ISSN: 2455 - 9172

EIJO Journal of Engineering, Technology And Innovative Research (EIJO–JETIR)

Einstein International Journal Organization (EIJO)

Available Online at: www.eijo.in

Volume – 6, Issue –1 , January - February - 2021 , Page No. : 01 - 13

Electrical Vehicle Renewable Energy Based Management of a Micro-Grid

[1]Vartik Joshi, M. Tech Scholar, Electrical Department, Jaipur Institute of Technology-Group of Institutions, Jaipur, (Rajasthan)

[2]Avanish Sharma, Asst. Professor, Jaipur Institute of Technology-Group of Institutions, Jaipur, (Rajasthan)

[3]Anil Sharma, Principal, Jaipur Institute of Technology-Group of Institutions, Jaipur, (Rajasthan)

Abstract

The main element is a photovoltaic system that is designed to satisfy the daily load energy requirement. A three-phase active filter is used to improve the power quality, manage the power, and corrected the unbalance. Backup energy storage systems including plug-in hybrid electric vehicles and the diesel generator are used to ensure an uninterruptible power supply in case of low solar irradiation. Microgrid systems became an important solution to reach the remote area and maximizing the economic, technological, and environmental benefits. In this paper, a model of Microgrid for power generation and energy management using a state flow algorithm is proposed. A combination of solar energy, diesel generator, and electric vehicle gave an excellent result to ensure an uninterruptible power supply in case of low irradiance of PV solar energy. To take care of the battery life, the PHEV supplies power to the load only during emergencies. This motivates the development of this work to the used robust algorithm, sizing, and energy management to balance the load consumption and electricity production this simulation has performed on MATLAB Simulink.

Keywords: Load Dispatch, Genetic Algorithm, ALO, single-zone thermal power plant, Optimization, PSO.

Introduction

Electric vehicles are widely used because of their greater benefits such as easy maintenance, lower running cost, and environmental pleasant. The storage of electrical energy in rechargeable batteries is the main source to propel electric motors present in an electric automobile. The 1880s was the year of the invention but popularized in the 20th century as an advance of internal combustion engines. In 1987, electric cars found their commercial use in the USA and it does not require gear exchange when compared with conventional vehicles. Characteristics of an electric vehicle depend on the battery size and electric range of utilization [1]. There is no tailpipe emission when compared with IC engines which in turn reduces the greenhouse gas emission-related issues. Significant reduction of air pollution in city areas is the result of EV usage because they do not emit pollutants including soot, hydrocarbons, carbon monoxide, volatile organic compounds, ozone, lead, and oxides of nitrogen. The pollutant emission is based on the emission intensity of charging sources as well as there is an energy wastage during the charging state. High power to weight ratios is the output of electric motors which require a heavy current supply. Fixed ratio gearboxes and clutch absence are the reason for the reliability and simplicity of the EV’s. Acceleration capability is based on the size of motors and has constant torque [2]. Especially at low speeds, acceleration performance will be more relative to that of the same motor power internal combustion engine. The power rate increment relies on motor-to-wheel configuration because wheels directly have the connection with motors for propulsion & breaking.

Renewable Energy

Easter, Biczel and & Klos (2009) Polish energy law, which regulates renewable energy such as the use of renewable energy, solar energy, hydropower, wave energy and waves, energy from rivers, biomass energy and energy in the conversion process produced in the process of burial biogas and treatment of contaminants and treatment of decay or damage to plants and animals. According to Musgrove (1983), wind energy is an independent form of solar energy, because wind is due to the presence of the equatorial surface of the earth more sun than Polar Regions, which will cause large tumors in the atmosphere the total amount of solar energy per year is enormous. For example, global fossil fuels, namely coal reserves, are expected to last 300 years based on current consumer trends, plus oil and natural gas reserves (based on current consumption trends, Gates, B (2012) taken from the Technical and Economic aspects of the energy conservation system for energy cooperation). Full energy the interior within 10 days is equal to the earth's energy from solar radiation.

Wind Energy

Wind is defined as a series of wind waves, in which there are numerous aerial movements on Earth. Due to the irregular heat of the sun on the ground, the pressure difference in the wind leads to the wind. Rotation due to the power of Coriolis. (Getachew, 2009). The use of wind energy is an ancient technology; its history can be traced back to the Middle East 1400-1800 years ago. The first application of wind energy includes the use of wind energy for agriculture, navigation and other irrigation. With the support of historical and archaeological evidence, the Chinese people first used water pumping with the use of energy around 200 BC. The electricity generation using wind energy was dated around 1877 after which it noticed further development during the mid-20th century because of the perceived idea that conventional energy sources are going to reach peak value and decline (Tzanakis, 2006).

Solar Pv Electricity Generation

Solar power is the conversion of energy from the sun to electricity. Among the main expansions in converting solar power into useful energy, the forms include the direct conversion of solar energy to electricity using the photovoltaic effect (Garcia-Lopez et al., 2015). Another wide application of indirect solar energy conversion is the manufacture of heat mostly in form of Concentrated Solar Power (CSP). Concentrated Solar Power (CSP) technology indirectly converts solar energy into electricity through conventional steam-driven turbines, using lenses, mirrors, and tracking systems to concentrate a great amount of solar radiation into a small beam for heating water to steam [17] Photovoltaic technology is the process of converting solar radiation into electrical energy using the basic photoelectric effect. This technology can also utilize diffused solar radiation, which makes it even more attractive for the location with low and higher insulation.

Diesel Generator

DG set (a unit of diesel engine and governor) is a unit that converts the fuel energy (diesel) into the mechanical energy of the diesel engine and then converts the mechanical energy into electrical energy of the governor. A governor can be defined as a mechanical or electromechanical device used to automatically control engine speed by correlating fuel intake. The engine management is a simple governor that allows the turbine to run at its designed speed. The governor's output is the throttle signal used to control the fuel entering the engine. After the literature review, four models were selected and analyzed to show the most effective model that can dynamically study DG and is more flexible. Use with multiple technologies.

Electric Vehicle Coordination

If there is a large series of vehicles in operation, the provision of additional services from electric vehicles is a very viable option [40] As Kempton et al. [40] In 2001, due to power restrictions, only one electric vehicle was able to enter the power market or establish a business relationship with the power agency. Therefore, the authors recommend using collection technology that can be used as an intermediary in the automobile, equipment industry, and energy market. Figure 3 clearly shows the collector structure and other features of the system [41,42]. In almost every case, the EV aggregator will generate a basic signal for the organization of the EV fleet based on the energy market, data distributed between TSO and DSO.

There are many reasons behind the installation of electric car chargers. First, in the current market situation, individual participation in small groups is prohibited. In addition, it allows for the simplest connection to the DSO in troubleshooting. The use of appropriate strategies can reduce the risk of traffic accidents.

