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Simulation and analysis of Grid-connected PV System

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ABSTRACT

Now in recent years the demand of electricity increased day by day. So we need to produce more and more energy to produce electricity. Conventional energy sources like diesel, petrol, gas are finished day by day. So requirement of nonconventional energy sources are increased. Nonconventional energy sources like wind, solar, hydro etc. are available from nature. In this paper we discussed about produce electricity from solar energy. This solar energy is related with grid connected system and produce electricity based on photovoltaic system. Matlab simulation of grid connected pv simulation is also given and produce appropriate results according to requirement. This produce electricity is used for domestic and industrial loads.

Keywords: *Photovoltaic System, Boost Converter, Mppt, Inverter Etc.*

1. INTRODUCTION

Now a days in most of houses there are most of solar system is working. This solar panels are taken based on the kW demand of customers. In the most of houses 1 kW load is required so based on that solar panels are installed. For 1kW load 4 solar panels are required to produce energy. If maximum energy produced than this energy gives to the grid. Grid also supply the energy to customers. Government gives some money for produced the energy. There are two types of PV system (i) Stand-alone PV system (ii) Grid connected PV system. We mainly focus on Grid connected PV system because of its advantages compared to Stand-alone PV system.

Grid connected PV system:-

There are five parts of Grid connected PV system:-

1. PV module
2. Boost Converter
3. MPPT
4. Inverter
5. Grid

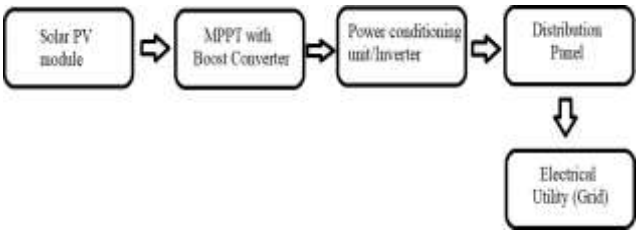

Fig 1. Block diagram of Grid connected PV System

As we know solar radiation is change in whole day. Solar radiation is fall on solar panel. Solar panel generate DC electricity. Solar radiation is change than not much power produce as per our requirement. For more requirement Maximum Power Point Tracker is required. Which tracks the power at maximum level. This voltages are very low so we need to step up the voltages by using boost converter. Boost converter step up the voltage as per requirement. Than inverter is converts dc voltages into ac voltages. These ac voltages may be single phase or three phase. In our paper we work on single phase ac supply. So single phase Inverter is used. This inverter gives excess power to the grid and grid also supply the power to the customers.

2. MATHEMATICAL MODEL

For simulation of pv cell we need to require modelling of pv cell. A current source in parallel with diode. No solar cell is ideal and thereby shunt and series resistances are added to the model.

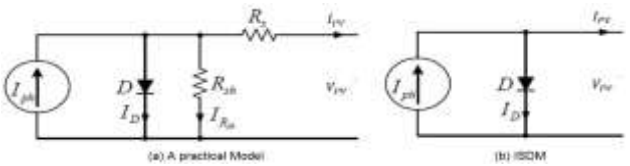

Fig 2. Models of PV cell

PV cell is made up of sum of five current photo current, saturation current, reverse saturation current, shunt resistor current, output current [1].

$$V_{OC}(tt, T) - V_{OC}(tt, T_o) = -|\beta|\Delta T$$

where V_{OC} (*tt*, *T*) is the open circuit voltage at given temperature and irradiance levels, V_{OC} (*tt*, T_o) is the open circuit voltage at STC temperature (25^oC) and irradiance, β is the temperature coefficient of $V_{OC.}$

3. MPPT

As we know solar radiation change day by day continuously so power obtained from the solar panels is variable so we need to get constant power. For constant power we need M PPT tracker.

There are various methods of MPPT:-

1. Perturb & Observe method
2. Incremental conductance method
3. Fractional open circuit voltage method
4. Fractional short circuit current method

In this paper we discuss about perturb & observe method.

