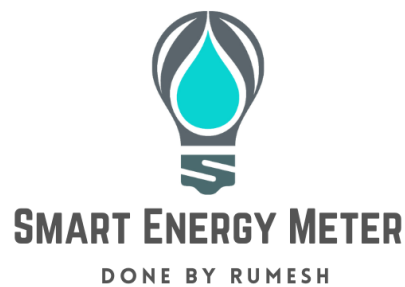# IoT Based Smart Energy Meter Appendix

By

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Code 1: Smart Energy Meter.ino

```
1  /*#########Script Information###########################
2    Purpose: IoT Based Smart Energy Meter Sketch
3    Board: ESP32-D0WDQ6 Rev 1
4    Sensors: Current Sensor (SCT-013-030), Voltage Sensor (ZMPT101B)
5    Created: 08-07-2022
6    Author : Rumesh
7    #################################################*/
8
9  #define BLYNK_TEMPLATE_ID ""
10  #define BLYNK_DEVICE_NAME "Smart Energy Meter"
11  #define BLYNK_AUTH_TOKEN ""
12  #define BLYNK_PRINT Serial
13  //#define APP_DEBUG
14
15  #include "EmonLib.h"    //https://github.com/openenergymonitor/EmonLib
16  #include <WiFi.h>
17  #include <WiFiClient.h>
18  #include <BlynkSimpleEsp32.h>
19  #include <ezTime.h>
20  #include <LiquidCrystal.h>
21  LiquidCrystal lcd(13, 12, 14, 27, 26, 25);
22
23  EnergyMonitor emon;
24  #define vCalibration 150
25  #define currCalibration 0.013
26  BlynkTimer timer;
27  Timezone Sri_Lanka;
28
29  //analogReadResolution(ADC_BITS)
30  char auth[] = BLYNK_AUTH_TOKEN;
31  char ssid[] = "Beast";
32  char pass[] = "";
33  const char* host = "DESKTOP-RISJFJ7";
34  float kWh = 0;
35  unsigned long lastmillis = millis();
36
37  void setup() {
38    Serial.begin(9600);
39    emon.voltage(35, vCalibration, 1.7); // Voltage: input pin, calibration, phase_shift
40    emon.current(34, currCalibration); // Current: input pin, calibration.
41    Blynk.begin(auth, ssid, pass);
42    lcd.begin(16, 2);
43    //timer.setInterval(10000L, myTimerEvent); // Defined update interval as 10sec
44    timer.setInterval(5000L, myTimerEvent); // Defined update interval as 5sec
45
46    lcd.setCursor(2, 0);
47    lcd.print("Smart E-Meter");
48    lcd.setCursor(4, 1);
49    lcd.print("By Rumesh");
50    delay(3000);
51    lcd.clear();
52    waitForSync();
53    Sri_Lanka.setPosix("IST-5:30");
54  }
55
56  void myTimerEvent() {
57      emon.calcVI(20, 2000); //Calculate all. No.of half wavelengths (crossings), time-out
58      Serial.println();
59      Serial.print("Date/Time: " + Sri_Lanka.dateTime("d-M-y H:i:s") + " Meter Reading\n"); //
            https://github.com/ropg/ezTime
60      Blynk.virtualWrite(V4, Sri_Lanka.dateTime("d-M-y H:i:s"));
61      Serial.print("Vrms: ");
62      Serial.print(emon.Vrms, 2);
63      Serial.print("V");
64      Blynk.virtualWrite(V0, emon.Vrms);
65      Serial.print("\tIrms: ");
66      Serial.print(emon.Irms, 4);
67      Serial.print("A");
68      Blynk.virtualWrite(V1, emon.Irms);
69      Serial.print("\tPower: ");
```

```
70        Serial.print(emon.apparentPower, 4);
71        Serial.print("W");
72        Blynk.virtualWrite(V2, emon.apparentPower);
73        Serial.print("\tkWh: ");
74        kWh = kWh + emon.apparentPower*(millis()-lastmillis)/3600000000.0;
75        Serial.print(kWh, 4);
76        Serial.println("kWh");
77        lastmillis = millis();
78        Blynk.virtualWrite(V3, kWh);
79        //Serial.println();
80
81        lcd.clear();
82        lcd.setCursor(0, 0);
83        lcd.print("Vrms:");
84        lcd.print(emon.Vrms, 2);
85        lcd.print("V");
86        lcd.setCursor(0, 1);
87        lcd.print("Irms:");
88        lcd.print(emon.Irms, 4);
89        lcd.print("A");
90        delay(2000);
91
92        lcd.clear();
93        lcd.setCursor(0, 0);
94        lcd.print("Power:");
95        lcd.print(emon.apparentPower, 4);
96        lcd.print("W");
