ENERGY MANAGEMENT CONTROL STRATEGY OF PV/BATTERY HYBRID DISTRIBUTED POWER GENERATION SYSTEM WITH AN INTEGRATED THREE-PORT POWER CONVERTER

P. LOGANATHAN[1], Dr. P. SELVAM[2], Dr. R. DEVARAJAN[3] and R .SHANTHY[4]

[1]Assistant Professor, Department of Electrical and Electronics Engineering, Vinayaka Mission's Kirupananda Variyar Engineering College, Vinayaka Mission's Research Foundation (Deemed To Be University), Salem-636308, Tamil Nadu, India. surya.jp07@gmail.com.

[2]Professor & Head, Department of Electrical and Electronics Engineering, Vinayaka Mission's Kirupananda Variyar Engineering College, Vinayaka Mission's Research Foundation (Deemed To Be University), Salem-636308, Tamil Nadu, India. selvamp@vmkvec.edu.in.

[3]Professor, Department of Electrical and Electronics Engineering, Vinayaka Mission's Kirupananda Variyar Engineering College, Vinayaka Mission's Research Foundation (Deemed To Be University), Salem-636308, Tamil Nadu, India. devarajan@vmkvec.edu.in.

[4]PG Scholar, M.E – Power System Engineering, Department of Electrical and Electronics Engineering, Vinayaka Mission's Kirupananda Variyar Engineering College, Vinayaka Mission's Research Foundation (Deemed To Be University), Salem-636308, Tamil Nadu, India. shanthytneb@gmail.com.

ABSTRACT

PV-based power generation is gathering steam in both grid-connected and stand-alone uses, the previous converters method have two ports, thus a large number of them are connected to a shared DC bus. Each port is managed individually in this scenario, using a separate communication channel that may comprise several switches controllers. So in the proposed method Photovoltaic (PV) / battery hybrid structure, drained late in the energy management enormous testing. For standard dispersed force edge structures with PV / battery mixing power units, two free force converters are required including a non-directional DC-DC converter and a boost converter. Due to its small form, minimal switch demand, and excellent efficiency, multi-port converters are becoming a better efficiency. The integrated three force for the converter, PV / Battery proposes development theory and control measures for the semi-mature transmitted power age structure. As the power changes from the associated relative converter full-interface DC-DC converter, the improper idea of the force thickness and system is refreshed. Extraordinary energy splash release sheets and control systems are proposed to understand the force balance between the three ports in different workplaces.

Keywords: Photovoltaic (PV), Energy Management, Distributed Power Generation, Maximum Power Point Tracking (MPPT).

I. INTRODUCTION

A PV / battery blending power unit shapes essential topography in a variety of conversion proprietor age systems. A typical DC / AC scaled organization comes with one stage and two continuous free force converters with interchangeable phases (for example, less than the direct current expected association-based plan). Some joint work PC / battery mix spreads around using a power system that is not the only typical cross-section [1], [2]. Typically, the PV / Battery Controller for hybrid force structure is included for Maximum Power Point Tracking (MPPT), Battery Controller and Charge Status Association for Charging / Delivering Inverter Controller System. Essentially, the PV-based Power Edge System examines the use of battery/super capacitor half and energy-saving stock filling units. Geography Involved, Three Ports Force Converter PV / Battery Half Breed Power Edge Structure [3].

General Geography includes two non-converter charge converters, and thus, the method can improve the thickness of the scheme force. The idea, demonstration and scheme of Multiport Power Converter is familiar with unlimited resources and in interfering with fuel stock lifting units [4].The manufacturers have created zero, so that system can fundamentally reduce the unreliable quality and hence, such a clear development requires a joint order. The system can address the multiport converter based on a full-shared module or a semi-extension module using a multi-winding transformer, source, battery, and suspended interface. This type of different force switches reduces the thickness of the force area and increases [5].

