Visvesvaraya Technological University

Belgaum, Karnataka-590 018

A Project Report on

WIRELESS AUTOMATED METER READING FOR POWER DISTRIBUTION NETWORKS

Project Report submitted in partial fulfillment of the requirement for the award of the degree of

Bachelor of Engineering
In
Electrical & Electronics Engineering

Submitted by

ASHWINI	**1CR17EE012**
KRUTIKA	**1CR17EE030**
PRAGATHI	**1CR17EE045**
RACHANA	**1CR17EE052**

Under the Guidance of

Ms. Geetanjali
Assistant Professor, Department of Electrical & Electronics Engineering
CMR Institute of Technology

CMR Institute of Technology, Bengaluru-560 037

Department of Electrical & Electronics Engineering

2020-2021

CMR INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
AECS Layout, Bengaluru-560 037

Certificate

Certified that the project work entitled **WIRELESS AUTOMATED METER READING FOR POWER DISTRIBUTION NETWORKS** carried out by Ms.Ashwini USN: 1CR17EE012; Ms.Krutika, USN:1CR17EE030; Ms.Pragathi, USN:1CR17EE045; Ms.Rachana, USN:1CR17EE052 are bonafied students of CMR Institute of Technology, Bengaluru, in partial fulfillment for the award of Bachelor of Engineering in Electrical & Electronics Engineering of the Visvesvaraya Technological University, Belgaum, during the year 2020-2021. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

Signature of the Guide	***Signature of the HOD***	***Signature of the Principal***
Ms. Geetanjali P, Asst Professor EEE Department CMRIT, Bengaluru	Dr. K. Chitra Professor & HOD EEE Department CMRIT, Bengaluru	Dr. Sanjay Jain Principal, CMRIT, Bengaluru

External Viva

Name of the Examiners Signature & Date

1.

2.

CMR INSTITUTE OF TECHNOLOY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

AECS Layout, Bengaluru-560 037

DECLARATION

We, [Ms.**ASHWINI (1CR17EE012),** Ms.**KRUTIKA (1CR17EE030),** Ms.**PRAGATHI (1CR17EE045),** Ms.**RACHANA (1CR17EE052)],** hereby declare that the report entitled **WIRELESS AUTOMATED METER READING FOR POWER DISTRIBUTION NETWORKS** has been carried out by us under the guidance of **Ms.Geetanjali,** Assistant Professor, Department of Electrical & Electronics Engineering, CMR Institute of Technology, Bengaluru, in partial fulfillment of the requirement for the degree of **BACHELOR OF ENGINEERING in ELECTRICAL & ELECTRONICS ENGINEERING**, of Visveswaraya Technological University, Belagaum during the academic year 2020-21. The work done in this report is original and it has not been submitted for any other degree in any university.

Place: Bengaluru

Date:

ASHWINI (1CR17EE012)

KRUTIKA (1CR17EE030)

PRAGATHI (1CR17EE045)

RACHANA (1CR17EE052)

Abstract

This Project is about the implementation of wireless automatic electric meter (AMR) network, implementing based on internet for reduced power consumption.

Wireless Electric meter is used for the collection of unitcount and it is evolved from traditional meter reading scheme and power theft from the transmission line.

This wireless automatic reading technology saves humanresources and improves the accuracy.

Reduced power consumption can be effectively achievedand this system focused to implement in a building or in an office.

Acknowledgement

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of people, who are responsible for the completionof the project and who made it possible, because success is outcome of hard work and perseverance, but stead fast of all is encouraging guidance. So with gratitude we acknowledge all those whose guidance and encouragement served us to motivate towards the success of the project work.

We take great pleasure in expressing our sincere thanks to ***Dr. Sanjay Jain****,* ***Principal, CMR Institute of Technology, Bengaluru*** *for providing an excellent academic environment in the college and for his continuous motivation towards a dynamic career. We would like to profoundly thank* ***Dr. B Narasimha Murthy****, Vice-principal of CMR Institute of Technology and the whole* ***Management*** *for providing such a healthy environment for the successful completion of the project work.*

We would like to convey our sincere gratitude to ***Dr. K Chitra****,* ***Head of Electrical and Electronics Engineering Department, CMR Institute of Technology, Bengaluru*** *forher invaluable guidance and encouragement and for providing good facilities to carry outthis project work.*

