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Power Scheduling Approach In Smart Home

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Abstract:- *Energy management in smart home environment is nowadays a crucial aspect on which technologies have been focusing on in order to save costs and minimize energy waste. This goal can be reached by means of an energy resource scheduling strategy provided by a suitable optimization technique. To improve the efficacy of the home appliance for energy management lot of study have been made. For smart home many power scheduling methods have been adopted. This paper reviews different journals and conference papers which covers the energy optimization methods for smart home appliance. In this paper the concept of smart home is introduced, then various methods are analysed like fuzzy logic, neural network, and heuristic methods and evolutionary algorithm.*

Keywords:- *Smart Home, power scheduling, energy management.*

I. INTRODUCTION

A smart home means the home equipped with smart devices [1]. A home network transfers information between devices. Residential gateway connects a smart home to the Ethernet or Internet. Through gateway home devices can be connected to Internet and can download new services.

The smart home concerns about the information as to improve the quality of a residential life by generating a flexible , comfortable, healthy and efficient environment. Smart home technology was first used to control environmental system such as lighting and heating system. However, in smart technology, almost all electrical components within a house can be incorporated into a smart system. So that each device can now be monitored and can be operated independently in predefined patterns or independently based on user requirements.

A home network is formed to send or receive the instruction from all smart devices in the smart homes that are connected to a home network. The home network allows a home to become fully connected and controlled externally and internally. The main goals of a smart home are to simplify the life of the people, reduce energy usage, and provide comfort and safety.

A smart home is composed of devices like, a washing machine, refrigerator, air conditioners and some control devices, such as sensors, motors, and voice, visual or graphical user interfaces. Service provider will offer a network at outside environment for communication between the smart home and service provider. The challenges are lack of a comprehensive infrastructure for integrating old appliances in new design.

The article from C. Nugent,D. Finlay, R. Davies, H. Wang, H. Zheng, J. Hallberg, K.Synnes and M. Mulvenna introduced homeML which is an open standard for the exchange of data within a smart home environment [2] Tiiu Koskela and Kaisa Va¨an¨ anen-Vainio-Mattila suggested the empirical evaluation of three different user interfaces to interact with the smart home environment by[3]. Another one is an article about the needs of an user and what people value within their smart home environment by Victoria Haines, Val Mitchell, Catherine Cooper und Martin Maguire[4].

II. ENERGY MANAGEMENT IN SMART HOMES

For home automation and to control the non-time critical processes, neural fuzzy controller was developed in the MATLAB/SIMULINK. MATLAB/SIMULINK was transformed into a tool with hardware and Internet access. The test result shows the capabilities of fuzzy logic toolbox for heating controllers [4]. To control electrical appliance based on user's operational information, an energy conservation method based on home state information has been applied, through a network with IP, XML, and JAVA[5]. The IP was used as a communication protocol, XML as data form and JAVA as a programming language. In this paper 16 electrical appliances are considered with different operating modes based on their characteristics. Simulation is carried out for 100 homes and for 100 days, which shows that the consumption of the electrical power can be reduced by 15.6% when appliances function or operate based on room's state. Also, electrical power can be distributed based on priority.

In [6] energy management system of small residential building through the personal computer is developed. This paper suggests the energy wastage by human carelessness can be avoided. To monitor the number of persons entering and leaving, sensors are connected. Based on the signal from sensors PC turns the appliances ON or OFF. When there are no persons in the room the system switches all the electrical equipment off so that energy will not be wasted. The program was developed using Visual Basic programming language.

The conclusion of the paper is energy can be saved by interfacing between hardware and software via PC. But, control circuit and software needs improvement. In[7] gligor A, Grif H, Oltean S, suggested an intelligent building management system to optimize energy consumption in a building. For control system Genetic Algorithm(GA) is used, which can solve complex decision and optimization problems. The controlling of lighting and heating systems is very profitable to the users. Paper [8] describes the home automation system that controls house hold energy usage for demand side management (DSM). The allocation of energy to the user is based on predictions. Therefore the mathematical model of house hold energy management is formulated with a constrained as a cost and comfort of customer. In [8] Ha DL, Ploix S, Zamai solved the problem by a tabu search (TS) technique to maximize the user comfort and minimize the energy cost. But the conclusion is it is difficult to set up TS method for all situations. Therefore different strategies must be applied along with this. This solution allows house holds to adjust their energy consumption automatically and participate in a DSM system. For residential sector, multilevel optimization system mechanism is described for DSM in [9]. In a house energy is distributed based on agent management system. Agent management can modify the power consumption limit of a household based on feedback from the client through home automation signal. With this the customer satisfaction can be taken into consideration with energy production as a constrained.

