Application of Smart Energy Management in Green Buildings

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ABSTRACT: Smart energy management intends to monitor and control consumption, in order that electricity companies can predict usage, reduce waste and make the power network more competent and effective in managing with increasing demand. In the present era, with the growing amount of supply and demand augmentation, in future there will be demand for smarter energy distribution system. The setting up of huge number of electric power generation stations may have undesirable effect on atmosphere. Hence, smart energy management system is one of the excellent and advanced techniques which facilitate smart grid operations. throughout the installation and amalgamation of smart grids there are a few aspects like utilization of electric energy, energy storage, and generation resources should be optimized in such a way that saves energy, enhances efficiency, maintains security and improves reliability during growing demand at lowest operating cost.
KEY WORDS: Energy consumption, Energy management system, Renewable energy system, Solar heating system, Artificial neural network, Fuzzy system**.**

1. INTRODUCTION

Energy management system has been introduced to maintain the balance between energy demand and supply. Owing to rise in demand it is difficult to maintain the balancing between energy demand and energy supply. There is requirement of an energy management system which compensates these issues without any loss of energy and supplies sustainable energy with less cost. Smart technology allows companies and households to use energy more efficiently, reducing the need to build more power stations, some of which burn polluting fossil fuels such as coal or gas. A few of the renewable energy sources may be considered as the foundation for making smart energy buildings which decreases the cost of building scheme. From the view of distributed generation it may be considered as upcoming power generation by the installation of renewable energy systems and storage systems. It will lead into smart energy buildings which will be in the form of Off-grid/Hybrid/Grid tied based solar system. Owing to the advancement of smart methods like fuzzy logic systems and artificial neural network system it is encouraging to decrease billing cost of energy building structures. Green house gas emission is too a grave concern during the installation of energy buildings. To reduce this pollution we can go for hydro or wind energy systems. But, they are completely weather dependent and they can reach up to only 14% generation of electricity due to intermittent sources in nature. To conquer the crisis of more energy demand and gas emission a novel technique is anticipated for instance smart system services for the development of building performance. This paper mainly focuses with the improved technologies for smart home energy management system in order to control its operations in secure, reliable and economical way. Smart energy management system has been defined as series of different policies, procedures and methods to monitor operational utilization of energy. Some techniques like PLC have also been introduced for making smart building infrastructure [6]. Energy is simply the direct consumption of fossil fuel like coal, water or natural energy source So there is an strategy of utilizing energy sources and produce electricity with high efficiency by employing smart methodologies keeping under consideration of

Fig.1Block diagram of smart energy management system.

low cost. Due to this it focuses on maximizing profits with reducing operational cost [7]. Figure 1 shows the block diagram of smart energy management system in which it performs various functions like monitoring and control, measurement and analysis, load balancing, load forecasting, energy planning and enhance factors of energy generation and transmission. All these functions are maintained during normal and dynamic condition. Thus the smart energy management system has capability for monitoring, controlling and the optimization of entire system operation for achieving better response. This paper is presented in six sections in addition to introduction. In section2, brief description about green energy and green building is presented. Section 3 outlines regarding role of smart energy management system technologies and utilization of sustainable resources. Section 4 describes about smart energy management system based on fuzzy logic. In section5, smart energy management systems based on artificial neural network have been discussed. Finally, section 6 gives the conclusion.

II. GREEN ENERGY AND GREEN BUILDING.

2.1 GREEN ENERGY

Green energy is a kind of energy which is produced from natural resources, like sunlight, wind or water. It often comes from renewable energy sources. The key with these energy resources are that they don't harm the environment through aspects like releasing greenhouse gases into the atmosphere. In turn to be deemed green energy, a resource cannot produce pollution, such as is found with fossil fuels. This means that not all sources used by the renewable energy sources are green. For example, power generation that burns organic material from sustainable forests may be renewable, but it is not necessarily green, due to the CO_2 produced by the burning process itself. Green energy sources are usually naturally replenished, as opposed to fossil fuel sources like natural gas or coal, which can take millions of years to develop. Green sources also often avoid mining or drilling operations that can be damaging to eco-systems.

