



# DESIGN OF DIGITAL ENERGY METER USING IOT

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## ABSTRACT:

In the scenario of power crises, it is very important to monitor power distribution at consumer end. The maximum demand protection is very much required to limit the customer to connect maximum load to the electrical connection given by the supply company. As excess connection of load doctorates the distribution condition and creates unbalance loading also allied problem such as negative phase sequence currents etc. In this paper the maximum demands are limited to customer, if the customer uses the load more than allotted value for more than a predefined time then automatically the system disconnect the supply from the consumer. The pre-paid Energy meter facilitates the customer to use pre allotted quota and avoid misuse of energy.

## OVERVIEW OF THE PAPER

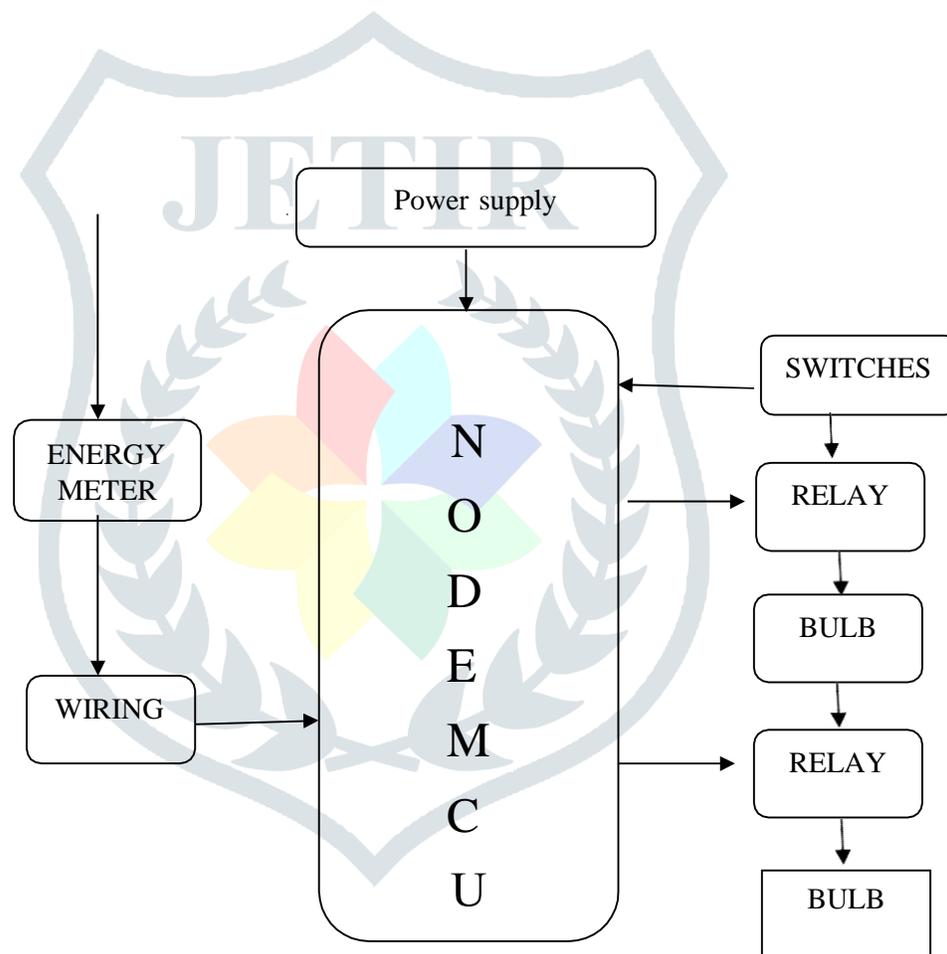
In the present billing system, the distribution companies are unable to keep track of the changing maximum demand of consumers. The consumer is facing problems like receiving due bills for bills that have already been paid as well as poor reliability of electricity supply and quality even if bills are paid regularly. The remedy for all these problems is to keep track of the consumers load on timely basis, which will held to assure accurate billing, track maximum demand and to detect threshold value. These are all the features to be taken into account for designing an efficient energy billing system.

