International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Residential Load Scheduling using Smart Grid

Madhavi S. Bhosale[1], R.A. Pagare[2]

[1]Trinity College of Engineering and Research, Pune, Maharashtra, India

[2]Professor, Trinity College of Engineering and Research, Pune, Maharashtra, India

Abstract: ***In these paper we propose a mechanism for load scheduling. Load scheduling is nothing but a smart option for load shedding. We propose a home based mechanism. Here we classified hone appliances into three categories according to their working and power consumption mechanisms. Using the power consumption we switch on or off these home appliances. These all things are done by considering the hourly load consumption.***

Keywords: load scheduling, smart grid, non shiftable , time shiftable , power shiftable appliances.

1. Introduction

The aim of the proposed scheduling is to minimise the peak hourly load in order to achieve an optimal (balanced) daily load schedule. The proposed mechanism is able to schedule both the optimal power and the optimal operation time for power-shiftable appliances and time-shiftable appliances respectively according to the power consumption patterns of all the individual appliances. Simulation results based on home and neighbourhood area scenarios have been presented[1]

Objective of proposed system is to demonstrate the effectiveness of the proposed technique to implement this design and validate it for multiple households and also incorporate future enhancements. Also to reduce the energy wastage to control shiftable appliances at home

2. Literature Survey

1. Adaptive Load Balancing Optimization Scheduling Based on Genetic Algorithm By Juanjuan Min,Huazhong Liu,Anyuan Deng,Jihong Ding (2010): The load balancing scheduling is the core of the load balancing technology in the cluster system. The actual load of servers will increase suddenly before the load value is updated if many clients link the servers in a short period. A mathematical model of load balancing was improved and an adaptive load balancing optimization scheduling based on genetic algorithm was proposed, analyzed and simulated. Empirical results show that the algorithm can reduce effectively the average execution time of all requests and speed up the average response time. Meanwhile, with the increment of the cluster size, the algorithm running time is not increased significantly while maintain good performance.

2. Residential Electricity Load Scheduling for Multi-Class Appliances with Time-of-Use Pricing Jang-Won Lee,Du-Han Lee(2011): It consider various appliances with different operation and energy consumption characteristics with each other, we classify appliances into four classes and provide mathematical models to describe them. With the developed appliance models, we also propose an electricity load scheduling algorithm that controls the operation time and energy consumption of each appliance adapting to Time of Use (TOU) pricing and its operation and energy consumption characteristics to minimize the total electricity bill.

3. Optimal Load Scheduling for Residential Renewable Energy Integration by Thanh Dang and Kathryn Ringland (2012): It propose an optimal load scheduling algorithm to minimize energy cost for residential homes in smart grids. The algorithm is designed for smart grids with renewable energy sources, energy storage, and two-way communication and energy dispatch. Each appliance in a home has jobs that can be deferred but have deadlines. The algorithm takes into account day-ahead pricing with inclining block rates from energy retailers, local energy generation information from renewable sources, and future jobs to make decisions on when to buy or sell energy while still accomplishing the jobs before their deadlines. The algorithm achieves its optimality by formulating a linear optimization problem that can be solved efficiently. Simulation results show that our approach can reduce energy cost by 20% and peak energy consumption by 100% compared to other approaches.

4.Optimizing Shiftable Appliance Schedules across Residential Neighbourhoods for Lower Energy Costs and Fair Billing by Salma Bakr and Stephen Crane_eld (2013): This early stage interdisciplinary research contributes to smart grid advancements by integrating information and communications technology and electric power systems. It aims at tackling the drawbacks of current demand-side energy management schemes by developing an agent-based energy management system that coordinates and optimizes neighbourhood-level aggregate power load. In this paper, we report on the implementation of an energy consumption scheduler for rescheduling\shiftable" household appliances at the household-level; the scheduler takes into account the consumer's time preferences, the total hourly power consumption across neighbouring households, and a fair electricity billing mechanism. This scheduler is to be deployed in an autonomous and distributed residential energy management system to avoid load synchronization, reduce utility energy costs, and improve the load factor of the aggregate power load.

3. Classification Of Home Appliances

A. Non-shiftable appliances:
They have fixed power requirement and operation period, the optimization will ensure continuous supply of power. No need to schedule this appliances. e.g. TVs, Refrigerators.

B. Power-shiftable appliances:
These appliances can be operated using less power when the load is more. So scheduling is done to operate them according to their power consumption. e.g. Bulbs, heaters.

C. Time-shiftable appliances:
These appliances can be switched to work at the time when load is less. Hence these called as time shiftable. e.g. washing machines.

