iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 **Issue:** VII **Month of publication:** July 2015

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Hierarchical Energy Management System for Smart Buildings

R.Karthikeyan[1], Dr.A.K.Parvathy[2]
[1] Research Scholar, [2]Professor and Head, Department of EEE
Hindustan university of Science and Technology

Abstract: ***The Hierarchical energy management allows generation facilities to be run more efficiently with the rapid introduction of network enabled digital technology. This technology offers exciting opportunities to increase the connectivity of devices within the home for the purpose of home automation and hybrid energy management. Moreover, with the rapid advancement of the Internet, there is the added advantage of the remote control and monitoring of such network enabled devices. Home appliances are assigned with dynamic priority according to their different energy consumption modes and their corresponding status. Based on the priority, the loads are scheduled according to the predicted output of renewable sources. This paper evaluates the potential of ZigBee for addressing these problems through the design and implementation of flexible home automation architecture for energy management system.***
Index Terms — Smart home, renewable sources, energy management, dynamic priority scheduling.

I. INTRODUCTION

Due to the continuous increase of residential electricity demand, energy consumption and management in households have received more attention inrecent years. To achieve the energy efficiency in smart homes [1], with the use of technology electronic devices in a house to act automated, issues on both communication technologies and energy management methods in the home domain need to be addressed. Issues on energy efficiency and security of machine to Machine communications were discussed in [4] and types of communication technologies and network architectures for M2M communications in home area networks were discussed in [5][6]. ZigBee is the most reliable technology to facilitate M2M communications in the home domain and the optimal traffic concentration for network design can minimize the total cost of the home energy management system. A ZigBee based energy management system and Wi-Fi network are integrated through a home gateway. The gateway provides a simple and flexible user interface, and remote access to the system. A virtual home is implemented for the security needs to avoid hacking. To demonstrate the effectiveness of the proposed system, three loads and ZigBee remote control have been developed and evaluated with the energy management system in home automation system. This paper presents a flexible low cost ZigBee based energy management system. The system is flexible such that allowing addition of multiple appliances, securely added to the home network. The system allows home owners to monitor and control connected devices in the system.

II. PROBLEM SCOPE

Each of the main electricity consumers in buildings are lighting, office equipment, cooling, and, ventilation has potential for increases in energy efficiency. However, these measures must be balanced against building performance to ensure design of the architecture. For instance, as a caution note that even a 2% decrease in the productivity of office building occupants has the same economic impact as all building maintenance and energy expenditures. Thus, while dimming all lights would result in large energy savings and comfort in buildings would not justify this measure during work hours. Of course, interior lighting energy usage can be reduced by efficient lighting technology such as LEDs and day lighting. Features such as automated dynamic exterior shading devices and dynamic dimming of interior fixtures can result in dramatic reduction in energy usage. To overcome this problem, automatic load scheduling methods is provided, which can collect status and power consumption demand from home appliances and schedule them in an energy efficient and also considering comfort as well [7].

III. COMMUNICATION ARCHITECTURE

A home gateway is implemented to provide interoperability between the Zigbee and monitoring over the home's devices and Hybrid

Volume 3 Issue VII, July 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

energy source. For the real time security a virtual home is implemented. Remote user can access the system using the Internet. They are then wirelessly transmitted to the Home Gateway using the homes Wi-Fi network. A ZigBee based remote control can be used to directly control connected devices and integrated with the home device database which contain status of all the connected device. Once the communication are sent to the real home automation system the communications are checked for security. All the devices connected with the Zigbee Network are allotted with a dedicated controller. The sensitive data from the controller and encrypted with the valid key for security. The data are decrypted at the receiving end and checked for authentication. The device address is extracted from the message and the device is checked for existence and status of the device is verified.

IV. LOAD SHEDULING

The load scheduling of household is done to improve the energy efficiency of the building. The scheduling and priority of scheduling is left to the consumer's comfort. The forecasting of demand is done by the periodic data and the energy consumption mode of appliances. To have a efficient scheduling the State of Charge (SOC) of the battery used for storing the Renewable resources are monitored regular intervals to make the scheduling efficient. The Renewable resource energy production such as wind and PV are highly fluctuating and which affects the stability of the system[11].