2.2 GREEN BUILDING

A green building is a building that, in its design, construction or operation, reduces or eliminates negative impacts and can create positive impacts on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life. A design which make feasible for adjustment to a changing environment. Green building in energy management is overarching strategies in a refurb project comprise reducing energy demand, increasing source efficiency, and tracking the live energy use of the building. Any building can be a green building, whether it is a home, an office, a school, a hospital or any other type structure. Though, it is to be noted that not every green buildings are and require being the same. Different countries and regions have a diversity of characteristics like distinguishing climatic conditions, distinctive cultures and traditions, building types & eras, broad ranging environmental, economic & social priorities-all of which shape their approach to green building. Some of the features of a green building are:-

(i) Efficient utilization of energy, water and other resources.

(ii) Utilization of renewable energy like solar energy.

(iii) Pollution and waste reduction measures and enabling of re-use & recycling

(iv) Utilization of non toxic, ethical & sustainable materials.

(v) Excellent indoor environment air quality.

III. ROLE OF SMART EMS TECHNOLOGIES AND UTILIZATION OF SUSTAINABLE RESOURCES.

Smart energy management intends to monitor and control consumption of energy, in order that electricity companies can predict usage, reduce waste and make the power network more proficient and effective in coping with rising demand. Smart technology permits companies and households to utilize energy more competently, reducing the necessity of building more power stations, a few of which burn polluting fossil fuels like coal or gas. Function of smart techniques is very significant and necessary to resolve

population concerns around their environment in order that they can attain better results with novel foundation of sustainable energy source. It is a prospect for customer to build up a new model for enhancing continuity of energy demands in their life. Hence a few key features such as global warming, minimization of energy cost, balancing among demand and supply etc. are needed to conquer the sustainable energy life. As green house gas emissions are incessantly growing gradually on huge scale because of change in climate concerns thus it impacts on the global environment. Aside from increase in carbon dioxide gas emission there is also trouble of nitrogen monoxide and methane gas emission. When we come across energy sector the production of electricity is globally based on fossil fuel on huge scale mainly on coal and natural fuel. Consequently rate of energy conversion is also very low owing to low efficiency and large gas emissions [8]. For coal based energy plants the anticipated level of energy production is around 30%-40% in terms of efficiency while for natural gas efficiency may be around 65%. The function of current fossil fuels based techniques may be followed with a huge rate of waste heat. Presently energy conversion efficiency of solar PV has been increased from 13 to 17% as compared to previous years. Similarly employing wind energy conversion technologies have also impact with an average efficiency of 35% to 40% depends on the category of wind farm whether it is onshore or offshore.   Main issue with wind energy is installation cost. The best way of utilization of renewable energy sources besides of advanced technologies is to connect with transmission grid properly means to ensure perfect connectivity for enhancing continuous supply of energy. Hence globally energy interconnection with grids is highly on demand for sustainable energy production and keeps balancing between customer and energy supply. The major goal of present advanced energy storage devices is to continue at least for 20 years with synchronously reducing degradation with adequate cost and security.

IV. SMART ENERGY MANAGEMENT SYSTEM BASED ON FUZZY LOGIC.

Fig.2 shows the fuzzy logic based smart energy management system. Application of fuzzy based system in smart energy management s y s t e m
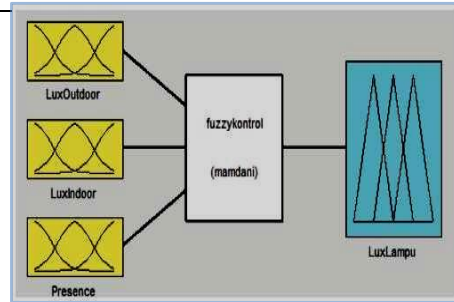

Fig.2 Fuzzy logic based smart energy management system.

has been carried out to resolve problems in one system. There are numerous techniques to accomplish optimal control for smart energy system with monitoring and controlling all the parameters keeping all the considerations. Zhang and Hanby [9] make use of supervisory control occupying renewable energy source and employs evolutionary algorithm in order to attain optimal solution. There are also optimizations methods developed to conquer the crisis of energy demand during peak load condition where power consumption and high utilization of power have to be controlled.

Fuzzy logic controller has been devised in order to optimize energy consumption to make certain proper functioning. Many researchers have developed intelligent energy management system with maintaining all the appropriate conditions favor to smart buildings. Fuzzy based systems are employed to monitor and regulate characteristics and climate conditions. So fuzzy logic based system has been developed by Lotfi Zadeh keeping in order to realize knowledge about controlling of system [10]. In this entire mechanism operation of inference can be proceed from enhancing inputs, makes a decisions rules based on those rules it has to execute and output has to be taken as ultimate conclusion.

