Journal of Theoretical and Applied Information Technology
15th April 2023. Vol.101. No 7

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

AN EVALUATION OF A RESOURCE ALLOCATION AND SCHEDULING MODEL SMART GRID ENVIRONMENT IN DIFFERENT LOAD AND FAULT SITUATIONS

NISHANT JAKHAR[1], RAINU NANDAL[2], RITU NANDAL[3]

[1]Research Scholar, UIET, MDU, Dept. of CSE, Rohtak, India

[2]Associate Professor, UIET, MDU, Dept. of CSE, Rohtak, India

[3]Assistant Professor, Pt. N.R.S Govt College, Rohtak, India

E-mail: [2]rnandal2646@gmail.com

ABSTRACT

The power clamor of consumers is escalating steadily; Resulting surge on electric depots that leads to subsequent electric collapse. One of the produced distresses of power zone is the uneven and rising power demands. An equilibrium of power dispensation with respect to consumer's requirement is trailed by smart grid in traditional dispersal process. Despite the fact that bulk load conditions amid constant power reserve; are still an obstacle in smart grid system. The presented study imparts stipulated and load governed technique to get the competent source allotment &utility. The suggested smart system will anticipate the probable strain during allotment time and will function load evenness utilization of accessible assets. The said framework is evaluated in this research under three different load conditions called Low, Average and High. The obtained outcomes are for mean energy hinderance, power controls and power collapse estimations. The introspected consequences determined the suggested application based decisive paradigm that enhanced the conduction of Intelligence system during utmost burdened times & attained productive solution within shorter span of time and minimum power collapse. The brought-forwarded technique gained genuine and efficacious transmission of the energy/power.

Keywords – *Electric Collapse, Power Zone, Source Allotment, Application Based, Intelligence System*

1. INTRODUCTION

Population surge is imposing high power consumption clamor. Due to these high demands, the Production, administration, and distribution of power has become influential investigation field. Numeral energy administered and transmissive projects that reduce the energy consumption are being researched and implemented. An estimated 10% energy is vanished during transmission and dispensation. Of which an amount of 40% wastage happens only during distribution. This led to the necessity of finding other power resources to minimize the above estimated loss. The escalating demands of power, roots the disaster of power scarcity. The Renewable Sources of Energy are now popularized as latest energy sources to meet the demands of latest era users [15][17].

One of the crucial confrontations that the consumer face is to keep record for the costing of power provided for the appliances. The innovated intelligent grid is furnished with smart meter, which is a smart gadget that keep the actual figures of the power supply and utilization. This is affixed with cloud computing & provide the statistics to the client. From getting the location services to power supply and demand additional it can be used to detect the burden along with power rise &fall [16][20].

Smart grids are incorporated with intelligent/smart meters to assure the efficient utilization of power at particular locality. Potential, energy, electricity utilization and power burdens concern are solved by smart grid encompassed with cloud status [21][23][24].

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

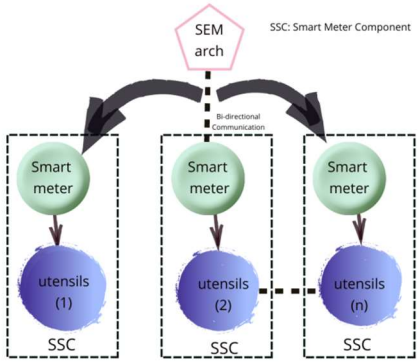

Figure 1: Smart Meter Component Unified Energy Management System [18]

Figure 1 depicts the operative framework of smart meter Components incorporated power administration arrangement. The observation of authority and management of energy driven operability through intelligent meter and gadgets is carried by Smart Energy Management (SEM). A basic authority to reduce the dissolution of energy is provided by these regulators. The governing device is SEM unit that function as intermediator within service and user that undertake the highest command of user and accounts to attain it. Utility introspection, load and charges are the essential liability of said unit. Smart energy management act as authorization for energy mediator. It manages the consumer devises and allocate the urgency based on utilization or another method. It can turn ON or shut down the utility of appliances by a specific user. Excess costing along with excess electricity usage cautions are marked by this arch. By composing the preference of devises, load and power utilization is managed by this technology. Intelligent IoT gadgets are also incorporated within the locality to manage each gadget/appliance [18][19][22].

