Portal Based Smart Billing System of Energy

Chirag Jain[1], Akshay Sharma[2], Bhanu Pratap Singh Rathore[3], Deepika Kerwal[4], Abhinandan Jain[5]

SKIT, Jaipur, India[1,2,3,4,5]

Email: 31chiragjain@gmail.com, sharmaakshay3414@gmail.com, bhanurathore1800@gmail.com, deepika98kerwal@gmail.com, jainabhinandan86@gmail.com

Abstract: **The aim of the system is to develop a system that will reduce the power loss due to power thefts and the hassle of paying the bill. Consumption of energy is increasing due to multiple factors and to improve the energy efficiency, consumers need to be more aware of their energy consumption. Recently, utilities have started developing new electric energy meters which are known as smart meters. Smart meters will enable two-way and real-time communication between the consumers and the provider. The meter which we are going to develop compute the energy and transfer the details to the energy provider, and notify the user through SMS messages. The traditional system will be replaced with the proposed system and enables multiple new features which will be beneficial for both energy provider and user. One of the benefit is that the meter readings can be monitored remotely without the person visiting each house.**

Keywords: *Arduino UNO, Smart/Energy meter, Optocoupler, GSM module, Relay, LCD.*

I. INTRODUCTION

The specific application of this embedded system describes a single phase energy meter. The components measures the active energy and current. It also allows the user to recharge the account using GSM technology. The system will work as long as the account has pending balance. The system first accepts the request and allows using only limited units of energy as per recharge and then cut off the supply until it is not recharged again. The user can get the information on the registered mobile if anything goes wrong. All the energy meter details can also be seen on the website.

II. LITERATURE SURVEY

Different methods have been implemented and analysed for measuring the energy utilization. This will describe different wireless technology for meter reading. The major wireless technologies like Zig Bee, Global standard for mobile communication (GSM), Power line communication (PLC), Radio frequency identification (RF-ID) method and Bluetooth. The present scenario of these technologies will be present here.

Table 1: Literature Survey

Description	Citation
Main idea is to construct a power line communication (PLC) which will be based on automated meter reading system	[1]
Emphasized on controlling of energy in industry, many experiments and readings has taken before deciding the solution to reduce consumption	[2]
Idea is to collect the data of meter reading with the help of Bluetooth technique	[3]
Presented the design of Prepaid Energy Meter on Proteus	[5]
Proposed the GSM based smart energy meter with the idea to computerize billing procedures and consumption of electric power	[6]
Proposed Pre-Post-Paid Smart Energy Meter with the addition of alarm and theft control	[7]

III. BLOCK DIAGRAM

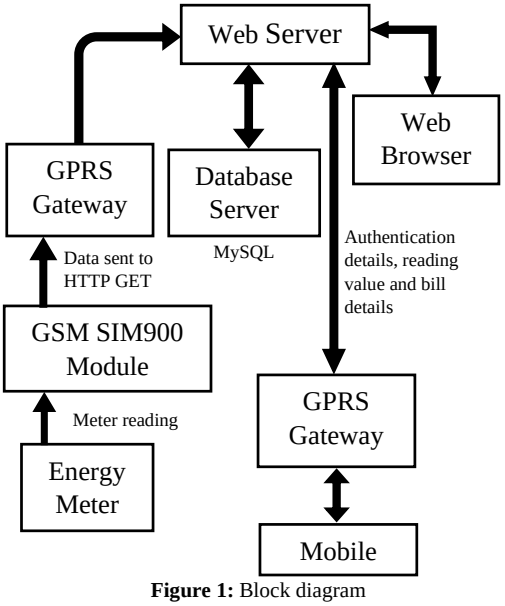

Figure 1: Block diagram

As the meter starts it display pulse and unit. Then, it checks for the message, if received or not because all the communication between energy meter and the user is done through text messages. As the messages is received it checks for authentication and dues. If there are any dues it disconnect the power supply till the dues are cleared. As soon as the dues are cleared it read the data in the memory and send pulse to the authenticated number. Then it

checks for the power status, if it's ON then it directly goes to first step which displays the pulse, unit and start counting the unit (increment pulse and unit), the balance reduces with the consumption of the load. At a particular balance, the user is alerted through an SMS. The messages will be beneficial for the user to take required actions. If the power is OFF then it only displays the pulse and unit.