97        lcd.setCursor(0, 1);
98        lcd.print("kWh:");
99        lcd.print(kWh, 4);
100       delay(2000);
101
102       double Bill = 0.0000;
103       double unit=kWh;
104        /*
105        * Monthly Consumption(kWh) | Unit Charge (Rs./kWh) | Fixed Charge (Rs./month)
106            0-60                      7.85                    N/A
107            61-90                     10.00                   90.00
108            91-120                    27.75                   480.00
109            121-180                   32.00                   480.00
110            >180                      45.00                   540.00              */
111
112      if(unit<=60){
113        Bill = unit*7.85;
114          }
115          else if(unit<=90){
116            Bill = 7.85*60+(unit-61)*10 + 90;
117            }
118            else if(unit<=120){
119              Bill = 7.85*60+ 30*10 + (unit-91)*27.75 + 480;
120              }
121              else if(unit<=180){
122                Bill = 7.85*60+ 30*10 + 30*27.75 + (unit-121)*32+ 480;
123                }
124                else if(unit>180){
125                  Bill = 7.85*60+ 30*10 + 30*27.75 + 60*32 + (unit-181)*45+ 540;
126                  }
127                  else{
128                    //when all statements are false
129                    Serial.println("error in bill calculation");}
130
131      if (emon.apparentPower>300){
132        Blynk.logEvent("warning_high_power_consumption",String("High Power Consumption Detected!
             kW: ") + emon.apparentPower + String(" \nE-Bill at the moment: ")+ Bill);
133      }
134
135       Serial.print("Total Electricity Bill at the Moment:\t");
136       Serial.print(Bill, 4);
137       Serial.print("\tLKR ");
138       Blynk.virtualWrite(V5, Bill);
139       Serial.println();
140
141         // Use WiFiClient class to create TCP connections
```

```cpp
142      WiFiClient client;
143      const int httpPort = 80;
144      if (!client.connect(host, httpPort)) {
145          Serial.println("connection failed");
146          return;
147      }
148
149      // This will send the request to the server
150   client.print(String("GET http://localhost/smartenergymeter/connect.php?") +
151                          ("&Vrms=") + emon.Vrms +
152                          ("&Irms=") + emon.Irms*1000 +
153                          ("&kWh=") + kWh +
154                          ("&Bill=") + Bill +
155                          " HTTP/1.1\r\n" +
156                  "Host: " + host + "\r\n" +
157                  "Connection: close\r\n\r\n");
158      unsigned long timeout = millis();
159      while (client.available() == 0) {
160          if (millis() - timeout > 1000) {
161              Serial.println(">>> Client Timeout !");
162              client.stop();
163              return;
164          }
165      }
166
167      // Read all the lines of the reply from server and print them to Serial
168      while(client.available()) {
169          String line = client.readStringUntil('\r');
170          Serial.print(line);
171
172      }
173      Serial.println();
174      //Serial.println("closing connection");
175
176 }
177
178 void loop() {
179   Blynk.run();
180   timer.run();
181
182 }
```

Code 2: connect.php

```php
1 <?php
2 /*##########Script Information###########################
3   Purpose: To Connect ESP32 to MySQL DB & Update Sensor Data
4   Created: 08-07-2022
5   Author : Rumesh
6   ################################################*/