Similarly, the possibility of geographical growth in inverter converters with at least four ports is talked about. In Coordinating the contrasting and symmetrical lift tri-port geography, the DC resistor-capacitor in the connection is fundamental to the lop side geography [6]. The normal voltage difference between the centers of both exchange legs is shown for this situation. In light of the included geography idea for a lift-to-full-connect converter, this method explores its potential application execution with a three-port force converter integrated into a Direct Current (DC) miniature matrix-based PV / battery crossbreed power unit [7]. Similarly, the comparative energy of the board and control technology have suggested the program's energy to complete the implementation of the officers and the ideal structure. The possible working conditions of the structure under different force conditions are presented in full. Entertainment checks the availability of PV / battery cross-generation power [8], [9].

II. PREVIOUS RESEARCH WORK

The control attitude of the converter shows that the N-1 self-functioning control factors are the N-port converter. Thus, two free control factors are essential. In enormous

quantities, the output port voltage should be stabilized and operated automatically by one control variable, while another variable should control the PV port or battery port. Primarily, the PV port and battery port will be kept adequate at any stage to accept the power balance. Considering everything, the 'three force transmission branches' and the 'two free control components' at any rate are [10], [11]. Three dynamic-full-communists Dc, full split dominance, as well as quality evaluation. Its various limitations, confirming the curvature of the geological structure and its applications, must be zero for a two-port converter with voltage and force assessment and safety requirements, self-independence and size of three-port voltage relationship, cost. The decode control based multiport force change system is promising for future evaluation [12].

This multiport segregated DC / DC converter is included with its presentation and control interests. To restrict the DC load and the bi-directional battery port, the change of high growth is to be absorbed with a clear goal that the DC load constantly accepts its force interest. The converter is given adjustment changes that are based on the specific acceptable implementation of the proposed converter taking into account the parasitic areas [13]. Depending on the system Little Sign model. Accepted decoupling control technology has been exhausted to control the MPPT of the PV module and allow different schemes of regulators to operate the unauthorized dean transport voltage using the small sign model Dell.

Although a separate three-port DC / DC converter was proposed, the synchronous iteration could be upgraded to improve synchronization compatibility. The bi-directional fly back removed from the DC / DC converter appears; it interfaces with both the bi-directional converter and the three-port converter by reducing cost and size. However, it has only one free control signal [14]. This method is more polite than the typical Matrix show, proposing a converter related to -filter. The topography of this converter is validated by presenting three free yield ports, another control plot and an application. Show in test with converters, and this scheme presents more opportunity for control, as it is free from stage shift change or more balance. Also, it delivers stale development due to inconsistent plans [15]. Drop system can apply control to go as a modifier to take a constant interest in the board's composition. All included hanging force association. Incidentally, the use of throat power is constantly lost without adaptability. Simultaneously, the force was added as frequently as an additional radiation stock filling unit to meet the requirements. [16].

In any case, both legs are inadvertently controlled by the other channel, including the resistor and the auxiliary capacitor. The voltage of the auxiliary capacitor can be kept constant, while the method of can changes the DC-transport voltage within a wide width [17]. Along these lines, three ports can find a DC-transport capacitor and reckon with to reconfigure. At that time, the motivation behind the DC-transport capacitor was to reflect the association's expectation in supplying the converter to provide radiation to the wave energy radiation [18]. The various external protections are provided, for example, attach

to the F-building fade. Plans and illustrations for three port transformers are also given in the same way. Full primer tests are based on center limits [19].

An attempt is being made to intervene in advantageously low-voltage saving, holiday saving, stock lighting gadgets with high-voltage DC transport. In this article, the most popular king stock lining structuring is suggested. The proposed topography involves planning of two special developments by removing galvanic explosion of batteries from DC transport, the use of wide trade switches, and comparable flow ports between any two. [20].

