IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
Vol. 3, Issue 6, June 2016

Mixed Simulated Energy Optimization Model for Household Building having PV Energy System and Grid Energy System

Mohd Hafizullah[1], Sanjay Gomasta[2]

Department of Mechanical and Automation Engineering, Amity University Madhya Pradesh, Gwalior, India[1, 2]

Abstract: This research work lay work laid emphasis on the efficient usage of energy transmitting module and the advantageous integration of renewable energy into household energy systems, the use of building energy management systems (BEMS) for the efficient use of the energy is undeniable. In this research work, we have focused on a modulated BEMS and its ability to modify or build architecture according to the need and personal specification or preferences that enable an adjustable and flexible way towards the optimization of building energy system. This approach is able to achieve the continuous energy flow in the building and across all energy transmitting module as well as the mutually dependency between the appliances and other devices, as long as this observatory approach is used for the devices and optimizing its operational system. The estimations with the help of simulated model and comparison with real world model shows the ability of the BEMS to improve the efficient use of energy, self-consumption, and self-reliance as well as to minimizing the energy consumption and costs/unit by an improved arrangement of the devices that considers all energy transmitting module in the buildings as well as its mutually dependent appliances and devices. A simulated mixed energy optimization model for optimal energy management strategy for household building using PV energy system and grid-connected energy system is developed. The simulated model is tested for various maximized values of the storage battery in storage system which can be consumed for household requirement at any point of time and minimizing the energy consumption from the grid-energy system. In this study we have considered four houses nearby in the neighborhood which are using both PV energy system and grid-energy system along with the battery storage. This simulated model is able to provide us with satisfactory solution than other algorithm with comparably a less computational effort and processing time.

Keywords: Simulated, Optimization model, grid energy, PV energy.

I. INTRODUCTION

In past 50-60 years the electricity production and supply system is dependent upon the electricity generated by the fossil fuels and nuclear power plants. This energy system is to be transformed into the renewable energy sources which include buildings maintained with the photovoltaic system [2] This model is the establishment for applications in insightful building atomization that need to manage data from home and office situations. These applications have in like manner that they comprise of a blend of imparting hubs and have numerous, somewhat negating objectives.. This huge transformation comes up with the new challenges in the sustainable use of the energy [3]. Sustainable can have many meanings depending on the various variables and factors. The main objective in our aspects is maximization of the consumption of the self-produced renewable energy and ionization of the consumption based on non-renewable energy [5]. Optimization algorithm is an effective tool used for optimization strategies within the complex energy management system.

Several computational and optimization approaches have already been proposed in literature in the context of building and grid energy management system. [8] Shows an optimization approach for efficient energy management of heating, ventilating and air conditioning (HVAC) system using a met heuristic simulation evolutionary programming coupling method. [2] Shows a particle swarm optimization approach to optimize a control system to improve task and user comfort with saving energy. [3] Tries to match the load consumption and heating, ventilating and air conditioning (HVAC) with available energy from hybrid renewable energy generation and energy storage system. An optimization approach based on genetic algorithm with a two point consideration is used to minimize the size of the photovoltaic and wind generation installation as well as storage capacity to supply HVAC load. [5] Says a dual evolutionary programming approach for a power system in which software agents co-evolve optimal operational behaviors for a simple grid configuration consisting of photovoltaic and conventional energy production resources, battery storage and partly controllable loads. [8] Describes a genetic algorithm for optimization of control a standalone hybrid electrical system to achieve cost minimization over system lifetime. This includes renewable resources batteries, a fuel cell, an AC generator and an electrolyzer.

According to [1] an intellectual engineering for building energy management in future renewable vitality situations has been introduced taking into account novel acknowledgment, basic leadership, and control techniques.

