PREPAID ENERGY METER

Submitted in partial fulfilment of the requirements for the degree of

Bachelor of Engineering

In

Electrical Engineering

Submitted by

Mr. Gaurav Amrutrao Patil (94)

Mr. Mayur Bapusaheb Nandale (87)

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Under the Guidance of

Prof. Mohd. Mubashshir Ansari

Department Of Electrical Engineering

Smt. Indira Gandhi College of Engineering

Navi Mumbai-400701

(Affiliated To University of Mumbai)

2021-2022

CERTIFICATE

This is to Certify that the project synopsis title **"Prepaid Energy Meter Using GSM Module"** A Bonafede work of **"Gaurav Patil (94), Mayur Nandale (87), Piyush Ahire (01), Kaustubh Teli (124)"** submitted to the University of Mumbai in partial fulfilment of the requirement for the award of the degree of **"Postgraduate"** in **"Electrical Engineering"**.

Prof. M. M. Ansari
(Project Guide)

Dr. Deepak. N. Sajnekar
(Head of Electrical Department)

Dr. Sunil. S. Chavan
(Principal)

PROJECT REPORT APPROVAL

This Project Work Entitled **"Prepaid Energy Meter Using GSM Module"** By,

Gaurav Amrutrao Patil (94)

Mayur Bapusaheb Nandale (87)

Piyush Anil Ahire (01)

Kaustubh Vilas Teli (124)

Is Approved for The Degree of **Bachelor of Engineering in Electrical Engineering** of University of Mumbai, For the year 2020-21

Examiner

Dr. Madhwi Kumari

(L. T. C. O. E)

Date:

Place:

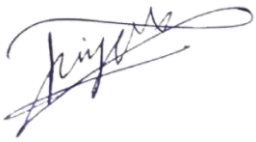
DECLARATION

We the undersigned, declare that the project entitled **"Prepaid Energy Meter Using GSM Module"**, being submitted in partial fulfilment for the award of bachelor of engineering degree in electrical engineering, affiliated to Mumbai University, is the work carried out by us. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/ data/ fact/ source in my submission. I understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Name: -

1. Gaurav Amrutrao Patil (94) 

2. Mayur Bapusaheb Nandale (87) 

3. Piyush Anil Ahire (01) 

4. Kaustubh Vilas Teli (124) 

Date: - _____

ACKNOWLEDGEMENT

It is indeed a matter of great pleasure and proud privilege to be able to present this project on **"Prepaid Energy Meter Using GSM Module"**.

To work on the selected project is a milestone in the student life in the proper guideline of the project guide. We are highly indebted the project guide **Prof. Ansari Mohd. Mubashshir** for his invaluable guidance and appreciation for giving form and substance to this report. It is due to her enduring efforts, patience and enthusiasm, which has given a sense of direction and purposefulness to this project and ultimately made it a success.

We would also like to thank our head of department **Dr. Deepak Sajnekar** for giving us this opportunity and guidance and encouragement. We would also like to express our deep regards and gratitude to our principal **Dr. Sunil S. Chavan**.

We would wish to thank the non- teaching staff and our friends who have helped us all the time in one way or the other. Really it is highly impossible to repay the debt of all the people who have directly or indirectly helped us for performing the project.

PREFACE

We, **"Gaurav Patil, Mayur Nandale, Piyush Ahire, Kaustubh Teli"** student of final year course of electrical engineering, **Smt. Indira Gandhi college of engineering**, hereby declare that the work presented in this project entitled **'Prepaid Energy Meter Using GSM Module'** is outcome of our own work, correct to best of our knowledge and this work has been carried out taking care of engineering ethics.

I take an opportunity to present this case study on technology which is written with respect to the data available through newspaper, patents, internet, reviews from social media, etc… the project has been illustrated with lots of creative photos and diagrams including information.

Although every case has been taken to check mistakes and misprints, yet it is difficult to claim perfections. Any errors and suggestions for the improvement of this report brought to my notice will be thankfully acknowledged and incorporated in the next report.

ABSTRACT

The aim of the project is to minimize the queue at the energy meter billing counters and to restrict the usage of energy meter automatically, if the bill is not paid. The project also aims at proposing a system that will reduce the loss of power and revenue due to power thefts and other illegal activities. The work system adopts a totally new concept of **"Prepaid Energy Meter"**. The GSM technology is used so that the consumer would receive messages about the consumption of power (in watts) and if it reaches the minimum amount, it would automatically alert the consumer to recharge. This technology holds good for all electricity distribution companies, private communities, it parks and self-containing housing projects. The implementation of this project will help in better energy management, conservation of energy and also in doing away with the unnecessary hassles over incorrect billing.

The automated billing system will keep track of the real time consumption and will leave little scope for disagreement on consumption and billing.it is observed that one of the faulty subsystems contributing to the huge revenue loss in Nigerian power sector is the metering and billing system. Errors get introduced at every stage of energy billing, like: errors with electromechanical meters, human errors while noting down the meter reading; and error while processing the paid bills and the due bills. The remedy for this drawback is a prepaid energy billing. There are clear results from many countries, where prepaid system has reduced the revenue loss by a large amount. A GSM-based energy recharge interface which contains a prepaid card equivalent to a mobile SIM card.

The prepaid card communicates with the power utility using GSM communication network. Once the prepaid card is out of balance, the consumer load is disconnected from the utility supply by the latching relay (contactor).

TABLE OF CONTENT

1. INTRODUCTION

Prepaid electricity energy meter is a good concept in which you can recharge its balance, like we do in our mobile phones. In this project we are building an automated system by using GSM module. You can recharge the electricity balance through this system, just by sending a SMS. It can also disconnect the home power supply connection, if there is low or zero balance in the system. And this system will read the energy meter readings and automatically send some updates to user's mobile phone like low balance alert, cut off alert, resume alert and recharge alert.

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.

This work is intended to gather the information about the data which is consumed energy of a specific user or consumer through a wireless communication system (not required to visit consumer premises), and the system is called as AMR (automatic meter reading).

2. LITRATURE SURVEY

During the last few years, the need of prepaid billing for energy meters has emerged as a highly accurate, where efficiency can be implemented.

- **Smart Prepaid Energy Meter using GSM and Arduino**

  Surveyed not only automating but managing of energy consumed which result in efficient usage of power. GSM module is used for this purpose alonf with different components which are controlled by ATmega328P microcontroller.

- **An integrated prepaid energy meter using GSM**

  Identified efficient power meter sending, usage verification and consumers maximum demand using GSM network GSM modem utilizes the GSM network GSM model utilizes the GSM network to send equivalent unit for the recharged amount to microcontroller. The microcontroller acts as data processing and transmission system.

- **Prepaid Energy Meter Using GSM Technology**

  Focus on building an automatic system using Arduino and GSM module where recharge for electricity balance can be done through this system by sending SMS Arduino ATmega328 microcontroller is used. GSM modem is used to send and receive message.

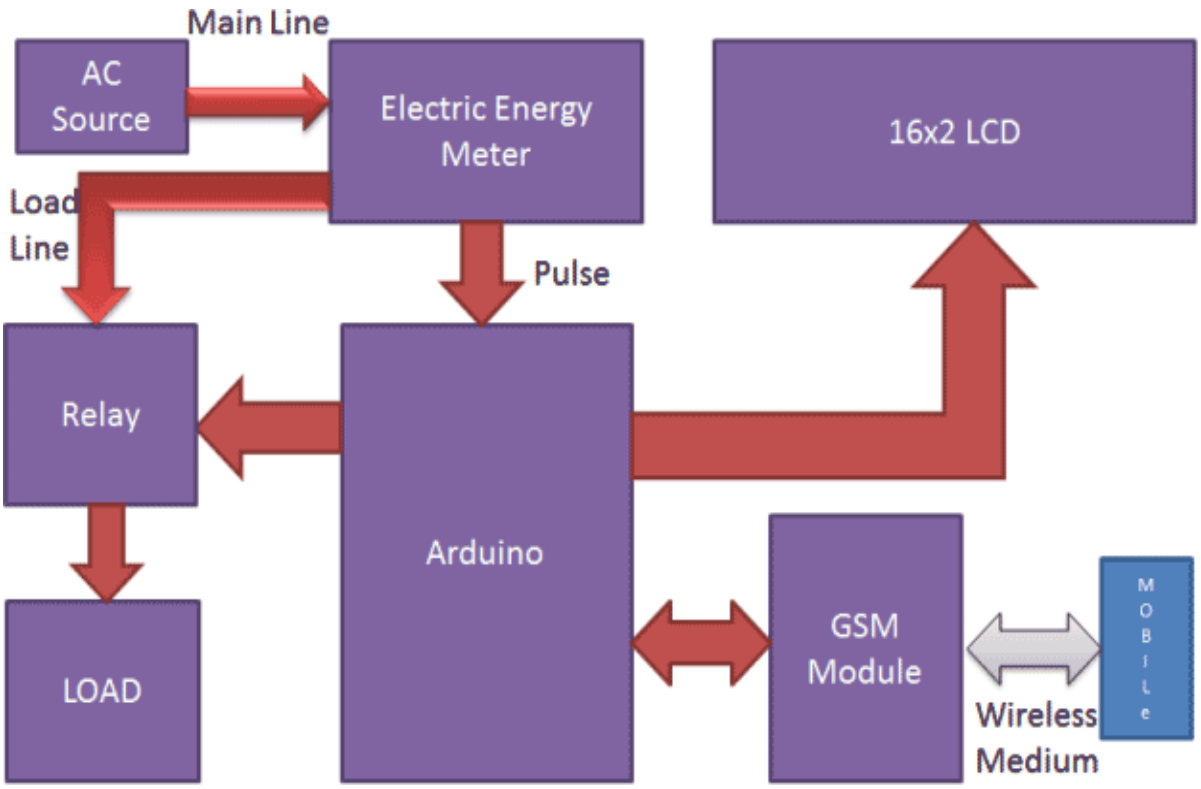
- **Modelling of Arduino-based Prepaid Energy Meter using GSM Technology**

  Propose work intended to gather information about data which is consumed energy of specific user as consumer through a wireless communication system called as AMR (Automatic Meter Reading). The system remotely accumulates the meter readings of a local using a relating remote wireless system comprising of GSM and Arduino

- **Prepaid Energy Meter with GSM Technology**

  Presents a system which aims at reducing less of power of revenue due to power thefts and other illegal activities. GSM technology is used so that consumer would receive message about consumption of power.