A Scheduling model evaluated for different load configurations has been put forward in the present study. A constrained assessment has been carried for maximum, lowest & normal load circumstances. The said framework is stipulated to impart undisturbed power supply along with shorter shifting/switching.The present section delas with the fundamental attributes, varied aspects and the confrontations of old intelligent grid & smart gadget/meter framework for energy dispersion. Section 2 depicts the examined work and innovations carried by previous investigators. Section 3 discusses about the schemed application-run framework for administering the bulk load conditions in smart/intelligent grid surroundings. The operational scheme & organizational representations are furnished in this part. Section 4, provides the imitated surrounding & assessment of the proposed framework under varied load conditions. The efficacy of the said model is determined by making use of diverse specifications. Section 5 provides the interpretation of the carried work.

2. RELATED WORK

A quantifiable technique for enhanced load equilibrium and power dissemination in grid system was suggested by Devi et al [2]. On basis of sorted load, an amount of power is allocated to main and subordinate base. This technique implied a superior adjustment at subordinated base in order to resist the energy deterioration and to manage the transmission of energy in load circumstances. The inventor also used horizontal block shifting & vertical column by column shifting methods for revamping the efficiency of power transmission. The examined outcomes indicates that the given technique attained the coherent load equilibrium and escalated the resource usage. Monyei et al [3] put- forwarded an upgraded load equilibrium grid quantized for improving the supports in smart homes. The suggested design classifies the general share for minimizing the power utilization and bill up to 2.9% and 7%. For power saver operation and upgrading the functionality of power transmission, Guo .et al [4] presented a Long short-term Memory fixed technique for efficacious load speculating in intelligence system surrounding. The cyclic figures of load in the system were extracted to produce the feed in series and to pull out the chronological pattern of the load. A manifold insight formed precise forewarn was described in the project. The investigated outcomes substantiate that the given design lessen the load instance and boosted the preciseness over typical LSTM design. A self-effacing load administered method for enhanced power saving in smart grid was given by Zhang et al. [5] The presented model utilizes the data rarefaction and power utilization studying techniques for diagnosing the devise intrusion. The administered and non-administered research is encompassed for load control in smart grid. The research examination enhances the power reliability in smart grid. An energy structured power administered technology for smart home is suggested by Avila et.al [6]. A cyclic load prospect inspection was described and managed in accordance with consumer's desire. To administer the working in grids, a bleary base preference technique was determined. The study was carried beside power utilization, costing plans and kind of

consumer. The conclusions recognized downfall in high costs, power ingestion and electric invoice amounts.

A competent directed method is taken forward by Amarnath et al. [7] for efficient electricity production and administration. The load dependent investigation was carried out to examine the substantial load cases. For improved production of the smart grid, a vital and novel modified procedure was described. The stated outcomes reveals that the estimated technique conquer the load equilibrized energy transmission in contrast to already available techniques. Antoniadis et al. [8] gave an overcharge inhibitor trouble known as Multi objective mixed integer quadratically constrain function. The presented approach was utilized for virtual and load equilibrized power transmission. The straight transfiguration-based utility procedure was described to forecast the overburden conditions. The research was carried out on 216 scripts and attained the productive and genuine outcomes for overburden conditions. Shchetinin et al. [9] gave an aggregate interpretation-based power utilization prediction technique. K Means clustering was imposed periodically as hour utilization figures to estimate the energy utility and to forecast the overburden conditions. The said predictive methodology was presented in the analysis. The emerged outcome reveals accomplished potent load prediction at minimum calibration charge. TChiu et al. [10] presented a stipulated and feedback operated load superintend in smart grid. The multifunction advanced trouble was produces in the present search in order to operate overburden condition. The suggested model was mimicked for programming of household consumers. The electric utilization was decided for various devises.

The outcome pointed out that the given framework is price efficient and got relevant outcomes in overburden circumstances. Kaneriya et al. [11] inspected the consequences of meteorological aspects on electricity utilization. The creator described periodic based figure operated method to forecast the power requisite and load assumption. The weather backgrounds were embraced for combined load forecast in actual situations. The imitated outcome recognize that the given model attained the efficient forecast of power clamor for domestic and commercial section. Naqvi et al. [13] utilized the fog computing procedure for enhancing the functionality of cloud assisted smart grid structure.

