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SMART ENERGY METER MONITORING AND BILLING USING IOT

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Abstract:

In this project electricity consumption by the user i.e. Units consumed in that meter will be available in the mobile phone/pc through internet using IOT module is provided to read units available. Whenever there is a change in count value / units in the meter get changed, these values are displayed on IOT. Hence this project provides a best solution for the users to know how much amount of power is consumed in their day- to- day life and also the amount of power consumed is also under the user control.

In this project electricity consumption by the user i.e. Units consumed in that meter will be available in the mobile phone through internet using IOT module is provided to read units available. Whenever there is a change in count value / units in the meter get changed, these values are displayed on IOT and also it reaches maximum units then load off else load on.

***Index Terms* – Node MCU,IoT,Arduino,Energy Meter,Debugging,Embedded System.**

I. INTRODUCTION

The measurement of energy is accomplished by means of a voltage-frequency converter connected downstream from the power meter. [5] The individual pulses are then summated through the use of an electromechanical meter, and are made available at a pulse output as well. A single-phase meter is used in alternating current systems.

A measuring system with three multipliers is required for 4-wire three-phase systems of unbalanced load with neutral conductor (N). [3]The three-wattmeter method can also be used in the absence of a neutral conductor if an artificial neutral is available. This method results in a highly accurate measurement if a precision wattmeter is used.

However, 3-wire three-phase systems are commonly found in industrial applications, for which ARON circuits are used. [2]This type of measuring circuit offers cost advantages because it allows for the measurement of power and energy with only two current transformers at phase conductors L1 and L3. [3]However, this measurement only provides correct results if the vector sums of all currents to be measured in the system are equal to zero (I1 + I2 + I3 = 0).

II. ENERGY METER

Energy Meter or Watt-Hour Meter is an electrical instrument that measures the amount of electrical energy used by the consumers. [5]Utilities are one of the electrical departments, which install these instruments at every place like homes, industries, organizations, commercial buildings to charge for the electricity consumption by loads such as lights, fans, refrigerator, and other home appliances.

The basic unit of power is watts and it is measured by using a watt meter. [4]One thousand watts make one kilowatt. If one uses one kilowatt in one-hour duration, one unit of energy gets consumed. [2]So energy meters measure the rapid voltage and currents, calculate their product and give instantaneous power. [3]This power is integrated over a time interval, which gives the energy utilized over that time period.