We would like to express our deep sense of gratitude to ***Name of guide, Assistant Professor, Electrical and Electronics Engineering, CMR Institute of Technology, Bengaluru*** *for his/her exemplary guidance, valuable suggestions, expert advice andencouragement to pursue this project work.*

*We are thankful to all the faculties and laboratory staffs of **Electrical and Electronics Engineering Department, CMR Institute of Technology, Bengaluru** for helping us in all possible manners during the entire period.*

Finally, we acknowledge the people who mean a lot to us, our parents, for their inspiration, unconditional love, support, and faith for carrying out this work to the finishing line. We want to give special thanks to all our friends who went through hard times together, cheered us on, helped us a lot, and celebrated each accomplishment.

*Lastly, to the **Almighty**, for showering His Blessings and to many more, whom we didn't mention here.*

CONTENTS

List of figures

Chapter 1

INTRODUCTION

1.1 History of the project

With the development of country's economy and the improvement of national power, the power requirement is still ever increasing due to use of improper power management systems and the conventional energy metering systems. Over the past years, metering devices have gone through much improvement, and are expected to become even more sophisticated, offering more and more devices.

Meters in the past, and today in a few countries, were electromechanical devices with poor accuracy and lack of configurability. Theft detection was also a challenge. Such meters are limited to providing the amount of energy consumption on site. Recent developments in this direction seem to provide opportunities in implementing energy efficient metering technologies that are more precise and accurate, error free, etc.

The implementation of Wireless Automatic Meter Reading System provides with many features as compared with the analog utility meter reading with man power

1.2 Reason for selecting this project

Automatic electric meter reading system is one method readingand processing data automatically with computer and communication.

It is the need of improving the automatic level of energyconsumption and the necessity of rapid development of computer and communication technology too.

It can relieve reading person's labor intensity, reduce the reading mistake, but also has the advantage of high speed and good real-time.

AMR requires smart meters. AMR requires specific infrastructures

Wireless Electric meter is used for the collection of unit count and it is evolved from traditional meter reading scheme and power theft from the transmission line. This wireless automaticreading technology saves human resources and improves the accuracy.

1.3 Requirements:

Hardware components:

- AC Static Watthour Meter
- Microcontroller (ESP-12E)
- Relay (SRD-05VDC-SL-C)
- Load (5W bulb)

Software used:

- Arduino
- Thing speak

Chapter 2

LITERATURE REVIEW

2.1 Details of literature survey

- Li Gang2 propose household metering system design based on Zigbee and GPRS technologies, using PIC18LF4620 as the core processor and CC2430 chip as close communication function, using SIM300 chip as communication function in distance.

- Md. Wasi-ur-Rahman, Mohammad Tanvir Rahman, Tareq Hasan Khan and S.M. Lutful Kabira proposed technique for remotely reading electricity meter readings using Short Message Service (SMS) has been illustrated. Existing Global System for Mobile communications (GSM) networks have been used for sending and receiving SMS.

- Dr. Mohd Yunus B Nayan1, Aryo Handoko Primicanta propose hybrid Automated Metering Reading (AMR) system which is a combination of ZigBee and GSM technology. In this propose system ZigBee module is attached to the electric meter by using interface board and the data collector will be connected to the central computer by using GSM

- Babak Aghaei presents a model for processes which are related to user of water, electricity and gas by using wireless sensor network in Iran.
  In this paper the amount of economy and optimization occurred in offices in Malekan those by proposed model are given.

- Vedran Bilas2 propose a wireless automatic water-meter reading system founded on ZigBee technology . The wireless automatic water-meter reading system presented here uses ZigBee networking to avoid difficulties and problems inherent to other meter reading techniques

2.2 objective of the project:

Wireless Electric meter is used for the collection of unit count and it is evolved from traditional meter reading scheme and power theft from the transmission line. This wireless automatic reading technology saves human resources and improves the accuracy.
Problem associates with traditional meter reading have been increased day by day, due to various reasons such as rapid growth in population, tedious location, environmental conditions etc. But with new developments of microcontroller, there are many improvements in automating various industrial aspects for reducing manual efforts. In traditional meter reading system in which utility usages are written on paper by workers, there is lot of chances of human errors. These will cost more to the utility company. Also there are chances that of unavailability of consumers during utility worker's visit for meter reading. In such cases, billing process will be pending & utility workers again require to visit to consumer. Going to each & every consumer's house & generating the bills is very difficult task & require lot of time. It becomes very much difficult in natural calamities specially in rainy season. Moreover it is also difficult for utility workers to find out unauthorized connections or malpractices carried out by consumers manually. This all will result in loss of revenue generation for utility company.

