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Development and Analysis of a NN-Based Controller for Enhancing Power Quality in EV Charging Station

N. Bindu Madhavi[1], Y. Vanitha[2], A. Thanuja[3], M. Yaswanth Akhil[4], J. Viswanath[5], S. Rupa[6]
Assistant Professor, Department of Electrical and Electronics Engineering[1]
UG student, Department of Electrical and Electronics Engineering[123456]
Siddharth Institute of Engineering & Technology, Puttur, India
yarramreddyvanitha@gmail.com , akulatnuja25@gmail.com, yaswanthakhil83@gmail.com,
Janneviswanath969@gmail.com, sivanadhamrupa@gmil.com

Abstract: *This paper presents development and analysis of a Neural Network (NN) controller for a PV-based Electric Vehicle charging station aimed at improving power quality. The charging station (CS) operates in grid-connected and standalone modes, incorporating bidirectional power flow to support both G2V and V2G operations. Replacing the conventional PI controller with an NN controller enhances system adaptability and dynamic response under varying grid and PV conditions. The NN controller is trained to optimize voltage regulation, reactive power compensation, and harmonic current mitigation, ensuring compliance with IEEE-519 standards for Total Harmonic Distortion (THD). Simulation results validate the proposed control strategy, demonstrating reduced THD, faster response to transient events, and improved charging/discharging efficiency. This innovative approach advances an integration of electric vehicle charging infrastructure with renewable energy systems, promoting sustainable energy solutions while maintaining robust grid interaction*

Keywords: Photovoltaic System, Grid, Power Quality, Electric Vehicle Charging Station, Battery, Voltage Source Converter, Neural Network Controller