III. HARDWARE DESCRIPTION

Table 2: Hardware Description

Sr. No.	Component	Description
1.	Energy Meter	Having unit consumption standard ratings of 1600 imp/kWh and 3200 imp/kWh indicates the calibration of LED blinks for 1600 times and 3200 times respectively indicating 1 unit energy consumption.
2.	Arduino UNO	Open source microcontroller based on ATmega328P microchip. The board is equipped with 6 analog pins and 14 digital pins used for interfacing with other circuits. The circuit designed has connection of arduino with energy meter through optocoupler.
3.	GSM Module SIM900	Global System for Mobile communication (GSM) used for establishing the communication between the GSM system and a computer. It requires SIM (Subscriber Identity Module) card to activate the communication between two or more networks. For identification, it has IMEI (International Mobile Equipment Identify) number.
4.	Optocoupler 4N35	It galvanically separates the microcontroller from any potentially dangerous voltage or current existing in its surrounding. It uses a short optical transmission path for transferring of signal to different elements of circuit, while keeping them electrically remote.
5.	LCD Module 16x2	It is an electronic display module. For producing a visible image it uses a liquid crystal. Commonly 16×2 LCD display is used for embedded projects. In this each character is being displayed in a 5×7 pixel matrix.

AT command:
AT is the abbreviation of ATtention. AT commands are used to communicate with GSM module. Every command line starts with "AT" or "at".

Table 3: Few AT Commands

Command	Description
AT+CMGS	Send SMS message to GSM
AT+CMSS	Send SMS message from storage
AT+CMGR	Read SMS message
AT+CMGW	Write message to memory
AT+CMGC	Send command
AT+CMMS	More messages to send
AT+CMGL	List all the messages

IV. METHODOLOGY

The interfacing of components will go in serial manner.

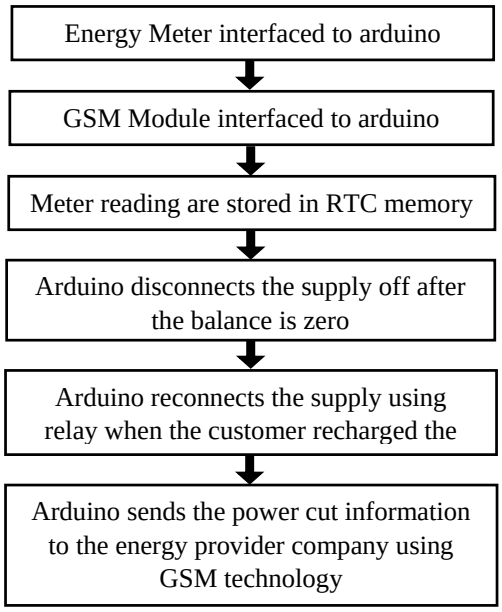

Figure 2: Methodology

In start energy meter will be interfaced with arduino then GSM module will get interfaced to check if the connection is establish or not. If yes, then the meter reading will stored in RTC memory to check the unit consumed and alert the user to recharge using GSM technology.

V. UNIT CALCULATION

Pulsating LED will blink 3200 times to indicate the 1 unit of consumption. So, 3200imp/kWh = 1 unit.

$$\text{Consumed unit} = \frac{\text{Number of pulses}}{3200}$$

Let's say number of pulses are 3000 then consumed unit can be calculated as,

$$\text{Consumed unit } = \frac{3000}{3200} = 0.9375$$

$$\text{Unit Charge} = \text{Consumed unit} * \text{Rate of a unit(Rs.)}$$

Let's say rate of a unit is 10 Rs. then unit charge can be calculated as,

Unit charge = Consumed unit * Rate of a unit (Rs.)

$$\text{Unit charge} = 0.9375 * 10$$

$$\text{Unit charge} = 9.375 \text{ Rs.}$$

VI. SOFTWARE IMPLEMENTATION

Proteus:

The Proteus Design Suite is a software tool suite used primarily for electronic design automation (EDA). The software is used to create schematics and electronic prints for manufacturing printed circuit boards (PCBs).

