DEMAND SIDE MANAGEMENT: DEMAND RESPONSE, INTELLIGENT ENERGY SYSTEMS AND SMART LOADS

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ABSTRACT
Request side administration is a helpful and vital device in savvy network vitality the executives framework to decrease absolute power request amid pinnacle request periods and henceforth, upgrading lattice supportability and lessening by and large expense. The proposed load planning approach dependent on gauge power costs and pre-booked burdens. It essentially utilizes the technique for load moving of move capable and interruptible loads and can be constrained by the brought together controller of things to come savvy network. This methodology advances the utilization bends of family unit, business and mechanical shoppers. The proposed calculation in this methodology limits the expense caused by clients while considering clients’ individual inclinations for the heaps by setting needs and favored time interims for load planning.

Keyword: Demand of smart expense

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1. INTRODUCTION
The demand for electricity has been growing rapidly around the world for the last decade. To cope with the growing demand and evolving governmental and environmental regulations, it is necessary to question if the current level of consumption can continue in the long run. Conventional methods have focused on improving the efficiency and methods of power generation and distribution. However, this improvement is limited by existing infrastructure of power stations. Hence, instead of altering the generation side of the power systems, much attention has been shifted on the demand or the consumer side. Demand side management strategies generally focus on improving efficiency and reducing cost in load scheduling.
These strategies are not new – the idea has been explored since the 1970s. In the USA, a few utility companies have tried introducing incentives for load shifting and demand response using different electricity rates by time of the day, which garnered a little support. Even back then its potential was recognized and studies were performed on demand side management using different technologies and control methods such as clock-based controls, communication via power lines, telephone lines and radio.

Energy demand management, also known as demand-side management (DSM) or demand-side response (DSR), is the modification of consumer demand for energy through various methods such as financial incentives and behavioral change through education. The goal of demand-side management is to encourage the consumer to use less energy during peak hours, or to move the time of energy use to off-peak times such as nighttime and weekends. Peak demand management does not necessarily decrease total energy consumption, but could be expected to reduce the need for investments in networks and/or power plants for meeting peak demands. An example is the use of energy storage units to store energy during off-peak hours and discharge them during peak hours. A newer application for DSM is to aid grid operators in balancing intermittent generation from wind and solar units, particularly when the timing and magnitude of energy demand does not coincide with the renewable generation. DSM refers to initiatives and technologies that encourage consumers to optimise their energy use. The benefits from DSM are potentially two-fold; first, consumers can reduce their electricity bills by adjusting the timing and amount of electricity use. Second, the energy system can benefit from the shifting of energy consumption from peak to non-peak hour.

Particle swarm optimization (PSO) is a population based stochastic optimization technique developed by Dr. Eberhart and Dr. Kennedy in 1995, inspired by social behavior of bird flocking or fish schooling. PSO shares many similarities with evolutionary computation techniques such as Genetic Algorithms (GA). The system is initialized with a population of random solutions and searches for optima by updating generations. However, unlike GA, PSO has no evolution operators such as crossover and mutation. In PSO, the potential solutions, called particles, fly through the problem space by following the current optimum particles. Each particle keeps track of its coordinates in the problem space which are associated with the best solution (fitness) it has achieved so far. (The fitness value is also stored.) This value is called pbest. Another "best" value that is tracked by the particle swarm optimizer is the best value, obtained so far by any particle in the neighbors of the particle. This location is called lbest. When a particle takes all the population as its topological neighbors, the best value is a global best and is called gbest.

The particle swarm optimization concept consists of, at each time step, changing the velocity of (accelerating) each particle toward its pbest and lbest locations (local version of PSO). Acceleration is weighted by a random term, with separate random numbers being generated for acceleration toward pbest and lbest locations. In past several years, PSO has been successfully applied in many research and application areas. It is demonstrated that PSO gets better results in a faster, cheaper way compared with other methods.

Another reason that PSO is attractive is that there are few parameters to adjust. One version, with slight variations, works well in a wide variety of applications. Particle swarm optimization has been used for approaches that can be used across a wide range of applications, as well as for specific applications focused on a specific requirement. Particle swarm optimization (PSO) is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. It solves a problem by having a population of candidate solutions, here dubbed particles, and moving these particles around in the search-space according to simple mathematical formulae over the particle’s position and velocity. Each particle’s movement is influenced by its local best
known position, but is also guided toward the best known positions in the search-space, which are updated as better positions are found by other particles. This is expected to move the swarm toward the best solutions. PSO is a met heuristic as it makes few or no assumptions about the problem being optimized and can search very large spaces of candidate solutions. However, met heuristics such as PSO do not guarantee an optimal solution is ever found. Also, PSO does not use the gradient of the problem being optimized, which means PSO does not require that the optimization problem be differentiable as is required by classic optimization methods such as gradient descent and quasi-newton methods.

