A
Final Year
Project Report
On

"INTEGRATED SMART ENERGY METER WITH HOME AUTOMATION"

Submitted in partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering
in
Electrical and Electronics Engineering

Visvesvaraya Technological University, Belagavi
Submitted by

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
BMS COLLEGE OF ENGINEERING
(Autonomous Institute, Affiliated to VTU)
BULL TEMPLE ROAD, BENGALURU-560019

2021-2022

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

2021-2022

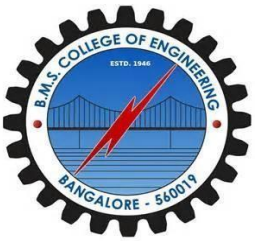
CERTIFICATE

Certified that the project work entitled **"SMART ENERGY METER WITH HOME AUTOMATION"** carried out by **Ananya Chakravarthi (1BM18EE007), Sangeetha S Iyer (1BM18EE045), Sandeep V(1BM18EE068) and Prayag Sridhar(1BM18EE041)** a bonafide students of BMS College of Engineering in partial fulfillment for the award of degree of Bachelor of Engineering in Department of Electrical and Electronics Engineering of Visvesvaraya Technological University, Belagavi during the year 2021-2022. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

Signature of the Guide	Signature of the HOD	Signature of the Principal
(Dr. S Pradeepa)	**(Dr. A N Nagashree)**	**(Dr. Muralidhara S)**

Name of the Examiners	Signature
1. _____	_____
2. _____	_____



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BONAFIDE CERTIFICATE FROM THE SUPERVISOR

Certified that this project entitled **"SMART ENERGY METER WITH HOME AUTOMATION" carried out by Ananya Chakravarthi (1BM18EE007), Sangeetha S (1BM18EE045), Sandeep V (1BM18EE068) and Prayag Sridhar (1BM18EE041),** who carried out under my supervision. This project work dissertation report was thoroughly scrutinized and corrected by me. All the corrections are incorporated by the students and the project report satisfies the academic requirements in respect of project work prescribed for the award of said degree. I duly certify the same.

Signature of the Guide

(Dr, S Pradeepa)

DECLARATION

We hereby declare that the project work entitled "**SMART ENERGY METER WITH HOME AUTOMATION**" submitted to BMS College of Engineering, is a record of an original work done by us under the guidance of **Dr S. Pradeepa, Professor**, Department of Electrical and Electronics Engineering, BMS College of Engineering, Bengaluru and this project work is submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Engineering in Electrical and Electronics Engineering. The results embodied in this thesis have not been submitted to any other University or Institute for the award of any degree.

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Prayag Sridhar

ABSTRACT

Due to the development and improvement of technology and embedded systems, human lives have become easier with the help of newly developed smart systems. These days, people are more interested in using the internet to control and observe different types of devices. Internet of things (IoT) creates an innovative evolution of the technology world with a new era of mature intelligence computing. IoT can be defined as the connection between many kinds of devices like smartphones, personal computers, and tablets to the internet, which brings in a very new kind of communicating between things and people and also between things themselves.

IoT has led to the evolution of electric devices and provided greater growth for smart homes to improve the standard of life. Over the last few years, the concept of a smart home has become interesting among consumers. There are tons of research done on home automation using IoT and one such research helped in developing a smart home system that provides high security and is cheaper in cost. This further led to the development of a system for power utilization using IoT in homes. In this system, they make use of image processing for monitoring human activities. A well-known renowned scientist designed a system that has the capability to control many household devices using GSM and Wi-fi.

In our project, we make use of home automation and energy monitoring system and the energy collected is then updated to the cloud. Arduino is used to collect energy values by taking in current and voltage values from the respective sensors. Using Controller ESP8266, the energy values calculated is updated to the cloud for every one hour. Servers are used for calculating total energy consumption by house hold appliances and the details are then sent to the users.

ACKNOWLEDGMENTS

We would like to take this opportunity to express our heartful gratitude to ***Dr. S Pradeepa***, Professor, B.M.S.C.E for her constant guidance and support throughout the year which helped us to complete the project.

Our earnest thanks to **Dr. A.N Nagashree**, HOD, Department of Electrical and Electronics, B.M.S.C.E for extending her support and providing her valuable suggestions.

We also deeply value the inputs provided by **Dr. C Lakshmi Narayana**, Professor, Department of Electrical and Electronics who helped us to improvise our work.

We would like to express our gratitude towards parents & members of **B.M.S College of Engineering** for their kind co-operation and encouragement which help me in completion of this project.

Our thanks and appreciations also go to fellow students in developing the project and people who have willingly helped us out with their abilities.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

A Prepaid Smart meter is used to measure energy consumption. The Energy meter shows the amount of units consumed and the associated electrical parameters. The user can check their Power usage from anywhere and at any time interval. The concept of Home automation is used to Turn on/off the household appliances using relay and Arduino interfacing. This project aims at integrating the above systems to provide a comprehensive solution to human intervention and appliance mechanization. The objective of this system is to automate appliance functions using sensors and consequently use the smart meter to bill the consumption information. This dual system mainly aids elderly and the disabled to control their utility appliances at the touch of a button. It also aids in consumer-side communication by utilities and demand side management.

For better understanding of the individual systems and their integration, we have simulated it using the Proteus 8 Professional (Version 8.12) software and Arduino IDE. The integration of smart energy meter and home automation with the LCD Display gives rise to an active feedback loop between data from the smart energy meter, the consumer and the home automation feature.

FIGURE 1.1: HOME AUTOMATION

2. SMART ENERGY METER

The Smart Energy Meter works by measuring the electrical current flow and voltage at regular intervals and then adding this up to calculate the power used in a certain time period. This information is then displayed on the LCD screen.

Smart meters differ from automated meter devices like it uses different technology, kind of information they measure. Smart meters give in-detail data than old devices and also give users access to meter's energy data usage. By doing this, you have the ability to have your energy usage under control by altering your usage habits.

Smart meters have the ability to assist customers to become more energy well-structured while offering sufficient understanding and opportunities to help save income on the electricity bill.

2.1 BLOCK DIAGRAM

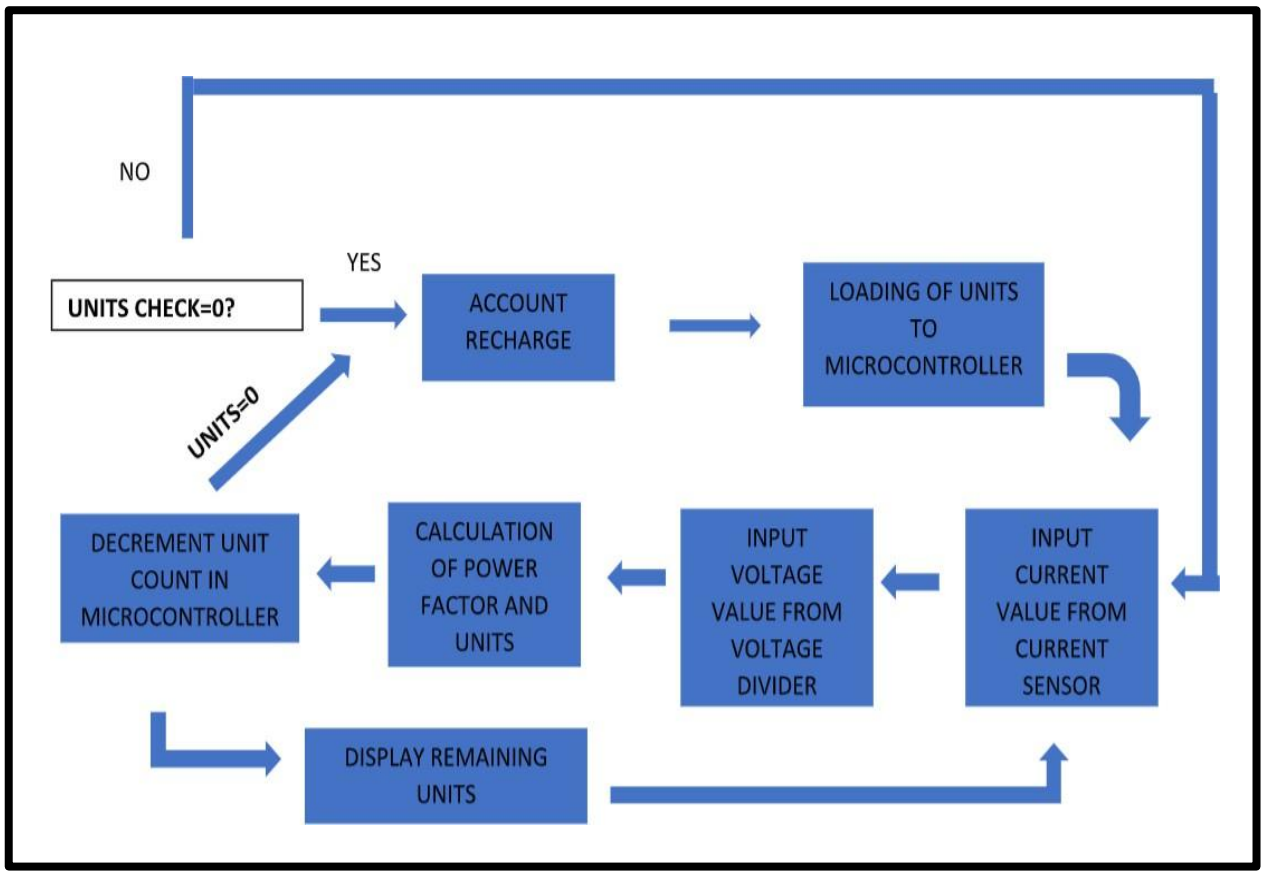


FIGURE 2.1: BLOCK DIAGRAM OF SMART ENERGY METER

2.2 SPECIFICATIONS

1. Voltage Range for Arduino - 7-12 V
2. Operating frequency of Arduino UNO - 16 MHz (ATMEGA328)
3. Voltage Divider Circuit (load V measurement) - 100kΩ and 10kΩ
4. Current Sensor ACS712
5. 16x2 LCD Display
6. 5V DC Voltage, (This DC shift is added to the incoming voltage level so that the negative portion of the signal may be converted into positive.)

