Design and Implementation of Single Phase Grid Tie Inverter

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***Abstract*—Renewable power source in late year has turned out to be more common, because of the contamination and exhaustion in the level of fossil fuels. In this project we will utilize solar energy and the utilization of that energy with the reliable and proficient way. This framework consists of a switch mode DC-DC converter and an inverter. The exchanging system of proposed inverter consists with a combination of pulse width modulation (PWM) and square wave alongside grid synchronization condition. In PV module, grid is executed utilizing Maximum Power Point Tracking technique used to build grid efficiency. Regularly the total power i.e. Active power is provided from PV framework and reactive power is taken from the grid. We will utilize active power from renewable energy source and reactive power from framework and supply to load. The underlying expense will be all the more yet it will be one time speculation. The entire system will be simulated in MATLAB/SIMULINK software.**

***Index Terms*—Photovoltaic (PV) Cell; Pulse width modulation(PWM), Grid synchronization, Zero Crossing Detector**

Introduction

In late decades, sun based photovoltaic (PV) innovation has been produced for grid inverter and PV power system control.

NON - RENEWABLE ENERGY

These are the vitality sources that we are utilizing and can't make in a brief time frame. However, we get the vast majority of our vitality from non - sustainable power sources, which include the fossil fuels oil, petroleum gas, and coal. They're called fossil energizes in light of the fact that they were shaped more than a great many a long time by the activity of warmth from the Earth's center and weight from shake and soil in the remaining parts of dead plants and creatures.

RENEWABLE ENERGY

These are the energy sources that we can use again and again once more. Renewable energy sources Renewable energy, which originates from the sun and can be transformed into electricity. Wind, geothermal vitality from inside the earth, biomass from plants, and hydropower and ocean energy from water are also renewable energy sources.

The development of PV framework usage and change is because of its favorable circumstances, for example, being cleaned, protected, dependable, unlimited, activity and low maintenance cost, and has no moving parts yet its establishment cost is moderately high. Normally, the PV grid has power converters between PV module and the utility grid to achieve two goals. First goal is to ensure the PV module is operated at the maximum power point (MPP) with the aid of the DC/DC converter and MPPT. Second goal is to inject a sinusoidal current into the utility grid through the DC/AC inverter[1]. As of now, Photovoltaic generators are outlined keeping in mind the end goal to create a greatest energy to the network. As a result of the stochastic idea of the PV control output, vast advancements of network associated PV frameworks include huge fluctuations of the frequency, power and voltage in the grid. Be that as it may, the drawback is that PV age is discontinuous, contingent on climate condition. Thus, the MPPT makes the PV system providing its maximum power and that energy storage element is necessary to help get stable and reliable power from PV system for both loads and utility grid, and thus improve both steady and dynamic behaviours of the whole generation system. In this paper, microgrid tested using renewable energy based power generation system which is composed of PV array, battery, power electronic converters, filter, controllers, local loads and utility grid [15].The paper examines the point by point demonstrating of grid associated PV/Battery generation system. PV array is associated with the utility framework by a boost converter to improve the PV output and DC/AC inverter to change over the DC output voltage of the sun powered modules into the AC system. meanwhile, the battery is associated with the regular DC line through a charge controller to help a steady voltage from PV. The proposed model of the whole segments and control system are all simulated under Matlab/Simulink software.

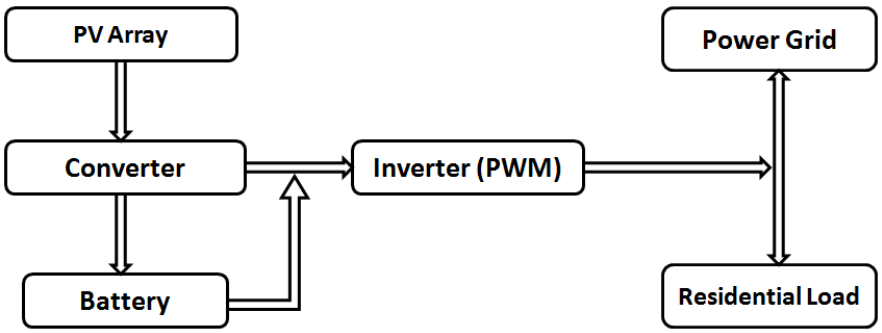

Figure 1: Block Diagram of Solar Cell Inverter Synchronization

With Grid

I. METHODOLOGY

A. SOLAR CELL MODELING

Solar cells made of a p-n junction fabricated in thin layer of semiconductors, whose electrical characteristics differ very little from a diode represented by the equation of Shockley. Thus the simplest equivalent circuit of a solar cell is a current source in parallel with a diode as shown in Fig. 2. So the process of modeling this solar cell can be developed based on Equation.[2]