DOI 10.17148/IARJSET.2016.3617

Moreover, a PV supplied, capacity expanded, matrix associated test bed was composed, which is suitable for adaptable testing the execution of our design in various future energy optimization scenarios. The test bed is presently introduced in the offices of the technology park Villach. Once operational, the proving ground wills be used to assess the execution of our psychological architectures energy optimization framework in light of genuine information. [8] Presents an adjusted recreated toughening optimization approach for consequently deciding ideal energy optimization methodologies in network associated, capacity increased, photovoltaic-supplied prosumer structures and neighborhoods in view of client particular objectives. For assessing the adjusted recreated strengthening enhancer, various test situations in the field of vitality self-utilization expansion are characterized and results are contrasted with an angle plunge and an aggregate state space look approach. The benchmarking against these two reference techniques shows that the adjusted reenacted strengthening methodology can discover altogether preferable arrangements over the inclination plunge calculation

– being equivalent or near the worldwide ideal

– With fundamentally less computational exertion and preparing time than the aggregate state space seek approach.

In this research paper we proposed an advanced topology model and strategy to minimize the energy consumption from the grid energy system and to maximize the energy consumption from the renewable resources, a fully studied energy management system which includes the grid energy system, PV system, and battery storage. To perform easy optimization of this model we have realized this within a Visual Studio C++ Simulation.

II. PROPOSED METHODOLGY

2.1 System topology and problem definition

The overview of the system topology is shown below in Fig.1 which gives the detailed representation of a four houses nearby which consists of the following components: (1) Grid energy system (2) Houses (3) PV energy system (4) Battery storage system

The arrows in the Fig.1 show the direction of the flow of grid energy and stored energy. The operating condition for this topology is mentioned in the Table 1 which is to be followed at the time of execution.

In Section 2.4, the operating condition will be specified and it will be indicated where the energy is flowing in each cycle time. The energy optimizer is developed will work to a specified sequence whose sole purpose will be to optimize the energy consumption i.e. Minimizing the non-renewable consumption and maximizing the renewable consumption. The optimization of energy will work in a fashion where each house will receive the optimized energy at a given period of time only.

In our experiment the houses are named H1, H2, H3 & H4 along with they have a storage batteries naming B1, B2, and B3& B4. Each battery is connected to the grid energy and also to the PV energy source. At initial point of time B1 will be connected to the grid energy and PV energy source, when B1 will be 25% charged at this point B2 will start charging from grid energy and PV energy and when B1 will be 50% charged it the grid energy will be cut off and energy from B1 will be consumed for both H1 & H2, this sequence will be repeated and vice versa. The communication is very much necessary for this negotiation will be conducted by the communication channels within the buildings.

For this experiment it is defined that for each action will carried out there will maximum energy transferred before the next action occurs. For instance the PV energy and the grid energy both are supplied to the battery storage, which charges and stores energy for further use, and after a series of actions an optimized energy will be used in every step of the topology.

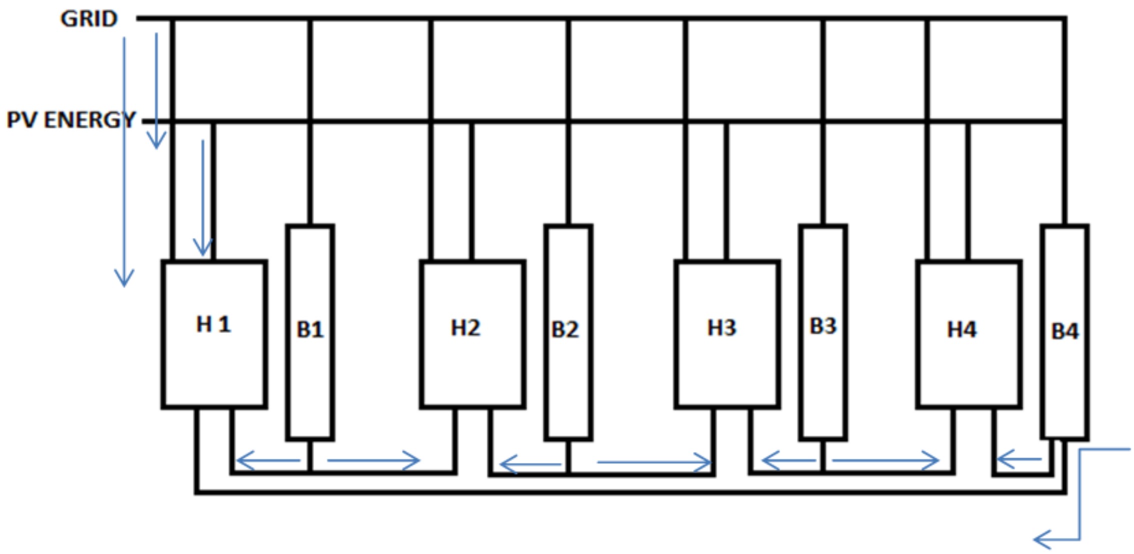

Fig.1 Schematic overview of topology setup including Houses, Grid, PV and Battery Topology

