INTELLIGENT SYSTEM DESIGN FOR DEMAND SIDE MANAGEMENT IN SMART GRID

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In Demand Side Management (DSM) systems have become predominant in both industrial and domestic applications. Basically, these systems help the customers to utilize electricity more efficiently. Using a priority table, commercial DSM systems choose the instantaneous load power request. In this article, an intelligent system is proposed to manage the loads at customer load points and thereby making optimal power flow across different nodes in the distribution network. The proposed system consists of smart meters installed at consumer load premises to which all the loads consumer network are connected individually. Along with this process, a procedure which enables the power flow along different node paths in the distribution network to be optimized thereby avoiding load shedding in the distribution network.

Keywords: Demand Side Management, Energy Management, Character Recognition, Decision Trees, Energy Resolution, Power Distribution

1. Introduction

Nowadays, one of the most important functions in the energy management of the smart grid is the Demand Side Management (DSM) [1]. The concept of Multi-Agent System (MAS) [2] was discussed by Logenthiran et al. that focuses on generation scheduling and DSM. Incorporating the modern cyber security measures, a grid wide framework [3] was presented that supports the multitude geographically and temporally coordinated hierarchical monitoring. A deep review on the reliability impacts was also discussed. A detailed and massive transformation on smart grid [4] was presented by Faranghi, which includes the concepts on different technologies and systems. Various benefits ad challenges [5] of DSM were discussed in detail by Strbac, which gives a detailed picture of the needs of the DSM and its effectiveness. Various aspects on DSM that includes Load Management, Load Profiling, Load Shifting, Residential and Industrial Consumer, Energy Audit, Reliability, Urban, Semi-Urban and Rural Setting [6] was explained by Indra K Maaharjan for better understanding of DSM and its implementation to various places.

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The implementation of optimization technique [7] to DSM was formulated by Logenthiran, which was more effective than the previously implemented traditional methods. Normally the electricity grid faces many challenges in terms of quality and satisfying the requirements of the customers. To obtain the aforesaid objective, the economic power generation through the way if environment friendly with effective DSM is most necessary. This is possible with the help of the present communication technologies and advanced information.

The DSM refers to the planning, implementation and monitoring of utility activities which influence customer use of electricity. Utility programs falling under DSM includes load management, strategic conservation, electrification, customer generation, and adjustments in market share [8]. DSM includes activities involving deliberate intervention by utility in marketplace in order to alter consumer's demand [9]. It is generally most convenient for utilities to look at DSM in terms of broad load shaping devices. The load shape is the daily and seasonal electricity demand by time-of-day, day-of-week, and season [10]. The application of smart loads and intelligent energy systems [11] was presented by palensky et al. A detailed energy planning model [12] was formulated and applied by kazemi et al. for the improvement of the DSM. Distributed Algorithm (DA) [13] was successfully applied for DSM that includes the Energy Consumption Controlling (ECC) unit. The DSM for residential users using optimization models [14] was discussed by Barbato et al. The application of load shifting and its incentives regarding the smart grid was discussed in [15].

A novel approach for smart home management system [16] was devised and presented by Gayathri et al. which constitutes the implementation of power hub. Sundara raghavan presented the DSM related to Indian Power Utilities [17], which depicts the detailed picture of the utilization of power in various regions of India. A generic DSM (g-DSM) [18] was modeled by Muhammed et al. for the purpose of reducing the peak-average ratio. Different research, reviews and its outcome [19] was presented by Saad, which includes the usage of different materials to improve the power system variations at the demand side. In this work, an overriding mechanism is introduced to avoid the human intervention. The organization of the work is as follows. Section 2 explains the different learning approaches. Proposed mechanism and algorithm explanation is presented in section 3. Simulation results and discussion is given in section 4. Section 5 concludes the proposed mechanism.

2. Learning Methodologies

Machine learning is a scientific /engineering discipline that deals with the construction and study of algorithms that can be learned from the data. Rather than following explicit programmed instructions, these algorithms operate on input based model to make predictions or decisions. In computing tasks where designing and programming rule-based algorithm is not feasible, machine learning is employed. Computer vision, Optical Character Recognition (OCR), Spam filtering and search engines are some of the examples. Although machine learning focuses more on data analysis, it is often conflicted with data mining. Machine learning and pattern recognition are the two faces of the same field. Compared to constituent learning algorithms, ensemble methods obtain better predictive performance in statistics and machine learning. Machine learning ensembles refer to a concrete finite set of alternative models contrary to statistical ensembles which are infinite, but flexible. Decision tree learning, one of the predictive modeling approaches in statistics, data mining and machine learning, maps observations to conclusions of an item's target value. The leaves in decision trees, also known as regression trees or classification trees represent class labels and branches represent conjunction of features.

