NEW HORIZON
COLLEGE OF ENGINEERING

Autonomous college affiliated to VTU, Accredited by NBA and NAAC with "A" grade

IoT BASED SMART ENERGY METER

A MINI PROJECT

REPORT

SUBMITTED BY

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In partial fulfilment for the award of the degree of

BACHELOR OF ENGINEERING

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

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BONAFIDE CERTIFICATE

This is to bonafide that the mini project report entitled "IoT BASED SMART ENERGY METER" submitted by BHARATH B(1NH18EE006), NANDEESH K V(1NH18EE023) and SUSHMA M (1NH19EE403) Department of Electrical Engineering, New Horizon College of Engineering, Bangalore in partial fulfilment for the award of the degree of bachelor of engineering, is a record of bonafide work carried out by him/her under my supervision, as per the NHCE code of academic and research ethics.

The contents of this report have not been submitted and will not be submitted either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university. The project report fulfils the requirements and regulations of the institution and in my opinion meets the necessary standards for submission.

Dr. S. Ramkumar

Project Guide

Dr. S. Ramkumar

HoD

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We wish to extend our profound sense of gratitude to our parents for all the sacrifices they made during our project and providing us with moral support and encouragement whenever required.

Date:

Place: Bangalore

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Nandeesh K V

Sushma M

LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS

1.ABSTRACT

In the most of the developing countries ,the effort of collecting electricity utility meter reading and detecting illegal usage of electricity is a very difficult and time consuming task which requires a lot of human resources .Energy meter reading and monitoring system using Internet of Things (IoT) that present an efficient and cost effective way to transfer the information of energy consumed by the consumer wirelessly as well as it provides facilities to detect the illegal usage of electricity. Aim of this is to measure electricity consumption in the household and generate its bills automatically using IoT. The Arduino microcontroller is employed to coordinate the activities with the digital energy meter system and to connect the system to a wifi network and subsequently to the internet and cloud server. The proposed system is capable of continuously monitor and being notified about the number of units consumed to the energy provider and consumer. The energy consumptions are calculated automatically and the bill is updated on the internet by using a network of Internet of Things. This automation can reduce the needs of the manual labours.

2.INTRODUCTION

Electricity plays a cardinal role in day to day life. The electrical energy consumption in India is the third biggest after China and USA with 5.5% global share in 2016. The per person energy use rate in India is closer to 0.7 KW. India's share with global energy demand will rise to 9% by 2035. The foremost objective of this project is to create awareness about energy consumption and efficient use of home appliances for energy savings. This system gives the information on meter reading, power cut and the alert systems for producing an alarm when energy consumption exceeds beyond the specified limit using IoT. This idea is being implemented to reduce the human dependency to collect the monthly reading and minimize the technical problems regarding billing process. This project extends the design and implementation of an energy monitoring system with the pre-intimation of power agenda using Arduino micro controller and a GSM (Global System for Mobile Communication) module.