TABLE 1 Specified sequence of operation for the optimization topology

GRID ENERGY	PV ENERGY	B1	B2	B3	B4
H1,H2	H1,H2	0	0	0	0
H2,H3,H4	H2,H3	25%	START	0	0
H3,H4,H1	H3,H4	50%	25%	START	0
H4,H1,H2	H4,H1	25%	50%	25%	START
H1,H2,H3	H1,H2	START	25%	50%	50%

2.2. Data acquisition and pre-processing

PV and load curves were plotted using renewable energy data generator with the help of project tool "Vision Step I-mart City Villach" to test the energy optimizer. Individual load profiles were generated for the four households for a period of month with a resolution of 3 hours regularly. Data was standardized to yield an average consumption of 16kWh per household. Once the data for each household was obtained, the same PV profile was generated for a period of month. The PV profile for each household was designed in such a way that orientation and tilt angle and in same number and same type of modules were equipped on the buildings. Again the data was standardized according to the energy consumed by the loads which turned out to simplify data analysis.

2.3 System Modeling

Fig.1 gives an overview of the topology to be adopted for the optimized energy system which is realized on Visual Studio C++ Simulation.

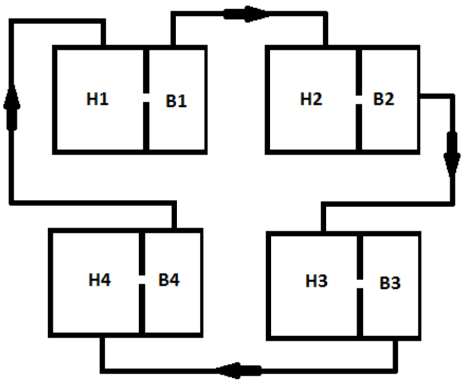

Fig.2 Optimized Block Topology

The individual losses in components (PV module, batteries, inverters etc.) are neglected to perform smooth and simple analysis of the model strategy. This allowed us to theoretically optimize the system modeling strategy for energy management system. The difference with the strategy and without strategy was calculated and an energy consumption graph per hour was plotted which showed that the initially consumption rate was higher which decreased gradually after a period of time.

2.4 Specified Test Scenarios

To test the developed optimization technique, four distinctive test situations were indicated from which the situations 3 to 5 were sub-divided into two further sub-cases. The primary objective of each of the five situations was to enhance the utilization of PV energy and minimize the grid energy consumption to diminish continuity trade with the network quite. To accomplish this target, for every situation, different activities can be chosen (see Table II).

In the situations 1 and 3, for occurrence, every building goes for optimizing its nearby PV consumption exclusively while in alternate cases, a vitality trade with neighbors is bolstered. In the situations 1 and 2, no buffering of PV vitality in a battery stockpiling is bolstered, while alternate situations take into consideration such a worldly continuity stockpiling. The situations 3 to 4 just permit an individual stockpiling use while situation 5 permits the trading of continues optimization the neighbor stockpiles. Moreover, the situations 3b, 4b, 5b support a connection of the battery stockpiling with the framework (charge stockpiling from network and bolster put away vitality into lattice) while alternate situations don't predict this choice.

Optimized assigned values, Final values with preference	Optimization Variable	Final Value	Preference
Loads supplied with sufficient energy	Energy_Required	0.5	2
PV energy not to be remained	PV_Remained	0	1
PV energy nearby t be Maximized	Local_PV	MAX	3
PV energy produced by own building should be maximized	Direct_Own_PV	MAX	4
Stored PV energy should be used within the neighborhood and self	Local_Storage	MAX	5
Storing PV energy within the own storage is preferred to storing surplus PV energy in the neighbor storages	Own_Storage_Loading	MAX	6

III. RESULTS AND DISCUSSION

This chapter deals with delineating and contrasting the aftereffects of the altered reenacted mixed simulation methodology with the aggregate space state search and slope descent reference strategies. This section represents the computational exertion of these calculations for the diverse test situations, contains a correlation of the discovered activity arranges and relating improvement estimations of the calculations and outlines the accomplished neighborhood PV energy utilization taking into account the energy optimization systems found by the calculations.

