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Smart Energy Meter

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Abstract
Electricity is one of the fundamental necessities of human beings. Smart Energy Meter (SEM) is an electric device having an energy meter chip for measuring the electric energy consumed and wireless protocol for data communication. Smart Energy Meter can be used for automatic metering and billing systems. In this meter energy is utilized and the corresponding amount will be displayed on the LCD continuously and communicated to the controlling base station. Communication between user/household and substation is done. This meter can work as a prepaid meter. Presently maintenance of the power is also an important task as the human operator goes to the consumer's house and produces the bill as per the meter reading. Going to each and every consumer's house and generating the bill is a laborious task and requires a lot of time. They can monitor the meter readings regularly without the person visiting each house. This energy meter will be useful for the people who cannot concentrate on energy meter readings due to their busy schedule. A device is built that can display power consumption and total cost of every month. This setup helps the consumers by letting them know about the peak loads (maximum energy consumption), energy consumed, billing status etc. The Energy meter readings are being sent to microcontroller and further based on calculations and visual alerts are generated. The meter readings are continuously stored in permanent memory. Moreover, it can send cost and usage information to consumers through IoT gateway.

Keywords:*GSM,SPWM,ESP8266 wifi,Node MCU,Relay.*

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I. INTRODUCTION

With the rapid developments in the Wireless communication technology by the use of micro-controllers, there are many improvements in automating various industrial aspects for reducing manual efforts. The traditional manual meter reading was not suitable for longer operating purposes as it spends much human and material resource. It brings additional problems in calculation of readings and billing manually. Now-a-days the number of electricity consumers is increasing in great extent. It became a hard task in handling and maintaining the power as per the growing requirements. Presently maintenance of the power is also an important task as the human operator goes to the consumer's house and produces the bill as per the meter reading. If the consumer is not available, the billing process will be pending and human oper-ator again needs to revisit. Going to each and every consumer's house and generating the bill is a laborious task and requires lot of time. It becomes very difficult especially in rainy season. If any consumer did not pay the bill, the operator needs to go to their houses to disconnect the power supply. These processes are time consuming and difficult to handle. Moreover, the manual operator cannot find the unauthorized connections or malpractices carried out by the consumer to reduce or stop the meter reading/power supply. The human error can open an opportunity for corruption done by the human meter reader. So the problem which arises in thebilling system can become inaccurate and inefficient.
The conventional energy meters have a great contribution in dissipation of energy.They are post-paid meters, so customers cannot keep track of their energy consumption, except on a monthly basis. Smart meters are electronic measurement devices used by utilities to commu-nicate information for billing customers and operating their electric systems . In this paper, the Node MCU technology ,GSM and ATMega328Pis used .Node MCU is a small board, based on the cheap ESP-12 Wi-Fi module containing a single-chip ESP8266 Wi-Fi SoC. The Node MCU is an open-source firmware and development kit that helps you to prototype your IOT product withina few Lua script lines.

The smart meter is connected to AC mains supply of the house in order to measure the current and voltage readings. Then the power and energy consumption is calculated. The smart meter

has a transmitter which sends energy consumption data periodically to the Gateway over Node MCU network. The gateway receives the data and uploads it to the utility provider's cloud/-database using internet connection. The utility provider monitors the data and manages the customer's billing information.

II. METHEDOLOGY

Thecurrent system of electricity billing is error level and also time consuming. Errors introduced at every stage are due to electro-mechanical meters, human errors while noting down the meter reading, errors while processing the paid bills and the due bills. Smart energy meter is a technique which can reduce the problems associated with billing and also reduces the deployment of manpower for taking meter readings. It has many advantages from both suppliers as well as consumer's point. This paper is also intended to present an overview of prepaid energy meter, which can control the usage of electricity on consumer side to avoid wastage of power. As the billing process is done automatically in the proposed system it mainly reduces the man power.