Fig 1

3.BLOCK DIAGRAM

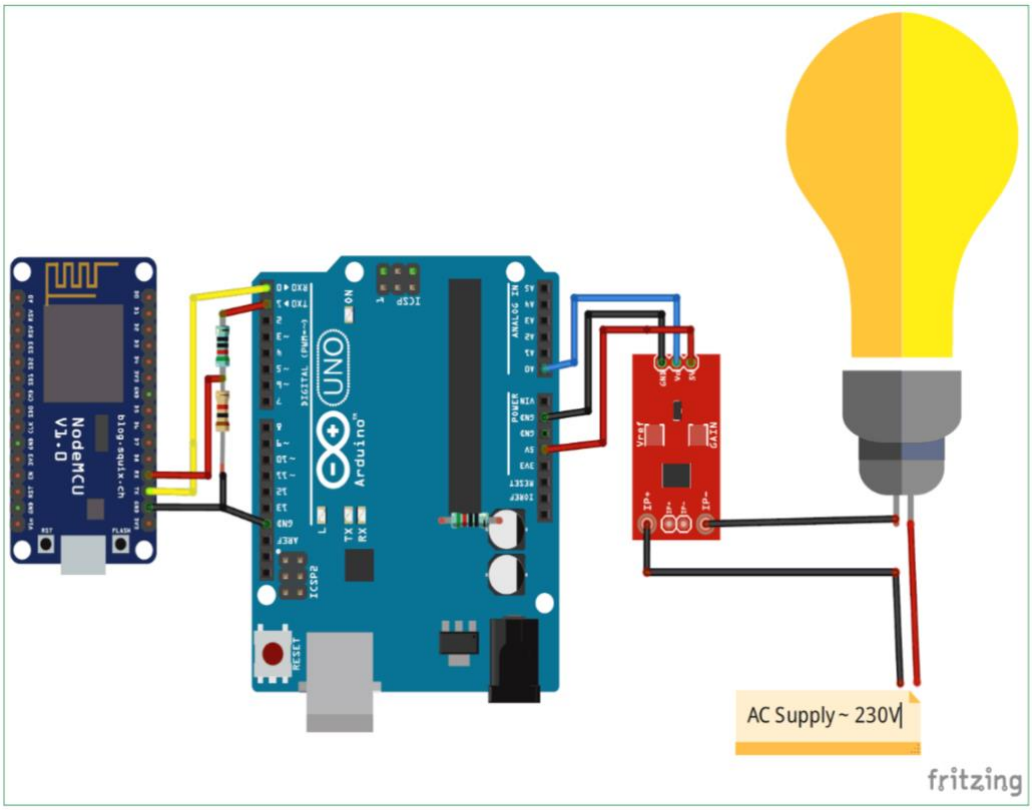

Fig 2

4.COMPONENTS REQUIRED

1. Arduino Uno
2. ESP12 or NodeMCU.
3. ACS712Current sensor.
4. Any AC Appliance like bulb.
5. Jumper wires.

5.COMPONENTS DESCRIPTION

5.1 ARDUINO UNO

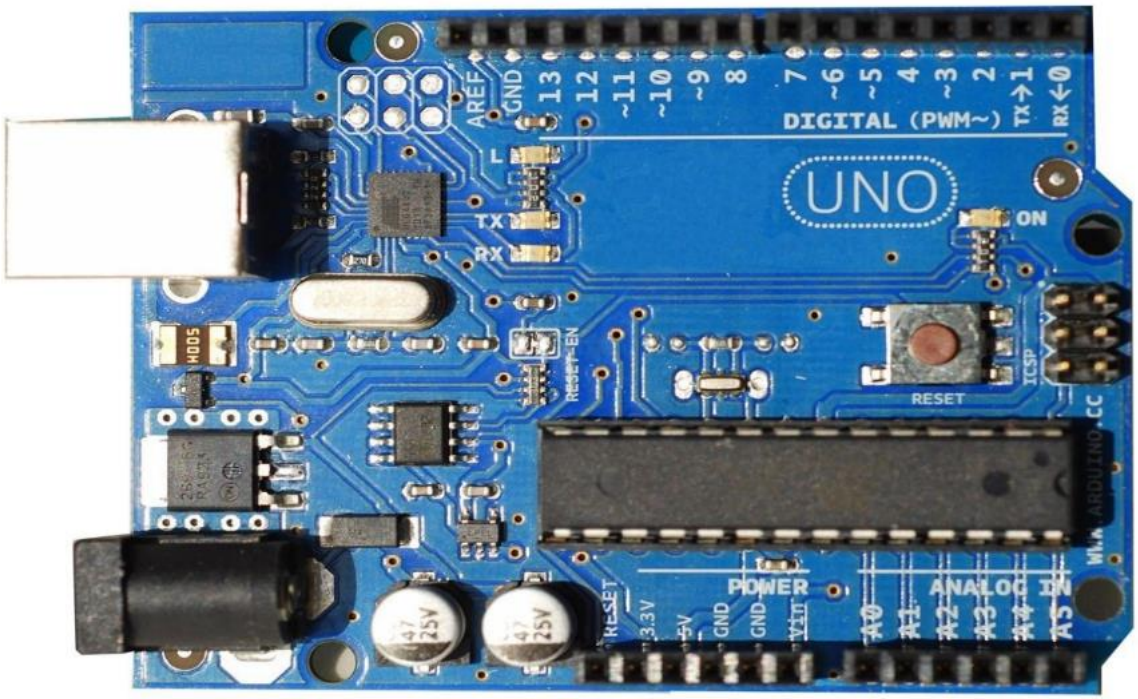

Fig 3.1

Arduino is basically an open-source computer hardware/software platform for building digital devices and interactive objects that can sense and control the physical world around them.For beginners it is very simple to use and also cheap. It can be used to create such devices that can interact with the environment using sensors.