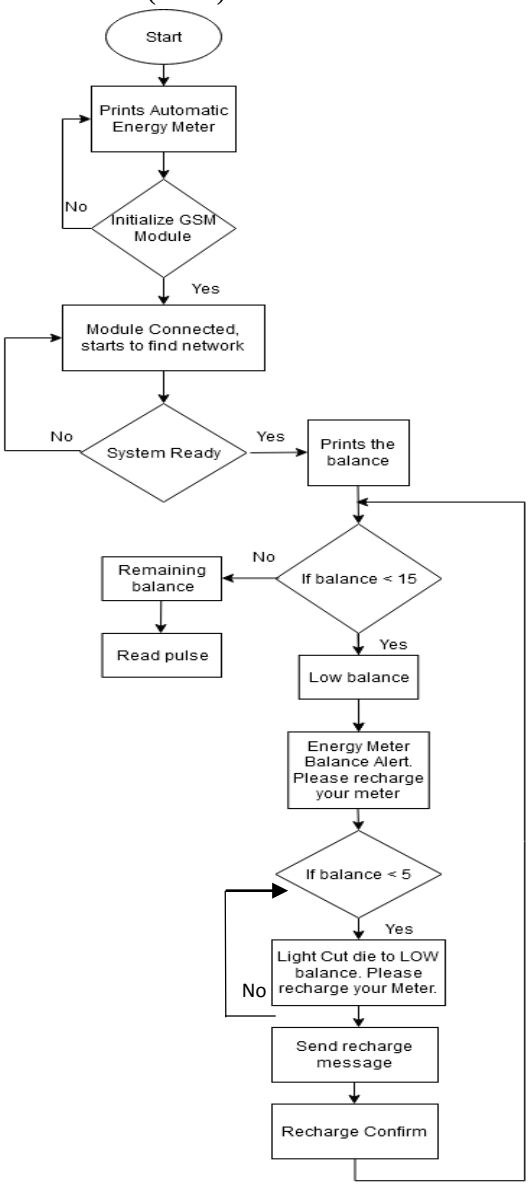

Figure 3: Flow Chart

Energy meter continuously display the meter reading in pulse and unit. Then, it checks for the message, if received or not because all the communication between energy meter and the user is done through GSM communication. Energy meter received the message through GSM communication then it checks for authentication and dues. If any unauthorized person trying to access the system then it sends alert to the energy provider company. If there are any dues it disconnect the power supply till the dues are cleared. As soon as the dues are cleared it read the data in the memory and send pulse to the authenticated number. Then it checks for the power status, if it's ON then it directly goes to first step which displays the pulse, unit and start counting the unit (increment pulse and unit), the balance reduces with the consumption of the load. At a particular balance, the user is alerted through an SMS. The messages will be beneficial for the user to take required actions. If the power is OFF then it only displays the pulse and unit.

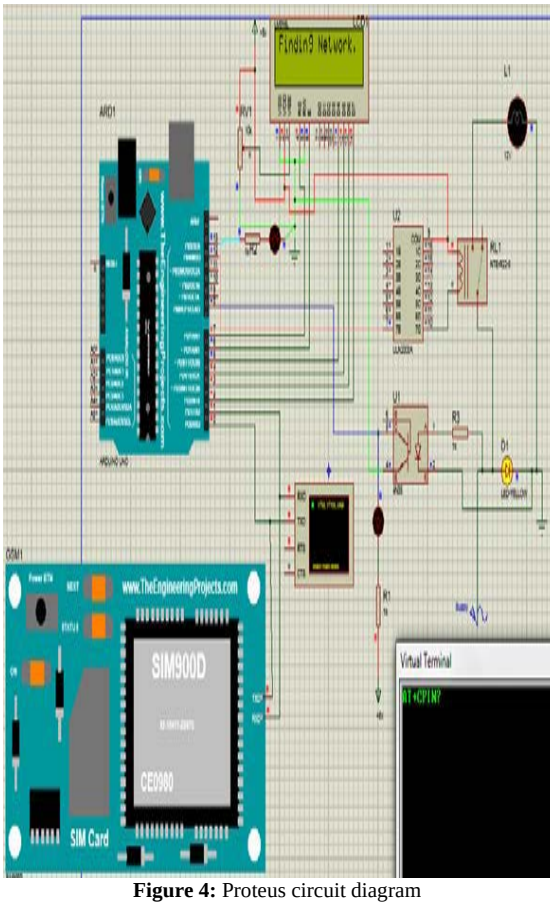

Figure 4: Proteus circuit diagram

Figure 4 show the Proteus Design circuit of portal based energy meter. In this project ardunio is the controlling elements. Ardunio are interfaced with LCD (16x2), GSM modem, Energy meter (Energy meter library not available so LED use for pulse and unit) with the help of optocoupler.