3.1 Perturb & Observe method

In this algorithm, minor voltage deviance is introduced. Back on demand to raise the output power or reduce it to tie the MPP, the deviance can be positive or negative. It depends on the power and voltage[3]. This technique reflects the PV voltage to be system's reference point. When the PV array works to the right of MPP, at this instant power decreases with increasing voltage. If the perturbation have to be unchanged the output be inverted. This procedure is repetitive on a constant basis until to reach the MPP. Perturb & observe algorithm has less accuracy, less tracking speed, less step size so we have implement proposed perturb & observe algorithm.

3.2 Proposed Perturb & Observe method

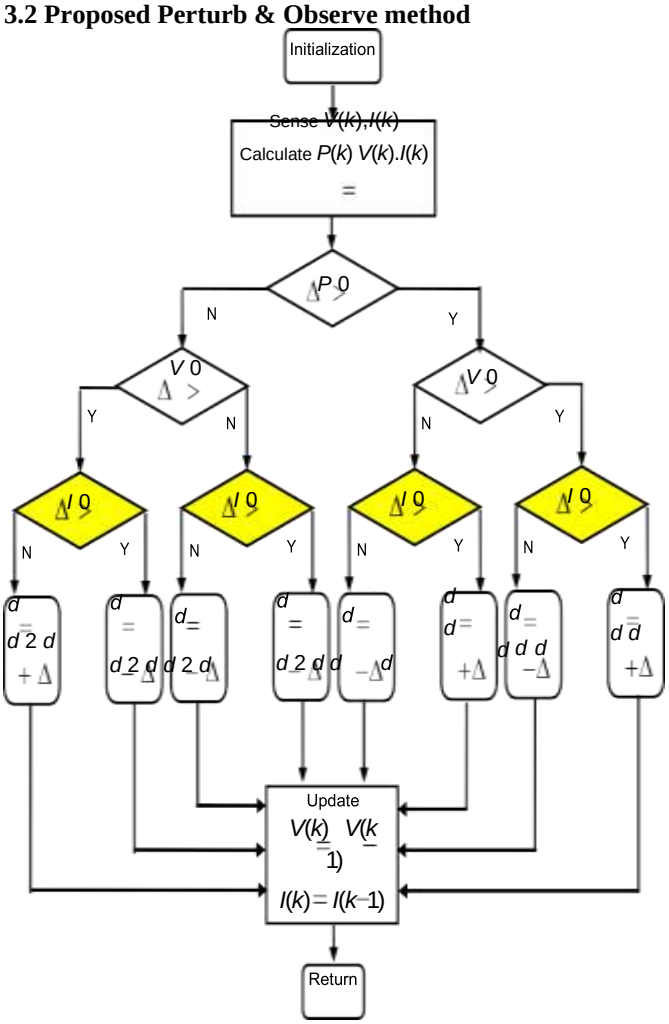

Fig 3. Flow chart of Proposed Perturb & Observe Method

In this paper we mainly focus on Proposed Perturb & Observe Method over Original Perturb & Observe Method because of many advantages. Total eight cases are discussed four cases are for fixed irradiance and other four cases are indicate the states of rapidly changing of irradiance either increasing or decreasing. The PV array gives constant illumination if the change in voltage and change in current have opposite sign. When the bad tracking way is detected, the step size must be doubled to augment the speed of tracking. A developed perturb & observe method is to reduce oscillations around MPP and increase tracking speed.

A small step reduces the changes around the MPP while a large step is to reach rapidly the MPP. The proposed algorithm has more adapted and faster response than the other algorithm when weather changes.

4. BOOST CONVERTER

Boost converter is a power electronics converter. Boost converter is generally step up converter which increase the voltage from low level to high level. This converter is converts only dc voltages not ac voltages. In this paper for solar radiation changes day by day than voltage is obtained less. So by using of this converter voltage obtained at the desired level.

5. INVERTER

Inverter is also a power electronics converter. Inverter is a converter which converts dc voltages into ac voltages. Inverter is either use for single phase or for three phase supply. In this paper we discuss about single phase grid connected pv system so single phase inverter is used. Single phase inverter are basically of two types half bridge inverter and full bridge inverter[7].

