

Review on Power Management in Smart Sensor Networks

Sangeeta .R. Singh¹, Dr. L. K. Ragha²

P.G. Student, Department of Electronics & Telecommunication, Terna Engineering College, Navi Mumbai, India¹

Vice-Principal, Department of Electronics & Telecommunication, Terna Engineering College, Navi Mumbai, India²

Abstract: The design and development of a smart monitoring and controlling system for household electrical appliances in real time has been proposed in this paper. IPM - Intelligent Power Management is the combination of smart sensors and actuators. This system principally monitors the electrical parameters such as voltage and current and subsequently calculates the power consumption of the home appliances that are needed to be monitored. The innovation of this system is controlling mechanism implementation in so many ways. In addition, the proposed system is an economical and easily operable. Due to these intelligent characteristics, it become an electricity expense reducer and people friendly. The goal is to develop a newly equipped well-designed prototype for consumers in home to limit the usage of power. This helps users to manage the power in an efficient manner.

I. INTRODUCTION

The advent of smart cities has led us to develop technologies that fit the criteria. The surging trend in Internet of Things or IOT as it is well known has brought forward several innovations and innovators to develop simple, cost effective yet highly useful systems, which can make our lives easier. As the personal space is crowded with more and more devices, the reach of Wireless sensor network (WSN) has improved exponentially. The use of these sensor networks has increased in the residential space for control and efficient energy management. The monitoring and control of day-to-day household appliances is performed using WSNs installed in these 'smart spaces'. New technologies have been brought forward in cutting-edge advancements in IT, sensor data, energy metering, data transmission and distribution, and battery technology, and big data analytics [1]

II. RELATED WORK

Erol-Kantarci(et al 2011)[3]in their research have introduced schemes like the optimization-based residential energy management (OREM) and the in-Home Energy Management(iHEM)for reducing the appliance power load during peak hours. The paper suggests that using the iHEM application has significantly reduced energy consumption by the appliances.

Han and Lim(et al 2010)[9]developed a ubiquitous home network which has pumped up their possibilities of developing smart home technology. They suggest in their paper, that wireless controls for lighting have benefits like higher flexibility in placement of electrical controls; also the expense for installation is saved. Cost saving happens not just on installation and wiring disruption but also on usage costs.

Han, Choi and Lee (et al 2011) [4] proposed a Home Energy Management System (HEMS) based on ZigBee communication and IR controls. They have actively reduced the power usage of home devices in standby mode by means of switching off the device and the power outlet simultaneously using the central control ZigBee hub.

Mokereno et al 2014[2] state their research objectives which defined the minimum number of active Sensor nodes (SNs) in order to attain performance levels. Using their methodology only, the sensors that are mandatory to fulfil the mission are in ON mode while the other ones are placed in Sleep mode. In this way, the lifespan of WSN is extended.

In this study we propose to implement a ZigBee based intelligent home energy management and control service. We are planning to use the IEEE 802.15.4 standard and ZigBee protocol stack which provides low cost, low data rate, and low energy consumption characteristics for WSN which enables us to be used in home and building environment.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

III. COMPARISONS

Han and Lim et al [9] have developed a smart node that has sensing, processing and networking abilities. It is equipped with a low power microprocessor and a narrow-band RF device that can support physical-layer functionalities of IEEE 802.15.4 [13] [12]. It is 40mm x 70mm in size, powered by two 1.5V AA batteries. Three type sensors are included in the smart node: light, temperature and humidity sensors. Although computerized control systems for lights in film and theatres are available as commercial products [10] [11], most current systems only provide actuation and do not exploit sensor data.

In Han/Choi's et al [4] model, the power outlet periodically monitors the power consumption of the connected home device. As soon as the monitored power consumption of the home device is below the threshold value for the predetermined period, the power outlet automatically cuts off the AC power to reduce the standby power consumption. This method actively reduces standby power consumption by turning off a home device and the power outlet simultaneously. Fig.1 shows the firmware process flow chart of the ZigBee hub to control the power outlet connected to a home device. With an IR remote control, a user can command the home server to display the power consumption information of the room through the ZigBee hub and then check it at the home server.