The outline was elucidated to split the six zones of word in N units of flocks. For each zone two flocks & two fogs were described. Nine essential devises were defined for each fog. Creator used round robin (RR), throttle and ant colony (ACO) advances to equilibrize the charge in intelligent system.

England et al. [14] suggested a energy firmness technique for minimizing the electric alteration in grid environment. The appeal feedback procedure was described along with charge estimation to perceive the compassionate electric utilization. The evaluation on charge was described along accessible highest to gain best steadiness in grid environment. Barman et al [25] observed and ruled power utilization by incorporating a significant modifying intelligent grid framework. Author utilized intelligent meters to combat electric abduct. The outcome revealed that the given model abated power utilization and improved the functioning of smart grid. Priyadarshini et al [26] designed an IoT build intelligent metering technique for observing and controlling power utilization. Household gadget-based pathway and certain load utilities were putted forward in the proposed work. The procedure was efficient for overburdened circumstances.

3. PROPOSED LOAD EFFECTIVE ALLOCATION MODEL FOR SMART GRID

Smart/intelligent meter is an actual achievement beyond traditional/old power administration technique which enroots the consumer behest and gives an efficient electric transmission. Despite escalating requirements of energy is a trouble for smart grid surrounding that impose bulky loads and electric failures. The proposed study introduced an upgraded and clever smart grid operability to go through the burdened and electric collapse conditions. A systematic build technique is putted forward for revamped source allotment and utility. Figure 2 depicts the enhanced vision of the stated model; in which the performance authority of the technique is split into two essential parts. An application runed load forecast is experimented in the first part, during which the user requisite, part usage & load periods are examined. The regulations are described for foretelling the bulky load conditions and anticipate collapsing site.

Journal of Theoretical and Applied Information Technology
15th April 2023. Vol.101. No 7

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

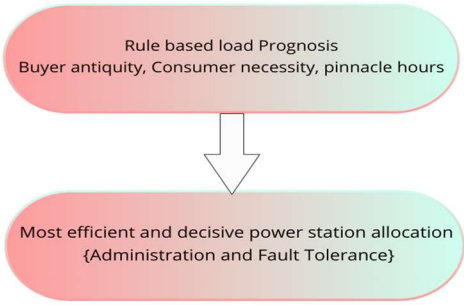

Figure 2: Proposed Load Effective Allocation model

For multiway transmission in later part, is described on the electric transmission is done for searching the efficient source. The procedures are aligned for inspecting the error resistant asset with minimized load. As the said collapse condition is recognized and development is concluded, the charge transmission condition is gained in lesser time period. Minimized charge boarding and hold up is gained in the examined work.

The given program build effective model is utilized on the basis cloud assisted smart grid project. The generalized IoT assisted smart grid project is depicted as Figure 4. A user interoperable monitored smart device/ gadget is allocated at location which is IoT enabled. The setup and mechanics interoperable interface are present in the system. Internet accessibility are incorporated in the seriate (layer) to administer and monitor energy requisite and utility. User requisite for utility and power bulk is administered in a standard database, which consist of the part usage plan of the consumer. The source particulars and consumer agreement to provide the required statistics in managed in intelligence system database. The source accessibility and electric availability on every resource is administered in the said system. The static administration section utilizes the data for making the past utility-based conclusions and preparing the programs. The setup zone is described along with statistic administration section for improvement of existing database. Set of programmed regulations are created on basis of those set up zones / sections to locate the approximate load and electricity collapse conditions. As soon as the circumstances happens, the note is transmitted and source allocation is carried on the grounds of effective rules. Figure 4 despite the main accessible source which grants the electric flow that takes place during allocation of sources efficiently.

Figure 3: Classic Engineering for Power handling in IoT based Smart Grid

Figure 3 depicts a smart and programmed driven technique which comprises of various IoT administered zones and constituents that are adjoined in intelligence system surroundings for foretelling load and collapse circumstances. The working /programming technique is showcased in figure 4. In presented programmed project, the programmed succession build on replicated and real surroundings are described. The arrangement of constituents programming of gadgets/devices and control of particulars across data set is explained. In the programmed model at initial server, system advancement is carried out. M energy station are described with their capability at this level. The load allotment along with the utilization of the energy depot is controlled in the standardized database. For power depletion, N mass of user are specified with particularized IoT gadgets. The user level gadgets can accomplish locate the load necessity. User particulars, utilization/ record and probable load requisite are managed in the standard repository. The energy depots and the user enabled IoT gadgets are associated to the standard index and a regular upgrade for allotment and utilization particulars is done into datasets.