A business model with sustainable business development principles [20] can help the industry to mitigate volatile energy management economically. Load shifting on seven different customer load sectors and the effects of the various DSM measures on the load shapes and on the system reliability indices used in generating capacity adequacy assessment [21].A demand side management strategy that can be employed in the future smart grid is a generalized technique based on load shifting, which has been mathematically formulated as a minimization problem and a heuristic based evolutionary algorithm is developed for solving the problem [22]. An optimal power flow (OPF) technique to evaluate which demand-responsive loads in a given distribution network provides the maximum value to the system, in terms of their ability to relieve upstream network constraints and provide ancillary services, such as operating reserve. The approach is demonstrated on typical U.K. radial and meshed distribution test systems [23]. It is shown that the exact network location of DSM resources has a significant impact on the value that a given deferrable load can provide to the system, in terms of managing upstream constraints. A class of billing mechanisms has been introduced which is optimal in minimizing the system cost. Different subclasses can be defined by changing the coefficient of this class and subclass has been proposed and is implemented by a privacy-preserving algorithm [24].

A two-stage RDSM method for REs that consist of the ESS and the PEVs with V2G option has been proposed in an MG under an environment with uncertainties [25]. In the first stage, an MPC-based rolling dynamic optimization model is established with the aim of minimizing the daily total cost and maintaining the supply-demand balance. During the second stage, a rule-based RTAC algorithm has carried out to adjust the optimization results of the first stage combined with the SA value of each RE. DSM is an effective way of matching the demand for electric energy services with available central and distributed resources. DSM will continue to be an important option as power systems continue to evolve [26]. The performance of an industrial building using a thermal storage tank coupled with heat pumps was studied for the summer cooling period by means of dynamic simulations [27]. The purpose of the analysis was to evaluate the viability of the TES installation aimed at recovering surplus PV electricity during weekends, thus different operational configurations were considered, and energy use and costs were assessed.

3. Proposed system

The proposed system is referred as Overriding Mechanism that works only during the Demand side management mode. This system consists of Smart meter at which all the individual loads of the consumer's load network are connected separately. The smart meter acts as a distributor of power to the individual loads from the service mains in the consumer load network. The block diagram of the proposed system model is shown in Fig. 1.

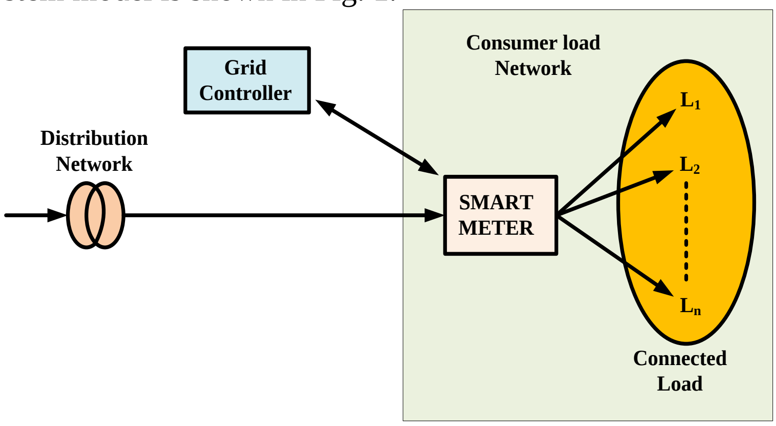

Figure.1 Block diagram of proposed system model

The problems that are formulated in the proposed system are Prioritization and Scheduling of the loads in the consumer load network. To evaluate the solution a machine learning algorithm is used to learn the consumer's electric power usage pattern. Initially the information about the time of usage of each individual loads are recorded by the smart meter during their operation. The solution algorithm uses this data to prioritize the loads. The machine learning algorithm used in this problem is Ensemble learning technique. The Ensemble learning algorithm is trained with the above-mentioned data to decode the consumer's electric power usage pattern. This priority order evaluated is dynamic, in the sense that the priority order changes if the consumer's electric power usage behavior changes.