7 $dbname = 'smartenergymeter';
8 $dbuser = 'root';
9 $dbpass = '';
10 $dbhost = 'localhost';
11
12 $connect = @mysqli_connect($dbhost,$dbuser,$dbpass,$dbname);
13
14 if(!$connect){
15   echo "Error: " . mysqli_connect_error();
16   exit();
17 }
18
19 echo "Connection Success to your Smart Energy Meter Database!\n";
20
21 $Vrms = $_GET["Vrms"];
22 $Irms = $_GET["Irms"];
23 $kWh = $_GET["kWh"];
24 $Bill = $_GET["Bill"];
25
26 $query = "INSERT INTO smartenergymeter (Vrms, Irms, kWh, Bill) VALUES ('$Vrms', '$Irms', '$kWh
      ', '$Bill')";
```

```php
27  $result = mysqli_query($connect,$query);
28
29  //echo $Vrms;
30  //echo $Irms;
31  echo "Data Insertion Success!";
32
33  ?>
```

Code 3: E-Bill.php

```php
1   <?php
2   /*##########Script Information#############################
3     # Purpose: To Generate Dynamic PDF From MySQL Database
4     #          & Send telegram message
5     # Created: 08-07-2022
6     # Author : Rumesh
7     ##########################################################*/
8   require('mysql_table.php');
9
10  class PDF extends PDF_MySQL_Table
11  {
12  function Header()
13  {    if ($this->PageNo() == 1 ) {
14      // Title
15      $this->Image('/logo.png',10,8,30);
16      $this->Image('/logo2.png',220,8,70);
17
18      // Arial bold 15
19      $this->SetFont('Arial','B',35);
20      // Move to the right
21      $this->Cell(50);
22      // Title
23      $this->SetTextColor(0,0,255);
24      $this->Cell(130,20,'Electricity Usage Bill',1,0,'C');
25   //$this->Cell(60,10,"\t",0,2,'C');
26      $this->SetTextColor(0,0,0);
27      $this->SetFont('Arial','B',20);
28      // Line break
29      $this->Ln(30);
30      $this->SetFont('Arial','B',15);
31      $this->Cell(100 ,5,'Account Info',0,0);
32
33      $this->Cell(59 ,5,'Billing Details',0,1);
34      $this->SetFont('Arial','',10);
35      date_default_timezone_set('Asia/Colombo');
36      $date = date('m/d/Y h:i:s a', time());
37
38      $this->Cell(100 ,5,'Electricity Account No: ',0,0);
39      $this->Cell(25 ,5,'Billing Month:',0,0);
40      $this->Cell(34 ,5,date("M Y"),0,1);
41
42      $this->Cell(100 ,5,'Tariff Rev: ',0,0);
43      $this->Cell(25 ,5,'Bill Date:',0,0);
44      $this->Cell(34 ,5,$date,0,1);
45
46      $this->Cell(100 ,5,'Premises ID: ',0,0);
47      $this->Cell(25 ,5,'Bill No:',0,0);
48      $this->Cell(34 ,5,'IRX707',0,1);
49      $this->Ln(3);
50
51      parent::Header();
52  }
53  }
54  function Footer()
55  {
56      // Go to 1.5 cm from bottom
57      $this->SetY(-15);
58      // Select Arial italic 8
59      $this->SetFont('Arial','I',8);
60      // Print centered page number
61      $this->Cell(0,10,'Page '.$this->PageNo(),0,0,'C');
```

```php
62
63  }
64  }
65  $dbname = 'smartenergymeter';
66  $dbuser = 'root';
67  $dbpass = '';
68  $dbhost = 'localhost';
69  // Connect to database
70  $link = mysqli_connect($dbhost,$dbuser,$dbpass,$dbname);
71
72  // #####################Send Message to Telegram########################
73
74  $query = "SELECT * from smartenergymeter ORDER BY Date_Time DESC LIMIT 1";
75  $result = mysqli_query($link, $query) or die(mysqli_error($link));
76  $row = mysqli_fetch_row($result);
77  $token = "";
78  date_default_timezone_set('Asia/Colombo');
79  $date = date('m/d/Y h:i:s a', time());
80  $data = [
81      'chat_id' => '1246299882',
82      'text' =>"Smart Energy Meter Reading\n".
83              "Meter Reading Date/Time ".$row[0]."\n"."Units Consumed ".$row[3]."\n"."