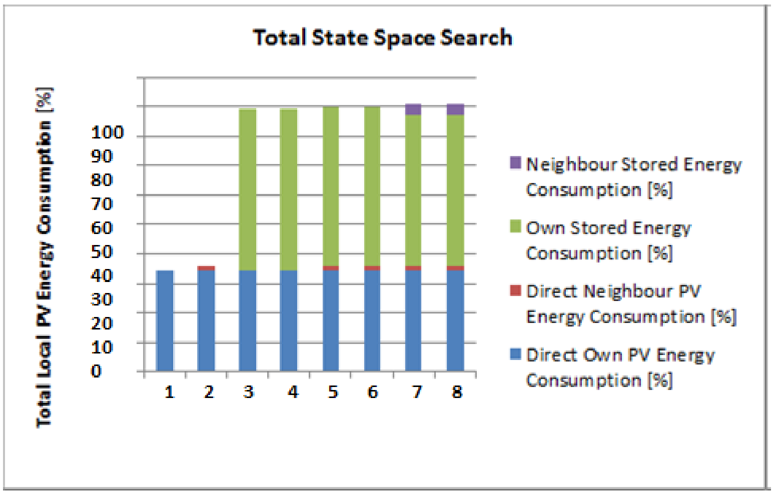

Fig. 3 Average local PV energy consumption and contributing by Total State Space Search

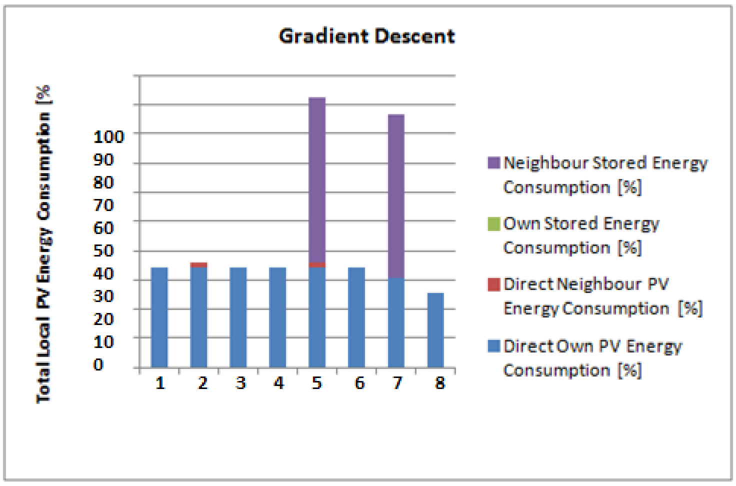

Fig. 4 Average local PV energy consumption and contributing by Gradient Descent Method

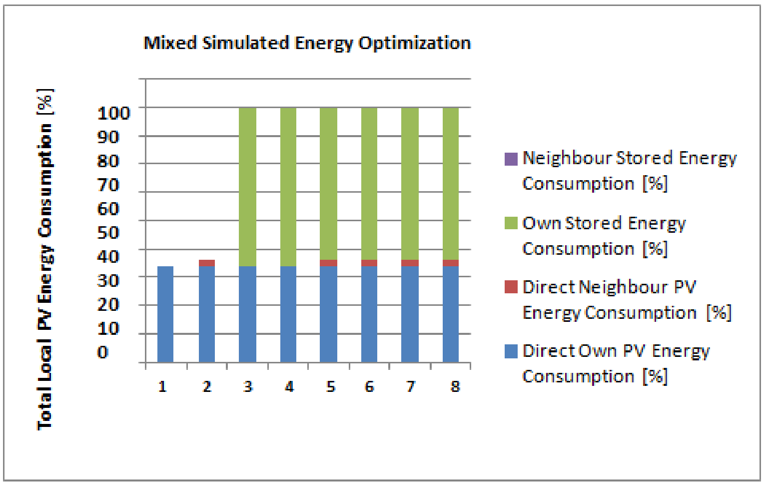

Fig. 5 Average local PV energy consumption and contributing by Mixed Simulated Energy Optimization