2.3 CIRCUIT DIAGRAM

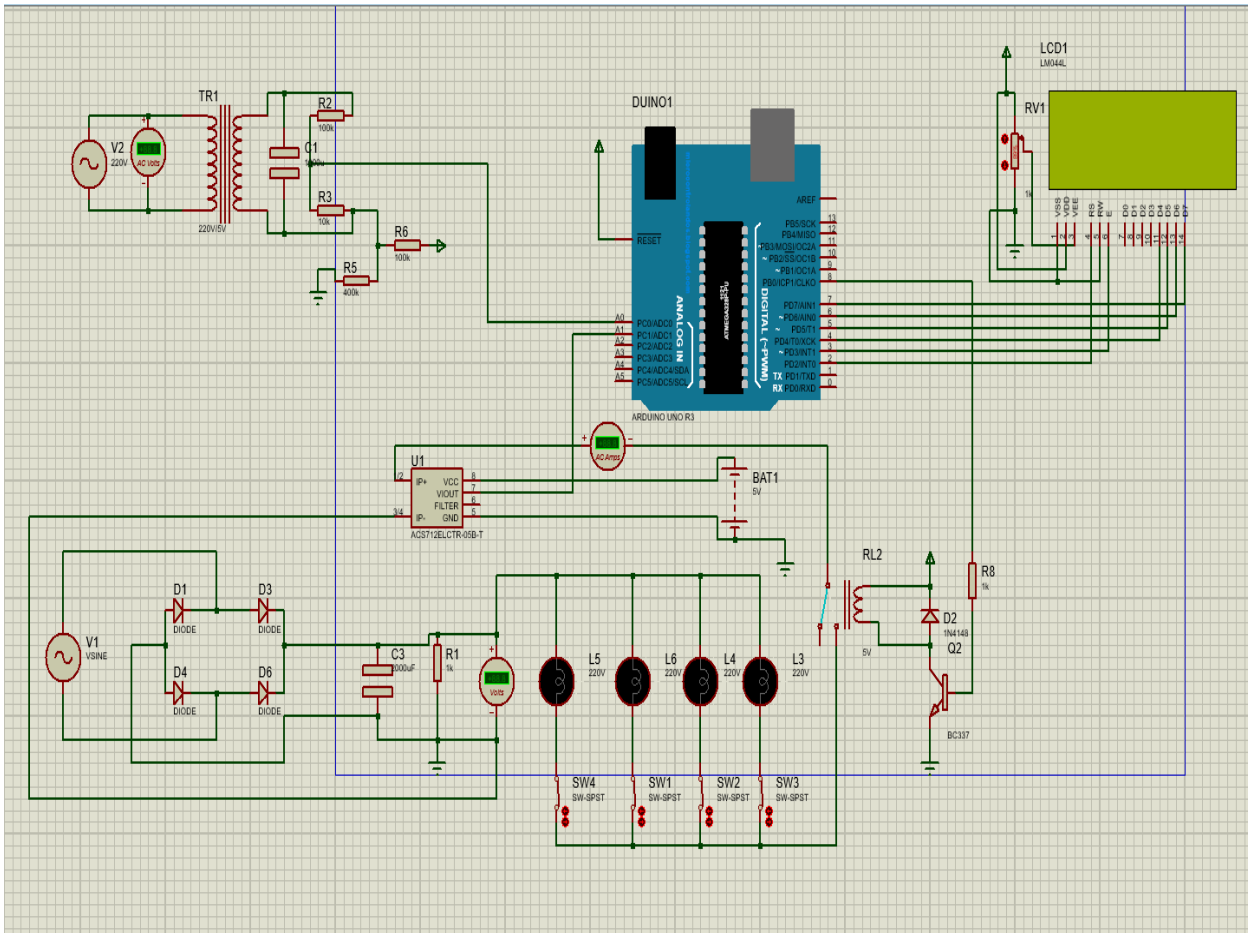


FIGURE 2.2: CIRCUIT DIAGRAM OF SMART ENERGY METER

2.4 : CODE

```
#include<EEPROM.h>
#include <LiquidCrystal.h>
LiquidCrystal lcd(2, 3, 4, 5, 6, 7);  // lcd(7,6,5,4,3,2);
int led;
#define pulsein 9
#define relay 8
#define sw 4
int sensitivity = 185;
int offsetvoltage = 2500;
float Voltage1 = A0;          //Defining and initializing the voltage
float Current1 = A1;
float I1 = 0;
float V1 = 0;
float power;
float energy =0;
float t;
float adc =0.00;
unsigned int pusle_count=0;
float units=0;
unsigned int rupees=0;
unsigned int temp=0,i=0,x=0,k=0;
//char str[70]
char flag1=0,flag2=0;
//String bal="";

void setup()
{
 lcd.begin(16,2);
 Serial.begin(9600);
 pinMode(led, OUTPUT);
 pinMode(pulsein, INPUT);
 pinMode( sw , INPUT);
 pinMode(relay, OUTPUT);
 digitalWrite(pulsein, HIGH);
 digitalWrite(relay, HIGH);
 lcd.setCursor(0,0);
 lcd.print("Smart Energy Meter");

 delay(2000);
 lcd.clear();

 digitalWrite(led, LOW);
 lcd.clear();
 EEPROM.write(1,40);
 rupees=EEPROM.read(1);
}

void loop()
{
```

```
    rupees=EEPROM.read(1);
    units=rupees/5.0;
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("Units:");
    lcd.print(units);
    lcd.setCursor(0,1);
    if (units<1)
    {
    lcd.print("Supply Cut!");
      lcd.print("Meter off!!!");
      exit(0);
    }
    if(rupees<15)
    lcd.print("LOW Balance:");
    else
    lcd.print("Balance:");
    lcd.print(rupees);
    lcd.print("       ");
    delay(1000);
    lcd.clear();
    energy=energy+(power*t);
    V1= ((analogRead(A0)*(4.5/1023)*60));
    adc= ((analogRead(A1))/1024.00)*5000;
    I1=(adc-2500 )/185;
    lcd.setCursor(11,0);
    lcd.print("V=");
    lcd.print(V1);
    lcd.setCursor(0,0);
    lcd.print("I= ");
    lcd.print(I1);
    power=V1*I1;
    lcd.setCursor(0,1);
    lcd.print("POWER=");
    lcd.print(power);
    lcd.setCursor(11,1);
    lcd.print("ENERGY=");
    lcd.print(energy);
    delay(1000);
    lcd.print("  ");
    read_pulse();
    check_status();
    if(temp==1)
    {
     //decode_message();

    }
}

void read_pulse()
{
```

```
if(digitalRead(pulsein))
{


 if ((0.00<I1) &&(I1<2.00))
 {
  if(units<1){lcd.print("Supply Cut");}

  else
  {
  units--;
  rupees=units*5;
  t=4.00;
  EEPROM.write(1,rupees);
  while(!digitalRead(pulsein));
  //digitalWrite(led,LOW);
  delay(1000);
  }
 }

 if ((2.00<I1) &&(I1<3.00))
 {
  if(units<1){ lcd.print("Supply Cut.");}

  else
  {
  units--;
  rupees=units*5;
  t=2.00;
  EEPROM.write(1,rupees);
  while(!digitalRead(pulsein));
  //digitalWrite(led,LOW);
  delay(1000);
  }
 }

 if ((3.00<I1) &&(I1<4.00))
 {
  if(units<1){lcd.print("Supply Cut.");}

  else
  {
  units--;
  rupees=units*5;
  t=1.33;
  EEPROM.write(1,rupees);
  while(!digitalRead(pulsein));
  //digitalWrite(led,LOW);
  delay(1000);
  }
 }
```

```
      if (I1>4.00)
      {
       if(units<1){}

       else
       {
       units--;
       rupees=units*5;
       t=1.00;
       EEPROM.write(1,rupees);
       while(!digitalRead(pulsein));
       delay(1000);
       }
      }
    }
}

void check_status()
{
     if(rupees>15)
     {
      digitalWrite(relay, HIGH);
      flag1=0;
      flag2=0;
     }
     if(rupees<=15 && rupees>=5)
     {
      lcd.setCursor(0,1);

      message_sent();
     }
     if(rupees<5 && flag1==0)
     {
     digitalWrite(relay, LOW);
     lcd.clear();
     lcd.setCursor(0,1);
     lcd.print("Low Balance");
     delay(2000);
     lcd.clear();
     lcd.print("Please Recharge!! ");
     lcd.setCursor(0,1);
     lcd.print("the Meter ");

     //message_sent();
     flag1=1;
    }
}
/*
void decode_message()
{
```

```
 x=0,k=0,temp=0;
 while(x<i)
 {
  while(str[x]=='#')
  {
    x++;
    bal="";
    while(str[x]!='*')
    {
      bal+=str[x++];
    }
  }
  x++;
 }
  bal+='\0';
}
void message_sent()
{
 lcd.clear();
 lcd.print("Please recharge!!");
 delay(1000);
 lcd.clear();
}
```

2.4 DESIGN AND ANALYSIS

Case 1: Initially when units is more than 3.