. Fig 1: ENERGY METER

III. BLOCK DIAGRAM

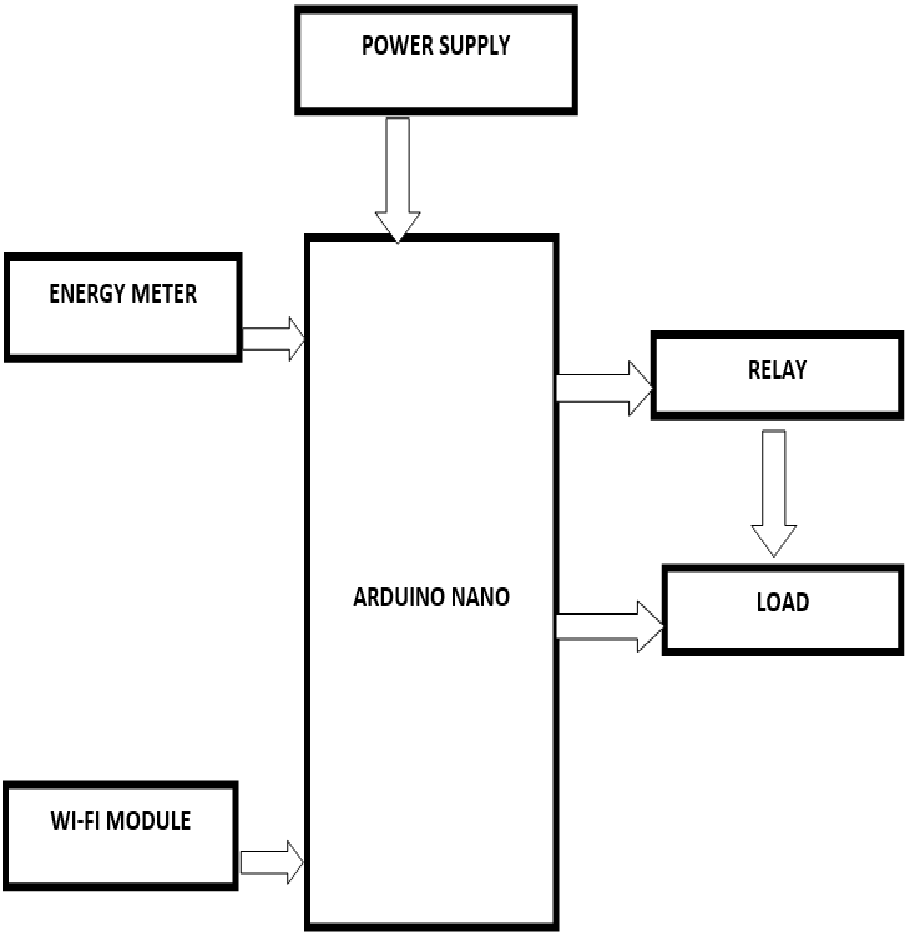

Fig 2: BLOCK DIAGRAM

IV. IOT TECHNOLOGY

[10]The Internet of things describes physical objects that are embedded with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks.

The future of IoT has the potential to be limitless. [5]Advances to the industrial internet will be accelerated through increased network agility, integrated artificial intelligence (AI) and the capacity to deploy, automate, orchestrate and secure diverse use cases at hyperscale.IoT involves extending internet connectivity beyond standard devices, such as desktops, laptops, smartphones and tablets, to any range of traditionally "dumb" or non-internet-enabled physical devices and everyday objects. [2]Embedded with technology, these devices can communicate and interact over the internet.

V. ESP8266 WI-FI MODULE

Espressif's[4]ESP8266EX delivers highly integrated Wi-Fi SoC solution to meet users' continuous demands for efficient power usage, compact design and reliable performance in the Internet of Things industry.[8] With the complete and self-contained Wi-Fi networking capabilities,ESP8266EX can perform either as a standalone application or as the slave to a host MCU.

When ESP8266EX hosts the application, it promptly boots up from the flash. [3]The integrated highspeed cache helps to increase the system performance and optimize the system memory. [5]Also, ESP8266EX can be applied to any microcontroller design as a Wi-Fi adaptor through SPI/SDIO or UART interfaces. ESP8266EX integrates antenna switches, RF balun, power amplifier, low noise receives amplifier, filters and power management modules.

The compact design minimizes the PCB size and requires minimal external circuitries. [2]Besides the Wi-Fi functionalities, ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor and on-chip SRAM. [2]It can be interfaced with external sensors and other devices through the GPIOs. Software Development Kit (SDK) provides sample codes for various applications. [4]Espressif Systems' Smart Connectivity Platform (ESCP) enables sophisticated features including:

• Fast switch between sleep and wakeup mode for energy-efficient purpose;

• Adaptive radio biasing for low-power operation

• Advance signal processing

• Spur cancellation and RF co-existence mechanisms for common cellular, Bluetooth, LVDS, LCD interference mitigation

Categories	Items	Parameters
Wi-Fi	Certification	Wi-Fi Alliance
	Protocols	802.11 b/g/n (HT20)
	Frequency Range	2.4 GHz ~ 2.5 GHz (2400 MHz ~ 2483.5 MHz)
	TX Power	802.11 b: +20 dBm
		802.11 g: +17 dBm
		802.11 n: +14 dBm
	Rx Sensitivity	802.11 b: –91 dbm (11 Mbps)
		802.11 g: –75 dbm (54 Mbps)
		802.11 n: –72 dbm (MCS7)
	Antenna	PCB Trace, External, IPEX Connector, Ceramic Chip
Hardware	CPU	Tensilica L106 32-bit processor
	Peripheral Interface	UART/SDIO/SPI/I2C/I2S/IR Remote Control
		GPIO/ADC/PWM/LED Light & Button
	Operating Voltage	2.5 V ~ 3.6 V
	Operating Current	Average value: 80 mA
	Operating Temperature Range	–40 °C ~ 125 °C
	Package Size	QFN32-pin (5 mm x 5 mm)
	External Interface	-
Software	Wi-Fi Mode	Station/SoftAP/SoftAP+Station
	Security	WPA/WPA2
	Encryption	WEP/TKIP/AES
	Firmware Upgrade	UART Download / OTA (via network)
	Software Development	Supports Cloud Server Development / Firmware and SDK for fast on-chip programming
	Network Protocols	IPv4, TCP/UDP/HTTP
	User Configuration	AT Instruction Set, Cloud Server, Android/iOS App

