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THREE PHASE FOUR WIRE DISTRIBUTION SYSTEM WITH RENEWABLE SOURCE POWER QUALITY IMPROVEMENT USING VARIOUS ALGORITHM

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Abstract : The evaluation of power electronics has emerged since last few decades ago. In modern contest the world is moving from conventional energy sources to the renewable one. It is due to it greater abundance and environment friendly characteristics. Solar energy is one of the most promising renewable resources that can be used to produce electric energy through photovoltaic process. A significant advantage of photovoltaic (PV) systems is the use of the abundant and free energy from the sun. Power electronic devices used as interface between renewable power and its user. It makes the power generated by renewable sources suitable for utilization. Solar power contribution in power generation has been increasing very fast and cost of power generated by solar photovoltaic is falling rapidly. Solar photovoltaic cell converts solar energy directly into dc power. Power is mostly transmitted and utilized in ac form because of advantages associated with it. To convert the dc power into ac, a highly efficient converter is required for optimum utilization of energy. The MPPT algorithm uses the IPV and VPV of the PV array and gives the MPP and a VDCREF. This voltage is then passed on to the inverter and then further to the three-phase grid. In this thesis the behavior of the active and reactive power of the grid which is supplied by the PV array is investigated. The various currents such as inverter current, grid current and load currents are also investigated.

Keywords: Photo Voltaic model, Grid Connected Solar PV Systems, Three Phase Circuit, MPPT, Power Quality.

I. INTRODUCTION

There are different sources of energy existing in this world. These sources are categorizes mainly into two groups. (a) Renewable (that don't get exhausted and replenished on its own), (b) Non-renewable (a source that requires a large amount of time). Renewable & non-renewable energy sources produce secondary energy sources such as electricity and hydrogen etc. However, in the present scenario most of the energy requirement is fulfilled by conventional or non-renewable energy sources. These are formed over a prolonged concerns over the climate changes and other environmental impact due to the extreme dependence on fossil fuel have led to the proliferation of renewable energy sources like wind and solar photovoltaic power across the globe, Solar PV energy source, which currently ranks third among the most deployed renewable energy sources in the world, after hydro and wind power.

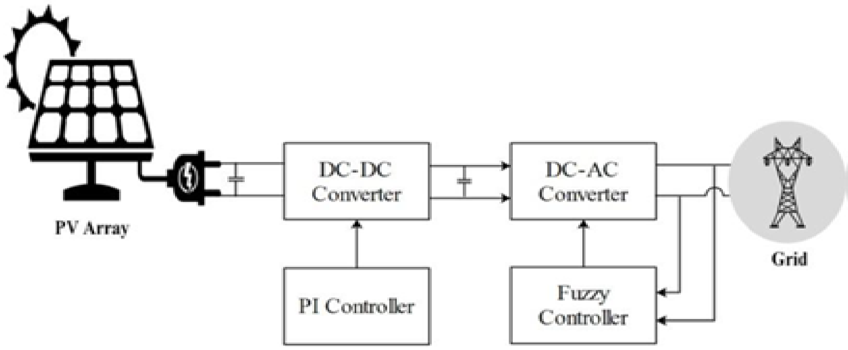

Figure 1: Block diagram of proposed system

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The demand for electric energy is expected to increase globally due to the rapid population growth and industrialization. This rapid increase in the energy demand requires electric utilities to increase their generation. In the last six decades, India's energy use has increased 16 times and the installed energy capacity by 84 times, still India is facing the problem of acute power deficit. The present scenario indicates that India's future energy requirements are going to be extremely high. In order to meet the ever increasing power requirements, huge amount of power needs to be generated in the existing power sector.

Penetration of solar energy is increasing rapidly over the last decade due to its availability and climate-friendly attributes. Solar energy is free from greenhouse gas (GHG) emission and plays a key role in developing a sustainable power system for the future. However, the intermittent nature of solar energy creates a number of potential challenges in integrating large-scale photovoltaic (PV) with the grid. Voltage fluctuation, voltage management, harmonic distortion, demand management, and load rejection are the major potential issues concerning the application of photovoltaic in Single Wire networks. Of particular interest was the adverse effect on voltage instability of the network with varying PV penetration. Studies shows that voltage raises across the network would exceed regulatory standards with the high penetration of PV in networks.

