



ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 9, Issue 2, February 2020

IOT Based Power Consumption Monitoring and Automation System Using Labview

Saran Kumar.R.S¹, Srevignesh.S², Vijay.S³, Sivaraman.M⁴ and T.Tamilarasan⁵

UG Final year student, Department of Instrumentation and Control Engineering, Saranathan College of Engineering,
Trichy, Tamilnadu, India ^{1 2 3 4}

Assistant Professor, Department of Instrumentation and Control Engineering, Saranathan College of Engineering,
Trichy, Tamilnadu, India ⁵

ABSTRACT: Power Consumption Monitoring is a system where the power consumed by user in the home is calculated and alert messages are sent to the user prior to a point after which the cost per unit increases. Through this system the cost paid for electricity can be reduced to greater extent. Total power consumed is calculated and user can view the information and also receive notifications through IoT. The Automation system is one that turns off the electrical appliances in the home if there is no presence any person. The IoT enables the user to turn on or off the electrical appliances remotely also.

KEYWORDS: Live Power Consumption Monitoring System, SMS and E-mail Alert System, NI LabVIEW, NI MyRio, IoT, IBM Watson Bluemix, AWS

I. INTRODUCTION

Energy is one of the major demands in this technological world. There are many ways through which energy can be produced or harnessed, but still the required energy demand could not be met. This is due to human's ineffective use of electricity.

So this paper suggests an effective way for monitoring the power consumed by the user because, monitoring the power consumed by the user would provide them a knowledge about how much power they have consumed and the cost estimated for it. With these information the user can make plans or steps to reduce the amount of power they consume and reduce the cost too, which will help the user to save money. So all the information of the total power consumed and its estimated cost can be viewed by the user in their mobile phones and computers. Through IoT.

The cloud services that are used for performing IoT applications are IBM and AWS as they are providing a base for students to work on IoT and also provide easy modification of the devices connected to it. We are using IBM IoT service to display the cost and amount of units consumed. This can be viewed by the consumer in mobile phones and computers. Then the AWS IoT service is used to provide alerts to the user. The alerts are sent as notifications through SMS and Email to the user.

Another main part of the paper is Automation of home electrical appliances. This is done using PIR sensor which detects the presence of any human and accordingly turns on/off the electrical appliances. This is also a solution for reduced the power consumption and the cost to a greater extent. This paper provides a methodology which makes use of myRIO-1900 of National Instruments to be acting as stand – alone system for performing power and rate calculations and also to publish these calculated values in the IoT. The Current and Voltage values are obtained from the sensors and the power consumed with its estimated cost is calculated. They are published in the IBM IoT which can be viewed



International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 9, Issue 2, February 2020

by the user and the Alert system is designed using the AWS IoT. The Automation part is also done in IoT with the help of PIR sensor.

II. LITERATURE SURVEY

Normally, the power consumption is measured by using conventional energy meters and digital energy meters are used, for measuring the live power consumption an alternative way is needed, which is done by using separate sensors for measuring current and voltage, the approach taken by [1] is similar but the way of indicating the output is like a digital energy meter, but [2] has done a different way of showing the output in a virtual machine which will run in a cloud of a particular platform, for measuring voltage the ZMPT101B voltage sensor is used, a research has been done by [3] for accurately calibrating the sensor, [5-9] has done the method of monitoring the live power usage via IoT which is for OFF-Grid households, whereas the [6] has designed a wireless energy meter which the power usage is monitored via IoT platform, to control power usage and save the electric city the automation is needed, [4-7] has implemented automation in home for multiple purposes where [8] has implemented the IoT control of individual home appliances by which it can be turned ON/OFF.

This paper proposes the design of wireless energy meter and control of the main supply by which the total power is turned ON/OFF via IoT which also overridden by a pushbutton, the automation of home appliances(Fan, Light etc..) is done by finding the presence of humans in each room with the help of PIR sensor.