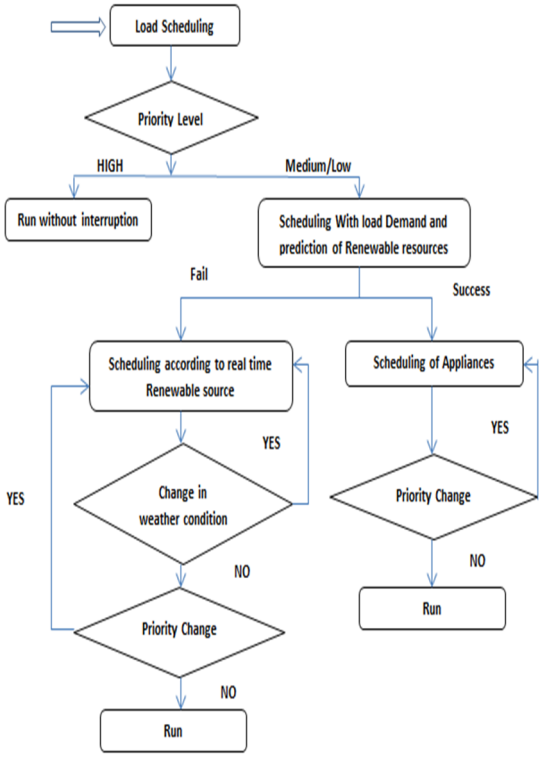


Fig. 1 shows the benefits and feasibility analysis of the

A. State Of Charge Of Battery

SOC determination based on the open circuit voltage is direct measurement method and efficient method for determining the performance and life of the battery. The proposed system uses the Li-ion battery where there will be voltage drop during the discharging in the linear or non linear way. The voltage is also affected by the current, temperature, discharge rate and age of cell.

S.No	Open Circuit Voltage	Charge
1.	12.73	100%
2.	12.62	90%
3.	12.50	80%

Volume 3 Issue VII, July 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

4.	12.37	70%
5.	12.24	60%
6.	12.10	50%
7.	11.96	40%
8.	11.81	30%
9.	11.66	20%
10.	11.51	10%

Table1: Percentage of SOC with open circuit voltage

B. Hierarchical Priority Allocation

In our proposed scheme, priority is Hierarchically allocated according to the status of appliances that can be scheduled. For appliances with battery installation, as shown in Fig. 2, they have low/middle/high priorities when their battery power is higher or lower than 50%, or lower than 3%, respectively.

0% 3% 50% 100%

High	Medium	Low

Fig2: Dynamic Priority allocation for appliances with SOC of Battery.

The proposed algorithm initially schedules the appliance according to its priority status and the current generation capacity of the renewable resources. Then, the appliance turn on immediately in the case it has high priority or waits for a certain time period to run in the case it has middle or low priority. The high priority appliance cannot be scheduled, no energy and cost will be saved. The middle and low-priority appliances will run according to their priorities so that energy and cost will be saved in the case they consume energy from renewable sources or only cost will be saved.

When the change in weather and generation of renewable sources drops the scheduling algorithm reschedules the appliance according to the new forecasting and tries to save energy and cost. Due to the consumers comfort the appliances priority will also change during the waiting period. The proposed algorithm can effectively schedule the appliances according to the changes of the weather and Battery SOC level and the appliance' priority change caused by consumer comfort.

V. SYSTEM IMPLEMENTATION

A ZigBee based home automation system is implemented for the monitoring and Energy management control of household devices. To demonstrate the feasibility and effectiveness of the proposed system Light souces with various Watts are used with various priority levels and ZigBee remote controller have been developed and integrated with the home automation system. The algorithm stability is verified by assigning the prioiry level at various stages.

Volume 3 Issue VII, July 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Figure 3: Snapshots of the Real time Hardware with appliances connected.

