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Measurement of Secure Power Meter with Smart IOT Applications

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Abstract

IoT is a network used to interrelate multiple things including mechanical and computer machines. It passes data to a computer interface over the networks without the help of humans or computers. This enables control of various parameters, including electrical, physical and environmental parameters. One of maximum significant limits to be monitored in IOT is electrical power consumption. There are many energy display insturments had in available but they are dearth in sufficient security aspects. The consumed electricity amount is also a parameter to be measured. To do this we need power meter which is much expensive. Thus, in this proposed work we adopt a basic portable low-cost power monitoring system with Wi-Fi capabilities. Different test results are provided to demonstrate the proposed work feasibility also IoT powered power monitoring system for calculating consumed electricity and secure data transmission via Wi-Fi module to the Blynk server (Cloud server). A Blynk application was developed for simulation purpose and hardware implementation. It is an in build app used for a project using

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multiple widgets and this app this app gives us to create amazing interfaces.

1 Introduction

Internet of Things is a technology that integrates detection and communication with common equipment to collect useful data. Such devices are used for the measurement of different physical and environmental parameters. Such research is further used to evaluate, recognize and address many of the problems that we face in our lifestyles. The major drawback is to use electricity efficiently. Our device will help solve all of our problems by providing information on day-to-day electricity consumption. Normal electric meters provided by electricity traders measure the power consumed throughout the building in the current scenario. Actually consumers are not aware of electricity consumption for individual equipment. These meters also lack an option of analyzing data since there is no communication facility in the meter. So the electricity used at each and every position has to be recorded manually for billing. It can be susceptible to human error due to this method.The power read can be automated, evaluated manually using our sma rt power meter system and the electricity can be shut off if the electricity bill is not paid on time. This will aid in the documentation and awareness rising of major power consumer. The details of how much power consumed can be sent safely to the platform of the manufacturer and its section of the network. By this, the error can be reduced due to manual reading.

A communication capability in smart power meters has been developed beforehand. High cost, big size, weak security, installation complexities are the demerits in this design. By recommending low cost, incorporate a stable, power monitor sensor implementation and low-complexity design to address problems in these designs. The intended sensor incorporated wireless communication with IEEE 802.1. Remote server can store and analyze data from instantaneous power consumption by using the wireless network via computer or smartphone over the Internet to retrieve data on server.

The entire article is laid out as follows. Similar studies and developments are listed in Section 2 of the proposed design. Section 3 explains device overview of the proposed power monitoring sensor. The importance of Blynk app cloud was discussed in section 4 and the output analysis of proposed method was given in section 5. Reports from the implementation and the quality review of the proposed system are depicted in section 6 and hardware implementation with Blynk. Section 7 explains the study concluded.

2 Related Works

In this work [1], various methods of IOT were discussed and also security protocols was analysed. The IOT architecture was explained by the approach of various layers with desired outcomes.

In this study [2] interesting fields of IOT was elaborated and the architecture was demonstrated. The devices used for IOT gives a suitable idea using for various areas and requirements.

In [3], the evolvement of IOT was presented with distinct features and recent development for the economic benefits.

In [4], discussed the foundations of computing with different concepts and a systematic way of approach is found in effective manner.

Most widely a pattern [5-6] for programming with different strategies and applications was reviewed.

The author reviewed [7] the challenges of handling big data and the issues, solutions to overcome big data was discussed. The major features of cloud architecture in layers require the software tools and ability in handling current capacity of big data transactions.

In this work [8] smart way of meter reading system was proposed using GSM and monitored by microcontroller. The energy consumption is defined by the range limited and suitable way to produce bill slips.

A method to save electricity was discussed [9] and a technique to estimate electricity power in home appliances was given in this work. The ultimate focus of this research work is to make people aware of power utilized in their home.

Two different approaches [10] were investigated in this research methodology. Operation faults of smart meters and operational data in running state has analyzed. Based on reliability various prediction methods were also explained.

In this work [11] explained various technologies and features involved in the design of smart meter. The security standards are also satisfied and will be able to implement a design in future electricity.

New technology of energy meter [13] has been discussed in this work that is used by the consumer and overcome the demerits of billing system with effective power consumption.