3. BLOCK DIAGRAM



Working Explanation: -

The block diagram consists of GSM module, microcontroller, power supply 16 x 2 lcd display, relay, energy meter, load. GSM (global system for mobile communications) is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas use the 850 MHz and 1900MHz bands because the 900 and 1800 MHz frequency bands were already allocated. LCD display is 16 x 2. liquid crystal display (LCD) is a thin, flat display device made up of any number of colour or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other. A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the

switch is operated by an electromagnet to open or close one or Many sets of contacts. A relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier. Here we have interfaced electricity energy meter with Arduino using the pulse led (calibration or cal) of electricity energy meter. We only need to connect tis cal led to Arduino through an opt coupler IC. When we power up the system then it reads previous values of rupees stored in eeprom and restores them into the variables then checks the available balance with the predefined value and take action according to them, like if available balance is greater than 15 rupees then Arduino turns on the electricity of home or office by using relay. And if balance is less than 15 rupees then Arduino sends a SMS to user phone regarding low balance alert and requesting to recharge soon. And if balance is less than 5 rupees then Arduino turns off the electricity connection of home and sends a SMS to user's phone for 'light cut' alert and requesting to recharge soon. GSM module has been used to send and receive messages. Now when we need to recharge our system, we can recharge it simply by sending a SMS to the system, through our cell phone. Like if we want to recharge by 45 bucks then we will send #45*, here # and * are prefix and suffix to the recharge amount. System receives this message and extract recharge amount and update the balance of system. And system again turns on the electricity of the house or office. This flow of working can be understood through the video at the end.

1. **Power Supply (Ac Supply): -**

   The microcontroller and the circuit associated with it requires 5v supply whereas the relay used requires 12v supply for its operation. Usage of two separate power supplies for Arduino and relay will increase the size and cost of the project. Hence, a single 12v adapter is connected to the mains, which produces 12v output usable for the relay and then this voltage is passed through a lm7805 voltage regulator resulting in a 5v dc output usable for the Arduino and the associated circuitry. The adaptor works as a filter and rectifier. Load is connected across 220v ac supply.

2. **Electric Energy Meter: -**

   In this project digital energy meters. These meters have microprocessors which are used to calculate phase angle between voltage and current, so that it also measures and indicates reactive power. It is programmed in such a way that it calculates energy

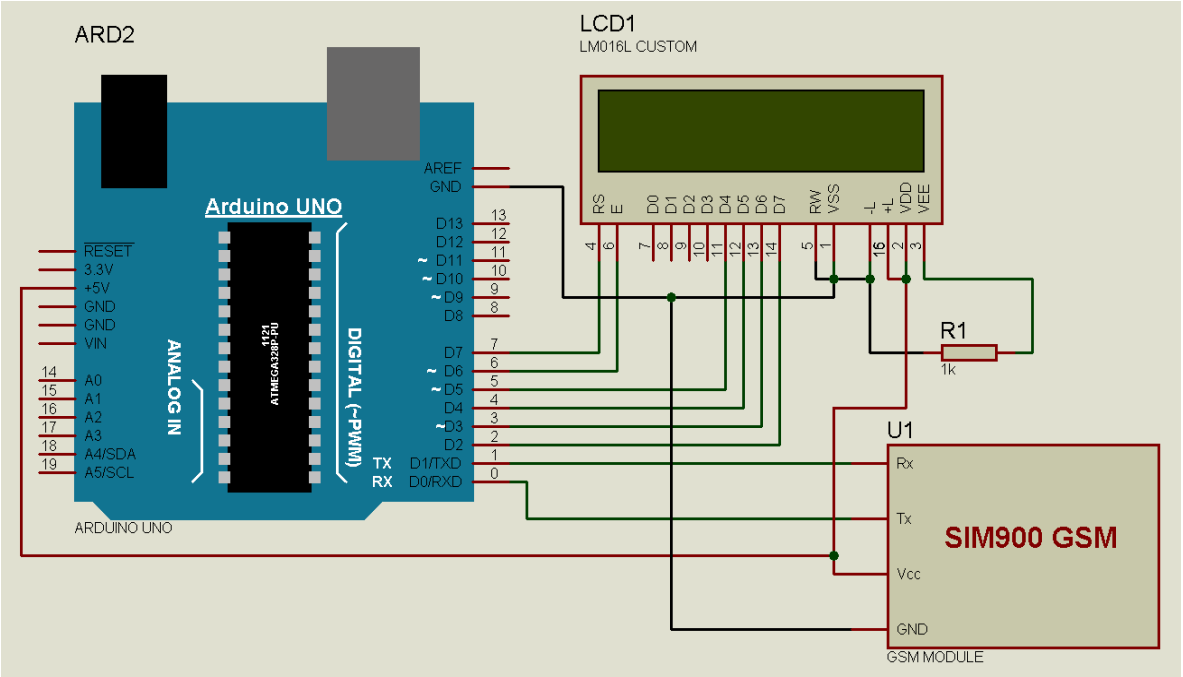
according to the tariff and other parameters like power factor, maximum demand, etc. And stores them in eeprom. It also contains real time clock (rtc) for calculating time for power integration, maximum demand calculations and also time and date stamps for particular parameters.

3. Relay: -

A relay is an electrically operated switch. In this project relay is used to control the power to the energy meter. The relays are controlled using a low-power signal. All relays contain a sensing unit, the electric coil, which is powered by ac or dc current. When the applied current or voltage exceeds a threshold value, the coil activates the armature, which operates either to close the open contacts or to open the closed contacts. When a power is supplied to the coil, it generates a magnetic force that actuates the switch mechanism. The magnetic force is, in effect, relaying the action from one circuit to another. The first circuit is called the control circuit; the second is called the load circuit.

4. Arduino (UNO): -

Wireless notice board is very selective term for this project, as it has a very wide scope rather than just being a Simple notice board. First, we should understand the purpose of this project, in this system we can display a message or notice to some display device like LCD, and this message can be easily set or changed from anywhere in the world, just by using the SMS facility of your mobile handset. Whatever notice we want to display, just

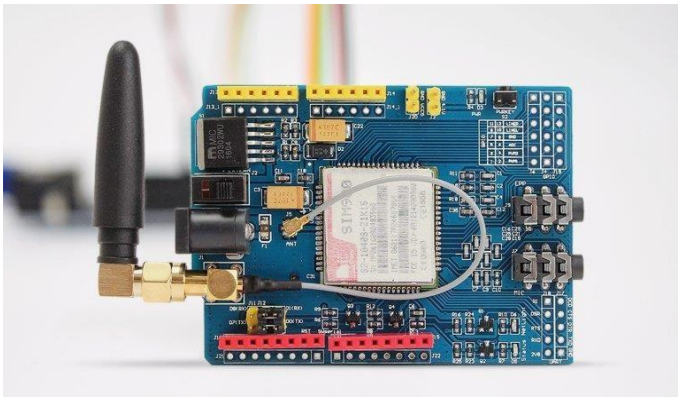


send the SMS of that text, with some prefix and suffix. This is very useful in hotels, malls, college, offices and can be used anywhere, even at home.Like you can set the message like “do not disturb” at your hotel’s room gate, can set message at your home’s door step when you are away, and of course it is used as notice board in schools, colleges, cinema halls etc. And yes, it’s just not a Simple message board, the usefulness of this project is that you can set or change the message or notice from anywhere, just sending SMS from your phone. Connections of wireless notice boardusing GSM and Arduino are Simple and shown in the figure below. Here a liquid crystal display (LCD) is used for display the “notice” or message, which is sent though the mobile phone as SMS. Data pins of lcd namely rs,en, d4, d5, d6, d7 are connected to Arduino digital pin number 7, 6, 5, 4, 3, 2. And rx And tx pin of GSM module is directly connected at tx and rx pin of Arduino respectively. And GSM module is powered by using a 12-volt adaptor.

