iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VII **Month of publication:** July 2021

DOI: https://doi.org/10.22214/ijraset.2021.36651

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

IOT Based Energy Meter Monitoring and Controlling

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Abstract: ***This paper aims at developing a system which helps in monitoring the readings from an energy meter and controlling the switching of energy meter. This system also has tamper switch, which helps in illegal removing of energy meter cabinet and alerts the authorities in the form of text message.***

Keywords: Internet of Things, Microcontroller, Energy meter, IoT modem, Tamper switch, Wi-Fi module

I. INTRODUCTION

Monitoring and keeping tracking of your electricity consumption for verification is a tedious task today since you need to go to meter reading room and take down readings. Well it is important to know if you are charged accordingly so the need is quite certain. Well we automate the system by allowing users to monitor energy meter readings over the internet. Our proposed system uses energy meter with microcontroller system to monitor energy usage using a meter. The meter is used to monitor units consumed and transmit the units as well as cost charged over the internet using Wi-Fi connection. This allows user to easily check the energy usage along with the cost charged online using a simple web application. Thus, the energy meter monitoring system allows user to effectively monitor electricity meter readings and check the billing online with ease.

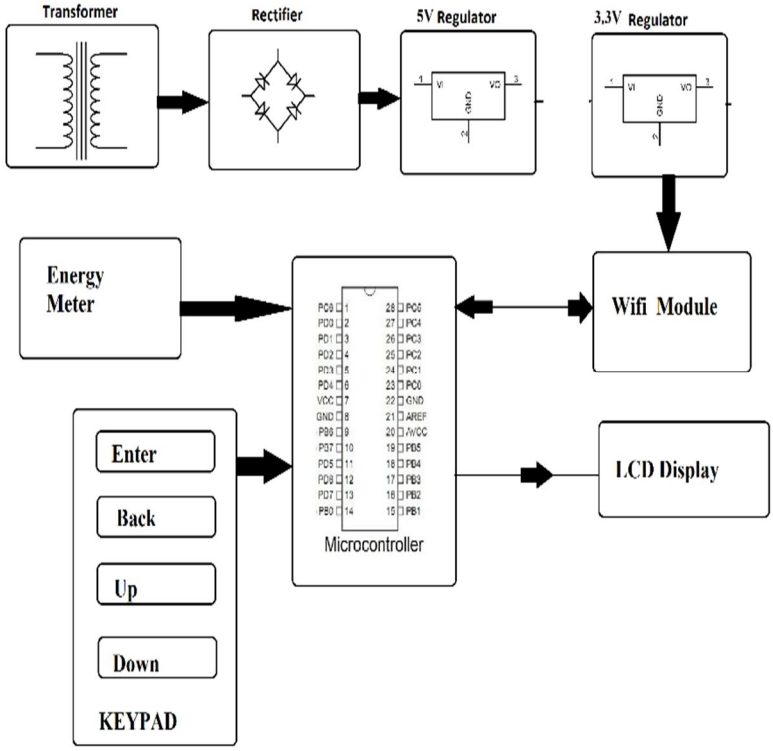


Fig.1: Block diagram

In the proposed method, the consumer can manage their energy consumption by knowing their energy usage time to time. This method not only provides two-way communications between utility and consumer but also provides other functions that are if the consumer fails to pay the electricity bill the energy supply would be cut down from the utility side and once the bill is paid the energy supply is reconnected.

A. Microcontroller

The ATmega328 is a single-chip microcontroller created by Atmel in the mega AVR family (later Microchip Technology acquired Atmel in 2016). It has a modified Harvard architecture 8-bit RISC processor core. Atmega328 microcontroller is used in basic Arduino boards, i.e., Arduino Uno, Arduino Pro Mini and Arduino Nano. The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz.