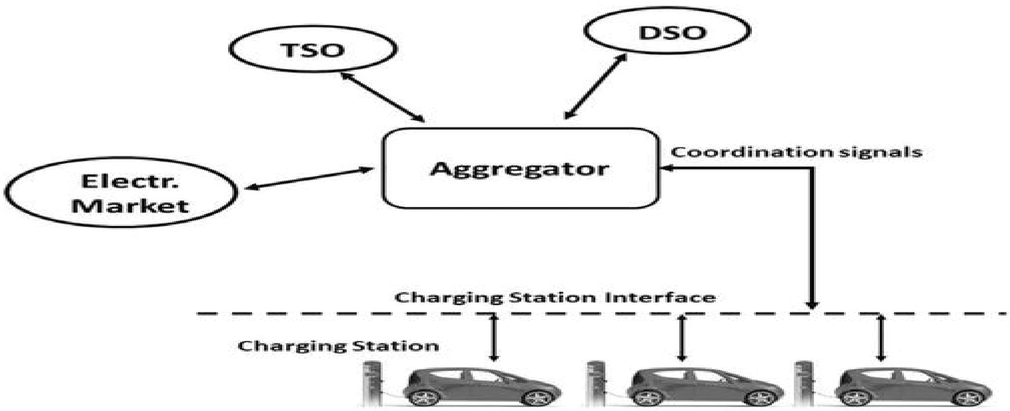

Figure 1: Simplified EV coordination framework: transmission system operator (TSO), distribution system operator (DSO), electric market, and charging stations for EVs.

With the increase in PV penetration of low-power power lines, EV load control can improve feeder performance and reduce investment requirements for infrastructure upgrades. In plates with such a high permeability, there is a constraint to keep in mind. The customer will evaluate the improvement in reliability, quality, and price. We expect a significant change in the quality of power in the near future, which aims to reduce the long-term changes in power growth that occur in the environment of decentralized RES production. In theory, we know that balancing car loads can promote a local balance between production and consumption, which can reduce power shortages and overheat.

Objectives Of Research Work

The objectives of the proposed research work are as follows.

- This research work presents a new cost-effective technique utilizing energy storage devices (battery and ultra-capacitor) jointly to expand the lifetime of the battery.
- An energy storage system for Electric vehicles is proposed to improve its transient performance. In this approach, the state of charge of the ultra-capacitor is measured and kept at the appropriate stage according to dissimilar speeds of the vehicle

- The energy management strategy of ultra-capacitor based on PI, control is proposed. By comparing controlling methods, the best controller for the proposed hybrid electric vehicle will be concluded and the entire work involves simulation using MATLAB Simulink.
- This research work also involves the design and testing of hardware and comparing it with the simulation results.

Methodologies

Introduction To Model

In a hybrid microgrid, the photovoltaic system is usually controlled to operate at maximum point-to-point extraction mode (MPPT). The energy storage system operates in the form of a power supply or a constant power supply. To provide frequent support and to prevent power fluctuations, this section offers dual SM monitoring strategies and high performance

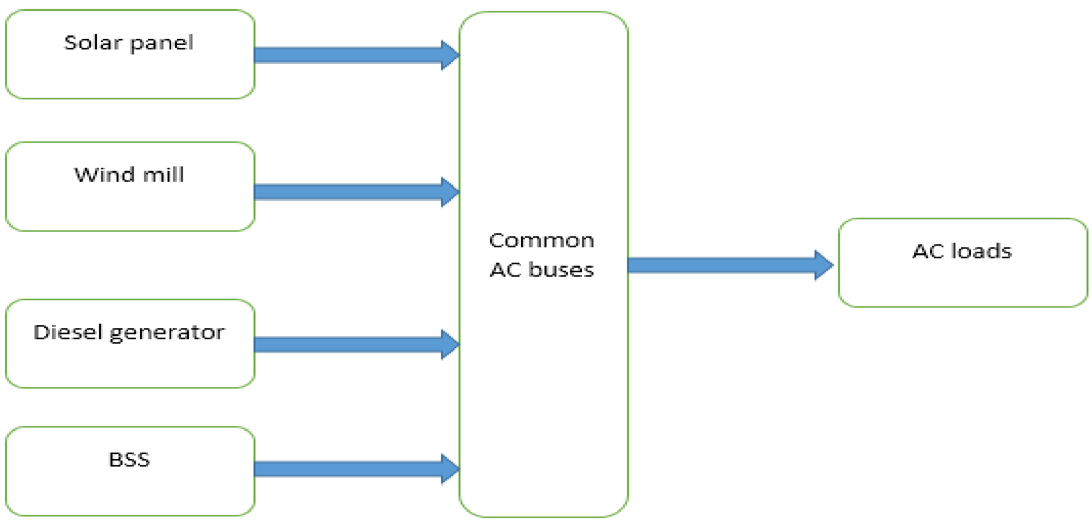

Figure 2: Proposed Block Diagram

Modules Description

The SM control is used to control the angle of WTG and pilot load reduction per diesel generator to improve the response speed and microgrid strength. Besides, the adaptive SMLFC has been redesigned based on turbulence controllers and regulations to improve the accuracy of the monitors and reduce SM jitter. By using a turbulence controller, the two SM LFCs can improve the frequency reduction within the power limit of the diesel generator. However, it cannot cover a strong energy intake beyond the limits of diesel power. If the renewable energy output is greater than the power supplied by the diesel generator, other methods (such as load loading) must be used to maintain the system's steady flow when the wind speed drops significantly.

Result & Discussion

Proposed Simulation Model

The immense introduction of fluctuating renewable energy means that the key to successful integration lies not only in the electricity system but also in the entire energy system and energy system integration. The successful integration of most fluctuating renewable energy sources requires complex interactions between energy production, storage, distribution, and consumption. At the same time, successful integration requires a paradigm shift. It is expected to transform the paradigm from a unique, radial and mainly centralized system of electricity, natural gas, biomass, and district heating into a single integrated interconnected, distributed, and partially autonomous system and Energy system. A battery-electric vehicle (BEV) runs exclusively on power storage. Its main components include a high voltage battery, one or more electric motors (AC [DC] or DC [DC]), and a controller for controlling the battery.