II.SCOPE OF WORK

The increased concerns over the climate changes and other environmental impact due to the extreme dependence on fossil fuel have led to the proliferation of renewable energy sources like solar photovoltaic power across the globe. Solar PV is a sustainable energy source, which currently ranks third among the most deployed renewable energy sources in the world, after hydro and wind power. AC modules are considered as the new face of PV power and it employs a commercial PV module together with an inverter. The composite system is to be monitored continuously. The objective of this article is

- To design Solar energy sources are used in distribution systems using power electronic converters.
- To design control strategy for grid interfacing inverters when in three phase four wire distribution system.
- To design power inverter with shunt active power filter to compensate current unbalance, load current harmonics, load reactive power demand and load neutral current.
- To design three phase non-linear and single-phase linear loads combination of diode and Transistors.
- To design the hysteresis controller is used to produce switching pulses for inverter.
- To design the reference current generation is based on PQ theory.

III.MODELING AND ANALYSIS

The downward tendency in the price of the photovoltaic modules, together with their increasing efficiency, put solid-state inverters under the spot lights as enabling technology for integrating PV systems into grid. Grid synchronization unit plays important role for grid connected SPV systems. The given system consists of a SPV array, DC/DC boost converter and a three phase voltage source converter with grid synchronization control schemes.

A. Solar cell modeling

Solar based cells made of a p-n junction created in thin layer of semiconductors, whose electrical qualities vary practically very little from a diode represented by the condition of Shockley. Therefore the least complex comparable circuit of a solar based cell is a present source in parallel with a diode as appeared in Fig. 2. So the way toward equation.

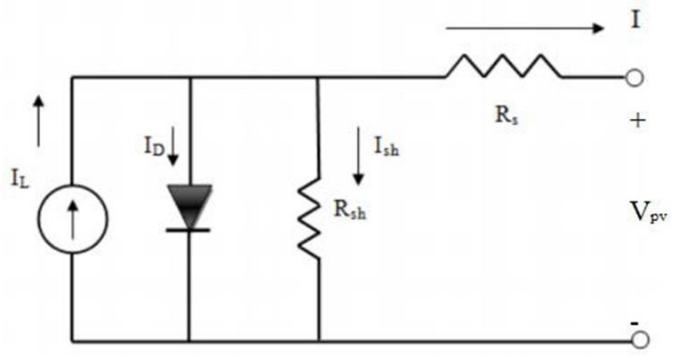

Figure 2: Equivalent Model of Solar Cell

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$$I = I_{PV,CELL} - I_{DIODE} \quad (1)$$

$$I = I_{PV,CELL} - I_{O,CELL}[\exp\left(\frac{q+v}{\propto+k+T}\right) - 1] \quad (2)$$

Where:

$I_{PV,CELL}$ = Current generated by the incident light.

I_{DIODE} = Shockley diode.

$I_{O,CELL}$ = Reverse Saturation current.

q = Electron charge (1.6021 x 10^{-19}).

k = Boltzmann constant (1.3805 x 10^{-23}).

T = PN junction diode Temperature.

∝ = Ideally constant (between 1 to 2).

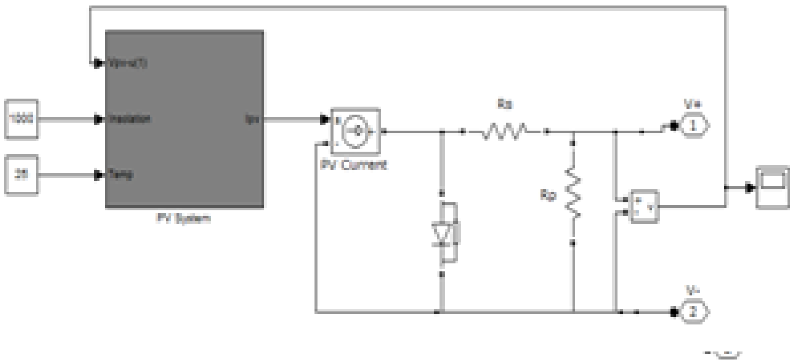

Figure 3: Equivalent Model of Solar Cell

B. MPPT

This area covers the operation of "Maximum Power Point Tracking" using P & O as utilized as a part of solar electric charge controllers. A MPPT or maximum power point tracker is an electronic DC to DC converter that improves the match between the solar based group (PV panels), and the battery bank or utility grid.