III. PROPOSED METHOD

Photovoltaic (PV)/battery hybrid power systems have captured expert's data. Two separate power converters, comprising a unidirectional DC–DC converter and a bidirectional converter, are often required for traditional distributed power generating systems with PV/battery hybrid power units. The dynamics for the dispatch of assets are incredibly confusing. The multiport converter can be based on a full-connect module or semi-connect module using a multi-winding transformer, interface to force source, battery and load.
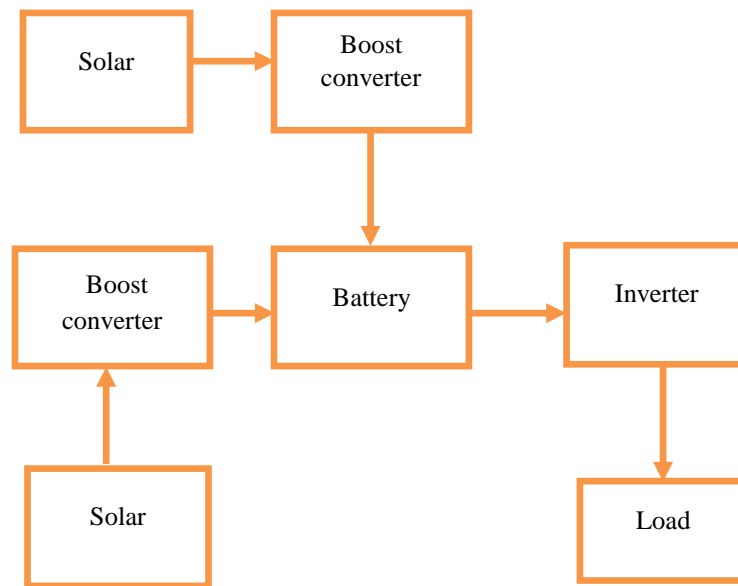

Figure 1 Proposed Block Diagram

The proposed four-port geography is estimated by adding two force switches based on a regular half-connected converter. The high force thickness of the system is

accomplished along these lines. The idea of a lift coordinated stage shift full-connect three-port converter is proposed. The two lifts include three-port converter geographies, specifically introduced for the potential use of symmetrical and unbalanced geo-transmitted power age-based PV / energy radiation units. In addition to the staging point shift control plot, the proposed Pulse Width Modulations (PWM) and PV / battery combination is confirmed as a suitable probability for three-port structures. This technique suggests the PV / Battery Crossover with only one included Three- Force for Converter for the Disintegrated Force Age System.

The two lifts combined three-port converter precisely which are symmetrical and lop side geospatial, are introduced for possible uses of the rotation power age system based on PV units. By controlling the mode of responsibility of the force switches, the bilateral force flow can be accomplished between the two ports on the required side of the great recurrence transformer. In contrast and similar structural structures, integrated geography benefits the structure to higher proficiency, higher force thickness and reduced cost. An integrated three-port lift converter connected to an interleaved bilingual lift converter and a stage shift full-connect converter for the PV / battery crossbreed power age system based on the asymmetrical lift of three-port geography is proposed.

3.1 SOLAR PANEL

The solar-oriented sheet integrates pure light as possible energy and converts that light into energy that the panel will then control the electrical load. The daylight-based board consists of several individual sun-controlled cells that are physically shaped by silicon, phosphorus, and boron layers. The sun-controlled board contains photons and, in doing so, begins to produce an electric current. Radar radiation generated by photons about the outer sun-driven base-up allows electrons to be ejected from their atomic circles and delivered to an electric field distributed by sunlight-aligned cells, which now move these free electrons to the field. Direction This whole cycle is known as the photovoltaic effect.
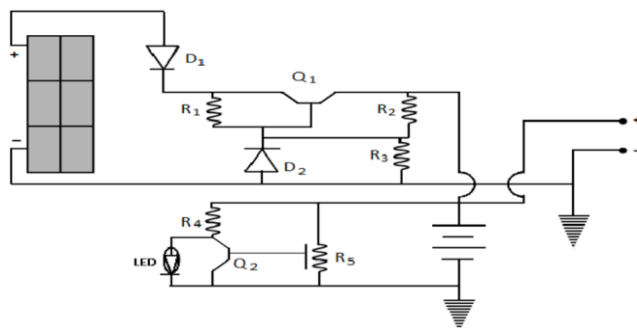