the development in the field of wireless technology along with microcontroller leads to unwrap the solution to many problems. The wireless media made the exchange of information fast, secured & more accurate. These wireless media, along with microcontroller or microprocessor leads to digital implementation which causes rapid utilization of devices such as computers & telecommunication devices. Communication media like GPRS, Internet are easily available everywhere. GPRS is widely used due to it's advantages such as always on-line, high speed transmission & charged fee according to the amount of data transmitted. After considering all this GPRS advantages, It is also can be used for sending power parameters on automatic system of reading digital meter.

Considering all above pro & cons of traditional & automatic metering system ,this study proposes a wireless automatic meter reading

Chapter 3

Proposed model

3.1 Block diagram:

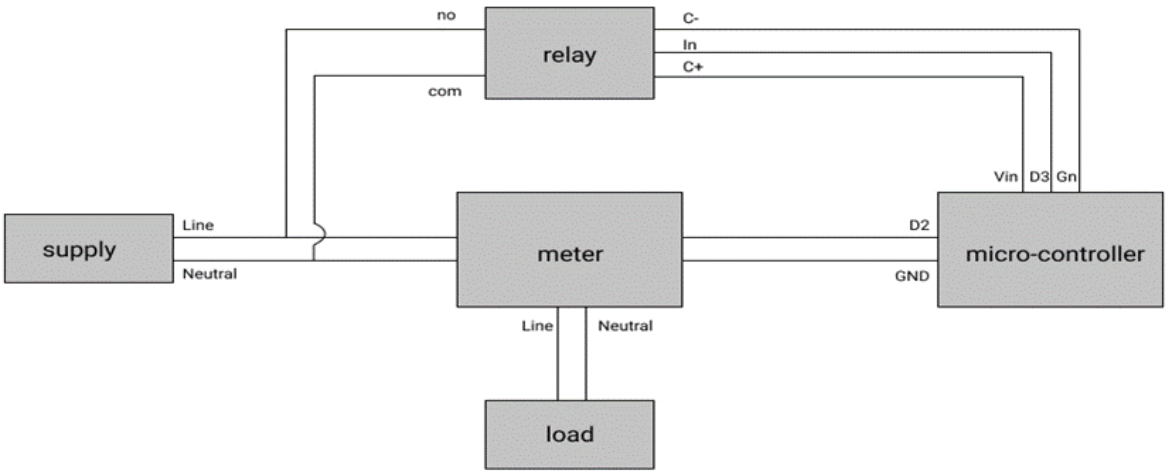

Figure 1 Block diagram

3.1.1 AC Static Watthour Meter:

It measures energy (Watthour) consumed by SINGLE PHASE / THREE PHASE, balanced / unbalanced load in power industry.
The meter comprises of microcontroller with DIP switch provision to accommodate different CT Ratios.

A Watt-hour meter is a measuring device that can evaluate and record the electrical power passing through a circuit at a certain time.

By implementing a Watt-hour meter, we can know how much electrical energy is used by

a home, business, or an electrically powered device.
Electrical utilities install watt-hour meters at their consumer's premises to evaluate their electrical usage (for billing purposes).

Figure 2 AC static meter

3.1.2 Microcontroller (ESP-12E):

The ESP-12E ESP8266 Wi Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi Fi network.
The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.
This module comes with AT commands firmware which allows you to get functionality like arduino wifi shield, however you can load different firmwares to make your own applicaiton on the modules' memory and processor.
It's a very economic module and has a huge and growing community support.
This module has onboard 80Mhz low power 32 bit processor which can be used for custom firmwares. This also means that you can host small webpages without any external controller.

The ESP8266 supports APSD for VoIP applications and Bluetooth co-existance interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

ESP8266 is transforming the world with its low cost and high features which makes it an ideal module for Internet Of Things (IOT). It can be used in any application where you need to connect a device to your local network or internet.

This module ESP-12E has 7 GPIOs.

Figure 3 WiFi chip

3.1.3 Relay (SRD-05VDC-SL-C):

The module with the SRD-05VDC-SL-C relay has three high voltage terminals (NC, C, and NO) which connect to the device you want to control. The other side has three low voltage pins (Ground, Vcc, and Signal) which connect to the Arduino.

