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MINIMIZING ELECTRICITY COST USING HYBRID GENETIC AND PIGEON INSPIRED TECHNIQUE

Udit Sangwan*1, Taiyab Ali*2

*1,2Undergraduate Student, Department Of Electrical Engineering, Delhi Technological University, Bawana Road, Delhi-110042, India.

ABSTRACT

Our foremost aim on this research paper is to limit the power value, consumption of strength at minimum consumer pain even as thinking about the peak energy consumption. electricity call for varies in residential, business and business sectors. it is a exigent project to preserve the balance among the contrary objectives: consumption of power and person consolation. to satisfy the rising power demand in residential location, on the idea of common power intake schedulable devices can be similarly disbursed to the available time slots. the principle goal is to limit the energy utilization throughout the electricity peak hours through distributing the strength load at some point of the off-peak hours. in this regard, Genetic algorithm (GA), Meta-heuristic set of rules (MA) and our proposed hybridization of GA and Pigeon stimulated optimization issue of Meta-heuristic algorithm (HGMp) in demand side management (DSM) are applied for residential load control to optimize the health feature. GA, PIO and HGMp are evaluated on the basis of real time pricing scheme (RTP) for unmarried domestic with three one of a kind operational time interval (OTI) and for more than one houses with a single OTI. Simulations results indicates that GA, PIO and HGMp are capable of minimize electricity bill and strength consumption while minimizing the person pain. The performance of HGMp is higher than GA, PIO with appreciate to strength automate optimization, energy load and power price for each single home and a couple of houses instances. The viable location is likewise represented between energy value and strength consumption. furthermore, the preferred alternate-off between energy value and consumer comfort is likewise satisfied with each of hybridization.

Keywords: Genetic Algorithm, Pigeon Optimization, Demand Side, Operational Time, Smart-Grid.

I. INTRODUCTION

In latest a long time power demand growing rapidly. Residential vicinity is considered to be the better zone where electricity is fed on, as a result huge amount of greenhouse gasoline (GHG) is emitted. The conventional grid has the functionality to deliver the electric the electricity from energy generation utility to the consumer. This one manner communique is not of managing several parameter of electrical community. Bulk generation and transmission infrastructure is needed to be mounted, to satisfy the growth in demand in residential vicinity. To cast off the deficiencies of conventional grid, smart grid (SG) is emerged to meet the excessive energy demand efficiently. It include smart home equipment, clever meter and energy control controller. to overcome operations, management, capacity bounds, strength controller is used. strength management include foremost additives deliver facet management (SSM) and call for aspect management (DSM). The control of energy utilized by the patron is obligation of DSM. strength transferring from on-top to off-height enables us to lessen price of energy however consolation of person is compromised due to the fact there postpone in operation of home equipment. to triumph over this distribution is finished the use of proposed hybrid set of rules by means of authors. The convergence price is also expedited the use of newton method. demand reaction (DR) is part of DSM, which encourages customer to alter their electricity intake pattern and shift their load from on-height to off-top hours. clients which can be fee sensitive participate in DR with the aid of adjusting their energy call for in response to time-varying expenses.

Several aspects must be considered in order to achieve a coordination between consumer and utility, such as, cost minimization, load balance, operational issues and user satisfaction. User satisfaction is one of the important aspect which must be considered along with electricity bill reduction. Hybridization of nature-inspired optimization techniques are able to efficiently address these complex tasks in load scheduling problems. In this hybridization of GA and PIO is applied to evaluating fitness function.

The aim of this work is to design an intelligent HEMS for a single and multiple homes which can effectively schedule consumers' power demand. We have applied hybridization technique to combine genetic algorithm

(GA) and pigeon inspired optimization (PIO) to, peak to minimize cost with minimum user discomfort. We compared heuristic techniques with LP in terms of cost, peak power consumption, peak to average ratio (PAR) and user discomfort. Our major contribution is to minimize consumers' electricity bill at minimum user discomfort.

II. METHODOLOGY

GA, PIO and HGMp. In the literature, several mathematical techniques such as LP, distributed algorithm and ILP are used to handle electricity consumption problem. The computational complexity of mathematical techniques is very high. We applied population based techniques to address the electricity consumption problem. We applied GA, PIO and our proposed HGMp techniques and compared them with previous researchers results.