Figure 2 Solar Panel

A. BOOST CONVERTER
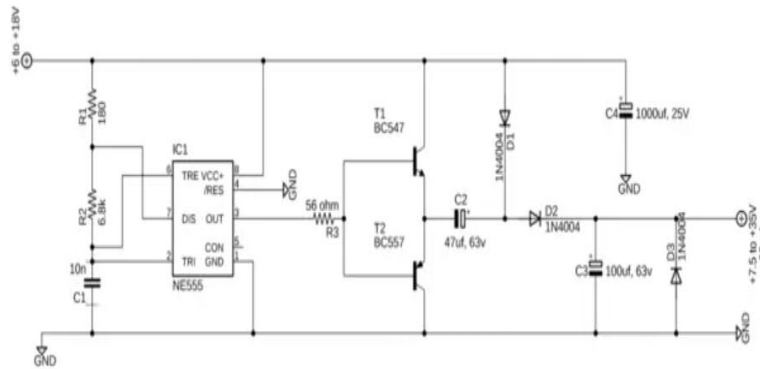
Figure 3 Boost Converter

A boost converter (corresponding to a hit adventure up converter) is a DC-to-DC converter circuit that attempts to convert data on a DV voltage with a level yielding a DC voltage that can be much higher than the data voltage level. The constant coupling mediator shows that the yield ratio decreases with the current output of the data voltage up converter. Hence, the output power is regularly equivalent to the data power. The markers here are used for voltage and capacitor amplification to check the traders' instability and reduce the current waves in the yield of the converter. The system can retrieve data from any sensitive DC source such as batteries, solar-powered aligned sheets, motors, and generators; in this regard, it should be supported or extended.

B. BATTERY

A battery is a paradox in having an electrochemical cell at any rate that has an external connection to fuel electrical devices such as bright lights, cell phones and electric vehicles. Then, when the battery is exposed to an external electric load, the red bull's reaction replaces high-energy radiation reactors to cut energy radiation objects, and the free-energy radiation difference is delivered as electrical energy radiation to the external circuit. Devices manufactured using different cells are characterized by "batteries", and the use of which in any case has progressed to include contracts made using loan cells.

The required (single-use or "charged") battery is used once and discharged. The cathode material changes problematically during discharge; the regular model is a rechargeable battery used for numerous bright lights and minimal electronic devices. Electric (battery-fuel) batteries can be burned and re-energized at various events using applied electric current; the main construction of the wood can be re-installed around the stream.
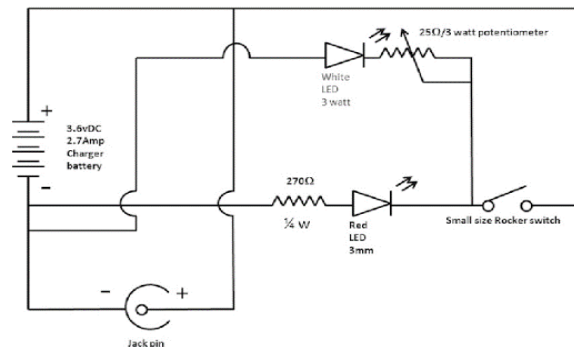
Figure 4 Circuit diagram of battery

C. INVERTER

The battery or DC source, is the principal source of electrical power. The battery's DC output is bucked or boosted depending on the application, and then converted to AC using a DC-AC inverter. An inverter converts a DC input voltage into a symmetric ac output voltage with the required magnitude and frequency. Ideal inverter output voltage waveforms should be sinusoidal. Practical inverter waveforms, on the other side, are non-sinusoidal and contain certain harmonics.

