

SMART METER READING MONITORING AND BILLING SYSTEM

**A Project submitted in partial fulfillment of the requirements for the
award of Bachelor of Science in Department of Electrical & Electronic
Engineering**

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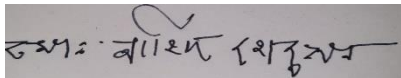
**Department of Electrical & Electronic Engineering
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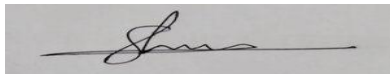
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This is to certify that this project and thesis entitled “**SMART METER READING MONITORING AND BILLING SYSTEM**” is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on September 2019.

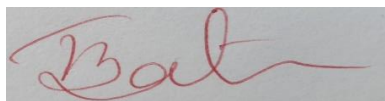
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Dedicated to

Our Parents

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Abstract

In this present era, the use of wireless automation in almost all the fields of power and the technology of electronic metering has gone through rapid technical growth developments. So in regards to that demand for a dependable and cost efficient automatic meter reading system has also increased. In present day Bangladesh an employee of Electricity board that is known as line man voyages house to house take the meter reading manually to prepare the bill. It is both time consuming and costly at the same time and the error rate is higher there are many incidents where a consumer is charged more then what he/she is used up and also the bill paying system is also very time consuming and painful . Although e-bill paying system is introduced in our country the use of this is very low among the masses.

The main objective of this project was to build a system that avoid the high production and maintenance costs in the existing meter reading technology. Smart meter will be connected to web server through Internet. Smart meter consist of Esp8266 microcontroller chip and to monitor a smart phone etc. The ESP8266 is used to send the meter reading to our web servers and our mobile app in which consumers can monitor their power usage, monthly bill and with the help of the app bill can also be paid. Also this system is theft proof.

CHAPTER 1

INTRODUCTION

1.1 Introduction

An energy meter is a device that calculate the amount of power consumed by a local residence, industry or an electrically power device. In the present system, a person from electrical distribution company has to go to each residence and industry to take the reading from each meter which is time consuming and also demands lot of manpower. The main intention of this project is to introduce and advanced electrical metering technology that can communicate wirelessly to selected servers update meter rating and bill in real time and will accessible to both party, means in this project the provider and consumer both can monitor the usage of power in real time and also consumer can pay the bill from anytime and anywhere.

Installation and development cost of this proposed system is lower than any other of its competitor system because of pre-installed meter a small chip is needed to adjusted with the meter and this system is ready to run which is far more better and cost efficient then installing new meters and develop new technology.

The proposed system is suitable for Industries, manufacturing plants, commercial buildings or any positions where electricity is consumed. Our energy meter monitoring system insures the federal energy monitoring and control. This Management System results in savings in the overall cost. These savings may be originated from many sectors like better deployment of manpower, overhauling cost, savings in the power consumption etc. This also ensures a non-breakdowns in system. The proposed smart energy meter comprises regular energy meter and a microcontroller (esp8266). The proposed smart energy meter is capable of providing all the metering and billing services like calculating the consumed energy, handover the generated bill as well as the security facilities. Truthfully at present-day, the metering and billing system of our country is totally conventional and it is very considerably slow, faulty and corrupted, so our proposed system deserves some consideration for national implementation.

1.2 Objective

The objective of this project is to design a meter rating monitoring system where a microcontroller nano chip is connected to a normal digital meter which will connect the energy meter to our servers. Which will erase the need of man power. ESC8266 chip which has built in wireless capabilities will update the meter rating to our servers in every 30seconds , so basically consumers can see there usage and reduce over consumption and wastage of energy also reduce the faults in our billing system by making it automated .

