

A Novel Method of Home Energy Management System for Cost Optimization Using Ga Based On Microcontroller

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ABSTRACT: Formerly, energy had been inexpensive and management of energy was efficient and was limited to elementary considerations. In the current scenario, due to a rapid increase in demand, complexity of the electrical network, probability of contingency and electricity cost have equally increased. In the recent past, home management system is proven to be the best way to minimize these problems in an easier and smart way. This paper proposes a way to reduce the total electricity cost using Genetic Algorithm. In the proposed algorithm, each user requires only the knowledge of the price of the electricity, which depends on the aggregated load of other users, instead of the load profiles of individual users. In order for the users to coordinate with each other, we introduce a penalty term in the cost function, which penalizes large changes in the scheduling between successive iterations.

KEYWORDS: home energy management; real time pricing; genetic algorithm.

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 GA algorithm. Through gateway home devices can be connected to AVR Controller. 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 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 Vaananen-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. PROPOSED SYSTEM ARCHITECTURE

In this paper, we propose a distributed energy scheduling algorithm as a demand response for the smart grid. We use day-ahead pricing scheme, where the price of the electricity for the day is determined on the previous day. We

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 6, Special Issue 11, May 2017

then find optimal operating times for the electric appliances and their corresponding energy consumptions by minimizing the overall cost of operation. Our approach is different from the related work in four main aspects: i) we jointly optimize both the start time and the energy consumption for each appliance of the user; ii) we bill all the users based on their time-dependent use of electricity; iii) we enforce realistic constraints on the operation of the appliances by categorizing them into two different classes; iv) we let the energy consumption vary in a discrete manner, which is more realistic. Further, our algorithm is fully distributed, where the only information available to the users is the prices for different time-periods.

Using this price, each user will find his energy consumption schedule. Since we allow the energy consumption to vary in a discrete fashion, the corresponding optimization problem will be NP-hard. Therefore, we employ a greedy iterative algorithm to find the sub-optimal energy consumption schedule of each user. In each iteration, all the users will communicate their energy consumption schedule to the utility company. The utility company will then adjust the price depending on the overall system load and broadcast the price to all the users. The users will then update their energy consumption based on the new price. These iterations continue until convergence.