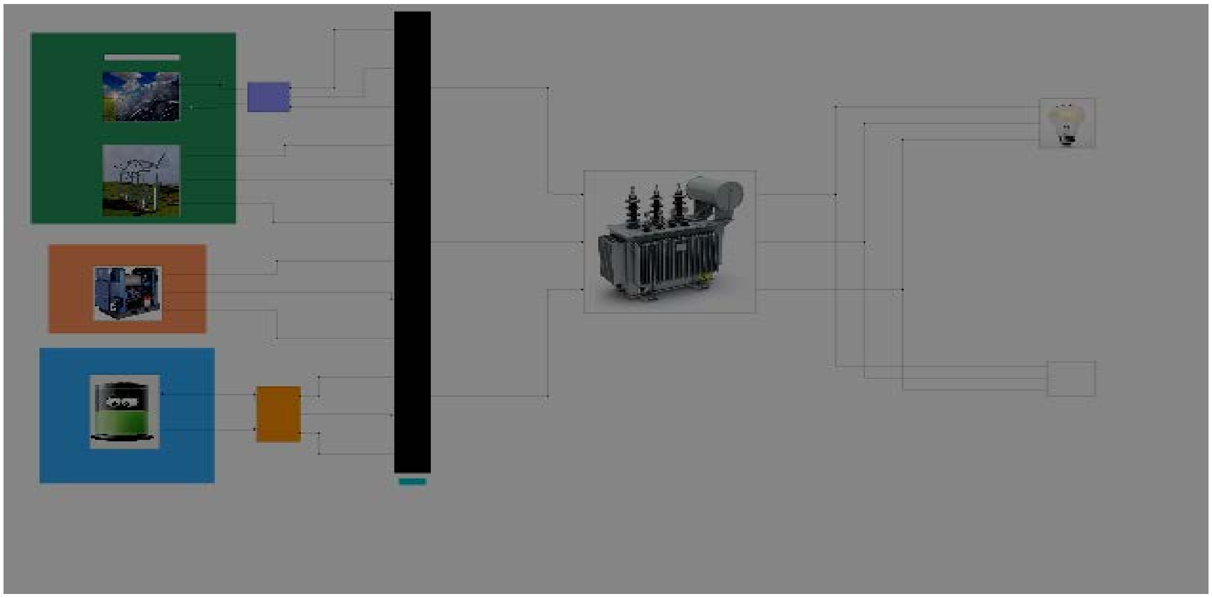

Figure 3: Simulink Model of Proposed System

Obtained Results

Figure 4: Solar Panel DC-DC Boost Converter Pulses

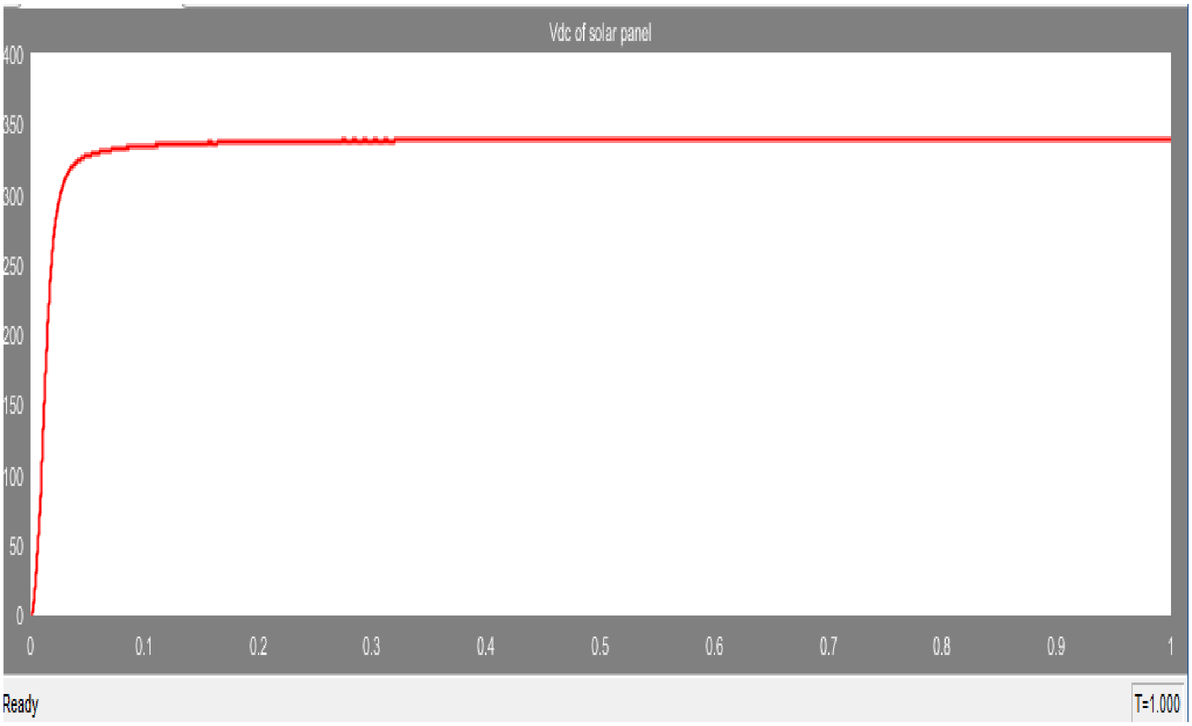

Figure 5: VDC from Solar Panel

The PV properties are shown in Figure 5, and the current Vs volts are based on the XY configuration. The solar cell produces a maximum power of 230 Kw at its current point, of which the products V and I are the largest, as shown in Figure 6.

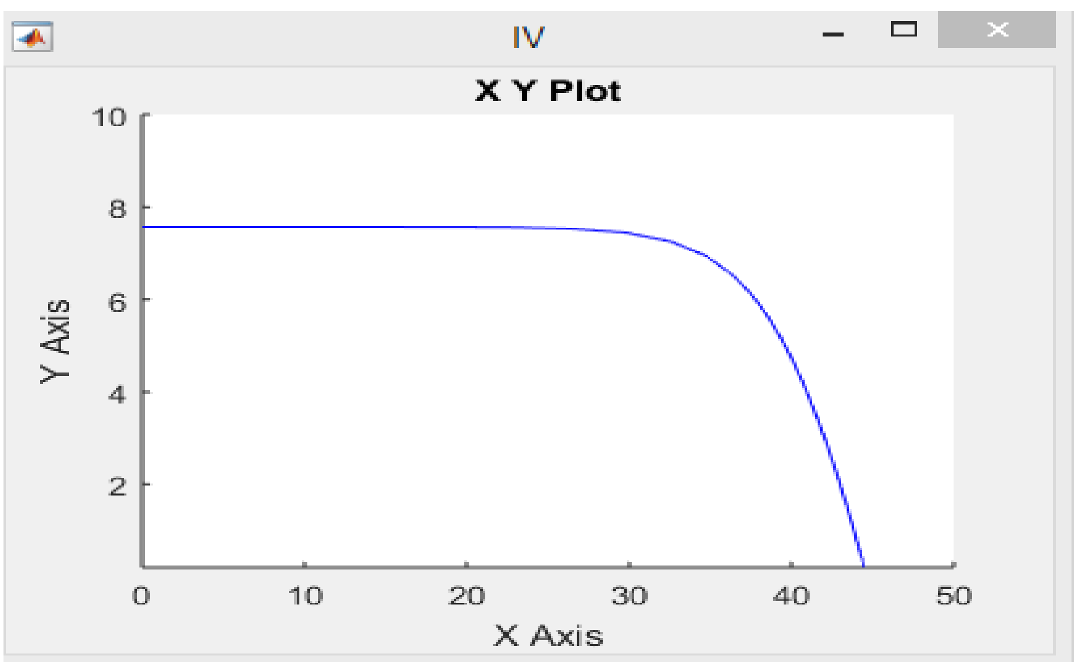

Figure 6: I-V Characteristics Waveform

Figure 6 shows PV individuality or there is X-Y coordinates power Vs current plotted. The greatest power generates 230 Kw by solar cell at the point of the current-voltage quality where the product of *V* and *I* is greatest shown in fig 7.5 Y-Axis plotted 230Kw and x-axis point maximum voltage.