This priority order list is stored in the memory of the system. When the system operates in the Demand side management mode, the Grid controller commands each individual consumer network about the power to be consumer by it at a given time instant.

This data along with the priority order list is used to schedule the load at the given time instant. The scheduling is done by a simple optimizing algorithm in the smart meter and the schedule data for the given time instant is stored in the memory.

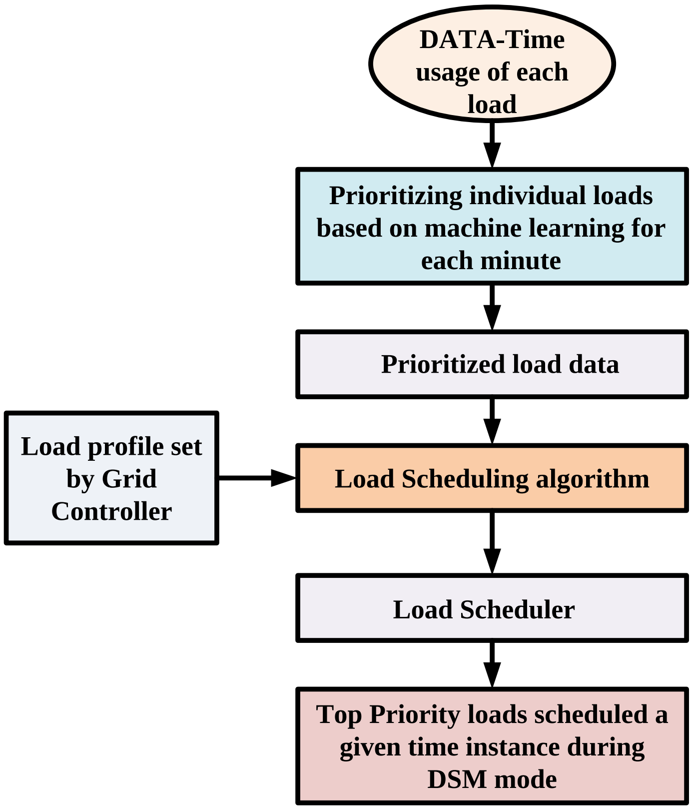

Figure. 2 Solution Algorithm for the proposed system

A. Algorithm Description

The problems that are formulated in the proposed system are Prioritization and Scheduling of the loads in the consumer load network. To validate the proposed mechanism, a machine learning algorithm is used to learn the consumer's electric power usage pattern. Fig. 2 represents the solution algorithm for the proposed system. The following are the steps involved in the proposed algorithm.

Step 1: Begin
Step 2: Initialize the time usage of each load
Step 3: Prioritize the load and load data (based on the algorithm)

Step 4: Scheduling the algorithm (Profile set by the grid controller)
Step 5: Assigning of values to the load scheduler
Step 6: Scheduling of top priority loads during the DSM mode.
Step 7: End