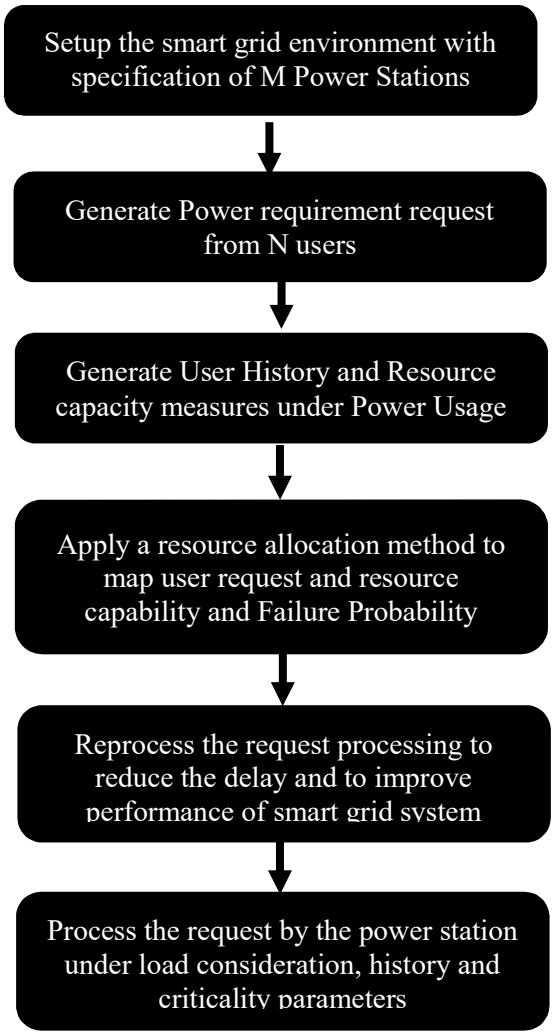

Figure 4: Practical Outflow of Proposed Model

The standard repository is linked with management and operational zones. The operational zone creates the improved regulations for electric depot allotment and provides a balanced electricity transmission. The management zone is capable to resist the bulk and electric collapse condition. The maintenance part also associated with management section to perform/ function on the order provided by the management component. The real source allotment is done by operational element. The management section specifies the best energy depot that will supply the estimated energy to user with crucial & maximized load requisite. The users with low requisite might be allotted a generalized electric station, which is low efficient but capable to generate enough power to fulfil the requirement. After trouble shooting & identification of the energy station, the management section allots it to the users. After allocation of the said part; a consumer can also switch to another section based on the necessity and requisite. Either of power depots failing to maintain the required loads of electricity, may lead to electric collapse.

The operational zone also gathers the allotment of energy depot, collapsing conditions in various datasets, as the consumer and electric depot past usage records. The presented investigation is mimicked in MATLAB surroundings with various load capacities. The model and examined outcomes specified to various loads are given in next part.

4. RESULTS AND DISCUSSION

The present study depicts the regulation- driven structure for productive source allotment in intelligent grid surrounding. The said environment is enabled with intelligent gadgets, smart Internet operated devises. Those devises grab the user's energy requisites. Directory elements are incorporated for tracking the consumer and electric depot history. Load data and allotment is administered in this directory. For composition of provider edge along with the specifications of energy depot, a cloud-server based surrounding is created. Every energy/power depot is demarcated with power bulk. The directory consists of the set-up and past details of the energy depots. The client serves as the edge user, associated in this grid mesh and are allocated with specified power needs. The past usages of the client along with the requisites are kept in the directory/database.

