



Smart Energy Meter

Brinda.S¹, Vishal Kumar Sah², Jaladi Harish³, Akshay.U⁴, Vishal Deo Mahto⁵, Swetha Umopathy⁶

Assistant Professor(O.G)¹, B. Tech Student^{2,3,4,5,6}

Department of Computer Science and Engineering
SRM Institute of Science and Technology, India

Abstract:

In the currently working system, electricity meter reading for electricity usage and billing is done by human workers from home to home and building to buildings. The purpose of this project is to develop a Smart Electricity meter using GSM. This can reduce human errors and helps to retrieve the real time meter value via GSM and send it to customers mobile phone through GSM. This also allows electricity board to modify the variable package price in specific duration. The administrator can analyse the customers power consumption data and generate the report from the data online. The prototype will be able to introduce the billing system to the customers, get the power consumption data from smart meter, keep the data in centralized database and generate the report.

Keywords: GSM, Power Consumption, Billing, Smart Electricity meter

I. INTRODUCTION

Electricity is one of the vital requirement for sustainment of contents of life. It should be used very judiciously for its proper utilization. But in our country we have lot of locality where we have surplus supply for the electricity while many areas do not even have access to it. Our policies of its distribution are also partially responsible for this because we are still not able to correctly estimate our exact requirement and still power theft is prevailing. On the other hand consumers are also not satisfied with the services of power companies. Most of the time they have complaints regarding statistical errors in the monthly bills. With this we can monitor meter and track if any fault is there or not. In previous meter a circular metal strip rotates and according to that rotation we calculate the consumption. But our meter works on pulse which is created according to consumption and we previously connected android board which monitor the pulse and according to pulse the bill is generated. With the help of this project we are aiming to receive the monthly energy consumption from a remote location directly to centralised office. In this way we can reduce human efforts needed to record the meter readings which are till now recorded by visiting every home individually.

II. EXISTING SYSTEM

1) Design of an Automatic Meter Reading System:

This paper describes the Automatic Meter Reading (AMR) system, an integrated and programmable meter reading and control system over existing telephone networks. The AMR system is an automated, two-way system for remote reading and management of utility meters. The meter reading and management processes are free from human involvement. Accuracy, speed, efficiency, and cost-effectiveness are the expected benefits achievable using the AMR system. The overall system is based upon the existing telephone networks, therefore the service can reach anywhere there is a telephone. All this is accomplished

electronically and truly automatically, thus ending manual (and semi-automatic) meter reading and entry, call-backs, reading errors, and billing floats. The AMR system should provide 100

2) *Data Collecting from Smart Meters in an Advanced Metering Infrastructure* : The classical solution for collecting data from energy meters, based on displacements of peoples, tends to be replaced by modern solutions: drive-by and Automated Meter Reading (AMR). Drive-by means that data are collected by mobile devices which pass near the meters. The personnel are considerably reduced and manually readings and records are eliminated. AMR means to automatically collect data from meters and send them to a central computer. The advantages of AMR are: reduced costs for meter readings, possibility to access meters otherwise difficult to attend because of their position or security reasons, support for real-time pricing, increased fraud detection, reduced read-to-bill time etc. AMR requires smart meters. Besides their classical role, to read the consumptions, smart meters must also be able to send the readings over communication lines. For advanced infrastructures, the meters must also be able to recognize their address and to activate/deactivate internal modules. A meter interface must fulfill the requirements of reading the data from the classical part of the meter and responding to the commands received from the lines. AMR requires a specific infrastructure. It can be unidirectional, meaning data are sent periodically by meters, or bidirectional which adds the possibility to manage the system, for example to connect/disconnect users, to collect the data from the meters according to some rules, to group the meters etc. Such an infrastructure is called Advanced Metering Infrastructure (AMI). The communication medium in an AMI system must ensure the communication smart meters data collector (or gateway) and data collector (gateway) central computer. There are two solutions: wired or wireless. The chosen solution must take into account the distances between the devices and, for financial reasons, the existing infrastructure. For example, in most cases a

