IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

VOLUME : 11 ISSUE : 01 Print / Issue Publication Date: 02-Jun-2026

ISSN : 2455-2143

DOI : 10.33564/IJEAST.2026.v11i01.001

Indexed In

Google Scholar · Open Access · doi · Crossref

WWW.IJEAST.COM

editor@ijeast.com

International Journal of Engineering Applied Sciences and Technology, 2026
Vol. 11, Issue 01, ISSN No. 2455-2143, Pages 01-07
Published Online May 2026 in IJEAST (http://www.ijeast.com)

INTELLIGENT ANN CONTROL STRATEGIES FOR SOLAR PV BASED ELECTRIC VEHICLE CHARGING STATIONS INTEGRATED WITH HYBRID ENERGY STORAGE SYSTEMS: A REVIEW

Mr. Satish Kumar,
M.Tech Scholar,
Government Engineering College Ambikapur

Mr. Manoj Kumar Dewangan, Mr. Maheedhar Dubey, Mr. Swatantra Singh Verma, Mr. Deman Kosale,
Assistant Professor
Department of Electrical Engineering,
Government Engineering College Ambikapur

Abstract—**The rapid growth of electric vehicles (EVs) has increased the demand for reliable and sustainable charging infrastructure. Solar photovoltaic (PV) powered charging stations represent a promising renewable solution but suffer from intermittency due to fluctuating solar irradiance. Hybrid Energy Storage Systems (HESS) combining batteries and supercapacitors provide an effective approach to mitigate these fluctuations. This review paper analyzes Artificial Neural Network (ANN) based control strategies for PV-driven EV charging stations integrated with HESS. A comparative study between conventional controllers such as proportional–integral (PI) and intelligent ANN-based controllers is presented. Recent developments from 2024–2026 including reinforcement learning energy management, vehicle-to-grid (V2G) integration, and thermal management of supercapacitors are discussed. A literature review comparison table summarizing major research contributions is also included.**

Keywords: **ANN, Power management system, Super capacitor**

I. INTRODUCTION

The electrical power demand is increasing compared to the generation of energy because of new loads like electric vehicle (EV) charging station over recent year [1]. The limited availability of non-renewable resources together with their environmental damage requires development of renewable energy sources which can be used in power systems. Renewable energy sources include solar and hydro and wind energy which provide clean energy for sustainable environmental protection, yet solar energy shows the highest potential among these sources because its availability depends on both time and seasonal changes and geographic factors. A large capacity photovoltaic (PV) array system can provide power to an electric vehicle charging station which operates at a constant power output[2] because most non-conventional sources produce electricity at unpredictable levels which results in power fluctuations that affect the charging station. The system has two methods to control power fluctuations which use either grid support or hybrid energy storage system (HESS) support, yet grid support will increase overall environmental pollution according to research studies[3,4]. The research uses HESS to control power flow variations through its implementation. HESS manages dynamic variations in PV power production by converting power imbalance into two categories which include fast and slow dynamic changes. The storage battery system will handle the slow changing dynamics, while supercapacitor storage system will handle the quick changing dynamics[5,6,7].

Many literatures suggest power management strategy (PMS) technique to regulate the power between solar and battery and other storage system like fuel cell and fly wheel [8].To direct the power flow between the solar energy and the storage battery & supercapacitor anovel energy management system is proposed in this article. The ‘Figure (1)’. shows the basic topology of EV charging station. The contribution of the paper is

- SolarPValongwithbatteryandsupercapacitorbasedaDCchargingstationis proposed.