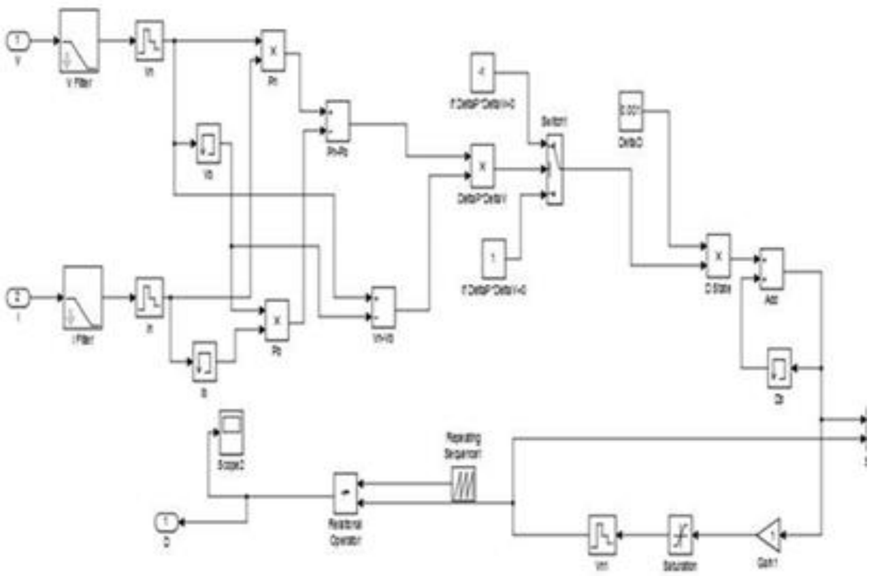

Figure 4: MATLAB Simulation of P&O MPPT Controller

Fundamentally, they change over a higher voltage DC output from solar panels down to the lower voltage anticipated that would charge batteries. There are numerous calculation for MPPT. I utilized the power under quick differing climatic conditions however it still exceptionally mainstream and basic than some other strategy. With the goal that the state of the output is Square PWM wave. In this paper utilized this on the grounds that on the off chance that we pass this sort of flag in a low pass channel than we get sine wave which matches to the network.

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C. FUZZY LOGIC CONTROL WITH BUCK-BOOST CONVERTER

The buck-boost converter system with the controller, the actual output voltage V0 is compared to the reference voltage Vref to produce an error signal that is used to determine the switching signal duty cycle. The switching signal is applied on the MOSFET used to reduce and enlarge output voltage on the circuit. The proposed buck-boost converter is designed for a battery power system that inconstant input voltage to constant output voltage for different currents. For 50Watt power, 20 kHz switching frequency, and 10% regulation the system is designed. The buck converter system is analyzed for switch on time and off time which is called duty cycle ratio D.
The system variables and a rule table which depend on the variables are described for the control algorithm. The buck converter output voltage is controlled by changing the switching duty cycle. The system error is defined as a difference between the reference voltage and measured output voltage value. For the system; r(k) is the reference voltage and y(k) is the measured output voltage values then the error voltage is calculated using Equation (1).

