IoT based Smart Energy Meter and Management System

Gargi Chauhan[1,*] , Sohail Ahmed[2], Himangshu Khound[3] , Saurabh M patel[4] ,Priyanka Shah[5], Parita Parikh[6]

[1,5,6]Assistant Professor, Information Technology Department, SVIT,Vasad, Gujarat, INDIA
[2,3] UG Students, SVIT, Vasad, Gujarat, INDIA

[4]Assistant Professor, E&C Engineering, SVIT,Vasad , Gujarat, INDIA

Gargi Chauhan

Sohail Ahmed

Himangshu Khound

Saurabh M patel

Priyanka Shah

Parita Parikh

Abstract. As the vitality request is expanding day-to-day agreeing to the increment in populace and mechanical development, there are need of specialized information in the case of observing and controlling of vitality utilizations. Customary vitality meters which utilize to degree vitality utilization in the families are offline gadgets. Readings are taken physically from the gadgets. While the Smart vitality meter can overcome such circumstances. Proposed framework utilizing IoT makes a difference individuals to take the readings from any place in the world. Along with vitality utilization it will moreover donate subtle elements of parameters such as voltage, current, control, vitality and recurrence. Hence we can accomplish a idealize stack administration. The framework will offer assistance the clients to select their possess duty on the premise of their utilize. The PZEM-004T sensor is utilized to degree the parameters and Node MCU will post this collected information to server. Client can control and screen the framework by utilizing portable application and web application.

Keywords: IoT; Smart Energy Meter; Blynk, Arduino; PZEM 004-T

1. Introduction

Electricity has ended up one of the essential necessities of people. It is utilized for residential, mechanical, and agrarian purposes. The existing meter framework is time consuming, so IoT based smart vitality meters can be utilized to overcome the existing issues such as decreasing man control, vitality observing, stack administration, control robbery etc.[1] Smart meters are the same as typical meters, but it is an progressed innovation for perusing, charging, and controlling the vitality utilization, as it screens the framework exceptionally rapidly and gives genuine time information to the clients. [2]It too collects control blackouts from loads and communicates this data to the client. The fundamental advantage of the shrewd meter is that it does not require numerous components to take the readings as shrewd meter sensor itself will donate all the diverse parameters readings. The meter takes the perusing and sends the point by point data to the client remotely.[3] Savvy meter moreover permits exchanging on/off loads remotely with the offer assistance of IoT. The objective of proposed framework is to screen the vitality utilization, controls the loads and oversees them in like manner so that the clients can overcome the tall charge sum. PZEM-004-T sensor can degree voltage, current, control, control calculate, vitality utilization and recurrence.[4,5] The collected information gets sent to server by NodeMCU. Client can moreover control transfer physically with the offer assistance of web/android application. Fig 1. shows traditional metering and smart metering system.

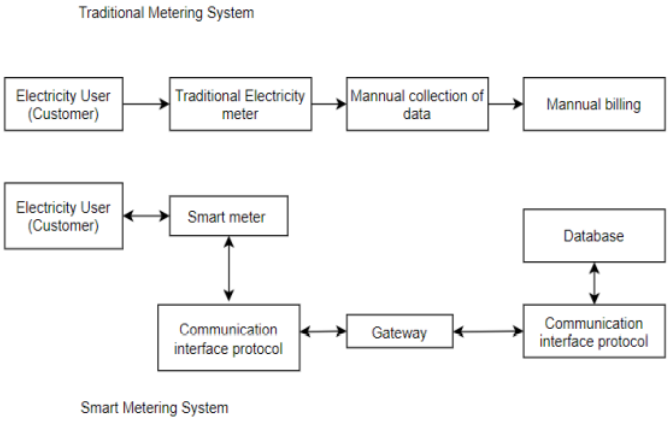


Fig. 1. Traditional and smart metering system

2. Theoretical Framework & Design Consideration

The system an integrated Internet of Things architecture for smart meter networks, it discusses the communication protocol, the data format, the data gathering procedure, and the decision system based on big data treatment. Real-time measurements show the benefits of the proposed IoT architecture for both the customers and the utilities.[6] Fig 2 shows the flow of system for smart meter is designed which is embedded with microcontroller, PZEM 004T sensor and relay.