IV. RESULT AND DISCUSSION

An electrical load is a cycle of an electrical piece or circuit that burns electrical power inside a home, such as electrical machines and lights. The word can similarly show the power applied by the circuit. This is the opposite of generating power, like a battery or generator, which generates power. The term is more widely used in compression for devices related to the sine source, even if it does not consider consumption pressure. The part of the terminals that make up the electrical sign, if the electric circuit has an output port, is the circuit shine associated with this terminal (or its data barrier). For example, if a Compact Disk (CD) player is concerned with improvement, the CD player is the source, and the compiler shines. Borden yields affect the introduction of voltage or current-related circuits, such as sensors, voltage sources and amplifiers.
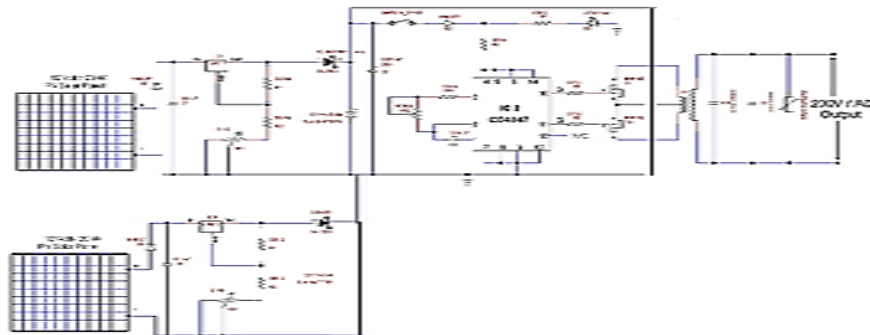
Figure 5: Circuit Diagram

Solar powered energy is an environment- friendly power source. It's anything but an appealing energy arrangement because of its endless stockpile source and it is non-dirtying in character. The aggregate sum of episodes of sun oriented energy on the Earth is a lot more prominent than the current and expected energy needs of the world. Sun oriented energy can possibly fulfill the entirety of things to come on the off chance that it is appropriately tackled. During its activity, it doesn't produce ozone harming substance or poisonous components. Its utilization assists with lessening reliance on petroleum products, adding to the decrease of ecological effect. For current and voltage control, a two-circle control technique is typically utilized.
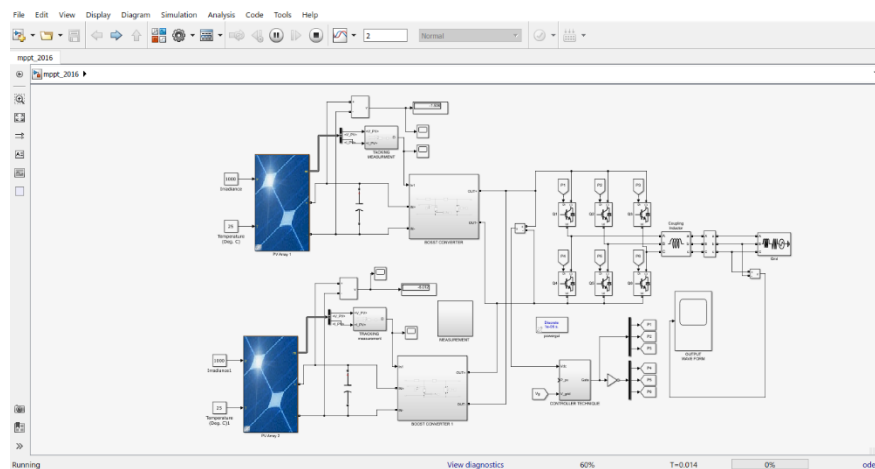