Table: Specifications of the ESP8266 module

VI. Code used in project

```
#include <LiquidCrystal.h>
#include <stdio.h>
LiquidCrystal lcd(6, 7, 5, 4, 3, 2);
 unsigned char rcv,count,gchr,gchr1,robos='s';
 //char pastnumber[11]="";
int sti=0;
String inputString = "";         // a string to hold incoming data
boolean stringComplete = false;  // whether the string is complete
int mtr      = 11;
int relay    = 10;
int buzzer  = 13;
int val1 = 0,val2 = 0;
int sts1=0,sts2=0;
float tempc=0;
float vout=0;
void okcheck()
{
  unsigned char rcr;
  do{
      rcr = Serial.read();
    }while(rcr != 'K');
}
void beep()
{
  digitalWrite(buzzer, LOW);delay(2000);digitalWrite(buzzer, HIGH);
}
void setup()
{
  // initialize serial:
  Serial.begin(9600);serialEvent();
//    serialEvent();
  pinMode(mtr, INPUT);pinMode(buzzer, OUTPUT);
  pinMode(relay, OUTPUT);

  digitalWrite(relay, LOW);
  digitalWrite(buzzer, HIGH);
  //cli();
  //serialEvent();
   // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
  lcd.print("IOT EnergyMeter");
   delay(1500);
  Serial.write("AT\r\n");         delay(3000);//okcheck();
  Serial.write("ATE0\r\n");         okcheck();
  Serial.write("AT+CWMODE=2\r\n"); delay(3000);
  Serial.write("AT+CIPMUX=1\r\n");delay(3000);//         okcheck();
  Serial.write("AT+CIPSERVER=1,23\r\n"); //         okcheck();
  lcd.clear();
  lcd.print("Waiting For");
  lcd.setCursor(0,1);
  lcd.print("Connection");
  do{
     rcv = Serial.read();
    }while(rcv != 'C');
  lcd.clear();
  lcd.print("Connected");
```

```
  delay(1000);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("U:"); //3,0
  lcd.setCursor(0,1);
  lcd.print("A:");  //3,1
  serialEvent();
              digitalWrite(relay, HIGH);
}

int units=0;
int amount=0;
void loop()
{
  if(digitalRead(mtr) == LOW)
    {delay(50);
     while(digitalRead(mtr) == LOW);
      delay(100);
      units++;
      amount = (units * 3);
       lcd.setCursor(3,0);convertl(units);
       lcd.setCursor(3,1);convertl(amount);
             Serial.write("AT+CIPSEND=0,17\r\n");delay(2000);
                 Serial.write("U:");
                 converts(units);
                 Serial.write(" A:");
                 converts(amount);
                 Serial.print("\r\n");delay(3000);
    }

   if(stringComplete)
    {
          if(inputString[2] == '1')
            {
              digitalWrite(relay, HIGH);
            }
          if(inputString[2] == '2')
            {
              digitalWrite(relay, LOW);
            }

      inputString = "";
      stringComplete = false;
    }
}
void serialEvent()
{
  while (Serial.available())
        {

         char inChar = (char)Serial.read();
           //sti++;
           //inputString += inChar;
          if(inChar == '*')
            {sti=1;
              inputString += inChar;
             //  stringComplete = true;
             // gchr = inputString[sti-1]
```

```
          }
         if(sti == 1)
          {
             inputString += inChar;
          }
         if(inChar == '#')
          {sti=0;
           stringComplete = true;
          }
       }
}
void convertl(unsigned int value)
{
  unsigned int a,b,c,d,e,f,g,h;
      a=value/10000;
      b=value%10000;
      c=b/1000;
      d=b%1000;
      e=d/100;
      f=d%100;
      g=f/10;
      h=f%10;
      a=a|0x30;
      c=c|0x30;
      e=e|0x30;
      g=g|0x30;
      h=h|0x30;
   lcd.write(a);
   lcd.write(c);
   lcd.write(e);
   lcd.write(g);
   lcd.write(h);
}

void converts(unsigned int value)
{
  unsigned int a,b,c,d,e,f,g,h;

      a=value/10000;
      b=value%10000;
      c=b/1000;
      d=b%1000;
      e=d/100;
      f=d%100;
      g=f/10;
      h=f%10;
      a=a|0x30;
      c=c|0x30;
      e=e|0x30;
      g=g|0x30;
      h=h|0x30;
   Serial.write(a);
   Serial.write(c);
   Serial.write(e);
   Serial.write(g);
   Serial.write(h);
}
```

VII. RESULT

The IOT based smart energy meter monitoring is shown in the fig6. Considering as 5seconds equals to 1day and 1pulses equals0.1unit power consumption. By taking 5Rs per unit power the bill for two months will be calculated. The same amount will bepaid for two months if the user paid the bill the supply will be given continuously after two months. After two months if hedoesn't pay bill buzzer will be ON for alert purpose.