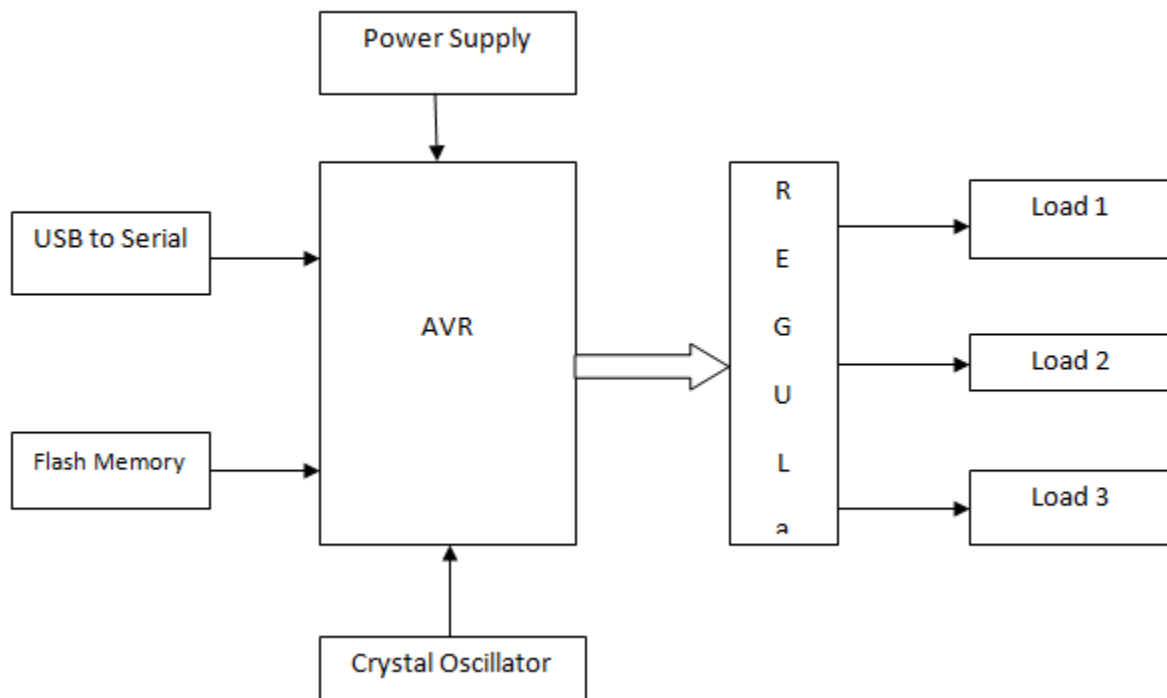


Fig - Working Architecture Of efficient Load Controller

III. SCHEDULING ALGORITHM

The appliances scheduling problem as formulated in Section IV is solved by using GA. Although, appliance scheduling problem is solved by different classical optimization techniques such as LP, ILP, MILP, OSR, dynamic programming, but these techniques can not handle large number appliances and face a lot of difficulties in convergence. Moreover, most of the classical techniques do not have the global perspective and often converge at the local optimum solution.

In contrast, evolutionary algorithms, for example, GA give alternative methods to solve complex problems and outperforms the classical techniques in most of the cases. The GA is an iterative optimization technique, rather than working on a single solution, GA deals with different possible solutions in each iteration. Therefore, we use GA to design our smart scheduler (SS). At the beginning of each day, when the presume gets the grid signals SS generates an

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 6, Special Issue 11, May 2017

optimized energy consumption pattern for all appliances. GA begins its search with randomly initialized binary coded chromosomes. The chromosomes pattern of GA represent the ON=OFF state of appliances, and the length of chromosomes show the number of appliances.

$$\text{Length of chromosomes} = N$$

Where,

N is the number of household appliances.

Once a population is created, the fitness function of each possible solution is evaluated according to the objective function of the optimization problem. In this case, the fitness of each population is evaluated. Then, a new population is generated by applying the natural genetic operators such as selection, crossover, and mutation. The working principle of GA is shown in Fig. 2. In each iteration new population is produced through crossover and mutation. In this work, a single point mutation and binary crossover are used. The rate of convergence of GA is directly proportional to crossover rate, and the optimal solution is inversely proportional to the mutation rate. A tournament based selection is used to form a new population from existing one. Elitism is used to remember and transform best solution from one generation to next one.