B. Overriding Mechanism

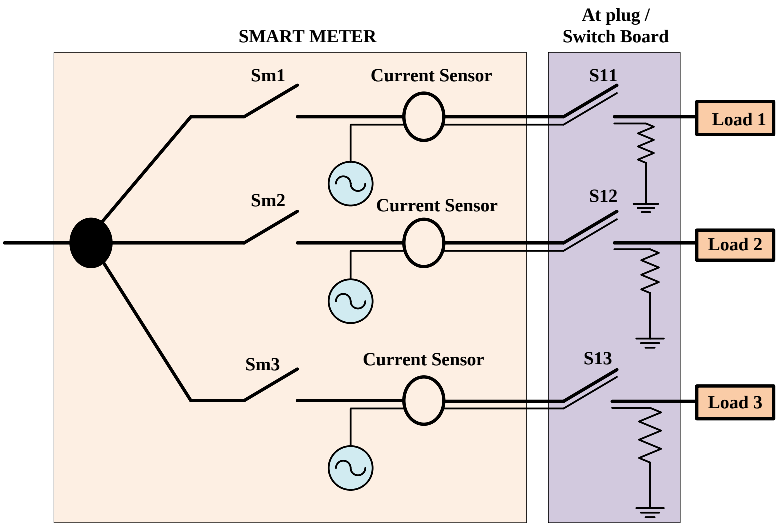

Figure.3 Overriding mechanism for the proposed system

In the proposed system, the loads will be scheduled based on the consumer power usage behavior. But still the human instincts are unpredictable. Fig. 3 represents the block diagram of the overriding mechanism. As per the normal power usage behavior the consumer will use those loads at that time instant. But if the consumer prefers another load instead of L1, say L3, at that time instant, and so if consumer switches off Sl1, the switch Sm1 is open and the next priority load, say L3, is scheduled by closing the switch Sm3. The Distribution Network in the power system comprises of Distribution substation, Primary distribution system, and Secondary distribution system and service mains which connect with the individual consumers. At any given node and at any given time, its load value is the summation of the load values at the nodes of lower hierarchy connected to it. As the consumers' Electric power usage follows a periodic pattern as mentioned before, nodes in the distribution network follows the same pattern in their load values. These ideas form the basis for the proposed intelligent system for demand side management at distribution networks in smart grid [2].

4. Simulation results and discussion

The Simulation work for the proposed system is done in two sections. Hardware is implemented to demonstrate the objective 1 of the proposed system and simulation is carried out to demonstrate objective 2 of the proposed system. The hardware implementation of the proposed system for the objective 1 is assumed for a consumer having 8 different loads. The work to be done by the smart meter is carried out by control circuit. MATLAB software is used for the purpose of simulation. When hardware is considered, the switches in the kit are the replacement for the plug/socket/switch board in the consumer end. In hardware kit the temperature and weather conditions are fed as input to the database from the switch board. The temperature and weather condition for different loads for a period of 30 days is presented in Table 1. Power usage command for various time periods is presented in Table 3. The results obtained for the objective 1 are tabulated in Table 2. The simulation of the proposed system for the objective 2 is done using MATLAB software.

Table I

Temperature and weather condition for different loads for a period of 30 days

Days	L1	L2	L3	L4	L5	L6	L7	L8	Temperature		Weather
1	10.30-11.10	00.00 – 00.00	09.06 - 11.36	10.17-11.36	09.00 – 12.00	09.45 - 10.39	09.30 – 12.00	09.00 – 12.00	9.00 – 10.30	Above 30ºC	Sunny
									10.30 - 12.00	Above 30ºC	Sunny
2	09.30-10.30	00.00 – 00.00	09.27-10.12	10.08-10.48	09.00 – 12.00	09.16 - 11.36	09.00 – 12.00	09.00 – 12.00	9.00 – 10.30	Above 30ºC	Sunny
									10.30 - 12.00	Above 30ºC	Sunny
3	09.24-11.12	09.48 – 10.12	09.36 - 11.12	10.23-11.48	09.00 – 12.00	09.00–11.11	10.13–12.00	09.00 – 12.00	9.00 – 10.30	Above 30ºC	Sunny
									10.30 - 12.00	Above 30ºC	Sunny
4	09.03-11.40	09.00 – 10.32	09.12 – 11.40	09.44 – 10.52	09.00 – 12.00	09.01 - 10.53	10.42 – 12.00	09.13 – 12.00	9.00 – 10.30	25ºC -30ºC	Sunny
									10.30 - 12.00	Above 30ºC	Sunny
5	09.46-11.01	09.23 – 10.55	09.00 – 12.00	09.29 – 11.36	09.00 – 12.00	09.05-11.48	00.00 – 00.00	09.03 – 12.00	9.00 – 10.30	25ºC -30ºC	Sunny
									10.30 –12.00	25ºC -30ºC	Sunny
6	09.37 - 11.28	09.15 – 11.23	09.36 – 11.26	09.00-11.12	09.00 – 12.00	10.48-12.00	00.00 – 00.00	09.55 – 12.00	9.00 – 10.30	25ºC -30ºC	Sunny
									10.30 –12.00	25ºC -30ºC	Sunny
7	09.26 - 10.40	09.00 – 12.00	10.26 – 12.00	11.01 – 11.56	09.00 – 12.00	10.28-12.00	00.00 – 00.00	09.55–12.00	9.00 – 10.30	18ºC -25ºC	Rainy
									10.30 –12.00	25ºC -30ºC	Sunny
8	10.40 - 11.30	09.36 – 11.18	11.50 – 12.00	11.32 – 12.00	09.15 – 12.00	10.00 - 12.00	10.29 – 12.00	10.42 – 12.00	9.00 – 10.30	25ºC -30ºC	Sunny
									10.30 –12.00	Above 30ºC	Sunny
9	10.01 - 10.39	10.38 – 11.15	11.12 – 12.00	09.21 - 11.31	09.01 – 12.00	10.12-11.36	00.00 – 00.00	10.27 - 12.00	9.00 – 10.30	18ºC -25ºC	Rainy
									10.30 –12.00	25ºC -30ºC	Rainy
10	09.52 - 11.36	09.00 - 10.59	09.00 - 12.00	09.09 - 11.52	09.00 – 12.00	09.30 - 10.15	00.00 – 00.00	10.26 - 11.38	9.00 – 10.30	18ºC -25ºC	Rainy
									10.30 –12.00	18ºC -25ºC	Rainy
11	09.01 - 11.59	09.37 – 11.26	09.00 – 12.00	09.30 – 11.26	09.00 – 12.00	00.00-00.00	00.00 – 00.00	10.47 – 12.00	9.00 – 10.30	Below18ºC	Rainy
									10.30 –12.00	18ºC -25ºC	Sunny
12	09.30 - 10.26	09.38 – 12.00	09.00 – 12.00	09.00-12.00	09.00 – 12.00	00.00-00.00	00.00 – 00.00	00.00 – 00.00	9.00 – 10.30	Below18ºC	Sunny
									10.30 –12.00	Below18ºC	Rainy
13	10.01 - 10.56	09.01 – 12.00	09.00 – 12.00	09.30 – 11.56	09.00 – 12.00	00.00-00.00	00.00 – 00.00	00.00 – 00.00	9.00 – 10.30	Below18ºC	Sunny
									10.30 –12.00	Below18ºC	Sunny
14	10.21 - 12.00	09.00 – 12.00	09.00 – 12.00	09.39 - 12.00	09.00 – 12.00	00.00 - 00.00	00.00 – 00.00	00.00 – 00.00	9.00 – 10.30	Below18ºC	Rainy
									10.30 –12.00	Below18ºC	Rainy
15	10.03 - 11.23	09.09-11.30	09.36-11.56	10.36 – 12.00	09.00 – 12.00	10.36 - 12.00	00.00 – 00.00	10.30 – 12.00	9.00 – 10.30	Below18ºC	Rainy
									10.30 –12.00	18ºC -25ºC	Rainy
16	09.04-	09.37 –	09.01 –	10.32 –	09.00 –	09.48 -	00.00 –	09.15 –	9.00 – 10.30	Below18ºC	Sunny