A static monthly electricity rate does not provide true cost of actual electricity consumption for the residential loads of the customers. If their bills are not affected by dynamic price changes they are motivated to reduce the electricity consumption. For major loads such as air-conditioners, water heaters etc. needs some special control strategies because these loads together cause highest consumption of electricity. The proposed strategy [10] can effectively manage between comfort and consumer price preferences. But the proposed method is customer centred rather that utility centred from the direct load control perspective and is effective and simple for real life use by residential customers. In paper [11] integrated fuzzy control technique is introduced to minimize the energy consumption. This method has man-machine interface based on smart card terminals to satisfy the user preferences. Users are considered as a dynamic part of the building. The proposed scheme integrates users preferences and ensures the energy saving by using suitable cost function. By using fuzzy

controller, users preferences are satisfied without variations and overshoots. Paper [12] discusses the thermal comfort and energy optimization problem, to minimize energy consumption and improve the thermal conditions for human comfort. Sensitive analysis of the optimization problem and its approximation with the fuzzy logic system for individual thermal comfort preferences has been considered. Paper [13] proposes an information fusion based smart home control system. In this method for control, internet access is required. Also it includes the information acquisition module, in-house networking services with blue-tooth wireless connectivity and information fusion based controller using Fuzzy logic (FL) and fuzzy neural network (FNN). With this approach information is collected from multiple sources to control home appliances and create smart home. Development of the control system is discussed in the paper. Also information collection and fusion, central control algorithm is studied. The FL and FNN are applied to the outputs of physical sensors and open sources. The modelling is implemented to improve the service delivery of the energy by maximizing the net benefit derived from the energy sources in [14]. The modelling is done on simulation platform. The technique decides as how the available distributed sources are managed to get desired energy with minimum cost. It decides the operating schedule of the distributed energy resources (DER). The strategy is nonlinear, non-convex and con continuous optimization problem, which was solved by particle swarm optimization (PSO) method. This algorithm has global search ability within reasonable computation time. The author proposed the approach in such a way that the DERs export maximum energy and reduced energy consumption when a net feed-in tariff is available. Also if the cost of the service is greater this method postpones the low value services. An optimal and automatic residential energy consumption scheduling framework based on linear programming was focused in paper [15] to achieve a desirable trade-off between minimizing electricity payment and minimizing wait time for operation of each appliance in the presence of a real- time pricing tariff combined with inclining block rates. But in real time pricing of electricity needs some price prediction capabilities to control household energy consumption. Test results of the paper shows that the proposed energy consumption scheduling design and price assumption of prediction reduces the user payments. Therefore these analytical results will encourage the customers to participate in the proposed residential load control program. The proposed scheme is beneficial to customers and utilities both. In Paper [16][17] a real time pricing based on power scheduling scheme is introduced to deal with demand response for the residential power consumption. The energy management controller (EMC) schedules appliance operation. This is termed as a follower and the other is provider, which sets real-time prices according current power usage profiles is termed as a leader. The service provider a forms a Stackelberge game. With this a model is formulated to analyse the interaction between consumer's EMC and a service provider. The simulation result shows that the proposed scheme saves money for the consumers and reduces peak load and variance between actual and planned supply, by avoiding the peak. In paper [18] an

integrated fuzzy multi-objective GA based approach was proposed to optimize total electricity expenditure, total appliance time shift, and total appliance shift frequency of the residential load. The GA gives multi-point search method to identify more economical electricity use for the appliance so as to get a close point of electricity expenditure and electricity budget. The test result shows that the goal of optimal electricity management in residential sectors can be achieved without significant change of the user's lifestyle. [19] in this paper peak load reduction algorithm is used for household appliances. Considering household appliance automation for reduction of household peak power demand, this study explored aspects of the interaction between household automation technology and human behaviour. The author suggested three algorithms. One is based on time flexibility of the load, second based on timings of frequent

intermittent loads and the third is for applying short-term time delays to avoid high peaks. The conclusion here is that a general factor determining the ability to shift the load due to a particular appliance is the time-buffering between the service delivered and the power demand of an appliance. Adaptive Critic Designs (ACDs) called Action Dependent Heuristic Dynamic Programming (ADHDP) that uses two neural networks, namely the Action and the Critic Network is suggested in paper [20]. This scheme is able to minimize a given Utility Function over a certain time horizon. The author suggested that In order to increase the performances of the ADHDP algorithm, suitable Particle Swarm Optimization (PSO) based procedures are used to pertain the weights of the Action and the Critic networks. The results confirm that the ADHDP is able to reduce the overall energy cost with respect to the baseline solution and the PSO techniques.

III. CONCLUSIONS

This paper has reviewed various power scheduling approaches like, FL, neural network, heuristic method and evolutionary approach for energy management in smart homes. The FL was used to combine the mixed source of information. It has limitations as the rules defined by the expert does not match with the real world applications. Artificial Intelligence including FL , neural networks etc can handle more powerful and complex decisions and manage the system. A hybrid intelligent control system is a better solution when the model is complex , non-linear and impossible to develop. Therefore, hybrid intelligent control system should be developed for generating control rules Energy management in smart home environment is nowadays a crucial aspect on which technologies have been focusing on in order to save costs and minimize energy waste. This goal can be reached by means of an energy resource scheduling strategy provided by a suitable optimization technique.

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