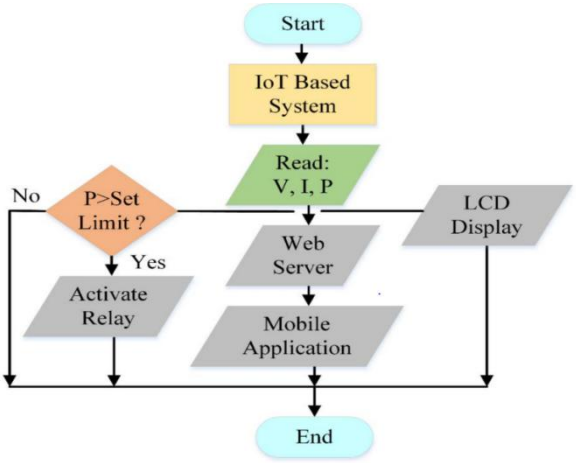


Fig.2. System Flow

We started the initial Implementation by thorough research of the topic i.e."IOT Based Smart energy Meter and Management System". We researched about the various components that are mentioned in the paper. Considering the important factors like estimation and compatibility of the components we identified the alternative hardware components for the proposed system.

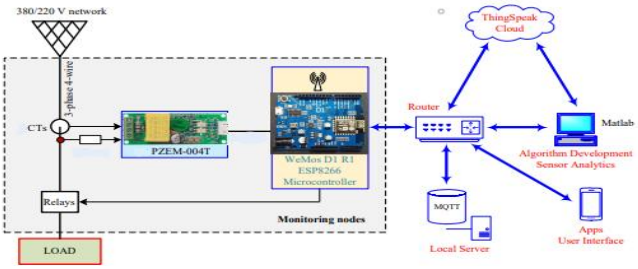


Fig.3. System Design

Fig 3. Shows system design for proposed system. The main component that we have used in our system is ESP 8266 microcontroller, since our system included integration of hardware components rather than more instructions processing wherein the ESP 8266 acts as minicomputer and majorly focuses on processing instructions. Due to similar functionality of both the components we have selected ESP 8266 which is more affordable.[7] Table 1 describes the components of the system.

Table.1. List of components

	Components	Purpose
1.	ESP8266	Controllingl,measurement,communication, data logging
2.	PZEM-004T	Measurement of the electrical appliances
3.	Wiring	To connect the devices
4.	Relay	To power on/off the socket
5.	LCD Screen	To display the readings

3. System Design

The system consists of three sub systems related to voltage reading, current reading and display and sending of data. Now we discuss each of this in detail. The fig 4 describes the circuit diagram of proposed system.

3.1. subsystem 1

Voltage reading: -

Securing the voltage reading is the to begin with step in building a essential control meter. In

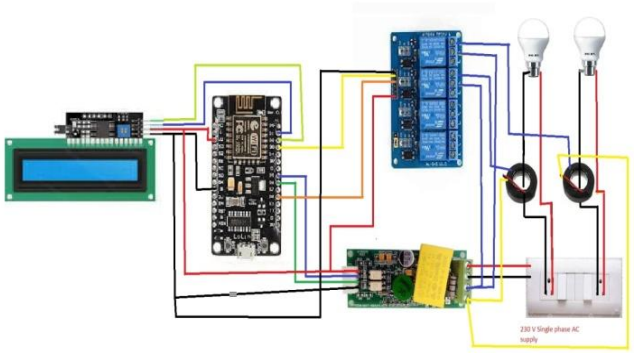


Fig.4. Circuit Diagram

any case, a few of the control meters that we came over, amid the investigate organize, did not counsel to utilize voltage reading, instep, they as it were preset a particular voltage level that will be consistent all through the entirety handle of calculation. Indeed in spite of the fact that this step would be exceptionally critical in sparing time and endeavors in both usage and calibration stages, we chose not to utilize it in our plan for a few precision reasons. In addition we came over a few plans that exhorted the utilize of control connector as voltage transformer as we expressed prior, in arrange to calculate the control in the ESP 8266 microcontroller, both current and voltage readings must be gotten already.[8]

3.2 subsystem 2

Current reading: -

Including a predisposition to the current flag utilizing a voltage source made by voltage divider associated over the ESP 8266 Microcontroller's control supply since ESP 8266 Microcontroller as it were acknowledges the positive values.

Amid the investigate organize we came over different of strategies that is utilized to get the current values. One of which was utilizing current tranducer[9]. This choice was not exceptionally ideal since it required control supply as well as its center was not of the part sort that would make the association simpler. Table 2. Provides the list of commands for reading the measurement variables from PZEM-004T.

3.3 subsystem 3

Initial Web Page: -

By Integrating the Python code with the ThingSpeak Cloud [10]. We have created a web based dashboard using python, and a module named plotly dash, which is used to create the dashboard.

