

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

Smart Energy Management System

M.Murali¹, B.Deepika², R.Deepika³, Ganugapentakavya⁴, Nellore Saiteja⁵

Assistant Professor, Department of Electronics and Communication Engineering, JNN Institute of Engineering,
Chennai, India¹

UG Students, Department of Electronics and Communication Engineering, JNN Institute of Engineering, Chennai,
India^{2,3,4,5}

ABSTRACT: Smart grids are an evolution of the existing electric distribution systems due to the growing demand of energy, the expansion in the use of renewable energy sources, and the development of novel communication technologies. This paper proposes a wireless energy management approach that combines a wireless network. The proposed addresses how energy is consumed by appliances and how energy can be generated besides electric board supply. Simulation results show that proposed approach is efficient in terms of reducing energy consumption and electric charges with an increase in comfort level of consumers. Proposed method is cost effective and easy

KEYWORDS: smart home, smart grid, home energy management, wireless sensor networks, zigbee communication

1. INTRODUCTION

The energy optimization is attracting an increasing interest among researchers as long as new “smarter” infrastructures and devices are going to replace the traditional ones in recent years. Smart energy management studies facilitates the cost-effective exploitation of the present renewable energy potential and to provide the required flexibility to the grid with the help of information and communication technologies. Considering that currently about 3% of world-wide energy is consumed by the information and communication technologies infrastructures, which causes about 2% of the world wide carbon dioxide emissions, several research efforts have been made in order to address and overcome this problem. These studies have led to smart grid concept in order to facilitate the cost effective exploitation of the present renewable energy potential and to provide the required flexibility to the electricity grid.

The smart grids are an evolution of the existing electric distribution systems due to the growing demand of energy [1], [2], the expansion in the use of renewable energy sources [3], [4] and the developments of novel and innovative ICT-based approaches [5], [6]. They are an efficient solution both from the energy and especially from the economic points of view. The term “smart grid” refers to an electricity transmission and distribution system that incorporates elements of traditional and cutting-edge power engineering, sophisticated sensing and monitoring technology, information technology, and communications to provide better grid performance and to support a wide array of additional services to consumers, such as energy efficiency, power quality and system reliability, obtained by using multiple tools of smart grid such as advanced meters, two-way communications and intelligent control equipment. From the studies and results shown in these works it is clear that smart grids can play also a concrete role in reducing the emissions of greenhouse gases, such as nitrous oxide, methane and carbon dioxide.

Applications of smart grid include several areas, such as transmission and distribution automation, optimized utilization, commodity trading in competitive markets, etc.,. However, an important role is also played by consumers because, the reduction of energy consumption can be obtained by only providing the consumption profile of appliances to the consumers and accordingly helping them to change their behaviour. This approach, known as Demand Side Management (DSM), based on bi-directional communication is enabled by smart grid in order to smooth the load curve of the traditional grid. DSM programs influence the behaviour of the consumers regarding electricity consumption. In fact, DSM technique mainly relies on matching present generation values with demand by controlling the energy consumption of appliances and optimizing their operation at the user side. A practical usage can be the shifting of “wet appliances”, such as washing machines and dishwashers, from peak time to off-peak time. Other

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

approaches are based on Time-of-Use (TOU) pricing, where electricity prices are set for a specific time period on an advance or forward basis.

Wireless Sensor Networks (WSNs) are getting more integrated to our daily lives and smart surroundings as they are being used for health, comfort and safety applications. In smart homes and office environments, WSNs are generally used to increase the inhabitant comfort. As the current energy grid is evolving into a smart grid, where consumers can directly reach and control their consumption, WSNs can take part in domestic energy management systems, as well. In fact, advanced ICTs, monitoring and control, energy harvesting and innovative metering technologies via smart wireless devices, are becoming increasingly important. For instance, a domestic energy management scheme based on a Wireless Sensor Home Area Network (WSHAN) is introduced. This scheme focus on the communication among smart appliances and an Energy Management Unit (EMU) through the wireless network and consumer demands are processed in near real-time. . The goal of the authors is to shift the consumer load to off-peak periods using the WSN for delivery their requests to the EMU. However, although the analyzed WSN-based works obtain good performance, their authors do not bother to choose the most appropriate wireless protocol. In fact, the choice of a wireless protocol with respect to another one may involve significant benefits and quite different results

To cope with the Home Energy Management (HEM) which can be optimized in smart grid environments, in this paper a novel energy management approach, called XbeeHEMS

