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# "Design of Prepaid Electricity Billing System using Arduino"

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**Abstract:** Energy Meters in India have dominantly been electrochemical in nature but are gradually being replaced by more sophisticated and accurate digital and electronic meters. A high percentage of electricity revenue is lost to power theft, incorrect meter reading and billing, and reluctance of consumers towards paying electricity bills on time. Considerable amount of revenue losses can be reduced by using Prepaid Energy Meters. A Prepaid energy meter enables power utilities to collect energy bills from the consumers prior to the usage of power by delivering only as much as what has been paid for. The proposed prepaid meter is implemented in a software model and Matlab has been used for simulation.

**Keywords:**

## I. INTRODUCTION

The Electrical metering instrument technology has come a long way from what it was more than 100 years ago. From the original bulky meters with heavy magnets and coils, there have been many innovations that have resulted in size & weight reduction in addition to improvement in features and specifications. Resolution and accuracy of the meter have seen substantial improvements over the years. Introduction of the digital meter in the later part of last century has completely changed the way Electrical parameters are measured. Starting with Voltmeters & Ammeters, the digital meter has conquered the entire spectrum of measuring instruments due to their advantages like ease of reading, better resolution and rugged construction of particular significance is the introduction of the Electronic Energy Meter in the mid-eighties. Now a days, the energy consumption and energy distribution has become a big subject for discussion because of huge difference in energy production and consumption. In this regard, energy consumers are facing so many problems due to the frequent power failures; another important reason for power cuts is due to the un-limited energy consumption of rich people. In this aspect, to minimize the power cuts and to distribute the energy equally to all areas, some restriction should have over the power consumption of each and every energy consumer, and according to that the Government should implement a policy, by introducing Autonomous Energy Meters everywhere in domestic sector. Hence, the need has come to think on this line and a solution has to be emerged out.

## II. METHODOLOGY

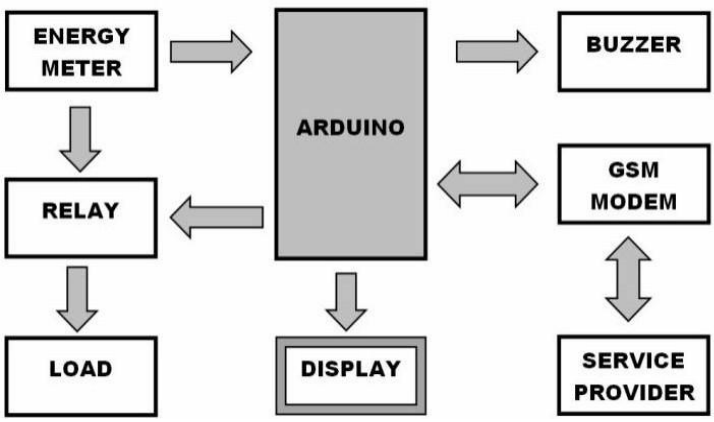


Figure 1: Block diagram

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In this system we are connecting energy meters to the internet i.e., IoT concept. This system eliminates the human involvement in electricity maintenance. The major components used in the system are Arduino micro controller, energy meters (main energy meter and sub energy meter), interfacing circuit (optocoupler), relay and relay driver circuit, LCD display and a PC. The main energy meters as well as the sub energy meter are connected to the Arduino microcontroller using an interfacing circuit. The interfacing circuit consists of an optocoupler. The basic design of an optocoupler consists of an LED that produces infra-red light and a semiconductor photo-sensitive device that is used to detect the emitted infra-red beam. The pulses from the energy meter are converted into digital signals. The live readings from the energy meters are collected by the microcontroller. This can be viewed through an LCD display which is connected to the micro controller. The LCD display shows the readings of the energy meters and the theft status.

During normal operation, the reading of the main energy meter should be equal to the sum of readings of sub energy meters. Since we are using only one sub energy meter the reading of both main and sub energy meters should be equal. A tolerance of 4 units is provided to account for the losses that may occur. If the readings of both energy meters are equal, the message "no theft" will be displayed in the LCD display. When energy theft occurs (i.e., a connection is tapped from the transmission line prior to sub energy meter), it will be read by main energy meter but not by the sub energy meter. This will result in discrepancies between the main and sub energy meter readings. When this difference is more than the tolerance provided, the message "Theft occurred" will be displayed in the LCD display. Then the relay will operate and this can be used for disconnecting the load. The readings from the energy meters are used for updating the contents of the web page. This web page can be assessed using the consumer number from anywhere on the globe at any time.The web page shows the readings of both main energy meter and sub energy meter and the theft status. Relay is used to makes and breaks the circuit by installing this system we can monitor the electrical loads from anywhere.