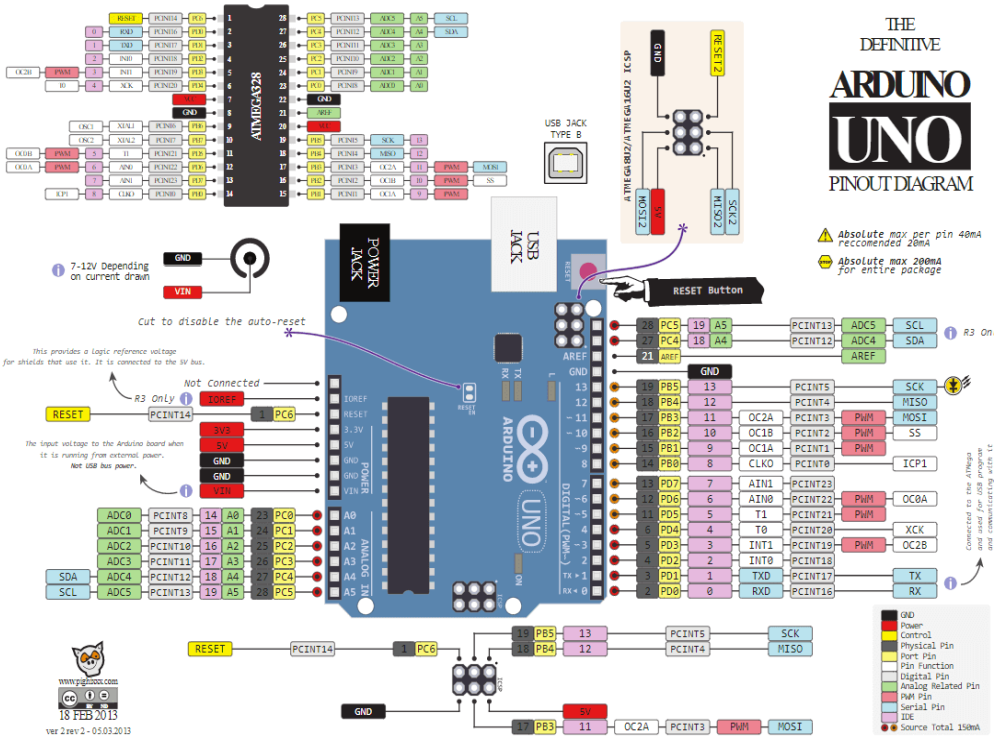

Fig 3.2

5.2 ESP12 or NODEMCU

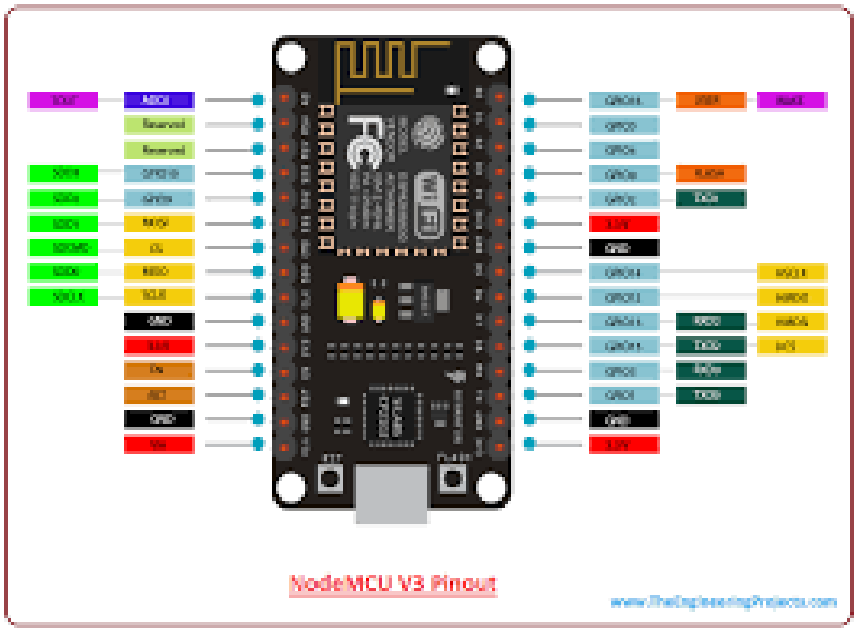

Fig 4.1

The NodeMCU is an open source software and hardware development environment built around an inexpensive Sysytem –on a chip called the ESP8266.The ESP8266, designed nad manufactured by Espressif System, contains the crucial elements of a computer: CPU, RAM,networking and even a modern operating system and SDK. That makes it a excellent choice of Internet of Things (IoT)projects of all kind.

However, as a chip, the ESP8266 is also hard to access and use. And we solder wire with the appropriate analog voltge, to its pins for the simplest tasks such as powering it on.

It is hufe burden for hackers or students who want to experiment with it in their own IoT projects.