Figure 6: Mat Lab Simulation

A state of this construction is the decoupling of the powerful reaction between the two circles. The inward circle should be quicker than the external circle. The normal construction is to have an internal circle and a voltage in external circle. PI regulators

are regularly utilized in both control circles, yet they have detriments like restrictions on voltage guideline, clashes between control circles and little locales of strength.
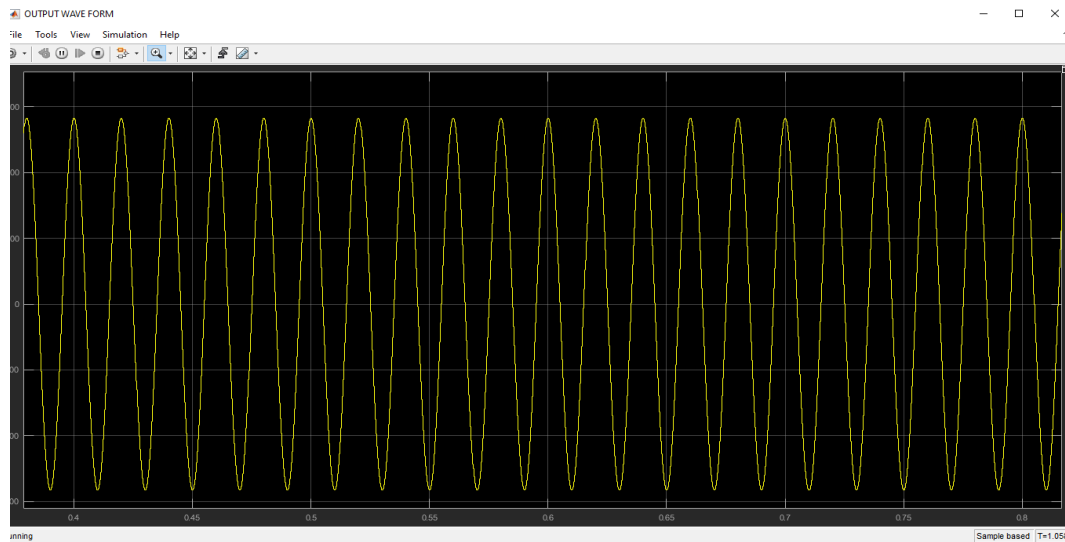
Figure 7: Simulation Output Waveform.

To improve the execution of two-circle system, hearty non-direct regulators have been proposed. Previous works have tended to a few control procedures in two-circle regulators, for example, dynamic aggravation dismissal and PI regulators, resignation based control prescient control hang control.
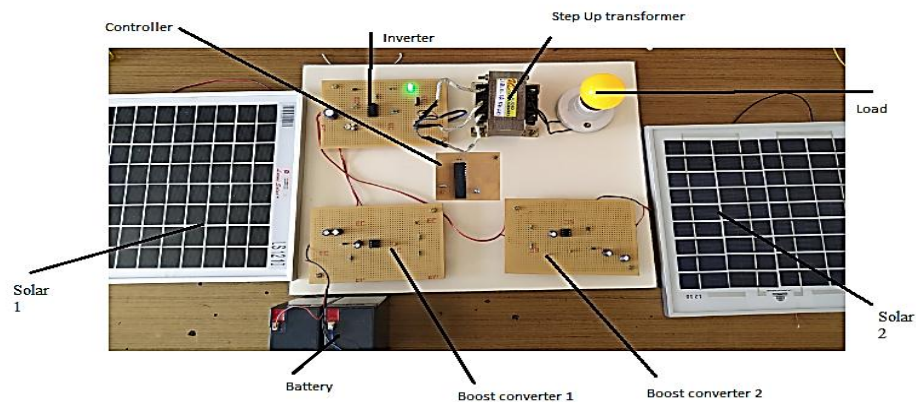
Figure 8: Hardware Experimental Kit

Table 1: Hardware Specification Output

Hardware	Specification	Input Ranges	Output Ranges
Power generation	Solar Power	-	12V
Microcontroller	Input power	5V DC	5V DC
Inverter	Output Power	10V DC	10V-AC
Transformer	Step up	10V DC	230V AC
Load Output	Load (Incandescent Lamp)	230V	0.58 A- 72 watts

4.1 ADVANTAGES

➢ Serious Concerns about environmental change.
➢ Improves power quality and structural dependence.
➢ Transmission Reduction in the misfortune of transmission and allocation.
➢ Transmission Obstacles are created to the development of new transmission lines.