The authoritative component is specified to draw conclusion about load and defect effectual allotment. The section provides imitated outcomes. The smart/intelligent grid is incorporated along N energy depots and M users. The evaluated outcomes do confine in premises of numeric electric collapses, stand by and ending time of user demand. Numeral demands can be made by any user in an hour. These demands are relevant to the load and necessities of the user. The energy demand/requisite of the user is 0 to 7 kWh. Our work is fabricated with three stations, every station comprised with load amplitude of 100 kWh. As power/load may be created by a number of users at single time, the chief goal of the presented smart grid optimization framework is to disperse the accessible electricity to the users efficiently. For analyzing the efficacy of given framework, the structure is fabricated with various number of energy/power demand carried out in time period of an hour. The stated evaluation of the work is carried respective to the demand collapse, figures of demand switching and mean hinderance perceived for each demand/requisite.

Figure 5 prepare the delay analysis for different load conditions. In this figure, evaluation of the proposed model is conducted in three different load conditions called heavy, average and low load. The horizontal bar graph shows that the delay in case of low load situation is under control maximum delay obtained in this load situation is less than 1. In low load situation the number of users is 50. In average load situation, the delay increased up to 3 sec. In this situations, number of parallel requests are between 100 and 200. In heavy load situation, the number requests are more than 200 and in such extreme load situation the maximum delay is up to 6 seconds.

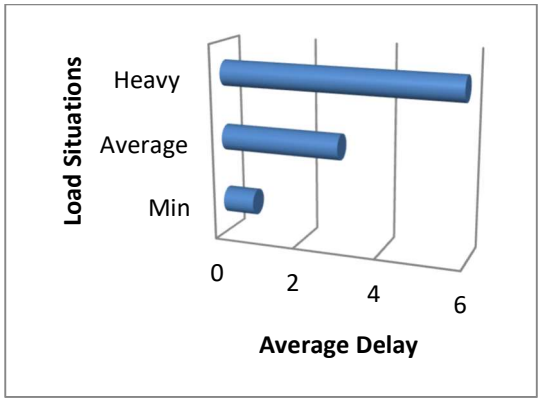

Figure 5: Power Delay Analysis

Other criterion taken in present study for accessing the capability of the given framework is the number of electric switches. As a user is having the power facility of M electric stations. Every electric depot is allocated with specific capacity and electric load. The efficiency, amount and efficiency of the electric distribution may vary entrenched the electric distributor. In the present smart grid allotment and dispensation framework, the allotment of power grid is carried on basis of previous load conditions and required necessities. In case the optimal power distributor which is completely engaged, or the fault start occurring in the allotted power distributor, thus the presented design has a catalogue of ranked electric distributors. The preferences are determined on basis of collapse rate and average hold-up. The demand of the user can be commutated to another electric distributor, if the assigned electric distributor is occupied.

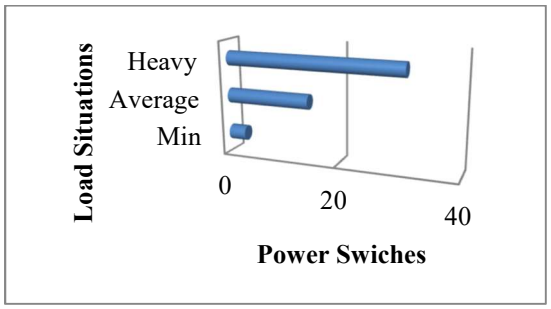

Figure 6: Power Switch Analysis

Figure 6 prepared the finding dossier in terms of number of power switches under three load situations i.e., minimum, average and heavy. In the figure 6, X-axis displays the number of power switches accomplished through buyers in an hour and Y-axis displays the load situation. The number of power switches is 3 for minimum load condition. The number increases to 18 for average load conditions and the power switches reaches up to 33 during heavy load situations.

The outcomes reveals that the presented approach attained the adequate implementation of the user's appeal on the allotted power distributor. In case any accessible power distributor is unable to supply the required amount of power as per consumer requirement or simultaneous demand could not be handled in simultaneous the accessible ability of the power distributor, then the position of power collapse happens. During comparable conditions, the electric supply of a particular user may cut off for specific time. The situation may be reversed as soon as the charge of electric station is empty repeatedly. The smart grid approach is efficient, only if it is capable of providing the power demands with fewer number of powers fail.