The present paper “IoT Based Smart Energy Meter” addresses the problems faced by both the consumers and the distribution companies. The paper mainly deals with smart energy meter, which utilizes the features of embedded systems i.e., combination of hardware and software in order to implement desired functionality. The paper discusses comparison of Arduino and other controllers, and the application of WIFI and Wi-Fi modems to introduce ‘Smart’ concept. With the use of WIFI modem the consumer as well as service provider will get the used energy reading with the respective amount, Consumers will even get notification in the

form text through WIFI when they are about to reach their threshold value, that they have set. Also, with the help of Wi- Fi modem the consumer can monitor his consumed reading and can set the threshold value through webpage.

This system enables the electricity department to read the meter readings monthly without a person visiting each house. This can be achieved by the use of Arduino unit that continuously monitor and records the energy meter reading in its permanent (non-volatile) memory location. This system continuously records the reading and the live meter reading can be displayed on webpage to the consumer on request. This system also can be used to disconnect the power supply of the house when needed.

### Block diagram



**Fig: Block diagram**

### SOFTWARE IMPLEMENTATION

The software used by the Arduino is Arduino IDE. The Arduino IDE is a cross- platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring project. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax

highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. There is typically no need to edit make files or run programs on a command-line interface. Although building on command-line is possible if required with some third-party tools such as Ino.

The Arduino IDE comes with a C/C++ library called "Wiring" (from the project of the same name), which makes many common input/output operations much easier. Arduino programs are written in C/C++, although users only need define two functions to make a runnable program:

◆ `setup()` – a function run once at the start of a program that can initialize settings.

◆ `loop()` – a function called repeatedly until the board powers off.

### SIMULATOR for ARDUINO:

The Arduino simulator app gives the user the freedom to work without the basic.



**Fig: Screenshot of ARDUINO SIMULATOR**

The Arduino simulator is a virtual portrayal of the circuits of Arduino in the real world. We can create many projects using a simulator without the need for any hardware.

The Simulator helps beginner and professional designers to learn, program, and create their projects without wasting time on collecting hardware equipment.

There are various advantages of using simulator, which are listed below:

- It saves money, because there is no need to buy hardware equipment to make a project.
- The task to create and learn Arduino is easy for beginners.
- We need not to worry about the damage of board and related equipment.
- No messy wire structure required.
- It helps students to eliminate their mistakes and errors using simulator.

- It supports line to line debugging, and helps to find out the errors easily.
- We can learn the code and build projects anywhere with our computer and internet connection.

## RESULTS

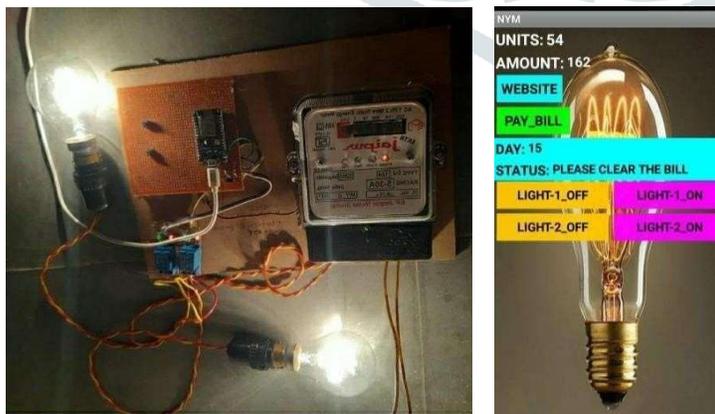
We conducted experiments to validate the proposed PREPAID ENERGY METER system and the associated algorithms. In the experiment, we apply the initial recharge using switches due to the units we can get the power.

### Photos of output:

**Step-1:** The power will be in 'ON' position. The units and amount are updated and displayed in the app.



**Step-2:** As days incremented and reaches the day limit, we set the status in the app will be displayed as please clear the bill.