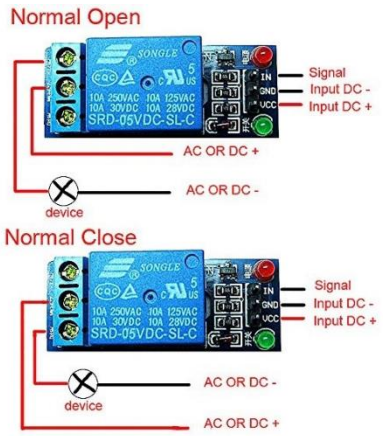

Figure 4 Relay

- NC: Normally closed 120-240V termina
- NO: Normally open 120-240V terminal
- C: Common terminal
- Ground: Connects to the ground pin on the Arduino
- 5V Vcc: Connects the Arduino's 5V pin Signal: Carries the trigger signal from the Arduino that activates the relay

Inside the relay is a 120-240V switch that's connected to an electromagnet When the relay receives a HIGH signal at the signal pin, the electromagnet become charged and moves the contacts of the switch open or closed.

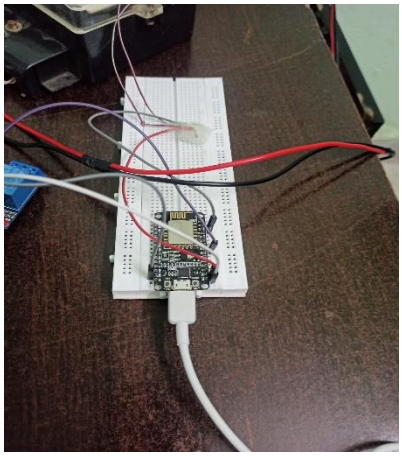

Figure 5 Connection from meter to wifi chip

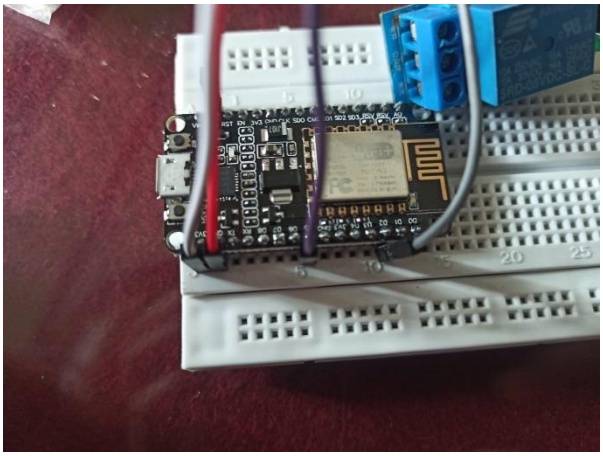

Figure 6 connections to relay from wifi chip

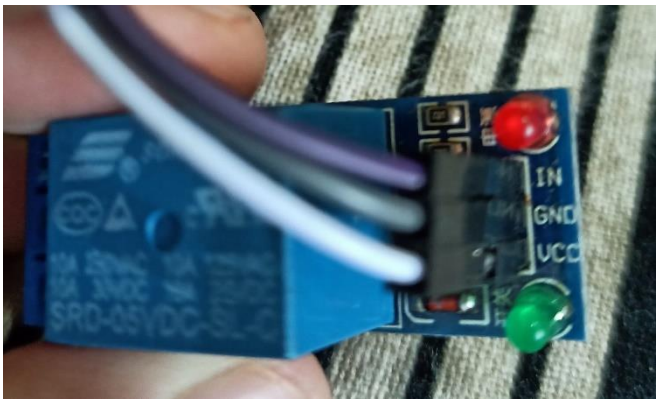

Figure 7 connections on relay

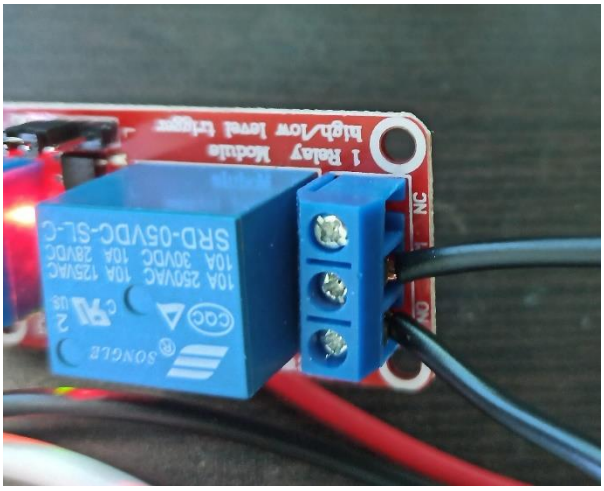

Figure 8 connections from relay to load

3.2 Methodology:

- The connections are done as per the block diagram
- The written code is dumped to the microcontroller.
- The code consist billing details (no of units consumed ,to what number the bill has to be sent , fixed billing amount, formula to calculate bill ,at what time the bill has to be sent, etc).
- The connected load is a 5W bulb, and as the load is less we use the number pulses counted in the given time as the units consumed.
- The microcontroller reads the signal from the meter and counts the pulses to give the number of units consumed.
- The bill is generated based on the units consumed (In case of bill generation).
- There is a limit set for units consumption(to control power theft).
- When the units consumed reaches the set limit value the microcontroller makes the relay trip and hence the power supply is cut (In case of power restriction).
- Alert message is sent to consumer when the consumed power is about to reach the limit and another message when the limit is reached.
- Bill is also sent on the set time.
- We can monitor the units consumed with the graphical representation on the Thing speak platform.
- Thing Speak is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. Thing Speak provides instant visualizations of data posted by your devices to Thing Speak. With the ability to execute MATLAB® code in Thing Speak you can perform online analysis and processing of the data as it comes in.
- It consist of a graph which records the units consumption for a set time (for monthly record).
- There is one more graph which keeps the track of the previous month's(or set time) units consumption.

- The information of units consumption is fed to thing speak via the wifi chip(from the code).