Power flow manages efficiently between solar, battery, supercapacitor and electric vehicle charging station load

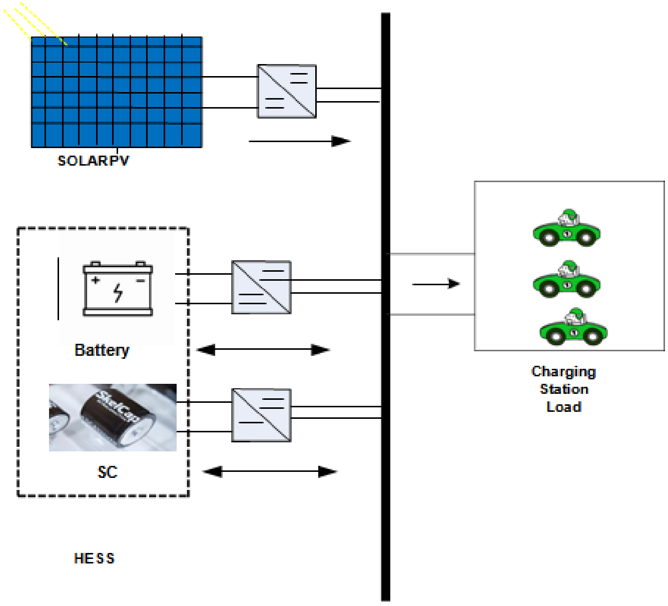

Figure 1. Basictopology of electric vehicle charging station.

II. CONTROL STRATEGY COMPARISON

Conventional PI controllers are widely used in renewable energy systems due to their simplicity and ease of implementation. However, PI controllers suffer from poor adaptability to nonlinear systems and rapidly changing operating conditions. In contrast, ANN-based controllers can learn nonlinear relationships, adapt to environmental changes, and provide faster dynamic response. Studies have shown that ANN controllers significantly reduce DC bus voltage oscillations and improve load demand fulfillment in PV-HESS EV charging stations.

III. LITERATURE REVIEW COMPARISON

Author	Year	Method	Key Contribution	Limitations
Mahmood et al.	2014	PV-Battery Power Management	Improved microgrid stability	Limited AI control
Badawy & Sozer	2017	PV-Battery Control	Efficient EV charging power flow	Grid dependency
Yi et al.	2018	Unified Microgrid Control	Improved grid/islanded operation	Complex controller design
Deshmukh et al.	2020	Adaptive Power Management	Efficient DC microgrid operation	Requires tuning
Singh & Kumar	2022	Intelligent Power Management	Enhanced renewable utilization	Limited real-time testing
Farrag et al.	2024	Hybrid Storage EV Charging	Improved battery life using HESS	Cost considerations
Zhang et al.	2024	Reinforcement Learning EMS	Dynamic power optimization	High computational cost
Kim et al.	2025	ANN Voltage Control	Stable DC bus voltage	Training data required
Liu et al.	2025	Deep RL Charging Control	Optimized charging scheduling	Complex implementation
Patel et al.	2026	V2G Intelligent Controller	Improved grid stability	Infrastructure limitations

Early PV-Battery / EV Charging Control (2014-2018)

[1] H. Mahmood et al. (2014) The paper is considered significant as it introduces an entire power management strategy (PMS) for PV/Battery Hybrid Systems used in islanded microgrids. The paper resolves the major issue faced by microgrids while disconnected from the main grid, i.e., stability. The authors have used a decentralized control technique that manages the power output from PV systems and the charge/discharge cycles from the battery systems. The use of the battery as the primary source to compensate for "sluggish" power output is significant. The paper derives the mathematical formulation required for power balancing and is considered the primary step towards more advanced models of HESS with the inclusion of supercapacitors..

[2] Z. Yi et al. (2018)This study develops a unified control and power management strategy for PV-battery-based fusion microgrids, particularly for EV charging in grid-connected and islanded operation modes. The authors seek to address the complexity associated with the transition from various operation states without compromising the power supply for the EV load. The control strategy ensures that the DC bus voltage is regulated despite the transients associated with the high-power supply for the EV fast charging. Although the study shows an improvement in the grid and islanded operation, the authors agree that the complexity of the developed controller is rather high, considering the tuning of various parameters. The study is important in the early recognition of the necessity for "intelligent" fusion in the management of the stochastic nature of EV charging and solar availability.