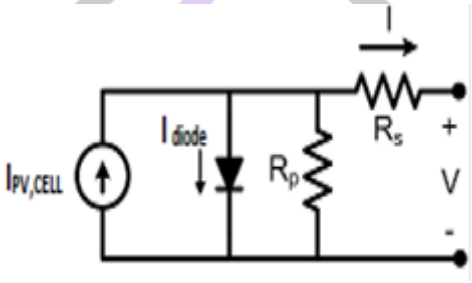

Figure 2: Equivalent Model of Solar Cell

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

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

Where:

IP V ;CELL = Current generated by the incident light

IDIODE = Shockley diode

Io;CELL = Reverse Saturation or leakage current

q = Electron charge (1.6021*10-19)

k = Boltzmann constant (1.3805*10-23)

T = Temperature of the PN junction diode

α = Ideally constant (between 1 to 2)

In viable model of PV exhibit a few segments are associated in arrangement or parallel so in sun oriented cell requires the extra segments are Rs and Rp.

$$I = I_{PV}\left[exp\left(\frac{V + R_S + t}{V_t + \alpha}\right) - 1\right] - \frac{V + R_S + t}{R_P} \quad (3)$$

The light created current of the model rely upon illumination G and further more temperature.

$$I_{PV} = (I_{PV,n} + K1)\frac{G}{G_n} \quad (4)$$

Where:

K1 is the temperature coefficient of short circuit current.

G is the irradiance (W/m2).

Gn is the irradiance at standard operating conditions.

The diode saturation current Io dependence on temperature can be expressed as

$$I_O = I_{O,n}\left(\frac{T_n}{T}\right)^3 exp\left(\frac{q + E_g}{\alpha + K}\right)\left(\frac{1}{T_n} - \frac{1}{T}\right) \quad (5)$$

Where:

Eg is the band gap energy of the semiconductor.

Io;n is the saturation current.

$$I_{O,n} = \frac{I_{SC,n}}{[exp\left(\frac{V_{DC,n}}{V_{t,n} + \alpha}\right) - 1]} \quad (6)$$

So,

$$I_O = \frac{I_{SC,n} + k1}{[exp\left(\frac{V_{DC,n}}{V_{t,n} + \alpha}\right) - 1]} \quad (7)$$

Where:

VDC is open circuit current.

ISC;n is the short circuit current.

Vt;n is the thermal voltage.

Tn is the temperature at standard operating condition.

B. DC TO DC CONVERTER

In this segment we utilized Boost converter. It is one of the DC to DC converter. Lift converter is utilized to advance up a source voltage to a more elevated amount. The pick up from help converter is straightforwardly corresponding to the obligation cycle (D). At the point when help converter is in PV applications, the information voltage originating from PV board is changed with climatic conditions. In this way if the obligation cycle shift than we get most extreme power purpose of PV module. The MATALB [simulink] Model of lift converter is given,

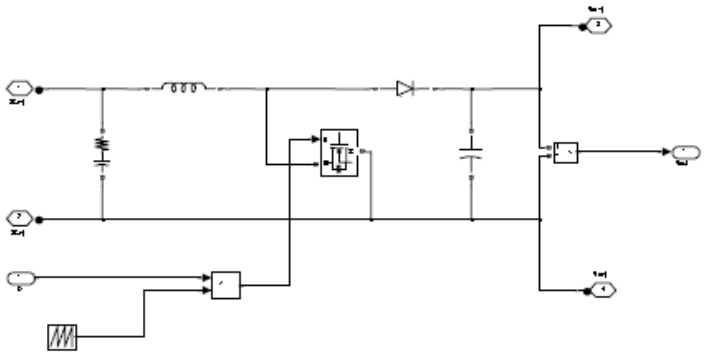

Figure 3: Boost Converter

C. MPPT

This area covers the hypothesis and task of ”Maximum Power Point Tracking” 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 enhances the match between the sun based cluster (PV panels), and the battery bank or utility framework. Basically, they change over a higher voltage DC output from solar panels down to the lower voltage expected to charge batteries.