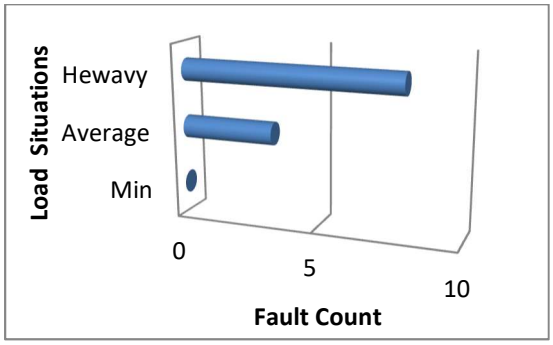

Figure 7: Power Faults Analysis

Figure 7 is showing the finding outcomes for considering the number of fault count in the system with respect to varied load situations. The figure depicts nearly negligible fault count in minimum

load conditions. In average load conditions the figure of fault count reaches to 3 and for heavy load conditions it reaches to 8.

The above said figure displays that the presented approach apportioned the adequate electric distribution with lesser number of power failure. The maximal number of failures detected through presented smart grid allocation model is 8 in an instance of intense load.

The above-mentioned impact consistent that the proposed model attained the decisive and adequate outcomes with insignificant setback, power distributor switching and request failure. The presented rule based decisive model directed the excessive charge conditions effectively along with very less power failure and setback. The comprehensive capacity of electric appropriation and circulation is enhanced by this exploration.

5. CONCLUSION

Present paper put forwarded to regulation operated influential framework for optimizing the functioning of intelligent grids. The suggested framework is structured to gain the efficient allotment of energy sources. As the power needs maximizes, power depots/stations collapse to attain optimum requirements. During the prevailing circumstances, the power breakdown escalates. In this article, a regulation-operated structure is created which will administer the energy requisite and capacity of the existing power depots/stations. The energy demands are allotted to depot/station on basis of load and previous utilizations of power depots. The assessment of the given structure is estimated under varied load circumstances. The outcomes proposed stated that the figure of energy switching & errors are nearly minute even in maximized load circumstances. With an increment in load, the power errors are escalated up to 3.5& power shifting up to 15 in normal load conditions. Whereas in heavy load circumstances, the power errors along with shifting/switching are at peak. The outcome also depicted that the maintenance holds up also extend during heavy load conditions.

REFERENCES:

[1] Maximilian Wurm, Vlad C. Coroama , Poster abstract: grid-level short-term load forecasting based on disaggregated smart meter data, Computer Science - Research and Development volume 33 (2018) 265–266

[2] Boddu Rama Devi, Load factor optimization using intelligent shifting algorithms in a smart grid tree network, Cluster Computing volume 22 (2019) 14603–14614

[3] Chukwuka G. Monyei,SerestinaViriri, An Improved Comfort Biased Smart Home Load Manager for Grid Connected Homes Under Direct Load Control, : Hybrid Artificial Intelligent Systems, (2018) 526-536

[4] Jianing Guo, Yuexing Peng, Qingguo Zhou, QingquanLv, Enhanced LSTM Model for Short-Term Load Forecasting in Smart Grids, Cloud Computing, Smart Grid and Innovative Frontiers in Telecommunications, (2020) 650-662

[5] ZijianZhang,JialingHe,Liehuang Zhu, Kui Ren, Non-intrusive Load Monitoring Algorithms for Privacy Mining in Smart Grid, Advances in Cyber Security: Principles, Techniques, and Applications, (2018) 23-48

[6] Manuel Avila, Pedro Ponce, Arturo Molina, Katya Romo, Simulation Framework for Load Management and Behavioral Energy Efficiency Analysis in Smart Homes, Smart Multimedia, (2020) 497-508

[7] D. Amarnath, S. Sujatha , Internet-of-Things-aided energy management in smart grid environment, The Journal of Supercomputing, 76 (2020) 2302–2314

[8] Nikolaos Antoniadis, Maxime Cordy,AngeloSifaleras, Yves Le Traon, Preventing Overloading Incidents on Smart Grids: A Multiobjective Combinatorial Optimization Approach, Optimization and Learning, (2020) 269-281

[9] Eugene Yu. Shchetinin, Cluster-Based Energy Consumption Forecasting in Smart Grids, Distributed Computer and Communication Networks, (2018) 445-456

[10] Chiu, Wei-Yu, Jui-Ting Hsieh, and Chia-Ming Chen. Pareto optimal demand response based on energy costs and load factor in smart grid. IEEE Transactions on Industrial Informatics 16(3) (2019) 1811-1822.