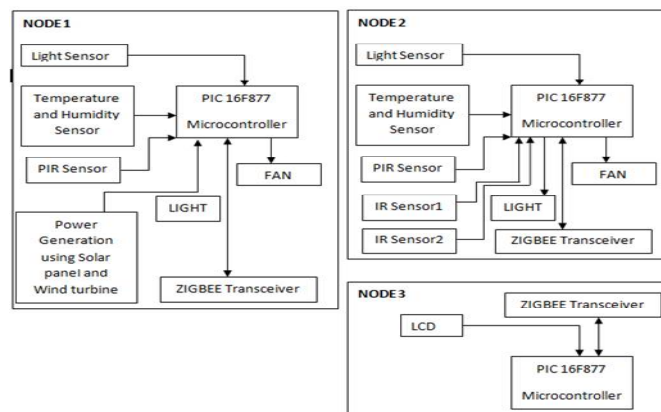


Fig 1.The proposed energy management system for smart home

(Zigbee Home Energy Management scheme) is introduced. In the proposed system, proximity sensors placed at the entrant of a building are used to identify the no of entrant/leaver/occupants in the room. If there is an occupant in the room, his/her position will be identified with the help of PIR Sensor (Works on the principle of thermal radiation). In addition to that the environmental parameters such as temperature, humidity and luminance re measured. Depending on the measured values the ON/OFF/SPEED CONTROL of the fan is achieved and also the brightness of the light is adjusted in-order to have low power consumption. The parameters measured from different parts of the building environment (node 1 & 2) were wireless (ZigBee Protocol-IEEE 802.15) transmitted to the base unit or node 3. In addition to reducing the power consumption, the power is also generated using solar panels and wind turbines in the node 1. Base unit computes and estimates the control strategy and send the signal back to the local monitoring units. This paper organized into three sections as follows node-1 where generation of power will takes, node-2 shows energy controlled consumption and node-3 shows simulation results.

II.EXPLANATION OF PROPOSED SYSTEM

It is necessary to note that the renewable power forecasting methodology is not addressed in this paper because it is not the main aim of this work. However, it is useful to briefly introduce some features that must be taken into account in the selection and development phases of renewable energy sources. For instance, regarding to the wind turbines, features like the high efficiency at low wind speeds and the capabilities of communication and remote monitoring have

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

to be considered. Likewise, the power ratings of solar photovoltaic panels and the power converter circuit required to DC-AC power conversion must be chosen in a similar way and the best angle for panels has to be calculated after facing the panels south in order to exploit solar energy potential.

Several electrical appliances are part of the smart home system. They are used at various time periods in every day depending mainly on the day of the week. In fact, there are substantial differences in the usage time of appliances through-out the day, especially between working days and weekend. For instance, a refrigerator can be active for a 25 min period in every 50 min because of its operation principle and similarly an air conditioner can be operated for 15 min in every half an hour only in the summer months.

The communication-based domestic energy management scheme proposed in this work aims at reducing home electricity consumption charges, decreasing the electricity bill of the consumer by shifting the appliances operation from peak demand hours to off-peak ones.

Here zigbee plays a major role for communication between nodes. PIC (peripheral interface controller) result about every node is communicated through zigbee.

A. Wireless Sensor Home Area Network

Wireless networks can be a great candidate for in-home applications because of their scalability for adding new appliances to the system easily. Both the power consumption and the amount of usage time of each consumption can be transferred through a wireless link and the on/off control on loads can be provided with commercially available "smart plugs

Several wireless technologies, such as Bluetooth Low Energy (BLE), IEEE 802.15.4/ZigBee and IEEE 802.11/Wi-Fi, that can support the remote data transfer, the sensing and the control, have been proposed in order to embed various levels of intelligence for smart homes. These protocols can use existing infrastructure, anyhow there is a main requirement that make a wireless protocol ideal for use in smart homes that is the energy efficiency. In many cases, the sensing nodes are battery-powered, so a low-power feature is a basic requirement both for the energy consumption of the entire house and for economic savings. For this reason the choice of the proper wireless protocol is a key feature in WSHAN

III. FEATURES OF ZIGBEE

1. Zigbee technology has many useful features and characteristics and these features of zigbee technology are the reason of its increasing demand.
2. Zigbee technology allows wireless networking to connect several units to control through one button like in business industry. This wireless networking avoids the threat of short circuiting.
3. As a wireless communication system zigbee technology helps to monitor the activities and manipulates in a better way. Low-power consumption feature of zigbee technology helps to run a device for long duration or sometimes this duration is of years.
4. Zigbee technology is used in three different types of devices which are used in networking according to its functionality. As prominently zigbee technology is a wireless technology for making a networking system. Coordinates are the primary devices to help in activation of the system by collecting the data in form of memory. Then router comes as a secondary device to perform the function by sending information to the destination. Third type of zigbee based devices are the end-user devices. These are basically receiver so are not able to send information itself. It remains in sleep mode while not in use so less amount of battery uses and resultantly longer life.

ALGORITHM FOR NODE 1:

1. Connecting the sensors to A/D converter of pic microcontroller.
2. Read through ADC_Read command.
3. Transmit it to zigbee using UART.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

ALGORITHM FOR NODE 2:

1. Similar to the algorithm used in node 1 sensors are interfaced to A/D converter of the pic controller and transmit it to zigbee using UART.