**Step-3:** The message will be sent to registered mobile numbers automatically once the day limit is reached asset.

11-22-2021 2:56 PM

PLEASE CLEAR THE  
BILL ....  
[https://www  
.tssouthernpower.com/](https://www.tssouthernpower.com/)

**Step-4:** Power will be automatically turned off when the user does not clear the bill before limited period which was set.



**Step-5:** The home automation also can be done by operating through mobile.



**CODING:**

```
#include<ESP8266WiFi.h> #include<FirebaseArduino.h>
#define FIREBASE_HOST "ktrmenrgey-default-rtdb.firebaseio.com"
#define FIREBASE_AUTH "W5Q2CVUZXFSSugLaYC2me2U3CK1GOELAWO3ro8zPV"
#define WIFI_SSID "poweriot"
#define WIFI_PASSWORD "poweriot01"

int sw=D5; int sw1=D3;
int relay1=D6;int relay2=D8;
int relay3=D1; ////THEFT BULBint buz=D8;
int i,j,k,l,count=0,u=1;
int day_v=0,p=1,amount=0;int z,a,p_v;
int y=1,k_v=1;
void ICACHE_RAM_ATTR units();void setup()
{
y=z=a=1; Serial.begin(9600); pinMode(relay1,OUTPUT);pinMode(relay2,OUTPUT);
pinMode(relay3,OUTPUT);pinMode(buz,OUTPUT);
pinMode(sw,INPUT_PULLUP); pinMode(sw1,INPUT_PULLUP);pinMode(sig,INPUT);
WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
Serial.print("Connecting"); while(WiFi.status() != WL_CONNECTED){
Serial.print(".");delay(500);
}
Serial.println(); Serial.print("connected: "); Serial.println(WiFi.localIP());
Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);Firebase.setFloat
("NPOWERBILL/UNITS",count);
Firebase.setFloat ("NPOWERBILL/AMOUNT",amount);Firebase.setFloat
("NPOWERBILL/POWERON",j);
Firebase.setFloat ("NPOWERBILL/DAY",day_v);
digitalWrite(buz,LOW); digitalWrite(relay1,LOW);digitalWrite(relay2,LOW);
digitalWrite(relay3,LOW);
}
```

```
void loop()
{
  //Serial.print("switch:");
  //Serial.println(digitalRead(sw));
  // Serial.println();
  if(Firebase.failed())
  {
    Serial.print("Firebase error"); Serial.println(Firebase.error());
  }
  /// Serial.print("SIG:");
  // Serial.println(digitalRead(sig));
  //
  // Serial.print("day_v:");
  // Serial.println(day_v);
  Firebase.setFloat ("NPOWERBILL/DAY",day_v);
if(!digitalRead(sw))
{
  day_v++; Serial.print("day_v:");
  Serial.println(day_v);
  // while(!digitalRead(sw));
}
if((day_v==15)&&(y==1))
{
  Serial.println("BILL SENT TO USER");a=1;
  y++;
  p_v=0;z=1;
  digitalWrite(buz,HIGH);
```

```
    Firebase.setFloat ("NPOWERBILL/EMERGENCY",i);i++;
    Firebase.setFloat ("NPOWERBILL/UNITS",count); Firebase.setFloat
        ("NPOWERBILL/AMOUNT",amount);delay(1000);
    Firebase.setFloat ("NSUBSTATION/UNITS",count); Firebase.setFloat
        ("NSUBSTATION/AMOUNT",amount);digitalWrite(buz,LOW);
}
if((day_v==20) &&(z==1))
{
    serial.println("POWER OFF");z++;
    y=1;
    p_v=1; digitalWrite(buz,HIGH); digitalWrite(relay1,LOW);digitalWrite(relay2,LOW);

        Firebase.setFloat ("NPOWERBILL/DAY",day_v);Firebase.setFloat
        ("NPOWERBILL/POWEROFF",j); j++;
        Firebase.setFloat ("NSUBSTATION/POWEROFF",j);j++;
        Firebase.setFloat ("NPOWERBILL/UNITS",count);delay(1000);
        Firebase.setFloat ("NSUBSTATION/UNITS",count);
}
if((Firebase.getString("NPOWERBILL/PAYBILL") == "\"PON\""))
{
    Serial.println("BILL PAID");y=1;
    p_v=0;z=1;
    day_v=0; count=0; amount=0;
    day_v=0; count=0; amount=0;
    p=0;
    digitalWrite(relay1, HIGH); digitalWrite(relay2, HIGH)
        digitalWrite(buz,LOW);
        Firebase.setFloat ("NPOWERBILL/DAY",day_v);Firebase.setFloat
        ("NPOWERBILL/POWERON",k);
        k++;
}
```

```
    Firebase.setFloat ("NSUBSTATION/POWERON",j);j++;
        Firebase.setFloat ("NPOWERBILL/AMOUNT",amount);delay(1000);
    Firebase.setFloat ("NPOWERBILL/POWERON",k); Firebase.setFloat
        ("NPOWERBILL/AMOUNT",amount);
k++;

        Firebase.setFloat ("NSUBSTATION/UNITS",count);
        Firebase.setFloat ("NSUBSTATION/AMOUNT",amount);
    }
if(!digitalRead(sw1) && (k_v==1))
{
    Serial.println("POWER THEFT .....");
k_v++;
        Firebase.setFloat ("NPOWERBILL/POWERTHEFT",k);k++;
        Firebase.setFloat ("NSUBSTATION/POWERTHEFT",k);k++;
    digitalWrite(buz, HIGH); digitalWrite(relay3,HIGH);
}
if((Firebase.getString("NPOWERBILL/LIGHT1") == "\"ON\"") && (p_v==0))
{
    Serial.println("RELAY_1-ON");
    digitalWrite(relay1, LOW);
}
if((Firebase.getString("NPOWERBILL/LIGHT1") == "\"OFF\"") && (p_v==0))
{
    Serial.println("RELAY_1-OFF");digitalWrite(relay1, HIGH);
}
if((Firebase.getString("NPOWERBILL/LIGHT2") == "\"ON\"")&& (p_v==0))
{
    Serial.println("RELAY_2-ON");digitalWrite(relay2, LOW);
```

```
}  
if((Firebase.getString("NPOWERBILL/LIGHT2") == "\"OFF\"") && (p_v==0))  
{  
  Serial.println("RELAY_2-OFF");digitalWrite(relay2, HIGH);  
}  
}  
void units ()  
{  
  count++; amount=count*3;  
  Serial.print("UNITS:"); Serial.println(count); Serial.print("AMOUNT:");  
  Serial.println(amount);  
}
```