## III. CIRCUIT DESCRIPTION

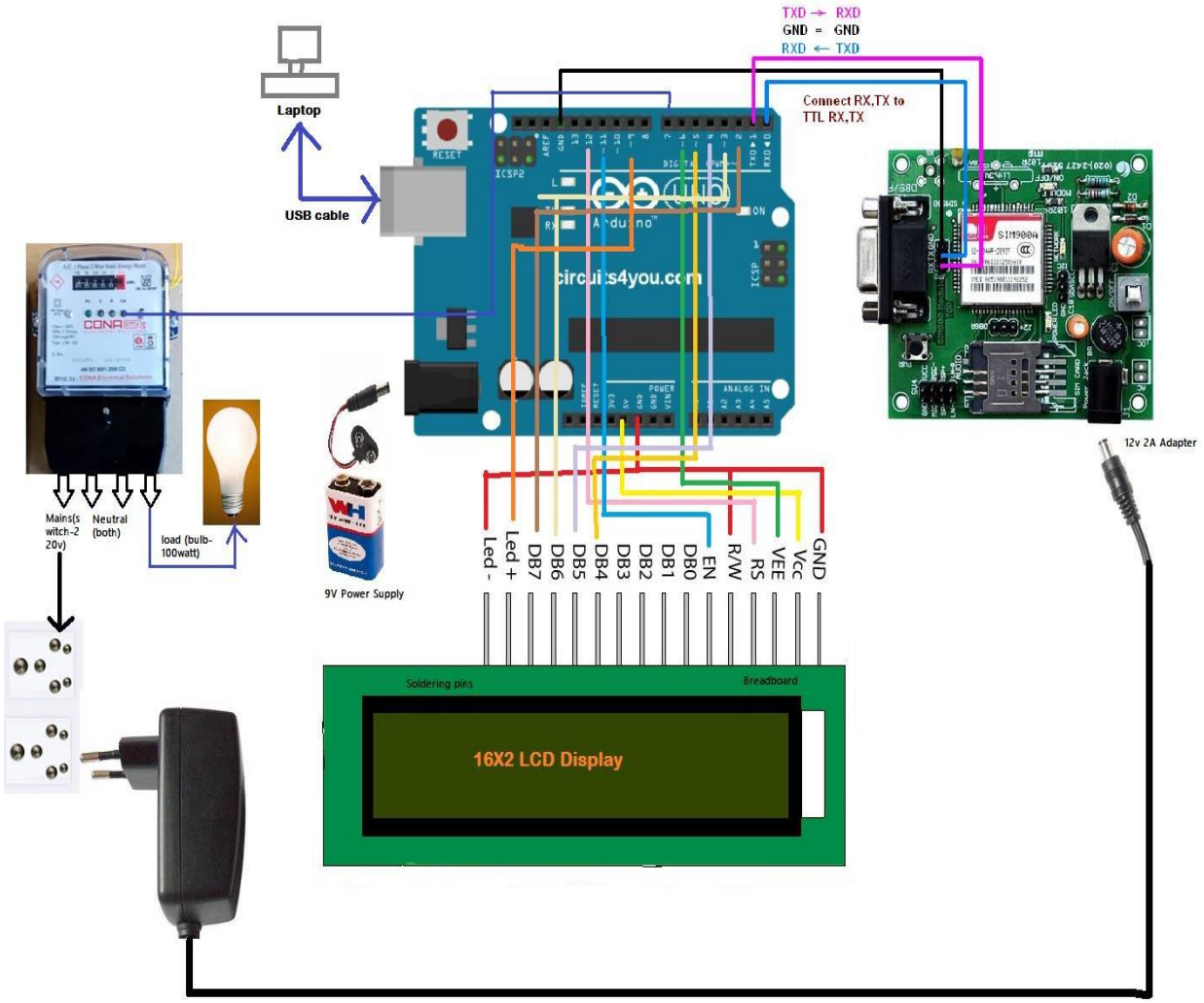


Figure 2: Circuit Description

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The complete circuit diagram is shown in Fig. In energy measure, the power information varying with time is calculated by a direct multiplication of the voltage signal and the current signal. The energy meter IC is producing impulses according to real power consumption. It calculates l KWh for 1600 impulses. For this the meter is rated as 1600imp/KWh. For every impulse the LED will blink. We have connected a Potentiometer to the LED which is used to adjust the contrast of the LCD. Arduino GSM shield is used for interfacing GSM modem with Arduino. It is a complete board contains all necessary pins and ports. The data communication pins are TX and RX. We have to connect TX pin of Arduino with RX pin of GSM modem and RX pin of Arduino with TX pin of GSM modem so that data communication occur. All ground pin GND must connect together. As it is an Arduino GSM shield the pin configuration is so made that we have to just put the GSM shield on the Arduino board. Before connecting the GSM shield to the Arduino board a valid SIM card must install in the SIM card port for wireless data communication over GSM protocol. After the power ON of the GSM shield the network light starts blinking fast until the detection of network coverage. When the network coverage is available, the NET light starts blinking slower than the previous. Sending the AT command to the modem, will response 'OK' after execution of every AT command which means that the modem is connected and interfaced successfully.

## IV. MESSAGE MODULE

This sketch sends a SMS message from an Arduino or Genuino board equipped with a GSM shield. Using the serial monitor of the Arduino Software (IDE), we should enter the number to connect with, and the text message to send.