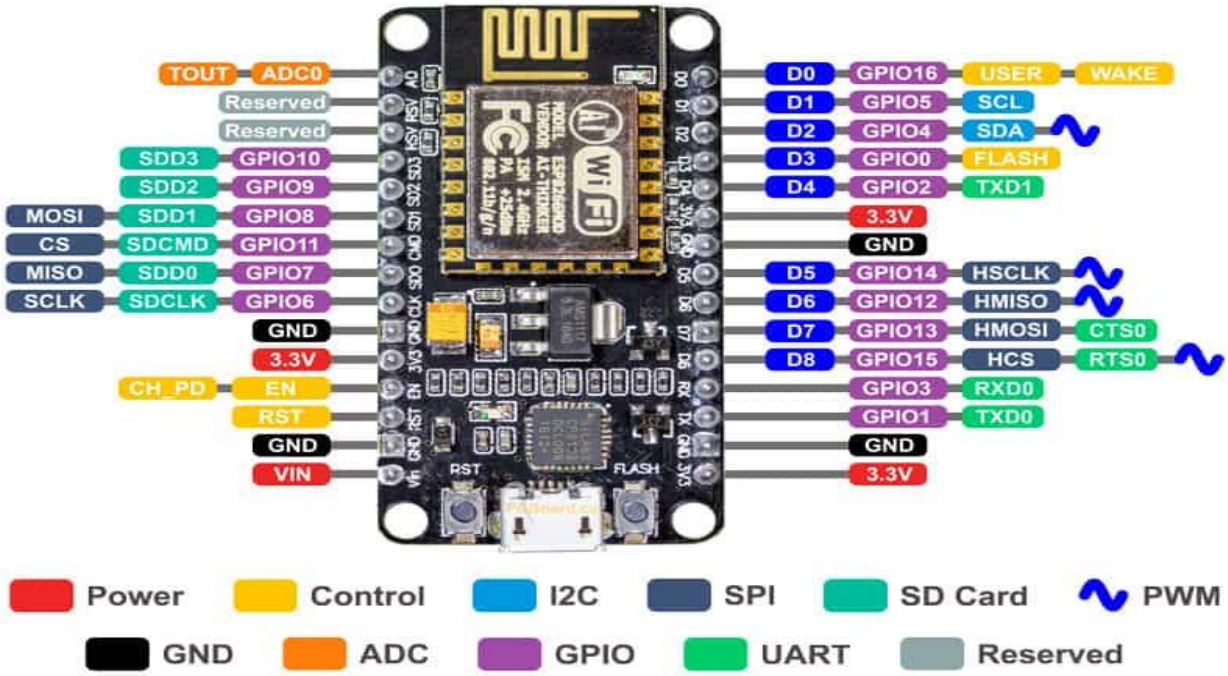

Fig 4.2

Power pins: There are 4 power pins, one is V input pin and three 3.3V pins.

GND: These are the ground pins of NodeMCU.

I2c pins: These are used to connect I2c sensors and peripherals and both the I2c Master and I2C slave are supported.It involves two lines that send and receive data.

ADC channdl: The NodeMCU is embedded with a 10-bit precision SAR ADC.

5.3 ACS712 Sensor

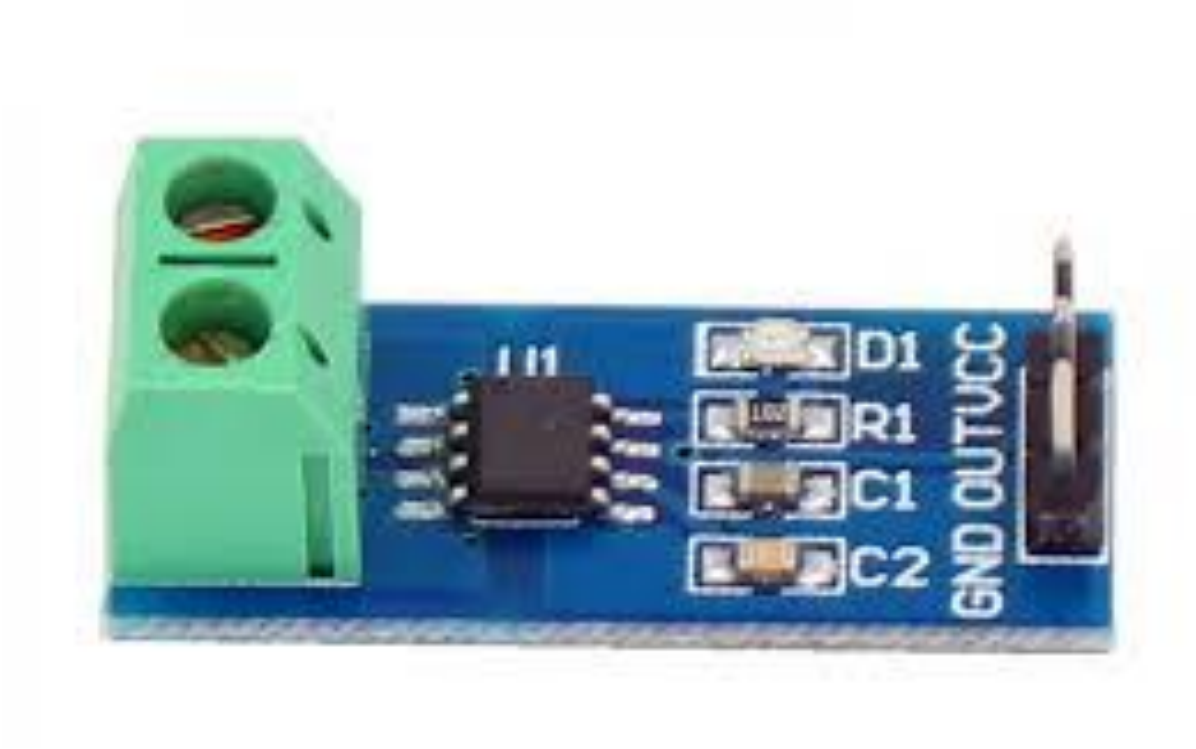

Fig 5

SPECIFICATIONS of ACS712 sensor

- Measures both the AC and DC current.
- Available as in 5A, 20A and 30A module.
- Provides isolation for the load.
- Easy to integrate with the MCU and its outputs analog voltage.
- Scale Factor.

The ACS712 current sensor is the key component in our project. For measuring current especially AC current is always a tough task due to noice coupled with improper isolation problem. But with the help of ACS712 we can overcome this problem.

This current sensor works on principal of Hall effect. Acording to this principle, “when a current carrying conductor is placed into a magnetic field, a voltage is generated across its edges perpendicular to the direction of both the current and the magnetic field”.

The measurement is interms of millivolt which is called as hall voltage and it is proportional to the current that was flowing through the conductor.