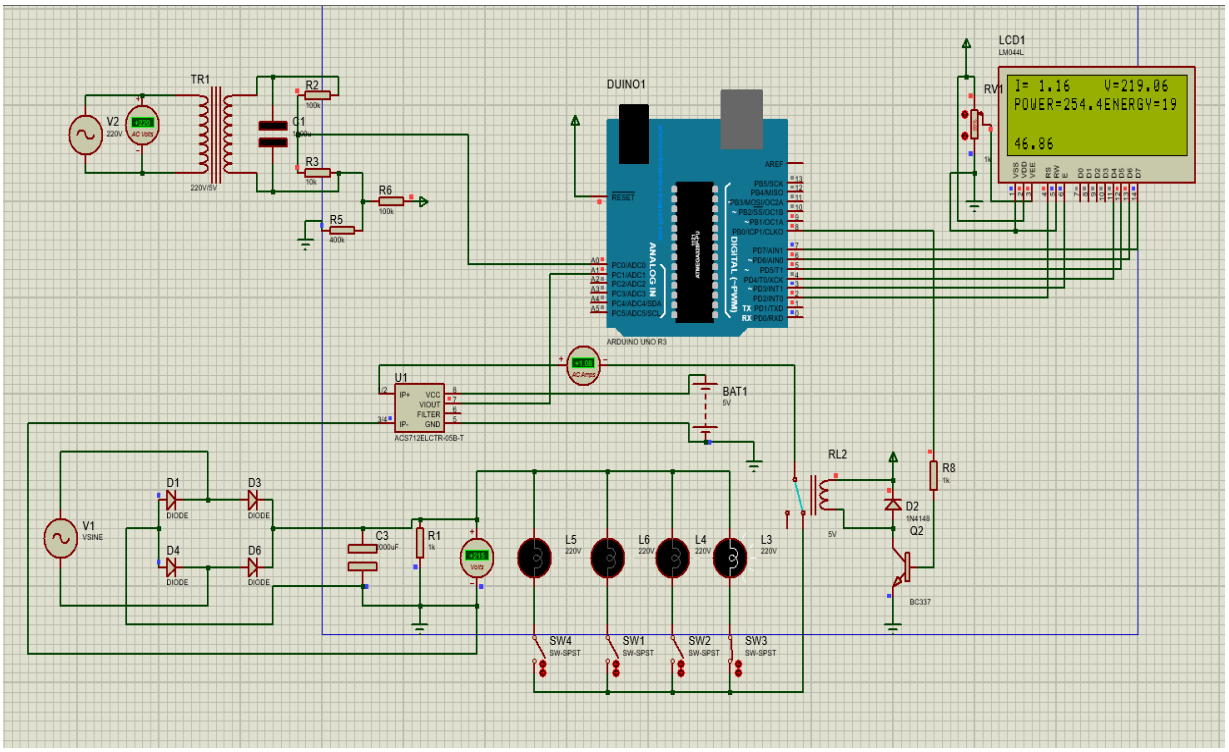


FIGURE 2.3: ENERGY METER WHEN UNITS ARE GREATER THAN 3

When units are greater than 3, LCD displays the amount of energy is being consumed along with Voltage, current, power and units remaining.

Case 2: When units is less than 3.

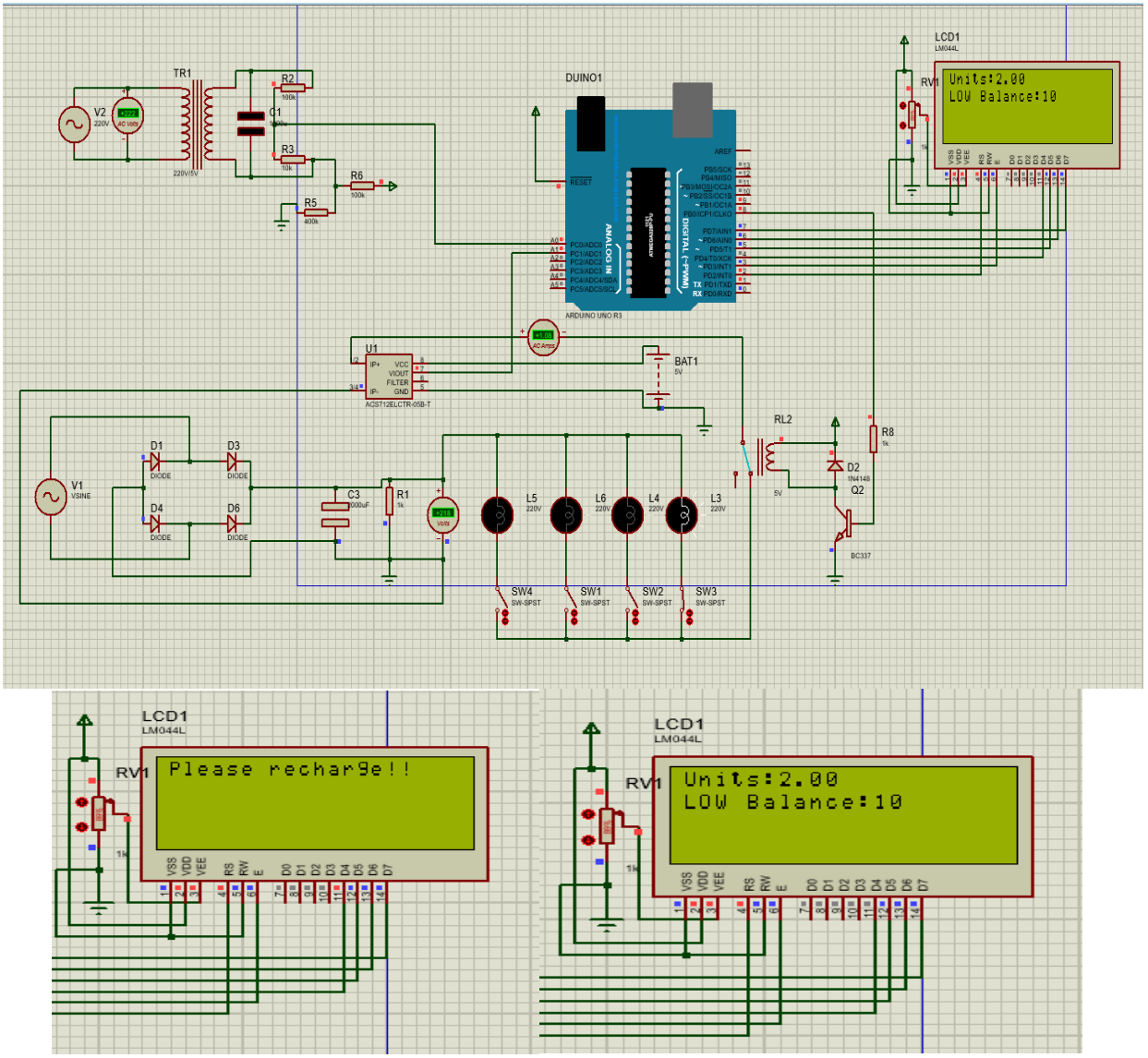


FIGURE 2.4: ENERGY METER WHEN UNITS ARE LESS THAN 3

When units are less than 3, a message **LOW BALANCE** is displayed and alerts the consumer to **RECHARGE** with a message.

Case 3: When units is equal to 0

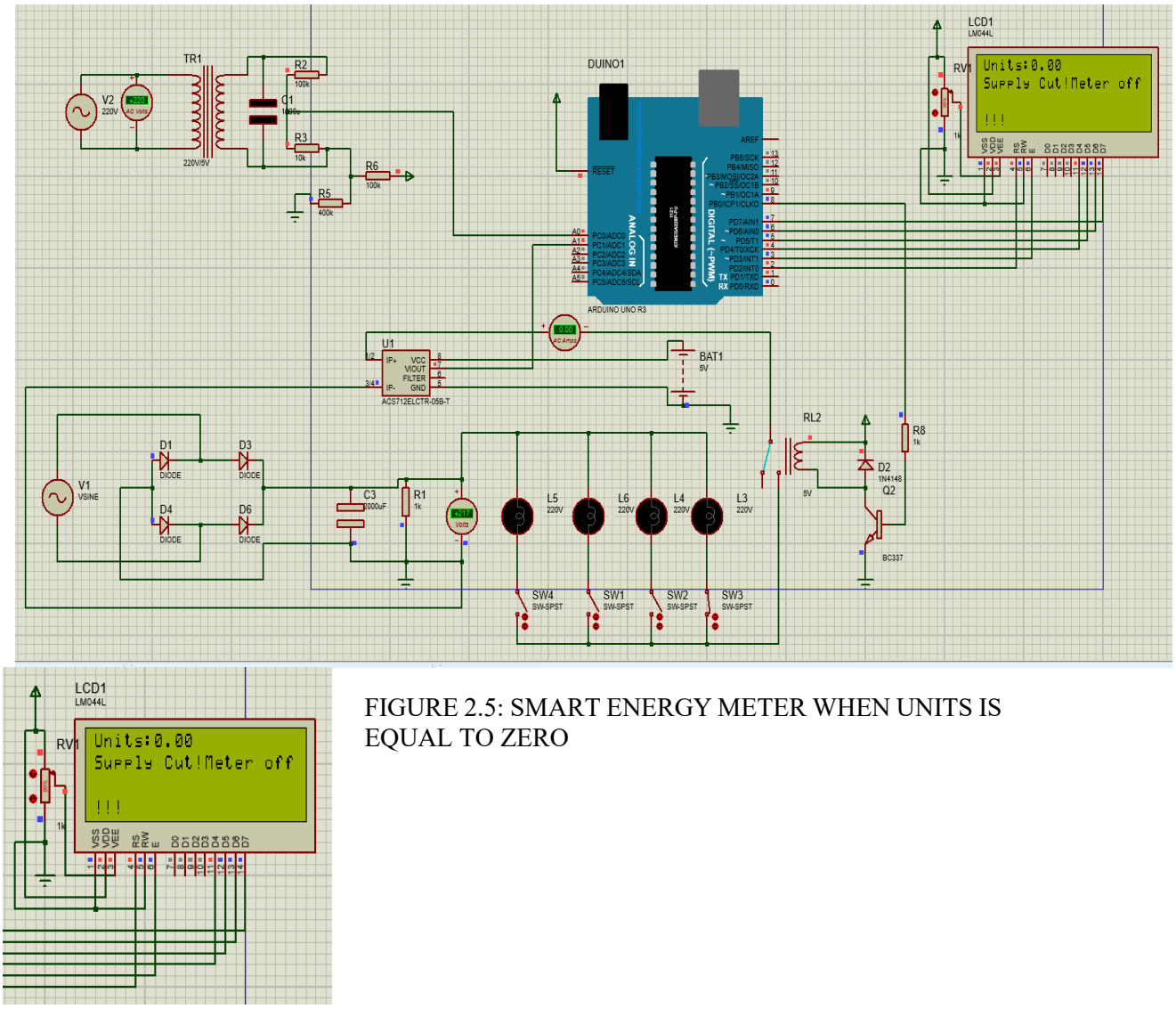


FIGURE 2.5: SMART ENERGY METER WHEN UNITS IS EQUAL TO ZERO

When unit goes to 0, the supply is cut off as the Relay circuit will switch to the other terminal.