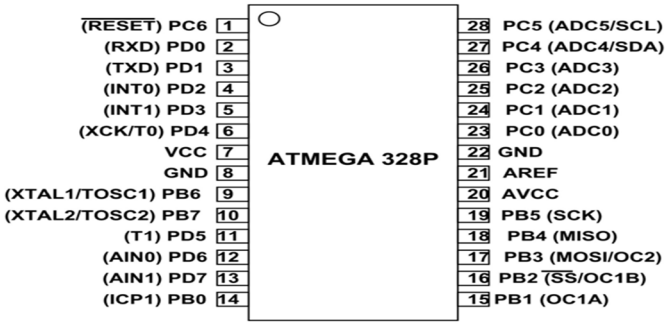


Fig.2: Pin Diagram of ATMEGA 328

B. ESP8266 Module

ESP8266 offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor. When ESP8266 hosts the application, and when it is the only application processor in the device, it is able to boot up directly from an external flash. It has integrated cache to improve the performance of the system in such applications, and to minimize the memory requirements. Alternately, serving as a Wi- Fi adapter, wireless internet access can be added to any microcontroller-based design with simple connectivity through UART interface or the CPU AHB bridge interface. ESP8266 on-board processing and storage capabilities allow it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime.

C. Relay

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism, but other operating principles are also used. Relays find applications where it is necessary to control a circuit by a low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re transmitting it to another. Relays found extensive use in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly drive an electric motor is called a contactor.

D. Energy Meter

An Electric meter or energy meter is a device that measures the amount of electrical energy consumed by a residence, business, or an electrically-powered device. Electric meters are typically calibrated in billing units, the most common one being the kilowatt hour. Periodic readings of electric meters establish billing cycles and energy used during a cycle. In settings when energy savings during certain periods are desired, meters may measure demand, the maximum use of power in some interval.

E. Buzzer

Basically, the sound source of a piezoelectric sound component is a piezoelectric diaphragm. A piezoelectric diaphragm consists of a piezoelectric ceramic plate which has electrodes on both sides and a metal plate (brass or stainless steel, etc.). A piezoelectric ceramic plate is attached to a metal plate with adhesives. Applying D.C. voltage between electrodes of a piezoelectric diaphragm causes mechanical distortion due to the piezoelectric effect.