In this paper we discuss about full bridge inverter. Full bridge inverter have one dc source and four switches and also four diodes and load. When supply is given for positive half cycle two switches are conducted in antiparallel manner and output obtain positive voltages. In other case for negative half cycle other two switches are conducted in antiparallel manner and output obtains negative voltages.

6. PLL

PLL is known as phase locked loop. A phase locked loop is a one type of control system that generates an output signal phase is exactly equal to an input signal phase. PLL is used for reduce any of the phase error. PLL is used for synchronization of pv system with the grid.

The phase locked loop is worked as oscillator for a voltage or current controlled electronic circuit.

7. SIMULATION

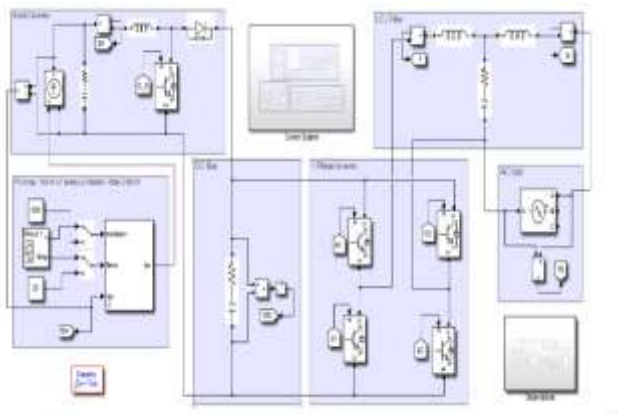

Fig 4. Simulation of Grid connected pv system

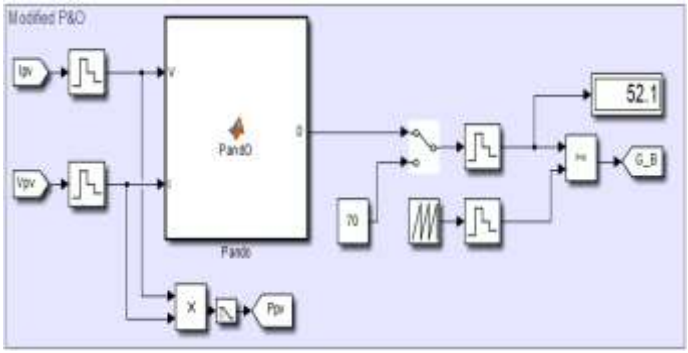

Fig 5. Simulation of Proposed P&O

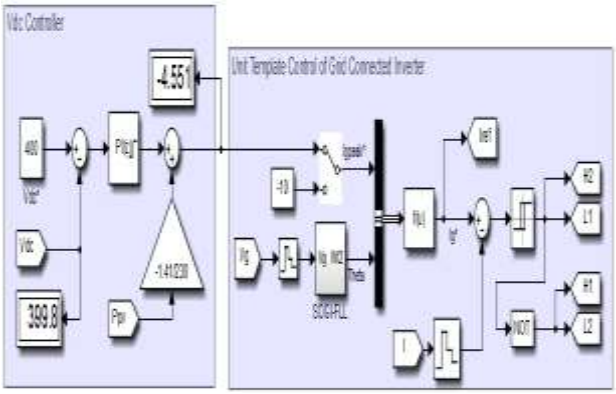

Fig 6. Simulation of Grid connected Inverter

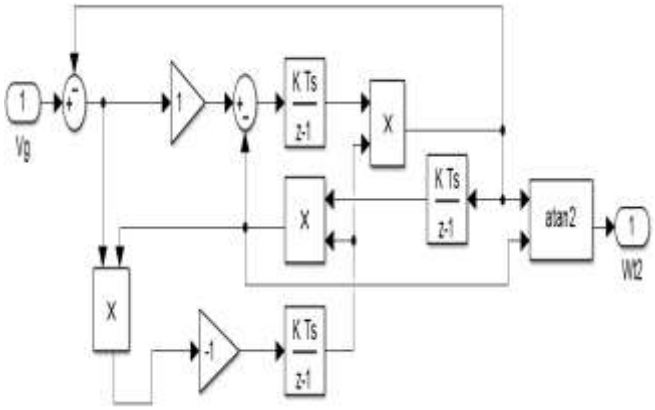