Hardware Required
Arduino Board
GSM/GPRS Shield
SIM card

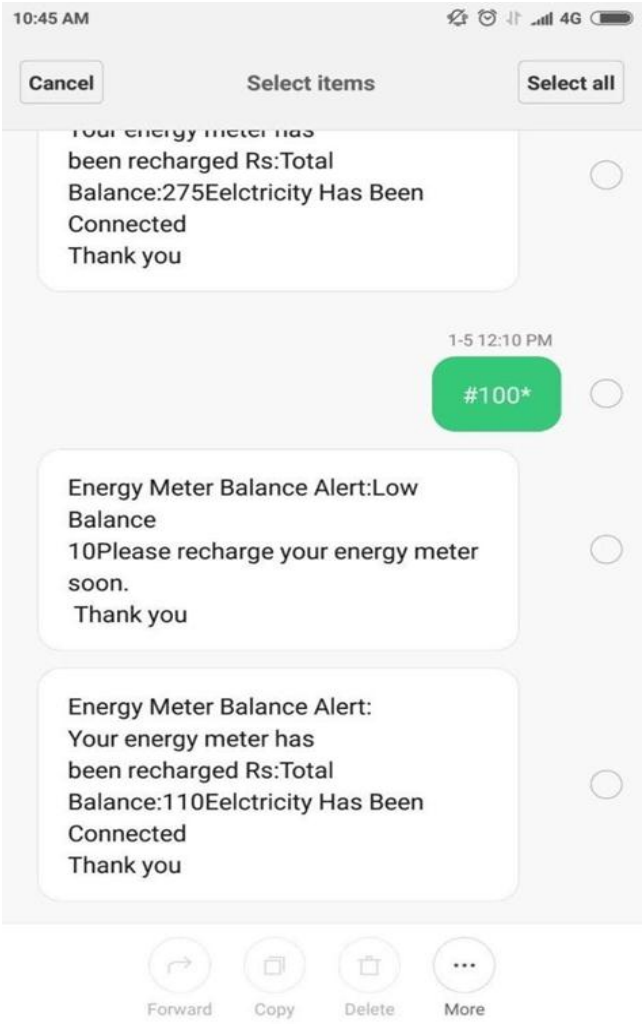

Figure 3: Mobile Message

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STEPS

1.Insert the SIM card to GSM module and lock it.
2.Connect the adapter to GSM module and turn it ON!
3. Now wait for some time (say 1 minute) and see the blinking rate of 'status LED' or 'network LED' (GSM module will take some time to establish connection with mobile network)
4. Once the connection is established successfully, the status/network LED will blink continuously every 3 seconds. We may try making a call to the mobile number of the sim card inside GSM module. If we hear a ring back, the gsm module has successfully established network connection.

Comments used to recharge and load control are as follows
• #amount*: This comment for recharge to account. Example #100* if we send this message to respective number for further recharge.
• #LN1*: To switch on the load.
• #LF1*: To switch off the load.

## V. CONCLUSION

In the era of smart city advancement, this project is concentrated on the connectivity &networking factor of the IoT. In this project, an energy consumption calculation based on the counting of calibration pulses is designed and implemented using Arduino Uno MCU in embedded system domain. In the proposed work, IoT based meter reading system is designed to continuously monitor the meter reading and service provider can disconnect the power source whenever the customer does not pay the monthly bill and also it eliminates the human involvement, delivers effective meter reading, prevent the billing mistake.

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