F. Schematic Diagram

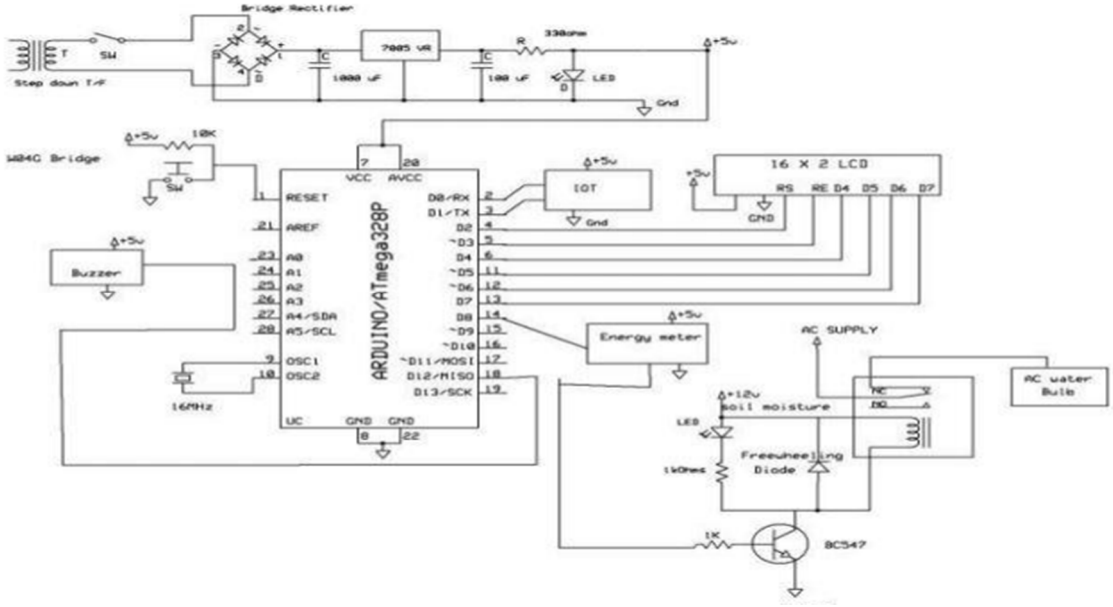


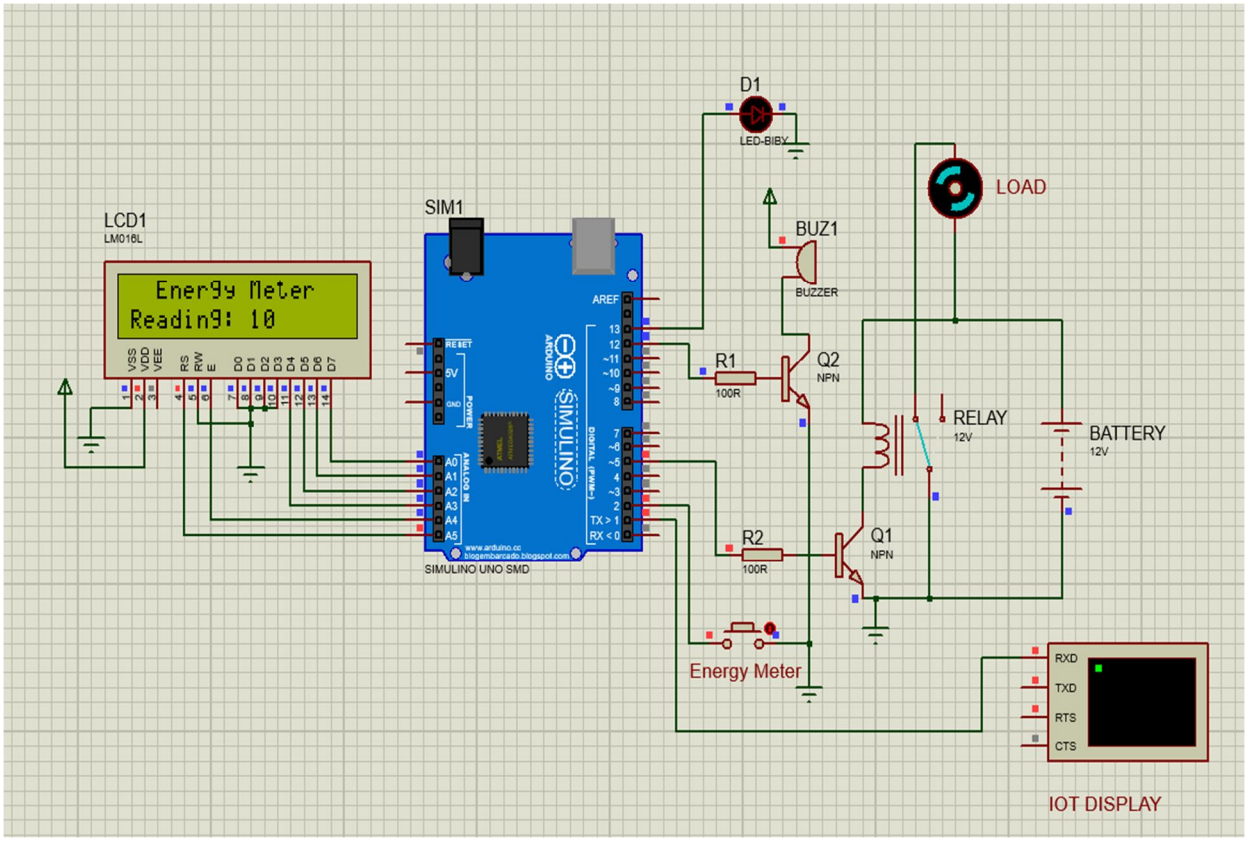
Fig.3: Schematic Diagram

G. Code uploaded in Arduino

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(19, 18, 17, 16, 15, 14);
int RELAY = 5;
int BUZZER = 12;
int EM = 2;  //Energy Meter
int led = 13;
int energy_meter_reading = 0;
void setup()
{
 pinMode(EM, INPUT);
 pinMode(BUZZER, OUTPUT);
 pinMode(led, OUTPUT);
 pinMode(RELAY, OUTPUT);
 Serial.begin(9600);  //for IoT display
 lcd.begin(16, 2);
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("    IOT BASED");
 lcd.setCursor(0,1);
 lcd.print(" Energy Meter");
 digitalWrite(BUZZER, HIGH);
 digitalWrite(led, HIGH);
 delay(1000);
 digitalWrite(BUZZER, LOW);
 digitalWrite(led, LOW);
 delay(1000);
 digitalWrite(led, HIGH);