New generation model [14] is presented with objective function, a PSO algorithm was utilized to obtain economic performance, and overall system size is reduced.

A knowledge-based procedure [12, 15, and 16] for smart meters was presented with various factors optimizing energy consumption and life span frequency is enhanced.

Various research methods [17-29] are discussed to explore sensing elements in electrical devices.

3 Systems Descriptions

The research work proposed has been used to display consumption of energy in Watthr.Each customer were able to get the information from any place in the universe. Blynk is an app one among the app used effectively in IOT which aids by embedded c algorithms which able to present the output in user friendly manner to the customer. Server of the Blynk app is accountable for the effective communications among the various other smart devices and instruments. Blynk enables the cusotmer the capacity to add any number of paths to any account and in each individual account details can be feed into eight fields. The incoming and outgoing instructions are supported by communication with server in all hardware platforms of Blynk libraries. One area division can be allocated an account, and n channels can be generated in the locality for a suite of n metres. Together the customer and utilitiy provider can view the analytics. The idea suggested is shown in Fig. 1 and it is separated into three different subsystems. First, the ESP 8266 Wi-Fi (Node MCU) frame, second potential transformer and last the current transformer. The system architecture is shown in Fig 2.

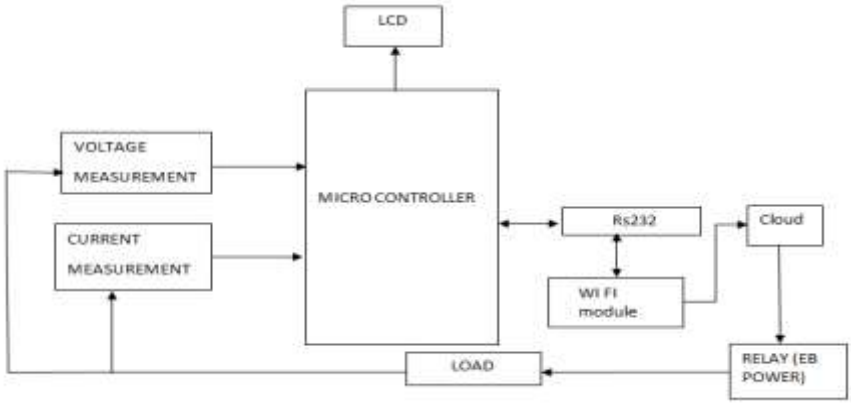

Figure 1 Block Diagram of IOT based Energy meter

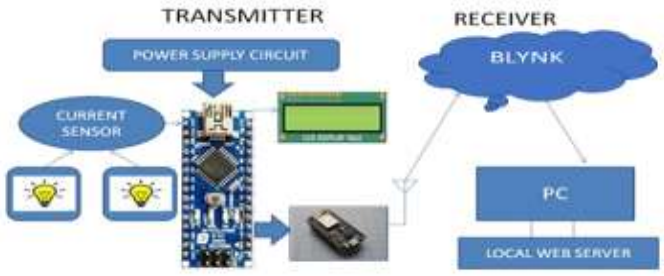

Figure 2 System Architecture

4 Blynk App Cloud

Blynk app is a fresh platform that all th users to construct the better interface for the user operating systems and enable customer devices to monitor and control any hardware based projects. After downloading the software the output window dashboard can be developed with user friendly front end. Using the widgets the pins can be turned on and off or display sensor data. In any project, hundreds of tutorials are likely to make the hardware component pretty simple but it's still tough to develop the software front end. However, the software point of view is even easier than the hardware, with Blynk.

Simple tasks can be done in Blynk such as following your fish tank temperature, or switch on and off lighting system remotely by interfacing. Recently IoT platform built solutions and impress connection between our hardware and the Blynk Cloud server.