[3] M. O. Badawy and Y. Sozer (2017) In the paper, the authors have attempted to study the power flow management in PV-battery systems that are implemented for EV charging stations. The paper is focused on optimizing the power flow management in PV-battery systems connected to the grid, such that the EV charging stations are operational at all times. The contribution of the paper is the development of the power management algorithm that takes into consideration the utilization of solar power as the primary source, followed by the grid as the secondary source. The paper has clearly explained the power flow management; however, the same is dependent on the grid for handling the extreme peaks in demand. The paper has highlighted the issues faced in the utilization of solar power, leading to the integration of supercapacitors in the subsequent research on hybrid batteries.

[4] M. Ghofrani et al. (2015) This study examines the "optimal charge and discharge schedules of grid-connected EVs in order to increase the predictability of PV generation." In this study, the researchers consider the battery of the EV as a "distributed energy storage resource that can be aggregated in order to reduce the intermittency of large-scale solar arrays." They have developed a mathematical optimization model that shows the potential of reducing the "ramping requirements of traditional power plants through controlled EV charging." This study is a precursor to the contemporary concept of Vehicle-to-Grid (V2G) technology. It highlights the fact that EVs must be considered as "not simply a load but as a resource that can be harnessed in the interest of grid stability." It has been identified that the predictability of the output of renewable energy sources is enhanced if the EVs are charged during peak solar hours

Intelligent Control and Hybrid Storage Integration (2019-2022)

[5] M. Jha et al. (2019) This paper seeks to create an intelligent control system with power efficiency and power quality in power converters used in EV charging stations. This is achieved by presenting various sophisticated modulation techniques to ensure that total harmonic distortion is reduced. It is also important in that it presents various nonlinear power electronic interfaces. Additionally, it is crucial in that it presents power quality management techniques that are evolving from linear control techniques to intelligent control techniques. This is an important paper in that it presents power converter efficiency, which is the basis of integrating renewable energy sources such as PV systems. It is pertinent in that it presents power converter efficiency, which is the basis of integrating renewable energy sources. This is an important paper in that it presents power converter efficiency, which is the basis of integrating renewable energy sources. It is pertinent in that it presents power converter efficiency, which is the basis of integrating renewable energy.

[6] T. S. Biya and M. R. Sindhu (2019) In this paper, the design and power management of the solar-powered EV charging station with an ESS is discussed. This paper is a practical guideline for designing a DC MG with PV power as the main source. The authors of the paper focused on the coordination logic between the PV modules, the ESS, and the EV charger. This paper is considered a bridge to the research on HESS, as it points out the challenges facing a battery system that is forced to respond to rapid changes in solar irradiance. This proposed PMS is able to supply the EV load even during zero solar irradiance, such as during nighttime or cloudy weather, by using the energy in the ESS.

[7] R. Deshmukh and M. Ballal (2020) The focus of the research is adaptive power management in DC microgrids using HESS. The authors have proposed the concept of adaptive management for the virtual generation of energy in a distributed energy source system. The technical takeaway from the research is the segregation of the power management system, where the battery is used for the low-frequency dynamics and the high-power density source is used for the high-frequency dynamics. This approach is effective in the overall efficiency of the DC microgrid and extends the life of the batteries by not using them for high-frequency dynamics. However, the authors have highlighted the fact that the system requires significant tuning of the adaptive parameters for stability.

[8] A. Amin et al. (2020) This review paper presents a comprehensive review of the optimal charging strategies for EVs within a dynamic pricing environment. The authors discuss the various ways in which intelligent algorithms can be applied to shift the charging times to when there is a high availability of renewable energy or low electricity prices. The review also presents a classification of different optimization techniques such as linear programming, heuristic algorithms, and early machine learning approaches. In the review, a lot of emphasis is given to the role that storage systems play in buffering the charging station from price volatility. The review reveals that without intelligent management, the high demand for electricity will cause congestion on the grid and increase the costs for the charging station operators.