III. MAIN DESIGN OF THE PAPER

According to Tamil Nadu Electricity board they have a separate tariff plan for the Electricity billing. So with this tariff plan a Slab table is prepared consisting of the amount of energy consumed and cost for the consumed power. This cost factor varies according to the units consumed by the user. The below table (Fig 2) shows the divisions of slabs based on the tariffs. This paper uses this Slab table for performing the power and rate calculations.

Slab	Units consumed	Cost per Unit in rupees
Slab 1 (<100units)	0 - 100	0
Slab 2 (<200units)	0 - 100 101 - 200	0 1.5
Slab 3 (<500 units)	0 - 100 101 - 200 201 - 500	0 2 3
Slab 4 (>500 units)	0 - 100 101 - 200 201 - 500 > 500	0 3.5 4.6 6.6

Figure: 2 Tariff Slab Table

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 9, Issue 2, February 2020

A simple method to calculate the power consumed by the electrical appliances is by calculating the amount of power consumed for a particular time interval. The power is calculated by finding the value of voltage and current flowing through the wire and multiplying both these values as per the formula $V \cdot I$, as power depends on both current and voltage flowing through the wire.

Then this calculated power value is given as input to the MyRio for further processing. A LabVIEW program to calculate the amount of power consumed and total cost is done in MyRio. This final calculated values are sent to the user using IoT. The IoT server used for displaying these values is IBM IoT platform. The IBM Watson is a free platform for students to work on their projects and researches.

Now with the calculated cost for the consumed power, these values are compared with the Slab table and a SMS notification and EMAIL is sent to the user 50 units before reaching the next Slab. This helps the user to cautiously consume the power in order to reduce the cost in electricity bill.

The fig 2 shows the block diagram of the system. The NI Myrio acts as the heart of the system, which accepts all the inputs process them give the required output. It is the processor that calculates the total power consumed by using the current and voltage values which are obtained from the sensor. Then this Myrio acts as a bridge way for connecting the hardware with the IoT. A LabVIEW code is written in the Myrio for performing all the required tasks of calculating the power consumed, estimate its cost and finally to display the information to the user. The Alert system is the one which notifies the user whenever the power consumed is about to reach the next slab through SMS and E-mail. With this system the user can cautiously consume the electricity thereby reducing the electricity bill and conserve electricity.

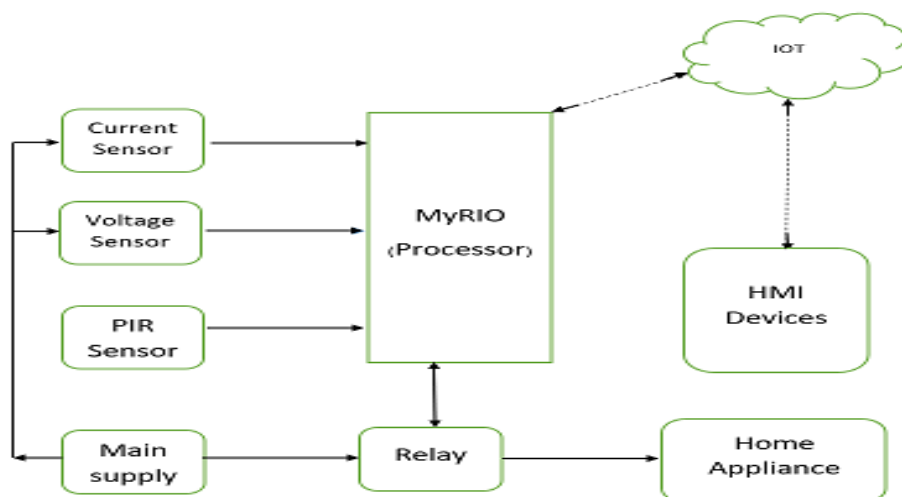


Figure: 3 Block Diagram of Energy Monitoring system

The second major part of the paper is the Automation of electrical appliances with the help of PIR sensor using IoT. The PIR sensor is used detect the presence of any human and if there is nobody present in the room then all the electrical appliances are turned OFF. This may also help the consumer to reduce their electricity bill very much. This system help the user very much if the user have forgot to turn OFF the lights and fan in the room when they go out. The

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 9, Issue 2, February 2020

user need not worry thinking about that if they have turned OFF all the electrical appliances because it may cost them more. And the user can also turn ON or OFF their electrical appliances through IoT.

