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TO IMPROVE POWER QUALITY USING PHOTOVOLTAIC CREATED DYNAMIC VOLTAGE RESTORER

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***Abstract*— Photo Voltaic (PV) model, DVR model and local grid model are implemented and the results of reproduction are presented. In order to improve the effectiveness of the PV system Incremental Conductance (INC) algorithm based Maximum Power Point Tracker (MPPT) is connected. The cascaded H-bridge multilevel inverter is used for exchange of real and reactive power to the sensitive load from PV system. Exhibiting of the proposed system was industrialised by MATLAB Simulink. The objective of the proposed system is to study the system behaviour, which allows the renewable energy sources for mitigating voltage disturbances.This exertion explains the built-in photovoltaic based dynamic voltage restorer (DVR) for alleviation of voltage hang down and engorge modification.**

***Index Terms*— PV system, DVR model, Maximum Power Point Tracker, Incremental Conductance (INC) algorithm, local grid model.**

I. INTRODUCTION

The major trouble in power system is voltage wilt and engorge, voltage flicker, transient. DVR is one of the devices that have a similar structure of series type of FACTS device [1]. The significance of this device is to guard a sensitive load from wilt or engorge and deviations in the supply side by quick succession voltage booster to recompense for the fall or grow in the supply voltage [3]. When there is a distortion in the source voltage, the proposed series device may also have to inject a distorted voltage to counteract the harmonic voltage .Among the existing control methods of DVR, the SMC technique has its high simplicity and robustness [4] [5]. A sliding mode input–output linearization controller for the zero-voltage switching (ZVS) is presented [6]. The proposed controller extensively improves the ephemeral response and disturbance, rejection of the converter while preserving the closed-loop stability and SMC utilizes discontinuous control laws to drive the system state trajectory onto a specified surface in the state space, the so called sliding or switching surface, and to keep the system state on this assorted for all the subsequent times. Photo voltaic systems can generate direct current electricity without environmental impact and contamination when exposed to solar radiation [7].

II. RELATED WORK

A. *Power System Modelling*

The proposed power system model comprises PV system, DVR, SMC, energy storage devices and Cascaded (H --- bridge) multilevel converter.

B. *Solar Cell Model*

A general dynamical analysis of I-V output characteristics of Photo voltaic cell was discussed. This equivalent circuit-based model is mainly used for the MPPT technologies. The voltage-current characteristic equation of a solar cell is given as equation (1) Assuming that of the ideal PV cell, the PV array can be described by the following equation.

$$I_{pv} = n_p I_{ph} - n_p I_{rs}\left[\exp\left(\frac{q}{kTA}\frac{v_{dc}}{n_s}\right) - 1\right] \quad (1)$$

$$I_{rs} = I_{rr}\left[\frac{T}{T_r}\right]^3 \exp\left(\frac{qE_G}{kA}\left[\frac{1}{T_r} - \frac{1}{T}\right]\right) \quad (2)$$

Where r T is the cell reference temperature, Irr is thereverse saturation current at Irr T, and G E is the band-gapenergy of a cell. The PV current, ph. I depend on irradiationlevel and the cell temperature as:

$$I_{ph} = 0.01\left[I_{scr} + K_v(T - T_r)\right]S \quad (3)$$

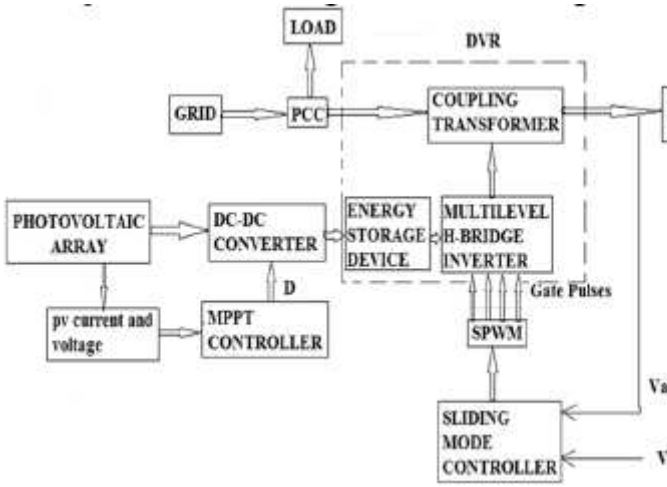


Fig.1 Over all block diagram of PV based DVR for voltage mitigation.