A message is sent to the consumer notifying that the supply is cut off

3. HOME AUTOMATION

"Smart Home" or "Intelligent Home" refers to automation of home appliances based on sensor monitoring. These systems include centralized control and surveillance of lighting, security and temperature of appliances within a house. HAS's enables energy efficiency, imbibing sustainability values in power consumption for users. The circuit is controlled by a number of sensors which activate the relays based on the threshold values and hence signals circuit operation. The LCD screen is used to display the status of the appliances..

The devices we have chosen for the circuit are bulbs, LED Lamps and Fan motors. The home automation system is one of the most useful features for the elderly and disabled. It provides increased security and simplicity with regard to power control and use.

3.1 : BLOCK DIAGRAM

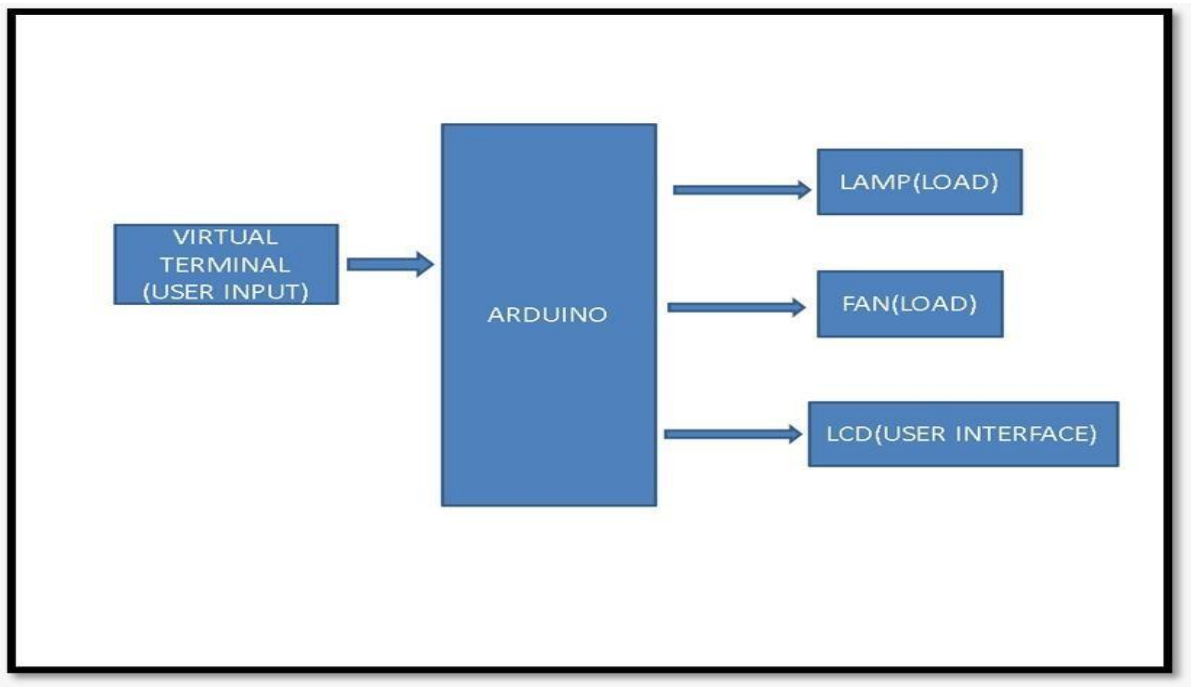


FIGURE 3.1: BLOCK DIAGRAM OF HOME AUTOMATION

3.2 : CIRCUIT SPECIFICATIONS

1. Operating frequency of ARDUINO UNO - 16 MHz (ATMEGA328)
2. 16x2 LCD Display
3. Relay
4. BC547 NPN transistor
5. Resistors(1k) , diodes
6. LED 12V
7. Motor- nominal voltage 12V
8. Serial monitor, to use virtual terminal

3.3 : CIRCUIT DIAGRAM

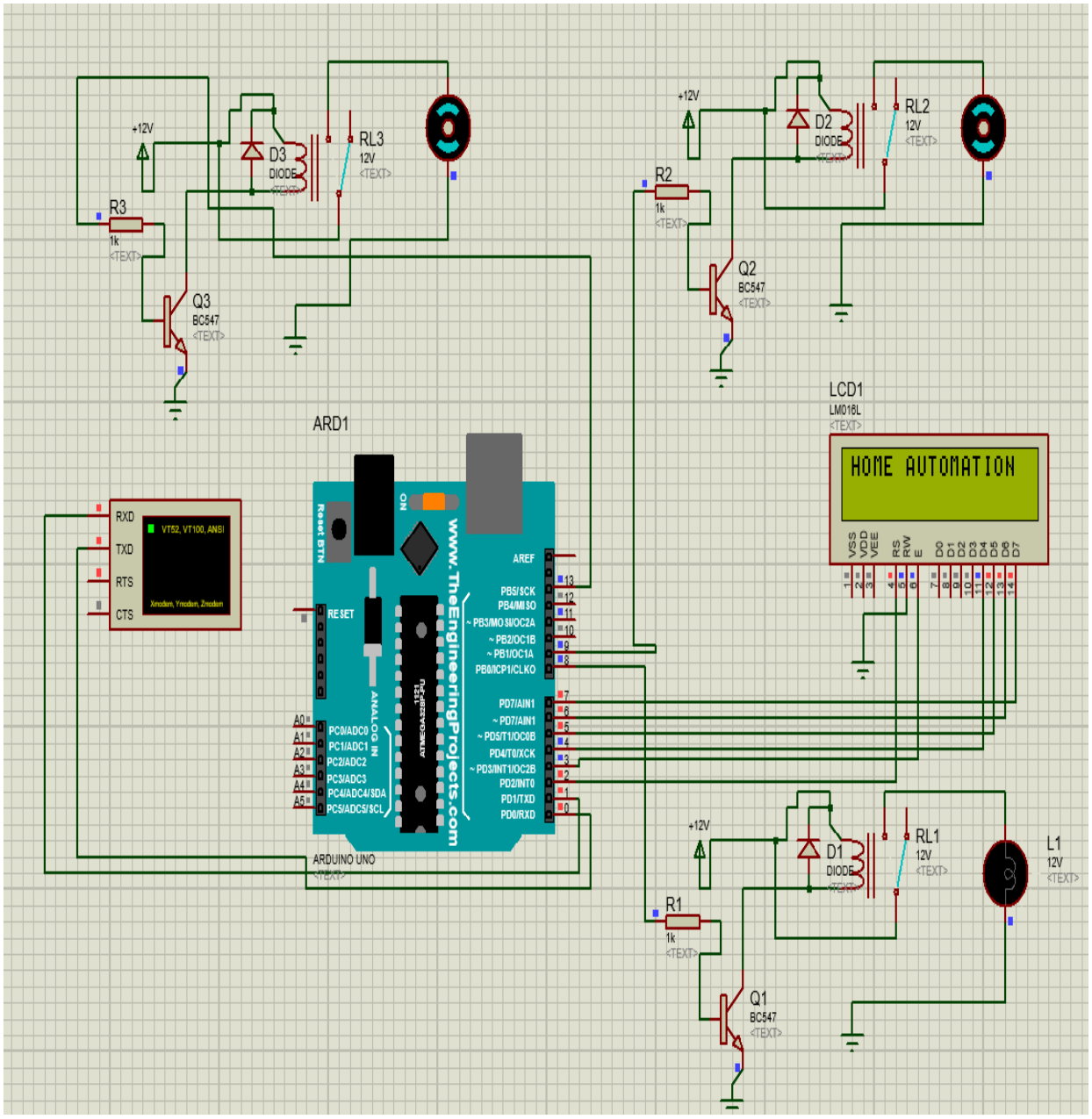


FIGURE 3.2: CIRCUIT DIAGRAM OF HOME AUTOMATION

3.4 : CODE

```
#include <LiquidCrystal.h> // includes the LiquidCrystal Library
LiquidCrystal lcd(2,3,4,5,6,7); // Creates an LCD object. Parameters:
//(rs, enable, d4, d5, d6, d7)

const int m1=10;
const int m2=11;
char NUM;
```

```
int F=0,R=0;
int N=0;
void setup() {

pinMode(8, OUTPUT);
pinMode(13, OUTPUT);
pinMode(9, OUTPUT);
pinMode(m2, OUTPUT);

Serial.begin(9600);
lcd.begin(16, 2);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("HOME AUTOMATION");
delay(5000);
lcd.clear();
}

void loop() {

if(Serial.available())
{
NUM= Serial.read();

if(NUM=='A')
{
digitalWrite(8,HIGH);
//delay(1000);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("LED ON");
}
else if(NUM=='B')
{
digitalWrite(8,LOW);
//delay(1000);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("LED OFF");
}

else if(NUM=='C')
{
digitalWrite(13,HIGH);
//delay(1000);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("FAN ON ");
}
else if(NUM=='D')
{
```

```
digitalWrite(13,LOW);
//delay(1000);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("FAN OFF");
}

else if(NUM=='E')
{
digitalWrite(9,HIGH);
//delay(1000);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("MOTOR ON");
}

else if(NUM=='F')
{
digitalWrite(9,LOW);
//delay(1000);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("MOTOR OFF");
}
else
{
digitalWrite(9,LOW);
digitalWrite(13,LOW);
digitalWrite(8,LOW);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("ALL OFF");
delay(2000);
}

}
}
```

3.4: DESIGN AND ANALYSIS

Case 1: LED controls depends on serial input given by the user. When “A” is given as the input the led turns ON and when “B” is given as input the led turns OFF.