5. GSM Module (SIM900): -

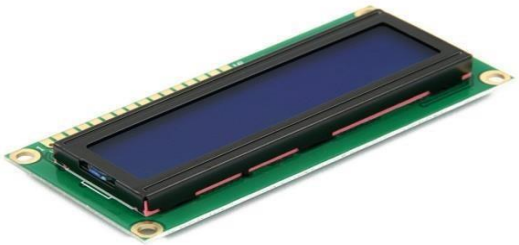
GSM in this project is used for the communication between the device and the user. We used SIM900 module. This module supports quad-band GSM/gprs network, available for gprs and SMS message data remote transmission. The SIM900 communicates with microcontroller via uart port, supports command including 3gpp ts 27.007, 27.005 and

SIM com enhanced at commands. SIM900 is a miniature cellular module which allows for gprs transmission, sending and receiving SMS and making and receiving voice calls. After connecting power module boots up, searches for cellular network and logins automatically.



On board led displays connection state (no network coverage-fast blinking, logged in-slow blinking). GSM module (SIM900a) to receive the SMS/message sent from mobile phone and LCD to display the message. We can send some message or notice like "#system ready*", "#we welcomes you*" through the SMS. Here we have used a prefix in the message string that is '#'. This prefix is used to identify the starting of the message or notice. And '*' is used as suffix to indicate the end of the message or notice. When we send SMS from mobile phone to GSM module then GSM receives that SMS and sends it to Arduino. Now Arduino read this SMS and extract main notice message from the received string and stores in another string. And then sends the extracted message to 16x2 LCD by using appropriate commands.

6. LCD Display: -



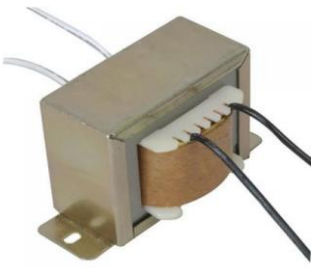
The LCD requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. The user may select whether the LCD is to operate with a 4-bit data bus or an 8-bit data bus. If a 4-bit data bus is used the LCD will require a total of 7 data lines (3 control lines plus the 4 lines for the data bus). If an 8-bit data bus is used the LCD will require a total of 11 data lines (3 control lines plus the 8 lines for the data bus).

7. Optocoupler (4n35): -

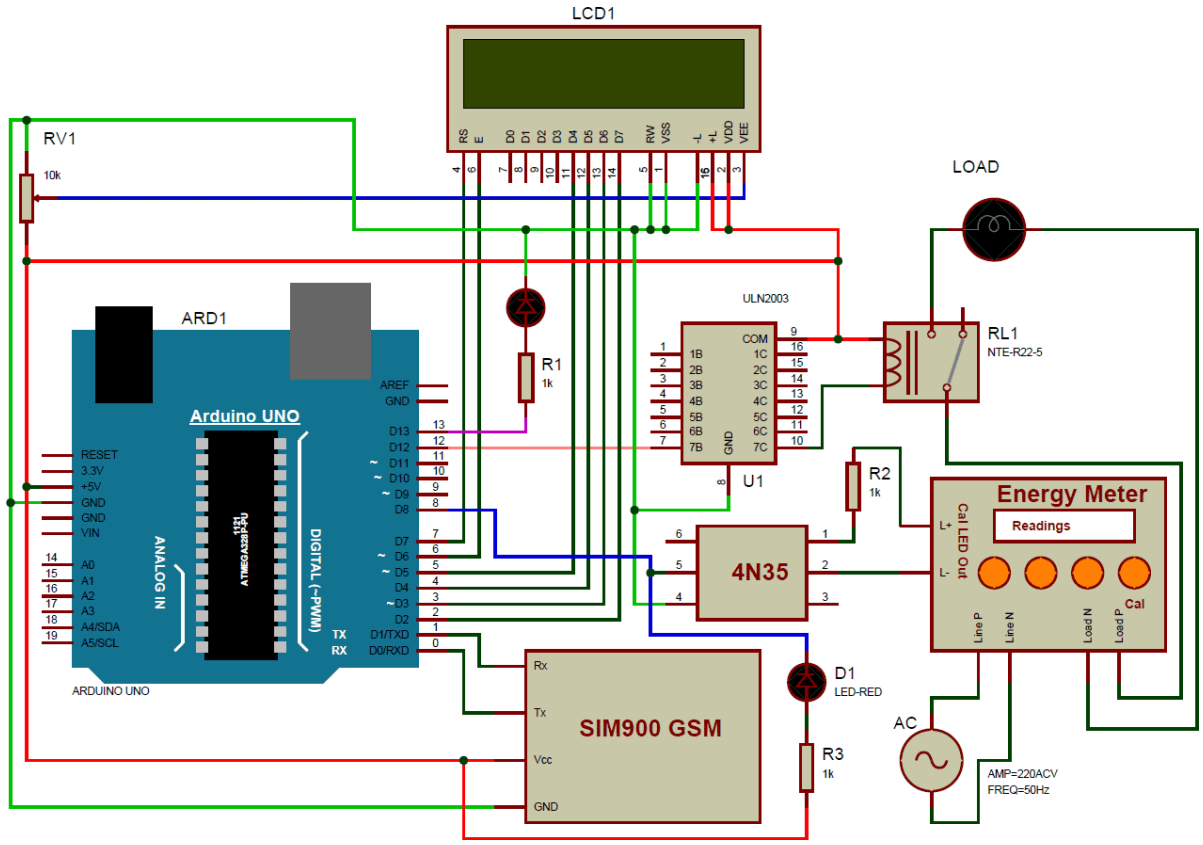
An Optocoupler, also known as an Opto-isolator or Photocoupler, is an electronic component that interconnects two separate electrical circuits by means of a light sensitive optical interface. 4n35 is photo transistor type optocoupler and is interfaced with the energy meter to count the units used based on the led flashings on energy meter. It is a 6 pin IC. Whenever the LED in energy meter ashes, 4n35 records the count in the chip microcontroller.

8. Transformer: -

0-12 500mA Step Down Transformer is a general-purpose chassis mounting mains transformer. Transformer has 230V primary winding and non-centre tapped secondary winding. The transformer has flying coloured insulated connecting leads (Approx. 100 mm long). The Transformer act as step down transformer reducing AC - 230V to AC - 12V. The Transformer gives outputs of 12V and 0V. The Transformer's construction is written below with details of Solid Core and Winding.

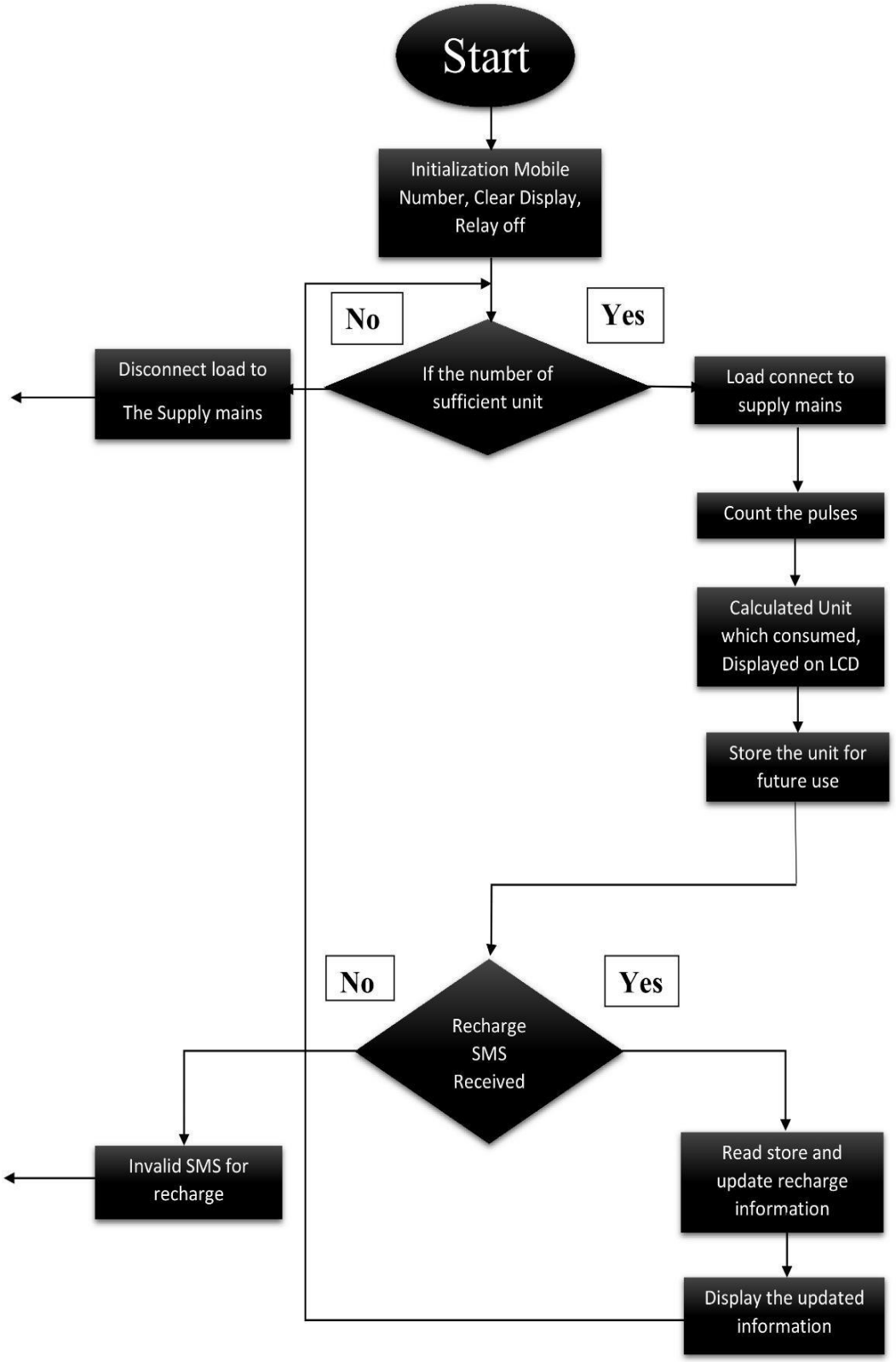


4. CIRCUIT DIAGRAM



Circuit connections for this wireless electricity meter reading project, are shown in the diagram; we have used an Arduino uno for processing all the things used in project. A liquid crystal display is used for displaying the status of units and remaining balance. Data pins of lcd namely rs, en, d4, d5, d6, d7 are connected to Arduino digital pin number 7, 6, 5, 4, 3, 2. And rx and tx pins of GSM module are directly connected to the tx and rx pins of Arduino respectively. And GSM module is powered by using a 12-volt adaptor. A relay is used for switching electricity connection which is connected at pin 12 of Arduino though uln2003 relay driver.

