ABSTRACT:

The billing process of electricity consumption which we are using at present is very long process and requires lot of man power. The energy billing in India is error prone and also time and labor consuming. Errors get introduced at every stage of energy billing like errors with electro-mechanical meters, human errors while noting down the meter reading and error while processing the paid bills and the due bills. There are many cases where the bill is paid and then is shown as a due amount in the next bill. There is no proper way to know the consumer's maximum demand, usage details, losses in the lines, and power theft.

For overcoming all the difficulties present in the system we are introducing fully automated billing process. In the proposed system front end is user friendly and can be operated easily by having minimum computer knowledge. The billing process is prepaid energy billing, which could be titled. Pay first and then use it. There are clear results from many countries, where prepaid system has reduced the wastage by a large amount. Another advantage of the prepaid system is that the human errors made reading meters and processing bills can be reduced to a large extent.

Keywords: GSM, Microcontroller, LCD display, Embedded Algorithm, Energy meter.

I. INTRODUCTION

From many years, the electric power systems had undergone negligible changes in their operating conditions and the equipment employed for their control and monitoring. Many attempts have been made to design the energy meter with instant billing but till now the designed energy meters did not give any replacement for the system.

The Automated Prepaid Energy Distribution control system using GSM is made up of prepaid billing system and multiple GSM power meter. The system provides efficient power meter reading, usage notification and distribution control using GSM network. GSM modem utilizes the GSM network to send power usage reading back to energy provider through wireless communication. The message consists of reading of the usage made together with a user identification number. At energy provider side electricity billing system is used to manage all reading, update the database and send usage notifications back to respective user. The dedicated GSM modem with SIM card is required for each energy meter. This method creates awareness among the customers thereby avoiding unnecessary wastage of power. In this system the user has to connect the recharge card to recharging unit, and then the units will be loaded into recharge card.
II. PROCEDURE

The proposed model has the 8051 microcontroller as Central Processing Unit. The whole system is interfaced with 8051 microcontroller. The GSM modem is serially connected with the controller which is the major communication module between user and provider. The GSM uses its own network for the transfer of information. Special coding in embedded c is used for programming 8051 microcontroller using programmer hardware along with MP-LAB IDE software. The programming makes use of messaging features of GSM command. The power circuitry converts 230v AC to 12v DC with the use of step-down transformer and bridge rectifier. The relay acts as switching device to cut off and restore power supply.

The LCD is interfaced to microcontroller using parallel port connection. In this project the Microcontroller based system continuously records the readings and the live meter reading can be sent to the Electricity department on request. This system also can be used to disconnect the power supply to the house in case of non-payment of electricity bills. A dedicated GSM modem with SIM card is required for each energy meter. The microcontroller pulls the SMS received by phone, decodes it, recognizes the Mobile no. and then switches on the relays attached to its port to control the appliances. After successful operation, controller sends back the acknowledgement to the user’s mobile through SMS. The coding emphasis the fact that it reduces human labour but increases the efficiency in calculation of bills for used electricity .the user will have an universal number and they can recharge outlets of electricity board .the acknowledgement of recharged coupon detail will come to notice of the consumer and also will get displayed in LCD module.

So this process will bring a solution of creating awareness on unnecessary wastage of power and will tend to reduce wastage of power. This module will reduce the burden of energy providing by establishing the connection easily and no theft of power will takes place. The LCD display will displays the used amount and balance amount that can be used.

![Fig.1. Block diagram](image-url)
A. GSM Architecture

A GSM network is composed of several functional entities, whose functions and interfaces are specified. Figure shows the layout of a generic GSM network. The GSM network can be divided into three broad parts. The Mobile Station is carried by the subscriber. The Base Station Subsystem controls the radio link with the Mobile Station. The Network Subsystem, the main part of which is the Mobile services Switching Centre (MSC), performs the switching of calls between the mobile users, and between mobile and fixed network users. The MSC also handles the mobility management operations. Not shown are the Operations intendancy Centre, which oversees the proper operation and setup of the network. The Mobile Station and the Base Station Subsystem communicate across the Um interface, also known as the air interface or radio link. The Base Station Subsystem communicates with the Mobile services Switching Centre across the A interface.

Mobile Station:

The mobile station (MS) consists of the mobile equipment (the terminal) and a smart card called the Subscriber Identity Module (SIM). The SIM provides personal mobility, so that the user can have access to subscribed services irrespective of a specific terminal. By inserting the SIM card into another GSM terminal, the user is able to receive calls at that terminal, make calls from that terminal, and receive other subscribed services. The mobile equipment is uniquely identified by the International Mobile Equipment Identity (IMEI). The SIM card contains the International Mobile Subscriber Identity (IMSI) used to identify the subscriber to the system, a secret key for authentication, and other information. The IMEI and the IMSI independent, thereby allowing personal mobility. The SIM card may be protected against unauthorized use by a password or personal identity number.