	11.21	11.21	10.36	12.00	12.00	10.12	00.00	11.23	10.30 –12.00	18ºC -25ºC	Sunny
17	10.20 - 11.30	09.10 – 11.36	09.00 – 12.00	10.01 – 11.36	09.00 – 12.00	09.12- 11.40	00.00 – 00.00	09.37 – 11.29	9.00 – 10.30 10.30 –12.00	18ºC -25ºC 18ºC -25ºC	Rainy Rainy
18	10.01 - 12.00	09.38 – 10.23	09.33 – 11.59	09.00 – 12.00	09.00 – 12.00	09.36- 11.21	00.00 – 00.00	09.00 – 11.31	9.00 – 10.30 10.30 –12.00	Below18ºC 18ºC -25ºC	Sunny Sunny
19	10.18 - 11.32	09.01 – 11.34	09.00 – 11.01	09.39 – 11.21	09.36 – 12.00	09.36 - 11.43	11.03 – 12.00	09.00 – 12.00	9.00 – 10.30 10.30 –12.00	25ºC -30ºC 25ºC -30ºC	Sunny Sunny
20	11.31 - 12.00	09.55 – 12.00	09.56 – 12.00	09.26 – 12.00	09.12 – 12.00	09.00 - 10.36	10.43 – 12.00	09.00 – 12.00	9.00 – 10.30 10.30 –12.00	18ºC -25ºC 25ºC -30ºC	Rainy Sunny
21	11.01 - 11.43	10.32 – 12.00	10.01 – 12.00	11.50 – 12.00	09.00 – 12.00	09.00 - 12.00	00.00 – 00.00	09.00 – 12.00	9.00 – 10.30 10.30 –12.00	25ºC -30ºC 25ºC -30ºC	Sunny Rainy
22	09.03- 10.23	10.03 – 12.00	09.00 – 12.00	11.01 – 12.00	09.00 – 12.00	10.30 - 12.00	09.00 – 12.00	09.36 – 11.36	9.00 – 10.30 10.30 –12.00	Above 30ºC Above 30ºC	Sunny Sunny
23	09.00- 12.00	11.32 – 12.00	09.59 – 11.01	09.00 – 12.00	09.00 – 12.00	11.03 - 12.00	09.00 – 12.00	09.00 – 12.00	9.00 – 10.30 10.30 –12.00	Above 30ºC Above 30ºC	Rainy Rainy
24	09.38 - 11.49	09.00 – 09.59	10.39- 12.00	10.41 – 12.00	09.00 – 12.00	11.36 - 12.00	09.00 – 12.00	09.06 – 10.36	9.00 – 10.30 10.30 –12.00	Above 30ºC Above 30ºC	Rainy Rainy
25	09.24 - 11.18	09.00 – 10.33	09.00 – 12.00	10.01 – 11.38	09.00 – 12.00	10.03 - 12.00	09.00 – 12.00	09.00 – 10.45	9.00 – 10.30 10.30 –12.00	Above 30ºC Above 30ºC	Sunny Sunny
26	09.00 - 11.59	09.33 – 10.57	09.36 – 11.35	10.36 – 11.48	09.12 – 12.00	11.40 - 12.00	10.36 – 12.00	09.00 – 10.53	9.00 – 10.30 10.30 –12.00	25ºC -30ºC Above 30ºC	Rainy Sunny
27	09.30 - 10.36	09.26 - 11.51	10.56 - 12.00	09.39 – 11.49	09.00 – 12.00	11.46 - 12.00	10.46 – 12.00	09.00 – 12.00	9.00 – 10.30 10.30 –12.00	25ºC -30ºC 25ºC -30ºC	Sunny Rainy
28	09.40 - 11.36	09.21 – 10.51	10.16 – 12.00	09.29 – 10.49	09.00 – 12.00	11.26 - 12.00	10.36 – 12.00	09.10 – 12.00	9.00 – 10.30 10.30 –12.00	25ºC -30ºC 25ºC -30ºC	Rainy Sunny
29	09.35 - 10.36	10.26 - 11.51	11.56 – 12.00	09.37 – 11.49	09.00 – 12.00	11.46 - 12.00	10.41 – 12.00	09.09 – 12.00	9.00 – 10.30 10.30 –12.00	25ºC -30ºC Above 30ºC	Sunny Sunny
30	09.30 - 10.46	09.26 – 11.51	10.26 – 12.00	09.32 – 11.49	09.45 – 12.00	11.46 - 12.00	00.00 – 00.00	09.00 – 12.00	9.00 – 10.30 10.30 –12.00	18ºC -25ºC 18ºC -25ºC	Sunny Sunny