 delay(1000);
```

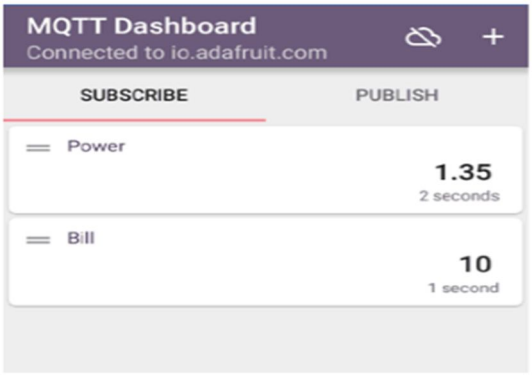
```
  digitalWrite(led, LOW);
  digitalWrite(RELAY, HIGH);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("  Energy Meter");
  lcd.setCursor(0,1);
  lcd.print("Reading: ");
  lcd.print(energy_meter_reading);
  delay(2000);
}
void loop()
{
  digitalWrite(led, HIGH);
  delay(50);
  digitalWrite(led, LOW);
  delay(100);
  Serial.print("Energy Meter Reading: ");
  Serial.println(energy_meter_reading);
  if(digitalRead(EM) == LOW)
  {
     energy_meter_reading++;
     lcd.clear();
     lcd.setCursor(0,0);
     lcd.print("  Energy Meter");
     lcd.setCursor(0,1);
     lcd.print("Reading: ");
     lcd.print(energy_meter_reading);
     delay(1000);
  }
  if(energy_meter_reading > 10) //Max Limit is 10
  {
     digitalWrite(BUZZER, HIGH);