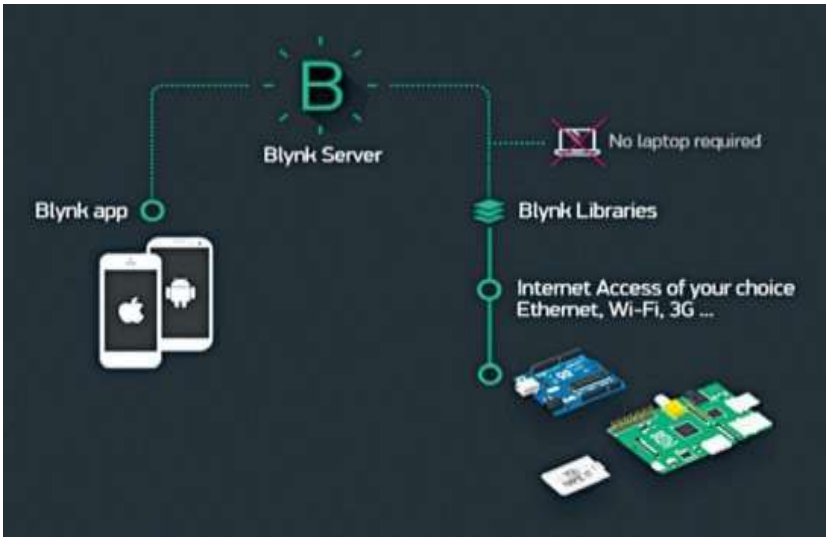

Figure 3 Blynk Cloud

This circuit is designed for charging control. The load can be a motor or any other load. The load is switched on and off by relay. The ON and OFF relays are controlled by switching transistor pairs (BC 547). In the collector terminal of the Q2 transistor relay is attached and it is a three pin electromagnetic switching system. It has excellent accuracy for power management as seen in figure 4. To calculate error in the measurement the regulated standards are then associated with real values. Threepoint calibration is used in this research work to yield better accuracy. To provide authenticity of data sufficient security mechanism should be there and preventing power data from users.

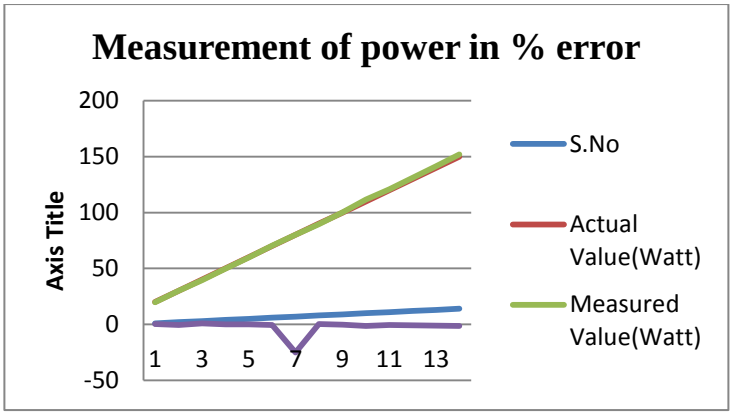

Figure 4 Measurement Of Power In % Error

5 Performance Analyses

5.1 The Goertzel Algorithm

This algorithm is used to obtain a computational complexity lower while compared with other frequency domain procedure. Based on this algorithm; the module of voltage spectrum and frequency evaluation is calculated. These obtained values are analyzed to discover the orginal frequency value. The frequency domain voltage and current are transposed using the goertzel algorithm. The period at regulatr interval analysis could be applied using this algorithm to modification the amount of samples.

```
#define pi 3.14159265
#define NumPoints 200

a=0;
b=0;
par=0;
reW_f = 2.0*cos(2.0*pi/20);
imW_f = 1.0*sin(2.0*pi/20);
for(i=0;i<NumPoints;i++)
{
        par = V(i) + reW_f*a - b;
        b = a;
        a = par;
}
Re_re = 0.5*rew_f*a - b;
Re_im = imW_f*a;
```

Figure 5 Segment for the Goertzel Algorithm code Using C

5.2 The Zero-Crossing Algorithm

This algorithm computes the sample points and the obtained input signal frequency. Both the algorithms used have a small error. The both algorithms are described as functions of the input frequency signal are computed with a

percentage relative error. To calculate the signs of the real power terms only the current and voltage are considered at the calculated frequency.