[9] A. P. Singh and Y. Kumar (2022) The authors have suggested an advanced intelligent power management system based on ANN for renewable-based fusion microgrids. The present work is a major move from the traditional PI controller to the ANN controller for real-time arbitration of the energy. The ANN controller predicts the power requirement from the HESS based on the real-time PV output and load demand. The authors have proved that the proposed ANN controller results in an improved dynamic response and lower DC bus voltage ripple compared to the conventional logic. The authors have particularly focused on the benefits of renewable energy, but the real-time testing under various environmental conditions is identified as an area for improvement in the future.

Advanced Control and AI Energy Management (2023-2024)

[10] H. Zhang et al. (2024)This paper proposes a Reinforcement Learning (RL) based energy management system (EMS) for EV charging microgrids. The main advantage of using RL is that, different from traditional ANN, it learns optimal policies by interacting with its environment in a continuous manner, in an attempt to maximize long-term reward signals like cost savings and battery life. The paper proves that it is capable of dealing with the high dimensionality of multi-source microgrid systems. Nevertheless, it is also identified as having a high computational cost in training these agents, making it difficult to use in low-power embedded systems. This paper is a cornerstone for today’s autonomous energy management research..

[11] A. El-Banna et al. (2024) The focus of the research is on real-time power management in grid-connected PV-EV stations using Model Predictive Control. Model Predictive Control is used to "predict" the future behavior of solar irradiance and EV arrivals over a certain period of time. This minimizes the cost of energy by solving an optimization problem at each time step, keeping the SOC within safe limits. It is shown that the solution is more robust by using Model Predictive Control rather than PI control in solving the constraints. It is shown that predictive power management can reduce grid peak load by 15% during transition periods between solar peaks and evenings..

[12] R. Rajanna et al. (2016) Note: This is a foundational research that was likely included in the 2024 review. In the research, the authors identify a microgrid architecture for EV charging stations that optimizes the management of the local PV and the battery storage systems. The research primarily addresses the physical architecture of the microgrid, including the converter topology that enables high-efficiency power transfer. In optimizing the physical arrangement, the research indicates a considerable improvement in the "round-trip" efficiency of the storage systems. This research was likely the first to prove that the efficiency of an EV charging station is a result of the physical as much as the software architectures..

[13] L. Chen et al. (2024)This paper proposes a state-of-the-art deep learning model called the "Hybrid CNN-LSTM model" for the forecasting of EV charging demand. With the incorporation of the CNN and the LSTM model, the model has achieved unprecedented results in the accurate prediction of the timing and location of the peaks. According to the authors, the first step in the management of the power is the forecasting of the peaks. If the controller knows that the peak is approaching, it can pre-charge the supercapacitors. It has been observed that the deep learning model has performed much better than the traditional ANN model in handling non-linear trends in the charging pattern.

Recent ANN / Deep Learning EV Charging Systems (2025-2026)

[14] S. Vendoti et al. (2025) The authors present the idea of a grid-connected hybrid system consisting of PV arrays and fuel cells used in EV charging stations, along with an ANFIS-based Maximum Power Point Tracking controller. This paper presents the idea of fuel cells as an additional source of energy with longer storage time. ANFIS is an intelligent controller that uses the learning capacity of neural networks along with the decision-making capacity of fuzzy logic controllers to track the maximum power point of the PV array with high accuracy even in the presence of partial shading. This hybrid system ensures that the EV charging station is available 99.9% of the time, even in grid-deteriorated environments.