The system further store data about PV panels system, and Scheduling of household equipment's. Such a system will complete the task by periodically calling the monitoring device, collecting the data and storing them in a database. This database can then be sorted in order to produce graphs and other output representing such things as charge curves, solar insolation data, average power output over time, and so on. A manually created graph constructed from data taken during a week-long test of this system with a functional solar power system.

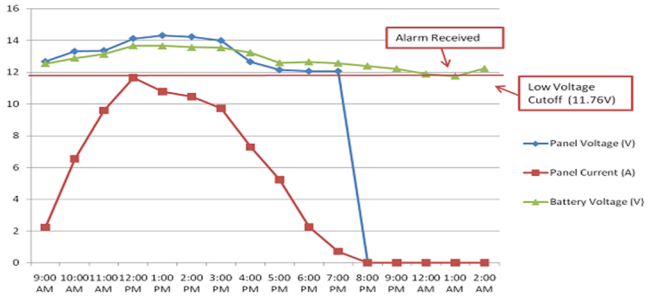


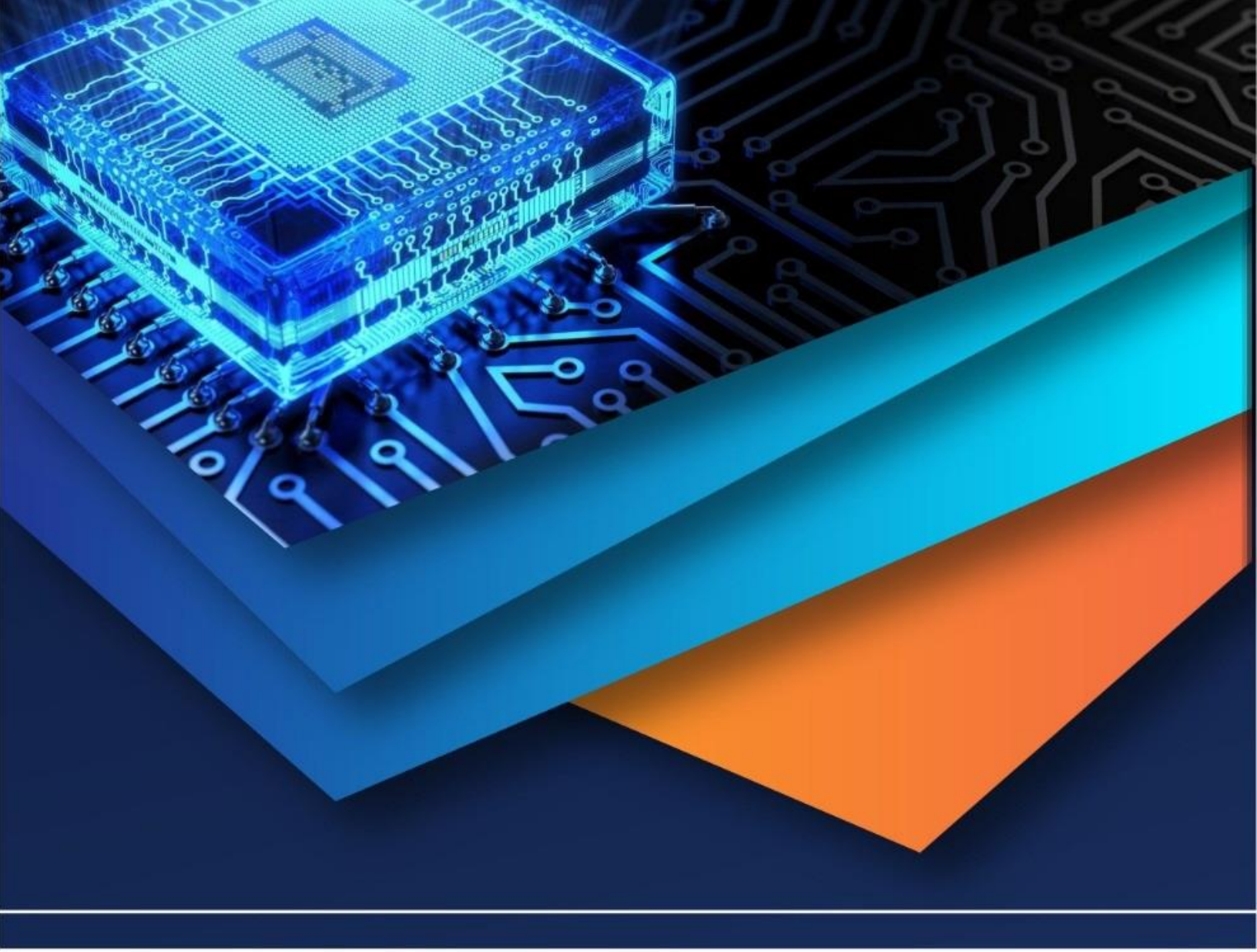
Figure 4: Manually Created Graph from Actual Measurements.