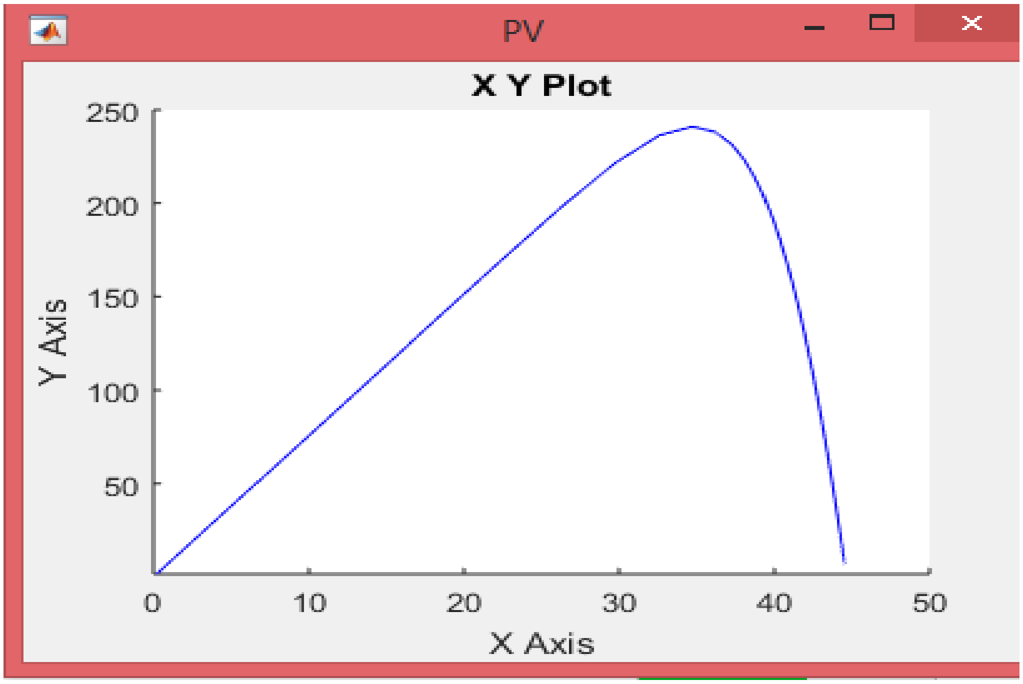

Figure 7: PV Characteristics Waveform

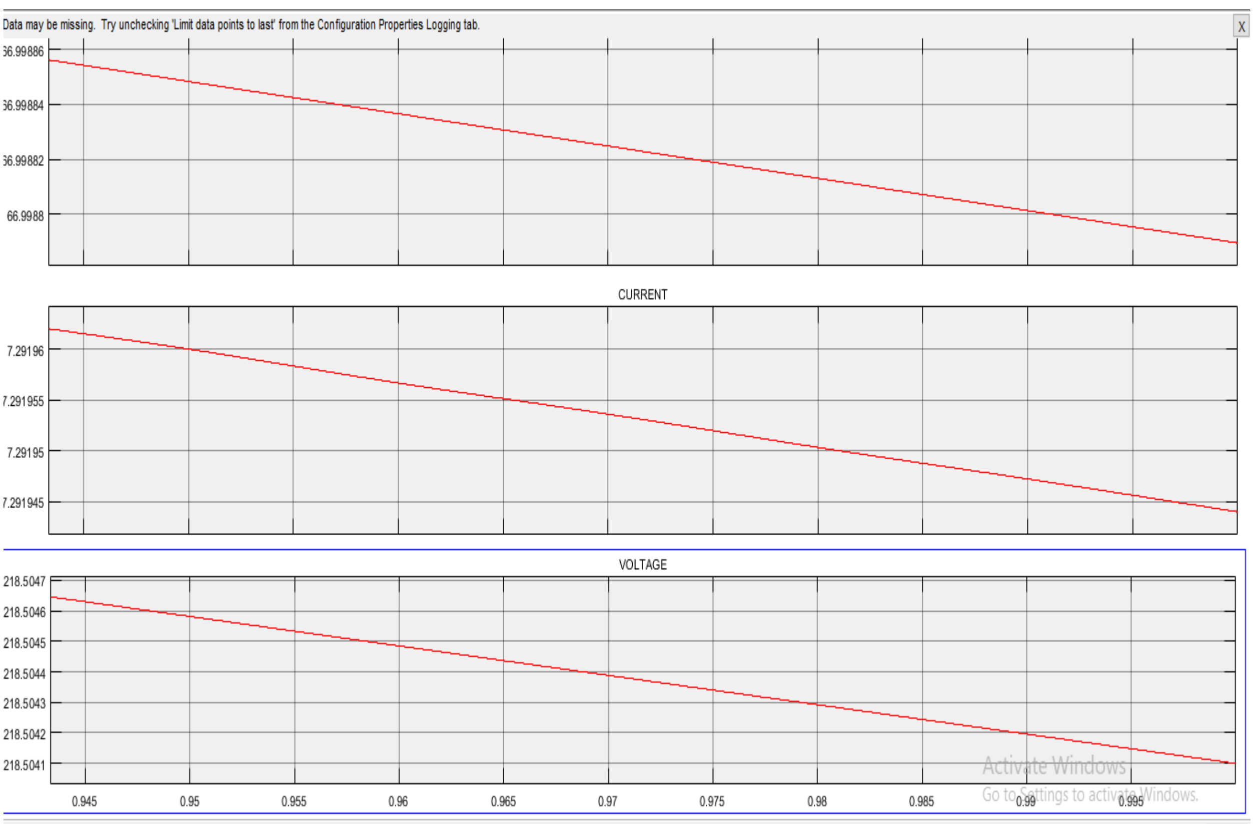

Figure 8: Charging Voltage and Current of Battery

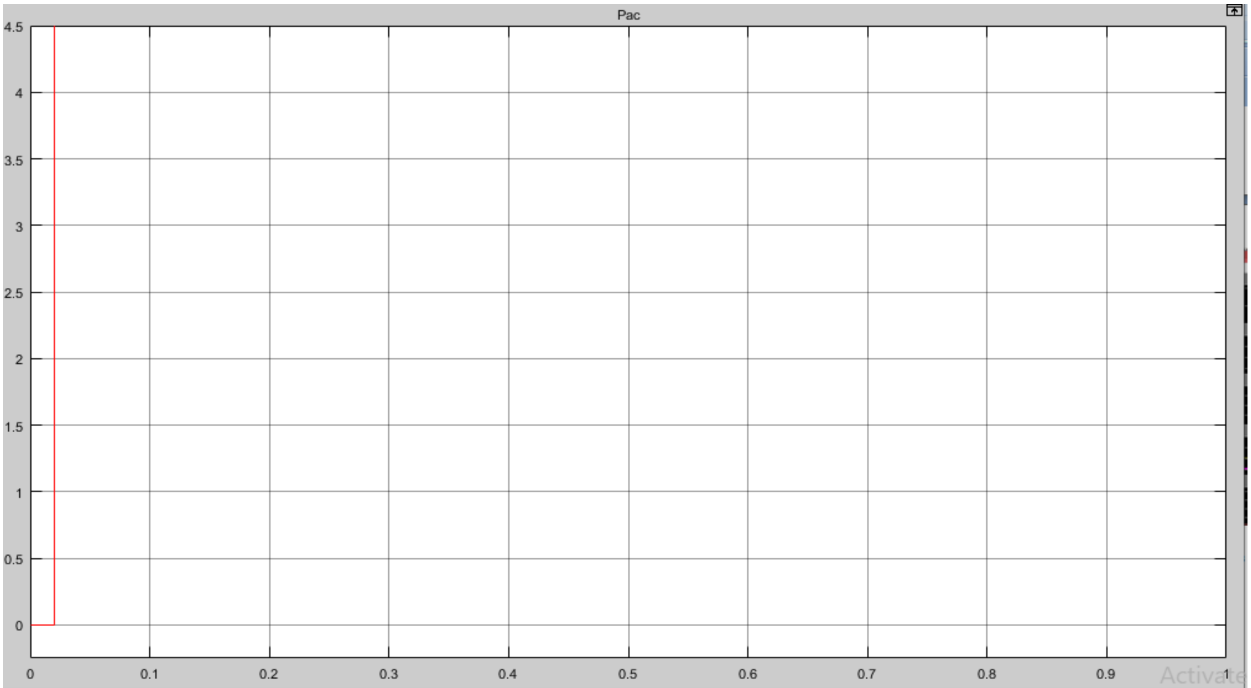

Figure 9: Wind Power

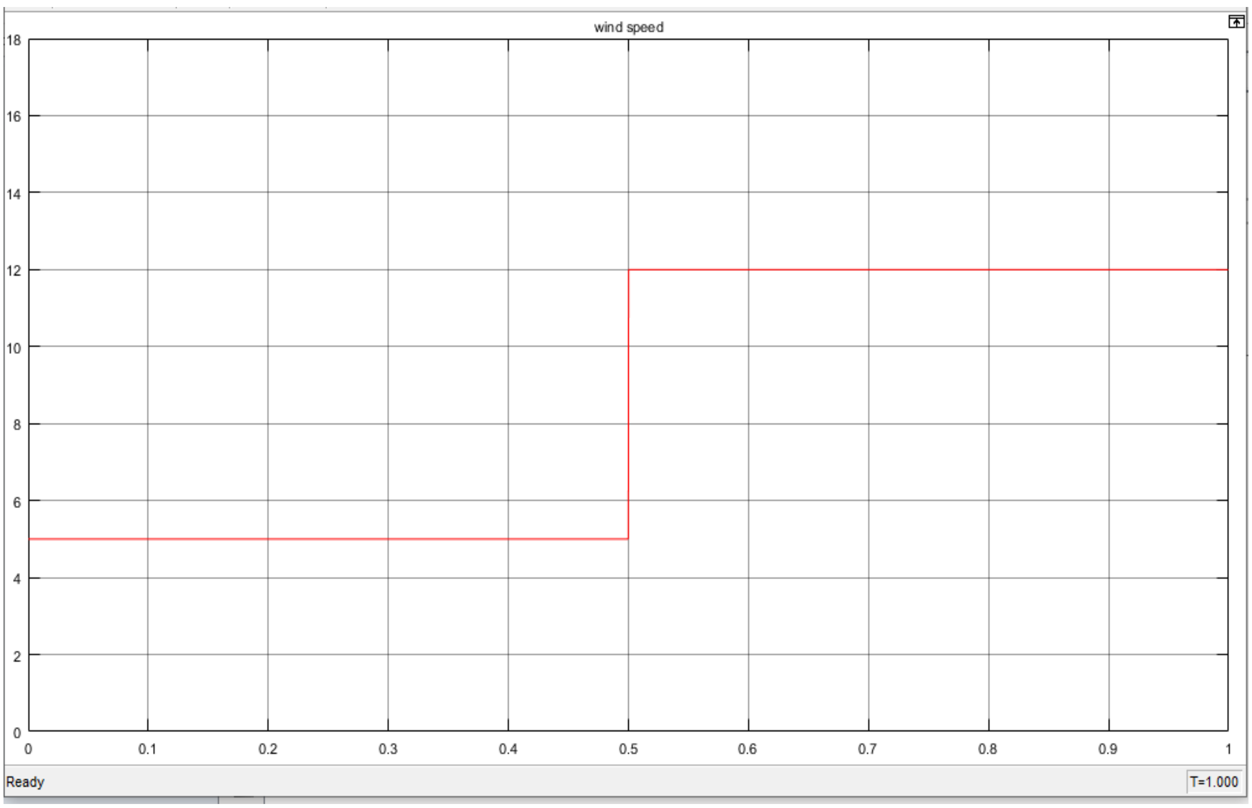

Figure 10: Wind speed

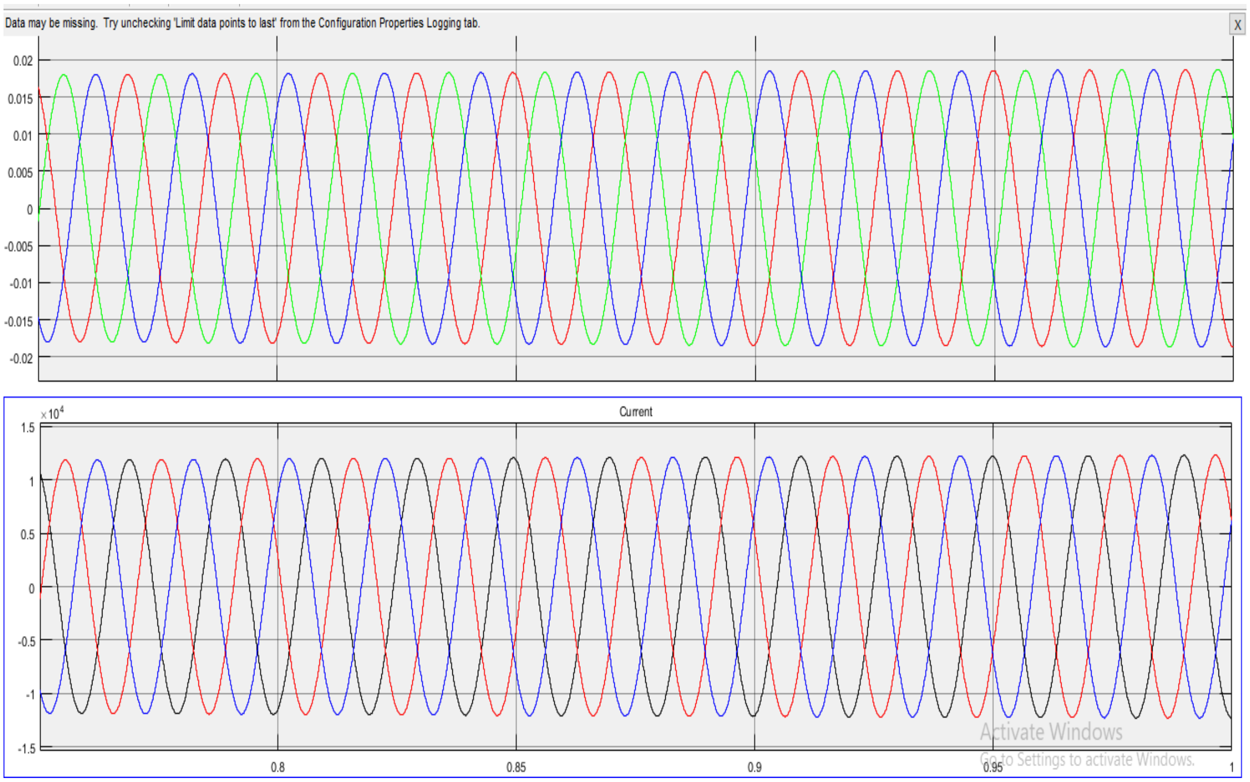

Figure 11: Output Synchronous Generator

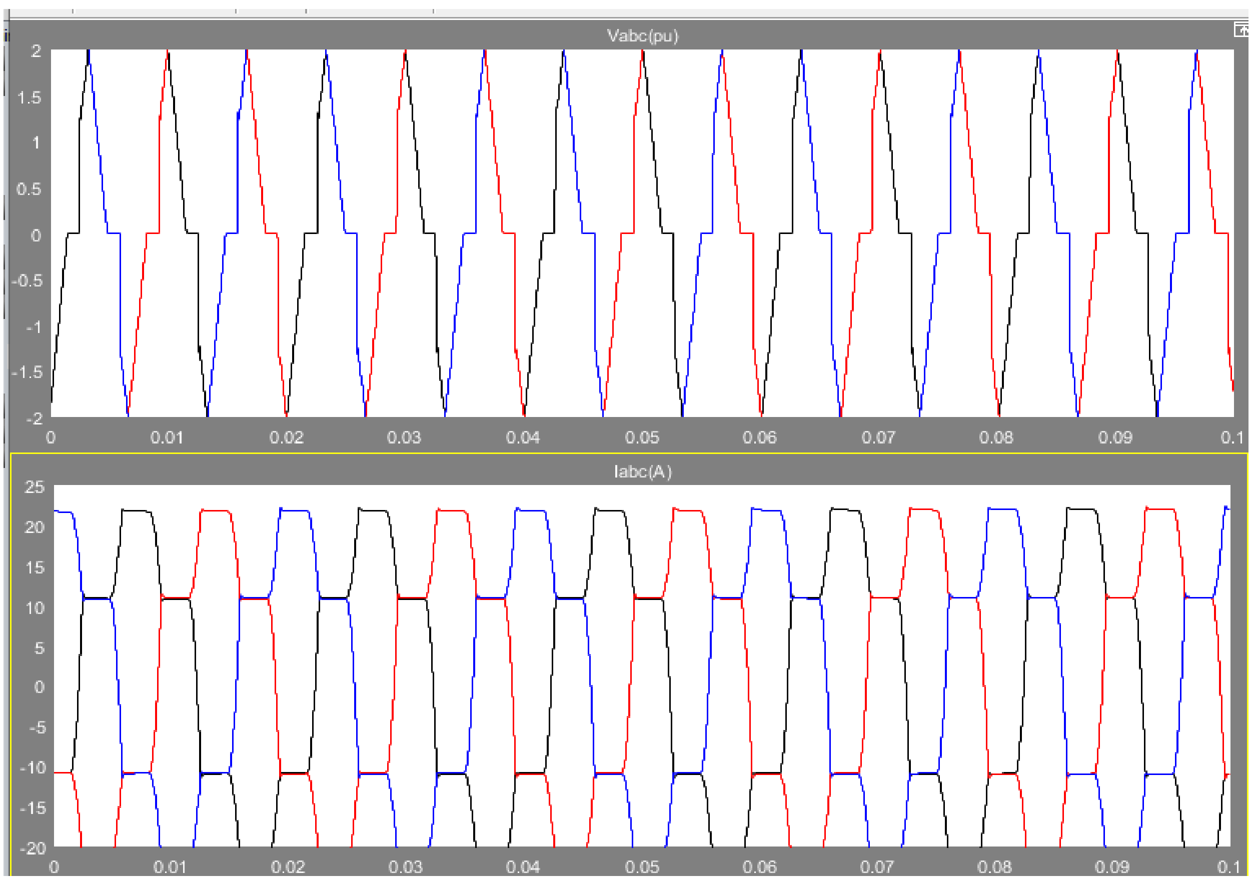

Figure 12: Diesel Generator

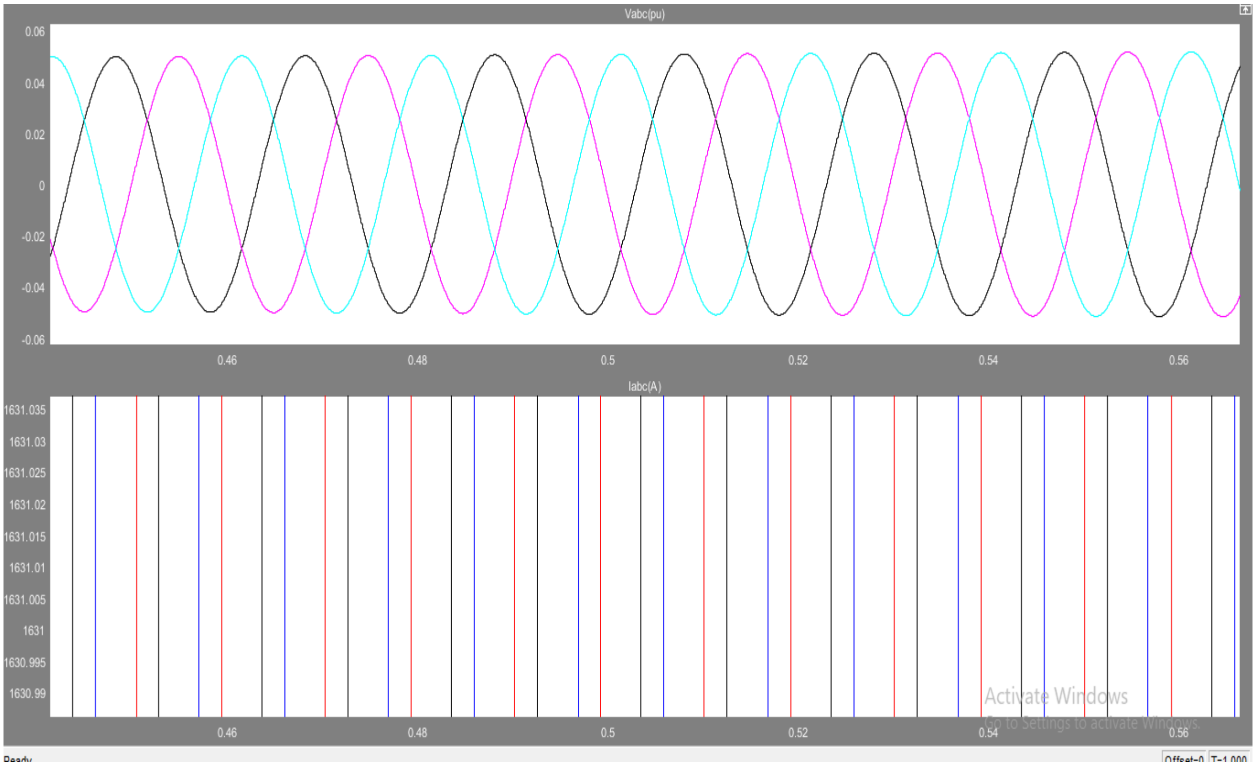

Figure 13: BSM Output of Diesel Generator

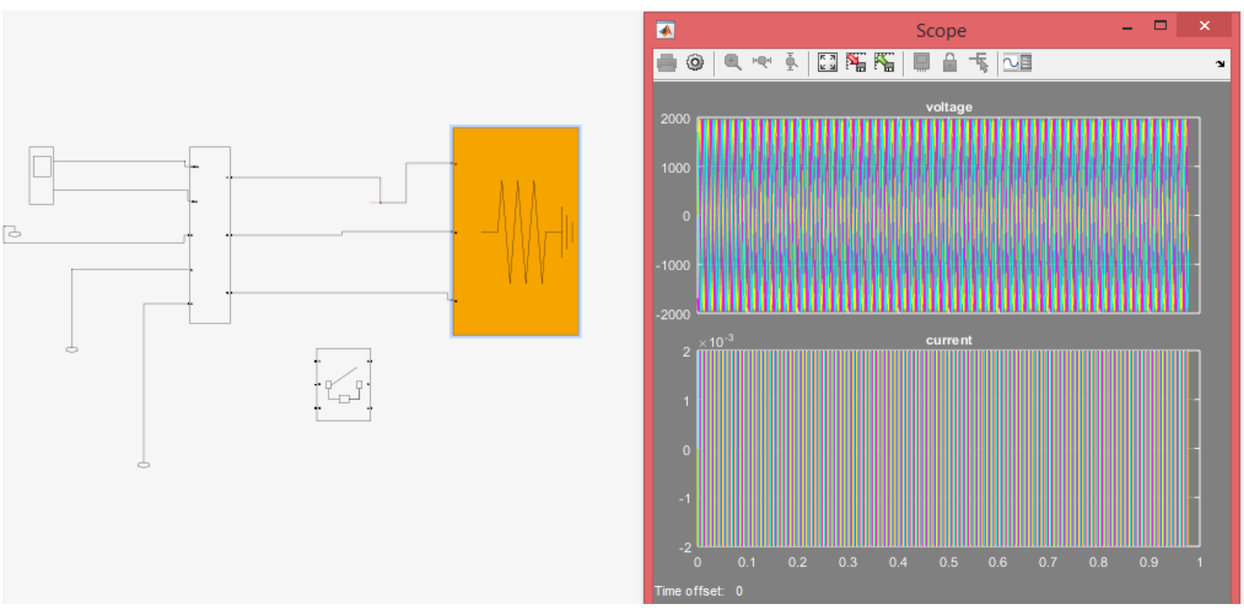

Fig. 14: linear Voltage and Current

Conclusion & Future Scope

Conclusion