4.2 APPLICATION

➢ Renewable energy.
➢ Operated for remote areas.
➢ The most well-known way to cut solar-based energy is to use a solar-powered board.
➢ Space warming and cooling by the sunlight-based system.
➢ Potable water by purification.
➢ Solar hot water tank.

V. CONCLUSION

The proposed coordinated three-power converter systems are compared and differentiated with Traditional construction geology is differentiated and based on that, the DC-DC is made free. The Unidirectional Change Stage and the related Change Stage enjoy the benefits of topography, high power thickness in the proposed structure and crazy quality. The full presentation stage shift point and switch responsibility of the difference of the specific working states of constructions under different power conditions are discussed, and extended energy emissions are recommended according to the needs and control strategies of the leaders. The requirement controller may

enable one of the control circles to classify circumstances to upgrade the entire construction execution by considering the MPPT advantages and the battery charging/organization requirements. Dispersion results monitor the performance and control estimates of the scattered power age design over a wide range of proposed PV / battery types.

The charging current control circle data bounder sign will be negative for the current circumstances, indicating that the respective circle accepts DC as charging voltage and damages the AV charging circle. This works as a power balance port for the current circumstances and the working place of the PV to satisfy the power balance of the construction. The potential movement states of the proposed PV / battery hybrid has suggested a force age structure between the three ports under different power conditions. PV produces the best return power MPPT and it will work in battery delivery mode by mixing PV and battery within the very force.

REFERENCES

1. Z. Wang, Q. Luo, Y. Wei, D. Mou, X. Lu and P. Sun, "Topology Analysis and Review of Three-Port DC-DC Converters," in IEEE Transactions on Power Electronics, vol. 35, no. 11, pp. 11783-11800, Nov. 2020, doi: 10.1109/TPEL.2020.2985287.
2. S. Neira, A. Lizana and J. Pereda, "A Novel Three-Port NPC Converter for Grid-Tied Photovoltaic Systems with Integrated Battery Energy Storage," 2020 IEEE 11th International Symposium on Power Electronics for Distributed Generation Systems (PEDG), Dubrovnik, Croatia, 2020, pp. 104-109, doi: 10.1109/PEDG48541.2020.9244383.
3. L. Yang, J. Peng, F. Yang, Y. Zhang and H. Wu, "Single-Phase High-gain Bidirectional DC/AC Converter Based on High Step-up/step-down DC/DC Converter and Dual-input DC/AC Converter," 2019 IEEE 10th International Symposium on Power Electronics for Distributed Generation Systems (PEDG), Xi'an, China, 2019, pp. 554-559, doi: 10.1109/PEDG.2019.8807762.
4. Q. Tian, G. Zhou, M. Leng, G. Xu and X. Fan, "A Non-isolated Symmetric Bipolar Output Four-Port Converter Interfacing PV-Battery System," in IEEE Transactions on Power Electronics, vol. 35, no. 11, pp. 11731-11744, Nov. 2020, doi: 10.1109/TPEL.2020.2983113.
5. S. Alomari and I. Smadi, "Modeling and Control of Multi-Port DC/DC Converter," 2019 IEEE 28th International Symposium on Industrial Electronics (ISIE), Vancouver, BC, Canada, 2019, pp. 920-925, doi: 10.1109/ISIE.2019.8781105.
6. L. Carvalho, L. H. Meneghetti, L. Bellinaso, R. Cardoso and L. Michels, "Bidirectional Interlink Converter for Bipolar DC Microgrids," 2019 IEEE PES Innovative Smart Grid Technologies Conference - Latin America (ISGT Latin America), Gramado, Brazil, 2019, pp. 1-6, doi: 10.1109/ISGT-LA.2019.8895334.
7. Y. Singh, B. Singh and S. Mishra, "Control of Solar-EV and Grid Integrated System," 2020 IEEE 17th India Council International Conference (INDICON), New Delhi, India, 2020, pp. 1-6, doi: 10.1109/INDICON49873.2020.9342191.