The proposed WSHAN enables a variety of use cases, for this reason a non-exhaustive list of examples is provided below:

- Light control: lights can be controlled from any switch in order to reduce the need of new wired connections. Lights can also be activated in response to a command from a remote control. Moreover, they can be turned on automatically when presence and luminance sensors detect that people are in a poorly illuminated room.
- Smart energy: window shades, HVAC, central heating, and so on may be controlled depending on the information collected by several types of sensors that monitor parameters such as temperature, humidity, light, and presence. Whereby, unnecessary waste of energy can thus be avoided. Furthermore, smart utility meters can be used to detect usage peaks and alert the household devices that may be causing them.
- Security and safety: advanced security systems can be based on several sensors (e.g., smoke detectors, glass-break sensors, and motion sensors) in order to detect possible risk situations that trigger appropriate actions in response. For example, smoke detectors may activate fire alarms.

IV.SOFTWARES USED:

1. PROTEUS
2. MIKRO C EMBEDDED

V.SIMULATION RESULTS

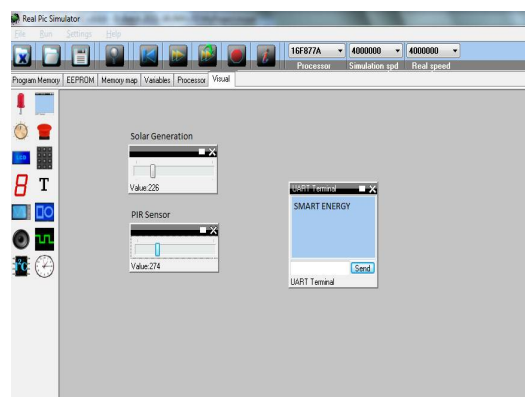
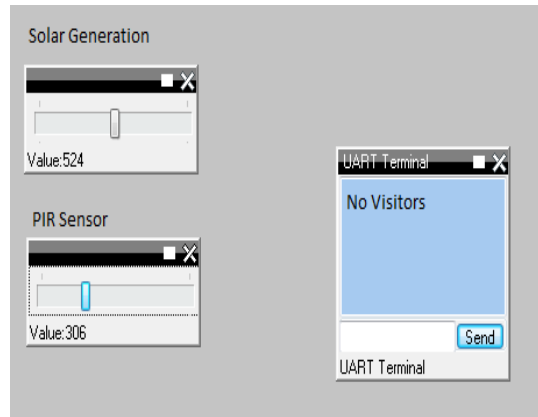


Fig2: simulation of UART terminal using real PIC Simulator

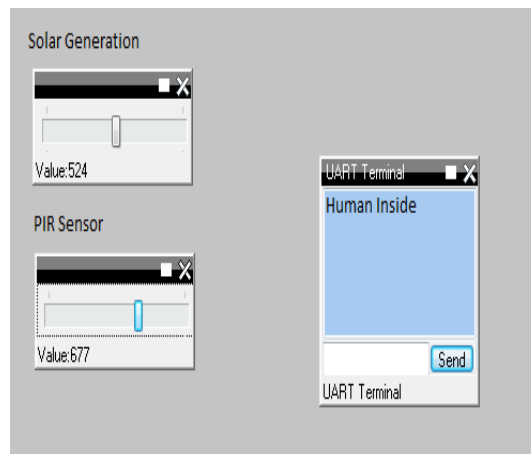
International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016



Since PIR sensor value is less than 500 the UART transmits. No visitors command



VI.CONCLUSION

The paper proposed an energy management approach for smart homes that combines a zigbee low energy WSHAN, for the communication among home appliances, with a HEM scheme .In fact, residential energy management, smart appliances, WSHANs, and their integration to smart grid applications are becoming popular topics because in these years a migration to smart grids is happening. Where by, a HEM implementation can lead to socially and economically beneficial environment by addressing consumers and utilities concerns.

Another future research direction is the application of Internet of things concept in smart home through zigbee low energy. In fact built on connections between digital devices and nearly an anything that can be monitored or controlled electronically, the IoT holds promise for making homes smarter.

REFERENCES

- [1].Giovanni pau and Mario Collotta ,”A Novel Energy Management approach for smart homes using Bluetooth low energy,” *IEEE Journal on selected areas in communication*, vol.33, no.12, Dec. 2015.
- [2].H.Nguyen,J.Song, and Z.Han ,”Distributed demand side management with energy storage in smart grid,” *IEEE Trans. Parallel Distrib. Syst.*, Nov. 2014, doi: 10.1109/TPDS. 2014.2372781.
- [3].A.Mishra,D.Irwin, P.Shenoy, J.Kurose and T.Zhu, “Green Charge: Managing Renewable Energy in Smart Buildings,” *IEEE J.Sel. Areas commun.*, vol.31,no.7, pp.1281-1293, July .2013
- [4].P.Samadi,H.Mohsenian-Rad, V.Wong, and R.Schober, “Tackling the load uncertainty challenges for energy consumption scheduling in smart grid,” *IEEE Trans. Smart grid*, vol.4, no.2, pp.1007-1016, June.2013
- [5].M.Erol-Kantarci and H.Mouftah, “Wireless sensor networks for domestic energy management in smart grids,” in Proc. 25th Biennial Symp. Commun, May 2010, pp.63-66.