4.1 APPLICATIONS OF FUZZY LOGIC SYSTEM

Fuzzy logic system has been employed for renewable energy sources like solar, wind, bio-energy and hybrid energy. Mamlook et.al has presented fuzzy logic set technique to evaluate the profit cost for various solar systems [11]. Gunderson et.al have proposed graphical method based on fuzzy logic to determine potential sites for solar system power plants. Thus, fuzzy densities are accomplished for criteria and sub-criteria purposes. The criteria purposes are land factor, energy factor, environmental and social factor. All of these criteria have its own sub-criteria. There are

a few dynamic fuzzy set models which are employed to resolve crisis in solar based array systems. So, fuzzy logic tool is introduced to handle spatial data to identify potential sites for solar array system installations. As well for maximum power point tracking system in solar system fuzzy logic controllers have been compared with traditional PI controllers. Hence a fuzzy based logic controller has been chosen for stand-alone utilization of solar power system. Therefore the designing of fuzzylogic based system has been proposed for different factor measurements such as voltage control, stability of power system and speed control principles. So for smart buildings we can develop fuzzy logic controller using renewable energy sources.

V. SMART ENERGY MANAGEMENT SYSTEM BASED ON ARTIFICIAL NEURAL NETWORK (ANN).

An Artificial Neural Network (ANN) is essentially an algorithm in which it develops non linear models and simulates human brain. It has distinctive method to deal with non linear relationships among input and output signals. Thus it collects input and output signals from dataset, pre- processes of inputs and outputs then it designs neural network designing and evaluates the Performance of neural network [12]. Fig.3 shows artificial neural network system which is based on smart energy management system.
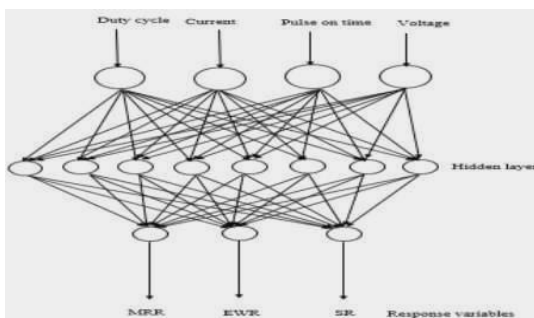

Fig.3 Artificial Neural Network System.

5.1APPLICATIONS OF ARTIFICIAL NEURAL NETWORK SYSTEM

Many researchers have presented their work based on artificial neural network through modeling and prediction in energy systems for buildings applications. They require proper models for the prediction of solar energy and wind power systems. These systems aredesigned based on their

environmental perceptions on which they operate. So ANN based system can be activated in diverse ways like solar water heating systems.

In solar water heating systems, a multilayer feed forward artificial neural system can be favored. This system is installed under all solar power forecast aspects under which it operates reliably. The useful extracted energy from the output network is stored and utilized for rising the temperature of collected water. Solar heating system is operated with keeping parameters which are acquired from performance equations. All the anticipated values used for operation of whole system are easily comparable. Thus the results attained show the proper evaluation of parameters and signify the overall optimal performance of solar heating system [13]. Fig.4 shows artificial neural network system for solar system.
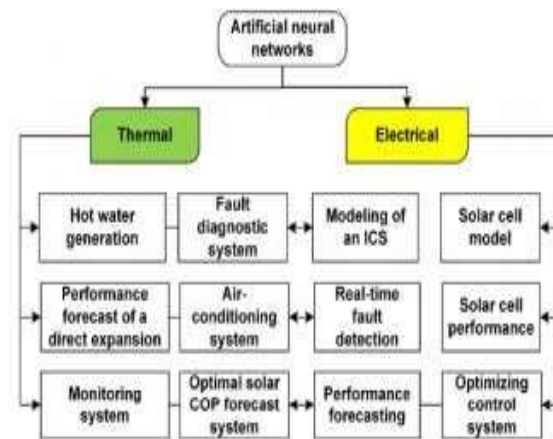

Fig.4 Artificial neural network system for solar system

VI.   CONCLUSION

In this paper we have briefly discussed about the green energy, green buildings and smart energy management systems with its techniques and applications. There are numerous approaches preferred for modeling of smart energy management systems like fuzzy based and Artificial Neural Network (ANN) based systems. All the performance has been carried out under all the predictions of various parameters. Hence, for making smart energy management system we may prefer artificial intelligence based techniques to implement all home or industrial appliances for attaining superior results.

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