1.3 Application Of This Project

In our normal everyday life, some application of this project is stated below:

- I. Smart power consumption and power saving.
- II. Electronic bill payment system.
- III. Real time usage monitoring.
- IV. Theft protection.
- V. Fully digitized and embedded .
- VI. Low maintenance energy metering system.
- VII. Low cost smart energy meter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction:

The proposed idea of this project is useful for concept of digital Bangladesh. In the past study up till now, energy meter reader goes to every residence and takes reading by hand then issues the bill. But in this system, possibility of error happening is very high by not providing accurate meter rate, To overcome is problem smart monitoring and billing system is introduced also it can further be improved by implementing same technology on prepaid meter. But in that way consumer has to pay first to use power. Automatic metering monitoring s can provide data at real time, daily and monthly as requested. This is proposed for reducing the manpower, reading collection time, theft of electricity also avoids late bill payment. It is more efficient them conventional billing system.

There are many errors in conventional billing. There is a phrase “to err is human” means where there is system operated my humans there will be faults. Evaluating the conventional billing system some common errors are summarized below:

- i. It's a very time consuming process.
- ii. There is no way authenticate and verify the meter reading and also check the balance.
- iii. There always a chance of human error during rating collection procedure manually.
- iv. Chance of corruption and fault is very high.
- v. Requires extra man power.
- vi. Consumers and never notified about their usage.
- vii. Consumers may not receive there bill slip timely.

In the other hand, our smart meter is wirelessly connected to the supplier that ensures the accurate data reading all time so there is no need for anyone to take the reading. Smart meters can operate in many ways, including using wireless mobile phone to send data. Some benefit of smart meter is given below

- I. Our smart energy monitor system shows us how much energy we are consuming in money .that means you getting correct information of your usage by the minute. Knowing more about consumption we help us to use our power more efficiently
- II. Smart meter sends data about your consumption automatically, so the bills will be more accurate and no need to submit bills manually.

III. If the meter is needed to be replaced in some points of time smart meter reading auto synchronized with the servers.

The proposed system consists of an energy meter and a micro controller connected by an Optocoupler. The usage of power is displayed in the LCD display of the meter and also it is updated in the servers and the app .when 0.005kwh power is consumed and the indicating led blink once, optocoupler send that reading to ESP8266 and it calculate the bill and update it to server and app. Unit's price can be adjusted by supplier very easily in the server.

2.2 Block Diagram.

Our smart metering system is embedded automated version of conventional metering system. Normal energy meter is connected to ESP8266 which is connected to server and app and thus it makes a cycle. Energy consumption is calculated by the meter and with the help of Optocoupler Esp8266 updates the rating first to the server, servers calculates the bill and send back the data to the microcontroller then it updates the bills and units to the app for the consumers to see.

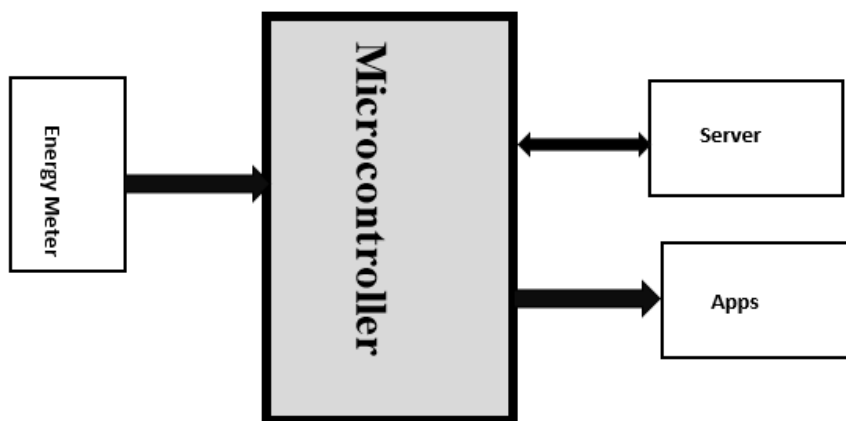


Fig 2.2 BLOCK DIAGRAM

2.3 Circuit Diagram.

Circuit diagram of our project is relatively easy .It is given below power source coming from energy meter is connected to Vcc and Gnd pins of Esp8266 and data line is connected to Gpio pin.