### Conclusion:

IOT based smart energy meter reading and monitoring system was proposed in this paper. The system provides many significant advantages, such as wireless data transmission, low-workload, remote monitoring and controlling, anti-theft mechanism and less-expenses. The system would provide a simple way to collect the meter reading and detect an electrical power theft without any human involvement.

The use of embedded Node MCU with Wi-Fi module increases the stability of wireless data transmission. By using this system, the customer can anytime check their consumed unit and bill in the Internet in which paper is not required for billing which saves paper and printing cost. The bill can be paid using online customer support system. In future, the paper can be integrated to form smart cities using Internet of Things based sensors as done globally.

When compare with the existing GSM based and other traditional energy metering and monitoring system, the propose system is more efficient and cost effective. It allowsthe consumer to check the energy consumption and bill any time they login to the system whereas other existing system send the bill monthly or on request to the customer. Thispaper is performing satisfactory function in laboratory condition. The device designed is used in conjunction with an Induction Energy meter. With minor modification in the software and hardware this system can be used for field application.

**Future expansion:**

This paper can be expanded in the following directions. The protection against the power theft and energy meter tampering can incorporate in this project. The major modes of power theft is tapping in the service line in order to bypass the energy meter. Solution to the power theft can be done by bypassing of energy meter will be placed in the system and as soon as the power theft takes place, it will alert the electricity board by sending SMS to the control unit of electricity board.



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