Fig 7. Simulation of Second order generalized integrator

8. RESULTS

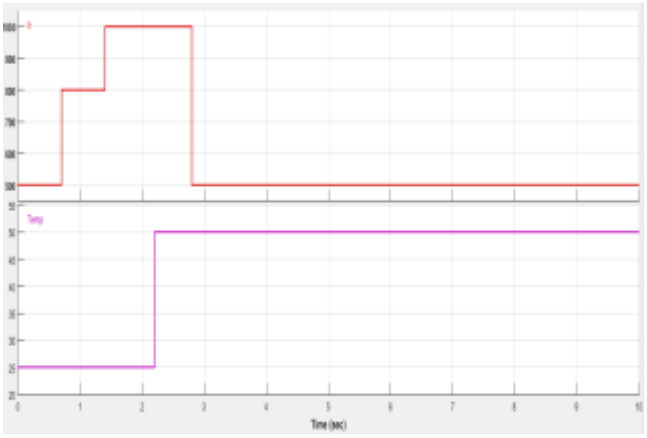

Fig 8. Waveforms of Irradiation and Temperature

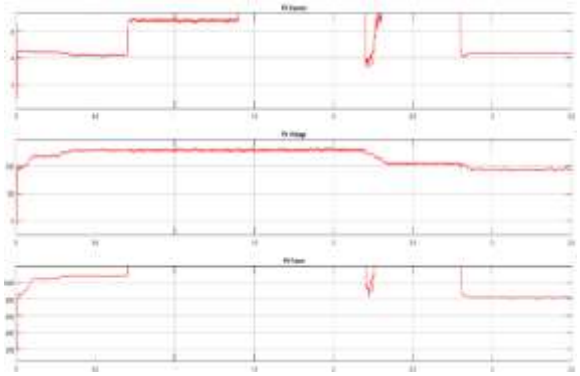

Fig 9. Output waveform of PV Array

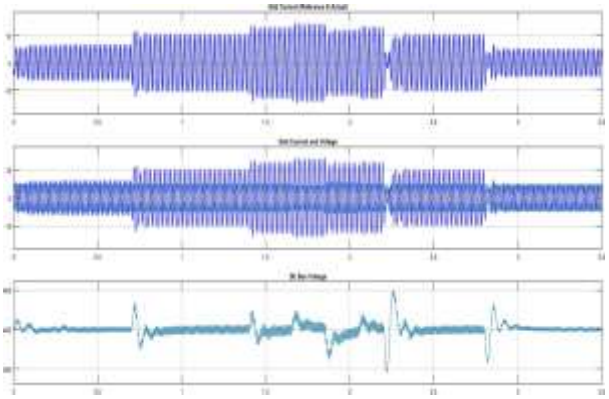

Fig 10. Output Waveform of Grid Voltage and current

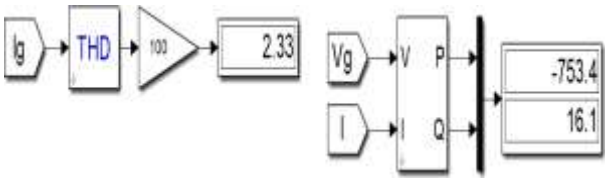

Fig 11. Observations of Grid connected PV system

9. CONCLUSION

In this paper, the modified Perturb & Observe MPPT Algorithm is used for improve the efficiency and accuracy of the PV panel output parameters. At different irradiation and temperature condition PV panel output is observed. As requirement of voltage is more so boost converter boost up the voltage at desired level. This voltage is obtained from the MPPT. Single phase inverter is convert this boost dc voltage into ac voltage. Second order generalized integrator PLL is used for synchronization purpose of grid with pv system. Than because of this overall efficiency of the pv system is improved.

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