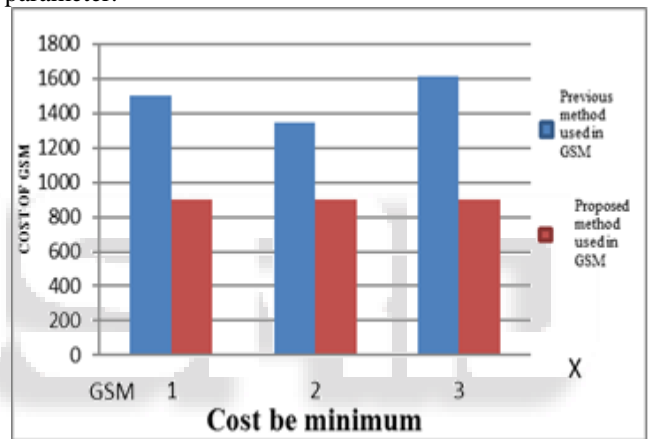


Fig. 4: Cost comparisons of GSM

In figure 1.5 X axis is showing microcontroller and Y axis is showing corresponding cost. This graph is show previous and proposed method microcontroller cost.

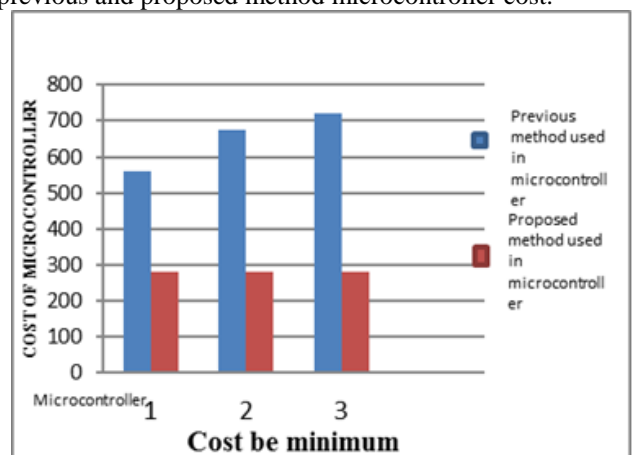


Fig. 5: Comparisons for cost of microcontroller

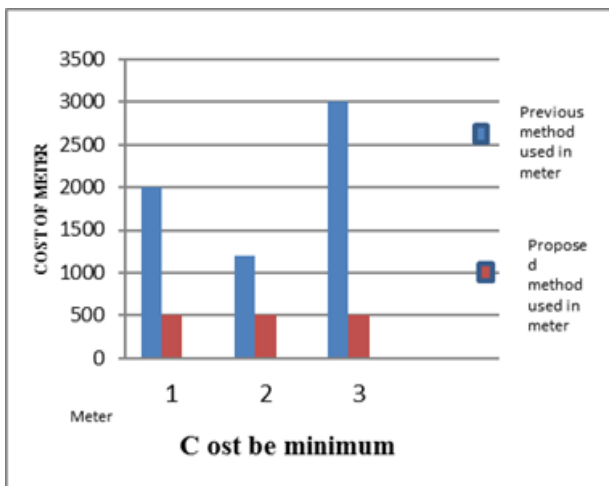


Fig. 6: Cost comparisons of meter

Figure 1.6 is showing graph for cost of meter i.e. Technology and meter cost is comparison of previous method and proposed method

V. CONCLUSION

The design of Smart Energy Meter using GSM technology facilitate the users to pay for the electricity before its consumption. An arrangement is also made to intimate the user with the help of GSM communication module when credit in their balance goes low. This system has been proposed as an innovative solution to the problem of affordability in utilities system. Since a microcontroller based system is being designed, the readings can be continuously recorded. This reduces human labor and at the same time increases the efficiency in calculation of bills for used electricity.

VI. SCOPE FOR FUTURE WORKS

- 1) Introduce advance technology to converting dc voltage in ac voltage.
- 2) In future, this project can be used to measuring natural gas or water consumption.
- 3) All the system can be converted to provide a online facility.
- 4) To send all information in form of voice message.
- 5) Reduce theft of electricity, if we design a security key attached with all electric components and meters

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