GENETIC ALGORITHM

GA is an evolutionary set of rules which is inspired by the genetic process of residing organisms. It has high convergence price and able to locate exact solution in minimum time. Parallel search is accomplished in GA which reduce the chance of being trapped and able to cope with huge and complicated trouble with much less computational attempt.

In GA population is generated randomly and up to date with every new release. population represented chromosomes, bits corresponds to home equipment status and length of chromosome represented the overall hour over the scheduling horizon. to begin with the health of randomly generated population is evaluated by way of fitness function of the optimization trouble. To save the elite contributors elitist choice is finished, so excellent characteristics of applicants aren't misplaced inside the subsequent iteration while the populace is updated. After that event based selection proceeds wherein chromosomes is selected from the population for replica process. Crossover operation is carried out over selected chromosomes, and the populace is updated by means of including new generated off-springs. the brand new generated off-springs inherits the properties of both mother and father, contains some bit from determine 1 and a few bit from parent 2. To reduce the probability of repetition of the identical chromosome, mutation operator is implemented that inverts a bit of decided on chromosomes. once the crossover and mutation process achieved, the fitness of newly generated population is evaluated once more and compare with the fitness of previous populace. till termination standards met the whole procedure keeps. Upon termination the chromosome with high health is selected. The crossover charge is saved better whilst mutation charge stored lower as high charge of crossover avoids the chances of premature convergence at nearby optimum solution and lower charge of mutation continues randomness in populace. operating of algorithm is given under step-by means of-step.

PIGEON OPTIMIZATION

PIO is an shrewd algorithm which is stimulated by using the behaviour of pigeons returned to the nest. PIO is derived from homing pigeons and its proposed through Duan and Qiao. It have two majors operators: compass and map operator and landmark operator. to start with populace is generated randomly and fitness function is used for locating best ideal solution. All populace is looked after in step with the health feature and half the populace is discarded using landmark operator.

HYBRID ALGORITHM

Hybridization combining two or more approach. GA, PIO are combined collectively with hybrid technique to shape HGP. In HGP, all of the steps of GA done in same way as mentioned in advance but the crossover and mutation step is changed by using compass and map operator of PIO.

III. PROBLEM STATEMENT

Optimization of strength is the one of the tough assignment in clever grid due to the fact patron energy call for and strength charges are not constant. on this, authors considered 40 houses, in which each domestic has 12 appliances. The multi-objective optimization hassle is solved the use of MILP. Carbon emissions discount and consumers' strength bill are achieved. Shiftable appliances aren't considered which performs a chief position in price minimization.

on this paper, single domestic, 15homes, forty houses and 60 homes with 14 distinct appliances are taken into consideration. 3 varieties of appliances are considered: schedulable, non-schedule-in a position and uninterruptable. Our goal is to minimize the strength fee, energy load whilst minimizing the user soreness. We

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applied GA, PIO, HGMp to attain our goals. The trouble can be stated as: Given are (a) appliances begin and stop time (b) period of operational time (c) RTP signal (d) Time c language (e) general electricity demand of each equipment. To be determined are (a) strength consumption pattern To locate the most reliable solution with minimal electricity cost, energy load and user discomfort, RTP is carried out. We evaluated our version on 3 exclusive time c programming language values: 20 minutes, 30 minutes and 60 mins. The four parameter on the basis of which our model is evaluated are: energy cost, peak-to-common ration (PAR), waiting time (consumer discomfort) and power.