IV. CONCLUSION

This article exhibited an adjusted reenacted toughening streamlining agent for finding ideal energy optimization methodology away enlarged network associated renewable structures and neighborhoods. The goal of optimization strategy was the amplification of the nearby utilization of privately created PV energy. The after effects of the adjusted recreated strengthening optimization agent were assessed by looking at them against the all inclusive ideal arrangement dictated by a computationally cost aggregate state space seek approach looking through all conceivable activity blends and the arrangement got by a computationally cheap slope drop calculation.

While the consequences of the inclination plunge calculation showed the need of building up a technique not getting effectively caught in nearby minima, the changed recreated toughening approach found the worldwide ideal in six out of the eight tried situations. For the staying two situations, it found a neighborhood ideal that was near the worldwide ideal (0.03 % mistake of the streamlining capacity, which interpreted into 1.3 % less nearby utilization of privately delivered PV vitality).

For complex situations including a wide range of conceivable activities, the altered reproduced strengthening approach ended up being computationally a great deal less costly than the aggregate state space seek strategy. For the two situations with the little remaining improvement blunder, the computational exertion was up to 92,458 times not exactly the exertion for ascertaining the worldwide optima with the aggregate state space seek approach.

This showed the changed recreated strengthening methodology is an intense methodology for finding ideal energy optimization methodologies in expansive hunt spaces. Further work on this issue focusing on likewise other vitality administration applications will be tended to in future work. Aside from this, comparative concerning the changed reproduced toughening approach presented here, the likelihood will be investigated to likewise adjust other advancement calculations to empower them to guide activity requests to improvement values.

REFERENCES

[1] R. Velik, “Cognitive Architectures as Building Energy Management System for Future Renewable Energy Scenarios – A Work in Progress Report,” IJSEI International Journal on Science and Engineering Investigations, vol. 2, no. 17, pp. 68–72, June, 2013.

[2] R. Velik, G. Zucker, D. Dietrich, “Towards Automation 2.0: A Neuro-cognitive Model for Environment Recognition, Decision-making, and Action Execution,” EURASIP Journal on Embedded Systems, Special Issue on Networked Embedded Systems for Energy Management and Buildings, vol. 2011, 11 pages, 2011.

[3] Z. Shu, P. Jirutitijaroen, “Optimal Operation Strategy of Energy Storage System for Grid-Connected Wind Power Plants,” IEEE Transactions on Sustainable Energy, vol. 5, no. 1, pp. 190-199, 2014.

[4] B. Zhao, Y. Shi, X. Dong, W. Luan, J. Bonemann, “Short-Term Operation Scheduling in Renewable-Powered Microgrids: A Duality-Based Approach,” IEEE Transactions on Sustainable Energy, vol. 5, no. 1, pp. 209–217, 2014.

[5] A. Bonfiglio, M. Brignone, F. Delfino, R. Procopio, “Optimal Control and Operation of Grid-Connected Photovoltaic Production Units for Voltage Support in Medium-Voltage Networks,” IEEE Transactions on Sustainable Energy, vol. 5, no. 1, pp. 254–263, 2014.

[6] Y. Zheng, S. Chen, Y. Lin, W. Wang, “Bio-Inspired Optimization of Sustainable Energy Systems: A Review,” Mathematical Problems in Engineering, vol. 2013, 12 pages, 2013.

[7] D. Zhang, S. Li, P. Zeng, C. Zang, “Optimal Microgrid Control and Power-Flow Study With Different Bidding Policies by Using PowerWorld Simulator,” IEEE Transactions on Sustainable Energy, vol. 5, no. 1, pp. 282–292, 2014.

[8] E. Çelebi, J. Fuller, “Master problem approximations in Dantzig–Wolfe decomposition of variational inequality problems with applications to two energy market models,” Computers & Operations Research, vol. 40, no. 11, pp. 2724-2739, 2013