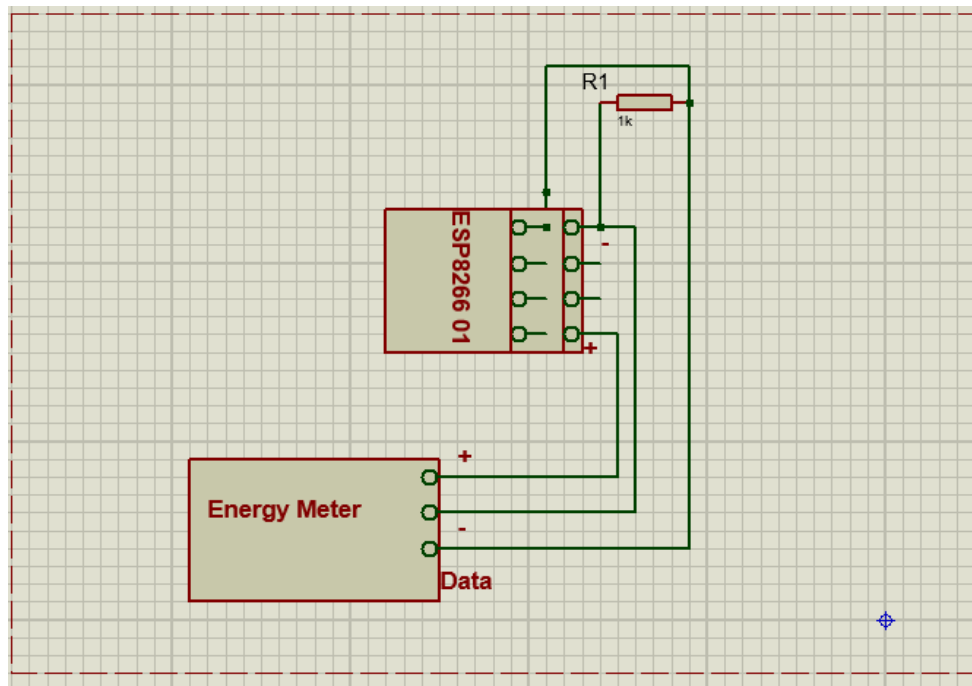


FIG 2.3 CIRCUIT DIAGRAM

2.4 Hardware Requirements.

In this sections we discuss about the hardware require to complete this project.

- I. ESP8266
 - II. Digital energy meter
 - III. Battery 3.7v
 - IV. Mobile phone.
- (For additional purpose)
- V. Lights
 - VI. Switch
 - VII. Wires
 - VIII. Circuit board.

2.5: Over View Of Hardware Used:

In this section we will learn more about the hardware we used in our project their internal structure and also the reason for selecting them.

2.5.1: ESP8226

Esp8266 is a low cost microcontroller chip with built in Wi-Fi capabilities reason for us to select this chip over other micro controller like Arduino because of this smaller footprint and low cost and also its higher and more accurate data transfer capabilities



FIG 2.5.1: ESP8226

The ESP8266 chip holds built in SOC with included TCP/IP protocol stack that easily can give any microcontroller easy access to any selected network. It's capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Every esp8266 chip comes pre-loaded with an AT command set firmware which means, we can connect it to any device and get easy access to the internet. Its Wi-Fi module is relatively new than its competitor chips but it is gaining more and more recognition due its capabilities and low cost properties .

2.5.1.1 Pinout

- I. VCC (The power input pin it can take up to 3.3v to 3.6v voltage larger then that will damage the chip)
- II. GND(The ground pin of the micro controller)
- III. TX(Also known as data transfer pin it transmit data wirelessly)
- IV. RX(Also known as receiver pin receives data)
- V. RST(Rest pin of the microcontroller)
- VI. RST(Rest pin of the microcontroller)
- VII. GPIO.2(General purpose input pin 1)
- VIII. GPIO.0(General purpose input pin 00)
- IX. CHPD (Power down pin).