Base Station Subsystem:

The Base Station Subsystem is composed two parts, the Base Transceiver Station (BTS) and the Base Station Controller (BSC). These communicate across the standardized Abis interface, allowing (as in the rest of the system) operation between components made by different suppliers. The Base Transceiver Station houses the radio transceivers that define a cell and handles the radio-link protocols with the Mobile Station. In a large urban area, there will potentially be a large number of BTSs deployed, thus the requirements for a BTS are ruggedness, reliability, portability, and minimum cost. The Base Station Controller manages the radio resources for one or more BTSs.

It handles radio-channel setup, frequency hopping, and handovers, as described below. The BSC is the connection between the mobile station and the Mobile service Switching Centre (MSC).

Network Subsystem:

The central component of the Network Subsystem is the Mobile services Switching Centre (MSC). It acts like a normal switching node of the PSTN or ISDN, and additionally provides all the functionality needed to handle a mobile subscriber, such as registration, authentication, location updating, handovers, and call routing to a roaming subscriber. These services are provided in conjunction with several functional entities, which together form the Network Subsystem. The MSC provides the connection to the fixed networks (such as the PSTN or ISDN). Signaling between functional entities in the Network Subsystem uses Signaling System
Number 7 (SS7), used for trunk signaling in ISDN and widely used in current public networks.

The Visitor Location Register (VLR) contains selected administrative information from the HLR, necessary for call control and provision of the subscribed services, for each mobile currently located in the geographical area controlled by the VLR. Although each functional entity can be implemented as an independent unit, all manufacturers of switching equipment to date implement the geographical area controlled by the MSC corresponds to that controlled by the VLR, thus simplifying the signaling required. VLR together with the MSC, so that the Note that the MSC contains no information about particular mobile stations --- this information is stored in the location registers. The other two registers are used for authentication and security purposes. The Equipment Identity Register (EIR) is a database that contains a list of all valid mobile equipment on the network, where each mobile station is identified by its International Mobile Equipment Identity (IMEI). An IMEI is marked as invalid if it has been reported stolen or is not type approved. Card which is used for authentication and encryption over the radio channel.

The Authentication Centre (AUC) is a protected database that stores a copy of the secret key stored in each subscriber's SIM card, which is used for authentication and encryption over the radio channel.

**Fig.2. GSM Architecture**

SIM: Subscriber identity module  
BSC: Base station controller  
MSC: Mobile switching center  
ME: Mobile equipment  
HLR: Home location register  
VLR: Visitor location register  
BTS: Base transceiver station  
Auc: Authentication center  
EIR: Equipment identity register
B. MAX 232 (Communication Interface)

RS-232 was created for one purpose, to Interface between Data Terminal Equipment (DTE) and Data Communications. International Conference on Computing and Control Engineering (ICCCE 2012), 12 & 13 April, 2012 ISBN 978-1-4675-2248-9 © 2012 Published by Coimbatore Institute of information Technology Equipment (DCE) employing serial binary data interchange. So as stated the DTE is the terminal or computer and the DCE is the modem or other communications device. RS 232 is the most widely used serial I/O interfacing standard. In RS 232, a 1 is represented by -3 to -25 v. while a 0 bit is +3 to + 25 v, making -3 to +3 undefined. For this reason, to connect any RS 232 to a microcontroller system we must use voltage converters such as MAX 232 to convert the TTL logic levels to the RS 232. Voltage level, and vice versa. This chip is used when interfacing micro controller with PC to check the Baud rate and changes the voltage level because micro controller is TTL compatible whereas PC is CMOS compatible.

C. Embedded Processor

In the proposed work, the power consumption circuit and GSM module are interfaced through the ports of standard microcontroller AT89C52. The AT89C52 is a low power, high performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel’s high density non-volatile memory technology and is compatible with the industry-standard 80C51 and 80C52 instruction set and pinout. The processor Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip and Atmel AT89C52 is a powerful microcomputer which provides a highly-flexible and low cost solution to many embedded control applications. The AT89C52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, three 16-bit timer/counter, a six-vector two-level interrupt architecture, full-duplex serial port, on-chip oscillator and clock circuitry. The extension of ports can be done by using 8255 standard PPI.