Table 1. Classification of appliances

Appliance Name	Groups	Class	Power Rating (kwh)	Starting Time	Finishing Time	Length of Operation Time
Fan	Non-Schedulable	Power Flexible	0.2	7:00 AM 1:00 PM 6:00 PM	11:00 AM 4:00 PM 7:00 AM	17 hr
Tv	Schedulable	Time Flexible	1.2	8:00 AM 1:00 PM 7:00 PM	9:00 AM 3:00 PM 11:00 PM	8 hr
Refrigerator	Non-interruptible	Inflexible	0.225	6:00 AM	6:00 AM	24 hr
Water Pump	Schedulable	Inflexible	1.3	7:00 AM 5:00 PM	8:00 AM 6:00 PM	2 hr
Tube Light	Non-schedulable	Power Flexible	1.5	9:00 AM 4:00 PM	1:00 PM 12:00 AM	13 hr
Mixing Machine	Non-schedulable	Time Flexible	1.1	8:00 AM 7:00 PM	8:30 AM 7:30 AM	2 hr
A.C	Schedulable	Power Flexible	1.4	1:00 PM 11:00 PM	3:00 PM 6:00 AM	8 hr
Iron	Schedulable	Inflexible	1	8:30 AM 6:00 PM	9:30 AM 7:00 PM	3 hr
Washing Machine	Non-Schedulable	Time Flexible	0.51	10:00 AM 5:00 PM	12:00 PM 7:00 PM	5 hr
Toaster	Non-schedulable	Inflexible	0.91	7:00 AM	8:00 AM	1 hr

IV. MODELING AND COMPONENTS

In this paper, a smart home where consumers are equipped with HEMS, and advanced communication network. The proposed model., which include home area network (HAN), a master controller (MC) and in-home display. Basic communication infrastructure between utility and consumer is assumed to be present. The power flow is denoted by solid represent wireless routes whereas solid lines indicate wired routes. Wide area network (WAN) is responsible for providing high bandwidth communication between utility and consumer. In, long-term evolution (LTE), power line carrier (PLC), broadband power line, fibre and cellular network are considered to provide long data transmission. The proposed model is demonstrated in Figure 1.

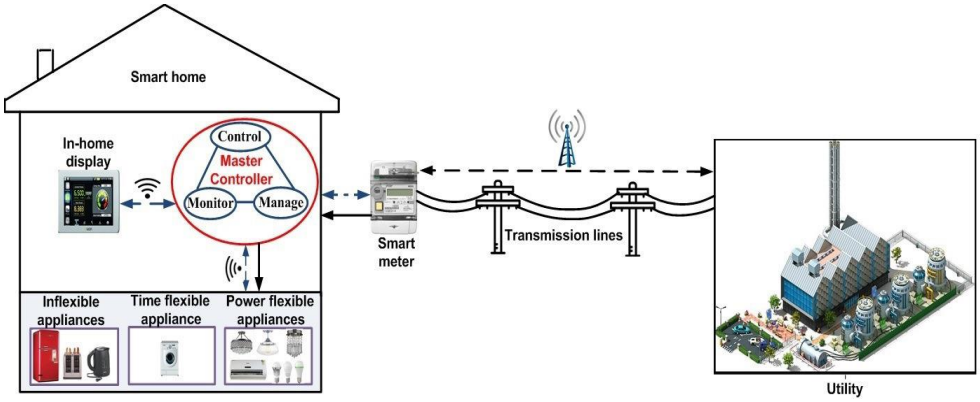

Figure 1: System Model

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In our model we considered 12 different appliances with different operation time interval. The total time horizon is 24h and each time slot represent 1h. To determine an optimal schedule, MC require number of parameters like appliances power profile, starting and finishing time and length of operation time interval. The goal of the model is to minimize electricity cost and user discomfort using HGP.

V. RESULTS AND DISCUSSION

In this section we highlighted the performance of GA, PIO techniques and our proposed hybrid meta-heuristic technique HGMp. We evaluated the given Techniques on the basis of four performance parameters: Electricity cost, PAR, Energy consumption and user comfort. We are considering a single home, consists of 14 appliances using the RTP price scheme and three different OTI of 20 minute, 30 minute and 60 minute. We also considered 15 homes, 40 homes and 60 homes scenario with 30 minute OTI and different power ratings. The classification of appliances is shown in Table 1.

POWER CONSUMPTION

In single home and multiple homes scenario we applied GA, PIO and HGP. We have applied introduced algorithms for three different operational time interval (OTI) to schedule the appliances from peak to off-peak hours.