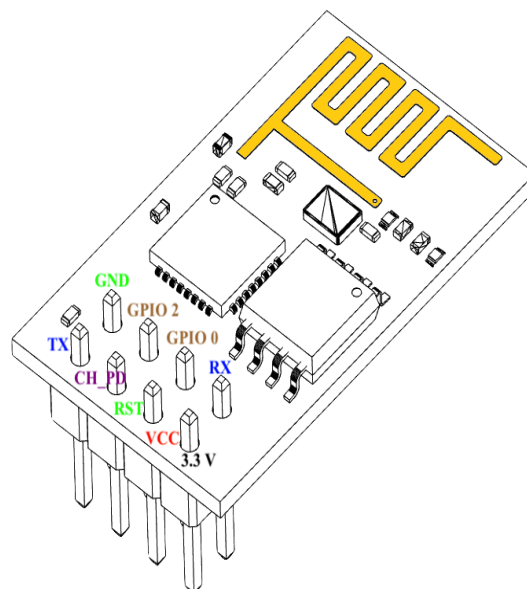


FIG 2.5.1.1 Pinout

2.5.2: Digital Energy Meter

An energy meter is a device that calculate the amount of electrical energy used by a household or a business or an electrically driven device. It is installed at consumer's locations for bill calculating purpose. Electrical energy meter basically calculate bills in per unit, per unit typically consists of 1kilowatt hour (kWh). Each unit read once in per billing period .Some digital energy meter is able to calculate maximum demand rate. "Time of day" metering allows electric charges to be reformed throughout a day, to record usage throughout peak high-cost

phases and off-peak, lower-cost, phases. Also some more advance meter contains relays which can cause controlled load shading during peak load period.



FIG 2.5.2: DIGITAL ENERGY METER

2.5.3 Battery

A battery is a device containing of one or more electrochemical cells with external connections which provide power to electronics devices. A battery has to 2 polar opposite sides, positive side is known as cathode negative side is known as anode. For our project we used 3.3V dc battery to power our micro-controller.



FIG 2.5.3 BATTERY

2.5.4 Smart Phones

Smart phones are branch of mobile or cell phones that are multipurpose computing device. In our project smart phone is used as output showing device from which consumers can control and monitor there meter.

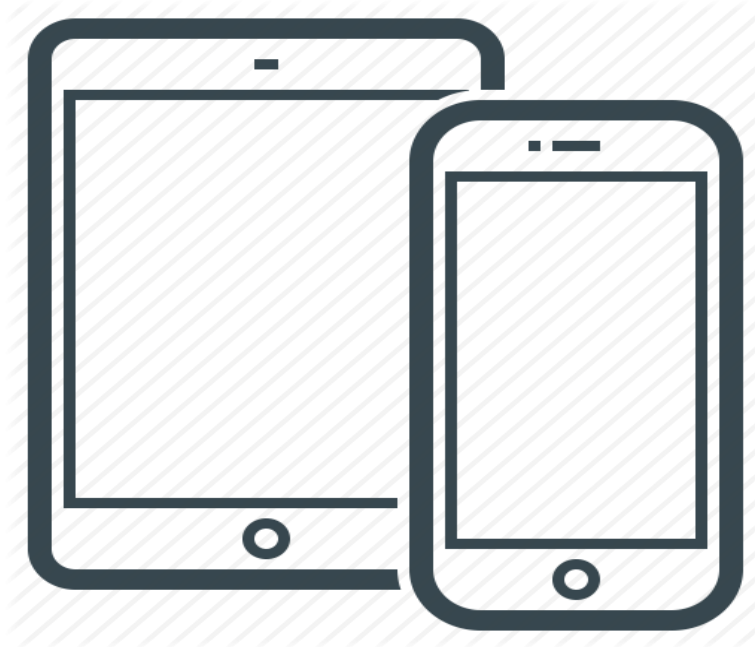


FIG 2.5.4 SMART PHONE

2.5.5 Lights

An light bulb, is an electric light which have a wire filament heated to such an extraordinary temperature that it luminosities with noticeable light. The filament is secured from oxidation by a glass or merged quartz bulb that is occupied with inert gas or a vacuum.

The light bulb is provided with electric current through terminals or wires implanted in the glass. Most bulbs are used in a socket which delivers mechanical support and electrical connections.



FIG 2.5.5 LIGHTS

2.5.6 Switch

An electronic switch is a device that is used to interrupt the flow of electricity, it is used to close or open the circuit.