VI. CONCLUSION

A novel method for home automation using Zigbee is proposed for Energy saving using priority scheduling. The usage Zigbee reduces the implementation cost of the project. The hierarchical priority scheduling of home appliances and remote monitoring of the system helps in improving the energy conservation and improves the usage of the Renewable sources in the homes. Further the system can be connected to the internet for extending the connectivity and control the appliances for larger area.

REFERENCES

[1] D. Han and J. Lim, "Smart Home Energy Management System using IEEE 802.15.4 and Zigbee," IEEE Trans. Consumer Electron.,vol. 56, no. 3, pp. 1403-1410, Aug. 2010.
[2] D. Han and J. Lim, "Design and Implementation of Smart Home Energy Management Systems based on Zigbee," IEEE Trans. Consumer Electron., vol. 56, no. 3, pp. 1417-1425, Aug. 2010.
[3] F. Benzi, N. Anglani, E. Bassi, and L.Frosini, "Electricity Smart Meters Interfacing the Households," IEEE Trans. Ind. Electron., early access.
[4] R. Lu, X. Li, X. Liang, X. Shen, and X. Lin, "GRS: the Green, Reliability, and Security of Emerging Machine to Machine Communications," IEEE Commun. Mag., vol. 49, no. 4, pp. 28-35, April 2011.
[5] D. Niyato, L. Xiao, and P.Wang, "Machine-to-machine Communications for Home Energy Management System in Smart Grid," IEEE Commun. Mag., vol. 49, no. 4, pp. 53-59, April 2011.
[6] Z. M. Fadlullah, M. M. Fouda, N. Kato, A. Takeuchi, N. Iwasaki, and Y. Nozaki, "Toward Intelligent Machine-to-machine Communications in Smart Grid," IEEE Commun. Mag., vol. 49, no. 4, pp. 60-65, April 2011.
[7] M. A. A. Pedrasa, T. D. Spooner,and I. F. MacGill, "Coordinated Scheduling of Residential Distributed Energy Resources to Optimize Smart Home Energy Services," IEEE Trans. Smart Grid, vol. 1, no. 2, pp. 134-143, Sep. 2010.
[8] P. Du and N. Lu, "Appliance Commitment for Household Load Scheduling," IEEE Trans. Smart Grid, vol. 2, no. 2, pp. 411-419, June 2011.
[9] J. M. Guerrero, F. Blaabjerg, T. Zhelev, K. Hemmes, E. Monmasson, S. Jemei, M. P. Comech, R. Granadino,and J. I. Frau, "Distributed Generation: Toward a New Energy Paradigm," IEEE Ind. Electron. Mag., vol. 4, no. 1, pp. 52-64, Mar. 2010.
[10] M. Erol-Kantarci and H. T. Mouftah, "Wireless Sensor Networks for Cost-efficient Residential Energy Management in the Smart Grid," IEEE Trans. Smart Grid, vol. 2, no. 2, pp. 314-325, June 2011
[11] M. Bragard, N. Soltau, S. Thomas, and R. W. De Doncker, "The Balance of Renewable Sources and User Demands in Grids: Power Electronics for Modular Battery Energy Storage Systems," IEEE Trans. Power Electron., vol. 25, no. 12, pp. 3049-3056, Dec. 2010.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY