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Grid Connected DC Voltage Control with MPPT by Buck/Boost Converter

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ABSTRACT: The project is about Grid Connected DC voltage Control with MPPT by Buck-Boost Converter. Solar Panel helps to sense both voltage and power ratings and uses MPPT Fuzzy control method for voltage control and regulation by operating both power and current as variables. It calculates temperature i.e., physical signal value. The scheme helps for satisfying the both forward and reverse mode of operation with Buck-Boost process based on the essential DC Voltage Level. Sinusoidal Pulse Width Modulation (SPWM) is used as pulses for inverter work. The switches of Boost Converter are operated in 120* mode of operation to control the short circuit across them. Duty cycle helps to control the current distortion by varying the frequency (in terms of time period) of a generated pulse. It helps to maintain constant voltage in DC Grid. Simulation work is used to verify the outputs. The software used is MATLAB.

KEYWORDS: Solar panel, MPPT Fuzzy control, Buck/Boost Converter

I.INTRODUCTION

In general, PV Modules produce DC voltage and current. AC voltages and current are necessary for feeding the electricity to the grid. To convert DC to AC, inverters are used. PV array is charged at the Maximum Power Point (MPP) near operating point and had done with MPP Tracking Algorithm. If the operating point is not the MPP, not all the possible power is being fed to the grid.To overcome the high voltage level across DC Grid, the solar panel is available as source for generating DC voltage with two components i.e., power and current. Optimization level (MPPT Fuzzy) has been used for control of the technique. For maintaining voltage as constant across DC Grid, the Buck/Boost operation is done. The maximum and minimum voltage level is varied in the source for the entire function of managing the voltage regulation near grid towards the load and vice-versa.

II.MAXIMUM POWER POINT TRACKING

To produce the maximum power from a solar array, MPPT algorithms are proposed. The work for MPP development was started over a decade. Difficulty, efficiency range, junction speed, accurate tracking differ with various techniques of MPPT algorithm. There are different methods to implement the system; among those Fuzzy Logic Control is used. Calculation of MPP based on capacity irradiance & temperature using PV module need *IMPP* and *VMPP* techniques. Its drawbacks are: to produce the required model of PV array and its necessity, sometimes difficult for more readings. The MPP is perfectly tracked under various atmospheric environments.

III. FUZZY LOGIC CONTROL

The apply of fuzzy logic control has happened to be trendy over the last decade because it can compact with imprecise inputs, does not need an exact mathematical form and can switch nonlinearity. Microcontrollers also helped in the popularization of fuzzy logic control. The fuzzy logic consists of three stages: fuzzification, inference system and defuzzification. Fuzzification comprises the process of transforming numerical crisp inputs into linguistic variables based on the degree of membership to certain sets. Membership functions, like the ones in Figure 1, are used to associate a grade to each linguistic term. The number of membership functions used depends on the correctness of the controller, but it usually varies between 5 and 7. In Figure, seven fuzzy levels are used: NB (Negative Big), NM (Negative Medium), NS (Negative Small), ZE (Zero), PS (Positive Small), PM (Positive Medium) and PB (Positive

Big). The values *a*, *b* and *c* are based on the rangevalues of the numerical variable. In some cases the membership functions are taken less symmetric or even optimized for the application for better accuracy.

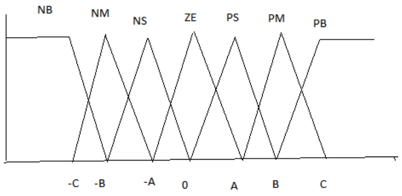

FIG 1: MEMBERSHIP FUCTIONS

The inputs of the fuzzy controller are frequently an error, *E*, and the change in the error, *Del* E. The error can be selected by the designer, but usually it is chosen as *DelP*, *DelV* because it is zero at the MPP. Then *E* and *DelE* are provided as follows:

$$E= P(K)-P(K-1)/V(K)-V(K-1) \qquad (1)$$

$$Del\ E= E(K)-E(K-1) \qquad (2)$$

E\dE	NB	NM	NS	ZE	PS	PM	PB
NB	NB	NB	NB	NB	NM	NS	ZE
NM	NB	NB	NB	NM	NS	ZE	PS
NS	NB	NB	NM	NS	ZE	PS	PM
ZE	NB	NM	NS	ZE	PS	PM	PB
PS	NM	NS	ZE	PS	PM	PB	PB
PM	NS	ZE	PS	PM	PB	PB	PB
PB	ZE	PS	PM	PB	PB	PB	PB