The proposed system has two sections mainly,one is Home Section and another one is Electrical Base Station (EB). Communication between these two sections is done through wireless network. This system monitors the load, monitoring means calculating the power consumed exactly by the user at a given time.Energy utilized and the corresponding amount will displayed on LCD continuously and communicated to the controlling base station. The feedback from the user helps in identifying and controlling the power theft. An SMS containing monthly bill along with the due date is sent to the respective meter owner using GSM module which is present in the EB section. This module also helps in alerting the authorized people through anSMS

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Modification

At the time of peak period during the day automatically non priority load are turned off.Non priority load includes additional load supply example extra light, equipments.

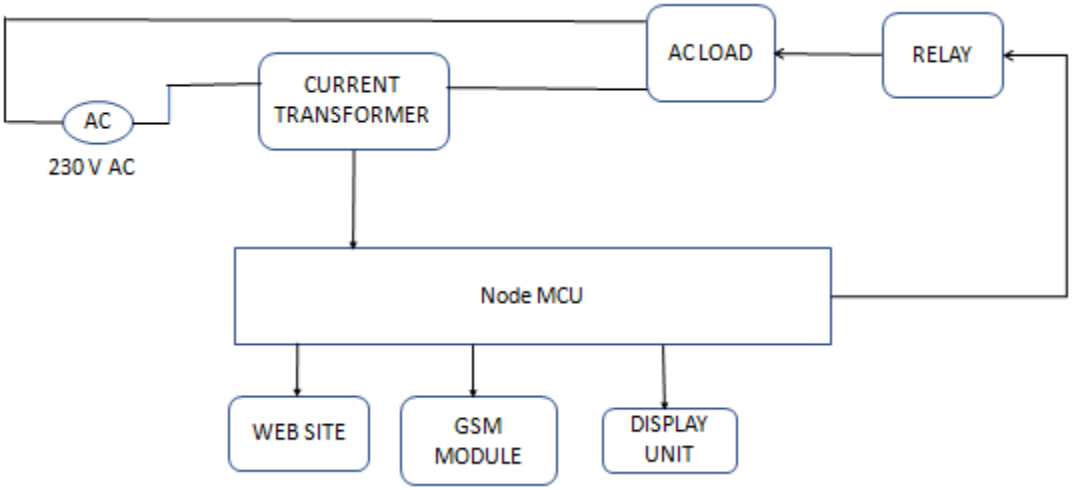

Figure 1: Flow chart of Smart Energy Meter

III. THE SIMULATION

AC supply is fed to the current transformer and voltage transformer module.Voltage transformer circuit consist of an AC voltmeter,Diode and Capacitor[D1 and C1]which act as a Half wave rectifier for rectifying the input supply.A resistor R1, variable resistor and a capacitor C1 is also present in the circuit.Variable resistor is used for controlling the current and voltage value to 5V and for controlling the current in CT.Capacitor C1 is for further rectification.Similarly in CT also it consist of these elements.Then these measured analog values are given to the arduino.

The 5 lamps are connected in series to make it a heavy load.And 4 SW-SPST switched are provided to disconnecting the lamps..If we use only one lamp ,then we need more time to demonstrate the energy consumption.

These lamps are connected to DC 12 V relay and to the transistor.BC547 transistor is used for converting the high current value to milliampere range.
When all switches are on (open state), all the lamps will consume energy .If switch SW1 is off (closed state), it will make a less resistive path .Therefore the current will flow through it and remove the lamp L1 from the circuit.Similarly other switches.
n Display the measured values like voltage , current , power consumed ,unit , Balance and rate are displayed .Alerts like Please recharge , Zero balance are also displayed.