$$V_{rms} = \sqrt{\frac{1}{N}\sum v^2(n)} \quad \text{.....(1)}$$

$$I_{rms} = \sqrt{\frac{1}{N}\sum i^2(n)} \text{.....(2)}$$

$$P = 1/N \sum v(n)i(n) \text{.....(3)}$$

$$S = V_{rms}I_{rms} \text{.....(4)}$$

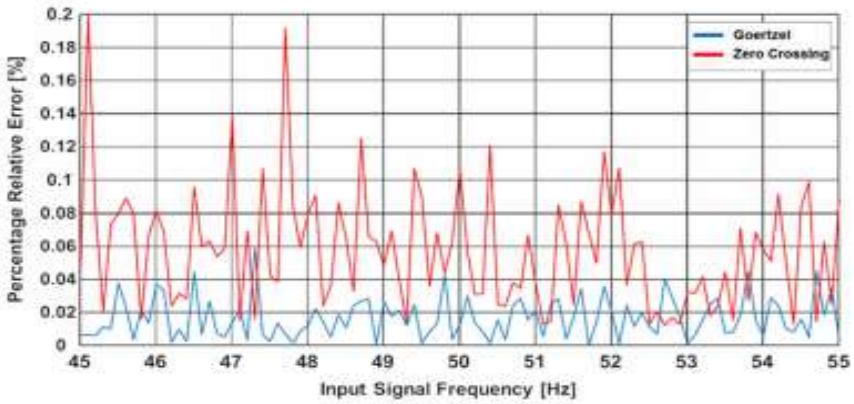

Figure 6 Percentage Relative Error with Zero-Crossing and Goertzel Techniques

6 Simulation Results and Discussion

Figure 6 shows the login page of Blynk and Figure 7 shows the page to develop a new project in Blynk application.

