ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Efficient Energy Management System Using ZigBee Communication By comparison of energy of Energy Usage

Ritu Ranjan Kumar*, Prof. A. A. Shinde
Department of Electronics, BVDU College of Engineering, Pune, India
puggu72486@gmail.com

Abstract

This paper concerns with efficient energy management using zigbee communication for reducing home energy usage. A technology is used for reducing and managing home energy usage is known as home energy management system. Our module supports with zigbee communication with an energy meter that enables bidirectional communication for the purpose of obtaining information regarding the total consumption, and receiving commands and notifications. Energy meter can be calibrated regarding pulse that is given to microcontroller. Proposed architecture gives efficient energy saving HEMS.

Keyword: Efficient Energy Management, Energy Usage, Energy meter, zigbee, Appliance.

Introduction

Current energy crisis and the environmental problem is a result of continuous increase in global energy consumption. Most important total energy usage can be reduced by feedback on energy consumption and it will be very useful to energy users [1]. By using energy consumption information system the total energy consumption was reduced by 12 % [2]. Efficient energy management in all areas is required now a days because of the ongoing energy crisis and green house effect. A technology is used which is known as home energy management system for reducing and managing energy consumption. Basically, this proposed work is designed for different sections of a home or for whole home.

In last decades so many home energy management system were analyzed and proposed [3]-[4]. As we seen in all previous home energy management system, only monitor home devices, due to this user is not able to understand particular appliance is energy efficient or not, hence it is necessary to compare energy usage of appliance to the same kind of appliances for reference. The technique of PLC based HEMS was analyzed and network architecture was also given for it [5]. Energy meter counts the pulses that can be like five pulse counts for one unit it is given by default. Pulse count in energy meter can be calibrated by writing code for microcontroller. In this paper, we propose more efficient green home energy management system through comparison of energy usage of appliances based on ZigBee communication.

Efficient energy management system related work

Energy monitoring on regular basis is necessary in HEMS. In fig. 1 home section I & II transmits the energy usage through Zigbee communication to the monitoring section fig.2. Electrical outlets are connected to the home section I & II fig.1and it measures energy usage by energy meter. Relays which are further connected to electrical outlets are provided with energy measurement of appliances with ZigBee communication [6]. Relays which are attached with electrical outlets further calculate the real-time ongoing accumulated energy consumption of appliances. Home server gathers the energy information from the electrical outlets in term of time and date regarding energy consumption and it shows daily and monthly energy usage of appliances with this a user can determine detailed energy usage information. Relays are connected to Electrical outlets which identify whether the connected appliance is turned on/off and whether it is on the standby/normal state by measuring the consuming power and comparison of energy usage is done by using reference/typical values.

The Efficient Energy Management System Using ZigBee Communication through Comparison of Energy Usage is divided into three subsystems home section-I, home section- II and monitoring section.

A. Home section- I

Home section- I transmits the energy usage through Zigbee communication to the monitoring section. fig.3 shows Home Section- I it has atmega 16

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

microcontroller, Zigbee communication ,triac, optocoupler, Power Supply for AVR 32 Micro controller ,lcd display energy meter, keypad buttons for setting date and time for measurement of energy usage as input key to microcontroller. In our proposed green home energy management system appliances are connected to electrical outlets which is further connected to relay for controlling the appliances.

