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Design and Implementation of Novel DVR Configuration for Electric Vehicles Charging Application

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Abstract

In today's world, conventional vehicles are replaced by electric vehicles due to their eco-friendly operation and reduced maintenance. Though the EVs are better than the conventional vehicles, the charging stations for EVs are very few, and there are many power quality issues that have been arising in these charging stations. This is due to voltage, current, or frequencies are abnormal which leads to sudden voltage drops, voltage swells, long interruptions, and short interruptions that occur in the charging stations. Conventional FACTS devices are attached closer to the load end to overcome problems caused by client-side anomalies. One such dependable custom power gadget for dealing with voltage sag is the developed in this article and it is called enhanced dynamic voltage restorer (DVR). The proposed device continuously monitor the load voltage waveform and inject (or absorb) the balance (or surplus) voltage into (or away from) the load voltage whenever a sag occurs. A reference voltage waveform is developed to achieve the aforementioned capabilities. In this paper, the methods of compensation for these problems in charging stations are discussed. Further the power quality problems are compensated by the proposed system using a SVPWM controller. Simulation and real time implementation is carried out and the results discussed are here.

1.Block Diagram of Dynamic Voltage Restorer

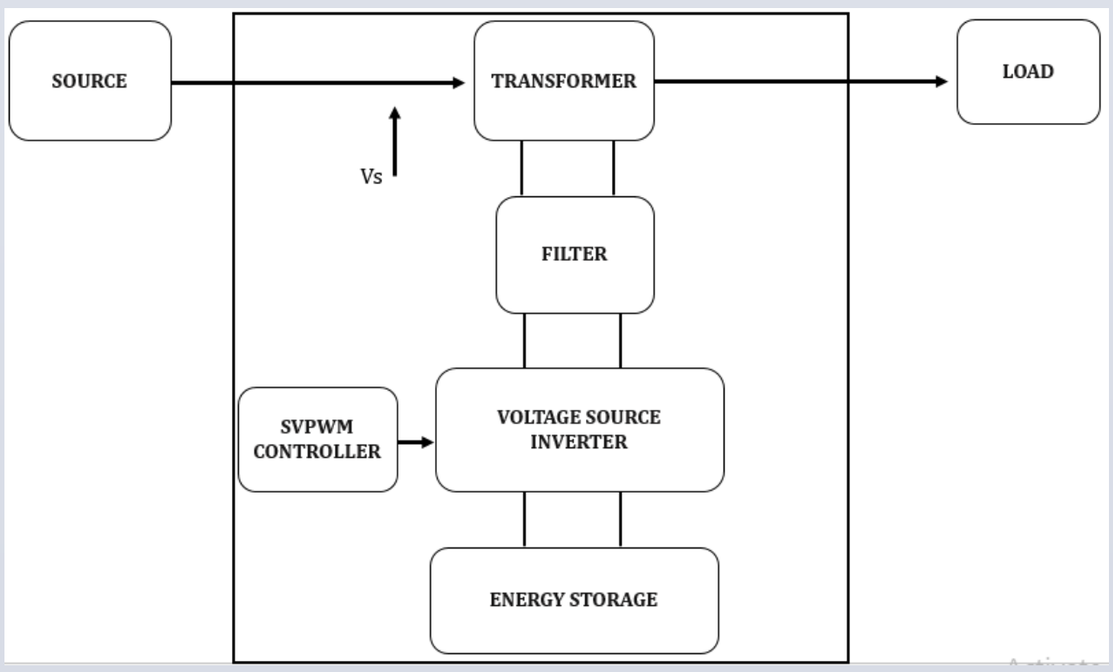


Fig. 1. Block Diagram

2. Simulation and Experimentation of DVR

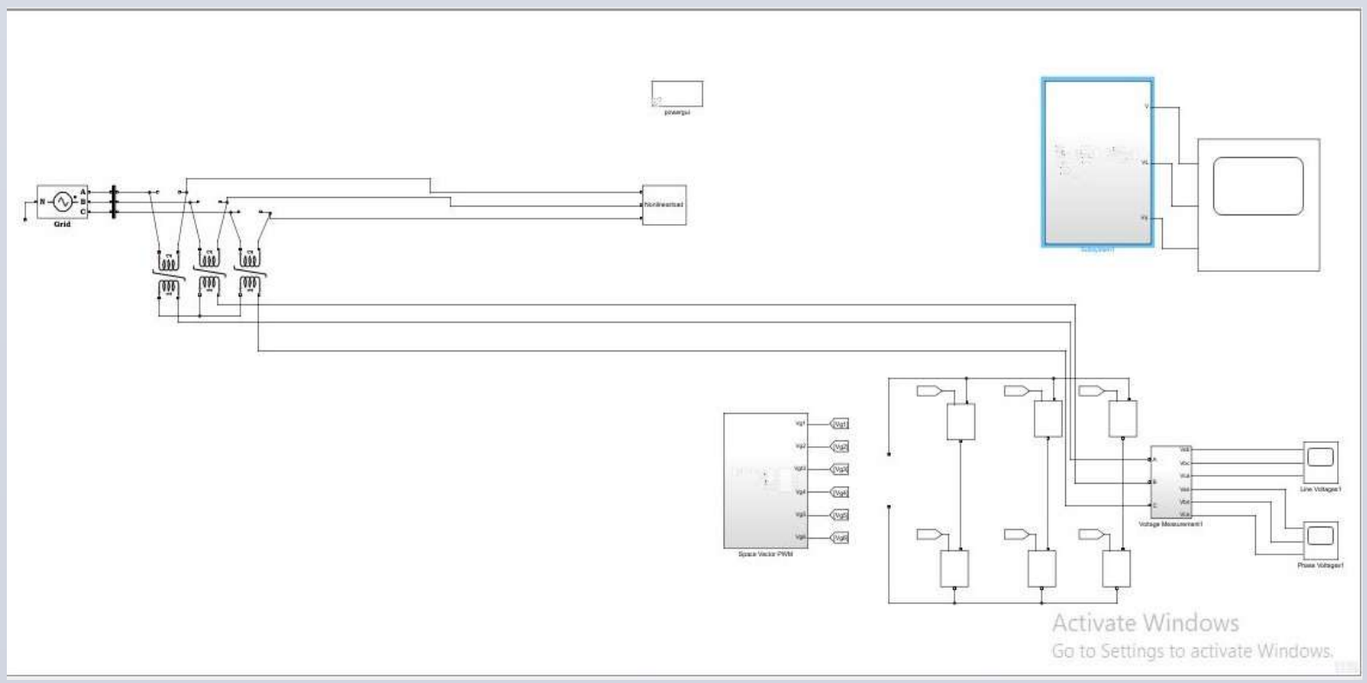


Fig. 2. Simulation Model of DVR

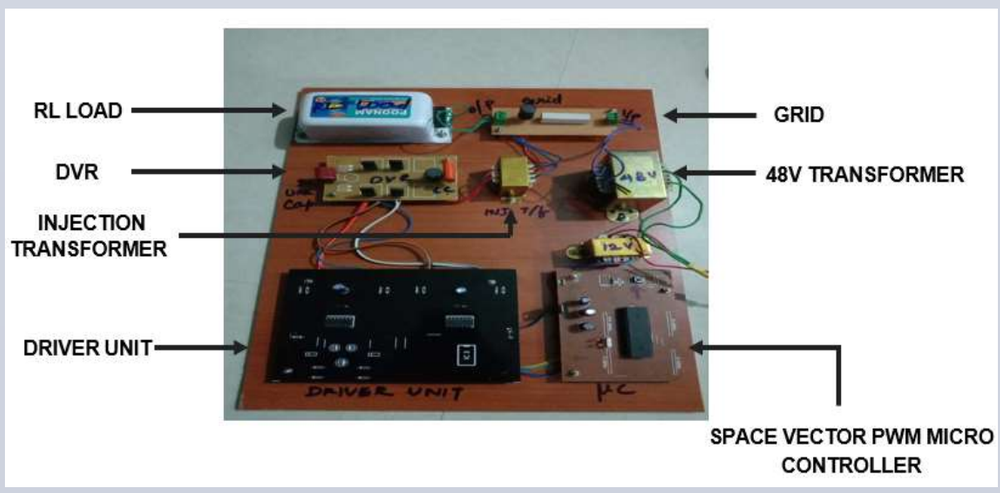
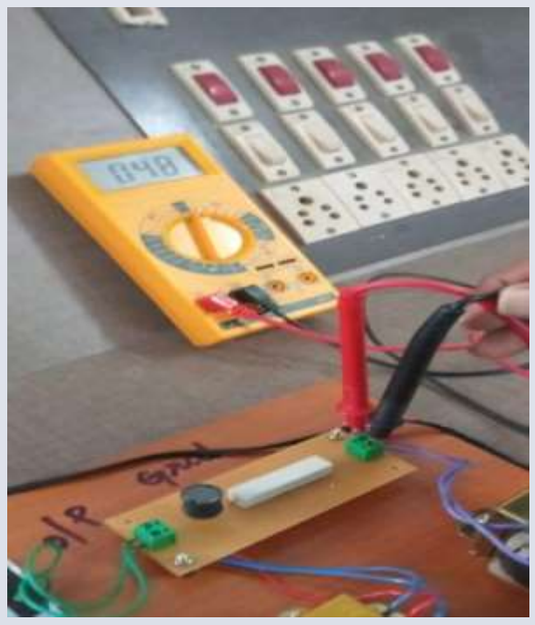
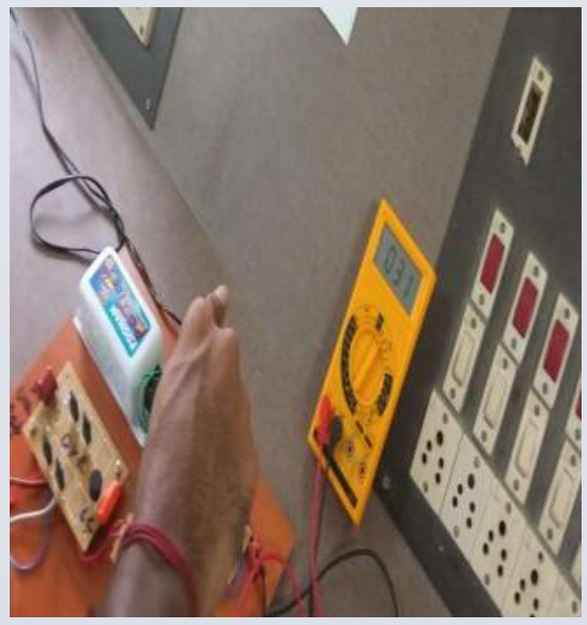
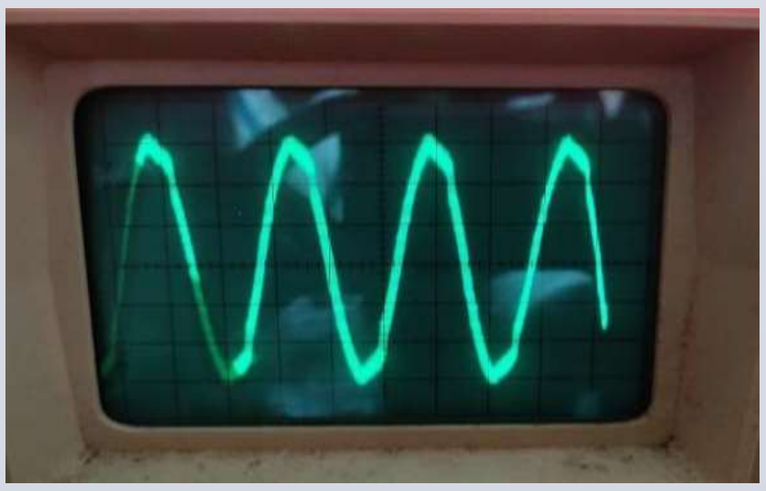