Table.2. The commands for reading the measurement variables from PZEM-004T

Syntax	Function
PZEM_SENSOR_ANALYSIS (String load)	Get data from PZEM-004T
voltage = pzem.voltage()	Read voltage data from PZEM-004T and then set to the voltage variable
frequency = pzem.frequency()	Read frequency data from PZEM-004T and then set to freq variable
power = pzem.power()	Read active power data from PZEM-004T and then set to power variable
energy = pzem.energy()	Read energy consumption data from PZEM-004T and then set to energy variable
pf = pzem.pf();	Read power factor data from PZEM-004T and then set to pf variable
current = pzem.current()	Read current data from PZEM-004T and then set to the current variable

To generate results different files are created. The data.py is used to get data from the ThingSpeak cloud to the code, result.py file to create various charts and graphs that is displayed in the dashboard, and dash.py file to define the whole structure of the dashboard. Table 3 provides command to read data from thinkspeak.[11]

Table 3. The syntax of ThingSpeak read command

Syntax	Function
Data= thingSpeakRead(channelID)	This command reads the most recent data from all of the fields of the specified public channel on ThingSpeak.com and returns the data as a numeric type

4. Result

The proposed demonstrate has been tried with a few electrical apparatuses. Reason of testing was to assess the exactness of the planned framework.

The chosen electrical devices were tried for a few periods amid which the voltage, current, and control utilization were recorded . The working voltage for all of the tried apparatuses was kept inside the extend 220 V to 240 V. The estimation is appeared in the Table 4.

Table 4. Estimation

Appliances	Rating	Measured value
Bulb 1	9 W	8.3 W
Bulb 2	7W	6.7 W
Laptop adaptor	50W	47 W

The outcomes about are appeared in Thingspeak, web application Blynk portable application and on LCD show. Add up to six field information have been proposed in the ThingSpeak channel in Fig 5. This incorporates: Voltage (field 1), Current (field 2), Control (field 3), Vitality (field4), Voltage Gage (field 5), and Current Gage (field 6). The channel status as appeared in the web server was collected and put away in the cloud. The channel was overhauled each miniature to show each of the over six areas graphically in ThingSpeak.

Additionally, in arrange to encourage a user-friendly interface, a Blynk application [12] has been utilized and the values of the comes about are shown through LCD screen covered in Fig 6 and Fig 7. These comes about illustrate the adequacy of the proposed strategy which is simple to actualize for existing family frameworks. Fig 8 and 9 provides results for output.