$e(k) = r(k) - y(k)$ (1)

The change in the error voltage is also calculated as;

$de(k) = e(k) - e(k - 1)$ (2)

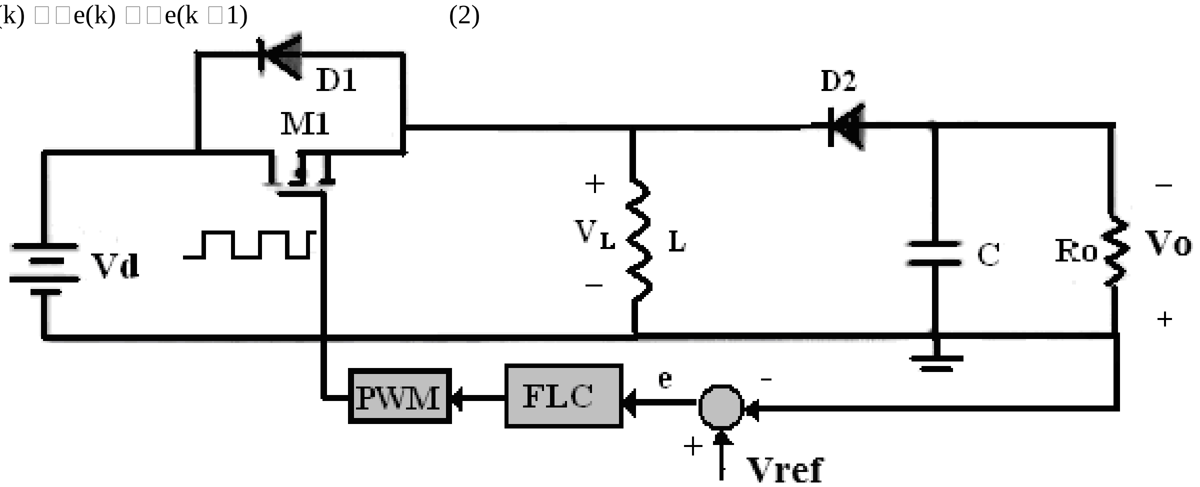

Figure 5: Fuzzy logic control with buck-boost converter system

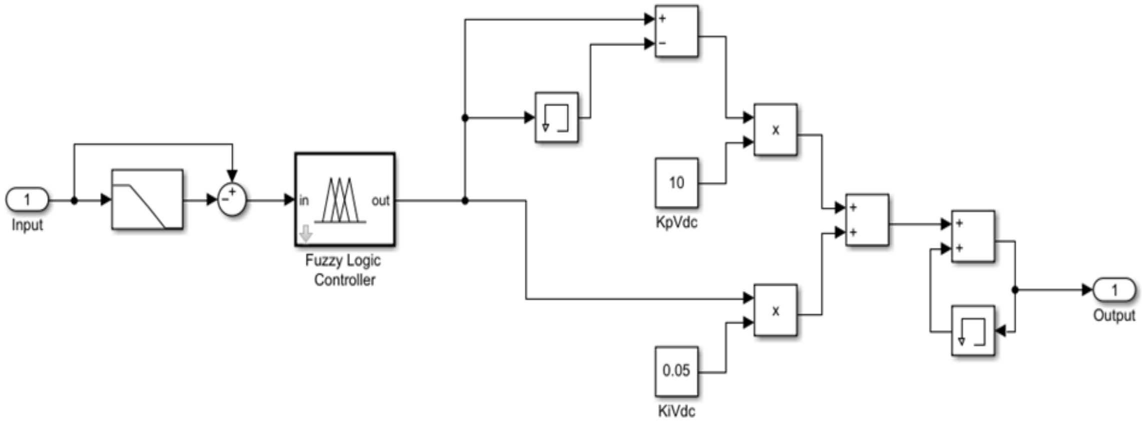

Figure 6: MATLAB Simulink Fuzzy logic control with buck-boost converter system

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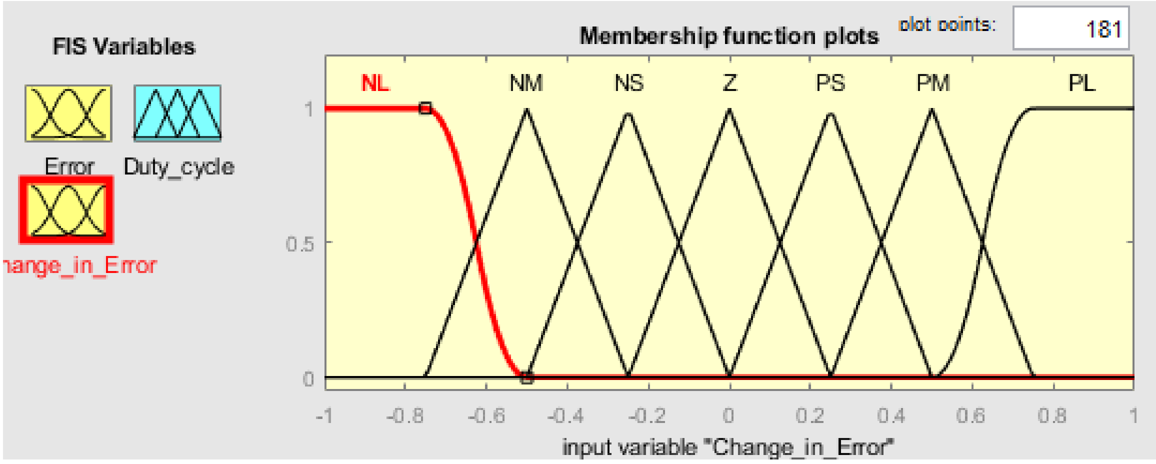