IV. PROPOSED METHODOLOGY AND DISCUSSION

The fig 4 gives the overall schematic representation of the methodology used in this paper. This diagram shows all the inputs and outputs present in the system that are used to perform the calculations and other tasks. The NI MyRio is main part of the whole system where all the computation and processing works takes place. The MyRio is a product of National Instruments which can be used for both industrial and commercial applications. Myrio 1900 configuration is used in this paper and the inputs, outputs are obtained from the ports present in the Myrio. The Power calculation is done programmatically in the Myrio by getting the current and voltage values from the connected sensors. The ACS712 Current sensor is used to obtain the current flowing through main supply line. This ACS712 Hall effect based current sensor that is capable of measuring current values upto 30A. It has a sensitivity of upto 66 mA. The Voltage is measured using the ZMP101B voltage sensor which can measure voltage levels upto 250v. The voltage sensor can calibrated according to the user's requirement.

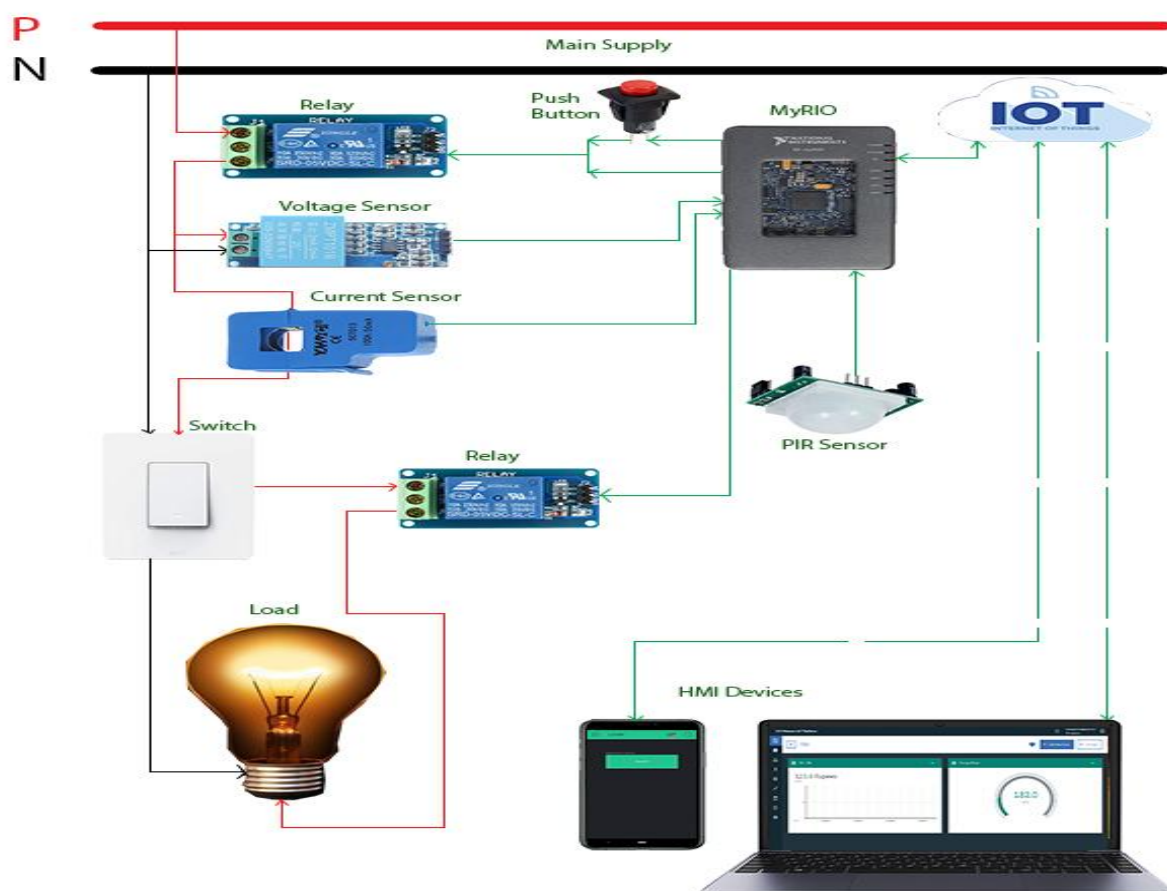


Figure: 4 Schematic diagram of the Home Automation system



ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 9, Issue 2, February 2020

IoT part is done for the user to view the total power consumed, estimated cost for the consumed power and also for the SMS, E-mail Alert system. The IBM Watson Bluemix is a free IoT service provided by the IBM for everybody to work on IoT projects. With the help of IBM IoT service the power consumed with its cost can be viewed by the user in their mobile and computers. For the Alert system AWS (Amazon Web Service) a free IoT service provided by the Amazon is used. With AWS E-mail and SMS are sent the user every 50 units before reaching the