power line infrastructure exists. It can be used for communication too, the solution being called Power Line Communication (PLC). There are several PLC standards, one of them being LonWork *Remote Energy Monitoring, Profiling and Control Through GSM Network*: To devise an efficient metering system, the concept of Automatic Meter Reading (AMR) and Energy Profiling System (EPS) originated, which provide an effective means of energy consumption information collection, and its analysis, for accurate billing. Radio frequency based EPS can make use of Handheld, Mobile, and Fixed network. In handheld and touch based EPS, a handheld computer equipped with a transceiver is used (radio frequency or touch) to collect readings, but it does not make optimum use of the AMR capable meters, as meter reading personnel are required. Mobile or Drive-by meter reading is another approach where a reading device is installed in a vehicle. Due to the short range of mobility, it again requires a team for collection of meter readings. AMR can also be implemented by making use of Power Line Communication (PLC), but it has an inherent disadvantage of interference and noise, which deems it unreliable. Wi-Fi, ZigBee and 3G technologies have also been used for transmission of metering information, but have not being widespread as they require installation of facility/ access points to cover the designated areas and thus do not provide a cost effective solution in existing environments. Our indigenously developed GSM transmission module induce transparency in the current meter reading system, by facilitating low cost real time monitoring of consumer energy consumption. Automation would lead to an efficient energy metering system by removing human errors. Our system also allows the energy supplier company to remotely control the consumer energy meter. A major feature is the inclusion of a user consumption profiling system, accessible to users and the energy supply company. By incorporating control coupled with profiling, An additional feature explored is the traffic profiling using Global Positioning System (GPS) to indicating the location of consumers which is extremely beneficial if used in collaboration with sensor circuits to indicate meter theft.

3) SMS-based Reconfigurable Automatic Meter Reading System: Automatic Meter Reading (AMR) has widely attracted many engineers, and utility companies. AMR is not just replacing the manual meter reading with an automatic procedure, but has many advantages, some of which are listed below [1]. - Higher speed. - Improved load profile.- Automatic billing invoice.- Real time energy cost. - Load management. - Alarm warning. - Remote power switch on/off.- Tamper detection. AMR is expected to be common in future. Nowadays, different AMR schemes are continuously evolving. Furthermore, integrating with the benefits of digital energy meters, contemporary AMR systems present more advanced and flexible features than their predecessors did in the past decades. Finally, thanks to the advent of new communication technologies, their competitive markets, and their ever-decreasing costs, the extinction of traditional meter reading system seems inevitable.

4) Electronic Energy Meter With Instant Billing: The importance of proposed work can be well understood

if we keep in mind the amount of electricity being stolen every day. With heavy loads on the power house one cannot track each and every household or commercial site[8]. So to track any misuse at any stage of distribution we can use this method of billing. As a user can get his or her bill at any instant and can even pay it at any instant, so any kind of misuse by any other person can be avoided. An extensive amount of energy can be saved if we can track the misuse and the whole power problem can be dealt with by using this technique .The chances of tempering with this are very low. It validates accuracy of utility billing charges consumption, demand and power factor. It has a real time data display and access to metering equipment and usage data. So people at power house and the person who owns the equipment both can monitor the usage whenever they want to.

III. SYSTEM ARCHITECTURE

In the existing system, electricity meter reading for electricity usage and billing is done by human workers from home to home and building to buildings. This requires huge number of workers and long working time to achieve complete area data collection and billing. Human workers billing are prone to reading error as sometime the houses electric meter is placed where it isn't easily accessible. Labour billing job is sometime also restricted and slowed down by bad environmental condition. Paper billing has the tendency of losing in the post box. The increased development of residential housing and industrial buildings in the developing country such as for example, India require more human workers and longer working hours to complete the usage reading task. These increases the energy provider operation costs for meter reading.