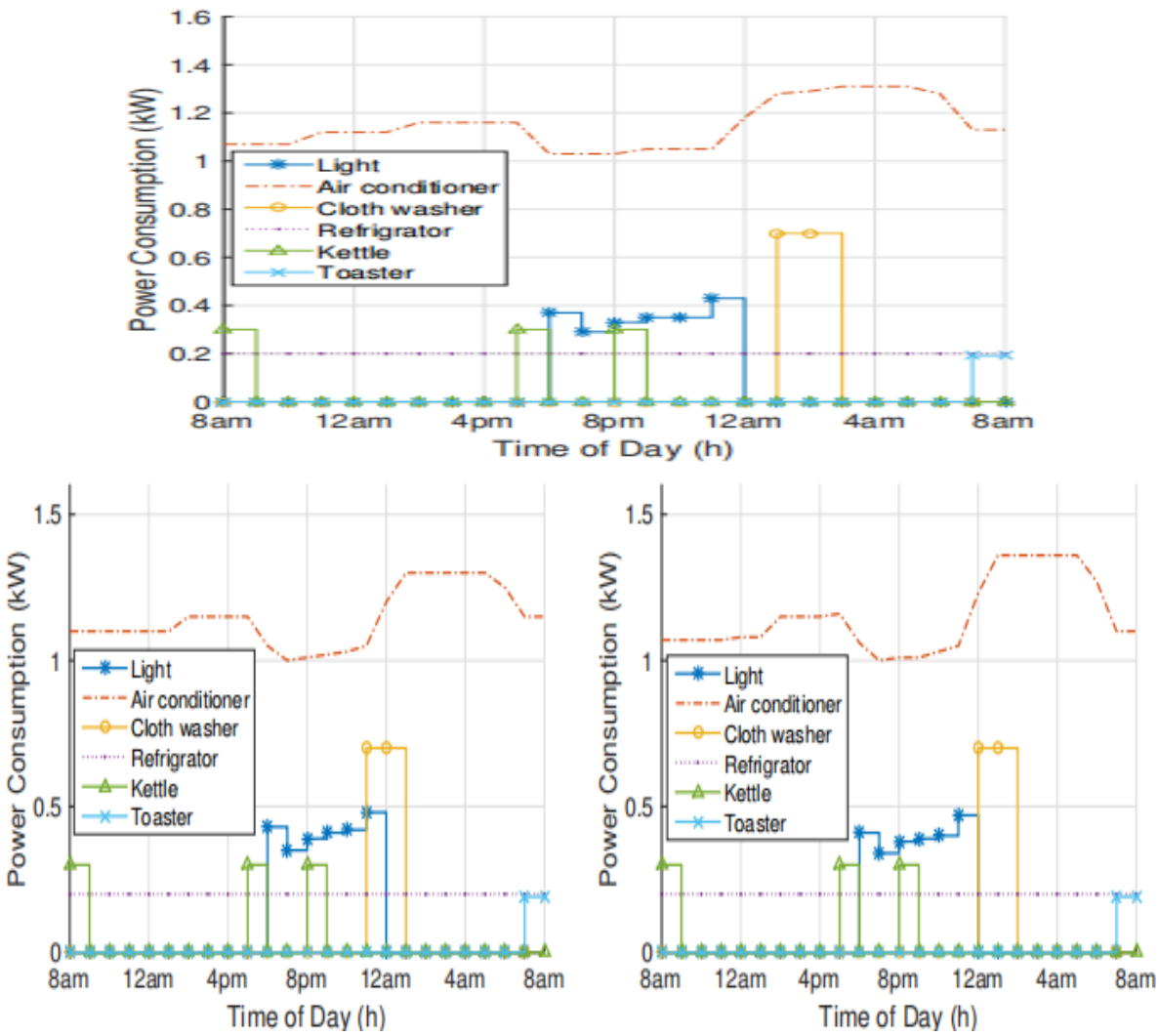

Figure 2: Power Consumption

PAR

PAR provides a measure on affects of peak electricity consumption on the system, particularly reliability. PAR is the ratio of peak power consumption with the average of total consumed power over the scheduling horizon i.e from t=1 to 24. The calculating expression is given as follows:

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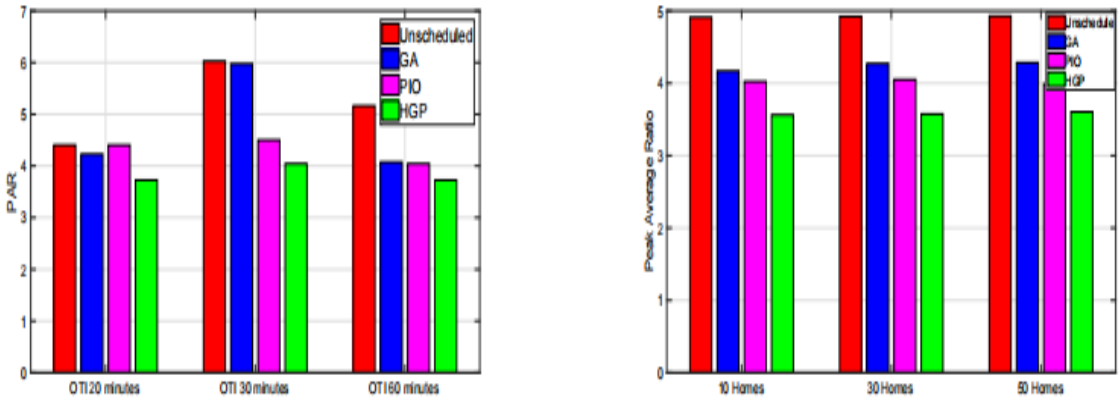
We applied GA, PIO and HGP on single and multiple home. PAR after scheduling is less than PAR in unscheduled, it means that our introduced algorithms controlling and scheduling the appliances so that load shift evenly between time slot.

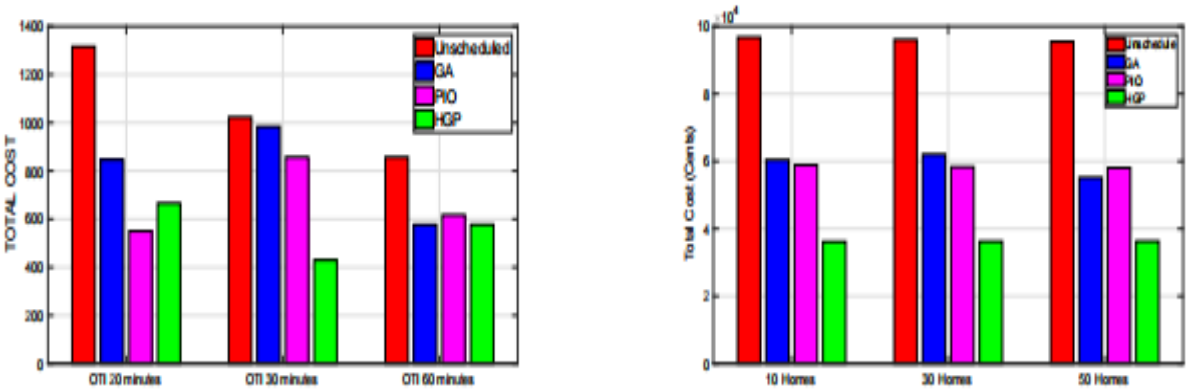


(a) PAR for a single home (b) PAR for multiple homes

Figure 3: PAR

ELECTRICITY COST

Total cost for single and multiple homes is shown in Fig.4. In single home scenario, GA reduces 4.32%, 2.86% of the total cost in case of 20 minutes OTI and 30 minutes OTI. PIO reduces 20.43%, 27.65% of the total cost in case of 20 minutes OTI and 30 minutes OTI. HGP reduces 30.72%, 40.93% of the total cost in case of 20 minutes and 30 minutes OTI. In multiple homes, unscheduled cost is more than the cost in all each cases.



(a) Total cost for a single home (b) Total cost for multiple homes

Figure 4: Electricity Cost

VI. CONCLUSION

In this paper, a hybrid algorithm is proposed to minimize electricity consumption cost while minimizing user discomfort. Hybridization technique is proposed for PAR for different OTI and compared its performance with PO, GA, and HGMp. Our proposed hybridization algorithm shows the comparable results with GA and PO with less computational efforts. Unlike GA and PO, proposed technique minimizes both user discomfort and cost without affecting PAR and peak power consumption. Furthermore, the effect of scheduling on cost and user discomfort is also demonstrated by feasible region. It is also shown that power-flexible appliances have a significant effect on consumers' electricity bill without affecting user discomfort.

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