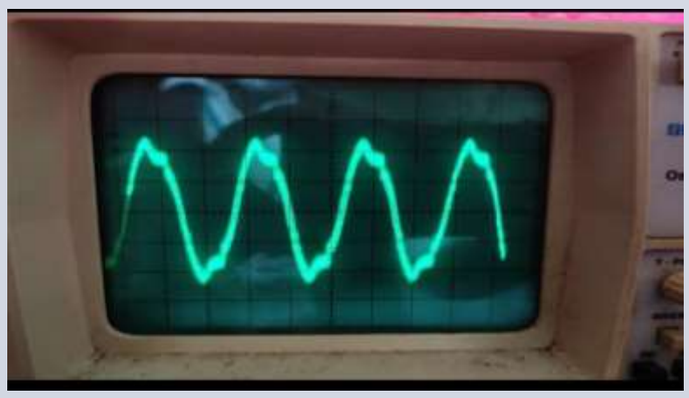
Fig. 3. Hardware Model of DVR



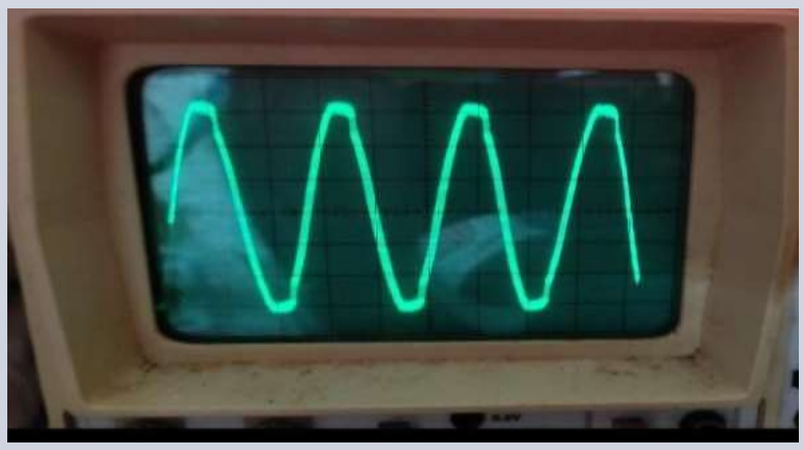




INPUT VOLTAGE 48V



VOLTAGE SAG 30V



COMPENSATED VOLTAGE 46V

Conclusion

The enhanced DVR ensures continuous operation of EV charging stations by effectively mitigating voltage sags and disturbances, thereby safeguarding sensitive equipment and enhancing system reliability. The integration of an SVPWM controller improves the dynamic response and precision of the compensation process, resulting in better voltage regulation and stability. Simulation and real-time implementation results validate the system's reliability, demonstrating improved efficiency and reduced Total Harmonic Distortion (THD). Additionally, the proposed DVR configuration is scalable and adaptable, making it suitable for future EV charging infrastructure demands while contributing to prolonged equipment lifespan and improved power quality.