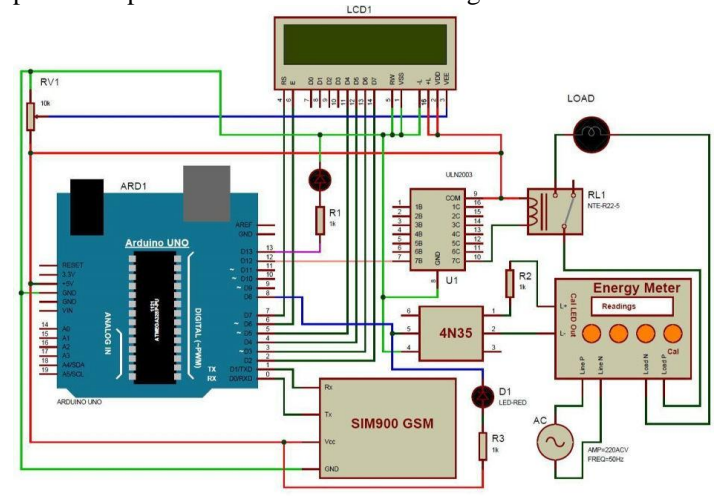


Figure.1. BLOCK Diagram

The energy meter records the amount of energy consumed by the load. In the older days electro mechanical type of energy meter are available and now a day's digital energy meter are available. The energy meter mainly works on the current increment in amount of current flow through circuit causes the disc to rotate, means that the rotational speed of disc is directly proportional to the amount of current flowing through circuit. Old type rotation effect of disc type meter causes the gear mechanism to work

accordingly and in similar way power consumption by the load is recorded by the micro controller the blinking rate of LED integrated within the meter. Present type of energy meter also had a blinking led for the counting the pulses are sent to the microcontroller and these readings are stored into external memory of the microcontroller. External memory is an EEPROM. This memory is able to store previous energy consumed as well in case one needs to check present Energy consumed status. LCD is connected with microcontroller, microcontroller sends a message to LCD display unit so that we can view the status of GSM Modem. GSM communicate over wireless system, GSM modem is connected to the microcontroller unit through MAX 232 IC. GSM modem communicates at RS232 standard voltage levels. MAX 232 converts the RS232 voltage levels into TTL voltage levels and MAX 232 converts the TTL voltage levels into RS232 voltage levels.

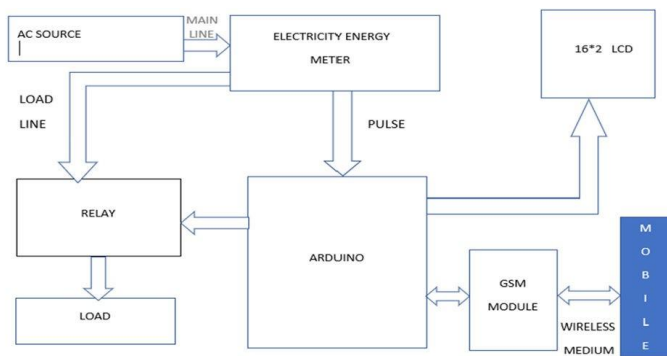


Figure.2. Circuit Diagram

IV. REQUIREMENT ANALYSIS

1. Software Requirement

- Arduino IDE

2. Hardware Requirement

- Arduino
- GSM Modem
- ENERGY METER
- OPTOCOUPLER
- LCD DISPLAY
- Potentiometer

V. COMPONENTS DETAILS

1. Arduino:

The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.



Figure.3. Arduino

2. Arduino IDE:

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

3. GSM Modem

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities. For the purpose of this document, the term GSM modem is used as a generic term to refer to any modem that supports one or more of the protocols in the GSM evolutionary family, including the 2.5G technologies GPRS and EDGE, as well as the 3G technologies WCDMA, UMTS, HSDPA and HSUPA.

4. ENERGY METER:

An electricity meter, electric meter, electrical meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device. Electric utilities use electric meters installed at customers' premises to measure electric energy delivered to their customers for billing purposes. They are typically calibrated in billing units, the most common one being the kilowatt hour [kWh]. They are usually read once each billing period. When energy savings during certain periods are desired, some meters may measure demand, the maximum use of power in some interval. "Time of day" metering allows electric rates to be changed during a

day, to record usage during peak high-cost periods and off-peak, lower-cost, periods.

5. OPTOCOUPLER

Optocoupler is a digital switch. It work by using an LED emitter paired with a photo detector transistor. This means they can be used to allow one circuit to switch a separate circuit without having any electrical contact between the two.