Until and unless paying bill the supply line will be disconnected. Using Wi-Fi technology is more advantageous for both user side and provider side. There is no need to go at consumer side to disconnect thesupply line, using IoT it can be monitored by online only.

Fig Output OFF-Period

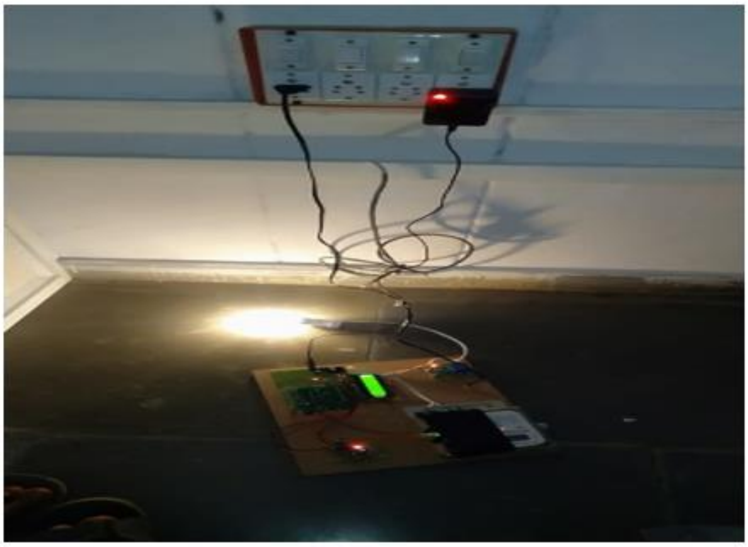

Fig Output ON-Period

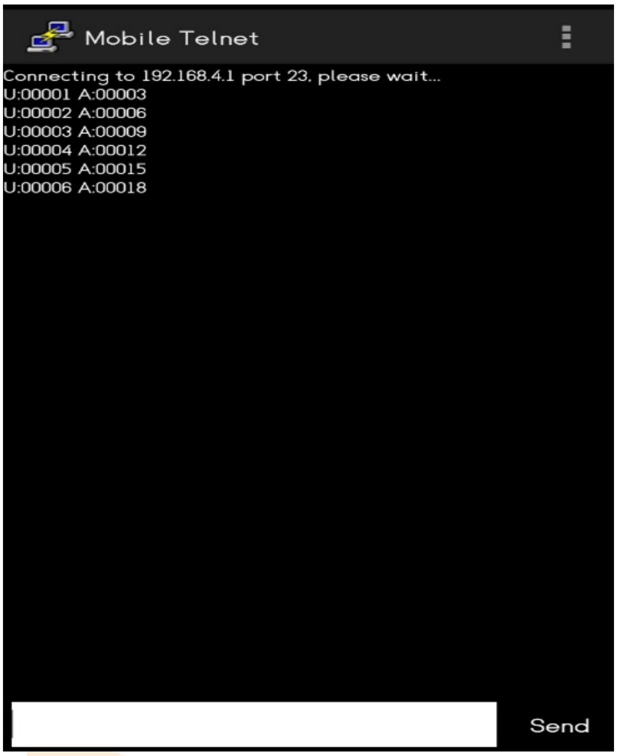

Fig 3: Application screen

VIII. CONCLUSION AND FUTURE SCOPE

Energy monitoring through the internet is easy. It gives the real power consumption as well as accurate reading. Also, it requires fewer labors and less time to monitor the energy. It can transmit the data to the utilities and also can receive information from utilities. After two months electricity bill will be paid otherwise supply line will be disconnected through the internet. After two months validity for alert purpose buzzer will be ON.

It is easy to know the two months validity. By making this thing the energy will be monitored. The future scope will be on PC side one server software is required for automatic data collection.

Smart meter is based on new technology to achieve future prospective demand of electricity. It is based on principal of two-way communication by which we can achieve rising demand of electricity. Smart meter will be part of a much wider internet of things in the future integrating multiple aspects of human needs service to satisfy all such needs.

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