In this research utilized unipolar based Voltage source PWM (pulse width modulation) dc to ac inverter. With the goal that the state of the yield 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.

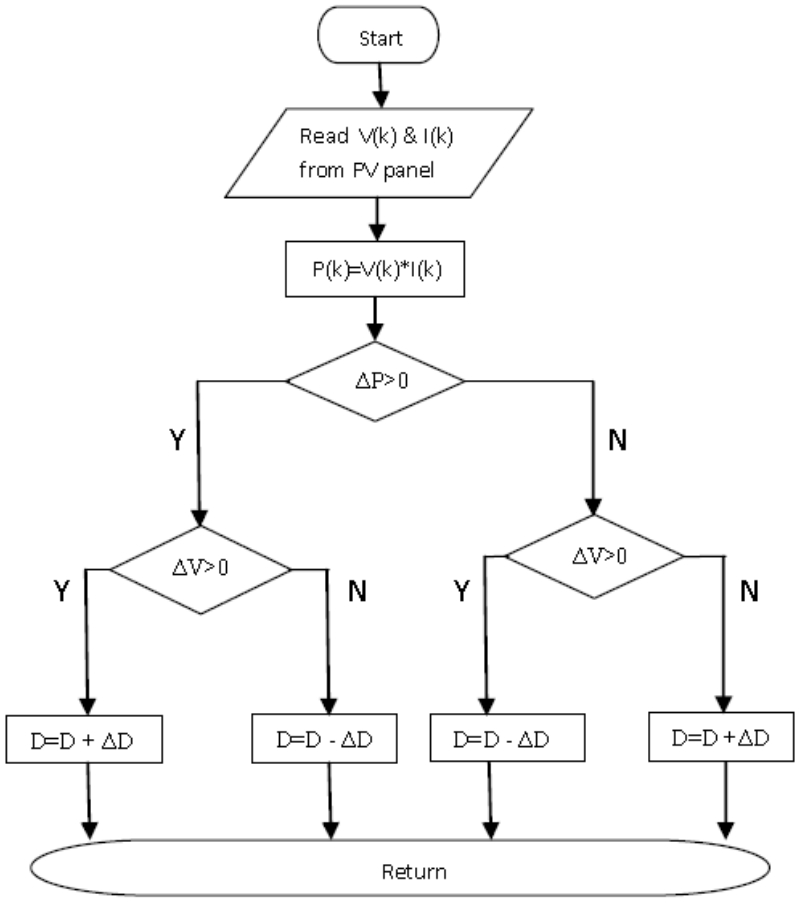

Figure 4: Flow Chart of MPPT

D. DC TO AC INVERTER

Here the sine wave is 50hz it is our reference flag which is contrasted with a high recurrence saw tooth wave. With the goal that the yield state of PWM inverter is given:

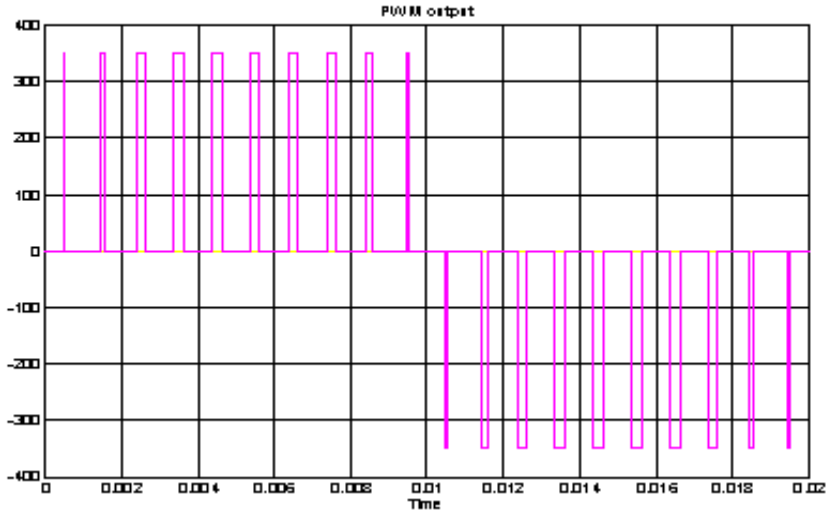

Fig. 5: PWM Inverter Output

Because of the fluctuating plentifulness of the reference flag, the widths of the yield beats of PWM inverter is changed too, bringing about heartbeat widths that are relative to the adequacy of the reference flag wave. The PWM based voltage source dc to air conditioning inverter in MTALAB[simulink] display.

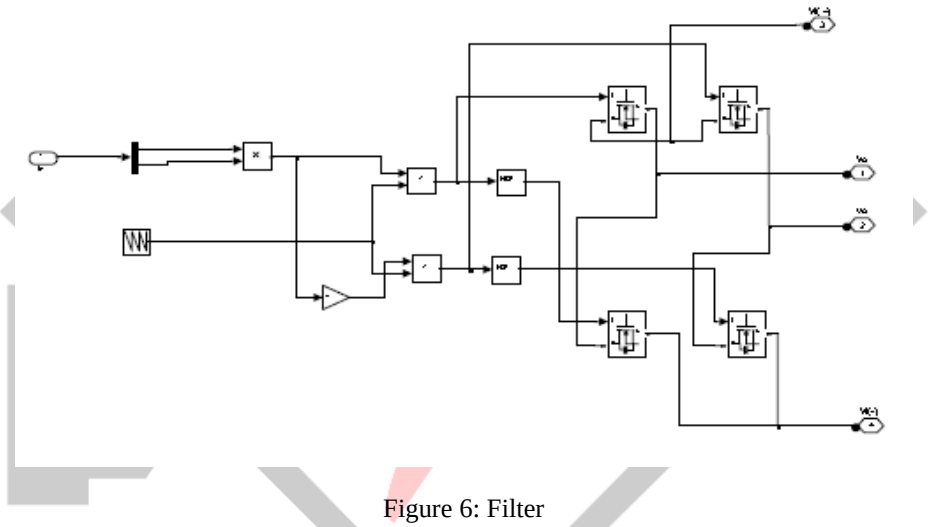

Figure 6: Filter

E. ZERO CROSING DETECTOR

A simple method of obtaining the phase information of a wave is to recognize the zero crossing point of the signal. Fig. 3 demonstrates the block diagram of a zero crossing detector based PLL. The strategy depends on checking the quantity of fixed frequency pulses between the adjacent zero crossings of a signal to determine its time period and thus its frequency.

The phase angle is estimated by integrating the angular frequency obtained and no control block is involved.The major drawback of the method is that it needs a signal that is devoid of any harmonic distortion and noise, to which it is highly susceptible. Moreover, since phase tracking action occurs only at the zero crossings, a fast dynamic response is not possible.[11]