Here we use 8051 microcontroller with embedded C language. This 8051 module is interfaced with GSM modem, LCD module, EB meter, load e. t. c. As already mentioned the billing system is an prepaid system. When power is being consumed the readings got noted by EB meter and displayed by LCD. When maximum consumption is reached and there is a need of recharge it is displayed by LCD and information is passed to the microcontroller. The controller is programmed in such a way that it sends the information to consumer module which is nothing but a cell phone .If consumer did not recharge within specified time then a message is sent from GSM modem connected to PC at electricity office to GSM modem connected to microcontroller which automatically disconnects the power supply to that particular consumer. When consumer recharges his/her balance then again message is sent from electricity board to controller that connection is reestablished. Hence the process is fully automatic.

AT89S52 FEATURES
- Compatible with MCS®-51 Products
- 8K Bytes of In-System Programmable (ISP) Flash Memory
- Endurance: 1,00,000 Write/Erase Cycles
- 4.0V to 5.5V Operating Range
- Fully Static Operation: 0 Hz to 33 MHz
- Three-level Program Memory Lock
- 256 x 8-bit Internal RAM
• 32 Programmable I/O Lines
• Three 16-bit Timer/Counters
• Eight Interrupt Sources
• Full Duplex UART Serial Channel
• Low-power Idle and Power-down Modes
• Interrupt Recovery from Power-down Mode

D. Interfacing with the GSM Module

GSM introduction: Global system for mobile communication is globally accepted standard for digital cellular communication. The microcontroller output is not compatible with the GSM module. To make it compatible, we require the DB9 Connector and the MAX 232 connector. This will enable the microcontroller to send a message to a predefined phone number. Here MAX232 acts as a driver which converts TTL levels to RS232 levels. For serial interference, the GSM modem requires the signal based on RS232 levels. The T1_OUT and R1_IN pin of MAX232 is connected to the TX and RX pin of the GSM modem.

C. LCD Interface with Microcontroller

An HD44780 Character LCD is an industry standard liquid crystal display (LCD) display device designed for interfacing with embedded electronics. These screens come in common configurations of 8x1 characters, 16x2, and 20x4 among others. The largest such configuration is 40x4 characters, but these are rare and are actually two separate 20x4 screens seamlessly joined together.

The most commonly used LCDs found in the market today are 1 Line, 2 Line, or 4 Line LCDs which have only one controller and support at most 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers. Apart from displaying some simple static characters, you can create animated text scripts and a lot more! LCD in the proposed system. The system also consists of a display system having a LED and an alarm system. When the meter is working LED glows when GSM module sends the message. The buzzer will also buzz indicating the message is sent or received.

LCD module has 8-bit data interface and control pins. One can send data as 8-bit or in pair of two 4-bit nibbles. To display any character on LCD, the microcontroller has to send its ASCII value to the data bus of LCD. For e.g., to display 'AB' microcontroller has to send two hex bytes 41h and 42h respectively. LCD display used here is having 16x2 sizes. It means 2 lines each with 16 characters. In our proposed system, we can find power usage instantaneously through the readings of this LCD. As we are using prepaid systems this very useful to know when to recharge and how many units still left for usage.

D. ENERGY METER

The STPM01 is able to perform active, reactive, and apparent energy measurements, RMS and instantaneous values for voltage and current, line frequency information. Most of the functions are fully programmable using internal configuration bits accessible through SPI interface. The most important configuration bits are the two application bits. Using these bits the STPM01 can be programmed as peripheral in microcontroller-based meter systems or as a standalone meter device.

![Fig.3. Hardware design](image-url)
III. CONCLUSION:
The proposed methodology is used to generate prepaid card for usage of electricity for all areas by the use of GSM technology. This method generates the message to the consumers either by day basis or weekly basis as per consumer requirements and also by the request of consumer at a moment. This technology will minimize the wastage of electricity and saves the power for future generation. GSM network infrastructure provides efficient wireless automatic meter reading, distribution control and making fast billing system, accurate, effective and reduction of labour cost of operation.

IV. Experimental results
This report explains that we know how much power is consuming and remaining units will be displayed in LCD.

![Fig.4.Units display on LCD](image)
When no of units is low then GSM mobile sends message to our mobile as “low balance please recharge”. If the total units are consumed then it sends the message as “power of due to insufficient balance” displayed as shown the below LCD. For continuing power supply we recharge the mobile to some amount.

![Fig.5.Text message on LCD](image)

V. REFERENCES


AUTHORS:
1. O.Vijaya lakshmi B.Tech 4th year (ECE)
2. N.Syamala B.Tech 4th year (ECE)
3. B.Sunil kumar B.Tech 4th year (ECE)