Table I illustrates the temperature and weather condition for different loads for a period of 30 days. In a 24 hours day, 8 different time intervals have been chosen and the temperature ranges and the climate on that day has been noted and tabulated. The maximum and minimum temperature ranges from 30^o and 18^{o}respectively. The temperature exceeds these two limits

Table II

Simulation results obtained by the overriding mechanism for objective 1 of the proposed mechanism

Time	Temperature	Weather	Scheduled Loads
09.00 – 09.31	25º-30ºC	Rainy	L1, L8, L5
09.32 – 09.35	25º-30ºC	Rainy	L8, L2, L5, L4, L1
09.36 – 09.39	25º-30ºC	Rainy	L8, L2, L5, L4, L3
09.40 – 10.15	25º-30ºC	Rainy	L1, L2, L8, L5, L4
10.16 – 10.29	25º-30ºC	Rainy	L1, L2, L3, L8, L5
10.30 – 10.31	Above 30ºC	Sunny	L5, L8, L6, L4, L3, L2
10.32 – 10.33	Above 30ºC	Sunny	L5, L8, L6, L4, L3, L2, L7
10.34 – 10.49	Above 30ºC	Sunny	L5, L8, L6, L4, L3, L7
10.50 – 11.31	Above 30ºC	Sunny	L7, L5
11.32 – 11.39	Above 30ºC	Sunny	L7, L5, L8, L4, L3
11.40 – 11.49	Above 30ºC	Sunny	L7, L5, L8, L4
11.50 – 12.00	Above 30ºC	Sunny	L7, L5, L8, L6, L3

Table II depict the simulation results obtained by the overriding mechanism for objective 1 of the proposed mechanism. Here the range of temperature is from 25-30oC and above 30oC. Temperature readings have been taken and are inserted in table II with the corresponding load schedules.