This sensor can measure both the AC and DC current this is the major advantage of this sensor and also provides the isolation for the loads.

It has three pins on the module which are Vcc, Vout and Ground. The 2-pin terminal block is where the current carrying wire should be passed and the module work on +5V so the Vcc should be powered by 5V and the ground should be connected to Ground of the system. The Vout pin has an offset voltage of 2500mV means when there is no current flowing through the wire then the output voltage should be 2500Mv.

Analog value	Vout(mV)	Current through the wires(A)
1023	5000	13.51351351
800	3910.068426	7.621991493
700	3421.309873	4.980053367
512	2502.443793	0.013209691
300	1466.27566	-5.587699136
301	1471.163245	-5.561279755
0	0	-13.51351351

Table 5

The above-mentioned values are information given in ACS712 current sensor datasheet which is used in the time of simulation.

5.4 JUMP WIRE

Jumper is an electrical wire or group of them in a cable, with a connector or pin at each end which is normally used to interconnect the components of a bread board or other prototype or test circuit, internally with other equipment or components without soldering.

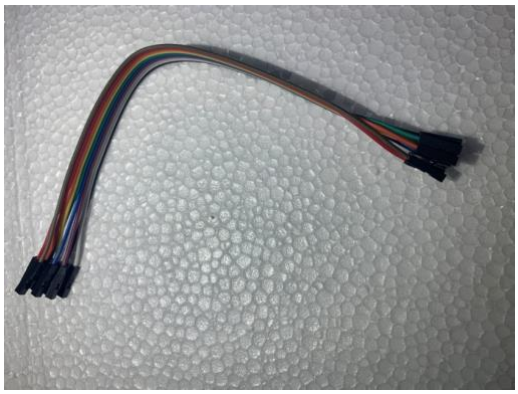

Fig 6.1

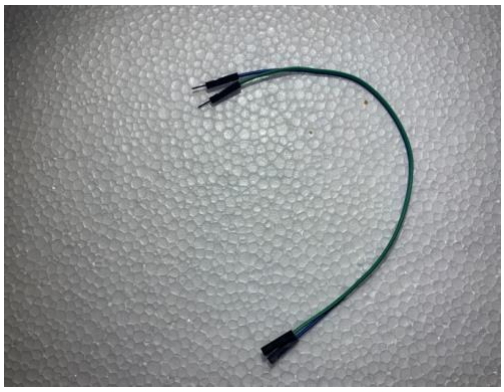

Fig 6.2

There will be three types of jumper wire are

i. Male to male jumper wire
ii. Male to female jumper wire
iii. Female to female jumper wire

6.METHODOLOGY

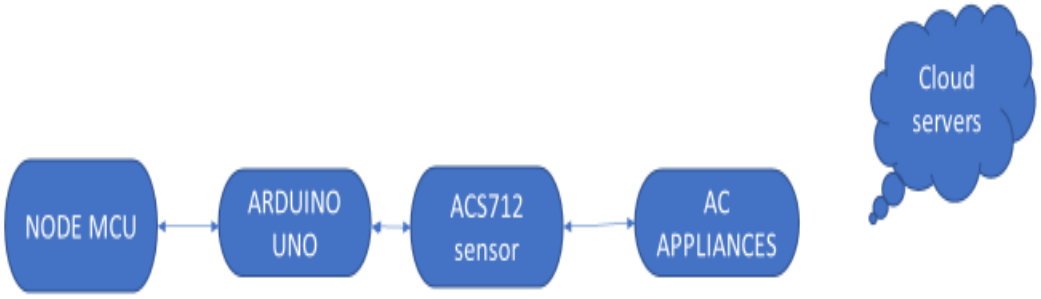

Fig 7

In this model we are using nodemcu ,Arduino uno ,ACS712 current sensor and ac appliances.

The ac appliances we have used an bulb or may be fan which is connected to 230 volts.

The current sensor works on the principle of hall effect and it is a key component in our project which measures both AC and DC component and it measures both voltage and current in mV and mA.

Now we need to monetarise over the internet by cloud severs. Here we are using cloud server in ADAfruit platform.

Connecting to cloud servers

Here in this project we are using cloud server called as ADAFRUIT IO.

First of all we need to create adafruitio account with our credentials or we need to sign up if we don’t have an account in adafruitio.

In the dashboard we need to give our project detailslike giving name of project and description what to feed.

Now we need to generate the authentication key and the password.