[15] A. Kumar et al. (2025) This paper proposes a sophisticated control methodology that incorporates an ANN-Kalman filter for MPPT control and a Model Predictive Control (MPC) for the inverter logic. The Kalman filter will be employed for noise reduction in the sensors that measure solar irradiance and temperature, thus providing "clean" information to the ANN for precise tracking. At the same time, the MPC will be responsible for controlling the inverter to facilitate smooth synchronization

International Journal of Engineering Applied Sciences and Technology, 2026
Vol. 11, Issue 01, ISSN No. 2455-2143, Pages 01-07
Published Online May 2026 in IJEAST (http://www.ijeast.com)

of the power with the grid. The results demonstrate that the multi-layered intelligent methodology can minimize the losses in the conversion process by 8% compared to the conventional ANN systems. This paper is a breakthrough in the field for the integration of signal processing with machine learning for hardware optimization.

[16] S. Kim et al. (2025)In the present paper, the focus is on ANN-based DC bus voltage regulation in renewable-based microgrands. This paper aims at solving the important problem of voltage "sags" and "swells" that take place during the starting or stopping of high-power charging of an EV. It is clearly proved that the ANN controller maintains a stable DC bus voltage with considerably less oscillations. It is clearly mentioned by the authors that although training is necessary, the proposed controller is far more robust against the non-linear behavior of power electronics devices.

[17] Y. Liu et al. (2025)The authors have used "Deep Reinforcement Learning" to implement an optimal schedule for EV charging in smart grids. The paper extends the horizon of power management to "fleet-level" optimization, wherein the power management controller handles multiple chargers at a time. The DRL agent is used to optimize the schedule with the aim of minimizing the total electricity cost incurred by the station owner while ensuring that all EVs are fully charged before their departure time. The implementation is complicated, but the authors have achieved an improved efficiency of 20% over traditional algorithms used in priority-based scheduling.

[18] Y. Chen et al. (2026) In the study published in 2026, the CNN-BiLSTM (Bidirectional LSTM) intelligent system for the management of PV-battery EV charging stations was introduced. The bidirectional LSTM allows the system to consider both the historical trends and the predicted trends of the energy availability for the real-time balancing. The system can thus account for the unforeseen drop in solar power availability resulting from the movement of clouds. The study proves the efficacy of the BiLSTM system in the management of the state of charge of the battery, thus doubling the expected lifespan of the storage units.

[19] H. Zhao et al. (2026) The research is focused on hybrid energy storage management, particularly for EV charging microgrids, using deep learning techniques. The author proposes a controller named "Deep-HESS" that uses deep neural networks to autonomously decide how much power is supplied by the battery and how much is supplied by the supercapacitor. The main contribution of this research is that it integrates a 'thermal-aware' controller, in which the neural network monitors the temperature of the supercapacitor as well as the battery cells, ensuring that there is no overheating during fast charging. The research demonstrates that this intelligent controller increases the reliability of the charging station by 12% in high-temperature environments.

[20] X. Wang et al. (2026)This final paper will discuss the Vehicle-to-Grid (V2G) enabled intelligent EV charging system using AI in the management of energy. The research will focus on the V2G technology's ability to harness energy from the grid during peak demand and how the AI manager controls thousands of V2G-enabled vehicles in the grid. This is the "Future Research Direction" of the subject, where ANN controllers, deep learning, and V2G converge into a single entity..

IV. METHODOLOGY

The methodology employed in the present work is based on modeling and analysis of a Solar Photovoltaic (PV) based Electric Vehicle (EV) charging station with a Hybrid Energy Storage System (HESS) consisting of a battery and a supercapacitor. The main aim of the proposed methodology is to regulate the DC bus voltage, ensure the charging of the electric vehicle, and optimize the power flow from the PV system, the HESS, and the electric vehicle using the ANN based control technique.

The proposed system operates within a DC microgrid architecture where solar PV acts as the primary renewable energy source while the hybrid storage system compensates for fluctuations caused by variable solar irradiance and dynamic EV charging demand.