4. Definition of Smart Grid

A smart grid is a digitally enabled electrical grid that gathers, distributes, and acts on information about the behaviour of all participants (suppliers and consumers) in order to improve the efficiency of electricity services or it is a technique used to increase the connectivity, automation and coordination between the suppliers, consumers and networks that perform either long distance transmission or distribution. [2]The objectives of smart grid are: fully satisfy customer requirements for electrical power, optimize resources allocation, ensure the security, reliability and economic of power supply, satisfy environment protection constraints, guarantee power quality and adapt to power market development. Smart grid can provide customer with reliable, economical, clean and interactive power supply and value added services. Electricity losses in India during transmission and distribution are extremely high varying between 30 to 45%. For residential consumers' class, the representative daily curves by utility and by consume range were defined. For each utility, the singular ranges were grouped and were finally: 0–50; 51–200; 201–300; 301–400 kWh/month. Fig. 1 shows and curves for one of these ranges of power utilisation in 24hrs.

Comparison of Existing Grid with Smart Grid:**[1]**

Existing Grid	***Smart Grid***
Electromechanical	Digital
One-way communication	Two-way communication
Centralized generation	Distributed generation
Few sensors	Sensors throughout
Manual monitoring	Self-monitoring
Manual restoration	Self-healing
Limited control	Pervasive control
Few customer choices	Many customer choices

5. Methodology

The scheduling optimization will be carried out mainly for the shiftable appliances. For time shiftable appliances, such as washing machine, the smart meter will be able to control the switch and provide sufficient electricity corresponding to the power pattern during the scheduled periods. For power shiftable appliances, such as water boiler and electric vehicle chargers, the smart meter will schedule flexible power and ensure the total supply. The system can be further extended to multiple users' scenario where many smart meters are connected together and they agree to achieve a cooperative scheduling. Following figure 1. shows the mechanism for power shiftable and time shiftable appliances[1].

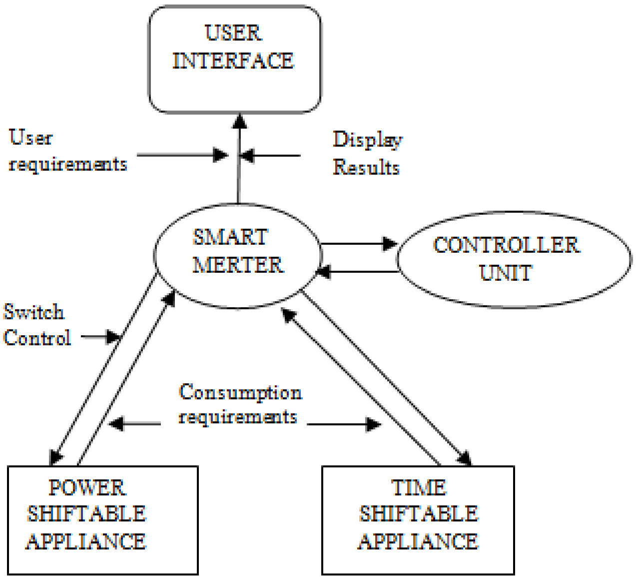


Figure 1: Basic Mechanism

6. Experimental Setup

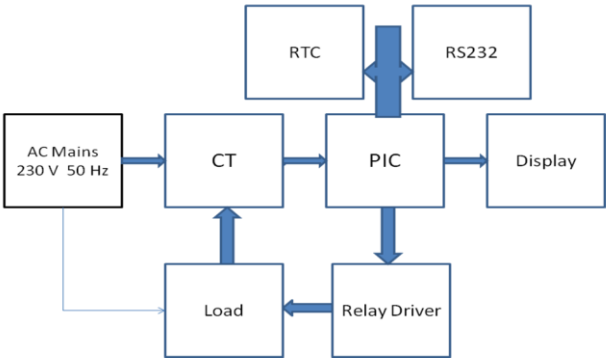


Figure 2: Block Diagram

Initially the 230 V 50 Hz supply is given to the circuit

1. CT Sensors:
Current Transformer sensor is step down transformer (1A:5V)

2. PIC CONTROLLER:
The PIC microcontrollers are based on a 16/32-bit CPU with embedded trace support, that combine the microcontroller with 32 kB, 64 kB, 128 kB, 256 kB and 512 kB of embedded high-speed flash memory. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at maximum clock rate.

3. LCD Display:
Available Modules:-
Based on Alphanumeric Displays

- 16×2 ("16" Represents Columns & "2" Represents Rows)

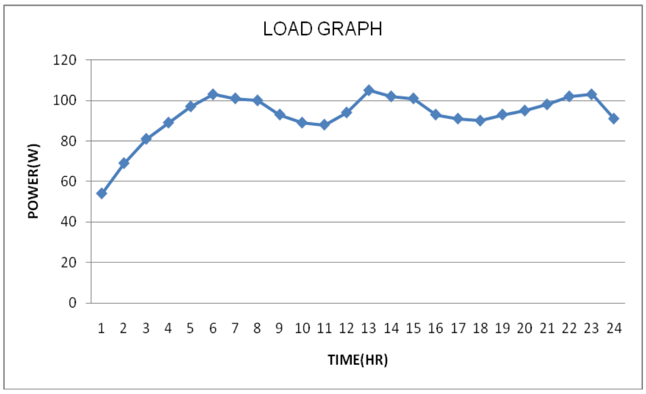
- 16×1
- 16×4
- 20×2

For system 16×2 is used.