     lcd.clear();
     lcd.setCursor(0,0);
     lcd.print("  Consumption");
     lcd.setCursor(0,1);
     lcd.print("    Exceeded ");
     delay(3000);
     digitalWrite(BUZZER, LOW);
     digitalWrite(RELAY, LOW);
     lcd.clear();
     lcd.setCursor(0,0);
     lcd.print("Load Disconected");
     lcd.setCursor(0,1);
     lcd.print("  Please Reset");
     exit();
  }
}
```

H. Simulation in Proteus



II. RESULTS

The IOT based smart energy meter monitoring is shown in the below fig. Considering as 5seconds equals to 1day and 1pulses equals 0.1unit power consumption. By taking 5Rs per unit power the bill for two months will be calculated. The same amount will be paid for two months if the user paid the bill the supply will be given continuously after two months. After two months if he doesn't pay bill buzzer will be ON for alert purpose. Until and unless paying bill the supply line will be disconnected. Using WIFI technology is more advantageous for both user side and provider side. There is no need to go at consumer side to disconnect the supply line, using IoT it can be monitored by online only.



III. CONCLUSION

In this paper, the generation of the triggering pulses for all the six switches of the Z source inverter is proposed using the MATlab Simulink. The simulation of the three phase Z-source inverter conducted and the results are shown. The results of Simulation shows the required load sinusoidal voltage and current is obtained by Z-source inverter concept which compared to the traditional inverter.

IV. FUTURE WORK

This paper can be extended using a GPS and GSM technology. GPRS is used to show details of the passport in weblinks.

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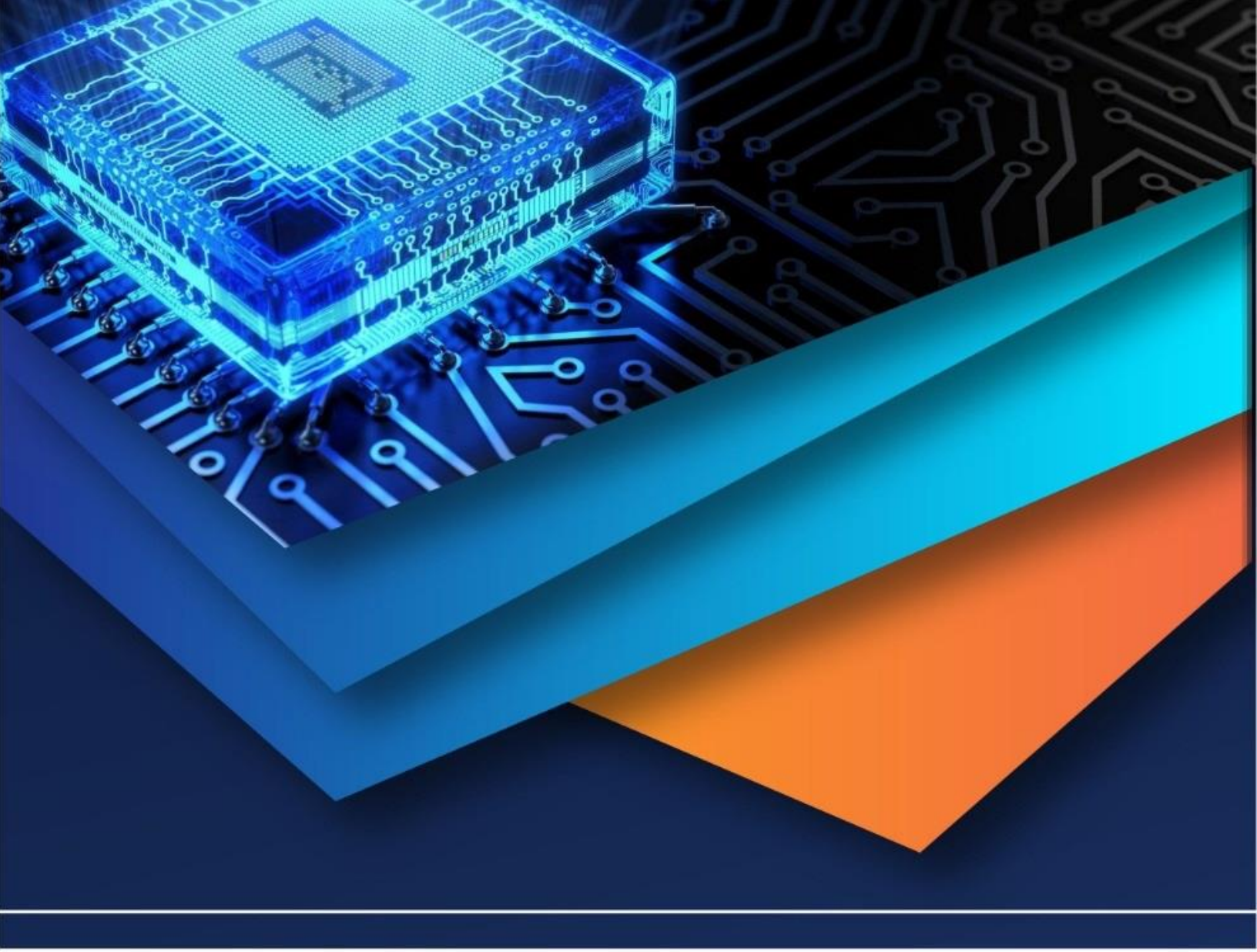

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