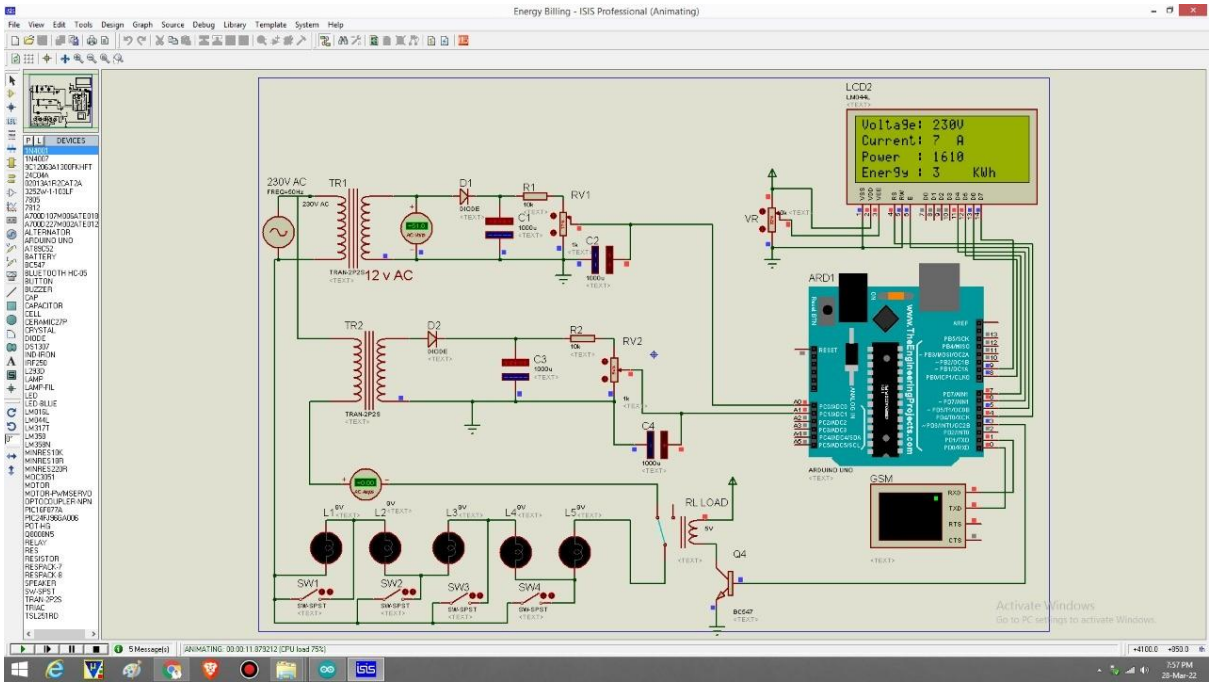

Figure 2 :Simulation Diagram

IV. SIMULATION RESULTS

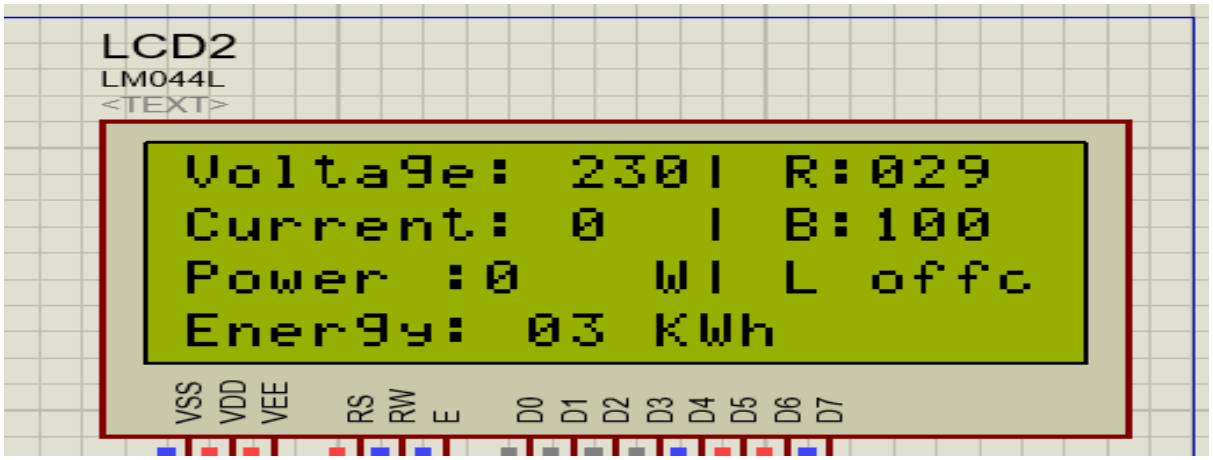

Figure 3 :Display unit

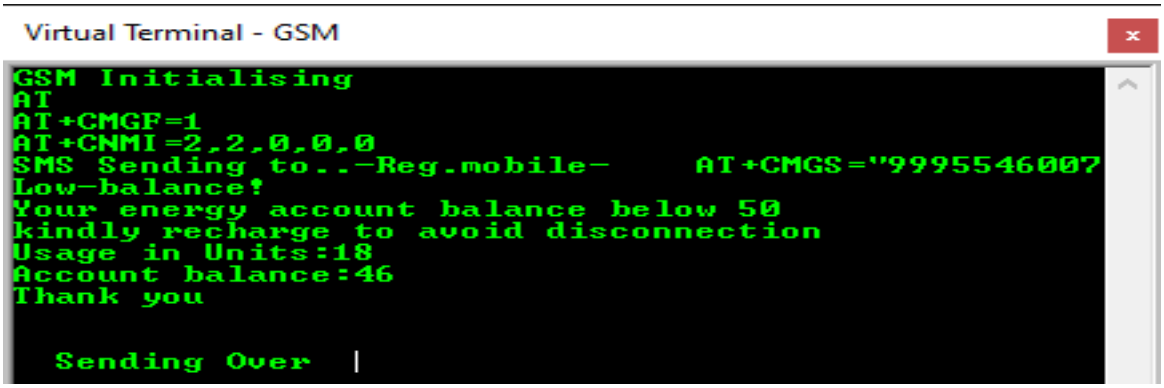

Figure 4:Simulation Output

V. HARDWARE IMPLEMENTATION

The proposed system is tested using three lamps and achieved good results. Figure shows the actual photographs of the proposed system.Node MCU is interfaced with GSM module,LCD Display ,Current transformer module and ATMega328p module.Figure 5.2 shows the connection of the proposed system. For demonstration purpose,Two 100 Watt and one 200 Watt bulb is used as load to examine our system. m. The bulb is connected to load and the current transformer , which is used to measure the average real power information. The test is performed and power consumption is observed. During this period the bulb glows continuously which is shown in Figure 5.3. After the due date,if it is not recharged controller turned off the bulb through the relay, which proves the accuracy of our system in terms of the power and calculation remote controlling.Figure shows the message alert that are received by the consumer.Messagelike unit consumed ,balance etc are given .And alerts like please recharge and zero balance are also given.