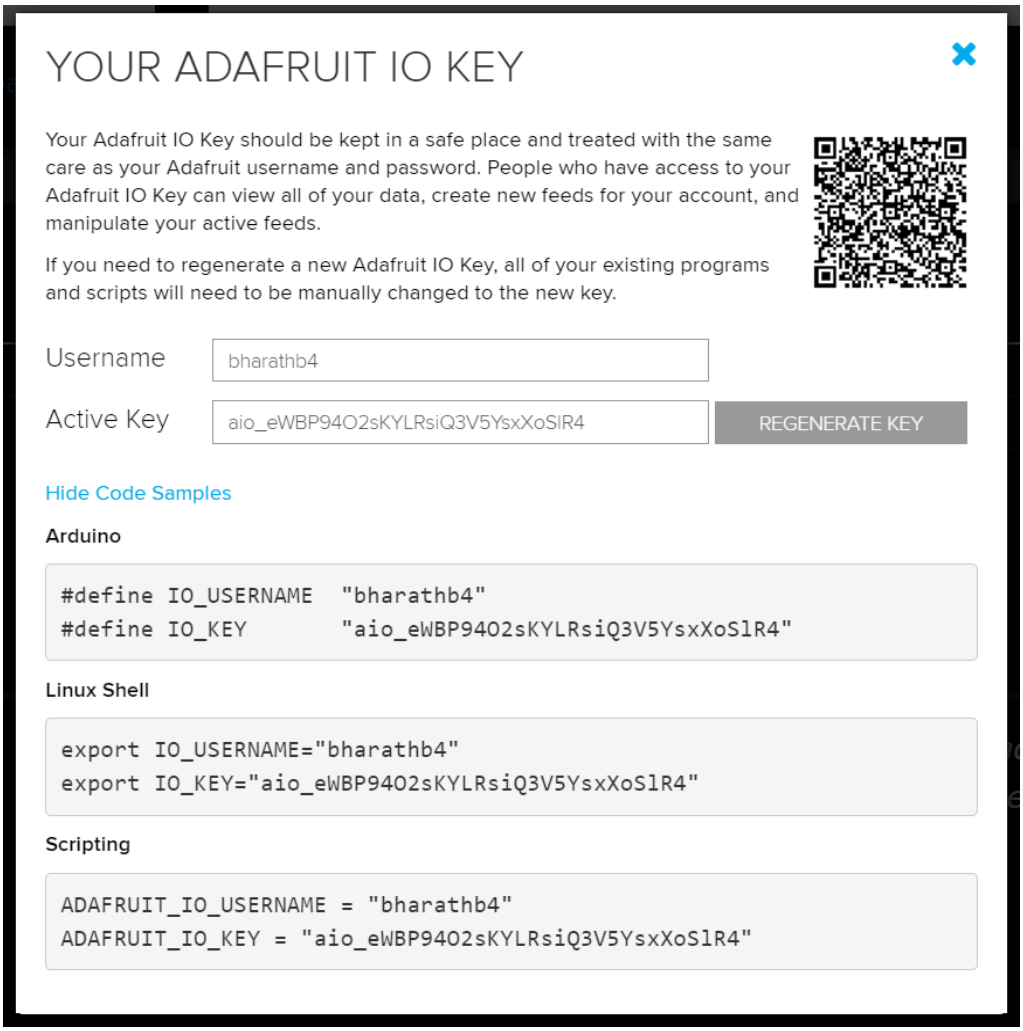

Fig 8

This is how it looks like which we are generated from the adafruitio.

Now we need to give name of a feed as Power and Bill and in the block settings we need to fill the details of max and min values of power and bill with a range of 0 to 100.As follows:

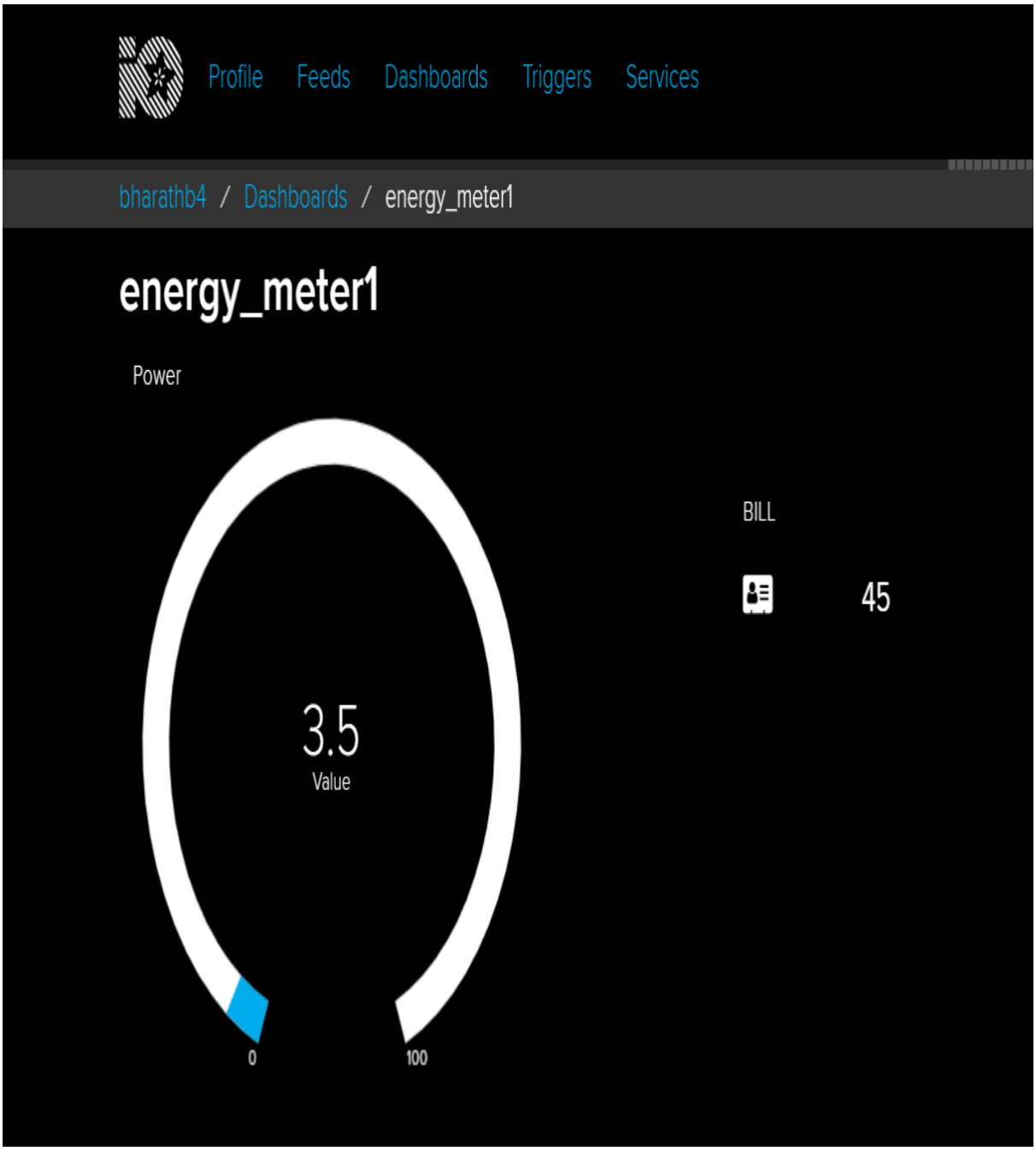

Fig 9

By this ADAFRUIT IO we are storing the Electricity meter readings.

To trigger the email for energy meter

To trigger the email, we need to use one more platform called as IFTTT platform.

The first step is to login with our credentials and then on new applet click on adafruit and we need to choose a service called as adafruit.

Now we need to give feed to bill as, if the value is equal to threshold value then it will send a email that as shown below as follows:

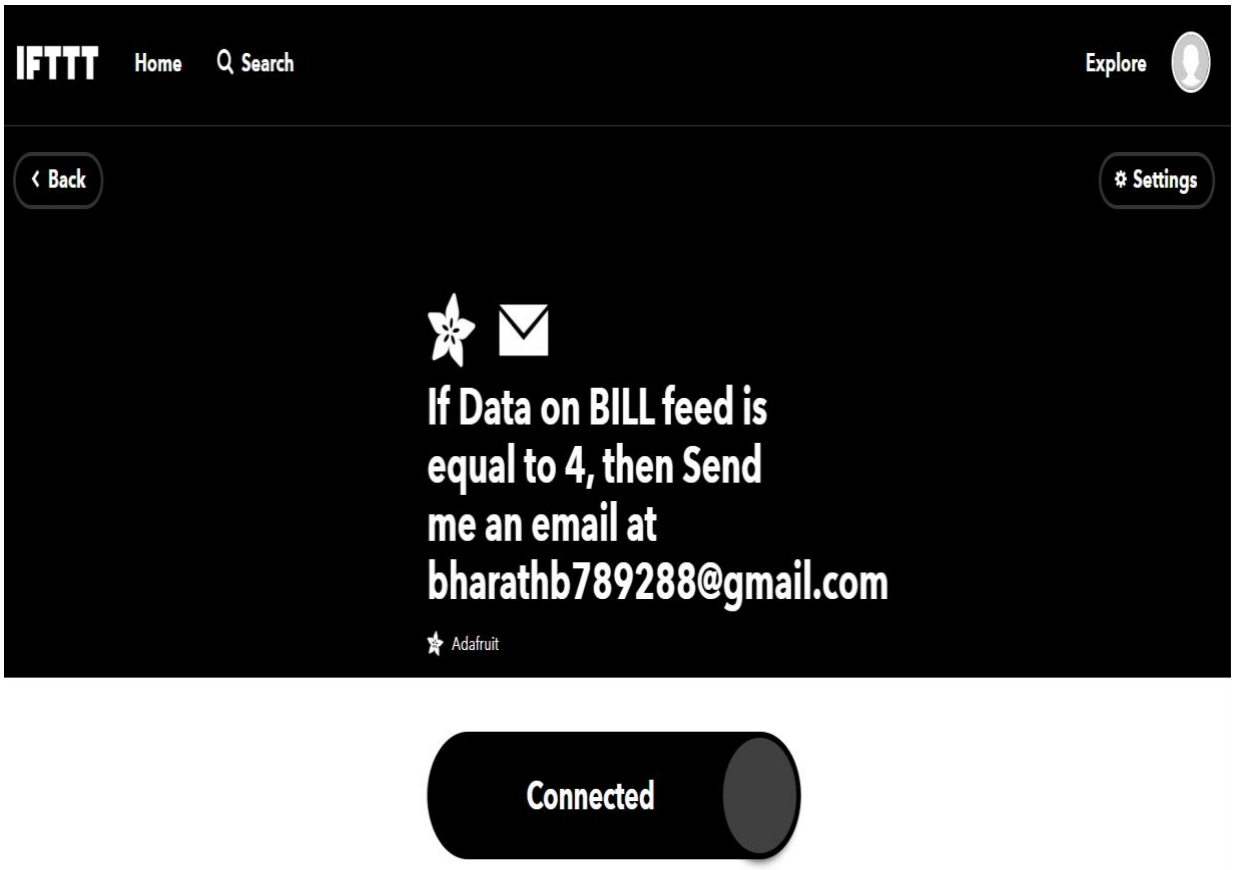

Fig 10

Now we are done with the web integration part. Now we need to upload the code as follows

Now we need to upload code for both Arduino and ESP8266.