next slab. Myrio is loaded with the LabVIEW code. It measures the power usage by getting input from the voltage sensor and current sensor and calculate the rate for the usage according to the Tariff slab table (fig 2), the calculated values are passed to the cloud for monitoring purpose, and it triggers the SMS and E-mail service 50 units before reaching the next slab.

For automation purpose, two relays are used one is the main relay and the other one is the sub relay. The main relay is connected to the main supply of the home, and the sub relay is connected for each room initially. Both the main and sub relays are in NC (Normally Closed) mode initially. The main relay is controlled by IoT which can also be overridden by a pushbutton for any worst-case. The sub relay is turned off by the Myrio whenever the room has no presence of any persons. This human detection process is done by using PIR sensor. PIR (Passive Infrared) sensor is a motion detection sensor which is used for detecting the presence of any human by emitting Infrared light. So this sensor is used to find the presence of any human and turn ON or OFF the electrical appliances. For example: If a person is present in the room and the person left the room without turning OFF the fan and light, then this may cause the total power consumption to increase. So with the help of PIR sensor the presence of human is found and there is no on present in the room then all the electrical appliances like fan, light are turned OFF automatically and they are turned on if the person enters the room again. The Pushbutton is used to reset the whole home electrical appliances back to its previous state. The NodeMCU board is used to provide remote control for user to turn ON and OFF their electrical appliances. With help of Blynk app the user can remotely control their Electrical appliances.