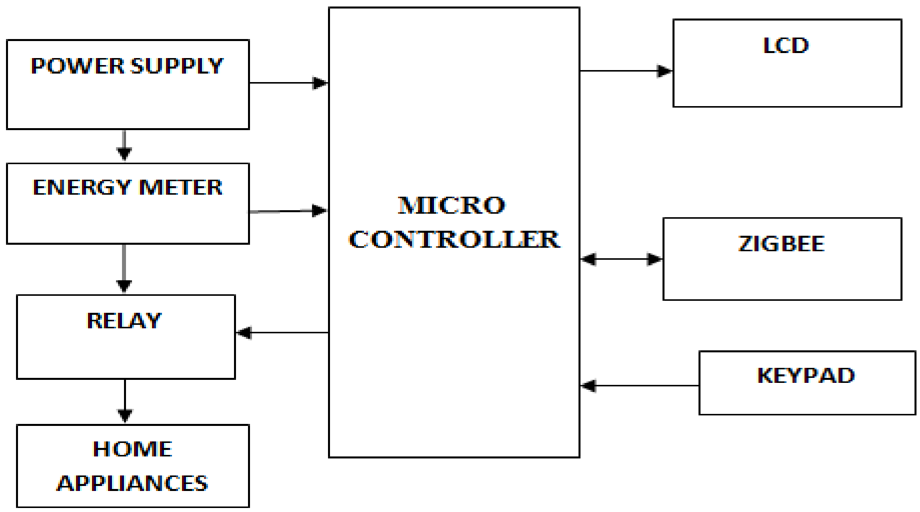

Figure 1 Home Section- I & II

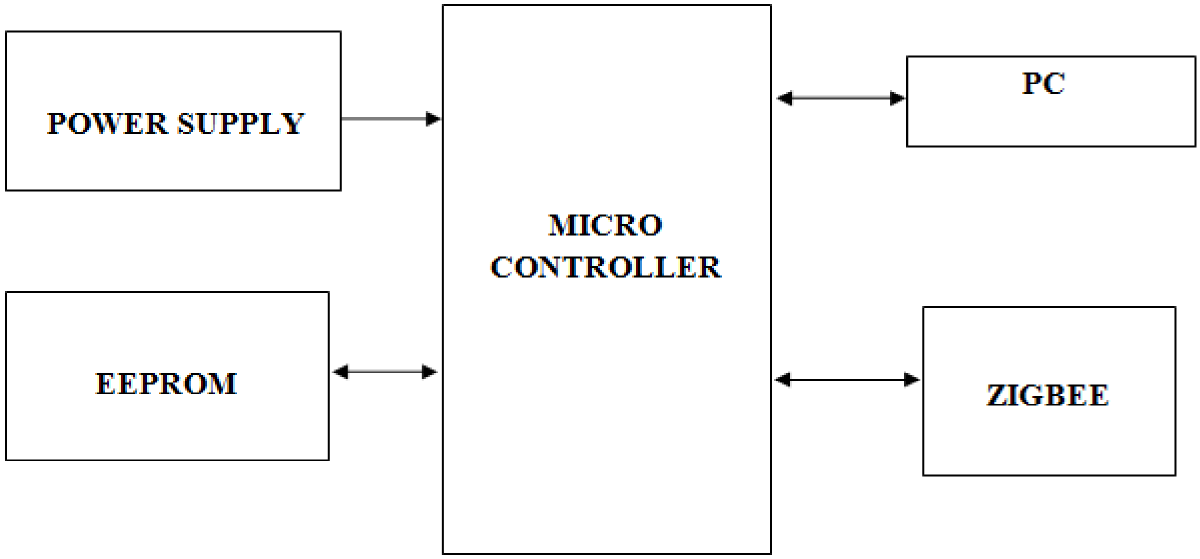

Figure 2 Monitoring Section

B. Home Section- I & II

Fig. 4 shows home section I & II transmits the energy usage through Zigbee communication to the monitoring section. Home appliances are connected to relay attached with electrical outlets. Electrical outlet measures the real-time ongoing accumulated energy consumption of appliances. Electrical outlet has provision of energy measurement of appliances with ZigBee communication. ZigBee network is suitable for low power management [7].In both sections appliances are connected through relays and for each appliance there is particular limit that can be set in microcontroller and by changing code limit also can be changed.

C. Monitoring Section and Home Section- I & II

Fig.5 shows monitoring Section and home Section- I & II, in this monitoring section includes pc with

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

Zigbee communication which receives energy usage from home section I & II. The most important is to measure the exact power and energy to transfer the energy usage of appliances. Monitoring section use IEEE 802.15.4 WPAN network and communicates with the ZigBee of the home server for information transmission and receiving. Home Section- I & II includes different appliances of different wattage and each appliance has its own limit in term of unit.