Table 1: Basic Rule

IV.BUCK-BOOST CONVERTER

A single-phase and three phase bidirectional inverter with buck/boost converter, and maximum power point trackers (MPPTs) for dc-distribution applications are provided. In a dc-distribution system, a bidirectional inverter is required to control the power flow between dc bus and ac grid, and to regulate the dc bus to a certain range of voltages, the MPPT topology is formed with buck and boost converters to operate at the dc-bus voltage around 380 V, reducing the voltage stress of its followed inverter.

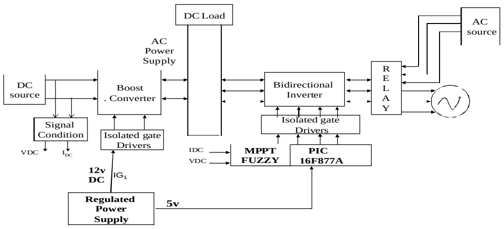

Fig 2: Proposed Block Diagram for the hardware system

V. RESULT AND DISCUSSION

Simulations have done in two different phases that is both single and three phase systems. The following are the two outputs for the simulation in both single and three phase system.

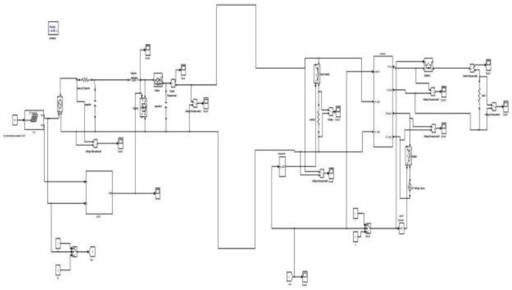

Fig 3: Output Simulation for 1-phase system

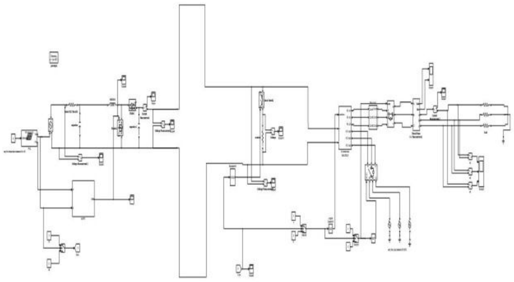

Fig 4: Output Simulation for 3-phase system

V.I.FOR SINGLE PHASE SYSTEM

In this procedure, the temperature changes takes place in between 8 to 40 in terms of voltage. And the voltage across the input source is generated as 23V which is boosted up and maintained the DC grid voltage as 85V as a result. The voltage and current near the load is produced as ±80V and ±8A. The following are the simulation results occurred in Single Phase System.

The following outputs have the axis of Voltage rating and Current as Y-axis and Time period as X-axis.

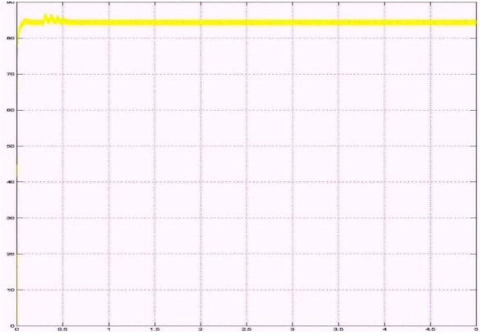

Fig 5: Voltage across DC grid

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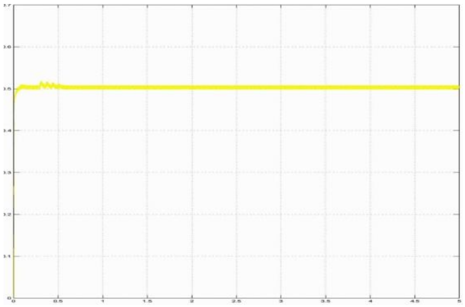