Table III

Power usage command from grid controller

Time	Power to be consumed
09.00 – 09.32	250W
09.32 – 10.32	350W
10.32 – 10.50	400W
10.50 – 11.32	180W
11.32 – 12.00	300W

Table III illustrates the power usage command from grid controller. In this table the exact power has been transferred to the grid in a particular interval of time has been monitored and inserted in the table. This will help to analyze the maximum demand needed during peak hours. Table IV depicts the load demands on the consumer end1. Based on the types of loads utilized, the corresponding temperature range, season and the duration has been presented in that table.

Table IV

Load details for consumer end 1

Days	Load	Load Usage Time	Temperature	Weather
1	L1	6.00 – 6.50	18ºC -25ºC	Sunny
	L2	6.13 – 6.32		
	L3	6.30 – 7.00		
	L4	6.45 – 7.00		
2	L1	6.06 – 6.20	18ºC -25ºC	Sunny
	L2	6.10 – 6.42		
	L3	6.20 – 7.00		
	L4	6.35 – 7.00		
3	L1	6.15 – 6.29	Below 18ºC	Rainy
	L2	6.20 – 6.32		
	L3	6.10 – 7.00		
	L4	6.31 – 6.49		

Table V

Load details for consumer end 2

Days	Load	Load Usage Time	Temperature	Weather
1	L1	6.20 – 7.00	18ºC -25ºC	Sunny
	L2	6.55 – 7.00		
	L3	6.05 – 6.55		
2	L1	6.10 – 6.20	18ºC -25ºC	Sunny
	L2	6.15 – 7.00		
	L3	6.05 – 6.35		
3	L1	6.15 – 6.29	Below 18ºC	Rainy
	L2	6.00 – 7.00		
	L3	6.05 – 6.25		

Table VI

Load details for consumer end 3

Days	Load	Load Usage Time	Temperature	Weather
1	L1	6.05 – 6.32	18ºC -25ºC	Sunny
	L2	6.35 – 6.46		
	L3	6.09 – 6.59		
2	L1	6.05 – 6.22	18ºC -25ºC	Sunny
	L2	6.45 – 6.55		
	L3	6.01 – 6.50		
3	L1	6.05 – 6.49	Below 18ºC	Rainy

Table VII

Load details for consumer end 4

Days	Load	Load Usage Time	Temperature	Weather
1	L1	6.15 – 6.21	18ºC -25ºC	Sunny
	L2	6.00 – 6.38		
	L3	6.30 – 7.00		
2	L1	6.05 – 6.29	18ºC -25ºC	Sunny
	L2	6.00 – 6.48		
	L3	6.20 – 7.00		
3	L1	6.05 – 6.49	Below 18ºC	Rainy
	L2	6.25 – 7.00		
	L3	6.06 – 6.35		

Table VIII

Load details for consumer end 5

Days	Load	Load Usage Time	Temperature	Weather
1	L1	6.18 – 6.40	18ºC -25ºC	Sunny
	L2	6.00 – 7.00		
	L3	6.00 – 6.30		
2	L1	6.08 – 6.30	18ºC -25ºC	Sunny
	L2	6.20 – 7.00		
	L3	6.10 – 6.45		

3	L1	6.08 – 6.30	Below 18ºC	Rainy
	L2	6.25 – 7.00		
	L3	6.06 – 6.35		

Table V to Table VIII depicts the details of load for 4 different consumer ends from consumer end 2 to consumer end 5. From the results obtained it is inferred that with the help of the proposed overriding mechanism, the allotted load is being efficiently used by the consumers at different weather conditions by satisfying their needs. The simulation for objectives are carried out on a simple distribution network having 5 different consumer ends and with 8 nodes of power usage data for 3 days with the time span of 6.00 am to 7.00 am. The proposed Machine Learning Algorithm, i.e. ensemble learning algorithm has been implemented in MATLAB programming.

5. Conclusion

This work proposes an intelligent system which learns the consumer's Electric usage pattern and uses this knowledge to manage the loads at consumer load network. The proposed system consists of a smart meter installed at consumer load network at which all the loads at consumer network are connected individually. The simulation data comprises the time of operation of 7 types of loads for 5 days between time intervals from 6.00 am to 9.00 am at a consumer network. The prioritized and scheduled loads obtained as output from the proposed system ensures the optimal and efficient energy usage in the Electric power system. This mechanism can be used as a sub-system in the future work which address the demand side management scheme for the entire distribution network.

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