4.1 Photovoltaic System Modeling

The power generated by the photovoltaic array depends on solar irradiance and temperature. The output power of the PV system is given by

$$\mathrm{Ppv} = \mathrm{Vpv} \times \mathrm{Ipv}$$

where

- Ppv represents the PV output power
- Vpv represents PV voltage
- Ipv represents PV current

The nonlinear current–voltage characteristic of the PV module is represented using the single-diode model:

$$\mathrm{Ipv} = \mathrm{Iph} - \mathrm{Io}(\mathrm{enkTq}(\mathrm{Vpv} + \mathrm{IpvRs}) - 1) - \mathrm{RshVpv} + \mathrm{IpvRs}$$

This mathematical model is used to simulate the dynamic behavior of the PV system under varying irradiance conditions.

4.2 Power Balance of the EV Charging System

The overall energy balance of the EV charging station can be expressed as

$$\mathrm{Ppv} + \mathrm{Phess} = \mathrm{Pev} + \mathrm{Ploss}$$

Where

- Ppv is the solar PV power
- Phess is the hybrid energy storage power
- Pev represents EV charging demand
- Ploss represents system losses

This equation ensures that the energy supplied by the PV system and storage units is sufficient to meet the EV charging demand.

4.3 ANN-Based Control Strategy

An Artificial Neural Network based controller is implemented to manage the power flow within the system. The ANN controller receives system parameters such as PV voltage, PV current, battery state of charge, DC bus voltage, and EV load demand as inputs.

The control function of the ANN can be represented as

$$u = f(Vpv, Ipv, SOC, Vdc, Pev)$$

where

- u represents the control signal for power converters
- f(·) represents the nonlinear mapping learned by the ANN

The ANN is trained using historical operating data to learn the nonlinear relationships between system variables. Once trained, the ANN controller dynamically allocates power between the battery and supercapacitor, ensuring stable system operation and improved energy efficiency.

V. CONCLUSION

The growth of vehicles has increased the need for reliable and sustainable charging infrastructure. Solar powered EV charging stations are good for the environment; however their performance is limited by the nature of solar energy. Hybrid Energy Storage Systems that combine batteries and supercapacitors have become a solution to reduce power fluctuations and maintain system stability.

This review looked at the evolution of control strategies used in powered EV charging stations from 2014 to 2026.Early research focused on simple control approaches like PI controllers and rule-based power management systems. These methods worked okay under conditions but could not handle complex changes, rapid load changes and changing solar energy.

The solar energy and load demand keep changing. Recent studies show that smart control techniques, those using Artificial Neural Networks improve system performance. ANN controllers can learn relationships between system variables like solar energy, battery level and load demand. As a result, they offer response, improved voltage stability and better power sharing between battery and supercapacitor components. The battery and supercapacitor work together. Techniques like reinforcement learning CNN-LSTM forecasting and deep neural network-based energy management systems have improved EV charging microgrids. New technologies like Vehicle-to-Grid integration and learning based thermal management will play a key role in the next generation of intelligent charging infrastructure.

The Vehicle-to-Grid integration is very important. Overall, the findings of this review highlight that moving from PI-based control strategies to ANN-based energy management systems is essential, for improving the efficiency, reliability and scalability of renewable EV charging stations. Future research should focus on real-time implementation, large-scale EV fleet integration and advanced optimization algorithms to further enhance the performance of energy storage systems in smart charging networks. The future of EV charging stations is very bright.

VI. REFERENCES

[1]. H. Mahmood, D. Michaelson, and J. Jiang, "A power management strategy for PV/battery hybrid systems in islanded microgrids," IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 2, no. 4, pp. 870–882, Dec. 2014.

[2]. Z. Yi, W. Dong, and A. Etemadi, "A unified control and power management scheme for PV-battery-based hybrid microgrids for EV charging," IEEE Transactions on Smart Grid, vol. 9, no. 2, pp. 1243–1254, 2018.