Figure 7: Membership function of change in error

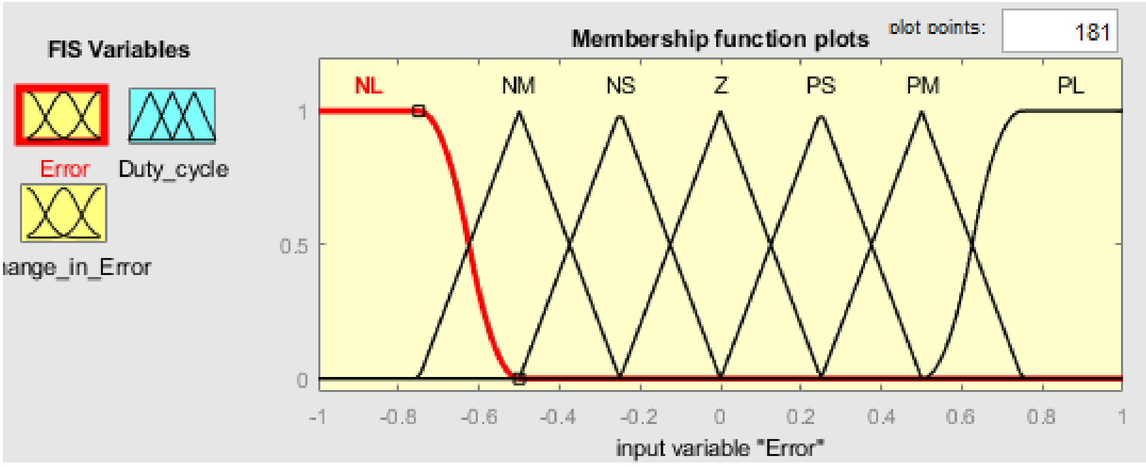

Figure 8: Member function of error

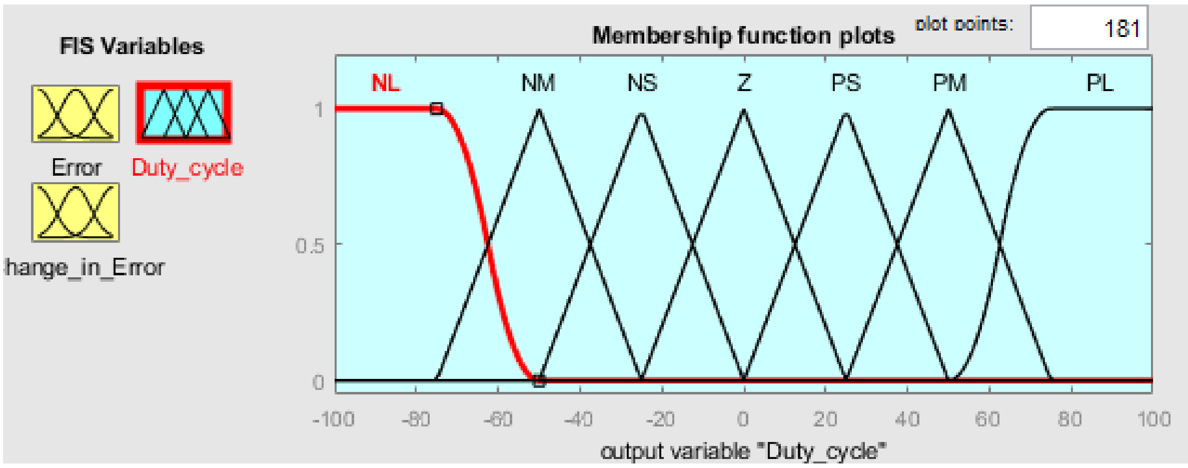

Figure 9: Membership function of output

Now, the MATLAB simulated model of a 3-phase grid connected system is shown in the Figure 