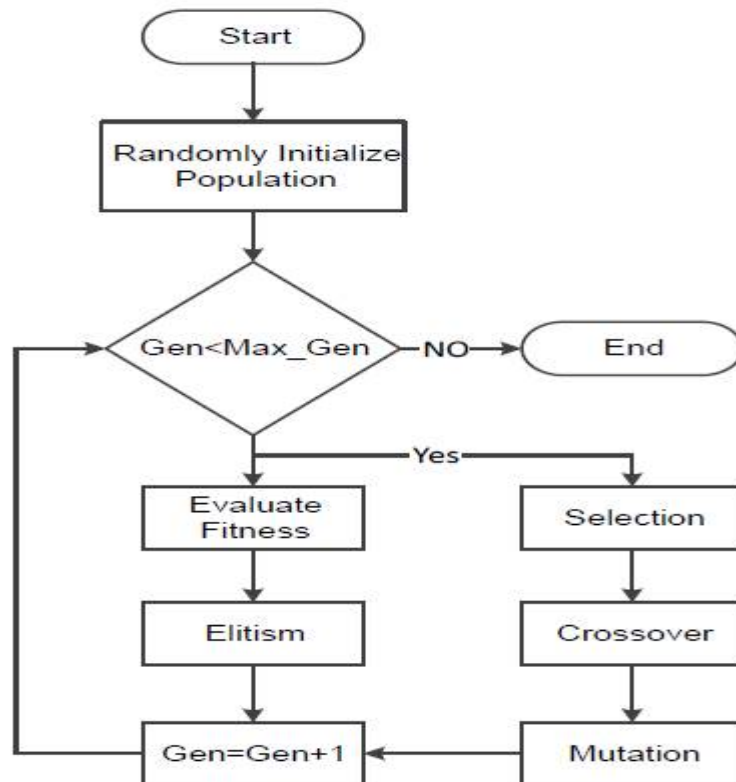


Fig: - Working Principal of Genetic Algorithm

IV.SIMULATION RESULT

In this section, simulation results of the proposed OHEMS are presented. In the proposed scheme, the integration of RES and ESS, as well as the performance of algorithms GA is evaluated via two stages simulations. In the first case, the integration of RES and ESS into the residential sector are evaluated in terms of energy consumption pattern, and electricity bill as well as PAR reduction. While in the second case, the same performance metrics (energy

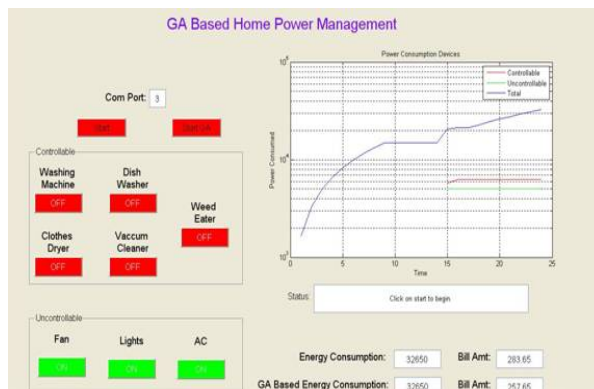
International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 6, Special Issue 11, May 2017

consumption pattern, and electricity bill as well as PAR minimization) are used to evaluate the effectiveness of GA . The Device shows the consumption of power step by step.

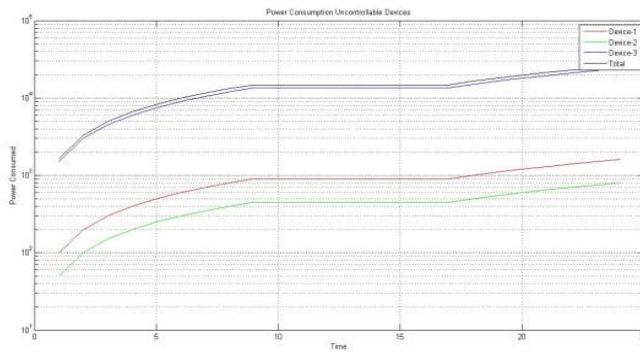
0	0	0	0	0	0	0	0	0
0	0	0	0	0	100	50	1500	1650
0	0	0	0	0	200	100	3000	3300
0	0	0	0	0	300	150	4500	4950
0	0	0	0	0	400	200	6000	6600
0	0	0	0	0	500	250	7500	8250
0	0	0	0	0	600	300	9000	9900
1000	0	0	0	0	700	350	10500	12550
1000	3000	0	0	0	800	400	12000	17200
1000	3000	1000	0	0	900	450	13500	19850
1000	3000	1000	750	0	900	450	13500	20600
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1000	3000	1000	750	500	1000	500	15000	22750
1000	3000	1000	750	500	1100	550	16500	24400
1000	3000	1000	750	500	1200	600	18000	26050
1000	3000	1000	750	500	1300	650	19500	27700
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1000	3000	1000	750	500	1500	750	22500	31000
1000	3000	1000	750	500	1600	800	24000	32650



International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 6, Special Issue 11, May 2017



V. CONCLUSION

In this paper, we proposed an RHEMS to facilitate the integration of RESs in the residential sector and to reduce the electricity bill as well as peak formation. First, the objective function is mathematically formulated and then evaluated by using GA-based scheduling in a dynamic pricing environment. Simulations results show that the scheduling of household appliances and estimated renewable energy in response to dynamic pricing signal significantly reduce the electricity cost and PAR. Moreover, the proposed RHEMS achieve a favorable tradeoff between the user comfort and cost reduction. In future, we are interested in forecasting and integration of energy storage system in residential sector to increase the benefits from RESs.

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