3.3 Arduino code:

```
#include <ESP8266WiFi.h>
#include <ESP8266HTTPClient.h>
#include <WiFiUdp.h>
#include "ThingSpeak.h"
const char* ssid = "realme6";
const char* password = "9876543210";
#include <NTPClient.h>
int meterpin = D2;
int preunit=0;
int currentunit=0;
int count=0;
WiFiClient  client;
unsigned long counterChannelNumber = 1443895;            // Channel ID
const char * myCounterReadAPIKey = "K474GHYJUT4W8RXM"; // Read API Key
const int FieldNumber1 = 1;  // The field you wish to read
const int FieldNumber2 = 2;  // The field you wish to read
const int FieldNumber3 = 3;  // The field you wish to read
String formattedDate;
String dayStamp;
String timeStamp;
const long utcOffsetInSeconds = 19800;

char daysOfTheWeek[7][12] = {"Sunday", "Monday", "Tuesday", "Wednesday", "Thursday",
"Friday", "Saturday"};
int h=0;

int c=1;

int billHH = 13;          //    HH - hours          ##Set these for reminder time in 24hr Format
```

```
int billMM = 40;          //    MM - Minute
int billSS = 00;          //    SS - Seconds
int relay=D3;
int creading;
int preading;
int totalreading;
float totalamount;
int generate=0;
int nowHr, nowMin, nowSec;                    // to show current mm,hh,ss
// Define NTP Client to get time
WiFiUDP ntpUDP;
NTPClient timeClient(ntpUDP, "pool.ntp.org", utcOffsetInSeconds);
int flag=1;
void setup()
{
  Serial.begin(9600);
  pinMode(meterpin, INPUT);
  WiFi.begin(ssid, password);
  pinMode(relay, OUTPUT);
  digitalWrite(relay,HIGH);
  while (WiFi.status() != WL_CONNECTED)
  {
    delay(1000);
    Serial.println("Connecting..");
  }
  ThingSpeak.begin(client);
   timeClient.begin();
   preading=preReading();
}
int readReading()
{
  int last = ThingSpeak.readLongField(counterChannelNumber, FieldNumber1,
myCounterReadAPIKey);
  int statusCode = ThingSpeak.getLastReadStatus();
```

```
  return last;
}

int preReading()
{
  int last = ThingSpeak.readLongField(counterChannelNumber, FieldNumber2,
myCounterReadAPIKey);
  int statusCode = ThingSpeak.getLastReadStatus();
  return last;
}

void loop()
{
  int metervalue = digitalRead(meterpin);
  metervalue=random(0,2);
  if (metervalue==1 and c==1)
  {
    count++;
  }
  if(count>10)
  {
     creading=readReading();
     WiFiUDP ntpUDP;
     if (WiFi.status() == WL_CONNECTED)
     { //Check WiFi connection status
       HTTPClient http;  //Declare an object of class HTTPClient
       if(generate==1)
       {

http.begin("http://api.thingspeak.com/update?api_key=U27IXPQD44EO5UP7&field1="+String(1
+creading)+"&field2="+String(creading+preading)+"&field3="+String(totalamount));  //Specify
request destination
          generate=0;
       }
```

```
      else
      {

http.begin("http://api.thingspeak.com/update?api_key=U27IXPQD44EO5UP7&field1="+String(1
+creading));
      }
      int httpCode = http.GET();                                        //Send the request
      if (httpCode > 0)
      {
        //Check the returning code
        String payload = http.getString();   //Get the request response payload
        Serial.println(payload);                    //Print the response payload
      }
      Serial.println("data uploaded to think speak");
      http.end();   //Close connection
     }
      count=0;
      check();
  }
  WiFiUDP ntpUDP;
  timeClient.update();

  Serial.print(daysOfTheWeek[timeClient.getDay()]);
  Serial.print(", ");