7.CODE FOR ARDUINO AND NODEMCU

Code for Arduino:

```
#include "ACS712.h"
char watt [5];
ACS712 sensor (ACS712_30A, A0);
unsigned long last_time =0;
unsigned long current_time =0;
float Wh =0 ;
void setup() {
Serial.begin(115200);
sensor.calibrate();
}

void loop() {
  float V = 230;
  float I = sensor.getCurrentAC();
// Serial.println(I);
  float P = V * I;
last_time = current_time;
current_time = millis();
Wh = Wh+  P *(( current_time -last_time) /3600000.0) ;
dtostrf(Wh, 4, 2, watt);
Serial.write(watt);
delay(10000);
}
```

Code for NodeMCU

```
#include <ESP8266WiFi.h>
#include "Adafruit_MQTT.h"
#include "Adafruit_MQTT_Client.h"
#define WLAN_SSID       "nandeesh’s iphone"
#define WLAN_PASS       "12345678"
char watt[5];
#define AIO_SERVER      "io.adafruit.com"
#define AIO_SERVERPORT  1883
#define AIO_USERNAME    "bharathb4"
#define AIO_KEY         "aio_eWBP94O2sKYLRsiQ3V5YsxXoSlR4"

WiFiClient client;
int bill_amount = 0;
unsigned int energyTariff = 8.0;
Adafruit_MQTT_Clientmqtt(&client, AIO_SERVER, AIO_SERVERPORT, AIO_USERNAME,
AIO_KEY);
Adafruit_MQTT_Publish Power = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME
"/feeds/Power");
Adafruit_MQTT_Publish bill = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME "/feeds/bill");
void MQTT_connect();

void setup() {
Serial.begin(115200);
delay(10);
Serial.println(F("Adafruit MQTT demo"));
Serial.println(); Serial.println();
Serial.print("Connecting to ");
Serial.println(WLAN_SSID);
```

```
WiFi.begin(WLAN_SSID, WLAN_PASS);
  while (WiFi.status() != WL_CONNECTED) {
delay(500);
Serial.print(".");
  }
Serial.println();

Serial.println("WiFi connected");
Serial.println("IP address: "); Serial.println(WiFi.localIP());
}

void loop() {
MQTT_connect();

 int i=0;
 float watt1;
if(Serial.available() > 0 ){
delay(100);
while(Serial.available() &&i<5) {
     watt[i++] = Serial.read();
    }
    watt[i++]='\0';
  }

 watt1 = atof(watt);
bill_amount = watt1 * (energyTariff/1000);
Serial.print(F("\nSending Power val "));
Serial.println(watt1);
```

```
Serial.print("...");

  if (! Power.publish(watt1)) {
Serial.println(F("Failed"));
  } else {
Serial.println(F("OK!"));
  }

   if (! bill.publish(bill_amount)) {
Serial.println(F("Failed"));
  } else {
Serial.println(F("OK!"));
  }

if (bill_amount==4){
for (int i =0; i<=2; i++)
{
bill.publish(bill_amount);
delay(5000);
}
bill_amount =6;
}

delay(5000);
}
void MQTT_connect()
 {
  int8_t ret;
   if (mqtt.connected()) {
```

```
   return;
  }

Serial.print("Connecting to MQTT... ");

  uint8_t retries = 3;
  while ((ret = mqtt.connect()) != 0) {
Serial.println(mqtt.connectErrorString(ret));
Serial.println("Retrying MQTT connection in 5 seconds...");
mqtt.disconnect();
delay(5000);  // wait 5 seconds
      retries--;
      if (retries == 0) {
        while (1);
      }
  }
Serial.println("MQTT Connected!");
}
```

Now we need to install one more application called as MQTT. for this download the MQTT DASHBOARD android app from the playstore.

In that the first step is to open the app, click on + sign, and fill the client ID. Now we need to give our project details and authentication key and password which we have generated from ADAfruit platform.

In that we need to create our project based on our requirement and select electricity meter and select subscribe.

Thus, the output consuming energy values will be displayed under the power and bill.

8.CONCLUSION

The development in technology about electrical distribution system is a nonstop process. In this project work, wireless meter reading system is calculated to endlessly monitor the meter reading of power and electricity bill. It avoids the human involvement, provide capable meter reading, and avoids the billing mistake and human intervention.

Using Wi-Fi technology, it is more helpfull for both user side and provider side. There is no need to go at the consumer side to disconnect the supply line, using IOT it can be monitored by online only from anywhere in the world.

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10.APPENDICES