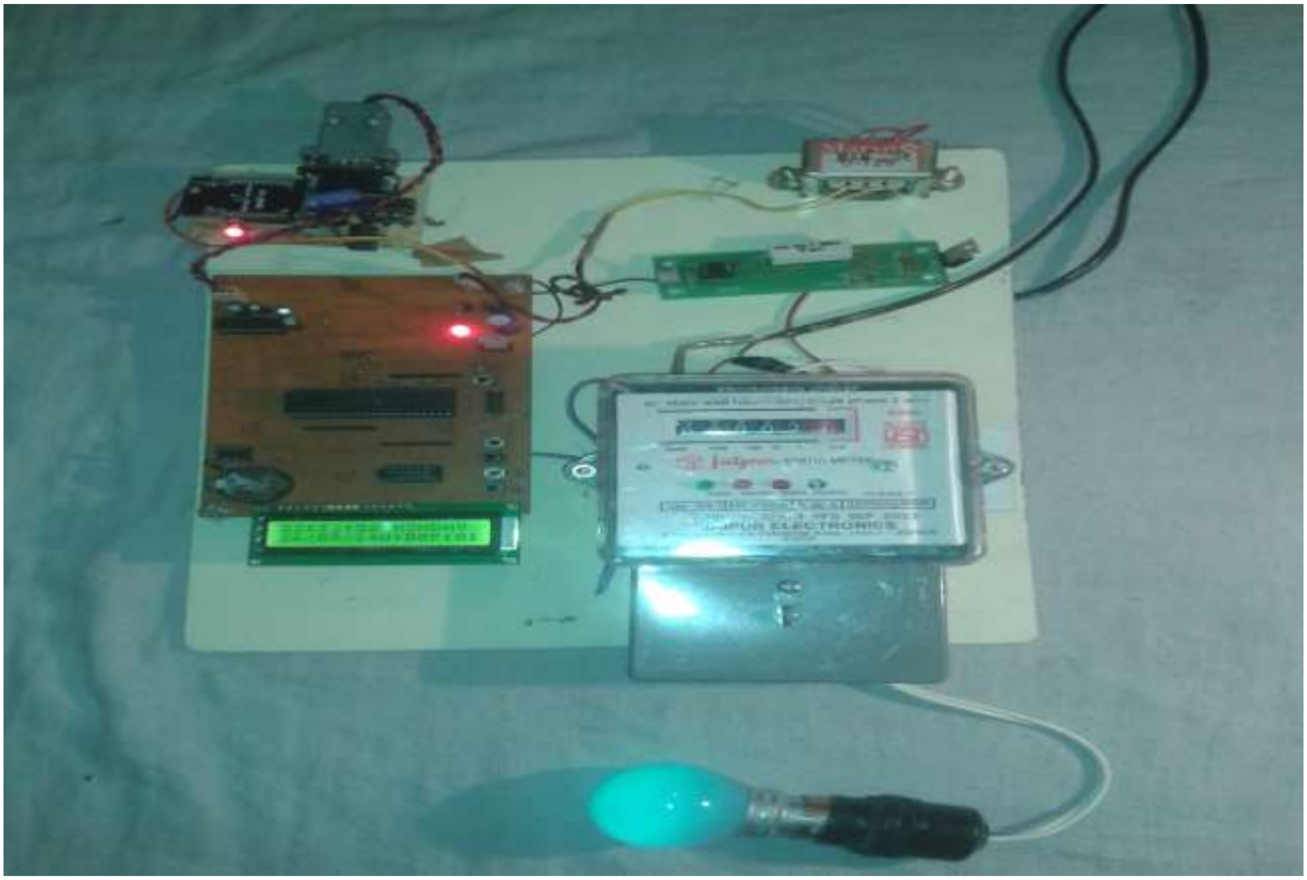

Figure 3 ***Home Section- I***

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

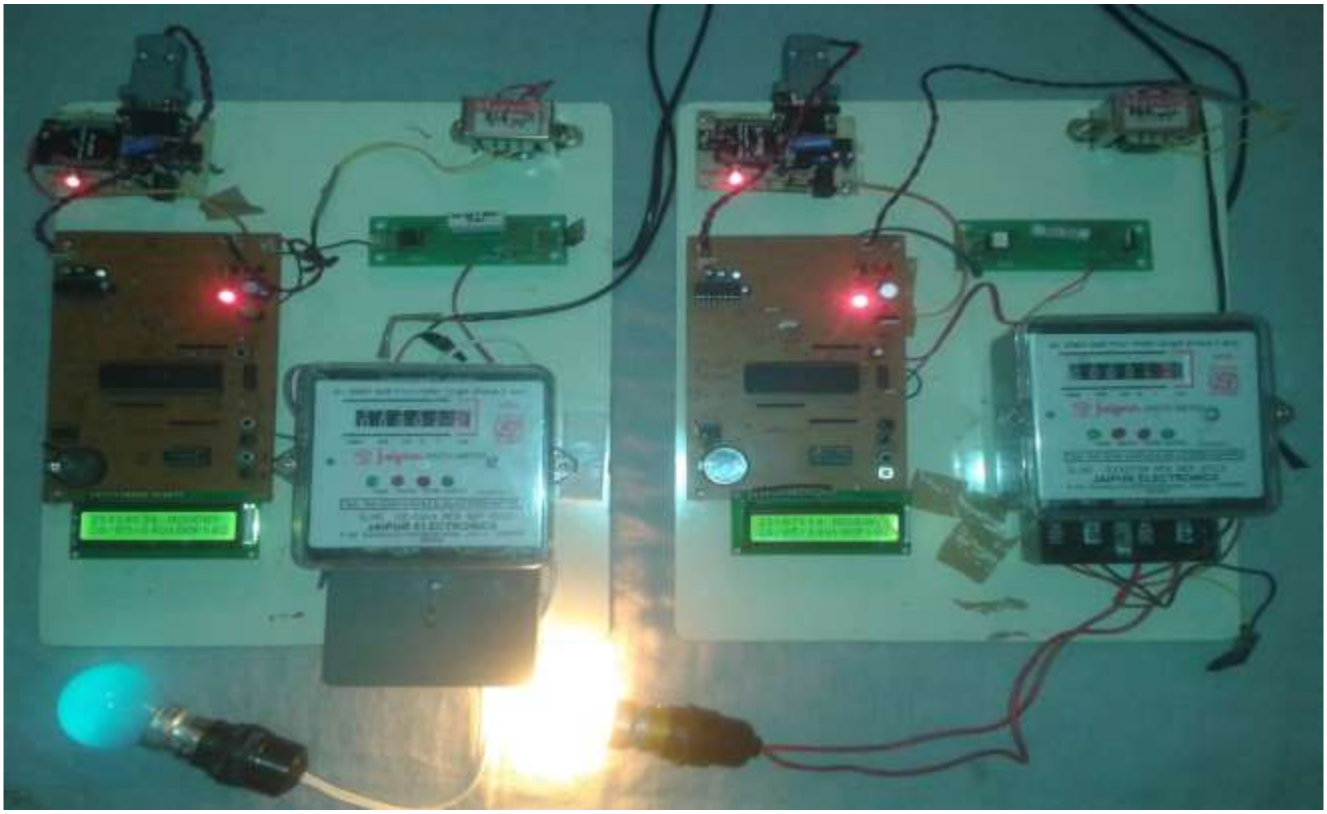

Figure 4 Home Section- I & II

Figure 5 Monitoring Section and Home Section- I & II

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

D .Component for giving power to AVR32 Micro controller:

Power supply unit contains transformer, regulator, capacitors and diodes. Transformer is used as step down transformer, 7805 regulator is used which gives +5V. Power supply is essential component as this section shows the important part from where the constant output is delivered all over the board in a regulated manner. Here a +5V DC power supply is used which has a 0-12V/1 mA step down transformer dedicated for this purpose. On/off switch is connected to the step down transformer which is provided with fuse to prevent from surcharge. Diodes are connected to secondary to convert 12V AC to 12V Dc voltage. Capacitors are used for filtering purpose which is regulated by LM7805.

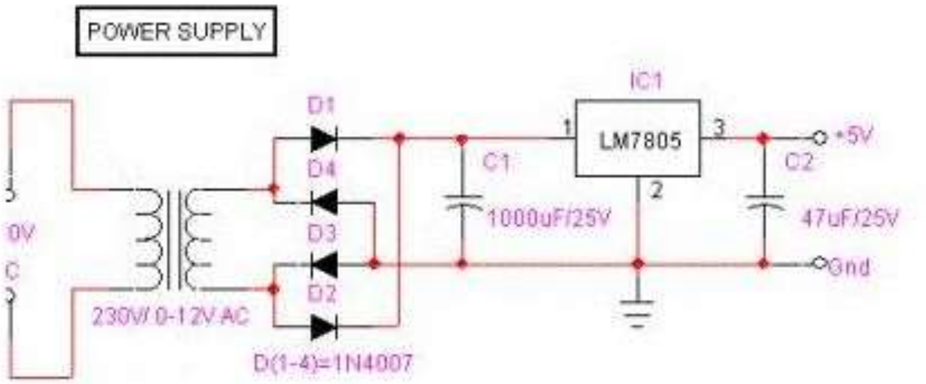

Figure 6 Power Supply

Proposed home energy management system

Fig.7 shows description of the proposed HEMS. The home consist two rooms and each room is attached with two power outlet, and one ZigBee hub. Appliances are connected through relay and particular limit for every appliance is set. After that limit exceeding by appliances relay goes in off condition. In monitoring section there is a log table which includes data regarding timing of getting on/off of appliances.

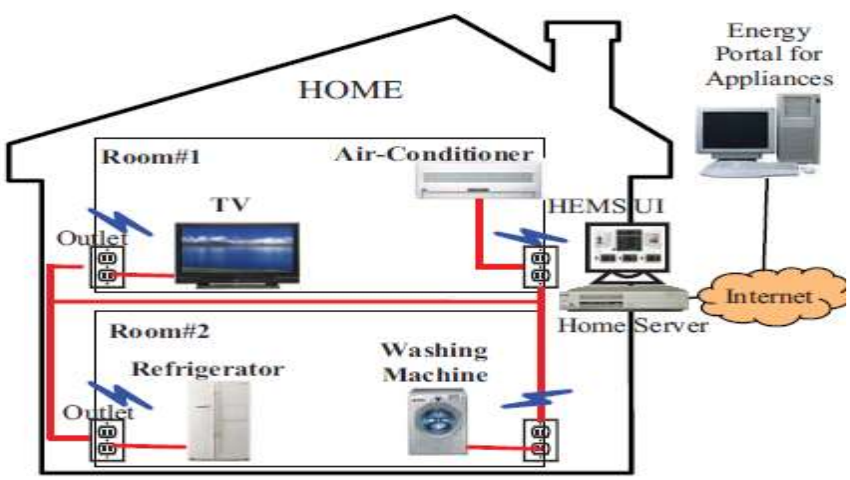

Figure 7 Description of Green HEMS

In microcontroller priorities are fixed regarding which appliance has to go in off condition as we can set least requirement appliance has to go in off condition first. Priorities will be given to which consumes maximum wattage in term of power for example air condition consumes maximum wattage then refrigerator, hence priority will be given to air condition and then refrigerator and so on. Users can easily determine full energy usage information of home. He can have explicit views of total energy he is using in each appliances and what kind of measures he could make by changing its functioning. This will help users to reduce and manage the home energy usage. Microcontroller also recognizes whether the connected home appliance is turned on/ off and whether it is on the standby/normal state by checking the consuming energy. Users can save the used time and energy usage detail of appliance as a record. He can also determine the insignificant energy waste in the standby mode and the operation energy usage in the normal mode. With the help of this kind of energy usage information from the HEMS in home-server, it is not easy for the user to know whether the appliance is energy efficient or inefficient, as there is no reference to match so we have used data log.

Implementation results

Fig.8 shows description of energy usage of different appliance in home section- I & II. In monitoring section there is a log table regarding timing of on/off of appliances and their corresponding energy consumption in term of unit. From log table, in normal mode, different appliances can consume different amount of power. As a result, least energy consuming appliances will be in on condition. We implemented home server and electrical outlet which measures energy usage of different appliances. Power and energy measurement is done by chip which communicates with ZigBee controller through serial communication. It can allow user to replace energy inefficient appliances with new appliance and to operate appliances in a very energy efficient pattern.

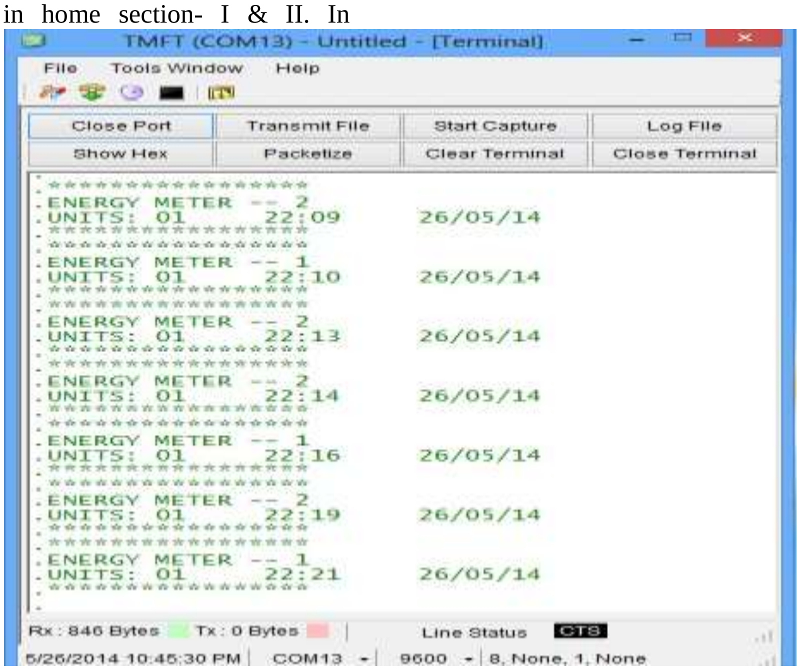

Figure 8 Description of Energy Usage of Appliance

Conclusion

User can control appliances by setting particular unit in microcontroller for controlling the appliances. In our configured ZigBee network there is home server, ZigBee hub, two home sections and lights of different wattage i.e considered as appliances. User also can control on/off condition of particular appliances by setting particular unit for particular appliances. Home server is a central control unit for controlling the appliances, which can control by relay. Home server can control the power outlets through the ZigBee hub. A user can understand energy efficiency of appliances by comparing the energy usage of appliances to the reference. With help of the energy usage comparison, a user can change the usage pattern of appliances into more energy efficient one, or replace an energy inefficient appliance into an energy efficient one. As a result, our proposed HEMS help to reduce and manage the total home energy usage that will also keep control of electricity bill and control the energy crisis and the environmental problem.

References

1. Sarah Darby, “The Effectiveness of Feedback on Energy Consumption,” Environmental Change Institute, Univ. of Oxford, Apr. 2006.
2. Tsuyoshi Ueno, Ryo Inada, Osamu Saeki, and Kiichiro Tsuji, “Effectiveness of Displaying Energy Consumption Data in Residential Houses - Analysis on How the

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 1.852

Residents Respond," Proceedings of ECEEE 2005 Summer Study,2005.

3. Young-Sung Son and Kyeong-Deok Moon, "Home Energy Management System Based on Power Line Communication," Proceedings of the 28th International *Conference on Consumer Electronics (ICCE), 2010*.
4. Chia-Hung Len, Ying-Wen Bai, Hsien-Chung Chen, and Chi-Huang Hung, "Home Appliance Energy Monitoring and Controlling Based on Power Line Communication," *Proceedings of the 27th International Conference on Consumer Electronics(ICCE),2009*.
5. Masahiro Inoue, Toshiyasu Higuma, oshiak Ito, Noriyuki Kushiro, and Hitoshi Kubota, "Network Architecture for Home Energy Management System," IEEE Trans on Consumer Electronics, Vol. 49, No. 3, pp. 606613, Aug. 2003.
6. Jinsoo Han, Chang-Sic Choi, and Ilwoo Lee, "More Efficient Home Energy Management System Based on ZigBee Communication and Infrared Remote Controls," Proceedings of the 29th International Conference on Consumer Electronics (ICCE), 2011.
7. Sungjin Park, Eun Ju Lee, Jae Hong Ryu, Seong-Soon Joo, and Hyung Seok Kim, "Distributed Borrowing Addressing Scheme for ZigBee/IEEE 802.15.4 Wireless Sensor Networks," *ETRI Journal*, vol.31, no.5, pp525-533, Oct. 2009