Website designing:

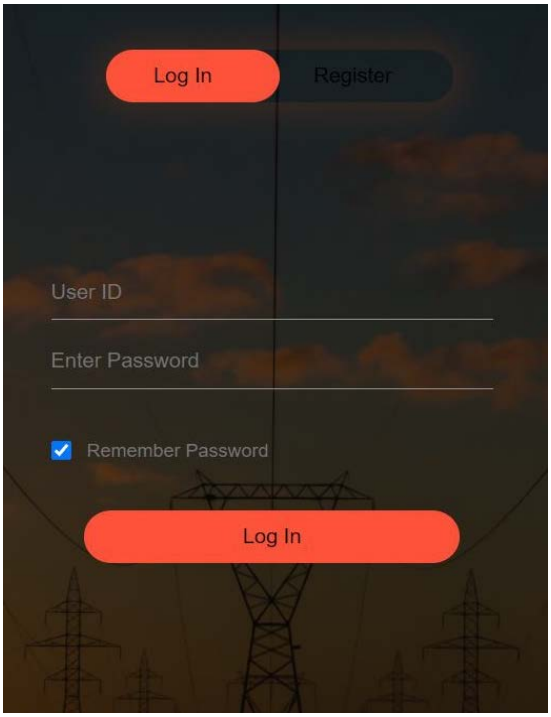

Figure 5: Login Page

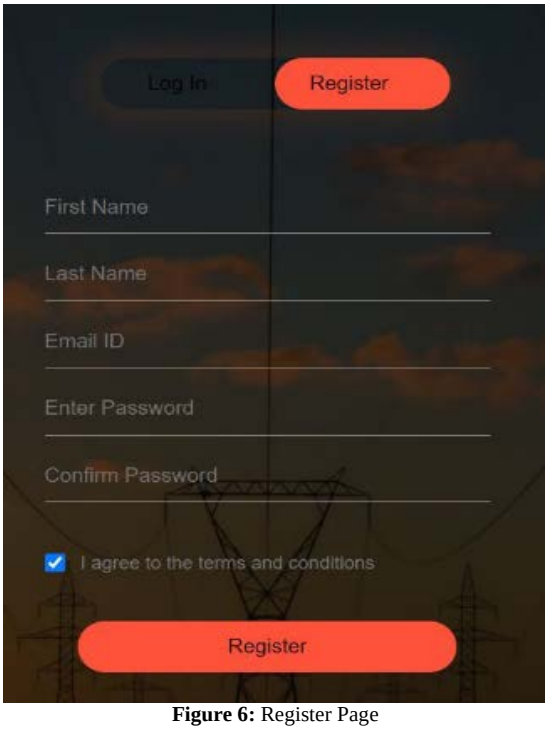

Figure 6: Register Page

Login Page and Register Page is shown in fig. 5 and 6. If the user is registered then with the credentials the user can easily login and can access the profile where all the details are mentioned related to energy meter.

If the user is not registered then after filling all the necessary information and after getting the credentials the user can login and access the profile where all the details are mentioned related to energy meter.

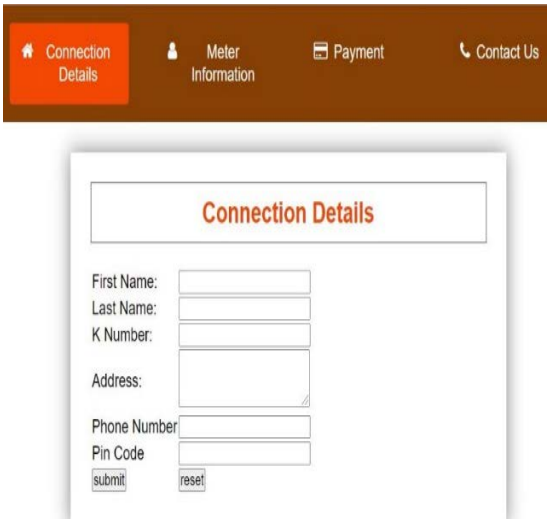

Figure 7: Connection Details

User can access this section after login with the credentials. Here all the details are pre-filled and user can easily access to the information. If there is any detail which is not correct according to the user then the user can edit it and submit it and then the request will go to the energy provider for verification.