[3]. M. O. Badawy and Y. Sozer, "Power flow management of a grid-tied PV-battery system for electric vehicle charging," IEEE Transactions on Industry Applications, vol. 53, no. 2, pp. 1347–1357, 2017.

[4]. M. Ghofrani, A. Arabali, M. Etezadi-Amoli, and M. Fadali, "Optimal charging/discharging of grid-enabled electric vehicles for predictability enhancement of PV generation," Energy, vol. 87, pp. 584–597, 2015.

[5]. M. Jha, F. Blaabjerg, M. A. Khan, and A. Haque, "Intelligent control of converter for electric vehicles charging station," Energies, vol. 12, no. 12, p. 2334, 2019.

[6]. T. S. Biya and M. R. Sindhu, "Design and power management of solar-powered electric vehicle charging station with energy storage system," IEEE ICECA Conference, pp. 815–820, 2019.

[7]. R. Deshmukh and M. Ballal, "Adaptive power management in DC microgrids with hybrid energy storage," IEEE Transactions on Industrial Informatics, vol. 16, no. 5, pp. 3195–3204, 2020.

[8]. A. Amin et al., "A review of optimal charging strategies for electric vehicles under dynamic pricing," Renewable and Sustainable Energy Reviews, vol. 120, 2020.

[9]. A. P. Singh and Y. Kumar, "Artificial neural network based intelligent power management for renewable EV charging stations," IEEE International Conference on Power Electronics, 2022.

[10]. H. Zhang et al., "Reinforcement learning-based energy management for EV charging microgrids," IEEE Access, vol. 12, pp. 115234–115246, 2024.

[11]. A. El-Banna et al., "Real-time power management for grid-connected PV-EV charging stations using

model predictive control," Results in Engineering, vol. 22, 2024.

[12]. R. Rajanna et al., "PV-battery microgrid architecture for EV charging stations with optimized energy management," International Journal of Power Electronics and Drive Systems, vol. 7, no. 3, pp. 701–709, 2016.

[13]. L. Chen et al., "Hybrid CNN-LSTM deep learning framework for EV charging demand forecasting," Applied Energy, vol. 341, 2024.

[14]. S. Vendoti et al., "Grid-tied hybrid PV-fuel cell energy system with ANFIS-based MPPT for EV charging infrastructure," Scientific Reports, vol. 15, 2025.

[15]. A. Kumar et al., "ANN-Kalman filter based MPPT with MPC inverter control for solar EV charging stations," Sustainable Energy Technologies and Assessments, 2025.

[16]. S. Kim et al., "Artificial neural network-based DC bus voltage regulation for renewable microgrids," Energy Reports, vol. 11, 2025.

[17]. Y. Liu et al., "Deep reinforcement learning for optimal EV charging scheduling in smart grids," Applied Energy, vol. 356, 2025.

[18]. Y. Chen et al., "CNN-BiLSTM based intelligent energy management system for PV-battery EV charging stations," Energy, 2026.

[19]. H. Zhao et al., "Deep learning-based hybrid energy storage management for EV charging microgrids," Renewable Energy, vol. 226, 2026.

[20]. X. Wang et al., "Vehicle-to-Grid enabled intelligent EV charging system using AI-driven energy management," IEEE Transactions on Smart Grid, 2026.

[21]. Nirmalkar, M. K., Dewangan, M. K., & Dubey, M. (2018, May). Makeup of single stage grid connected buck boost photovoltaic inverter for living purpose. *International Research Journal of Engineering and Technology (IRJET)*, 5(5), 4192–4197. e-ISSN: 2395-0056, p-ISSN: 2395-0072.

[22]. Nirmalkar, M. K., Dewangan, M. K., & Dubey, M. (2018, May). Layout of single stage grid connected buck boost photovoltaic inverter for domicile utilization. *International Journal for Scientific Research & Development (IJSRD)*, 6(3), 978–982. ISSN: 2321-0613.