V. EXPERIMENTAL RESULTS WITH TABLE AND FIGURES

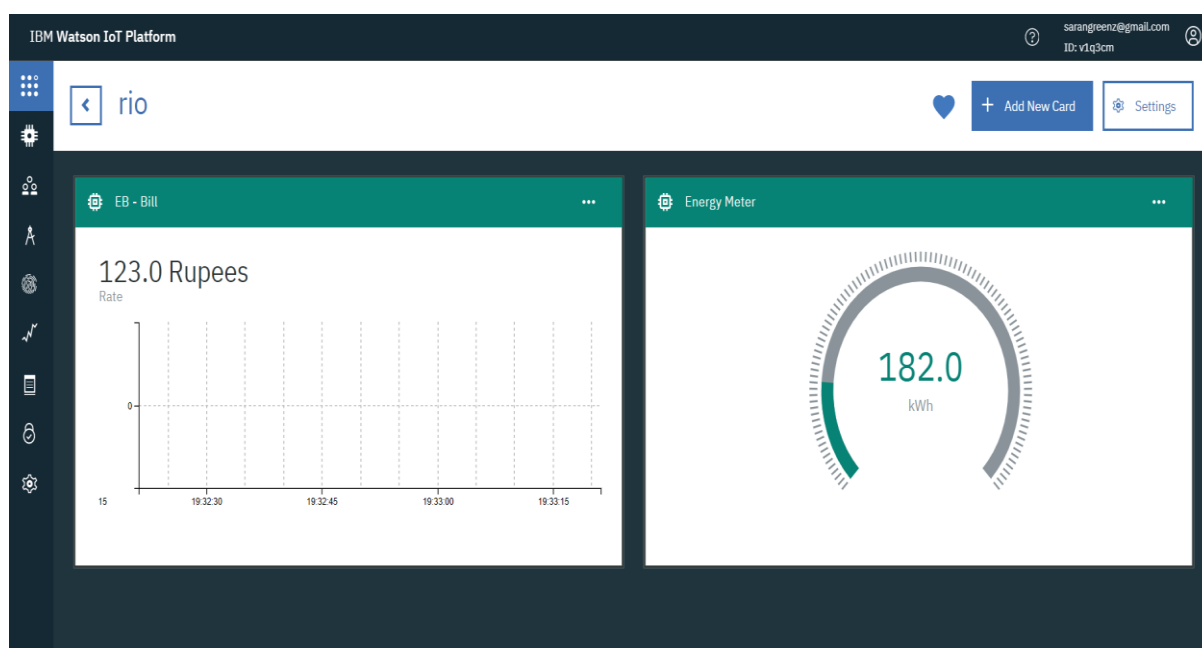


Figure: 4 Power consumed and estimated cost displayed in IBM IoT platform

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 9, Issue 2, February 2020

This paper suggests a better and effective way to reduce the electricity bill by continuously monitoring the power consumed, its estimated cost and an alert system that sends the user notifications when the consumed power is about to reach the next slab. By implementing this method the user can know or view the power consumed and its cost wherever and whenever the user needs it with the help of IoT. The below figure shows the overall setup of the system that consists of Myrio, Arduino, current and voltage sensor and its connection.

All the solutions proposed in this paper is for reducing the total power consumed which in turn will also decrease the cost. So the user need not pay more money for the unnecessary power they use and also make their living easy by automation through IoT.

To access a cloud, the MQTT protocol is needed, It varies for every platform, In the above block diagram the functions numbered as 1, 4, 5 is used for IBM platform which is used for monitoring purpose, the functions numbered as 6, 7, 9, 10, 11 is used for SMS and E-Mail services by AWS(Amazon Web Services).