The development of the vehicle for the last few years has become an emerging and moving towards eco-friendly technologies and the usage of the energy and storage sources has been improving over the years. The research has focused on the storage system and controlling system of the vehicle. For this research study, a specifically rated ultracapacitor and battery have been selected as sources, and different converters like a buck, boost, and full-bridge buck-boost converters have been simulated. It also involves the design of three-level inverter using MATLAB Simulink Concerning EV batteries being distributed in smart environments, there are technical issues that need to be addressed: energy management strategies and control of the integration of EVs into tablets is the key to using EVs as shared storage, which needs to be carefully examined. People putting electric cars on plates, we need to understand the problem of control and management. Before starting charging, the EV battery needs to be connected to the device needed to determine if there is any residue in the system to start charging the battery, so we need a competent inverter.

Future Scope

Research and development is a continual and relentless process. For any research work already carried out, there is always room for improvement, which opens up many avenues for further research. As a result of the research in this paper, the following aspects are determined to further the research work.

Current work can be extended through various energy storage, such as battery storage systems (BESS) and power-saving systems (SMESS) for AGCs.

It can be seen at the nominal value that the proposed observer is very strong in many standards and functional limitations. And finally, by considering the physical constraints such as delaying time and repositioning the gas turbine, the proposed method will be expanded to a more robust power model.

Various methods can be used to realize the wireless connection to the car to eliminate the difficulty of unlocking.

SC-Bank location can be used for heavy-duty vehicles and stand-up and vehicle testing.

Other customizable ways to choose the rotation of the car.

The fixed lanes of the vehicle can be projected to reach the maximum rate of renewal rate and rate of application.

