REVIEW OF RENEWABLE ENERGY MANAGEMANT SYSTEM FOR SMART HOMES

Nupur Sinha[1], Prof. Rupali S. Khule [2]

[1] *Student, Electronics and Telecommunication, MCEORC, Nashik Maharashtra, India*
[2] *Professor, Electronics and Telecommunication, MCEORC, Nashik Maharashtra, India*

ABSTRACT

Energy consumption increases day by day as more appliances used in today's home. Increasing energy demand and limitations of fossil fuels, time to use the renewable resources for energy generation in domestic areas. This paper reviews various energy saving techniques used in home automation and proposes renewable energy management system architecture for smart homes in which energy consumption and generation simultaneously for efficient energy, minimization of consumption and environment friendly. Microcontroller based energy management module with ZigBee is used to control and monitor the energy consumption of smart home. The propose system is used the solar and wind resources as these are not always available, also introduce water resources to generate the electricity. The charge controller, battery bank and battery level monitoring are used to provide stable energy module for smart home. Energy consumption should be minimized by users, can access home energy information through smart devices. The propose system save the limited fossil fuels, generated efficient energy and minimize energy consumption.

Keywords: - *Renewable Energy Sources (RES), Renewable Energy Management System (REMS), Charge Controller, Battery Level Monitoring, ZigBee*

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1. INTRODUCTION

Today's energy crisis becomes global problem for the world. We need to reduce the wastage of electricity in day to day life. But the consumption of electricity increases year to year as more home appliances are installed. So, today's the energy saving becomes first priority. Because of the limited fossil fuels, these generations have started the use of different ways of electricity generation like using the renewable energy sources. Solar, wind and water sources are easily available anywhere on earth. Renewable Energy Sources (RES) as an important approach to meeting rural energy needs, reducing pollution, and promoting economic development. A Smart Home is a house that uses new technologies to monitor the in-house temperature, out-house climate changes, control and monitor the home appliances and communicates with the worldwide. This paper gives an overview of different techniques used for energy management and proposes an efficient energy model for energy consumption and generation.

Smart Homes provide various controls over appliances like

- Remote Lighting Control
- Home Security Solution
- Outdoor Security
- Temperature and Humidity Alert
- Door and Windows Controlling
- Smoke and Air Alert
- Leak and Water Alert
- Vibration Alert
- Energy Efficient

This paper has been organized into four sections. In section 2 gives the brief review of different proposed paper for energy consumption. In Section 3, a brief idea about proposes system architecture. Finally the paper is concluded in section 4.

2. REVIEW OF PREVIOUS WORK

Several researches have proposed for energy saving model for Home Energy Management System (HEMS).

In 2008, Chia-Hung Lien, et al, proposed an embedded system without any new additional wiring has been developed for home power management. By using PLC technology, electric home appliances can be controlled and monitored through domestic power lines. Techniques describes a PPCOM (PLC Power-Controlled Outlet Module) which integrates the multiple AC power sockets, the power measuring module, the PLC module and a microcontroller into a power outlet to switch the power of the sockets on/off and to measure the power consumption of plugged-in electric home appliances. This HEMS model that monitors, compares, and controls home appliances. [1]

In 2009, Khusvinder Gill, et al, proposed a new and exciting opportunities to increase the connectivity of devices within the home for the purpose of home automation. Moreover, with the rapid expansion of the Internet, there is the added potential for the remote control and monitoring of such network enabled devices. However, the adoption of home automation systems has been slow. This paper identifies the reasons for this slow adoption and evaluates the potential of ZigBee for addressing these problems through the design and implementation of flexible home automation architecture [2].

In 2010, Young-Sung Son, et al, proposed an optimization of home power consumption based on power line communication. This work considers a device control module to handle networked home appliances. Smart metering and power line communication can provide detailed information of energy consumption patterns and intelligent controlling to appliances at home. This work considers a device control module to handle networked home appliances; it does not consider the energy generation. The HEMS consists of three modules: an advanced power control planning engine, a device control module, and a power resource management server. Our prototype system reduces the cost of power consumption by about 10%. [3]

In 2011, Jinsoo Han, et al, proposed a new technology Home Energy Management System to reduce and manage home energy use. The feedback on energy consumption to energy users is known to be effective to reduce total energy use. A typical HEMS just shows the energy consumption of the whole home and home appliances. This HEMS that monitors, compares, and controls home appliances has been proposed. Users cannot figure out how efficient a home appliance is, compared to the others. So it is necessary to compare the energy usage of home appliances to that of the same kinds of home appliances. [4]