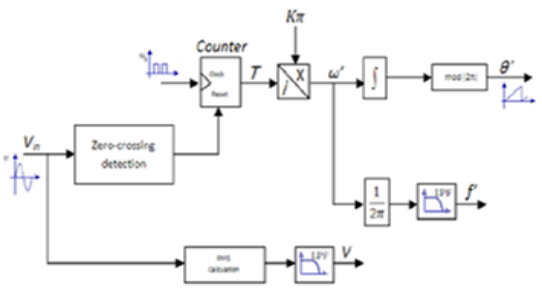

Figure 9: Block Diagram of a Zero Crossing Detector PLL

F. SIMULATION SYSTEM

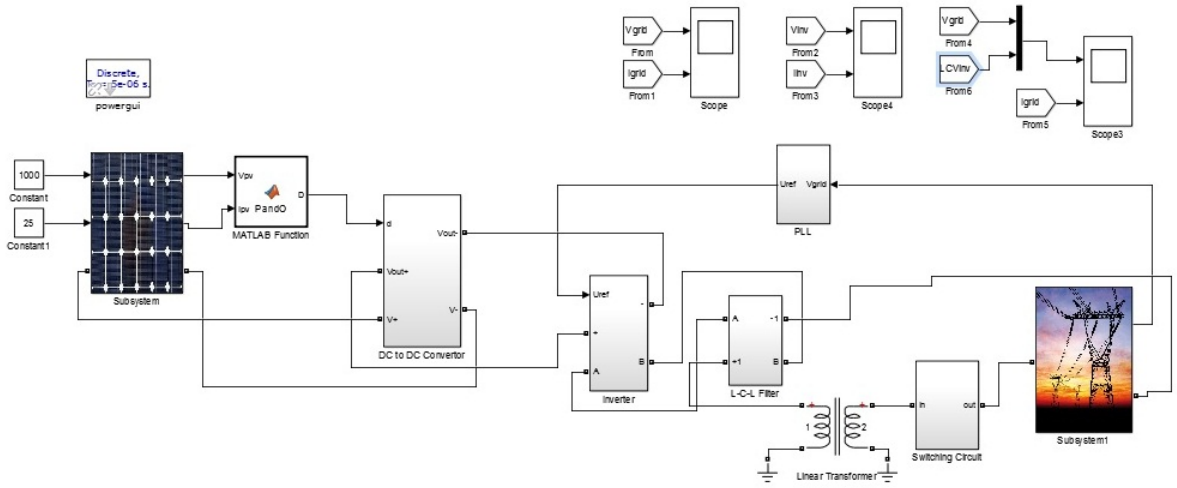

Fig. 7: Simulation of Solar Cell Inverter Synchronization with Grid

II. CONCLUSION

This paper introduces that the interfacing of solar power control with grid taking frequency into consideration. Synchronization is accomplished for solar output frequency and grid frequency. Power is conveyed to the network by manual breaker. Microcontroller is utilized to check the frequency of grid and solar. And furthermore recognizes zero crossing of the sine wave to drive the circuit. Unfluctuated load with synchronized frequency is been deliverd to the grid.

III. RESULT

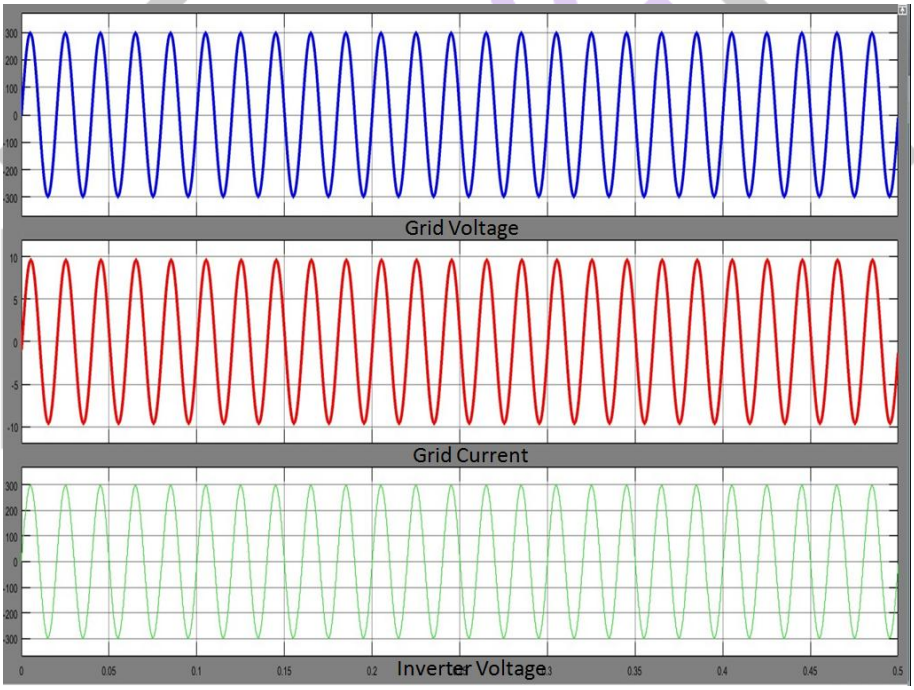

Fig. 8: Graph of Solar Cell Inverter Synchronization with Grid

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