2. METHODOLOGY
Proposes load scheduling approach based on forecasted electricity prices and pre-schedule loads. It mainly uses the method of load shifting of shift-able and interruptible loads and can be controlled by the centralized controller of the future smart grid. The main objective of this demand side management approach is to minimize cost for the consumers while maintaining their specified preferences for the pre-scheduled loads, and in turn, maximizing their satisfaction. The demand side management can be performed daily in smart grids, the demand side management controller asks for the user inputs for the pre-scheduled loads. For each load, the user will input the starting time the deadline the load duration and the ideal time for the load to run. Furthermore, the loads are classified into following three classes.

- Class 1 includes uncontrollable loads – these loads will run at ideal times specified by the users and will not be considered for load shifting.
- Class 2 includes controllable but un-interruptible loads. These loads will run continuously for the given load duration, within the time interval specified by the users but will be shifted to achieve minimum cost.
- Class 3 includes controllable and interruptible loads, which can be cut off while running, and resumed separately within the time frame specified by the users.

The class types of the loads also contribute to minimize total cost of the load scheduling.

3. DEMAND SIDE MANAGEMENT
Energy demand management, also known as demand-side management (DSM) or demand-side response (DSR), is the modification of consumer demand for energy through various methods such as financial incentives and behavioral change through education. The goal of demand-side management is to encourage the consumer to use less energy during peak hours, or to move the time of energy use to off-peak times such as nighttime and weekends. Peak demand management does not necessarily decrease total energy consumption, but could be expected to reduce the need for investments in networks and/or power plants for meeting peak demands. An example is the use of energy storage units to store energy during off-peak hours and discharge them during peak hours. A newer application for DSM is to aid grid operators in balancing intermittent generation from wind and solar units, particularly when the timing and magnitude of energy demand does not coincide with the renewable generation. DSM refers to initiatives and technologies that encourage consumers to optimize their energy use. The benefits from DSM are potentially two-fold; first, consumers can reduce their electricity bills by adjusting the timing and amount of electricity use. Second, the energy system can benefit from the shifting of energy consumption from peak to non-peak hour.
4. TYPES

4.1. Energy efficiency
Using less power to perform the same tasks. This involves a permanent reduction of demand by using more efficient load-intensive appliances such as water heaters, refrigerators, or washing machines.

4.2. Demand response
Any reactive or preventative method to reduce, flatten or shift demand. Historically, demand response programs have focused on peak reduction to defer the high cost of constructing generation capacity. However, demand response programs are now being looked to assist with changing the net load shape as well, load minus solar and wind generation, to help with integration of variable renewable energy. Demand response includes all intentional modifications to consumption patterns of electricity of end user customers that are intended to alter the timing, level of instantaneous demand, or the total electricity consumption. Demand response refers to a wide range of actions which can be taken at the customer side of the electricity meter in response to particular conditions within the electricity system (such as peak period network congestion or high prices), including the aforementioned IDSM.

4.3. Dynamic demand
Advance or delay appliance operating cycles by a few seconds to increase the diversity factor of the set of loads. The concept is that by monitoring the power factor of the power grid, as well as their own control parameters, individual, intermittent loads would switch on or off at optimal moments to balance the overall system load with generation, reducing critical power mismatches. As this switching would only advance or delay the appliance operating cycle by a few seconds, it would be unnoticeable to the end user. In the United States, in 1982, a (now-lapsed) patent for this idea was issued to power systems engineer Fred Schweppes. This type of dynamic demand control is frequently used for air-conditioners. One example of this is through the Smart AC program in California.

4.4. Distributed Energy Resources
Distributed generation, also distributed energy, on-site generation (OSG) or district/decentralized energy is electrical generation and storage performed by a variety of small, grid-connected devices referred to as distributed energy resources (DER). Conventional power stations, such as coal-fired, gas and nuclear powered plants, as well as Hydroelectric dams and large-scale solar power stations are centralized and often require electric energy to be transmitted over long distances. By contrast, DER systems are decentralized, modular and more flexible technologies that are located close to the load they serve, albeit having capacities of only 10 megawatts (MW) or less. These systems can comprise multiple generation and storage components; in this instance they are referred to as hybrid power systems. DER systems typically use renewable energy sources, including small hydro, biomass, biogas, solar power, wind power, and geothermal power, and increasingly play an important role for the electric power distribution system. A grid-connected device for electricity storage can also be classified as a DER system, and is often called a distributed energy storage system (DESS). By means of an interface, DER systems can be managed and coordinated within a smart grid. Distributed generation and storage enables collection of energy from many sources and may lower environmental impacts and improve security of supply.
5. SIMULATION RESULT

Figure 1 Output voltage and current for PV Battery

Figure 2 Inverter Output Load Voltage and current
6. CONCLUSION
Demand side management strategy proposed in this paper proves to be effective in producing substantial cost savings while reducing the peak demand. The simulation also shows that it can be used to find an optimal load schedule for a large number of different devices over a day. This method primarily works with load shifting techniques, and hence, further studies can be conducted on using load curtailing when the algorithm produces a peak demand in less expensive time intervals when the user-specified loads are too flexible.

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