4. RS 232:
DS232A Dual RS-232 Transmitter/Receiver is used with the following features:
a) High data rate - 250 kbits/sec under load
b) 16-pin DIP or SOIC package
c) 20-pin TSSOP package for height restricted applications
d) Operate from single +5V power
e) Meets all EIA-232E and V0.28 specifications
f) Uses small capacitors: 0.1 µF
g) Optional industrial temperature range

7. Results

1) Two bulbs are connected and power consumption is measured and displayed
2) When power increases more than 90w one bulb will operate at low power this will show power shifting
3) Graph shows how power is shifted to adjust the load
4) If still load is increasing one bulb will get off and when power is measured below 90w it will get on this shows time shifting



Graph shows optimisation for shiftable appliances.

8. Conclusion

1) This proposed architecture is an effective solution for monitoring and optimizing energy utilization.
2) The system design mainly concentrates on single phase electric distribution system, especially suited for Indian scenario.
3) The system provides the solution for some of the main problems faced by the existing Indian grid system, such as wastage of energy.
4) The proposed mechanism for the home demand-side management in smart grid is able to schedule the optimal power for power-shiftable appliances and time-shiftable appliances respectively.

9. Future Scope

1) It is possible to implement this design and validate it for multiple households and also incorporate future enhancements to suit the system for three phase electric distribution system in India.
2) The system with minor modifications can be used for line fault and power theft detection by using different sensors.
3) This method will reduce the energy wastage and save a lot of energy for future use.
4) Two way communication is possible between user and power station.Cloud computing can be used to create data base and monitor the consumption of large area

10. Summary

1) We propose a consumption scheduling mechanism for home area load management in smart.
2) The aim of the proposed scheduling is to minimise the peak hourly load in order to achieve an optimal (balanced) daily load schedule.
3) The proposed mechanism is able to schedule both the optimal power and the optimal operation time for power-shiftable appliances and time-shiftable appliances respectively according to the power consumption patterns of all the individual appliances
4). Simulation results based on home and neighbourhood area scenarios have been presented to demonstrate the effectiveness of the proposed technique
5) We can broadcast power need for large area using cloud computing and schedule that using shifting mechanism

References

[1] Adaptive Load Balancing Optimization Scheduling Based on Genetic Algorithm By Juanjuan Min,Huazhong Liu,Anyuan Deng,Jihong Ding (2010)
[2] Residential Electricity Load Scheduling for Multi-Class Appliances with Time-of-Use Pricing Jang-Won Lee,Du-Han Lee(2011)
[3] Electrical Load Schedule Optimization for Manufacturing Plants by Fei Hu, Jianrong Qin, Jiacun Wang, Suzhou Taigu (2014)
[4] An Integer Linear Programming Based Optimization For Home Demand Side Management In Smart Grid by Ziming Zhu ,Jie Tang(2011)
[5] Optimal Scheduling of ICT for Demand Side Management in Smart Grid by N.Naslin Sithara , V.Saminathan (2014)
[6] Optimal Load Scheduling for Residential Renewable Energy Integration by Thanh Dang and Kathryn Ringland (2012)
[7] An Efficient Energy Management and Household Appliances Scheduling for Residential Customers using Embedded System by R. Sureshkumar1, Remya. K. R2 (2014)
[8] Optimizing Shiftable Appliance Schedules acrossResidential Neighbourhoods for Lower Energy Costs and Fair Billing by Salma Bakr and Stephen Crane_eld (2013)
[9] Smart Home Electricity Management in the Context of Local Power Resources and Smart Grid by Weiliang Zhao, Lan Ding, Paul Cooper, and Pascal Perez (2014)

Author Profile

Prof. R. A. Pagare . is Assistant Professor, Trinity college of engineering and research, Pune. His has teaching experience of 11 years. He has done UG: MIT College of engineering, Aurangabad, PG: SGGS College of engineering, Nanded. He has presented two papers IEEE explore, Two international conference, Four national conference, Two international journals, Two international journals

Madhavi Surendra Bhosale is in Trinity college of engineering and research, Pune**.** She is pursuing ME 2[ND] Year (Digital Systems). Her Educational Details include UG: SVPM'S College of engineering, Malegaon(BK).