Enhancement of Energy Management System In EV Fast Charging Stations Fed MicroGrid Using DVR

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Abstract. Electric charging vehicle (EV's) battery packs are indeed a possible source of energy conservation for micro grids. Battery-powered automobiles may be able to assist micro-grids with saving energy by storing excess the grid electricity for the purpose of the electrical vehicle and restoring it to network when needed. Because EV technology is progressing quickly and cost of batteries are falling, the inclination for electric mobility has indeed been rising. The lengthy battery charge controller becomes a problem as a result. Incredibly quickly stations are being designed to address this issue. The issue of lengthy rechargeable batteries has been resolved by quick charging stations, however this adds to the microgrid's strain. This study presents a control method for such a Micro grid that includes distributed power generation with electric drive incredibly quickly stations. This paper primary objective is to decrease voltage droop & swelling problems by employing an electric vehicle's batteries as just a dc supply for such a Dynamic Voltage Restorer (DVR) device. The outcomes of simulations in MATLAB/SIMULINK show that the proposed electric vehicle to grid method can enhance power quality by reducing voltages swell and sagging.

Keywords: Electric vehicle, Fast charging stations, Dynamic voltage restorer (DVR), Microgrid , Distributed generation, Vehicle-to-grid.

1 Introduction

In [1-2] Fast-charging out stations have been set up to assist with issues like range concern and lengthy charging times, which are typical with battery technology vehicles (EVs).

In [3] The use of electric cars has grown quickly in the last ten years, increasing by 63 percentage out over preceding year. The automation of the automotive industry also presents a challenge towards the functioning of power grids since EVs increase alike total energy usage and maximum load requirement. Electric cars (EVs) are becoming more popular, which may have a significant influence on the electrical network.

At [4-5], it is stated that frequent EV charging upon that utility grid, which also lowers voltage stability, puts the energy system's dependability in jeopardy. When such EV's rechargeable battery pack matches with both the utilities network's full capacity, the effect of the load charging will also be conspicuous.

In addition, power dissipation and voltage instability brought about by EVCSs' nonlinear properties have an impact on electricity quality. As domestic level DC EV quick chargers is connected to utility grid, these problems are even more problematic [6].

The usage of electric motor rapid charging infrastructure in microgrid situations using distributed energy resources has lately become popular as a way to reduce the detrimental consequences of the issues associated. GarcaTrivio et al. [7] designed a dispersed control system for a networking microgrid that includes two EVFCS's, Solar pannel pairs, and maybe a Storage technology network in order to preserve the power flow Dc side voltage and the storing state of charging (SOC) within specified limits.

Even before surplus electricity becomes available, this same battery may be charged using simple algorithms [8] or individual objectives could be targeted while also still trying to meet EV requirement, like lowering energy consumption [9,10,11], limiting the effects upon that grid [12,13,14], but instead minimizing waste just at mechanism or utility level [15,16].

An strategy for managing energy for distributed generation including an EV parking garage, PV arrays, and live load makes use of PV productivity and loading demand estimates in order to maximize both charging and recharging properties of powered mobility. Another management and planning technique regarding both charging and discharging Electrical vehicles been suggested in order to make it easier to integrate a substantial percentage of EVs into a microgrid. A V2G programming schedule while grid integration [17,21] proposed a strategy that utilized frequency control for the objective of protecting and conserving EV batteries.

By using a Z-source converter and hysteresis modulating mode to improve the network efficiency, the suggested approach is novel. Additionally, the variable frequency harmonics filter receives assistance in this system to enhance system reliability [18].

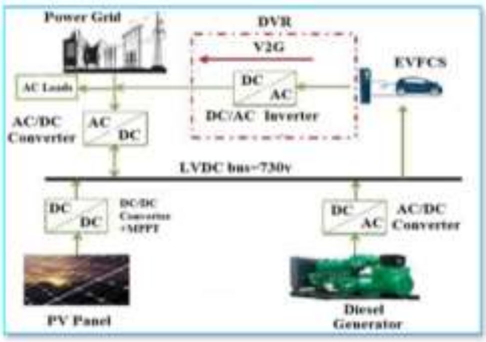
Using [19] IOT technology , among the most advanced in recent years is indeed a key factor in the fundamental change from traditional practices. Innovation has improved human existence simpler in [20] but also offers comprehensive protection with dependability wherever it is wanted. Among the most important components of the IOT devices innovation is the communication system of two embedded systems [21] [22].

2 System Description

Microgrids contain distribution network including both DC and alternating-current power. There are many levels of transmitting and dispersion. The node of knowledge and facts serves as a link seen between distribution grid & main grid. In this assessment, a DC microgrid being taken into account because it offers benefits for EVFCS across an AC microgrid, primarily in terms of raising the general grid's maximum performance despite growing the scale factor. For AC/DC or DC/AC transformations, power converters need essential grid elements [23].

Because wind direction is less precise when comparison to Photo voltaic system, Renewable sources provide more possibilities for EVFCS incorporation. A diesel engine is also connected to the Photovoltaic system to supply the PV with the assistance it requires at various times. The Photovoltaic panel is an economical method for storing energy, doing away with the need for system accounting.

Fig.1. Schematic Structure of the Proposed System.



This research explored a low power DC micro-grid with distribution generators that are linked with the EVFCS, as furnished in above Fig.1. The envisioned system using such a network of photovoltaic arrays operating under ideal circumstances (1000W/m2 Intensity, 25°C temp), a EV set, for networking power to deliver the associated electric vehicle towards the EVFCS.

Table 1 . EV Fast charging Input Parameters

Parameter	Values	Parameter	Values
P_{pv}	170 kW	X/R ratio	7
P_{diesel}	130 KW	Pb	103.8
V_b	480 V	Battery capacity	100 Ah
V_{grid}	400 V	Battery initial SOC	60%
f_{grid}	50 Hz	Battery response time	1e-3 Sec

The proposed control variables are displayed in Table 1 creates precise illustrations of photovoltaic modules systems and diesel type generators. A convertible DC/DC inverter topology is used in the developed framework to communicate the EVFCS towards the DC bus as well as a DC to DC conversion to link the PV chain to that same Dc link. The diesel car, the electricity system, and other individually controlled applications are all connected to the DC-linked converter (AC to DC). The inbuilt both current & voltages looped PI controller generates pulse width modulated signals that operate the converters different ways depending upon that network infrastructure. It is important to emphasise that the suggested model definition uses both PWM and PI modulation. Any improved methodology of inverter-based microgrid model prediction control, for instance, can be simply used for multiple reasons because it is among the most widely used control approaches.

3 Control topology

A federated control scheme is taken into account in this suggested system so that each rechargeable battery component operates separately from the rest of the infrastructure. As a result, each element is managed by controllers built on PI systems designed for grid with diesel generator conversions. This control method is preferred because it makes adding new components to the EVFCSs simple and without disrupting some other infrastructure.

The primary function of a voltage regulator in something like a Photovoltaic is to control the end voltage across the solar panels in order to monitor the PV array's ultimate power peak. PI regulation is not required. Assuming that PV operates at its maximum power point (MPPT). The main goals of this decentralization are to maintain the low voltage DC profile within such a recommended ranges and guarantee the EVFCS power relationship. The outputs of the Photovoltaic system, the diesel engine, as well as the required voltage network are used to operate the LVDC bus.

a) Inverter control

To ensure stable Dc link voltage and sources and demand power relationship, many control mechanisms are employed. As a bid to keep the system's power relationship and transmit electricity in between community and the system, the Voltage regulation is changed to a major subject when power generation or load profiling change. Therefore in proposed model, the D - q 's model is taken into account with three PI controllers. It has one outer control loop as well as two current looping. The diesel voltage is modified and the system is synced. with the aid of a phase-locked loop (PLL).

The developed scheme controls the operating AC even though a closed loop network governs the Dc link voltage using a d-axis exterior loop. Switching off the amount of reactive power. The outgoing voltage V_d as well as an Alternating current source the input voltage are used by the PLL mechanism. Frequencies signals are acquired and put to use in the framing inverter. The proportionality and cumulative by experimentation and error. Variables of 0.5 and 200 were obtained for the regulator by experimenting with it.

b) Battery charger control

Battery charger controlling has been developed as indicated in fig. Storage, converter and controllers make up the charge system's three basic parts. The Proportional intigral controller make up the control network, as well as the DC/DC converter's IGBTs are pulsed by pulse width generator

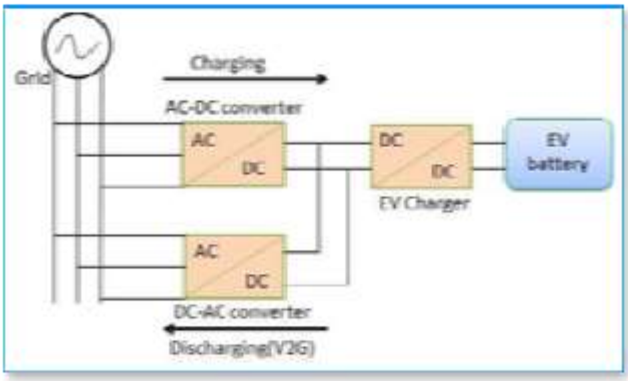


Fig.2. Battery charger control

4 Proposed Topology

Grid stability is significantly increased by an Electric vehicle with vehicle to grid because it could be used for peak shaving or trough dipping. As a DC power supply, an electric car battery in V2G modes may also be used. In the DVR device, add a source to improve power quality. The Fig.3 says an AC-DC converter shows how charge and discharge being segregated so that rates can be changed as needed. This system incorporates two AC to DC transformations as well as a bidirectional DC-DC converter to replace the normal connections.