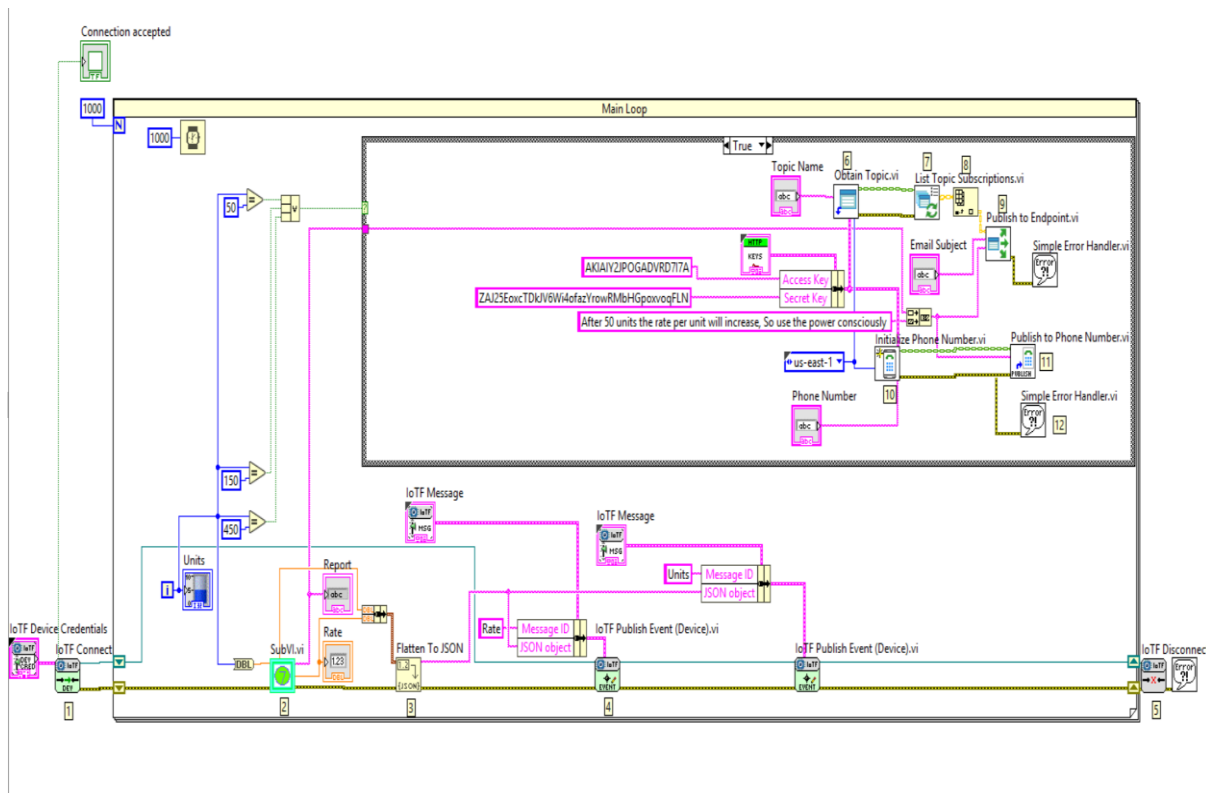


Figure: 5 LabVIEW code for Power consumption monitoring and alert system

For Accessing IBM IoT Platform:

1. **IoT Connect** is a function which has the MQTT protocols, It is given a cluster of four strings (Organization ID, Device Type, Device ID, Auth-token) as Input which are required things to connect with IBM, the Device Type, Device ID and Auth-token are user-defined the Organization ID is a unique one which is generated when we create an IoT resource in IBM Platform.



ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 9, Issue 2, February 2020

2. **SubVI** deal with the operational part it is given with the Units used as an input, Inside the SubVI the rate calculation will be done according to the tariff slab, the calculated value is return as output with a string report.
3. **Flatten to JSON** is used for putting the data into curly braces, the cloud only recognizes the data which are present inside the curly braces. Example: data 17 is sent as {17}.
4. **IoT Publish Event** is used to send the data to the cloud according to the credentials given to it. It can send one data at a time for sending multiple data we have to use these functions multiple times.
5. **IoT Disconnect** is used to disconnect the connection between the device and cloud, which recommended to use.

For Accessing AWS:

6. **Obtain Topic** function is used to obtain the topic which is related, the term topic is an AWS terminology which will be created by the user in AWS console (SNS). While creating the topic the user has to enable the E-mail service and mention the mail ID which the alert emails to be sent.
7. **List Topic** function is used when the user has created many topics it lists all the one as output.
8. **Index Array** function is used to choose the required topic from the list, It is chosen by giving the index value as input to it.
9. **Publish to Endpoint** function deals with sending the emails to the E-mail ID given by the user while creating the topic.
10. **Initialize Phone Number** is used for SMS service which gets the phone number as input from the user.