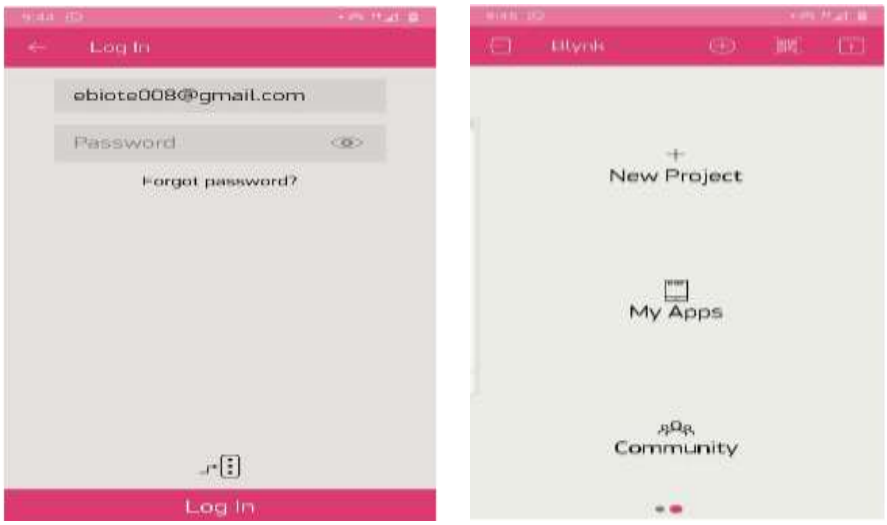

Figure 6 and 7 Login Page and New Project of Blynk App

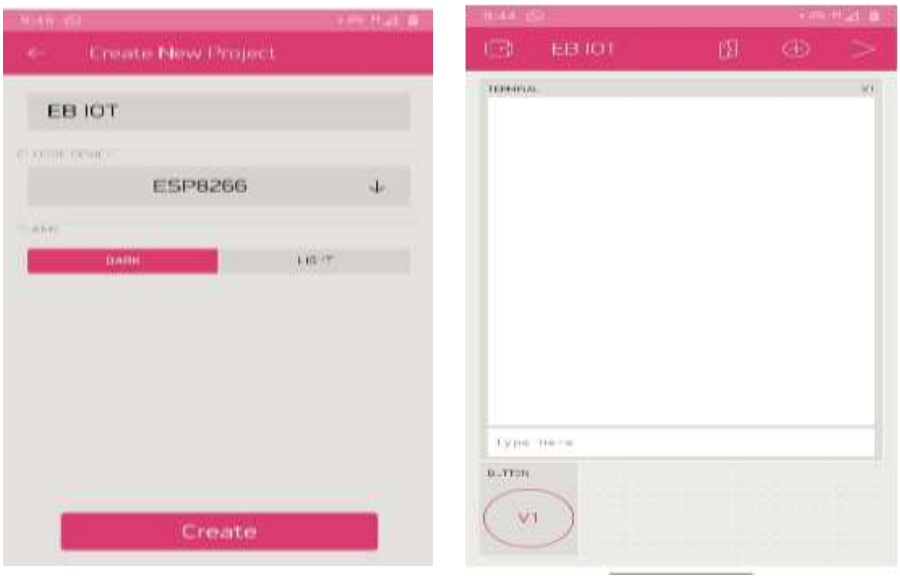

Figure 8 and 9 Creation of New Project and Empty Terminal in Blynk App

Figure 8 represents to develop a project named EB IOT in Blynkapp and select the device used in the project and Fig 9 represents the empty terminal created when a new project is created. The accuracy is checked using Hioki Power Analyzer 3390 to calibrate the power values first. Of greater accuracy we use a three-point test. To assess uncertainty in the calculation, the measured values are then correlated with the actual values.

Figure 10 Hardware in OFF State (NO SUPPLY)

Figure 10 represents the hardware setup when it is not connected to the power supply and fig 11 describes the output terminal when supply is given to the hardware and the usage of voltage and current are shown in LCD display.

Figure 11 Setup of Hardware (Power Supply Is ON)

7 Conclusion

IOT based energy management is an innovative project established to manage home appliances remotely through the cloud at all places in the universe. In an emerging area such as IoT Power monitoring, a ground-breaking technology is being created to read from any corner of the world the power used by each and every system within home remotely over the web. The actual collected current is monitored and viewed over the internet using IoT in our proposed work sensor i.e. current sensor. The machine changes its reading every 3 seconds. The proposed model updates the information in every one or two seconds on the internet by means of cloud BLYNK. In future, the usage of electricity can be controlled for many houses using single application and user terminal can be created.

References

[1] Tabassum Ara, et.al., "Internet of Things Architecture and Applications: A Survey", Indian Journal of Science and Technology, Vol. 9, no. 45, pp.1-7, 2016.

[2] Paul Fremantle Et.Al., "A Reference Architecture for the Internet of Things", WSO2 White Paper, 2015.

[3] Rafiullah Khan Suk et.al., "Future Internet: The Internet of Things Architecture Possible Applications and Key Challenges", IEEE 10th International Conference on Frontiers of Information Technology, 2012.
[4] Mark Weiser et.al., "The Computer for the 21 st Century", Scientific American, Vol. 265, no. 3, pp. 94-105, 1991.
[5] Fabrizio Montesi et.al., "Circuit breakers discovery and API gateways in micro services", Software Engineering, Vol.1, 2016.
[6] P. Fremantle et.al., "A Reference Architecture for the Internet of Things", IEEE Software, Vol. 33, no.1, pp.112-116, 2016.
[7] Sambit Satpathy, Sanchali Das, Swapan Debbarma, "A new healthcare diagnosis system using an IoT-based fuzzy classifier with FPGA", Journal of Supercomputing, Vol. 76, no. 8, pp. 5849–5861 2020. .
[8] Terry Chandler et.al., "The Technology Development of Automatic Metering and Monitoring Systems", The 7th International Power Engineering Conference, pp. 147-150. 2005.
[9] Sindhu V., "A Survey on Task Scheduling and Resource Allocation Methods in Fog Based IoT Applications", Lecture Notes in Networks and Systems, Communication and Intelligent Systems, pp.89-97, 2020.
[10] Hao-wei Yao et.al. "Prediction method for Smart Meter Life Based on Big Data", Procedia Engineering, Vol. 211 pp. 1111-1114, 2018.
[11]U. Gowshika, T. Ravichandran, "A Smart Device Integrated with an Android for Alerting a Person's Health Condition: Internet of Things", Indian Journal of Science and Technology, Vol. 9, no.6, pp.1-6, 2016.
[12]Soma Shekara Sreenadh Reddy Depuru et.al. "Smart meters for power grid: Challenges issues advantages and status", Renewable and Sustainable Energy Reviews, Vol. 15, no. 6, pp. 2736-2742, 2011.
[13]S Maitra et.al. "Embedded energy meter - a new concept to measure the energy consumed by a consumer and to pay the bill", Joint International Conference on Power System Technology and IEEE Power India Conference, pp. 1-8, 2008.
[14]J. Every et.al. "Leveraging smart meter data for economic optimization of residential photovoltaics under existing tariff structures and incentive schemes", Appl. Energy, Vol. 201, pp. 158-173, 2017.
[15]Janvier Kamanziet.al., "Study and Modelling of Factors Driving the Performance of Solar Modules", Journal of Green Engineering, Vol. 7, no.3, pp. 333-359, 2017.
[16]Yishak Kifleet.al., "Assessment and Enhancement of Distribution System Reliability by Renewable Energy Sources and Energy Storage", Journal of Green Engineering, Vol. 8, no. 3, pp. 219-262, 2018.
[17]Issa Etier et.al. "Cell Zooming Techniques and Optimization Function in Cellular Based Networks with Energy Efficient and Consumption", International Journal of Innovative Technology and Exploring Engineering, Vol.9, no.6, pp.237-241, 2020.