$$P_{pv} = n_p I_{ph} v_{dc} - n_p I_{rs} v_{dc} \left[\exp\left(\frac{q}{kTA} \frac{v_{dc}}{n_s} \right) - 1 \right] \quad (4)$$

Inverter consists of m dissimilar H-bridges having split dcsource is connected to a single phase full bridge or H-bridgeinvertereach inverter level can engender three different voltage outputs, by connecting the dc source to the ac output by different combinations of the four switches S1, S2, S3 and S4. The phase voltage relation of individual bridge is

$$\frac{C}{2} \frac{dv_{dc}^{2}}{dt} = P_{pv} - P_{dc} \quad (5)$$

$$Van = V_1 + V_2 + \ldots + V\left[\frac{(m-1)}{2} - 1 \right] + V\left[\frac{(m-1)}{2} - 1 \right] \quad (6)$$

Being a semiconductor device, the PV system is static,quiet, free of moving parts, and has little operation andmaintenance costs. But due to relatively high initial cost andlow efficiency, maximum power point tracking (MPPT) isessential. Hence many literatures have dealt on MPPT. Forthe effective integration of the solar power into the powersystem, good controlling methods should be developed usingpower electronics devices. In this paper PV power generationsystem is used as energy source for DVR, when disturbanceoccurs and any other disturbance time it will supply power todump loads. It happens through different converter topologies.The concept of a multilevel converter to achieve advancedpower is to use a series of power semiconductor switches withseveral lesser number of voltage dc sources, which is mostsuitable for the proposed system collecting power from PV.

III. PROBLEM STATEMENT

- Boost converter topology is obtained by rearranging the components of a buck converter.
- When the switch is closed energy is transferred to the inductor while the diode is preventing the capacitor to discharge through the switch.
- When the switch opens current through the inductor continues to flow in the same direction as during the previous cycle.
- This forward biases the diode and both the input voltage source and the inductor are transferring energy to the load.
- Hence the voltage boost occurs across the load which causes the output voltage to be higher than the input voltage.

IV. PROPOSED METHOD

A. *Dynamic Voltage Restorer (DVR)*

DVR is the most competent and successful modern custom power device used in power distribution networks. Usually it is installed in a distribution system between the supply and the load feeder at the point of common coupling (PCC). In addition to reducing voltage dip and engorge, DVR can also ensure of ephemeral in voltage, line voltage harmonics mitigation and fault current margins integrated PV based DVR.

B. *Cascaded multilevel converter*

A single phase configuration of an m- level cascaded inverter consists of m dissimilar H-bridges having split dc source is connected to a single phase full bridge or H-bridge inverter .Each inverter level can engender three different voltage outputs, by connecting the dc source to the ac output by different combinations of the four switches S1, S2, S3 and S4. The phase voltage relation of individual bridge is

C. *Energy Storage Devices*

Energy storage unit is dependable for energy storage in DC form, Super-Capacitors, Superconducting Magnetic Energy Storage (SMES), lead acid batteries and Flywheels are generally used as energy storage devices. In proposed model energy generated from PV is stored in SMES and supply to DVR at the time of unavailability of solar irradiation.

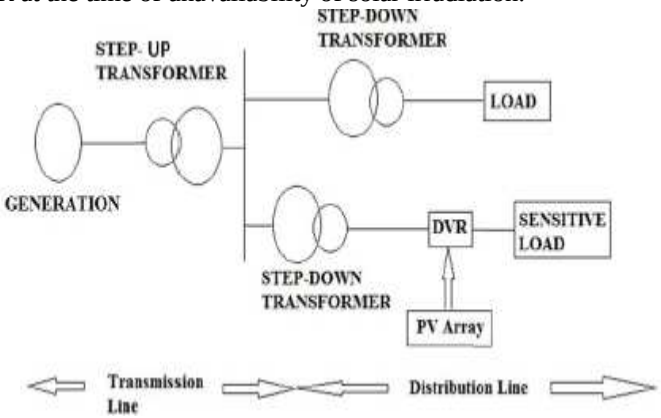


Fig: 2 Integrated PV based DVR.