FIG 2.5.6 SWITCH

2.5.7 Plug

Electrical plugs connect the electrical components to the AC power supply in a building and other sites. A plug might be two pin or three depending on the socket.



FIG 2.5.7 PLUG

2.5.8 Circuit Board

A circuit board supports and electrically attaches electronic components or electrical components using conductive paths, pads and other features imprinted from one or more sheet coatings of copper layered onto and/or among sheet coatings of a non-conductive substrate. Components are usually soldered onto the CB to both electrically connect and mechanically attach them to it. Circuit boards are used in all but the modest electronic products. They are also used in some electrical products, as like switch boxes.

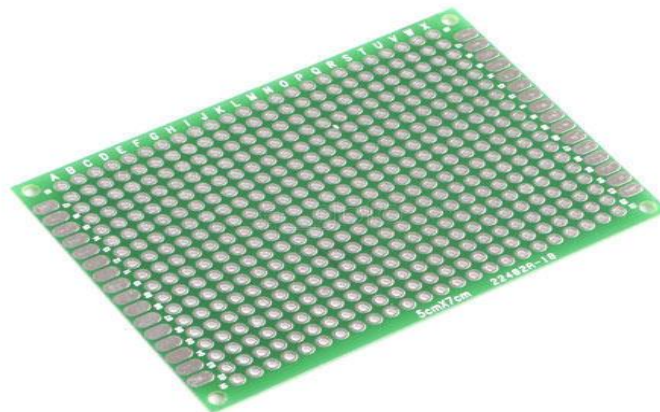


FIG 2.5.8 CIRCUIT BOARD

2.5.9 Jumper Wires

A jumper wire is an electrical wire, or group of them in a cable, which has a pin on there each end jumper wires usually used for testing and making prototype project. Singular jump wires are fixed, by implanting their "end connectors" into the openings provided in a breadboard, or a piece of test apparatus.



FIG2.5.9 JUMER WIRES

CHAPTER 3

COMPUTER PROGRAMMING CODE

3.1: Code

Source code for our project

```
#include <FirebaseArduino.h>
#define FIREBASE_HOST ""
#define FIREBASE_AUTH "jEPDhlUUPQTElyouJeRfFx1e1uAtId6BRj9UySJP"
#define WIFI_SSID "nahid"
#define WIFI_PASSWORD "nahid@12345"
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

int k;
float Unit=0;
float Bill;
floatAmps,Price;
charauth[] = "ztxcwx8O4UYEFWSi7_omAnY3PZC9G6JE";
charssid[] = "DCL";
char pass[] = "dcl@12345";
WidgetLCDlcd(V0);
int data ,datap;
void setup()
{
  Serial.begin(9600);
  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  Serial.print("connecting");
  while (WiFi.status() != WL_CONNECTED) {
    Serial.print(".");
    delay(500);
  }
  Serial.println();
```

```

Serial.print("connected: ");
Serial.println(WiFi.localIP());
Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);
Blynk.begin(auth, ssid, pass);
lcd.clear(); //Use it to clear the LCD Widget
lcd.print(0, 0, "Voltage:"); // use: (position X: 0-15, position Y: 0-1, "Message you want to
print")
while(Unit<=1)
{
  Unit=Firebase.getInt("Nahid/Unit");
  Price=Firebase.getInt("Nahid/Price");
  Serial.println("loop ok");
  Serial.println(Unit);
  Serial.println(Price)

}
}
void loop()
{
  ReadData();
}
void ReadData()
{
  data=digitalRead(0);
  if(data>datap)
  {
    Unit+=.0025;
    Bill=Unit*Price;
  }
  datap=data;
  Display();
  SendData();
}
}

```

```

void Display()
{
Blynk.virtualWrite(V1, Unit);
Blynk.virtualWrite(V2, Bill);
Blynk.virtualWrite(V3,Amps);
}

void sendData()
{
Firebase.setInt("Nahid/Bill",Bill);
Firebase.setInt("Nahid/Unit",Unit);
}

```

3.2 Software Used

3.2.1 Firebase

Firebase is a mobile and web application development platform owned by google. As of 2019 it has 18 products which is used by 1.8 million apps. Firebase provides a real-time database and backend as a service. The service provides application developers an API that allows application data to be harmonized across clients and stored on Firebase's cloud. The company provides client libraries that enable with Android iOS and other application. Developers using the simultaneous database can secure their data by using the company's server-side-enforced security rules .Also, Firebase Storage gives us the option of secure file uploads and downloads for Firebase apps. The developer can use it to store images, audio, video, or other user-generated content. Firebase Storage is backed by google is self so, without any doubt it could be said that for a concept like our proposed system firebase is the best option because of its free real time database and storage options.