  Serial.print(timeClient.getHours());
  Serial.print(":");
  nowHr=timeClient.getHours();
  Serial.print(timeClient.getMinutes());
  Serial.print(":");
  nowMin=timeClient.getMinutes();
  Serial.println(timeClient.getSeconds());
  nowSec=timeClient.getSeconds();
  Serial.println(timeClient.getFormattedTime());
```

```
 if (nowHr == billHH && flag==1) {

   if (nowMin == billMM) {
     flag=0;
      Serial.println("GenerateBill()");
      generateBill();
   }
 }

 delay(1000);        // delay in between reads for stability
}


void check()
{
 totalreading=creading-preading;
 Serial.println("This Month:"+String(totalreading));
  if(totalreading==4)
 {
   if (WiFi.status() == WL_CONNECTED)
        { //Check WiFi connection status

          HTTPClient http;  //Declare an object of class HTTPClient

http.begin("http://edutechindia.co.in/awsfreesms/results.php?send=ok&api=sVScKbRqGJW7dB2
mgUxpy&numbers=7022230678&msg=you%20are%20going%20to%20reach%20the%20limit%
20for%20this%20month");
          int httpCode = http.GET();                                          //Send the request
          if (httpCode > 0)
          { //Check the returning code
            String payload = http.getString();   //Get the request response payload
            Serial.println(payload);                    //Print the response payload
          }
          http.end();   //Close connection
```

```
        }
  }
  if(totalreading==5)
  {
    c=0;
    digitalWrite(relay,LOW);
    if (WiFi.status() == WL_CONNECTED)
        { //Check WiFi connection status

          HTTPClient http;  //Declare an object of class HTTPClient

http.begin("http://edutechindia.co.in/awsfreesms/results.php?send=ok&api=sVScKbRqGJW7dB2
mgUxpy&numbers=7022230678&msg=Alert!!!!!%20Limit%20reached");
          int httpCode = http.GET();                                          //Send the request
          if (httpCode > 0)
          { //Check the returning code
            String payload = http.getString();   //Get the request response payload
            Serial.println(payload);                    //Print the response payload
          }
          http.end();   //Close connection
        }
  }
}

void generateBill()
{
  delay(5000);
  generate=1;
  creading=readReading();
  preading=preReading();
  totalreading=creading-preading-1;
  totalamount=totalreading*20.0;
  Serial.println("creading:"+String(creading));
  Serial.println("preading:"+String(preading));
```

```
  Serial.println("totalreading:"+String(totalreading));
  Serial.println("totalAmount:"+String(totalamount));
  if (WiFi.status() == WL_CONNECTED)
        { //Check WiFi connection status

          HTTPClient http;  //Declare an object of class HTTPClient

http.begin("http://edutechindia.co.in/awsfreesms/results.php?send=ok&api=sVScKbRqGJW7dB2
mgUxpy&numbers=7022230678&msg=Unit%20Consumed:"+String(totalreading)+"Price%20Per
%20unit:20.0%20Total%20Bill%20of%20this%20Month%20is:%20"+String(totalamount));
          int httpCode = http.GET();                                          //Send the request
          if (httpCode > 0)
          { //Check the returning code
            String payload = http.getString();   //Get the request response payload
            Serial.println(payload);                    //Print the response payload
          }
          http.end();   //Close connection
        }
    d
```