The Fixed Route, with and without a driver can be tested and the regeneration, as well as utilization of the energy, can be estimated. In the battery management of the hybrid vehicle, the future work can be extended to integrating concepts of the battery management system and power management that can be controlled with the state of charge, controlling the power flow. The state of charge can be controlled with different types of controllers like PI, PID, and fuzzy controllers and can also be extended to the artificial neural networks. The vehicle can also be analyzed with different types of converters with different switching designs where a higher gain can be obtained. A vehicle can also be analyzed with different multilevel inverters and so the total harmonic distortion of the output of the inverter can be decreased. Also, the motor drive for the vehicle can be realized with different controllers to obtain control over the speed and reduction of torque ripples.

References

1. Fadoul Souleyman Tidjani, Abdelhamid Hamadi, Ambrish Chandra*, Fellow IEEE, Benhalima Saghir, Energy Management of Micro Grid-based Electrical Vehicle to the Building (V2B) 978-1-7281-5152-6/19/$31.00 ©2019 IEEE.
2. Q. Xu, J. Xiao, P. Wang, X. Pan, and C. Wen, "A decentralized control strategy for autonomous transient power-sharing and state-of-charge recovery in hybrid energy storage systems," IEEE Trans. Sustain. Energy, vol. 8, no. 4, pp. 1443–1452, Oct 2017.

3. K. Thirugnanam, S. K. Kerk, C. Yuen, N. Liu, and M. Zhang, “Energy management for a renewable microgrid in reducing diesel generators usage with multiple types of battery,” IEEE Trans. Ind. Electron., vol. 65, no. 8, pp. 6772–6786, Aug 2018.
4. Y. Liu, C. Yuen, N. U. Hassan, S. Huang, R. Yu, and S. Xie, “Electricity cost minimization for a microgrid with distributed energy resource under different information availability,” IEEE Trans. Ind. Electron., vol. 62, no. 4, pp. 2571–2583, April 2015
5. X. Xu, Q. Liu, C. Zhang, and Z. Zeng, “Prescribed performance controller design for dc converter system with constant power loads in dc microgrid,” IEEE Trans. Sys., Man, and Cyber.: Sys., pp. 1–10,2018.
6. D. K. Dheer, S. Doolla, and A. K. Rathore, “Small-signal modeling and stability analysis of a droop based hybrid ac/dc microgrid,” in IECON2016 - 42nd Annual Conf. of the IEEE Ind. Electron. Society, Oct 2016, pp. 3775–3780.
7. SrikanthKotra and Mahesh K. Mishra, “A supervisory power management system for a hybrid microgrid with hess,” IEEE Trans. Ind.Electron., vol. 64, no. 5, pp. 3640–3649, May 2017.
8. R. W. Erickson and D. Maksimovic, Fundamentals of power electronics.Springer Science & Business Media, 2007.
9. R. Kötz and M. Carlen, “Principles and applications of electrochemical capacitors,” Electro Chim. Acta, vol. 45, no. 15–16, pp. 2483–2498, 2000.
10. J. W. Dixon, M. Ortúzar, and E. Wiechmann, “Regenerative braking for an electric vehicle using ultracapacitors and a buck-boost converter,” in Proc. EVS18, Berlin, Germany, Oct. 2001, pp. 148.
11. Hong G, Yi-min G, and Ehsani M. A neural network-based SRM drive control strategy for regenerative braking in EV and HEV. In: Electric machines and drives conference, IEMDC 2001, Cambridge, MA, pp.571–575, 17–20 June 2001.
12. J. W. Dixon and M. Ortúzar, “Ultra capacitors+ DC-DC converters in a regenerative braking system,” IEEE Aerosp. Electron. Syst. Mag., vol. 17, no. 8, pp. 16–21, Aug. 2002.
13. Gao, L., Dougal, R.A., and Liu, S., Active Power Sharing in Hybrid Battery/Capacitor Power Sources, in Applied Power Electronics Conference and Exposition, APEC'03, Eighteenth Annual IEEE, 1, pp. 497-503, 2003.
14. G. L. Plett, “Extended Kalman filtering for battery management systems of LiPB-based HEV battery packs—part 1. Background,” Journal of Power Sources, vol. 134, no. 2, pp. 252–261, 2004.
15. S. Ban, J. Zhang, L. Zhang, K. Tsay, D. Song, and X. Zou, “Charging and discharging electrochemical supercapacitors in the presence of both parallel leakage process and electrochemical decomposition of solvent,” Electro Chimica Acta, vol. 90, pp. 542–549, 2013.
16. Wu, X., Du, J., and Hu, C. “Energy Efficiency and Fuel economy Analysis of a Series Hybrid Electric Bus in Different Chinese City Driving Cycles” International Journal of Smart Home, Vol. 7, No. 5, pp 353-368, 2013.
17. Y. M. Nie and M. Ghamami, "A corridor-centric approach to planning electric vehicle charging infrastructure," Transportation Research Part B: Methodological, vol. 57, pp. 172–190, November 2013.
18. . L. Jian, et al., "A scenario of vehicle-to-grid implementation and its double-layer optimal charging strategy for minimizing load variance within regional smart grids," Energy Conversion and Management vol. 78, pp. 508–517, February 2014.

19. L. Zhang, W. Zhenpo, F. Sun, and D. Dorrell, “Ultracapacitor modeling and parameter identification using the extended Kalman filter,” ITEC Asia Pacific vol. 7, pp. 3204–3217, 2014.
20. Y. Wei, J. Zhu, and G. Wang, “High-specific capacitance supercapacitor base on vanadium oxide nanoribbon,” IEEE Trans. Appl. Super cond., vol. 24, no. 5, 2014.
21. Burke, A.F., “Present and future supercapacitors: Technology and applications” presentation at the Supercapacitor USA 2014, Santa Clara, California, November 2014.
22. L. Zhang, Z. Wang, F. Sun, and D. G. Dorrell, “Online parameter identification Of ultracapacitor models using the extended Kalman filter,” Energies, vol. 7, no. 5, pp. 3204–3217, 2014.
23. Dubal, D.P., Ayyad, O., Ruiz, V., and Gomez Romero, P., Hybrid Energy Storage: The Merging of Battery and Supercapacitor Chemistries, Chemical Society Reviews, vol.44, no.7, pp. 1777- 1790, 2015.
24. R. T. Meyer, R. A. DeCarlo, S. Pekarek, " Hybrid model predictive power management of a battery-super capacitor electric vehicle", Asian Journal of Control, vol. 18, no. 1, pp. 150–165, Jan. 2016.
25. Y. Wang, W. Wang, Y. Zhao, L. Yang, W. Chen, "A fuzzy-logic power management strategy based on Markov random prediction for hybrid energy storage systems", Energies, vol. 9, no. 25,2016.