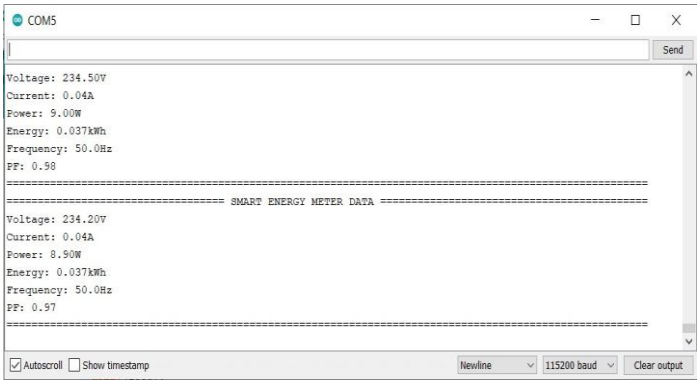


Fig.5. Serial Monitor Reading

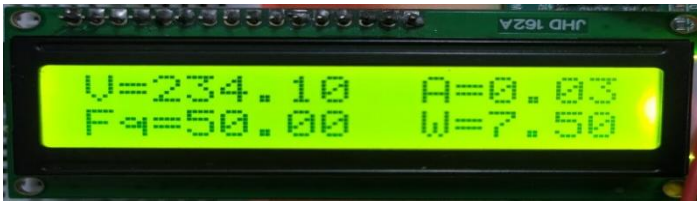


Fig.6. LCD Display Reading

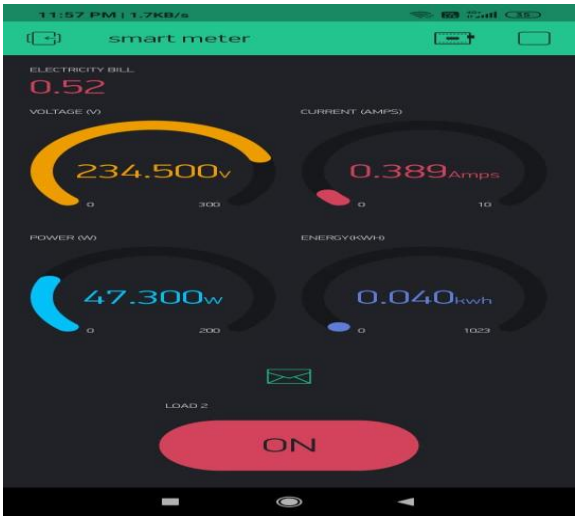
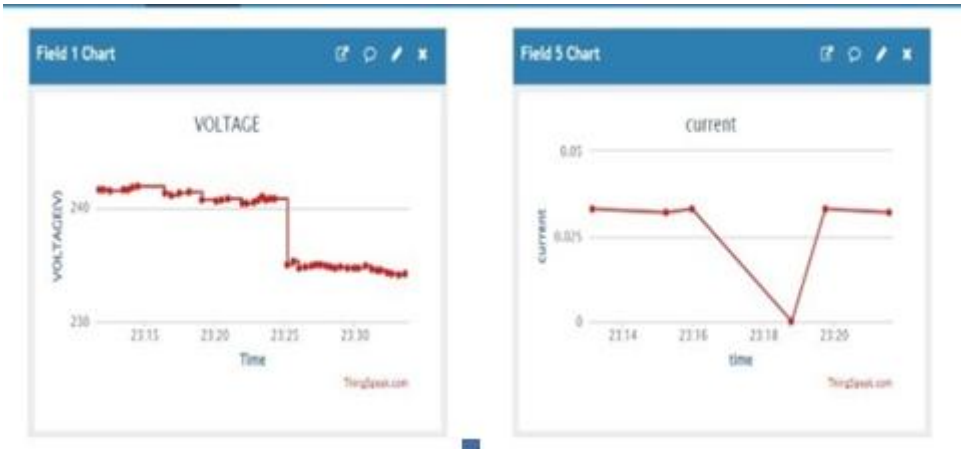


Fig.7. Readings from Mobile Application



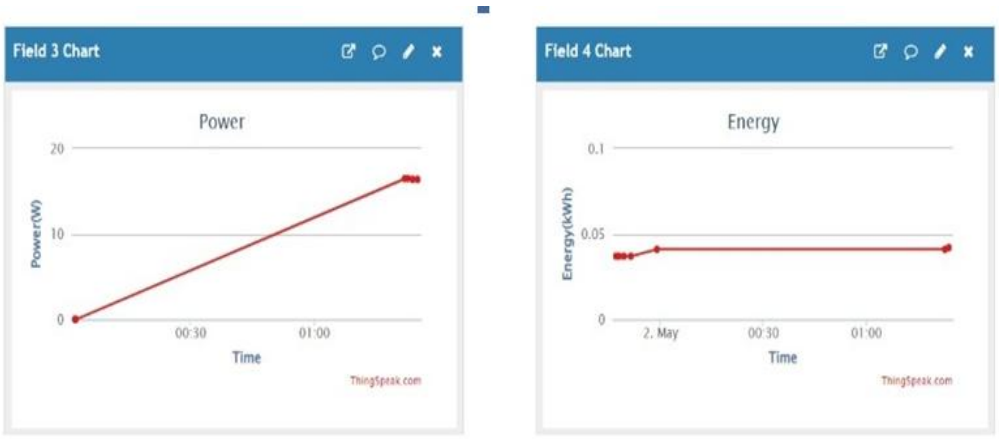


Fig.8. ThingSpeak Readings

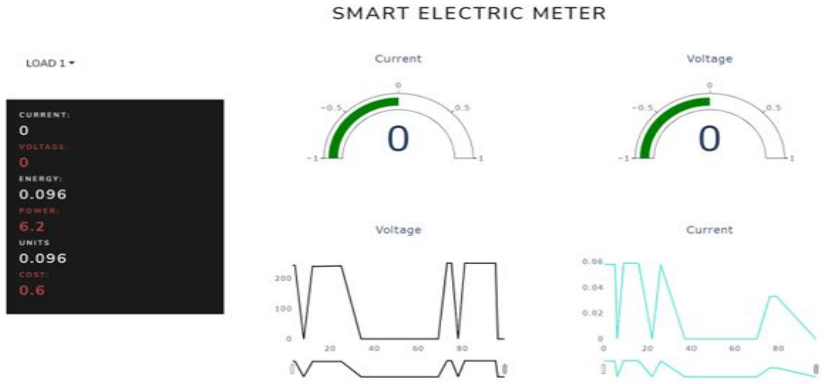


Fig.9. Web Dashboard Reading

5 CONCLUSION

The proposed frameworks concentrate on controlling vitality, burglary, domestic automations, diminishing man control, moderate vitality subsequently lessening the charge sum by legitimate stack administration and by deciding our claim tax. We can decide the piece, agreeing to our budget and the sum of vitality required, and the parameters can be checked and recorded over long periods and put away for assist purposes.

In future, the framework might be assist created to get more understanding on vitality utilization profile and learn to naturally distinguish which apparatus is in utilize by utilizing fake insights and machine learning methods.

Conflict of interest

There is no conflict of interest.

- Competing Interests - Not Applicable
- Funding Information - Not Applicable
- Author contribution - Not Applicable
- Data Availability Statement - Not Applicable
- Research Involving Human and /or Animals - Not Applicable
- Informed Consent - Not Applicable

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