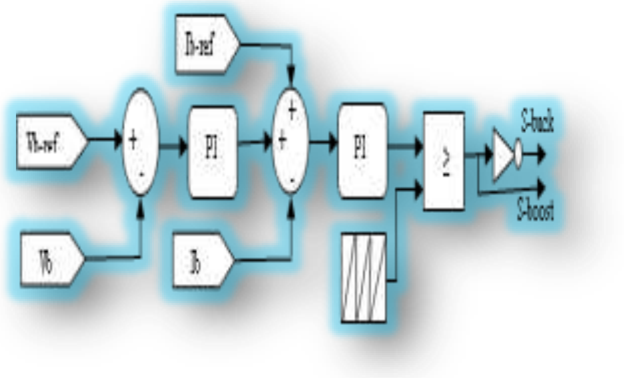
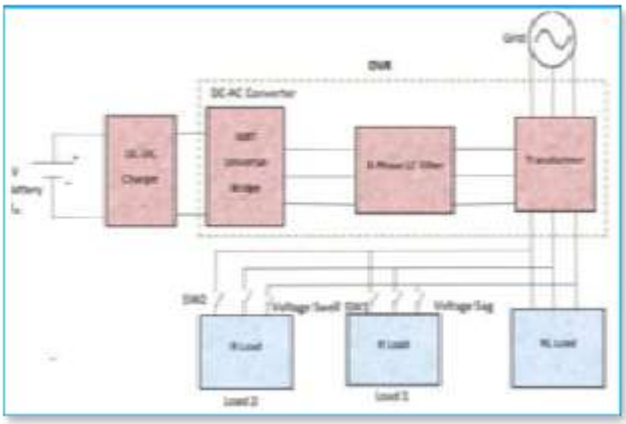


Fig.3. Proposed diagram of gas level monitoring and booking

Fig.4. DVR controller link between electric battery & three phase loads



To solve issues with system reliability in distribution systems, also including voltage instability, voltage spikes, and distortions, DVR is a parallel connected device. DVR is composed of four fundamental parts, as shown in Fig.4 a voltage source converter (VSI), an LC filters, a controller, and a Dc power supply.

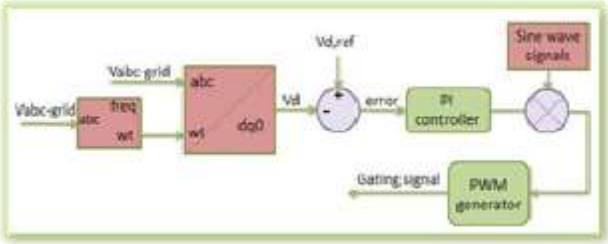


Fig.5. PI Controler scheme designed for the DVR

Therefore in this proposed paper states a Dc power supply includes such DVR & it is advised to use the Control signal shown in Fig. 5 to monitor the necessary voltage level at the common reference point for the delicate loads which are going to connect when network disruptions occurs. So, DVR as well as PI controller is designed processes were taken directly from and Table 2 displays the model parameters that were reached.

Table 2. DVR Specifications

Parameters	Ranges used	Parameters	Ranges used
Resistor with filter	0.66 ohms	Resistance of inverter	1 milli Ω
Capacitor with filter	8.2 μicro Farads	PI (Kp)	0.0251 Const
Inductor with filter	0.0072 Henry	PI (Ki)	0.000252 Const

5 Simulation Results

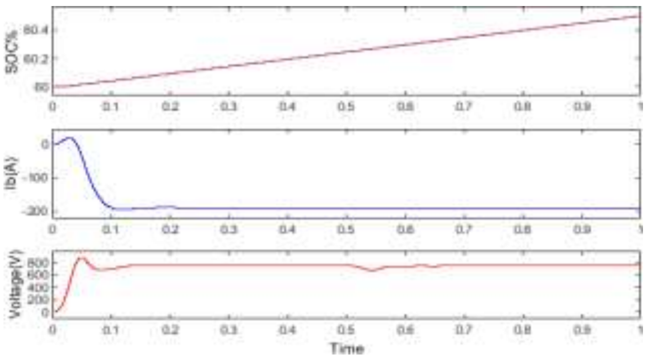


Fig.6. State of Charging , Current in EV battery & DC bus voltage

As shown in Fig. 6, three separate charging devices are used to produce the requisite bus voltage at 730 V. The electrical vehicles are attached & filled from all of the microgrid's power sources for 0.52 seconds, during which the EVFCS is turned on among 0 and 1 sec. The PV and diesel engines has been shut off between 0.52 sec as well as 1sec, during which time the utility grid supplies electricity to the EV. Different energy sources effects on DC bus voltage are also shown.