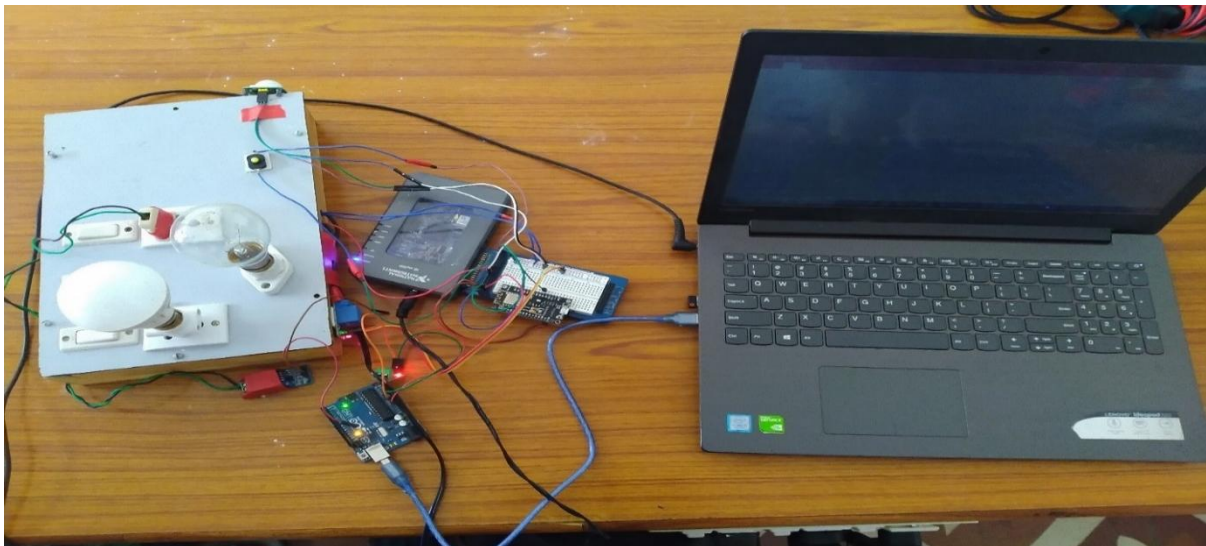


Figure: 6 Experimental setup of the system

The real time prototype appearance of the whole system is shown in fig 6. Using IoT the Alert system is designed to give notifications to the user if the power consumed is about to reach the next slab. This SMS and E-mail notifications are shown in fig 7 and fig 8. The fig 9 shows window of Blynk app through which the user can turn ON or OFF their electrical appliances remotely.



ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 9, Issue 2, February 2020

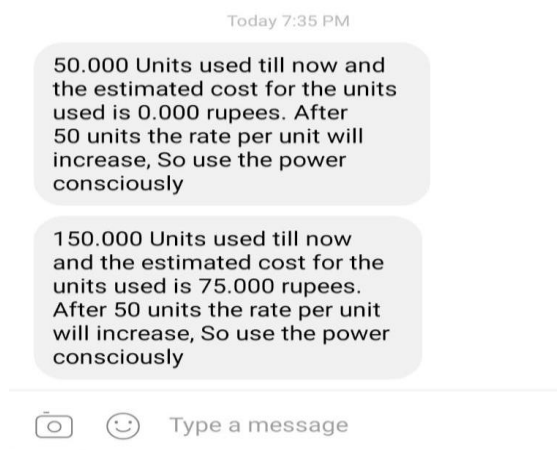


Figure: 7 Alert SMS

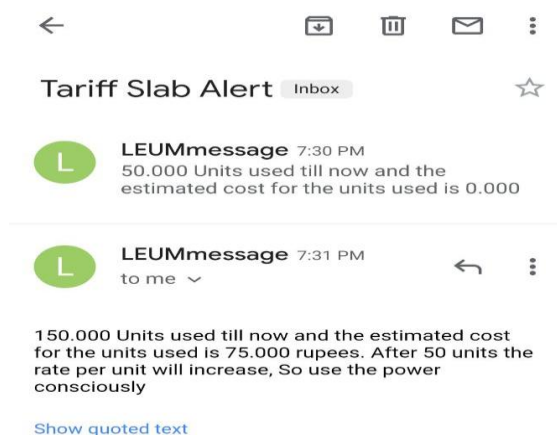


Figure: 8 E-mail Alert

VI. CONCLUSION

This paper suggests an idea to reduce power consumption in home by continuously monitoring the power consumed and allow the user to view the estimated for the usage. By sending alert messages to the user he/she may use the power cautiously. The PIR sensor also helps in reducing the power consumption by make the automated. The user can also control the electrical appliances remotely through IoT. With all these features the Home Automation could be done easily and also helps to reduce total power consumed and thereby saving the energy.

ACKNOWLEDGEMENT

The authors would like to express their deepest gratitude to Mr.Tamilarasan who guided us for this paper. We also like to thank all the other staffs and friends from Instrumentation and Control Engineering department who have helped us in this paper.



ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 9, Issue 2, February 2020

REFERENCES

- 1) Elamvazuthi, M.K. A., Ahamed Khan, Syajiq Basri Bin Shaari, Rajendran Sinnadurai and M.Amudha, -“Electrical Power Consumption Monitoring using a Real-time System”, 2012 IEEE Conference on Sustainable Utilization and Development in Engineering and Technology (STUDENT) Universiti Tunku Abdul Rahman, Kuala Lumpur, Malaysia. 6 - 9 October 2012.
- 2) Tsung-Yueh Wan, Chun-I Chiang, Chao-Tung Yang, Shuo-Tsung Chen, and Jung-Chun Liu,- “Implementation of an Energy Saving Cloud Infrastructure with Virtual Machine Power Usage Monitoring and Live Migration on OpenStack”, 2016 IEEE 22nd International Conference on Parallel and Distributed Systems.
- 3) I. Abubakar, S. N Khalid, M. W. Mustafa, Hussain Shareef and M. Mustapha, “Calibration of ZMPT101B Voltage Sensor Module Using Polynomial Regression for Accurate Load Monitoring”, Vol. 12, NO. 4, February 2017 ARPN Journal of Engineering and Applied Sciences.
- 4) C. Meetoo, S. Bahadoorsingh, N. Ramsamooj and C. Sharma, “Wireless residential power monitoring system”, IEEE Manchester Power Tech, Manchester, 2017.
- 5) Viorel Miron-Alexe, “IoT Power Consumption Monitoring System For Off-Grid Households”, December 2017 IEEE.
- 6) R. Bharathi, M. E. Madhushree, Priyanka Kumari, “Power Consumption Monitoring System using IoT”, Volume 173 – No.5, September 2017 International Journal of Computer Applications.
- 7) Antony Jerome, Ashra Ahmed Saied, Rithika Bekal, Santhrupthi S. M., Rahul V. A. “AutoHome an NI MyRIO Based Project”, International Journal of Internet of Things 2017, 6(2): 29-33.
- 8) Bibek Kanti Barman, Shiv Nath Yadav, Shivam Kumar, Sadhan Gope “IOT Based Smart Energy Meter for Efficient Energy Utilization in Smart Grid” 2018 IEEE.
- 9) Shu-ping Le, Hong Zeng, Jian Qiu, Song Zhang “Design and Implementation of Wireless Power Monitoring System for Public Buildings”, International Conference on Electronic & Mechanical Engineering and Information Technology 2011.
- 10) Pampa Sadhukhan, “An IoT based Framework for Smart City Services” 2018 IEEE.
- 11) George Suciu, Lucian Necula, Raluca Iosu, Teodora Usurelu, Marian Ceaparu “IoT and Cloud-Based Energy Monitoring and Simulation Platform” IEEE March 28-30, 2019.