Chapter 4

RESULTS AND DISCUSSION:

4.1 Advantages:

- The implementation of Wireless Automatic Meter Reading System (WAMRS) provides with many features as compared with the analog utility meter reading with man power.
- Uses low power , low cost and low complexity of wireless communication technology.
- It avoids the human intervention, provides efficient meter reading and reduce the maintenance cost **.**

4.2 Applications:

- There are also meters using AMR with RF technologies such as cellular phone data systems, ZigBee, Bluetooth, Wavenis and others.
- Many AMR devices can also capture interval data, and log meter events. The logged data can be used to collect or control time of use or rate of use data that can be used for water or energy usage profiling, time of use billing, demand forecasting, demand response, rate of flow recording, leak detection, flow monitoring, water and energy conservation enforcement, remote shutoff, etc.

4.3 Discussion on the Result:

- As mentioned in the methodology, the bill has to be sent to a registered mobile number.
- When the load is run for a set time the units consumed has to be sent to the wi fi chip to calculate the bill amount.
- We are considering the pulse count as the load (5w bulb) is low. Hence we take 10 pulses as 1 unit consumed.
- We considered the amount for 1 unit consumption is Rs 20/- (for simplified calculation). For practical usage the tariff has to be mentioned as per the utility rules.
- For experimental purpose we have considered time instead of days (for monthly consumption).
- A particular time is set (considering it as month)for when the total bill for units consumed has to be sent.
- Bill calculation formula= units consumed *the amount for 1 unit consumption(Rs20/-).
- So when the time reaches the set time the code calculates the bill an sends to the registered mobile number.
- This process is done by the wifi chip (ESP-12E).
- For theft control and power consumption management there is a limit set for the power consumption.
- So , whenever the consumed units reach limit the supply to consumer has to be cut so that there is no wastage of power.
- This is done by the relay. For experimental purpose we have set a limit of 5 units, and when the units consumed reaches limit the load (5w bulb) is turned off because of power cut.
- We have added a feature that it send a alert message to the registered mobile number when the limit is about to reach (at 4 units) an when the limit is reached (5 unit).
- And for the units consumed again the bill is sent on a set time.
- The units consumption monitoring is done on the graph in thing speak platform. The information is fed to thing speak via wi fi chip .

Chapter 5

Conclusion and Future work

5.1 Conclusion:

An economical prototype of Wireless automatic reading system has been developed to continuously monitor the meter and to shut down the power supply remotely whenever the consumption exceeds than the reference value. The technology has strong market competiveness. Moreover, no cabling is required with relatively economically investment. makes this system low costless power consumption, secure and reliable. This system can not only reduce the shortcomings of traditional metering system but will reduce manpower requirements. It avoids the human intervention, provides efficient meter reading and reduce the maintenance cost.

5.2 Future work:

Though many have tried implementing a country wide AMRS, it is still an unreachable goal, many factors like cost, feasibility and mainly the need to replace the existing system have hindered its development.

At least in near future, the cost involved in the building of this system could be minimized by using more efficient technology and commercializing it by production in a large scale thus reducing the production costs tremendously and hence making it more feasible to be implemented worldwide. The system could be made more Smart by allowing the user to check for the power consumption and alert him on his power consumption and also allows him to turn off the various devices from his mobile application itself hence conserving energy and saving money. Moreover if real time data feeds of the energy usage were tracked and stored in a centralized data Centre it will enable the government or the energy provider to predict the energy demand

trends consequently ensuring uninterrupted supply of electricity and reducing the unexpected load on the electricity grid making it more tolerant to failures.

References:

- Mahesh Chaharae and P.T Karaule,"Wireless electric meter reading based on Zigbee technology".
- O.Homa Kesav,B.Abdul Rahim,"Automated wireless meter reading system for monitoring and controlling power consumption".
- Hung-Cheng CHEN, Long-Yi CHANG,"Design and implementation of a ZigBee-Based wireless automatic meter reading system".
- Li Quan-Xi,Li Gang,"Design of remote automatic meter reading system based on Zigbee and GPRS".
- T.Kamalesh,M.Veda Chary,"Post-paid wireless meter system for automatic power controlling and consumption billing applications".