[18]Sunil Thomas et.al., "Bacterial foraging optimization based adaptive neuro fuzzy inference system", International Journal of Electrical and Computer Engineering, Vol. 10, no. 4, pp. 3568-3575, 2020.

[19]C. Arul Murugan et.al., "The reordenred deblocking filter and SAO architecture for HEVC system", International Journal of Engineering & Technology, Vol. 7, no. 2.8, pp. 617-621, 2018.

[20]Chinnandi Arul Murugan et.al., "Survey on Image Encryption Schemes, Bio cryptography and Efficient Encryption Algorithms", Mobile Networks and Applications, 2018.

[21]B. Banuselvasaraswathy et.al. "High Gain Enhanced CMOS Charge Pump with Reduced Leakage and Threshold Voltage", International Research Journal of Engineering and Technology, Vol 2, no.3, pp.2251-2256, 2015.

[22]Banuselvasaraswathy.B et.al, "A Fuzzy Based Ultra-Nano Water Purification Technique", International Journal of Innovative Technology and Exploring Engineering, Vol .8, no.4s, pp. 453-457, 2019.

[23]M. Ishwarya Niranjana et.al. "Efficient high throughput decoding architecture for non-binary LDPC codes", International Journal of Engineering & Technology, Vol.7, no.2-8, pp.195-200, 2018.

[24]B Banuselvasaraswathy et.al, "Automatic Retinal Lesions Detection of Diabetic Retinopathy Using Curvelet Based Enhancement", Indian Journal of Public Health Research & Development, Vol.10, no.2, pp.1029-1035, 2019.

[25]Kannan Nithiyananthan., Thomas, S., Mobarak, Y., Alharbi, F., "Enhanced data communication models for real-time power system monitoring in a distributed platform", Transactions on Emerging Telecommunications Technologies, 2020.

[26]Kannan Nithiyananthan., Mobarak, Y., Alharbi, F., "Application of cloud computing for economic load dispatch and unit commitment computations of the power system network", Advances in Intelligent Systems and Computing, AISC, pp. 1179-1189, 2020.

[27]Nithiyananthan, K., Ramachandran, V., "RMI based distributed model for multi-area power system on-line economic load dispatch", Journal of Electrical Engineering, Vol. 56, no. 1-2, pp. 41-44, 2005.

[28]K.Nithiyananthan, Ramachandran, V., "Distributed mobile agent model for multi area power systems automated online state estimation", International Journal of Computer Aided Engineering and Technology, Vol. 5, no. 4, pp.300-310, 2013.

[29]K.Nithiyananthan, Ramachandran, V., "Versioning-based service-oriented model for multi-area power system online economic load dispatch", Computers and Electrical Engineering, Vol. 39, no. 2, pp.433-440, 2013.

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