In 2011, J. Han, et al, proposed a design of more efficient home energy management system to reduce power consumption in home area and consider the room easily controllable with an IR remote control of a home device. The room has automatic standby power cut-off outlets, a light, and a ZigBee hub. The ZigBee hub has an IR code learning function and educates the IR remote control signal of a home device connected to the power outlet. Then the power outlets and the light in the room can be controlled with an IR remote control. A typical automatic standby power cut-off outlet has a waiting time before cutting off the electric power. It consumes standby power during that time. To eliminate the waiting time, we turn off the home device and the power outlet simultaneously with an IR remote control through the ZigBee hub. This method actively reduces the standby power. The proposed HEMS provide easy way to add, delete, and move home devices to other power outlets. When a home device is moved to the different outlet, the energy information of the home device is kept consistently and seamlessly regardless of location change. The proposed architecture gives more efficient energy-saving HEMS. This works only consider the energy consumption. [5]

In 2013, M. Kuzlu, et al, proposed the hardware demonstration of the proposed HEMS for managing end-use appliances. The HEM's communication time delay to perform load control is analyzed, along with its residual energy consumption. HEMS system plays a crucial role in realizing residential DR programs in the smart grid

environment. It provides a homeowner the ability to automatically perform smart load controls based on home utility signals, customer's preference and load priority. This work considers a device control module to handle networked home appliances; it does not consider the energy generation. [6]

In 2014, Nabih Jaber proposed a practical HEMS that support various existing and emerging actors. Consumer domain energy management systems or HEMS is largely neglected in existing practical smart grid EMS studies. It presents Some of the proposed features include the support of automatic and manual scheduling and control of the devices, continuous monitoring and efficient notification. The goal of the design is to achieve optimized performance under dynamic situations. For better understanding and implementation of the concepts behind our proposed design, detailed Use Case diagrams of the various actors and their functionalities are presented. A substantial amount of peak shaving/shifting is observed using the proposed application. [7]

In 2014, M. M. Rahman, et al., proposed a web-based architecture to enable information retrieval and appliance management for HEMS. With the proposed architecture, homeowners can monitor their basic energy usage information, and can perform necessary appliance management based on their pre-defined load priority, preferences, and comfort settings. The proposed architecture is designed based on the Standard Energy Usage Information, which ensures interoperability among smart grid equipment. It is also designed with comprehensive security measures. It is expected that the proposed architecture can serve as a reference model for custom hardware designs and implementation of a real time, lightweight and reliable embedded web server for HEM applications in the smart grid environment. [8]

In 2014, D. Bian, et al, proposed a design of effective HEMS requires selection of an appropriate communication technology. The objective of this paper is to compare commonly used communication technologies for HEMS implementation in a premises area network, in terms of their latency, throughput, reliability, power consumption and implementation costs. Communication technologies of interest include ZigBee, Wi-Fi and Ethernet. These technologies are simulated in OPNET. This paper compares the performance of selected communication technologies using two communication schemes, i.e., Always-on and Turn-on-in-loop. It also analyzes the impact of the number of devices being controlled by the HEM on the technology performance [9].

In 2014, Jinsoo Han, et al, proposed a smart HEMS architecture that considers both energy consumption and generation simultaneously. ZigBee based energy measurement modules are used to monitor the energy consumption of home appliances and lights. A PLC based renewable energy gateway is used to monitor the energy generation of renewable energies. The home server gathers the energy consumption and generation data, analyzes them for energy estimation, and controls the home energy use schedule to minimize the energy cost. The remote energy management server aggregates the energy data from numerous home servers, compares them, and creates useful statistical analysis information. By considering both energy consumption and generation, the proposed HEMS architecture is expected to optimize home energy use and result in home energy cost saving. [10]

Electricity generation using renewable energy sources and utilization of electricity is focus of the propose system. The existing project limits the use of generated electricity via renewable energy resources. We are using battery bank to store energy generated by solar energy system, wind energy system and water energy system. And also focus to provide sufficient energy to modernize the rural or rare areas homes.

The objective of the proposed work is to provide automation using Graphics User Interface (GUI) to end user, and reach to save power consumption of the home appliances. Design an Energy Management System for home, based on renewable energy sources.

- To encourage the use of renewable energy source.
- To save the limited fossil fuels.
- To provide energy security.
- To reduce the environmental pollution.
- Design an energy efficient smart home.
- Design a secured smart home for users.

Applications of the propose system are

- Increasing energy efficiency.

- Easy to handle home automation
- Decreasing costs of energy uses
- Decreasing the carbon footprint
- To enhance the use of Green Energy
- Developing rural home infrastructure
- Realization of the low carbon society and sustainable development

From discussion of all above work related HEMS which manage energy use to achieve a balance between energy saving and a comfortable lifestyle in the home. Also defined the limitation of existing system and significant of proposed system. This chapter is also discussed about need of using renewable energy resources in short. We propose a novel model to use of renewable energy resource for smart home.