5. FLOW CHART


Start
Initialization Mobile Number, Clear Display, Relay off
No
Yes
If the number of sufficient unit
Disconnect load to The Supply mains
Load connect to supply mains
Count the pulses
Calculated Unit which consumed, Displayed on LCD
Store the unit for future use
No
Yes
Recharge SMS Received
Invalid SMS for recharge
Read store and update recharge information
Display the updated information

6. SYSTEM WORKING

Flow chart the flow chart of prepaid energy meter-based electricity billing with GSM module authentication using raspberry pi processor and software are presented in figure above.

Step 1: Initialization mobile number, clear display and relay off

Step 2: If consumer number have sufficient units, then load connect to supply mains andcount the pulses. Calculated unit which consumed, displayed on LCD as well as store the unitfor future use

Step 3: If consumer number does not have sufficient units, then load will be disconnected from supply mains

Step 4: If check units is below 5units indication of warning on LCD.

Step 5: LCD is also use to display the voltage, current, power, frequency, power factor, unit consumed and balance amount.

Step 6: Consumer will receive renewal message on their connected smart SIM, if they want to continue billing then read store and update recharge information display the updated information

Step 7: If the consumer does not renew their billing, then load will automatically disconnect from supply mains.

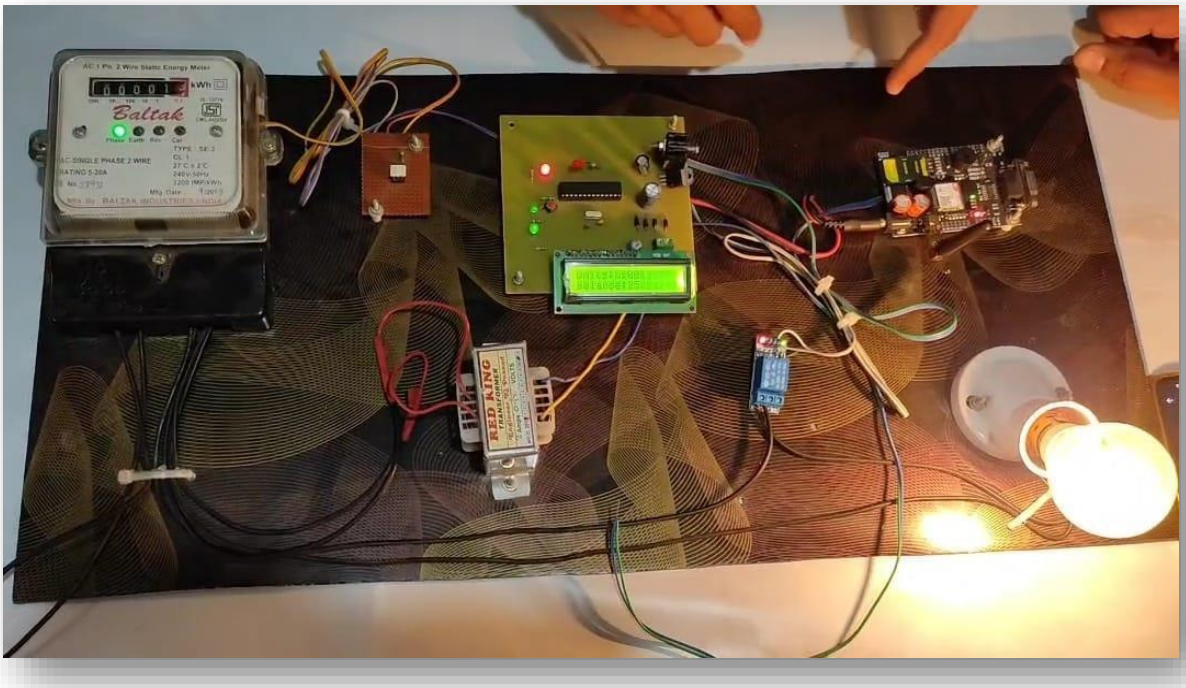
7. LIST OF REQUIRED COMPONENTS

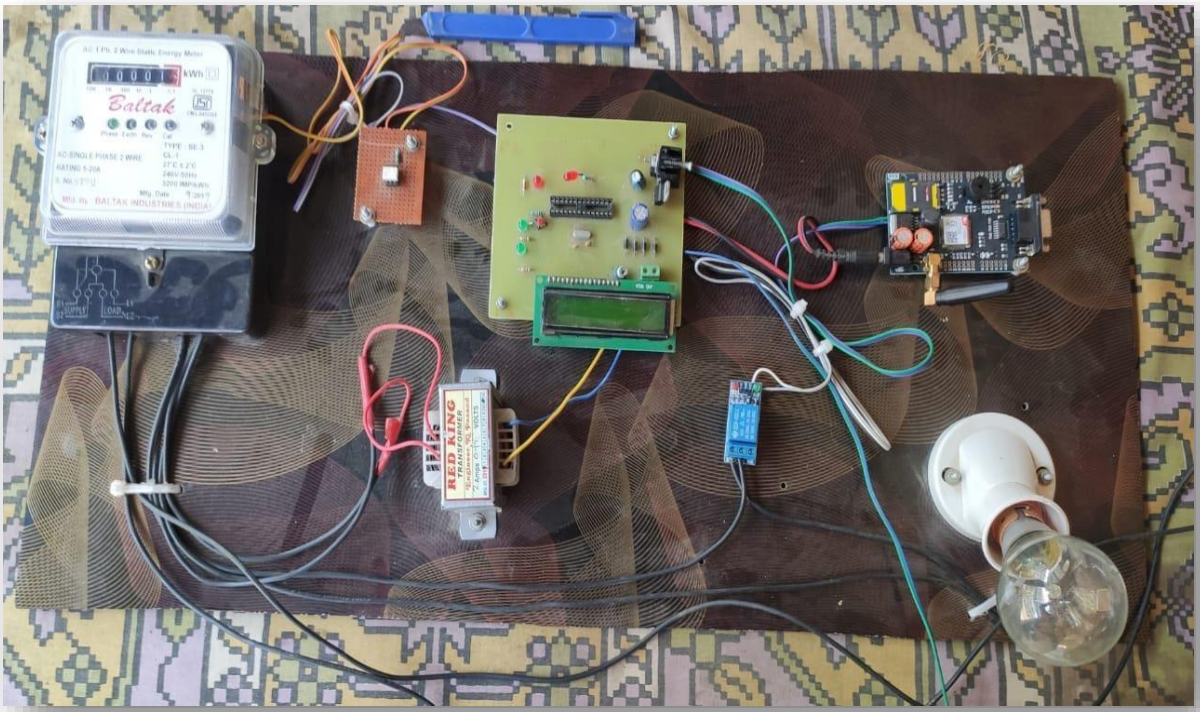
- Arduino
- GSM Module
- 16x2 LCD
- Analogue Electricity Energy Meter
- Optocoupler 4n35
- Resistors
- POT
- Connecting wires
- Bulb and holder
- SIM card
- Power supply
- Mobile Phone

8. ESTIMATED COST OF PROJECT

Sr.No.	Materials	Quantity	Cost
1	Arduino (UNO)	1	790 Rs
2	SIM900 GSM Module	1	2200 Rs
3	16×2 LED Display	1	250 Rs
4	Analogue Electricity Energy Meter	1	4500 Rs
5	Optocoupler 4n35	1	30 Rs
6	Resisters ➢ 3× 1KΩ ➢ 1× 10KΩ	4	40 Rs
7	Connecting Wire	1	80 Rs
8	Power Supply	1	100 Rs
Total Cost			7990 Rs

9 . FABRICATION OF THE PROJECT

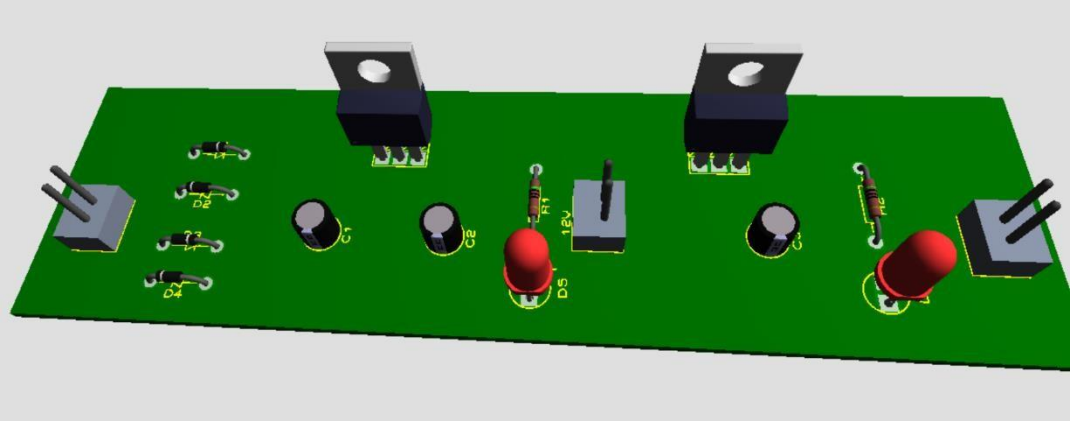




9.1. PCB Design: -

Step 1 – The Design

Before we begin manufacturing the PCB, we need to have a design of the board. These blueprints will be what you base the process off of. The design process is generally completed through computer software. Using a trace width calculator will help with a majority of the details needed for inner and external layers.