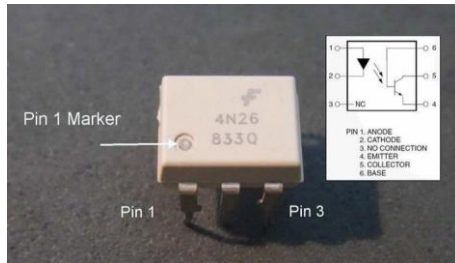


Figure.4. Optocoupler

6. LCD DISPLAY

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special even custom characters (unlike in seven segments), animations and so on.

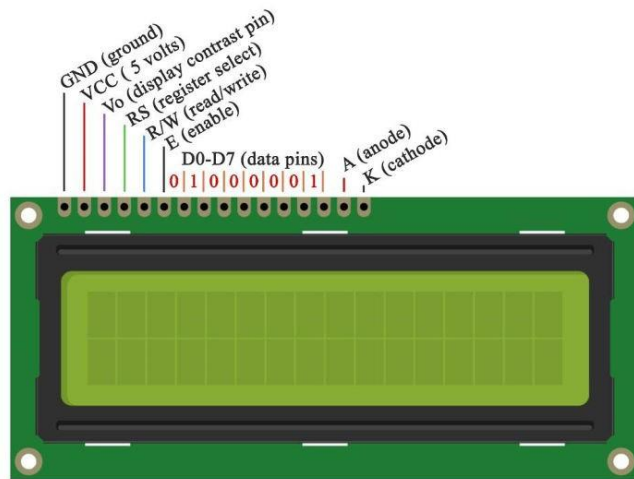


Figure.5. Lcd display

7. Potentiometer:

Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick. Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load.

VI. CONCLUSION

This paper is intended to present an overview of prepaid

energy meter which can control the usage of electricity on consumer said to avoid wastage of power. Prepaid energy meter is a concept to minimise the electricity theft with a cost efficient manner. The users are not bound to pay excesses amount of money, users have to pay according to their requirement. Prepaid energy meter is more reliable and user friendly. This prepaid remote energy meter proves to be a boon in the power sector. It control the usage of electricity on consumer said to avoid wastage of power. It helps to the country revenue by stopping current theft and punishing the dishonest customers. However their design has to meet certain prepaid standards and regulations. The only concern is the security and privacy of data as they are prone to cyber attack. However the use of GSM in this particular system provides numerous advantages over methods that have been previously used. Data transmission is charged at standards SMS rates, thus the charges are not based on the duration of data transmission. The cost efficient of readings. Developed system also gives information about daily, monthly and yearly power usage. Details regarding daily power consumption will help consumer to manage their power usage. This developed system is reliable and secure as only authorized person can access the system.

VII. ACKNOWLEDGMENT

Authors would like to warmly thanks Ms.Brinda.S, M.E. Assistant Professor (O.G) Dept. Of Computer Science And Engineering SRM Institute of Science and Technology for his great cooperation during the development of this project.

VIII. REFERENCES

- [1]. Sh-Wei Lee, Cheng-Shong Wu, Meng-Shi Chiou, Kou-Tan Wu A re- search paper on , Design of an Automatic Meter Reading System National Chung Cheng University
- [2]. M. Popa A research paper on ,Data Collecting from Smart Meters in an Advanced Metering Infrastructure, Politehnica University, Timisoara, Romania
- [3]. Adnan Rashdi, Rafia Malik, Sanam Rashid, Anam Ajmal, Sulaiman Sadiq, A research paper on, Remote Energy Monitoring, Profiling and Control Through GSM Network, 1 National University of Sciences and Technology, Islamabad, Pakistan
- [4]. Ali Abdollahi, Marjan Dehghani, and Negar Zamanzadeh, A research paper on, SMS based Reconfigurable Automatic Meter Reading System
- [5]. A research paper on, Electronic Energy Meter with Instant Billing
- [6]. Jawed Ahmed, M. Afshar Alam, Abdul Mobin, Shahla Tarannum4, A research paper on ,A Soft Computing Approach for Obesity Assessment Computer Science, Jamia Hamdard, New Delhi