5.10 which incorporate a PV array connected to a DC-DC boost converter, a DC to AC three phase voltage source inverter, a three phase 415 V grid with the above mentioned load connected at PCC point.

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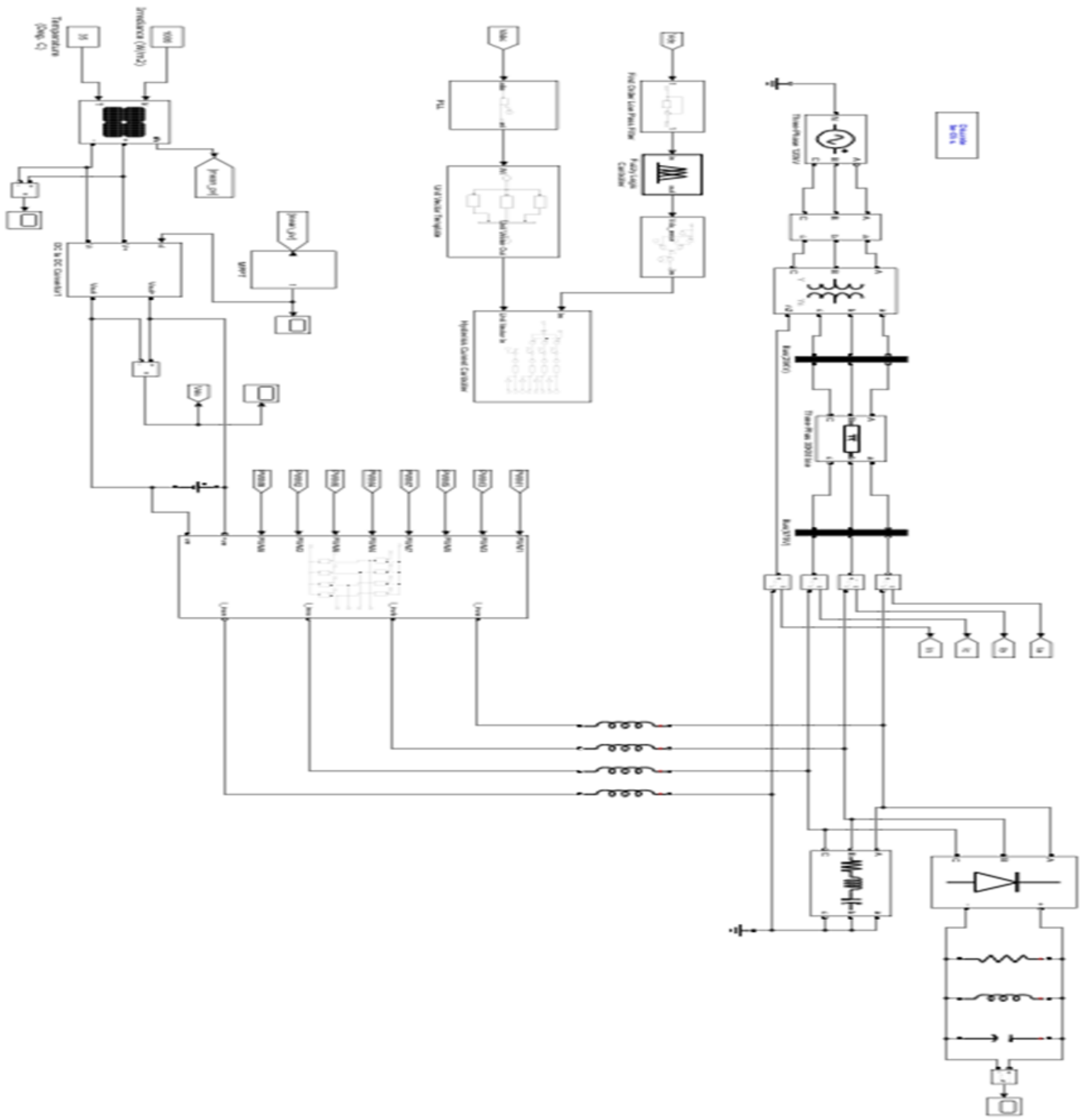