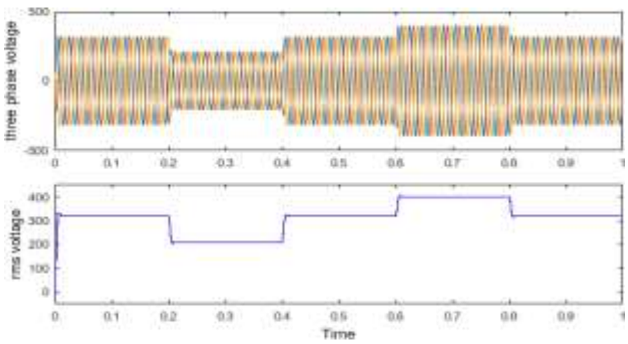


Fig.7 . Three phase load voltage & Load Voltage in RMS

The use of a Batteries in EV as that of the DVR's electrical supply is suggested in order to lessen voltage sag/swell while draining mode. As demonstrated in Fig 7 whenever a 20 kilowatts heavy load (1-Load) has been placed on the network to change switch1, a voltage sag occurs around 0.2 and 0.4 seconds later. The voltage decreases by more than 34.3 percent when measured against the standard RMS value (320 V - 210 V). During the 0.4 sec the switch1 opens and being stayed on for the total time. On the contrary hand, a voltage swell takes place around

0.6 and 0.8 sec when a 20 kilowatts high loads (2-Load) going to switched off with switch 2. The vehicle voltage needs to be raised in such a scenario.

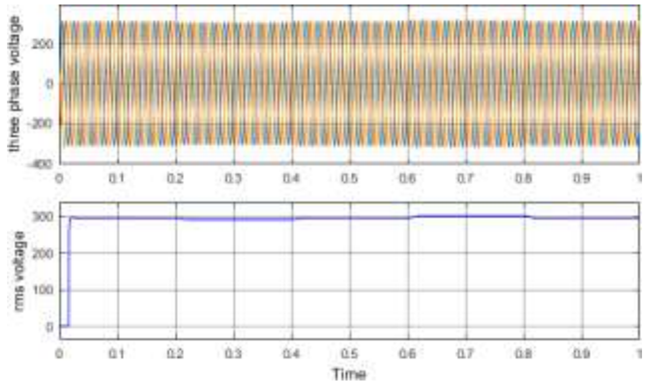


Fig.8. decrement mode of SOC, battery constant current & voltage

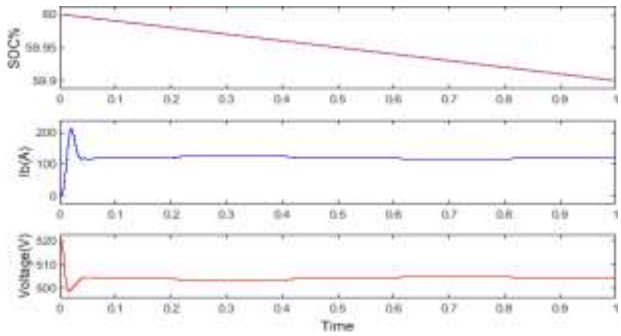


Fig.9. Three phase load voltage & Load Voltage in RMS using DVR

6 Conclusion and Future Scope

In order to reduce dependency on the network and improve system efficiency, this article suggests using a more straightforward decentralised PI control approach with sustainable power for fast charging methods. Control strategies for a contaminated systems are employed to assert control. When two separate network units cooperate, they transform this concept of utilising an storage system also has the potential to produce a Dc power for a DVR gadget. In this paper, the topic of lowering voltage imbalance is covered. The model has been implemented in MATLAB/Simulink with SIM Power Solutions, and the PI control scheme is incorporated with DVR. The postulated V2G is practical, as demonstrated by the study's results from stimulating simulations. Energy reduction, power droop and swelling issues can be effectively overcome using technologies to new standard. Future evaluations will assess the success of the suggested IOT based approach. The technique would be examined in a larger power grid. adding more parts to the system.

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