Figure 5:Hardware

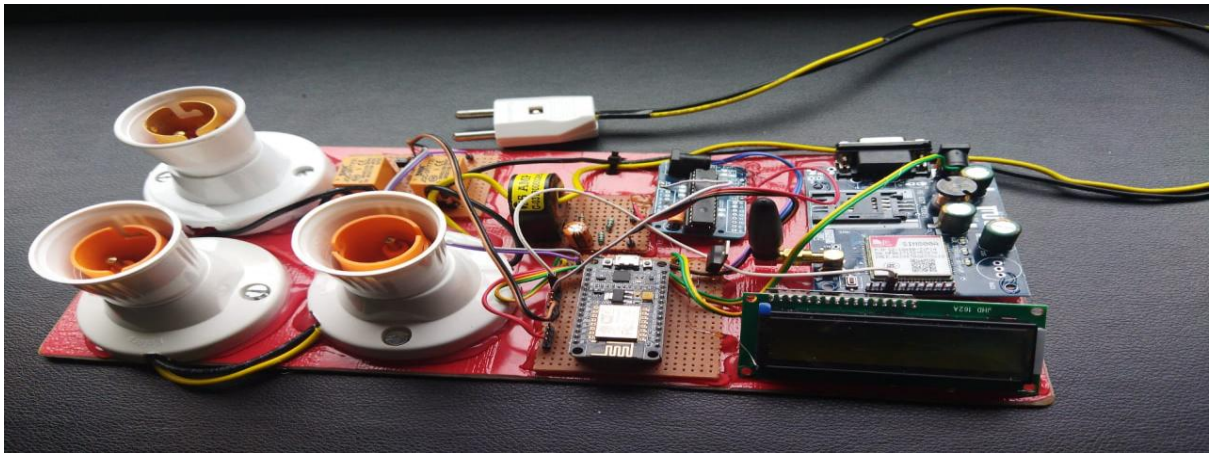

Figure 6:Hardware connection

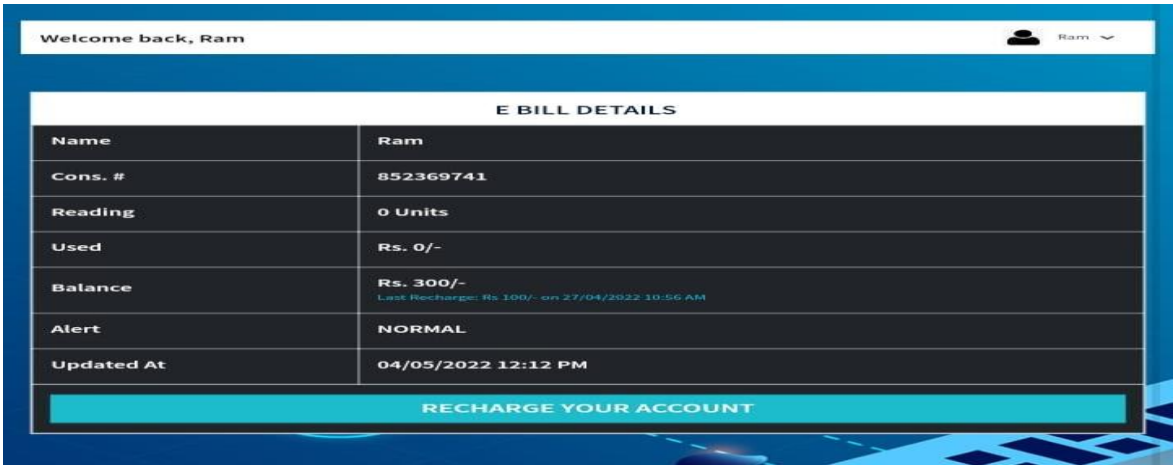

Figure 7: Website

VI. CONCLUSION

The progress in technology about electrical distribution network is a non-stop process. In the present work wireless meter reading system is designed to continuously monitor the meter reading and to shut down the power supply remotely whenever the consumer fails to pay the bill. It avoids the human intervention, provides efficient meter reading, avoids the billing error and reduces the maintenance cost. It displays the corresponding information on LCD for user notification. The advantages of Smart Energy Meter are it requires less manpower, there is no need to chase payments, bill is sent to the consumer with due date, the meter can act as either prepaid meter, can minimize the power consumption in a house.The conservation of energy is much needed in the modern world. This proposed design of smart metering contributes to energy conservation and also reduces human effort in billing. The user just needs to buy and install the smart meter. Website can be easily assessed by using a smart phone.In the present work wireless meter reading system is designed to continuously monitor the meter reading and to shut down the power supply remotely whenever the consumer fails to pay the bill. It avoids the human intervention, provides efficient meter reading, avoid the billing error and reduce the maintenance cost. It displays the corresponding information on LCD for user notification.

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