Figure 10: MATLAB Simulation of P&O MPPT Controller

IV.SIMULATION RESULT & DISCUSSION

The performance of three phase grid connected solar PV System is analyzed for different kind of loads. Also the impacts of changing meteorological parameters especially irradiance is studied. Impacts of increasing percentage penetration of solar PV on the existing grid is also analysed through THD and voltage at the PCC point.

A Fuzzy Logic Controlled (FLC) buck-boost DC-DC converter for solar energy-battery systems has been presented. The buck-boost converter circuit has been designed with Matlab/Simulink and simulation results have been obtained. The simulation results have been found for Matlab/Simulink approach. For the controller FLC, PI, and FLC+PI controllers are used and the simulation results are compared. It can be seen from the results that there is no big overshoot in output voltage and no need for any change in parameters to stable the system. It can be noted that it is possible to use a fuzzy logic controller for power electronics applications and also practical to simulate the designed circuits in Matlab/Simulink.

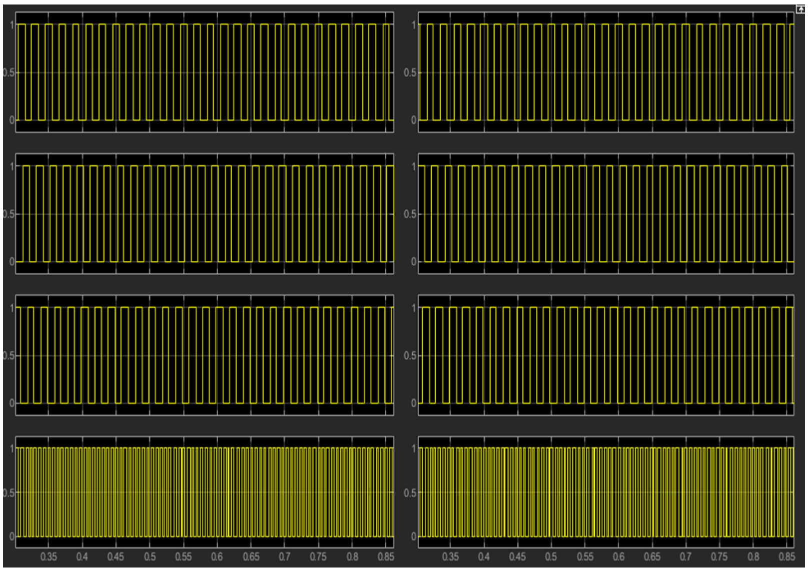

Figure 11: PWM signal for inverter

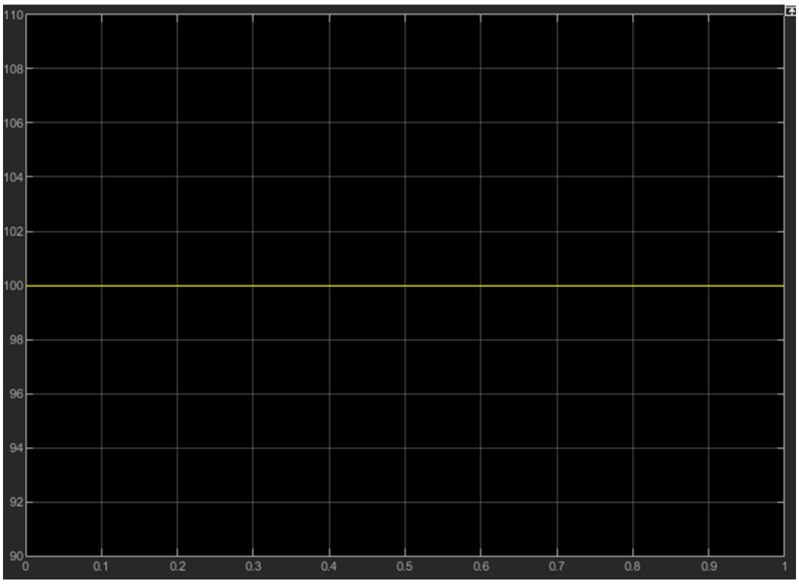

Figure 12: Inverter Dc input Voltage

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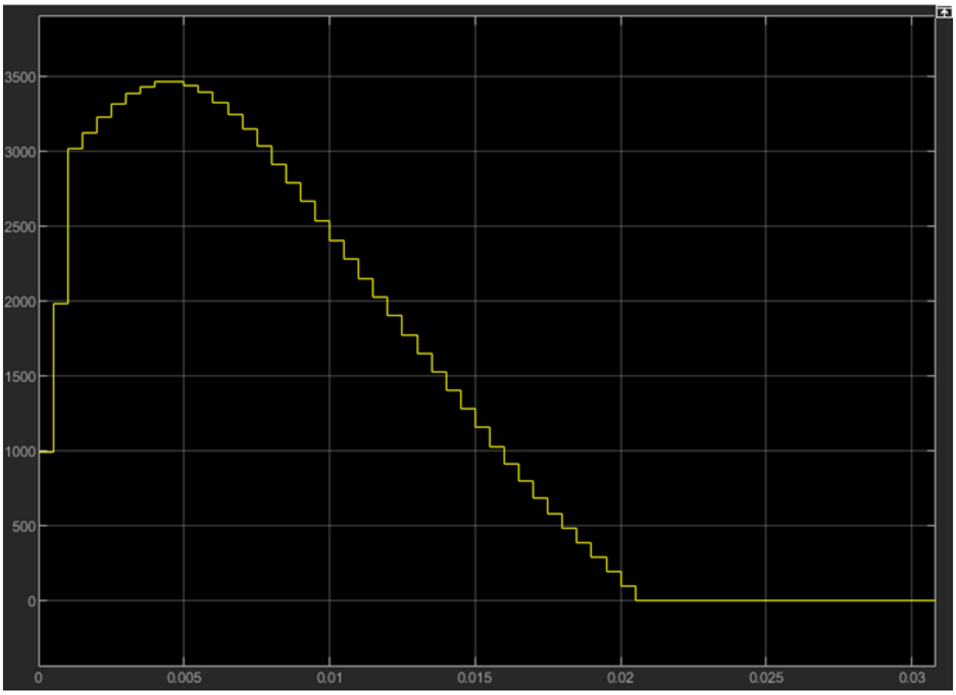

Figure 13: Non-linear output

V.CONCLUSION

In this paper the issues and difficulties involved due to the Grid integration of Solar PV System was completely analyzed. The harmonics present in this proposed system was efficiently eliminated using SAPF. Comparison with other conventional techniques shows that FUZZY controlled SAPF limit the total percent of THD. Voltage effectively to an attainable level. This prototype affords reliability in feeding the load. This prototype also supplies the active power indispensable during the unreliable grid operation all the way through the solar energy linked at the DC side of the SAPF. The obtained results prove that the proposed model animatedly performs the THD of source voltages at inverter and Grid is reduced.

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