Depending upon this error signal, the modulating signal is varied which in turn changes the PWM signals obtained. Accordingly, the desired MOSFETS are gated and the necessary voltage is obtained at the inverter output. Fig 6 shows that load voltage before interfaced with DVR. The load voltage after interfaced with DVR. Fig 8 & 9 shows that THD of the proposed system without and with DVR. The inverter output is injected into the distribution lines to compensate for the sag or swell in voltage created.

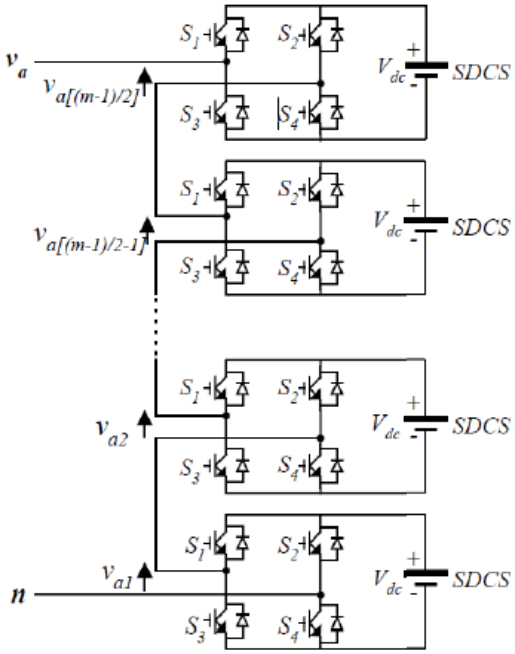


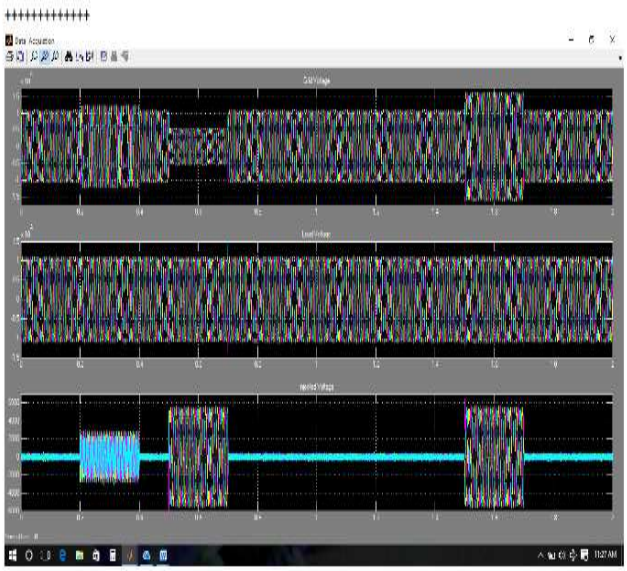
Fig: 3 General Model of Cascaded H-bridge inverter injected

The sensitive load is well within the limits thereby ensuring efficient operation and long life of equipment's. The THD value of before and after compensation as shown in shows that the THD value of load voltage drastically improved.

V. SIMULATION RESULTS AND DISCUSSIONS

Simulation results are given from. Now, the disturbances in voltage are compared with the desired voltage. Based on this comparison, a sag and swell detector provides an error signal to the SMC. This in turn reduces the error signal to as small as a value possible.

A. WAVEFORM



VI. CONCLUSION

Simulation was carried out with PV interfaced multilevel converter based DVR employing sinusoidal PWM technique with MATLAB/SIMULINK software. Many paper worked on voltage mitigation for sag or swell, but in the proposed model both are mitigated whichever required. To further boosts up the operation of a DVR, we suggest a few techniques. In this work, the eminence of voltage in the distribution side was enhanced with the help of DVR, when the disturbance occurs in sensitive load feeder. Although it is a PV with MPPT algorithm incorporating this techniques into a DVR can greatly improve its performance and ensure reliable operation of the sensitive loads. Analysis was carried out to various custom power devices, DVR having excellent compensation for voltage disturbances. As the number of levels in a multilevel inverter increases, we can ensure harmonic free sinusoidal output, but the cost increases as the level increases. However, by means of fuzzy based controller for space vector PWM technique to drive the power switches in an inverter we can get the desired results for non-linear loads.

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