3.2.2 Blynk

Blynk is a platform that lets us quickly build interfaces for supervising and monitoring our hardware projects from our iOS and Android device. After downloading the Blynk app, anyone can make a project control panel and assemble buttons, sliders, and charts. We can use the button for controlling our project like on and off switch or display ta sensor data.

In most of the cases building the hardware version of our project is easy, but building the software interface is still problematic. But With Blynk, though, the software side is even easier than the hardware. So we find out that blynk is the most suitable software for us to easily showcase our vision and our projects output.



3.2.3 Arduino Ide

It is an open source software which is needed to upload codes to any Arduino or Esp micro controller boards.



CHAPTER 4

RESULT AND DISCUSSIONS

4.1 Introduction

Main purpose of our project was to take the meter reading and deliver it to user's smart phones. we have succeeded in doing that our chip delivers the data in real time but sometimes there is a 30 sec delay because of network issues and also sometimes due to not having a proper server and app. Though the delay time so little which is hardly noticeable. The delay can be easily fixed with proper dedicated servers and proper connection of the internet.

If we consider 1 unit or 1kwh costs us 20tk and by the time of our test it should be noted that price can be change by updated any time by the provider and database will auto sync with it.

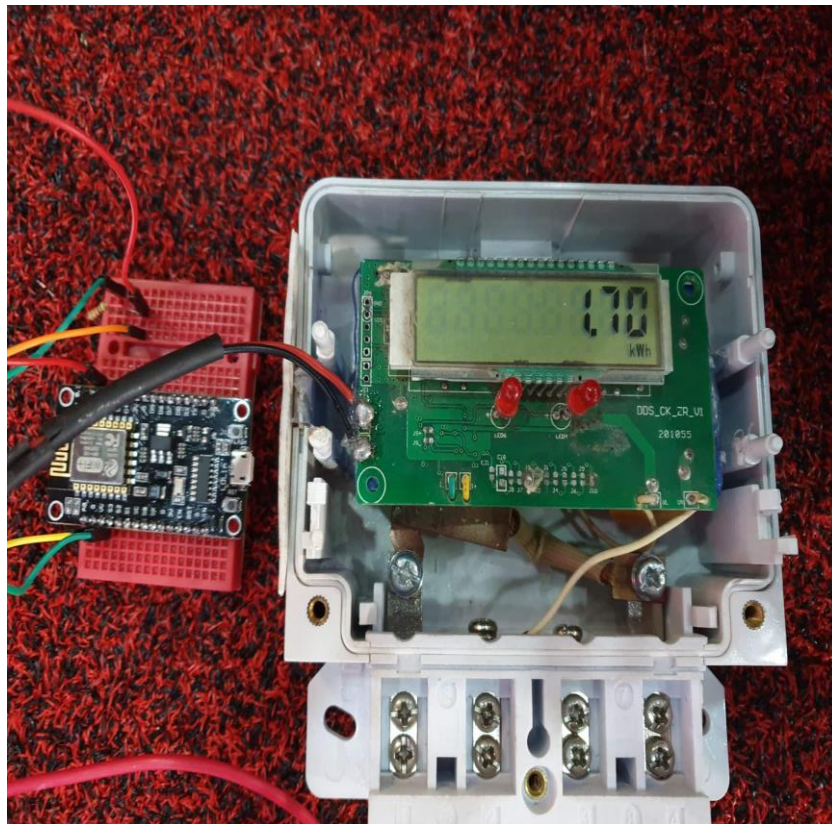


FIG 4.1 ACTUAL PROJECT

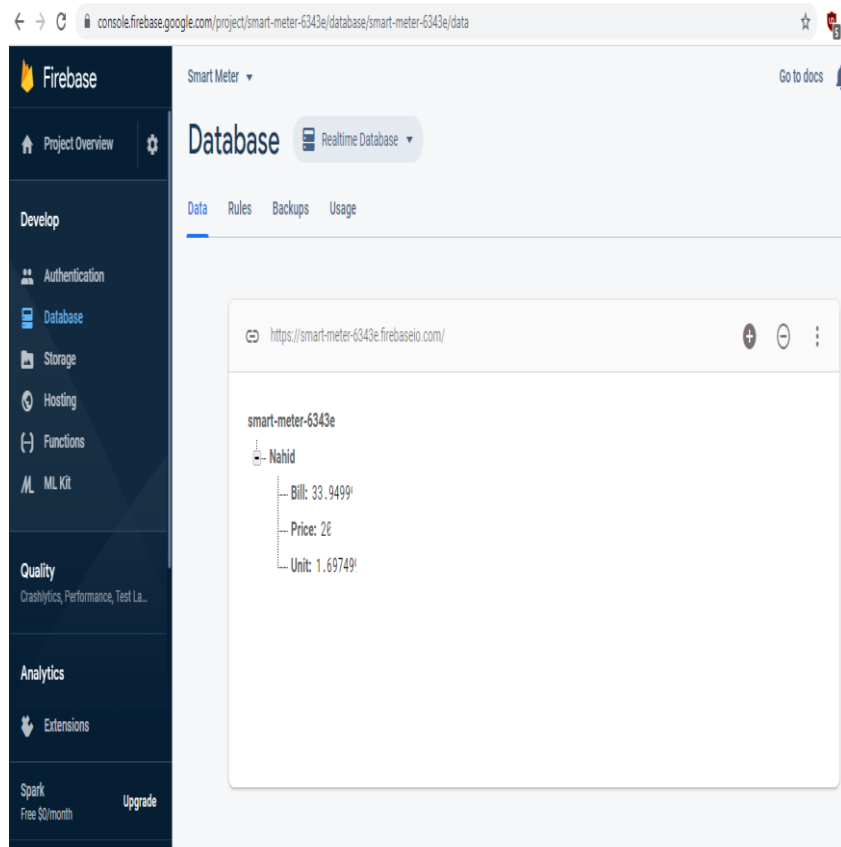


FIG 4.2 DATABASE



FIG 4.3 APP

4.2 Problem and Drawbacks:

- I. Main problem faced on our project was lack of proper resources and lack of info regarding meter technology.
- II. Our micro controller needs internet connection although it needs a small amount but it needs it constantly, so we need to provide external internet connection.
- III. Lack of proper app and servers to use.

4.3 Cost

Cost of our project:

NAME	COST
Energy Meter	900tk
Esp8266	300tk
Plug	15tk
Socket	15tk
Blub	50tk
Wires	50tk
Circuit board	10tk
Total cost	1340tk

CHAPTER 5

CONCLUSION

5.1 Conclusion

Our system will deliver safe and cost efficient method for electricity calculations. The present meter reading procedure is manual which demands man power higher labor rate and is not cost and time efficient. But our proposed system will eliminate all of that cons. This system monitors rate of consumption of electricity so chance of stealing and fraud is next to none also if our chip got disconnected from the meter it will alert the respected power distribution company . It is our thought that our proposed system will provide the smart and safe infrastructure and a smart digitalized metering and billing system.

5.2 Future Scope

Our system is just in its prototype face and it need lots of worked we have planned some out and after using sometimes more things can be added

- I. Install a relay system to auto disconnect the power is bill is due.
- II. Improve app and server make it more accessible for everyone.
- III. Give the devise its internal internet connection.
- IV. Make it compatible with prepaid meters.

References

[1]<https://en.wikipedia.org/wiki/esp8266>

[2] Swati Khokale, Patil Kaveri, Patil Nikita Smart Meter Billing and Power Consumption Monitoring System using Arduino Microcontroller.