[11] Kaneriya, Shriya, Sudeep Tanwar, Anand Nayyar, Jai Prakash Verma, Sudhanshu Tyagi, Neeraj Kumar, Mohammad S. Obaidat, and Joel JPC Rodrigues. Data consumption-aware load forecasting scheme for smart grid systems. In 2018 IEEE Globecom Workshops (GC Wkshps) IEEE, (2018) 1-6.

[12] Si, Caomingzhe, Shenglan Xu, Can Wan, Dawei Chen, Wenkang Cui, and Junhua Zhao. Electric Load Clustering in Smart Grid: Methodologies, Applications, and Future

Trends. Journal of Modern Power Systems and Clean Energy, 9(2) (2021) 237-252.

[13] Syed Aon Ali Naqvi, Nadeem Javaid, Hanan Butt, Muhammad Babar Kamal, Ali Hamza,Muhammad Kashif, Metaheuristic Optimization Technique for Load Balancing in Cloud-Fog Environment Integrated with Smart Grid, Advances in Network-Based Information Systems, (2018) 700-711

[14] Brandon S. England, Ali T. Alouani,Real time voltage stability prediction of smart grid areas using smart meters data and improved Thevenin estimates,International Journal of Electrical Power & Energy Systems, 122 (2020) 106189

[15] Rathor, Sumit K., and D. Saxena. Energy management system for smart grid: An overview and key issues. International Journal of Energy Research, 44(6) (2020) 4067-4109.

[16] Hans, Manoj, and Vivekkant Jogi. Peak load scheduling in smart grid using cloud computing. Bulletin of Electrical Engineering and Informatics, 8(4) (2019) 1525-1530.

[17] Barcelos, Rayana Kristina Schneider, Wanderley Cardoso Celeste, Luís OtávioRigo Júnior, and Gisele de Lorena Diniz Chaves. Identification of Similar Loads for Electric Power Management in Smart Grid. IEEE Latin America Transactions, 17(08) (2019) 1318-1325.

[18] Pawar, Prakash. Design and development of advanced smart energy management system integrated with IoT framework in smart grid environment. Journal of Energy Storage, 25 (2019) 100846.

[19] Amarnath, D., and S. Sujatha. Internet-of-Things-aided energy management in smart grid environment. The Journal of Supercomputing, 76(4) (2020) 2302-2314.

[20] Hussain, Hafiz Majid, Nadeem Javaid, Sohail Iqbal, Qadeer Ul Hasan, Khursheed Aurangzeb, and MusaedAlhussein. An efficient demand side management system with a new optimized home energy management controller in smart grid. Energies, 11(1) (2018) 190.

[21] Mubariz Rehman, Nadeem Javaid, Muhammad Junaid Ali,TalhaSaif,MuhammadHassaanAshraf,Sadam Hussain Abbasi,Threshold Based Load Balancer for Efficient Resource Utilization of Smart Grid Using Cloud Computing, Advances on P2P, Parallel, Grid, Cloud and Internet Computing, (2018) 167-179

[22] Han, Dong, Weiqing Sun, and Xiang Fan. Dynamic energy management in smart grid: A fast randomized first-order optimization algorithm. International Journal of Electrical Power & Energy Systems, 94 (2018) 179-187.

[23] Hans, Manoj, Pallavi Phad, Vivekkant Jogi, and P. Udayakumar. Energy Management of Smart Grid using Cloud Computing. In 2018 International Conference on Information, Communication, Engineering and Technology (ICICET) IEEE, (2018) 1-4.

[24] Dileep, G. A survey on smart grid technologies and applications. Renewable Energy, 146 (2020) 2589-2625.

[25] Bibek Kanti Barman et al., "IOT Based Smart Energy Meter for Efficient Energy Utilization in Smart Grid," 2018 2nd International Conference on Power, Energy and Environment: Towards Smart Technology (ICEPE), IEEE, pp. 1-5, 2018. Crossref, https://doi.org/10.1109/EPETSG.2018.8658501

[26] S.G Priyadharshini, C. Subramani and J. Preetha Roselyn, "An IOT Based Smart Metering Development for Energy Management System," International Journal of Electrical and Computer Engineering, vol. 9, no. 4, p. 3041, 2019. Crossref, http://doi.org/10.11591/ijece.v9i4.pp3041-3050