                    Electricity Bill ".$row[4]."\nPlease Check Your E-mail For Detailed E-Bill
                    "."\n\n"
84              ."Message Delivered Time ".$date."\nAutomated By Rumesh"
85  ];
86      $a = file_get_contents("https://api.telegram.org/bot".$token."/sendMessage?" .
          http_build_query($data));
87
88  // ##################################################################
89  //FPDF
90  // #####################FPDF Generate#############################
91  $pdf = new PDF( 'P', 'mm', 'A3' );
92  $pdf->AddPage();
93  // First table: output all columns
94  $pdf->Table($link,'select * from smartenergymeter order by Date_Time ASC');
95  $pdf->Ln(7);
96  $pdf->SetFont('Arial','BU',20);
97  $pdf->SetTextColor(255,0,0);
98  $pdf->Cell(60,10,'Bill Amount to Pay',0,2,'L');
99  $pdf->SetTextColor(0,0,0);
100 $pdf->Table($link,'SELECT * FROM smartenergymeter ORDER BY Date_Time DESC LIMIT 1');
101 $pdf->SetFont('Arial','B',15);
102 $pdf->Cell(60,10,"Units Consumed\t\t\t".$row[3],0,2,'L');
103 $pdf->Cell(60,10,"Amount to Pay\t\t\t\t\t".$row[4],0,2,'L');
104
105 $pdf->AddPage();
106 $pdf->Image('/logo.png',10,8,30);
107     // Arial bold 15
108     $pdf->SetFont('Arial','B',25);
109     // Move to the right
110     $pdf->Cell(35);
111     // Title
112     $pdf->SetTextColor(93,93,93);
113     $pdf->Cell(140,20,'Tariff Calculation Information',1,0,'C');
114     $pdf->SetTextColor(0,0,0);
115     $pdf->SetFont('Arial','B',20);
116
117 $pdf->Image('C:/localhost/smartenergymeter/pdfgenerate/tariff.PNG',40,40,-250);
118 $pdf->SetX(50);
119 $pdf->SetY(100);
120 $pdf->SetTextColor(255,0,0);
121 $pdf->SetFont('Arial','B',10);
122 $pdf->Cell(250,10,'Please Pay your bill at earliest to get discount! | Save Energy for better
        future...',0,2,'L');
123 $pdf->Cell(250,10,'contact for queries: Rumesh',0,2,'L');
124 $pdf->Cell(250,10,'-Demo Design Project',0,2,'L');
125 $pdf->SetTextColor(0,0,0);
126 $filename="/Ebill.pdf";
127 $pdf->Output($filename,'F');
128 $pdf->Output();
129 ?>
```

Code 4: mail.php

```php
<?php
/*##########Script Information##############################
  # Purpose: Send mail Using PHPMailer & Gmail SMTP Server
  # Created: 08-07-2022
  # Author : Rumesh
  ###########################################################*/

//Include required PHPMailer files
  require 'PHPMailer.php';
  require 'SMTP.php';
  require 'Exception.php';
//Define name spaces
  use PHPMailer\PHPMailer\PHPMailer;
  use PHPMailer\PHPMailer\SMTP;
  use PHPMailer\PHPMailer\Exception;
//Create instance of PHPMailer
  $mail = new PHPMailer();
//Set mailer to use smtp
  $mail->isSMTP();
//Define smtp host
  $mail->Host = "smtp.gmail.com";
//Enable smtp authentication
  $mail->SMTPAuth = true;
//Set smtp encryption type (ssl/tls)
  $mail->SMTPSecure = "tls";
//Port to connect smtp
  $mail->Port = "587";
//Set gmail username
  $mail->Username = "";
//Set gmail password
  $mail->Password = "";
//Email subject
  date_default_timezone_set('Asia/Colombo');
      $date = date('m/d/Y h:i:s a', time());
  $mail->Subject = "Electricity Bill - ".date("M Y");
//Set sender email
  $mail->setFrom('','Smart Energy Meter');
//Enable HTML
  $mail->isHTML(true);
//Attachment
  $mail->addAttachment('/Ebill.pdf');
//Email body
  $mail->Body = "<h1>Monthly Electricity Bill</h1></br><p>Please find the attached Electricity
      Bill | This is system generated mail | Automated by Rumesh</p>";
//Add recipient
  $mail->addAddress('smartmeter@mailto.plus');
//Finally send email
  if ( $mail->send() ) {
    echo "Email Sent..!";
  }else{
    echo "Message could not be sent. Mailer Error: ";
  }
//Closing smtp connection
  $mail->smtpClose();

?>
```