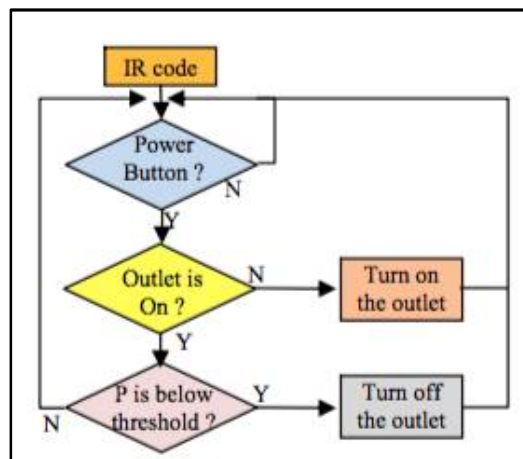


Figure 1 - Han & Choi ZigBee Hub Firmware – the figure explains the basic algorithm of how the system works in the real world.

The above mentioned home power monitoring and controlling systems have limitations with respect to true home automation such as: 1) energy consumption control mechanism is limited to only certain devices like light illuminations, whereas several house-hold appliances can be controlled; 2) energy control is based on fixed threshold power consumption, which may not be applicable to different consumers; 3) controlling the home appliances through network management functions, in practice inhabitant requirements may vary according to their behaviour but not with network characteristics.

Han and Lim expect that their work will contribute in the developing of ubiquitous home networks. Energy savings and user happiness are two major design considerations for modern lighting systems. Global standards like ZigBee RF4CE for RF-based consumer electric remote controls are going to change our expectations for the home entertainment experience. A smart home control system can provide both significant cost savings in a home environment, as well as a great level of flexibility and control for the building administrators and great comfort for the occupants. [9]

IV. TECHNOLOGY

ZigBee is widely used for wireless sensor home area networks (WSHANS) and it is a strong candidate for smart grid energy management applications. ZigBee is a short-range, low-data rate, energy-efficient wireless technology that is based on the IEEE 802.15.4 standard. ZigBee utilizes 16 channels in the 2.4 GHz ISM band worldwide, 13 channels in the 915 MHz band in North America, and one channel in the 868 MHz band in Europe. The supported data rates are 250 kbps, 100 kbps (available in IEEE 802.15.4-2006), 40 kbps, and 20 kbps, and its range varies between 30–70 m

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

indoors. ZigBee can support up to 64,000 nodes (devices). ZigBee certified devices can work for several years without the need for battery replacement due to the low duty cycle mechanism.

However, one of the drawbacks of ZigBee is that it does not initially support IP addressing. Nevertheless, recently developed IPv6 over low-power wireless personal area networks (6LoWPAN) standard, which is defined in the IETF RFC 4944 [10], aims to integrate IPv6 addressing to LoWPANs like ZigBee. 6LoWPAN adds an adaptation layer to handle fragmentation, reassembly, and header compression issues in order to support IPv6 packets on the short packet structure of ZigBee.

V. CONCLUSION

There are several proposals to interconnect various domestic appliances by wireless networks to monitor and control developed by Xiaoguang et al 2011 and Andrey et al 2010. However, the prototypes are verified using test bed scenarios. Also, smart meter systems suggested by Andrey, Han and Kamat [6] have been designed to specific usages particularly related to geographical usages and are limited to specific places. Different information and communication technologies integrating with smart meter devices have been proposed and tested at different flats in a residential area for optimal power utilization [7], [8], but individual controlling of the devices are limited to specific houses.

The system proposed by Suryadevara [1] is used in our research. The system will enable us to determine the power consumption of daily peak hours of electricity usage. This helped us to develop a solution by which we can lower the consumption and enhance better utilization of already limited resources during peak hours.