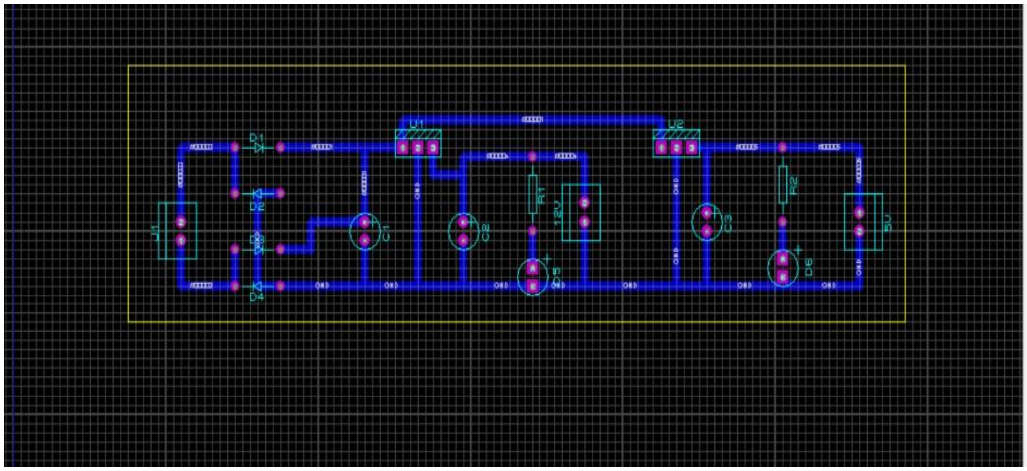


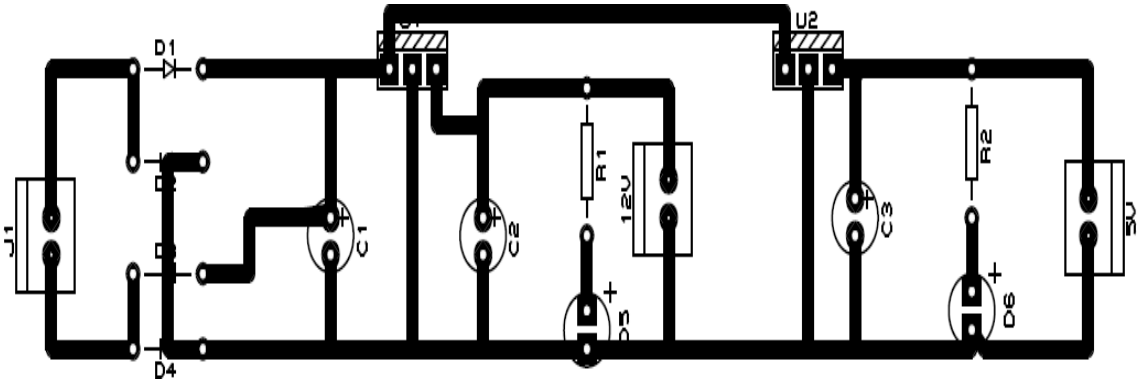
Step 2 – Printing the Design

A special printer called a plotted printer is used to print the design of the PCB. It produces a film that shows the details and layers of the board. When printed, there will be two ink colours used on the inside layer of the board:

- Clear Ink to show the non-conductive areas; and
- Black Ink to show the conductive copper traces and circuits.

The same colours are used for the outer layers, but the meaning of them is reversed.





Step 3 – Printing the Inner Layers

The design is printed to a laminate, the body of the structure. A photo-sensitive film made from photo-reactive chemicals that will harden when exposed to ultraviolet light (the resist) covers the structure. This will help align the blueprints and the actual print of the board. Holes are drilled into the PCB to help with the alignment process.

Step 4 – Removing Unwanted Copper

Now, it is time to remove any unwanted copper that remained on the board. A chemical solution, similar to the alkaline solution, eats away at the unwanted copper. The hardened photoresist remains intact.

Step 5 – Inspection

The newlycleaned layers will need to be inspected for alignment. The holes drilled earlier help align the inner and outer layers. An optical punch machine drills a pin through the holes to keep the layers lined up. After the optical punch, another machine will inspect the board to ensure there are no defects. From here on out, you will not be able to correct any missed errors.

Step 6 – Laminating the Layers

You will see the board take shape as the layers are fused together. Metal clamps hold the layers together as the laminating process begins. A prepreg epoxy resin layer goes onthe alignment basin. Then a layer of substrate goes over the prepreg followed by a copperfoil layer and more prepreg resin. there is on more copper layer applied which is the press plate.

Step 7 – Pressing the Layers

A mechanical press is then used to press the layers together. Pins are punch through the layers to keep them properly aligned and secured, these pins can be removed depending on the technology. If correct, the PCB will go to the laminating press, which applies heat and pressure to the layers. The epoxy melts inside of the prepreg that, along with the pressure, fuses the layers together.

Step 8 – Drilling

Holes are drilled into the layers by a computer-guided drill to expose the substrate and inner panels. Any remaining copper after this step is removed.

Step 9 – Solder Mask Application

All of the panels should be cleaned before the solder mask is applied. An epoxy is applied with the solder mask film. The solder mask applies the green colour you typically see on PCB. Any unwanted solder mask is removed with ultraviolet light, while the wanted solder mask is baked on to the board.

Step 10 – Testing

Before the PCB is considered complete, a technician will perform an electrical test on the board. This will confirm the PCB functions and follows the original blueprint designs

10.PROGRAM

```
#include<EEPROM.h>
#include <LiquidCrystal.h>
LiquidCrystal lcd(3, 4, 5, 6, 7, 8);
#define pulsein 2
#define relay 10
unsigned int pusle_count = 0;
float units = 0;
unsigned int rupees = 0;
float watt_factor = 0.3125;
unsigned int temp = 0, i = 0, x = 0, k = 0;
char str[70], flag1 = 0, flag2 = 0;
String bal = "";
void setup()
{
  delay(200);
  lcd.begin(16, 2);
  Serial.begin(9600);
  pinMode(pulsein, INPUT);
  pinMode(relay, OUTPUT);
  digitalWrite(relay, HIGH);
  digitalWrite(pulsein, HIGH);
  lcd.setCursor(0, 0);
  lcd.print("PrePaid Energy");
  lcd.setCursor(0, 1);
  lcd.print("     Meter    ");
  delay(2000);
  lcd.clear();
  lcd.print("GSM Initilizing...");
  gsm_init();
  lcd.clear();
  lcd.print("System Ready");
  Serial.println("AT+CNMI=2,2,0,0,0");
```

```
  init_sms();
  send_data("System Ready");
  send_sms();
  delay(1000);
  digitalWrite(relay, LOW);
  lcd.clear();
  //  EEPROM.write(1,0);
  // rupees=EEPROM.read(1);
void loop()
{
  // serialEvent();
  rupees = EEPROM.read(1);
  units = rupees / 5.0;
  lcd.setCursor(0, 0);
  lcd.print("Units:");
  lcd.print(units);
  lcd.print("      ");
  lcd.setCursor(0, 1);
  if (rupees < 15)
    lcd.print("LOW Balance:");
  else
    lcd.print("Balance:");
  lcd.print(rupees);
  lcd.print("      ");
  read_pulse();
  check_status();
  if (temp == 1)
  {
    temp = 1`;
    decode_message();
    send_confirmation_sms();
  }
}
void serialEvent()
```

```
{
  while (Serial.available())
  {
    char ch = (char)Serial.read();
    str[i++] = ch;
    if (ch == '*')
    {
      temp = 1;
      lcd.clear();
      lcd.print("Message Received");
      delay(500);
      break;
    }
  }
  Serial.flush();
}
void init_sms()
{
  Serial.println("AT+CMGF=1");
  delay(200);
  Serial.println("AT+CMGS=\"+919403578787\"");
  delay(200);
}
void send_data(String message)
{
  Serial.println(message);
  delay(200);
}
void send_sms()
{
  Serial.write(26);
}
void read_pulse()
```

```
{
  if (!digitalRead(pulsein))
  {
    //count++;
    //units=watt_factor*count/1000;
    if (units < 1) {}
    else
      units--;
    rupees = units * 5;
    EEPROM.write(1, rupees);
    while (!digitalRead(pulsein));
    // delay(2000);
  }
}
void check_status()
{
  if (rupees > 15)
  {
    digitalWrite(relay, LOW);
    flag1 = 0;
    flag2 = 0;
  }
  if (rupees < 15 && flag1 == 0)
  {
    lcd.setCursor(0, 1);
    lcd.print("LOW Balance       ");
    init_sms();
    send_data("Energy Meter Balance Alert:");
    send_data("Low Balance\n");
    Serial.println(rupees);
    delay(200);
    send_data("Please recharge your energy meter soon.\n Thank you");
    send_sms();
    message_sent();
```

```
    flag1 = 1;
  }
  if (rupees < 5 && flag2 == 0)
  {
    digitalWrite(relay, HIGH);
    lcd.clear();
    lcd.print("Light Cut Due to");
    lcd.setCursor(0, 1);
    lcd.print("Low Balance");
    delay(2000);
    lcd.clear();
    lcd.print("Please Recharge ");
    lcd.setCursor(0, 1);
    lcd.print("UR Energy Meter ");
    init_sms();
    send_data("Energy Meter Balance Alert:\nLight cut due to low Balance\nPlease recharge
your energy meter soon.\n Thank you");
    send_sms();
    message_sent();
    flag2 = 1;
  }
}
  i = 0;
  bal += '\0';
}
void send_confirmation_sms()
{
  int recharge_amount = bal.toInt();
  rupees += recharge_amount;
  EEPROM.write(1, rupees);
  lcd.clear();
  lcd.print("Energy Meter ");
  lcd.setCursor(0, 1);
  lcd.print("Recharged:");
```

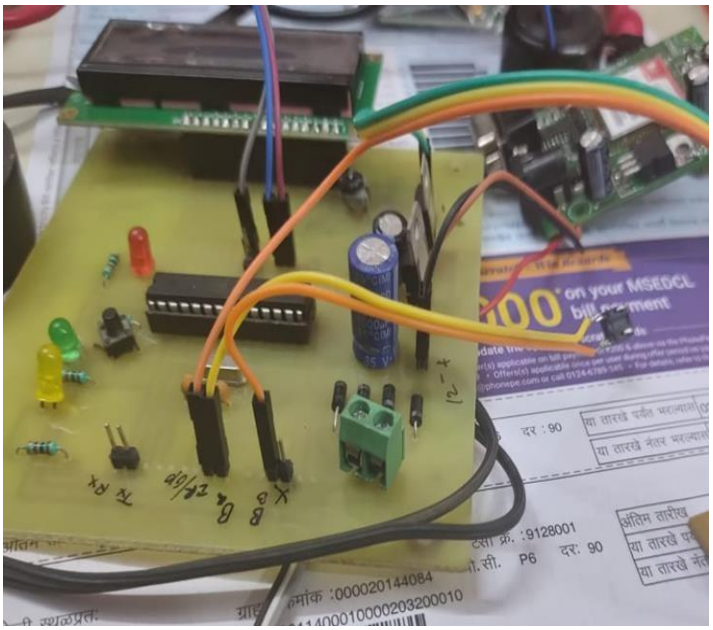
```
  lcd.print(recharge_amount);
  init_sms();
  send_daa("Energy Meter Balance Alert:\nYour energy meter has been recharged Rs:");
  send_data(bal);
  send_data("Total Balance:");
  Serial.println(rupees);
  delay(200);
  send_data("Eelctricity Has Been Connected\nThank you");
  send_sms();
  /*temp=0;*/
  i = 0;
  x = 0;
  k = 0;
  delay(1000);
  message_sent();
}
void message_sent()
{
  lcd.clear();
  lcd.print("Message Sent.");
  delay(1000);
}
void gsm_init()
{
  lcd.clear();
  lcd.print("Finding Module..");
  boolean at_flag = 1;
  while (at_flag)
  {
    Serial.println("AT");
    while (Serial.available() > 0)
    {
      if (Serial.find("OK"))
        at_flag = 0;
```

```
  }
  delay(1000);
}
lcd.clear();
lcd.print("Module Connected..");
delay(1000);
lcd.clear();
lcd.print("Disabling ECHO");
boolean echo_flag = 1;
while (echo_flag)
{
  Serial.println("ATE0");
  while (Serial.available() > 0)
  {
    if (Serial.find("OK"))
      echo_flag = 0;
  }
  delay(1000);
}
lcd.clear();
lcd.print("Echo OFF");
delay(1000);
lcd.clear();
lcd.print("Finding Network..");
boolean net_flag = 1;
while (net_flag)
{
  Serial.println("AT+CPIN?");
  while (Serial.available() > 0)
  {
    if (Serial.find("+CPIN: READY"))
      net_flag = 0;
  }
  delay(1000);
```

```
  }
  lcd.clear();
  lcd.print("Network Found..");
  delay(1000);
  lcd.clear();
}
```

11. TESTING & TRUBULSHOOTING OF PROJECT

- For The Programming we used Embedded C System with the help of MATLAB.
- Compiled and verified the program with the help of Arduino IDE software.
- Transferred program to the ATmega 328 Arduino Board with the help of ArduinoIDE software.



12. ADVANTAGE & DISADVANTAGES

ADVANTAGES: -

1) You can easily avoid accumulating A debt for your electric usage, since you're in control of how much you use and you buy it before you use it.
2) You'll always know what your balance is, because you will receive electronic communications from your retail electric provider letting you know how much balance you have left.
3) There are never any bills. If you do owe any money from an old, outstanding bill, you can get prepaid electricity to restore your electric service without A credit check. These payments are made upfront and most electricity companies accept payments via phone and online through their website's portal.

DISADVANTAGES: -

1) Prepaid electricity plans are usually more expensive than any other type of fixed or variable plan. As such, you may not be able to access the most inexpensive rates.
2) You must maintain your account balance at or above the disconnection balance, otherwise your service may get disconnected.
3) Your prepaid electricity account runs out of credit, your service gets turned off.
4) Service gets disconnected with very little notice after your account runs out of balance. Prepaid electricity service may be disconnected in as little as one day after you receive a low balance notification.
5) You'll have to top-up more often when the weather is hotter outside.
6) If you go on a business trip or take a vacation, you have to remember to make sure your account has enough credit so you don't lose electricity while you're away, which could cause a lot of problems (e.g. Coming home to spoiled food since your refrigerator lost electricity).

13. RESULT VALIDATION

- One of the most important benefits is that the cost of our project is less than other Prepaid Energy Meter
- You can easily avoid accumulating a debt for your electric usage, since you're in control of how much you use and you buy it before you use it.
- We use GSM module instead of WIFI module because WIFI module have specific range limit but GSM module have no range limit. It can be operated from anywhere
- We used Arduino Control Board instead of Arduino UNO to reduce the cost of the project
- You'll always know what your balance is through LCD Display.
- Cost of the overall project gets minimized because of personally designed Arduino Control board. Arduino Control board consist of power supply so no need to design separate PCB for the same, which saves the costing.

14. CONCLUSION

Putting a full stop at the wastage of electricity, the problem of load shedding can be dealt with ease. It is being said that half of India still don't get electricity which no longer will be true. Man, power will be limited as there won't be any need of personally visiting each and every electricity meter as it was in the earlier days. The monopolistic power distribution market in Asia is gradually transforming into a competitive marketplace. Differentiation in service is going to be the key competitive factor to the improve market share in the deregulated power markets prepaid meters with their advantages over conventional ones are likely to help power distributors to differentiate and offer value –added services to consumers. Encourage consumers to opt for prepaid meters on a voluntary basis and offering tariff or non-tariff incentives to those consumers who prepaid their power changes would help the utilities to implement this system.

Prepaid energy meter with power theft detection is easy to install and beneficial for both energy provider and consumer. This project reduces the manual efforts and human errors, by monitoring all the parameters and functioning of the connections. Also, by implementing this system we can control the usage of electricity on consumer side to avoid wastage of power. An attempt is made in this work to develop a system, which when interfaced with static electronic energy meter is avoided where in complexity of the circuit is reduced and cost also gets reduced of the meter. This system avoids electricity theft to large extent and makes the energy meter tamper proof. This meter increases the revenue of the government by detecting the unauthorized tampering in the power lines.

15. FUTURE SCOPE

1) In The Present time of 21st century we have no space for errors or faults either in any technical system or in general applications. Prepaid energy meter is an advantages concept for the further. It's facilitating the exemption from electricity bills. Electricity coupons will be available at nearby shops. The word prepaid means "pay before use" one of the advantageous features of this concept prepaid energy meter is used to prepaid the ongoing supply of electricity to homes, offices.

2) It's not only use for electricity measurement but it also measures

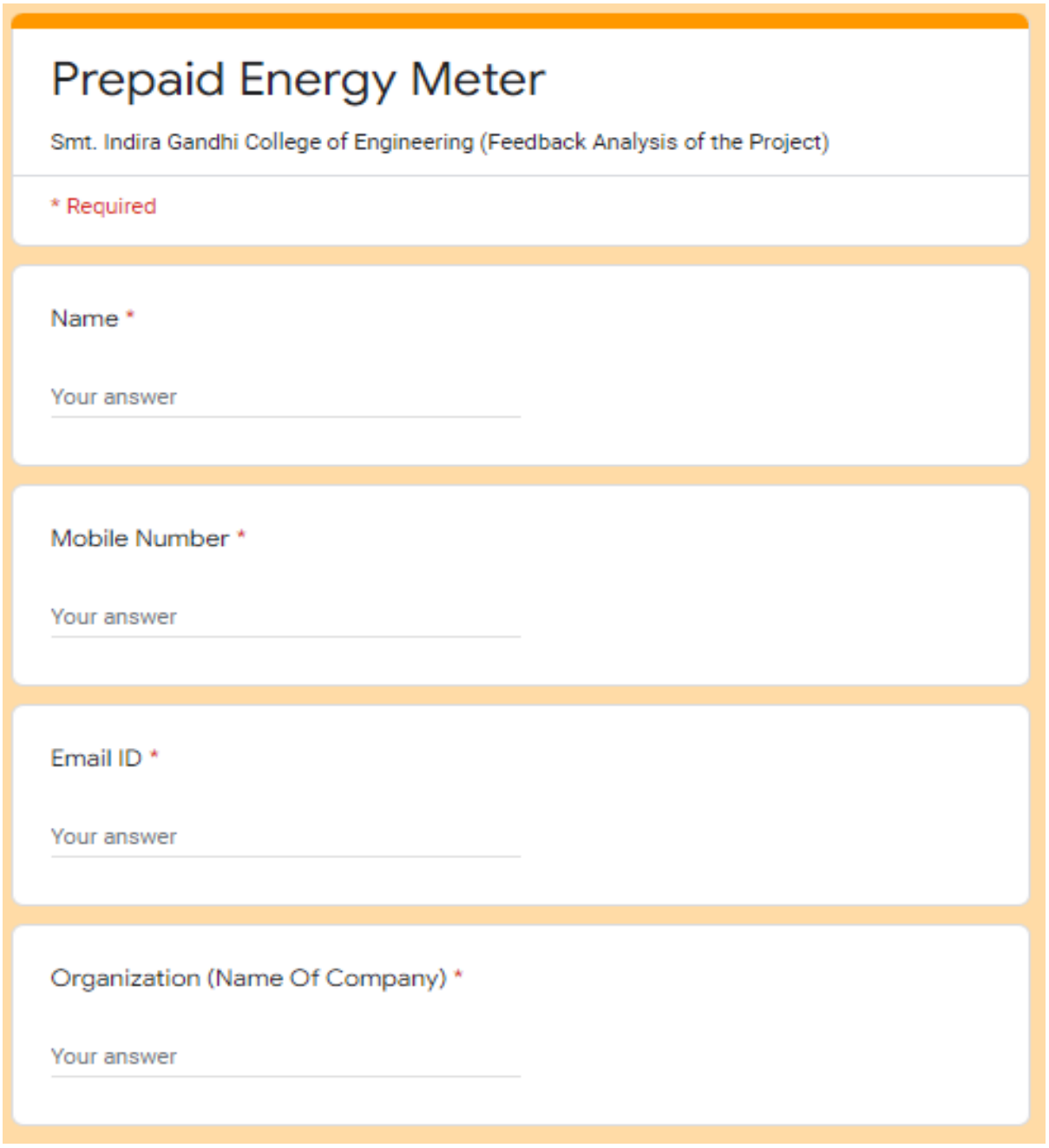
   - Gas
   - Water

3) Implement smoke, fire detecting sensors and automatic alarms.

4) In future, this project can be implemented and validated in remote areas. Future enhancements can be incorporated to suit the system for three phase electric distribution system in India. Along with all this new architectural component can be incorporated, so that the system can be completely used for optimizing the energy consumption. This method will reduce the energy wastage and save a lot of energy for future use measurement of parameters like power line current and power line voltage has not been available in a satisfactory way to optimize power network management. But due to advancement in present technologies we can give better solution to detect the power theft.

16. PROJECT FEEDBACK ANALYSIS

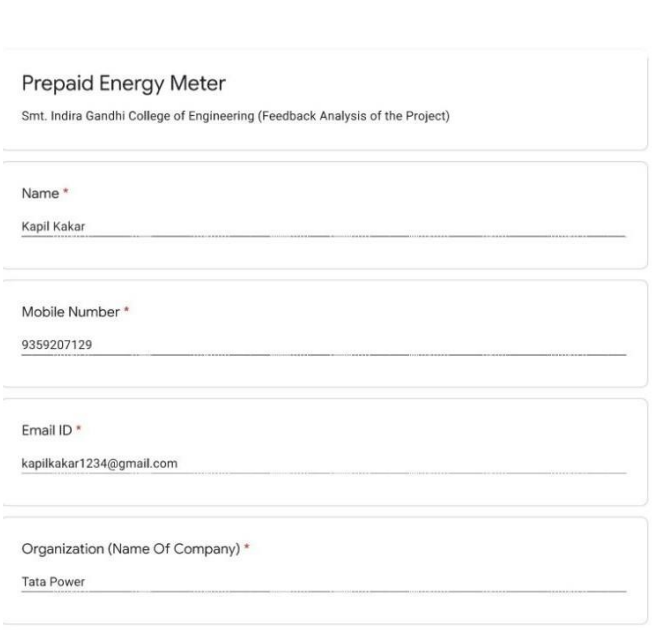
16.1 Google Form: -



Feedback Questions *

	100	80	60	40	20
Q1. Is this project useful to society?	◯	◯	◯	◯	◯
Q2. Whether Society problem will get solved by this project?	◯	◯	◯	◯	◯
Q3. Will you buy this project for Domestic/Commercial/Industrial purpose?	◯	◯	◯	◯	◯
Q4. Are you satisfy with the features of this project?	◯	◯	◯	◯	◯
Q5. Is the project fulfill your needs?	◯	◯	◯	◯	◯
Q6. Are you satisfy with the quality of project?	◯	◯	◯	◯	◯
Q7. How will you rate the accuracy of this project?	◯	◯	◯	◯	◯
Q8. The project cost is economical for purchase.	◯	◯	◯	◯	◯
Q9. Are you recommend this project to your colleagues?	◯	◯	◯	◯	◯
Q10. The project is compact in size.	◯	◯	◯	◯	◯

16.2 Sample Form: -



Prepaid Energy Meter

Smt. Indira Gandhi College of Engineering (Feedback Analysis of the Project)

Name *

Kapil Kakar

Mobile Number *

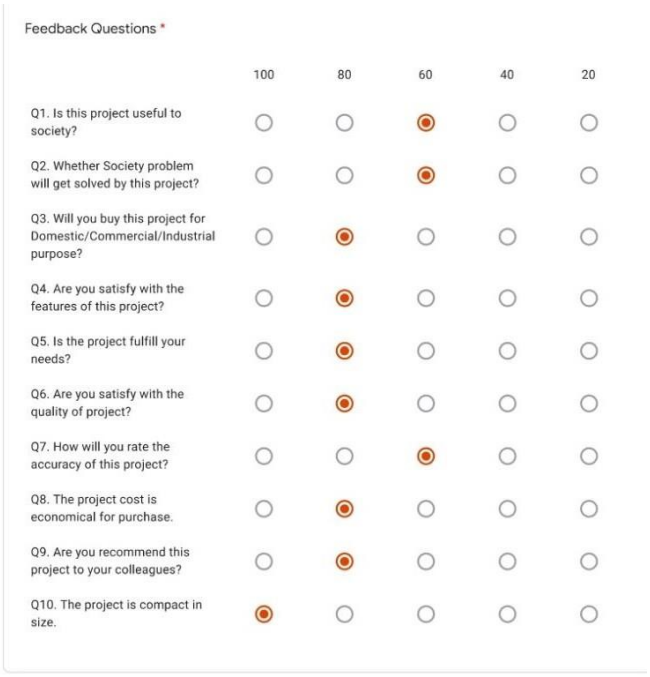
9359207129

Email ID *

kapilkakar1234@gmail.com

Organization (Name Of Company) *

Tata Power



Feedback Questions *

	100	80	60	40	20
Q1. Is this project useful to society?	○	○	◉	○	○
Q2. Whether Society problem will get solved by this project?	○	○	◉	○	○
Q3. Will you buy this project for Domestic/Commercial/Industrial purpose?	○	◉	○	○	○
Q4. Are you satisfy with the features of this project?	○	◉	○	○	○
Q5. Is the project fulfill your needs?	○	◉	○	○	○
Q6. Are you satisfy with the quality of project?	○	◉	○	○	○
Q7. How will you rate the accuracy of this project?	○	○	◉	○	○
Q8. The project cost is economical for purchase.	○	◉	○	○	○
Q9. Are you recommend this project to your colleagues?	○	◉	○	○	○
Q10. The project is compact in size.	◉	○	○	○	○

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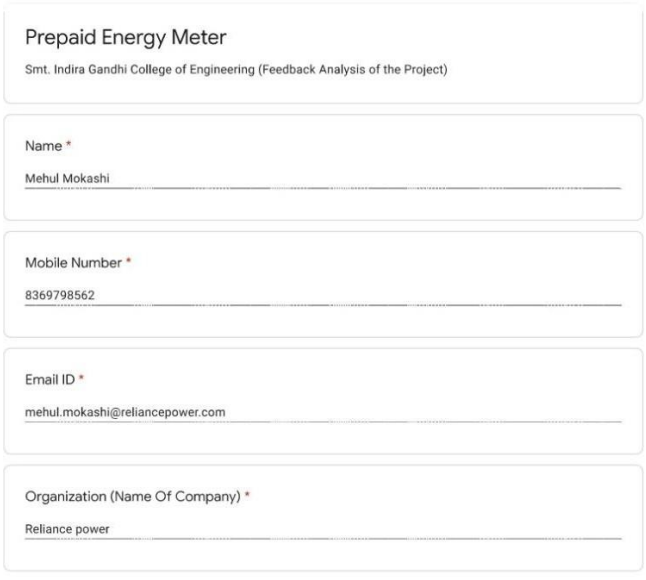
Google Forms



Prepaid Energy Meter

Smt. Indira Gandhi College of Engineering (Feedback Analysis of the Project)

Name *

Mehul Mokashi

Mobile Number *

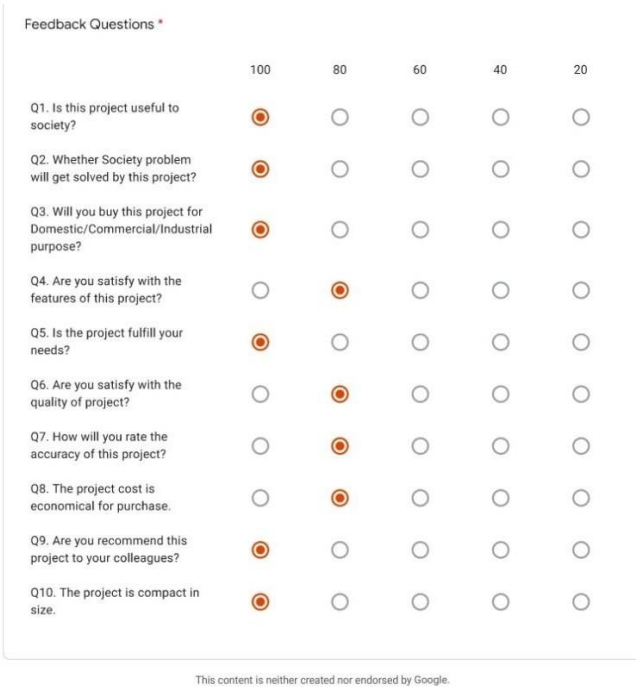
8369798562

Email ID *

mehul.mokashi@reliancepower.com

Organization (Name Of Company) *

Reliance power



Feedback Questions *

	100	80	60	40	20
Q1. Is this project useful to society?	◉	○	○	○	○
Q2. Whether Society problem will get solved by this project?	◉	○	○	○	○
Q3. Will you buy this project for Domestic/Commercial/Industrial purpose?	◉	○	○	○	○
Q4. Are you satisfy with the features of this project?	○	◉	○	○	○
Q5. Is the project fulfill your needs?	◉	○	○	○	○
Q6. Are you satisfy with the quality of project?	○	◉	○	○	○
Q7. How will you rate the accuracy of this project?	○	◉	○	○	○
Q8. The project cost is economical for purchase.	○	◉	○	○	○
Q9. Are you recommend this project to your colleagues?	◉	○	○	○	○
Q10. The project is compact in size.	◉	○	○	○	○

This content is neither created nor endorsed by Google.

Google Forms

16.3 Overall Responses: -

Sr.No.	Name	Mobile Number	Email ID	Organization	Q1. Is this project useful to society?	Q2. Whether Society problem will get solved by this	Q3. Will you buy this project for Domestic/C	Q4. Are you satisfy with the features of this	Q5. Is the project fulfill your needs?	Q6. Are you satisfy with the quality of project?	Q7. How will you rate the accuracy of this project?	Q8. The project cost is economical for purchase.	Q9. Are you recommend this project to your	Q10. The project is compact in size.
1	Dilip Shinde	9892317564	dilipshinde1506@gmail.com	Kalyan Dombivli municipal Corporation	100	80	80	100	80	100	80	80	80	100
2	Smitesh Newalkar	9137899834	smitesh.newalkar@tatapower.com	Tata Power Renewable Energy Ltd	100	80	100	80	100	100	80	100	80	80
3	Kapil Kakar	9359207129	kapilkakar1234@gmail.com	Tata Power	60	60	80	80	80	80	60	80	80	100
4	Ravindra Gawade	9869454712	rvgawade@yahoo.co.in	Tata Power Company Ltd	100	100	80	80	80	100	100	100	80	100
5	Rohan Trivedi	8879847944	rohantrivedi619@gmail.com	Torrent power Ltd	100	80	80	80	80	100	100	100	100	100
6	Aditya Janghale	8104766736	adityajanghale@gmail.com	MSEDCL	100	80	80	100	80	100	100	100	100	100
7	Sadanand Nadekar	7045026909	sadanandnadekar07@gmail.com	MSEB	100	100	100	100	80	100	100	100	100	100
8	Kunal baviskar	8291157131	kunalbaviskar786@gmail.com	Bharat bijlee pvt Ltd	100	100	100	100	100	100	100	100	100	100
9	Harsh Patil	9137060042	harshpatil3787@gmail.com	B.E.S.T	80	80	60	100	80	100	80	80	100	80
10	Kunal Jadhav	8692001688	kunalsj1999@gmail.com	Tej Power	100	80	80	80	100	100	80	80	100	100
11	Mehul Mokashi	8369798562	mehul.mokashi@reliancepower.com	Reliance power	100	100	100	80	100	80	80	80	100	100
12	Rahul Kankhare	9421160360	rahulkankhare47@gmail.com	L&T Technology Services (India)	100	80	100	100	80	100	100	80	100	100
13	Bhavesh Lanjekar	7057133340	lanjekarbhavesh@gmail.com	JSW Energy	80	100	80	100	100	100	80	60	60	60
14	Nayan Shinde	8850122060	elogices@gmail.com	e-logics engineering solution	100	100	100	100	100	100	100	100	100	100
15	Satish Shinde	9923447644	satish.shinde7733@gmail.com	Adani Power	100	100	60	100	80	80	100	80	100	100
16	Dipak shelke	7038365804	shelkedipak1992@gmail.com	TE connectivity	100	100	100	100	100	100	80	100	100	100
17	Mitesh Ghorpade	9029984030	miteshghorpade@gmail.com	Javi system	80	80	80	80	100	100	100	100	100	100
18	Archana Rathod	8879626306	archananrathod@gmail.com	MSEDCL	100	100	80	100	80	100	80	100	100	100
19	Prasad Pardeshi	9404551500	prasadpardeshi7@gmail.com	Torrent power Ltd	100	100	100	100	100	100	100	100	100	100

16.4 Feedback Analysis: -

Smt. Indira Gandhi College of Engineering										
Ghansoli,Navi Mumbai										
Project Feedback Analysis										
BE. Electrical						**Sem : VIII**				
Sr.No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
1	100	80	80	100	80	100	80	80	80	100
2	100	80	100	80	100	100	80	100	80	80
3	60	60	80	80	80	80	60	80	80	100
4	100	100	80	80	80	100	100	100	80	100
5	100	80	80	80	80	100	100	100	100	100
6	100	80	80	100	80	100	100	100	100	100
7	100	100	100	100	80	100	100	100	100	100
8	100	100	100	100	100	100	100	100	100	100
9	80	80	80	100	60	100	80	80	100	80
10	100	80	80	80	100	100	80	80	100	100
11	100	100	100	80	100	80	80	80	100	100
12	100	80	100	100	80	100	100	80	100	100
13	80	100	80	100	100	100	80	60	60	60
14	100	100	100	100	100	100	100	100	100	100
15	100	100	60	100	80	80	100	80	100	100
16	100	100	100	100	100	100	80	100	100	100
17	80	80	80	80	100	100	100	100	100	100
18	100	100	80	100	80	100	80	100	100	100
19	100	100	100	100	100	100	100	100	100	100
Total Marks	**1800**	**1700**	**1660**	**1760**	**1680**	**1840**	**1700**	**1720**	**1780**	**1820**
% of Marks	**94.737**	**89.474**	**87.368**	**92.632**	**88.421**	**96.842**	**89.474**	**90.526**	**93.684**	**95.789**
Overall Subject Feedback %.	**91.89473684**									

17. REFRANCE

Book,

[1] Hashmi, M.U., & Jayesh, G.P. (2015). Anti-Theft Energy Metering for Smart Electrical Distribution System. International Conference on Industrial Instrumentation and Control (Icic), May 28-30

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[1] Pradeep Mittall 2015, Wireless Electricity Billing System, International Research Journal of Engineering and Technology (Irjet) Volume: 02, Pp.21-34.

[2] J.L.Parra And E.A.S.Calderon 2013, Use Of Shunts Detecting Equipment For The Identification Of Illegal Power Outlets, International Journal Of Innovative Research In Science, Engineering And Technology, Pp. 1–4.

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[1] Smart Energy Metering and Power Theft Control Using Arduino & GSM Automated Smart Metering; (Ieee2017)

[2] Khusvinder Gill, Et.Al, " A Zigbee-Based Home Automation System",Ieee Transactions On Consumer Electrionics, Vol, 55,No. 2, Pp. 422-430 May 2009

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[1] https://circuitdigest.com