3. PROPOSE SYSTEM

Fig.1 shows the system architecture of Renewable Energy Management System for smart home which generate energy using RES and minimize the energy consumption using remote access of home appliances. In the energy consumption part, the energy consumption of home appliances is monitored through users mobile to know about the current status of the appliances.

3.1 Description of Proposed System

The user can see the current status of their home appliances anywhere of the world and control it via graphic user interface (GUI) of the home. In the energy generation, RES used to generate electricity as the solar panel generates DC voltage and the wind and water turbines generates AC voltage. Generated electricity stored in battery bank, which have controlled by use charge controller module. Charge controller unit maintained the charging voltage, control charging current and protects battery from being overcharged. ARM 9 microcontrollers used to control relay module to control the home appliance.

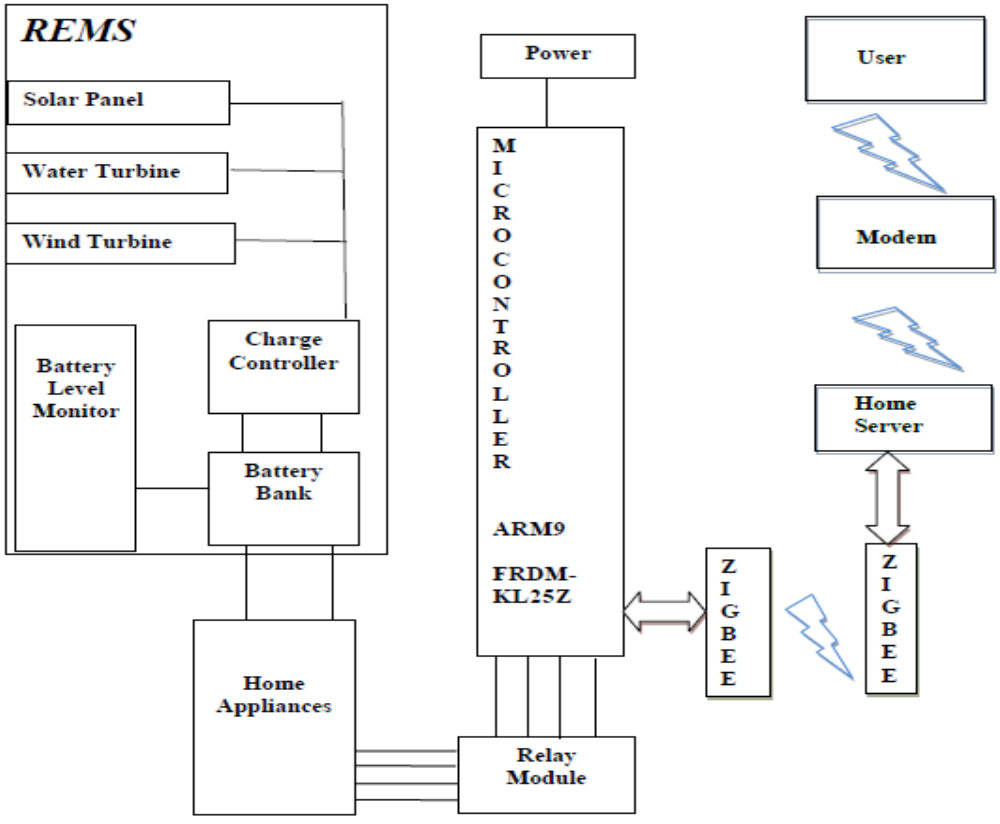

Fig. - 1 Propose System Architecture

The figure 1 shown above is the architecture of the proposed system. It is illustration of how we have to implement the energy generation and reduce the energy consumption using home automation.
User - For home automation, first the user call the home automation web page and select home appliances, which send commands and instructions to server via internet(GPRS, Wi-Fi), where top-level directory of the web application hierarchy is also the document in root of the application. We will place the HTML files and JSP pages that comprise the application's user interface. When the system administrator deploys the application into a particular server, need to assigns a context path to the application. Thus, if the system administrator assigns the application to the context path /catalog, then a request URI referring to /catalog/index.html will retrieve the index.html file from the document root.
Modem - User can access the home server which is connected to internet via modem or Wi-Fi.
Home Server - The Home Server connects user interface to hardware interface. It has application programming, which communicate with user via GPRS and microcontroller through ZigBee. Home server sends command to microcontroller through ZigBee transceiver. Microcontroller get signal and run accordingly to carry out specific operations.
ZigBee TxRx – ZigBee used to communicate the microcontroller to home server and provide a wireless interface with wide range.
ARM 9 Microcontroller – Control the relay module as per the user request and command received from home server via ZigBee.
Relay Module – Relay is using to switch the appliances, which user send commands to microcontroller.
Home Appliances – Proposed system provide the home automation means controlling of appliances can be done remotely. Appliances controlled by relay which is connected to the controller.
Battery Bank – Battery bank is used to store DC voltage generated by solar. Wind, and water resources generates AC voltage
Battery Level Monitoring (BLM) – BLM used to monitor the voltage level of battery bank.
Charge Controller – Charge controller used in the project for following purpose.