The system possesses various user interfaces suitable for users of varying ability and for expert users such that the system can be maintained easily and interacted with very simply. Local and remote user interfaces are easy to handle by a novice consumer and are efficient in handling the operations. Thus we recommend the use of this [1] system for use in smart power management.

There has been design and developments of smart meters predicting the usage of power consumption. However, a low-cost, flexible, and robust system to continuously monitor and control based on consumer requirements is at the early stages of development. In this study, we have chosen to implement a ZigBee-based intelligent home energy management and control service. We plan to use the ZigBee (the IEEE 802.15.4 standard) technology for networking and communication, because it has low-power and low-cost characteristics, which enable it to be widely used in home and building environments [14].

REFERENCES

- [1] Suryadevara, Mukhopadhyay, Kelly, Gill "WSN-Based Smart Sensors and Actuator for Power Management in Intelligent Buildings," IEEE/ASME Transactions on Mechatronics, vol. 20, no. 2, pp. 564-571 April 2015
- [2] O. Mokrenko, S.Lesecq, W. Lombardi, D.Puschini, C.Albea-Sanchez, "Dynamic Power Management in a Wireless Sensor Network using Predictive Control" 40th Annual Conference of the IEEE Industrial Electronics Society, Oct 2014.
- [3] 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, Jun. 2011.
- [4] J.Han, C.S.Choi, and I.Lee, "More Efficient Home Energy Management System Based on ZigBee Communication and Infrared Remote Controls," IEEE Trans. Consumer Electron., vol. 57, no. 1, pp. 85-89, Feb. 2011
- [5] P. Cheong, K.-F. Chang, Y.-H. Lai, S.-K. Ho, I.-K. Sou, and K.-W. Tam, "A ZigBee-based wireless sensor network node for ultraviolet detection of flame," IEEE Trans. Ind. Electron., vol. 58, no. 11, pp. 5271-5277, Nov. 2011.
- [6] V. N. Kamat, "Enabling an electrical revolution using smart apparent energy meters & tariffs," in Proc. Annu. IEEE India Conf., 2011, pp. 1-4.
- [7] F. Benzi, N. Anglani, E. Bassi, and L. Frosini, "Electricity smart meters interfacing the households," IEEE Trans. Ind. Electron., vol. 58, no. 10, pp. 4487-4494, Oct. 2011.
- [8] I.Kunold, M.Kuller, J.Bauer and N.Karaoglan, "A system concept of an energy information system in flats using wireless technologies and smart metering devices," in Proc. IEEE 6th Int. Conf. Intell. Data Acquisition Adv. Comput. Syst., 2011, pp. 812-816
- [9] D. Man Han and J. Hyun 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.
- [10] Tasshik. Shon, Yongsuk Park, "A Hybrid Adaptive Security Framework for IEEE 802.15.4-based Wireless Sensor Networks," KSII Transactions on Internet and Information Systems, vol.3, no.6, Dec. 2009.
- [11] Heemin. Park, Jeff. Burke, Mani B. Srivastava, "Intelligent Lighting Control using Wireless Sensor Networks for Media Production," KSII Transactions on Internet and Information Systems, vol.3, no.5, Oct. 2009



ISSN(Online) : 2319-8753
ISSN (Print) : 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

- [12] IEEE Computer Society, Low-Rate Alternative PHY Task Group of IEEE 802.15.4 (TG4a) for the ranging and location, IEEE 802.15.4a-2007.
- [13] IEEE Computer Society, MAC and PHY Specifications for Low-Rate Wireless Personal Area Networks (LR-WPANs), IEEE 802.15.4 TM-2003.
- [14] G. Montenegro, N. Kushalnagar, J. Hui, and D. Culler, "Transmission of IPv6 packets over IEEE 802.15.4 networks," Request for Comments 4944 [Online]. Available: <http://www.ietf.org>