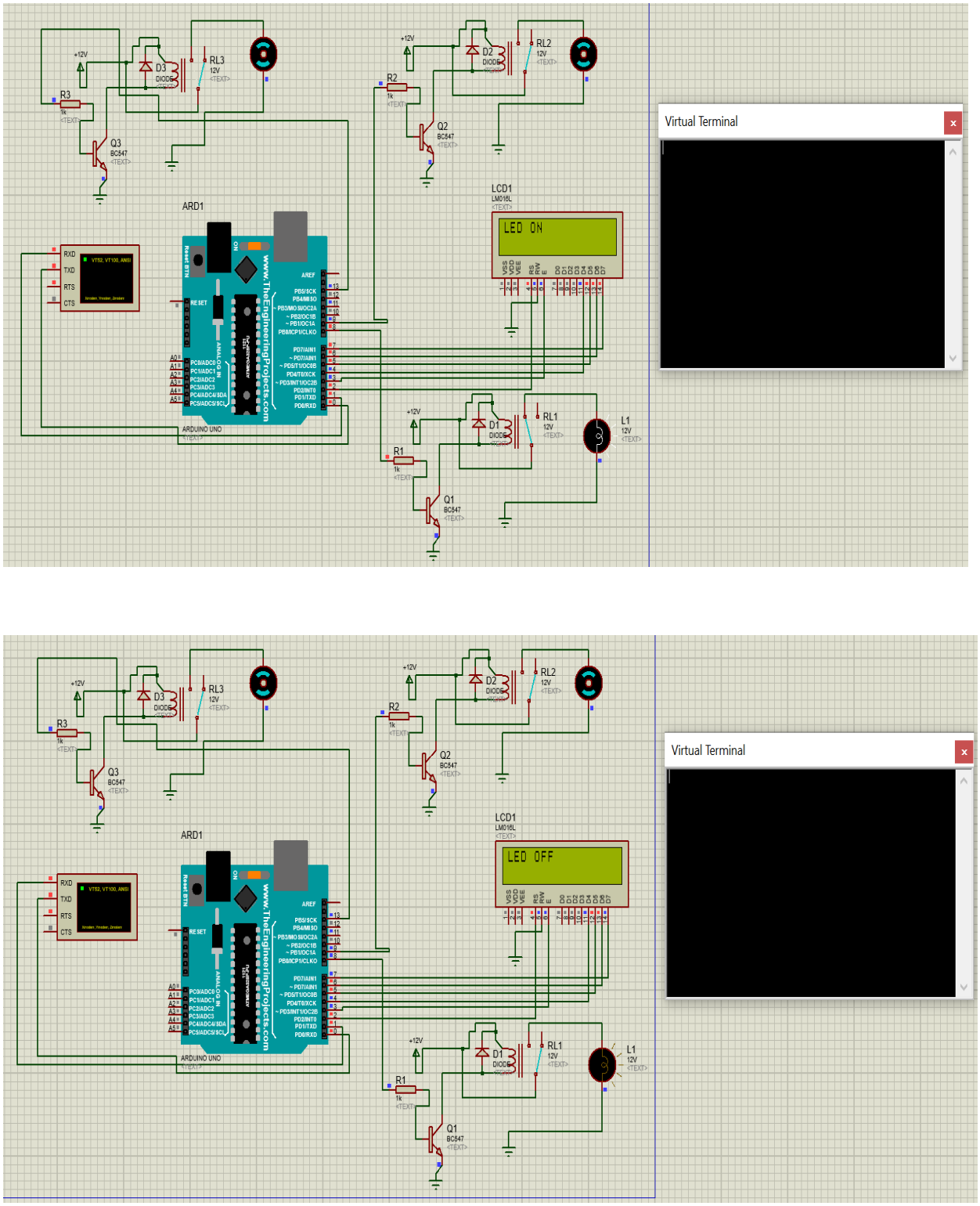


FIGURE 3.3: LED CONTROL USING VIRTUAL TERMINAL(USER INPUT)

Case 2: MOTOR/FAN control depends on serial input given by the user.

- When “C” is given as the input the FAN turns ON and when “D” is given as input the FAN turns OFF.
- When “E” is given as the input the MOTOR turns ON and when “F” is given as input the MOTOR turns OFF.

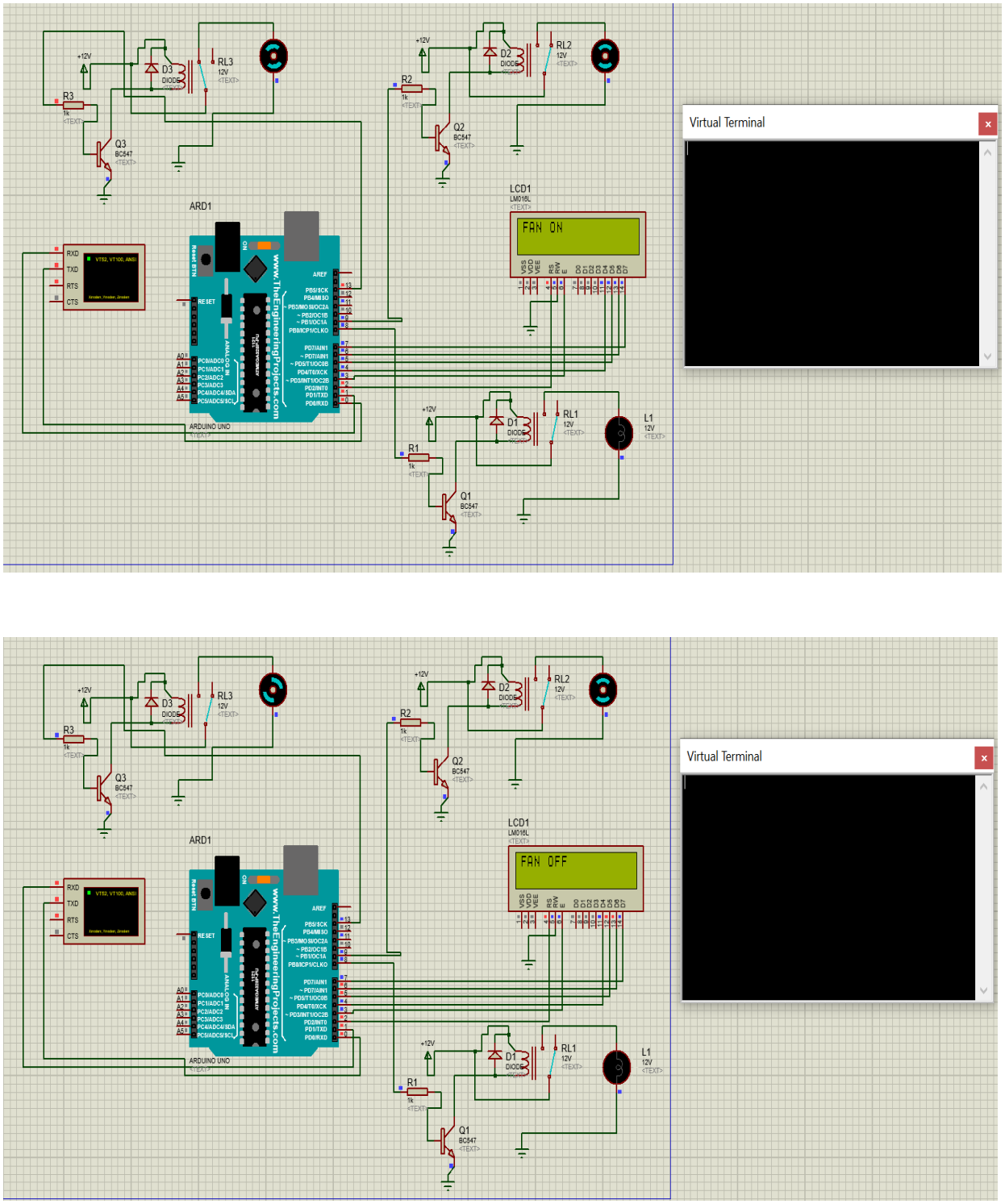


FIGURE 3.4: FAN/MOTOR CONTROL USING VIRTUAL TERMINAL(USER INPUT)

Case 3: LED/MOTOR/FAN control depends on serial input given by the user.
When the user gives any other input, then all the relay will turn down and all loads will TURN OFF.

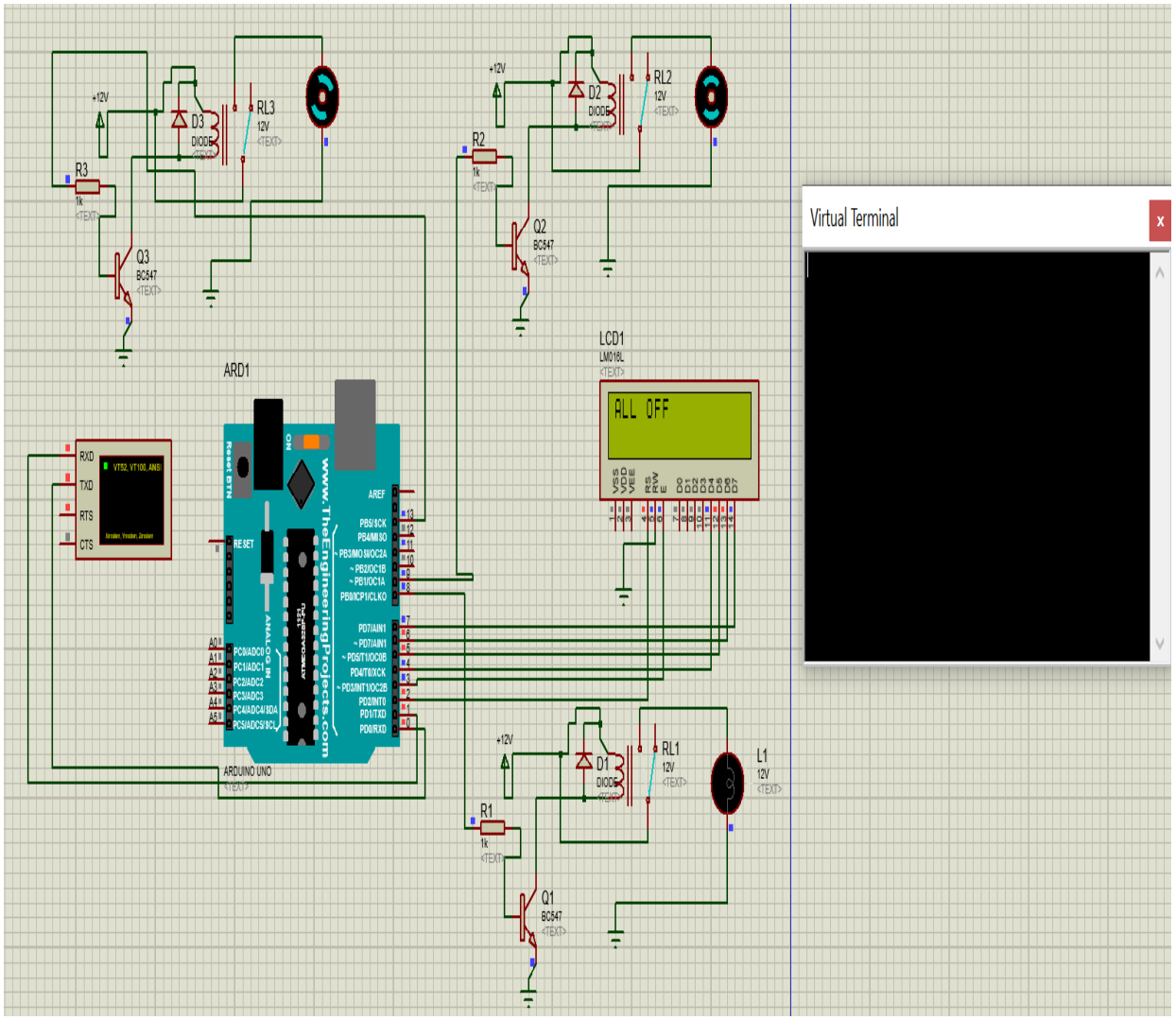


FIGURE 3.5: ALL LOADS TURN OFF WHEN WRONG USER INPUT IS IDENTIFIED

4. INTEGRATION OF SMART ENERGY METER AND HOME AUTOMATION

An integrated system of metering and control provides dual benefits of automation and billing. The project involves the concept of automating appliances, then bringing into picture- the smart metering which performs energy and power calculations. This provides mechanized control, preventing consumers from energy wastage and removing human intervention from the metering and billing areas.

In addition, we propose to imbibe data analytics features within the system to perform studies and give consumer reports on their usage pattern and suggest solutions based on thresholds

4.1 : BLOCK DIAGRAM

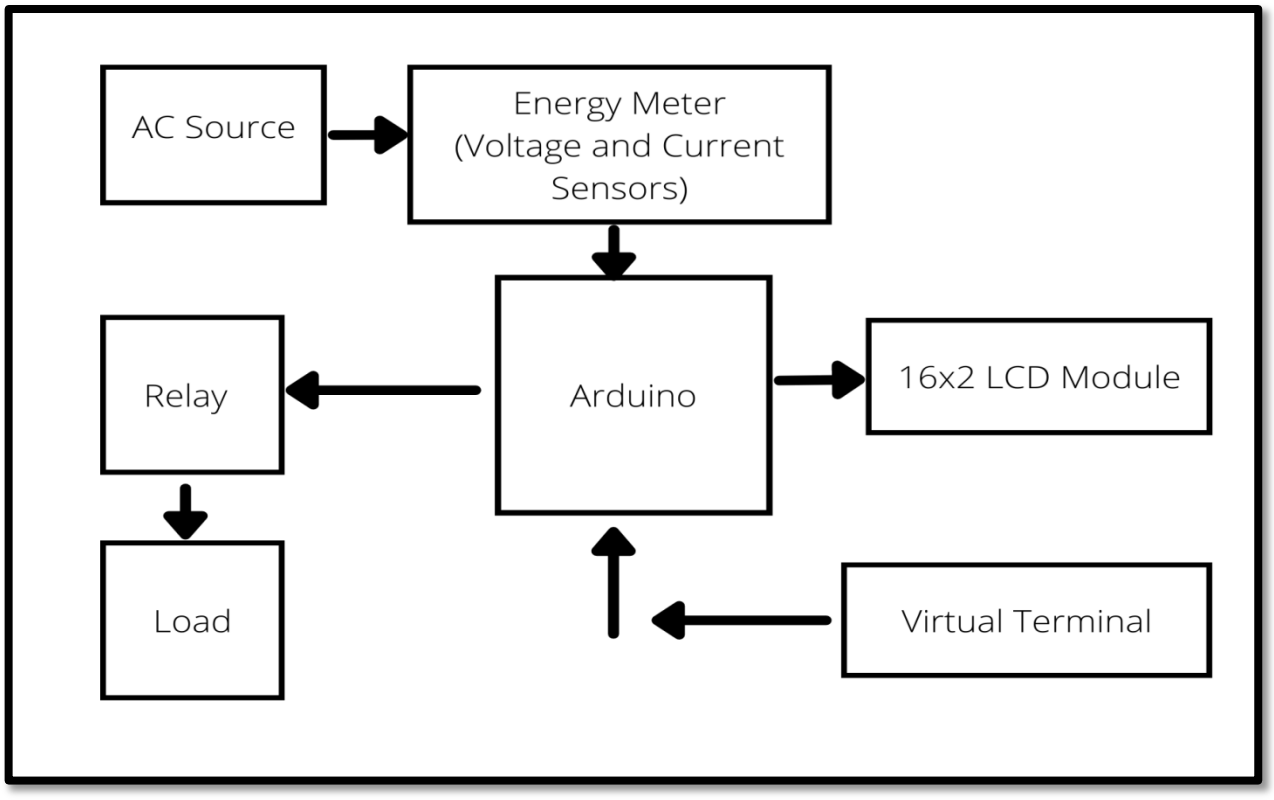


FIGURE 4.1: BLOCK DIAGRAM OF INTEGRATED CIRCUIT

4.2 : CIRCUIT DIAGRAM

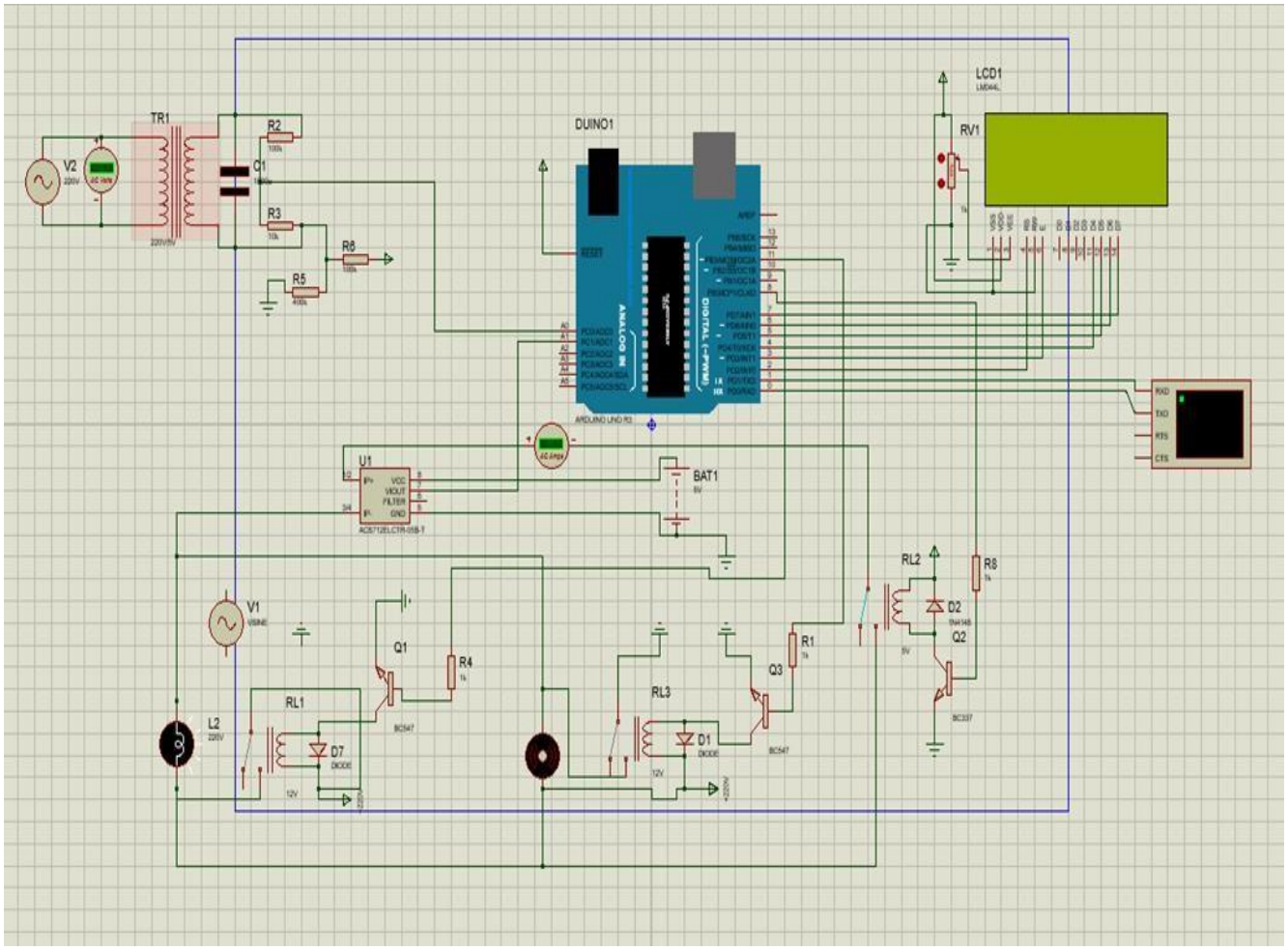


FIGURE 4.2: CIRCUIT DIAGRAM OF INTEGRATED CIRCUIT

4.3 : CODE

```
#include <EEPROM.h>
#include <LiquidCrystal.h>

/* ---------- LCD pins (same as your Proteus drawing) --- */
LiquidCrystal lcd(2, 3, 4, 5, 6, 7);

/* ---------- I/O pins ---------------------------------- */
constexpr byte RELAY_PIN    = 8;      // cuts mains
constexpr byte PULSE_PIN    = 9;      // 3200-imp/kWh LED, active-LOW
constexpr byte LOAD_LED_PIN  = 10;     // serial 'A/B'
constexpr byte LOAD_FAN_PIN  = 11;     // serial 'C/D'

constexpr byte VOLTAGE_PIN   = A0;     // divider  ~0-4.5 V
constexpr byte CURRENT_PIN   = A1;     // ACS712   ~0-5 V
```

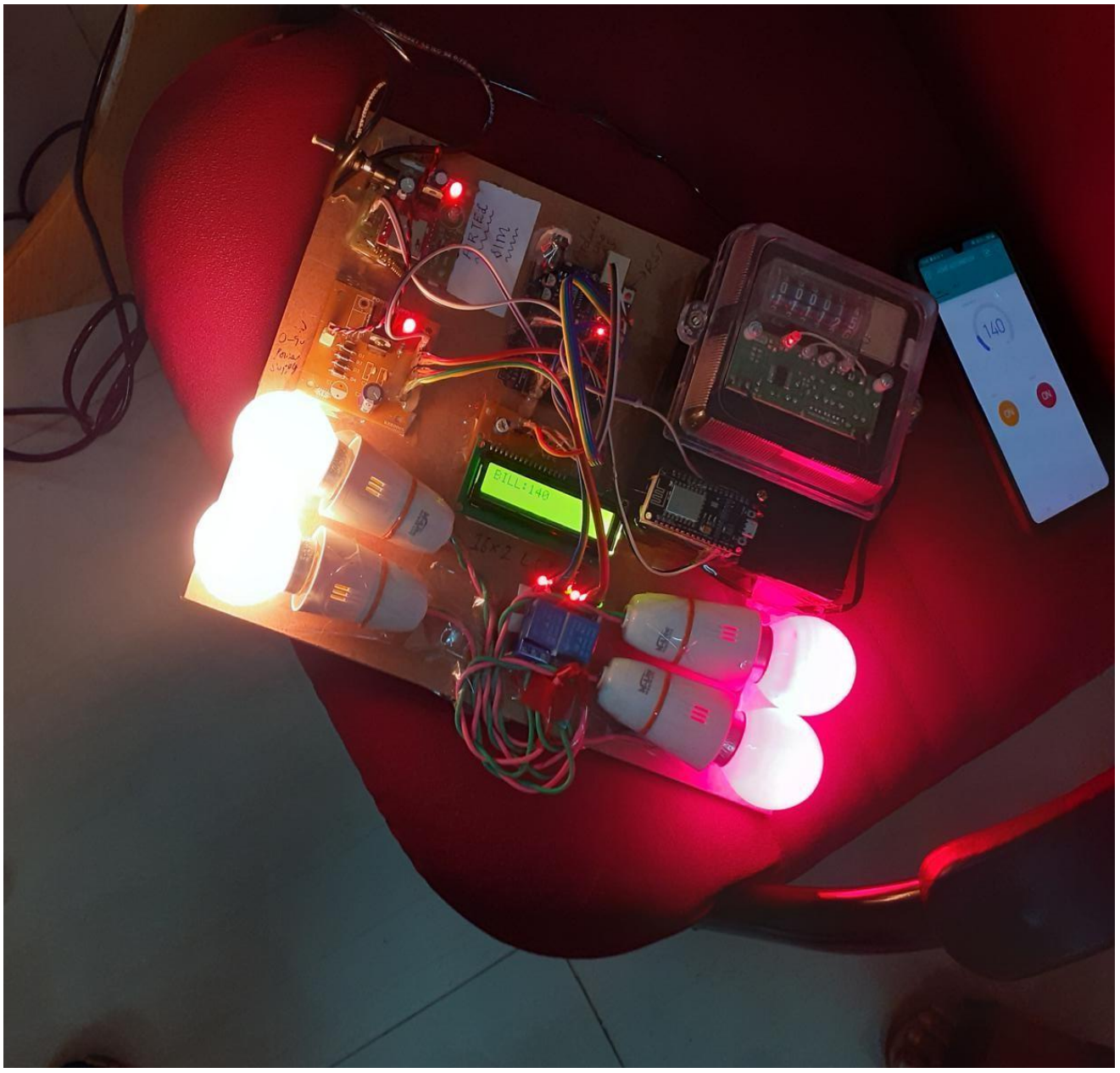
```
/* ---------- Wi-Fi & Adafruit IO ---------- */
#include <AdafruitIO_WiFi.h>

AdafruitIO_WiFi io(IO_USERNAME, IO_KEY, WIFI_SSID, WIFI_PASS);
AdafruitIO_Feed *feedPower   = io.feed("power");
AdafruitIO_Feed *feedUnits   = io.feed("units");
AdafruitIO_Feed *feedBalance = io.feed("balance");

/* ---------- Meter / tariff constants ---------- */
constexpr float ADC_mV_STEP       = 5000.0 / 1023.0;   // mV per LSB
constexpr float VOLTAGE_GAIN      = 60.0 * 4.5 / 1023.0;
constexpr float CURR_ZERO_mV      = 2500.0;
constexpr float CURR_SENS_mV_A    = 185.0;

constexpr uint8_t EEPROM_BAL_ADDR  = 1;
constexpr uint8_t DEFAULT_RUPEES   = 40;  // 8 units  (₹5 each)
constexpr float RS_PER_UNIT        = 5.0;
constexpr uint8_t LOW_BALANCE_RS   = 15;

float vRms = 0, iRms = 0, pInst = 0, energyWh = 0;

/* ---------- Timing ---------- */
constexpr unsigned long SAMPLE_MS     = 1000;
constexpr unsigned long ADAFRUIT_MS   = 30000;
unsigned long tLastSample   = 0;
unsigned long tLastPublish  = 0;

bool lastPulse = HIGH;   // for edge detect

/* ================================================== */
void setup() {
  Serial.begin(9600);
  lcd.begin(16, 2);

  pinMode(RELAY_PIN, OUTPUT);
  pinMode(LOAD_LED_PIN, OUTPUT);
  pinMode(LOAD_FAN_PIN, OUTPUT);
  pinMode(PULSE_PIN, INPUT_PULLUP);

  // init balance once
  if (EEPROM.read(EEPROM_BAL_ADDR) == 0xFF)
    EEPROM.write(EEPROM_BAL_ADDR, DEFAULT_RUPEES);

  lcd.print(F("Connecting WiFi"));
  io.connect();                  // blocks until connected
  lcd.setCursor(0, 1); lcd.print(F("Adafruit IO OK"));

  delay(1500);
  showBalance();
  tLastSample  = millis();
  tLastPublish = millis();
```

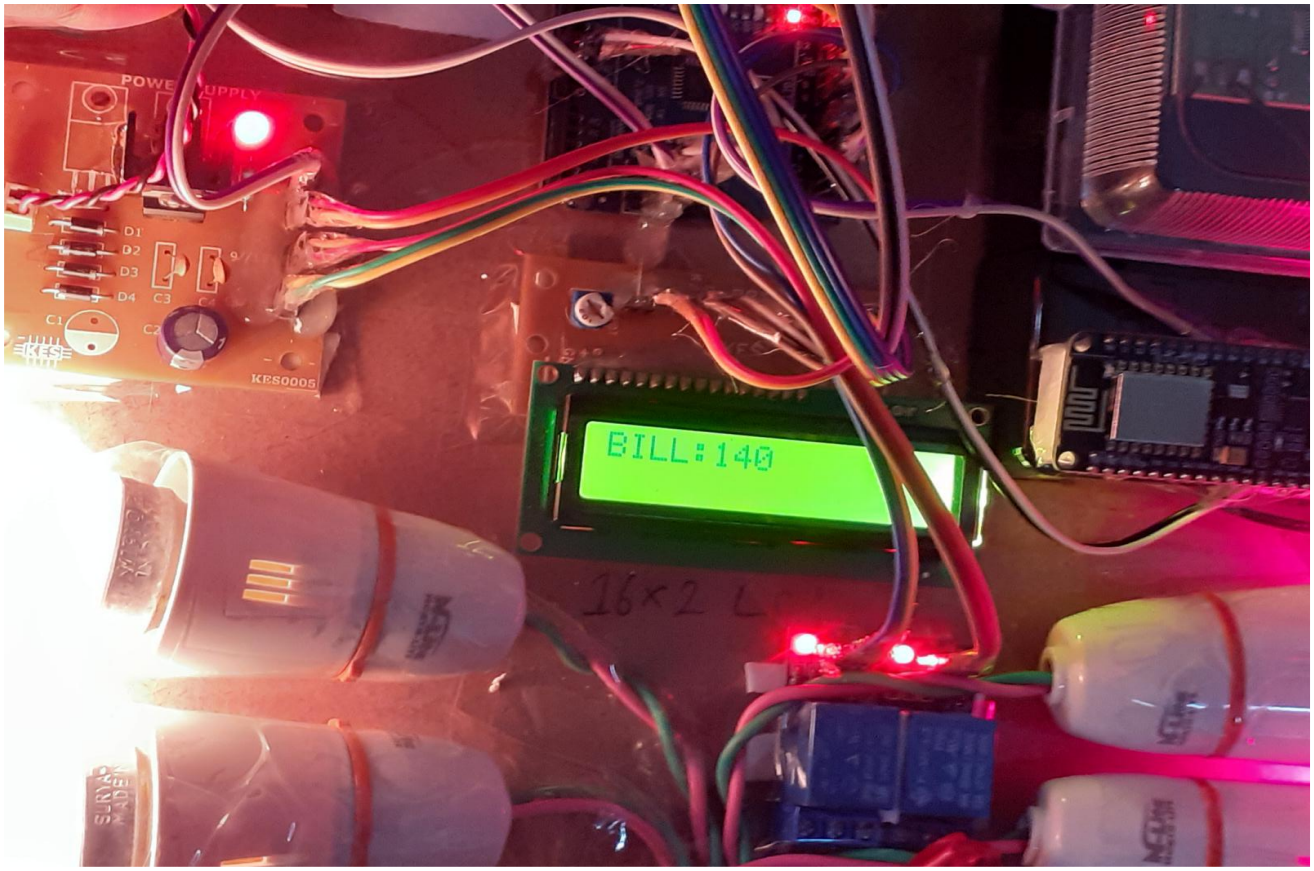
```
}

/* ================================================== */
void loop() {
  io.run();   // keep MQTT link alive  (non-blocking)

  /* ------------ Serial load control ------------------ */
  if (Serial.available()) {
    switch (Serial.read()) {
      case 'A': digitalWrite(LOAD_LED_PIN, HIGH);  break;
      case 'B': digitalWrite(LOAD_LED_PIN, LOW);   break;
      case 'C': digitalWrite(LOAD_FAN_PIN, HIGH);  break;
      case 'D': digitalWrite(LOAD_FAN_PIN, LOW);   break;
    }
  }

  /* ------------ 1 s acquisition ---------------------- */
  if (millis() - tLastSample >= SAMPLE_MS) {
    tLastSample += SAMPLE_MS;
    acquireVI();                // updates vRms, iRms, pInst
    energyWh += pInst * (SAMPLE_MS / 3600000.0);

    lcd.setCursor(0, 0);
    lcd.print(F("P:"));
    lcd.print(pInst, 0);
    lcd.print(F("W "));
    lcd.print(F("E:"));
    lcd.print(energyWh, 1);
    lcd.print(F("Wh "));

    handlePulse();
    checkBalance();
  }

  /* ------------ Adafruit IO publish ------------------ */
  if (millis() - tLastPublish >= ADAFRUIT_MS) {
    tLastPublish += ADAFRUIT_MS;
    sendToAdafruit();
  }
}

/* ===================== helpers ========================== */
void acquireVI() {
  int rawV = analogRead(VOLTAGE_PIN);
  int rawI = analogRead(CURRENT_PIN);

  vRms = rawV * VOLTAGE_GAIN;

  float mV  = rawI * ADC_mV_STEP;
  iRms = (mV - CURR_ZERO_mV) / CURR_SENS_mV_A;
  if (iRms < 0) iRms = 0;
```

```
  pInst = vRms * iRms;
}

void handlePulse() {
  bool now = digitalRead(PULSE_PIN);
  if (lastPulse == HIGH && now == LOW) {      // falling edge
    deductOneUnit();
    sendToAdafruit();                         // instant update
  }
  lastPulse = now;
}

void deductOneUnit() {
  uint8_t bal = EEPROM.read(EEPROM_BAL_ADDR);
  if (bal >= RS_PER_UNIT) bal -= RS_PER_UNIT;
  else bal = 0;
  EEPROM.write(EEPROM_BAL_ADDR, bal);
  energyWh = 0;             // reset counter
  showBalance();
}

void checkBalance() {
  uint8_t bal = EEPROM.read(EEPROM_BAL_ADDR);

  if (bal == 0) {
    digitalWrite(RELAY_PIN, LOW);
    lcd.setCursor(0, 1);
    lcd.print(F("SUPPLY CUT      "));
  } else if (bal < LOW_BALANCE_RS) {
    lcd.setCursor(0, 1);
    lcd.print(F("Low Bal Rs: "));
    lcd.print(bal);
    lcd.print(F("  "));
    digitalWrite(RELAY_PIN, HIGH);
  } else {
    digitalWrite(RELAY_PIN, HIGH);
  }
}

void showBalance() {
  uint8_t bal = EEPROM.read(EEPROM_BAL_ADDR);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print(F("Units: "));
  lcd.print(bal / RS_PER_UNIT, 1);
  lcd.setCursor(0, 1);
  lcd.print(F("Bal Rs: "));
  lcd.print(bal);
  lcd.print(F("    "));
}
```

```
/* ---------- Adafruit IO publish helper ---------- */
void sendToAdafruit() {
  if (io.status() != AIO_CONNECTED) return;     // don't block

  uint8_t bal = EEPROM.read(EEPROM_BAL_ADDR);
  float   unitsLeft = bal / RS_PER_UNIT;

  feedPower  ->save(pInst);
  feedUnits  ->save(unitsLeft);
  feedBalance->save(bal);
}
```

4.4 THE HARDWARE MODEL OF THE CIRCUIT

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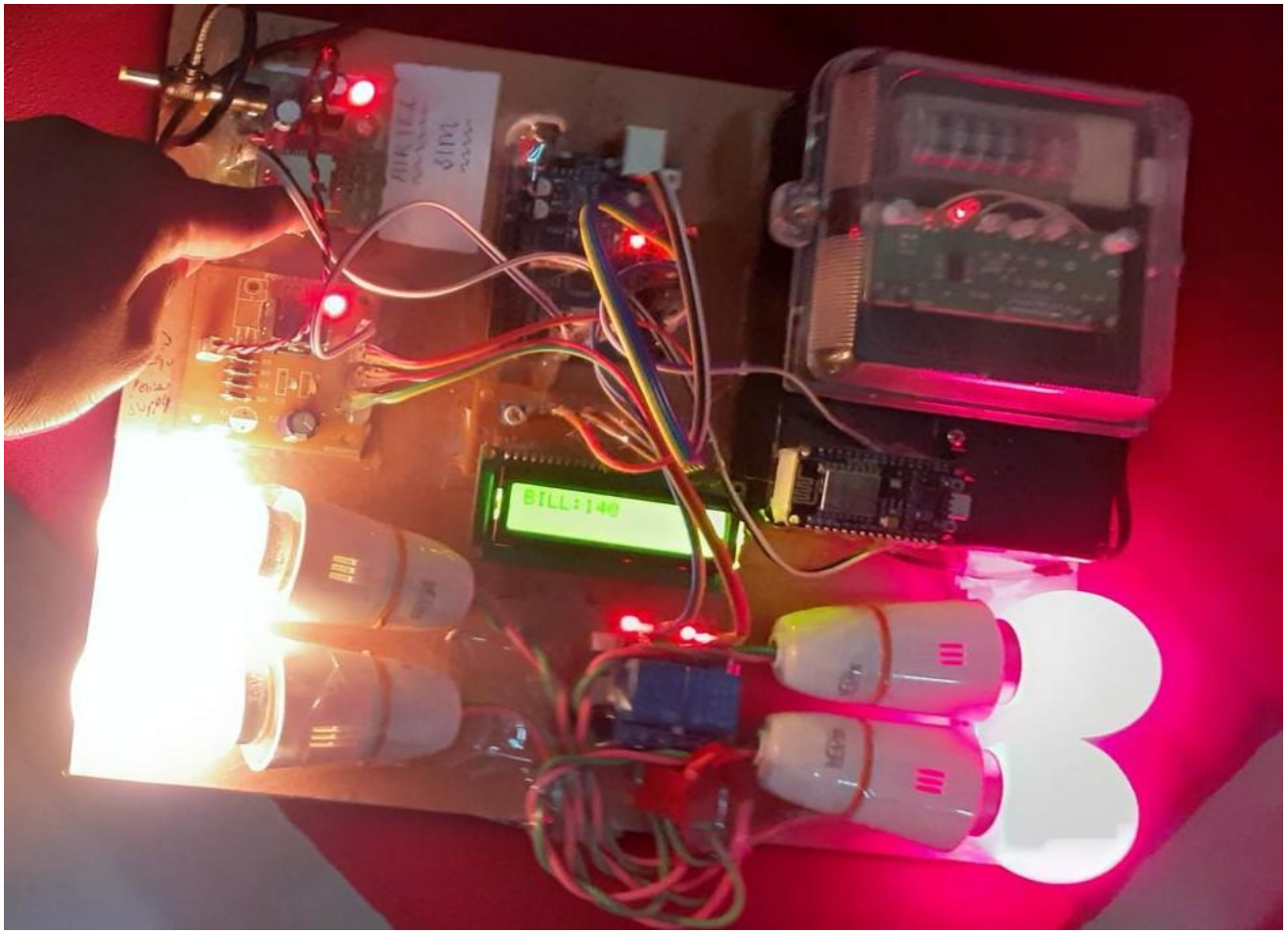
BILL:140

5. RESULTS

- **Smart energy meters** measure electricity consumed and display it to the user. Home **automation** will monitor/control home appliances.
- Both have a common underlying principle - encouraging **savings** in consumption. Hence, an energy meter which has an interface for home automation can switch off home appliances when not in use.
- This project has thus proposed an IOT based energy efficient practical system integrating mechanization in common utilities. The concept involves metering without human intervention and sensor based automation of appliances.
- The project would hence serve as an extensive use to the elderly and the disabled, providing ease of accessibility and insight.

6. FUTURE SCOPE:

- Utilising the LCD details to create a report for energy consumption of a consumer, thereby allowing the consumer to fine-tune his/her consumption pattern.
- Extending home automation features to Temperature, alarm and motion sensing.
- Hardware implementation of Integrated system with above features

7. SOFTWARE TOOLS USED

- Proteus 8
- ARDUINO ID

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