- To maintain the charging voltage
- Control the charging current.
- Protect battery for being overcharged.

Renewable Energy Generation - In the propose system energy generates from Solar, Wind as well as Water resources. Renewable energy sources as solar, wind and water that is used in this project, which promise a clean and cost effective factor that simultaneously turns out to be an opaque medium against harmful reactions to our ecosystem. Solar panel can generate 3w, 6V DC, water turbine 5-10VAC, wind turbine, 5-10 VAC.

3.2 Software Architecture

Figure 2 shows the software architecture of the proposed system.

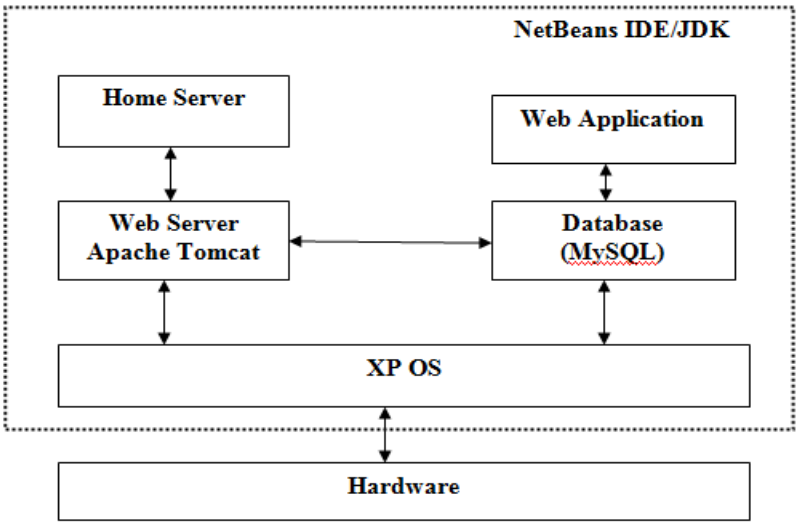

Fig. 2 - Software Architecture of the Proposed System

Home Server - The home server is a centralized controller and user interface for an in-house system. It also provides a simple Web browser for information and guidance from the Internet.
Web Server - Internet technologies such as TCP/IP, HTML, JavaScript, Web Server and Cipher Security are ported into the embedded home server which is controlled and monitored with HTML interface from both in-house and out-of-house via the Internet. Property and status of appliances are expressed with their structure by HTML and JavaScript, whose description capability is excellent.

Database (MySQL) - MySQL is a popular choice of database for use in web applications, and is a central component of the widely used LAMP open source web application software stack (and other 'AMP' stacks). LAMP is an acronym for "Linux, Apache, MySQL, Perl/PHP/Python." Free-software-open source projects that require a full-featured database management system often use MySQL

XP OS – Window Xp is an operating system. An operating system (OS) is software that manages computer hardware and software resources and provides common services for computer programs. The operating system is an essential component of the system software in a computer system. Application programs usually require an operating system to function.

Web Application - Web Application programs are used to control appliances in a house. Application service providers can monitor/control appliances remotely and can develop various application service for home users with network access techniques using HTML and JavaScript. A Graphic User Interface (GUI) web application created, so the user can easily access the home server status. We built the web application to monitor the appliances status and the power consumption. The user can have their secured login id and password which provide security profile to home users. The users can create own login id and password in registration window. The On/Off control of home appliances can be done in home web window.

Hardware - We use the ZigBee to receive/transmit between the home server and the hardware. The home server provides an automation system for energy monitoring and controlling to home users.

4. CONCLUSION

The present paper reviews the different home automation techniques. The major techniques used for the home automation using ZigBee and Power Line communication using different algorithm. We propose an efficient energy model for smart homes which consider energy consumption as well as energy generation by using renewable sources and use a low-power ZigBee communication network to measure and transfer the power and energy of home appliances. Limitation of fossil fuels and nuclear fuels are the major factors to think about using renewable energy resources to generate the electricity. The propose system save the limited fossil fuels, generated efficient energy and minimize energy consumption.

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