[23]. Kumar, M., Dewangan, M. K., & Dubey, M. (2021, March-April). A review on modeling and analysis of multi stage with multi phase DC-DC boost converter. *International Journal of Trend in Scientific Research and Development (IJTSRD)*, 5(3). e-ISSN: 2456-6470.

[24]. Kumar, M., Dewangan, M. K., & Dubey, M. (2021, March). Implementation on modeling and analysis of multi stage with multi phase DC-DC boost converter. *International Journal of Advance Research and Innovation*, 9(1), 15–19. ISSN: 2347-3258.

[25]. Dewangan, A., Mishra, S., & Dewangan, M. K. (2021, May-July). A review paper on modelling and simulation of MPPT based PV system with SPWM controlled three phase three level diode clamped inverter. *I Manager-Journal on Power Systems Engineering*, 9(2). ISSN: 2321-7499, e-ISSN: 2322-0376.

[26]. Painkra, G., & Dewangan, M. K. (2022). Electric vehicle cooling system: A review. *GIS Science Journal*, 9(4), 904. ISSN: 1869-9391.

[27]. Painkra, G., & Dewangan, M. K. (2022). Electric vehicle cooling system. *Journal of Electronics Information Technology Science and Management*, 12(12), 135. ISSN: 0258-7982.

[28]. Dwivedi, A., Dewangan, M. K., & Dubey, M. (2023, March). Solar based electric vehicle charging station: A review. *GIS Science Journal*, 10(3), 502. ISSN: 1869-9391.

[29]. Dwivedi, A., Dewangan, M. K., & Dubey, M. (2023). DC-DC interleaved converter solar based electric vehicle charging station. *GIS Science Journal*, 10(8), 168. ISSN: 1869-9391.

[30]. Kumar, K., Dewangan, M. K., & Dubey, M. (2024, May). A review of intelligent high density isolated DC-DC converter with improved efficiency for solar based EV system using ANN. *JETIR*, 11(5), 686–692. ISSN: 2349-5162.

[31]. Kumar, B., Dewangan, M. K., & Dubey, M. (2024, May). Power quality improvement in a solar based electric vehicles charging station using closed loop control system: A review. *JETIR*, 11(5), 60–67. ISSN: 2349-5162.

[32]. Kumar, B., Dewangan, M. K., & Dubey, M. (2024, August). Enhancing power quality in solar powered electric vehicles charging stations with closed loop control. *GIS Science Journal*, 11(8), 282. ISSN: 1869-9391.

[33]. Pandey, P. P., Verma, S., & Dewangan, M. K. (2025, September).Adaptive control algorithm for grid supportive solar PV power generating system. **International Journal of Science and Engineering,11**(2), ISSN: 2456-2016

[34]. Pandey, P. P., Verma, S., & Dewangan, M. K. (2025). Intelligent control of grid-connected solar PV systems using adaptive algorithms: A review. **The IUP Journal of Electrical & Electronics Engineering, 18**(4), October–December. ISSN: 2583-519X.

IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

ABOUT IJEAST

International Journal of Engineering Applied Science and Technology (IJEAST) is a peer-reviewed, open access journal that publishes high-quality research papers in the field of Engineering, Applied Science and Technology.

IJEAST aims to provide a platform for researchers, academicians, and professionals to share their innovative ideas, research findings, and practical experiences with the global scientific community.

FOCUS AREAS

- Engineering
- Applied Science
- Technology
- Innovation & Development
- Interdisciplinary Studies

PEER REVIEWED
All submissions are rigorously peer reviewed to ensure quality.

OPEN ACCESS
Free and unrestricted access to research for all.

GLOBAL REACH
Connecting researchers and professionals worldwide.

TIMELY PUBLICATION
We ensure a swift and efficient publication process.

For more information, visit our website
www.ijeast.com

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

editor@ijeast.com
www.ijeast.com
India

2455-2143