8. Qing-Chang Zhong, "Droop-Controlled Loads for Continuous Demand Response," in Power Electronics-Enabled Autonomous Power Systems: Next Generation Smart Grids, IEEE, 2020, pp.301-320, doi: 10.1002/9781118803516.ch19.

9. Y. Wu et al., "A 150-kW 99% Efficient All Silicon Carbide Triple-Active-Bridge Converter for Solar-Plus-Storage Systems," in IEEE Journal of Emerging and Selected Topics in Power Electronics, doi: 10.1109/JESTPE.2020.3044572.

10. T. Chaudhury and D. Kastha, "A High Gain Multiport DC-DC Converter for Integrating Energy Storage Devices to DC Micro grid," IEEE Transactions on Power Electronics, vol. 35, no. 10, pp. 10501-10514, Oct. 2020, doi: 10.1109/TPEL.2020.2977909.

11. Liu, Q., Li, Y., Luo, L. F., Peng, Y., & Cao, Y. "Power Quality Management of PV Power Plant with Transformer Integrated Filtering Method". IEEE Transactions on Power Delivery, 1–1. doi.2018.

12. Swain, S. D., Ray, P. K., & Mohanty, K. B. "Improvement of Power Quality Using a Robust Hybrid Series Active Power Filter". IEEE Transactions on Power Electronics, 32(5), 3490–3498.2016.

13. Ko, H.-S., Jang, M.-S., Ryu, K.-S., Kim, D.-J., & Kim, B.-K. "Supervisory Power Quality Control Scheme for a Grid-Off Micro grid". IEEE Transactions on Sustainable Energy, 9(3), 1003–1010.2017

14. Shabbir, M. N. S. K., Liang, X., Li, W., Khan, N., & Le, A. M. "A Novel Data-Driven Voltage Control Approach for Grid-Connected Wind Power Plants". IEEE Transactions on Industry Applications, 1–1.2019.

15. Zhao, X., Guerrero, J. M., Savaghebi, M., Vasquez, J. C., Wu, X., & Sun, K. "Low- Voltage Ride-Through Operation of Power Converters in Grid-Interactive Micro grids by Using Negative-Sequence Droop Control". IEEE Transactions on Power Electronics, 32(4), 3128–3142.2016.

16. International Symposium on Networks, Computers and Communications (ISNCC). Jabbar, W. A., Alsibai, M. H., Amran, N. S. S., & Mahayadin, S. K. "Design and Implementation of IOT-Based Automation System for Smart Home". PP 1-6, year 2018.

17. GUZMAN, J., & NUNEZ, F. "A Multi-Interface Home Automation System with Distributed Intelligence". IEEE International Conference on Automation/XXIII Congress of the Chilean Association of Automatic Control (ICA-ACCA).PP 1-6, the year 2018.

18. Sato, F., Shimada, T., & Ouchi, T. "Novel Switching Control Method for Full-Bridge DC-DC Converters for Improving Light-Load Efficiency Using Reverse Recovery Current", International Power Electronics Conference (IPEC-Niigata 2018 -ECCE Asia).2018

19. Kapat, S., Mandi, B. C., & Patra, A. "Voltage-Mode Digital Pulse Skipping Control of a DC-DC Converter with Stable Periodic Behavior and Improved Light-Load Efficiency", IEEE Transactions on Power Electronics.2016.

20. K. Bhattacharjee and I. Batarseh, "An Interleaved Boost and Dual Active Bridge-Based Single-Stage Three-Port DC–DC–AC Converter With Sine PWM Modulation," in IEEE Transactions on Industrial Electronics, vol. 68, no. 6, pp. 4790-4800, June 2021, doi: 10.1109/TIE.2020.2992956.

21. Riya Anto, Bindukala M. P, "Full Bridge Three-Port Converters for Solar Power Systems ",International Journal of Science and Research (IJSR), Volume 3 Issue 2, February 2014, 383 - 388