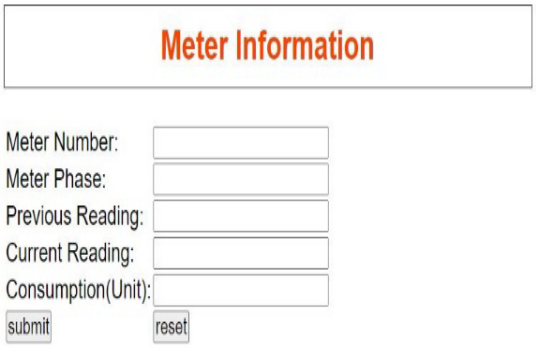

Figure 8: Meter information

This is the second tab on the Index page. Here the user will see the meter consumption and other details.

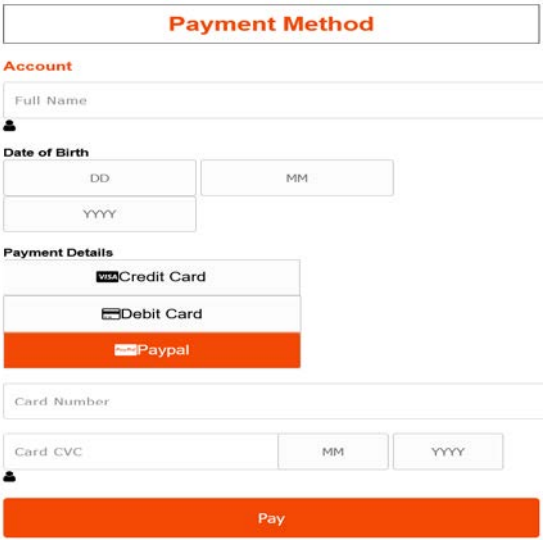

Figure 9: Payment Method

This is the third tab on the index page. Here the user can recharge the meter after the payment.

VII. HARDWARE IMPLEMENTATION

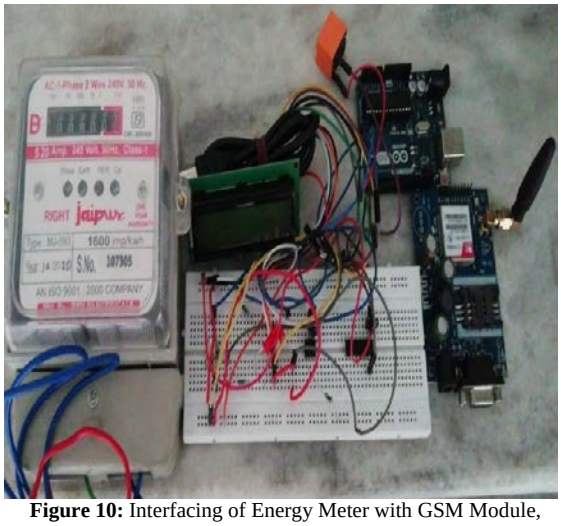

Figure 10: Interfacing of Energy Meter with GSM Module, Arduino and LCD

In the fig. 10 all the hardware components is shown. The components used are Energy meter (single phase), LCD (16x2), GSM SIM900 module, Arduino UNO, 5pin relay, optocoupler (4N35), ULN2003A (relay driver), LED's, Resistors.

VIII. CONCLUSION

The system is designed to allow the amount of energy to be used as long as the account is not zero. The system allows the user to recharge the account using GSM. The consumer can see all the details (like meter specification, meter details, meter readings, consumed balance, remaining balance, etc.) of the meter in real time on a web portal easily and recharge through the mobile number by sending commands to the energy meter through GSM module. So after the successful completion of the proposed product it can be utilized in Households, offices, factories. Also, with this new system one can save with energy efficient improvements.

IX. REFERENCES

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