Fig 6: Voltage across resistor over the DC grid

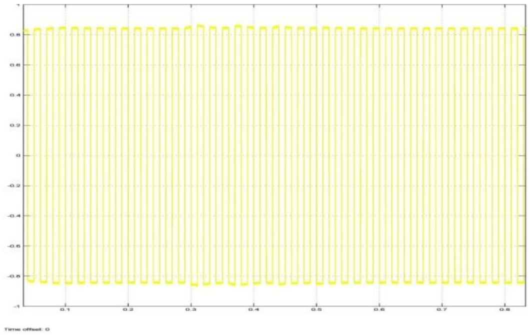

Fig 7: Output Current across the Load

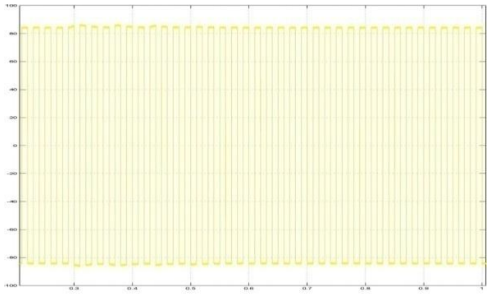

Fig 8: Output Voltage across the Load

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V.II.FOR THREE PHASE SIMULATION

The various types of waveforms of voltages across the source, grid and load are designed below. With different input sources, the output generated at the grid remains same.

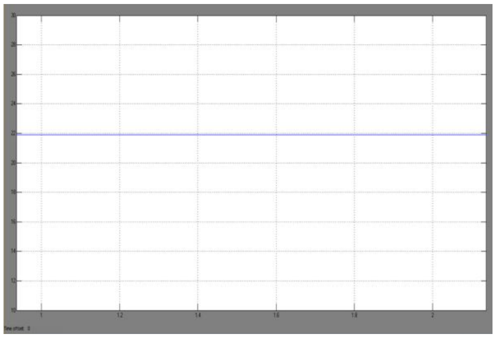

Fig 9: Voltage across the Source

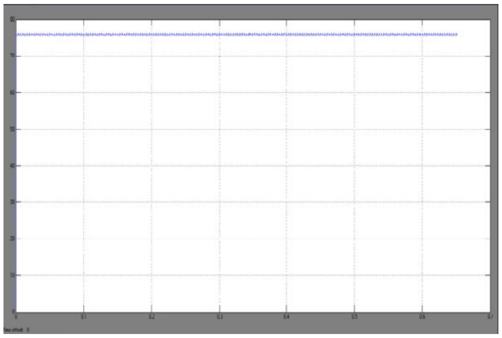

Fig 10: Voltage across the Grid

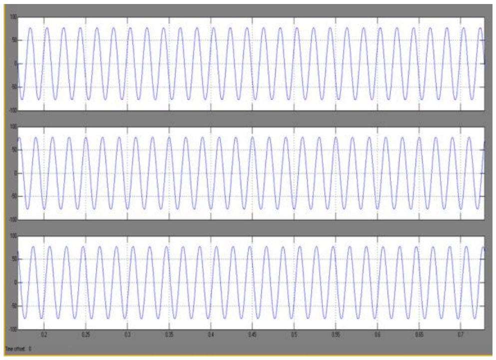

Fig 11: Voltage across the Load

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VI.CONCLUSION

The operation of maintenance of constant voltage across the DC grid is studied. Using MPPT algorithm, the fuzzy control method is properly studied by managing power and current parameters for having equal magnitude in grid voltage. Duty cycle is varied with the help of time period for reducing the short circuit across the switches.

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