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DESIGN & SIMULATION OF PHOTOVOLTAIC SYSTEM USING INCREMENTAL MPPT ALGORITHUM

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ABSTRACT: This paper presents the design and simulation of a photovoltaic system using incremental conduction maximum power point tracking (MPPT) algorithm with boost converter . The current-voltage (I-V) & power-voltage (P-V) characteristics are obtained for solar module . The MPPT algorithm, which is based on the incremental conduction method, is also described

Keywords: Solar Module, Incremental Conduction, Boost Converter, M.File ,Matlab/Simulation

I. INTRODUCTION

Renewable sources of energy acquire growing importance due to its enormous consumption and exhaustion of fossil fuel. Also, solar energy is the most readily available source of energy and it is free. Moreover, solar energy is the best among all the renewable energy sources since, it is non-polluting. Energy supplied by the sun in one hour is equal to the amount of energy required by the human in one year. Photo voltaic arrays are used in many applications such as water pumping, street lighting in rural town, battery charging and grid connected PV systems. Solar energy is a renewable, inexhaustible and ultimate source of energy. If used in a proper way, it has a capacity to fulfill numerous energy needs of the world. The power from the sun intercepted by earth is approximately 1.8 x 1011MW.This figure, being thousands of time larger than the present consumption rate enables more and more research in the field of solar energy so that the present and future energy needs of the world can be met. Thus Even though the PV system is posed to its high capital fabrication cost and low conversion efficiency, the skyrocketing oil prices make solar energy naturally viable energy supply with potentially long-term benefits. As known from a Power-Voltage curve of a solar panel, there is an optimum operating point such that the PV delivers the maximum possible power to the load. The optimum operating point changes with solar irradiation and cell temperature. This paper deals with Incremental conductance MPPT algorithm method due to its simple approach.

II PHOTOVOLTAIC CELL

Solar cells are connected in series and parallel to set up the solar array. Solar cell will produce dc voltage when it is exposed to sunlight. Fig. 1 shows the equivalent circuit model for a solar cell. Solar cell can be regarded as a non-linear current source. Its generated current depends on the characteristic of material, age of solar cell, irradiation and cell temperature**.**

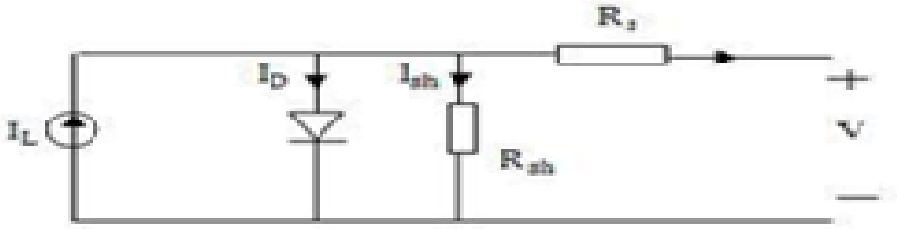

Fig-1: Equivalent Circuit of Solar Panel

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I=IL−$Io(e(q(V+I$Rs) KT -1)− $V+IRs\ Rsh$ (1)

Equation (1) describes the I-V characteristics of the PV model.

III. MAXIMUM POWER POINT TRACKING

The efficiency of a solar cell is very low. In order to increase the efficiency, methods are to be undertaken to match the source and load properly. One such method is the Maximum Power Point Tracking (MPPT). This is a technique used to obtain the maximum possible power from a varying source. In photovoltaic systems the I-V curve is non-linear, thereby making it difficult to be used to power a certain load. This is done by utilizing a boost converter whose duty cycle is varied by using a MPPT algorithm.

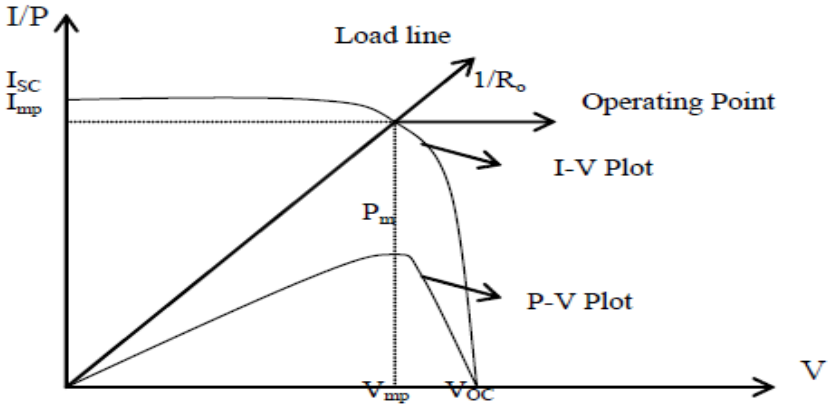

Figure 2: Maximum Power Point

The point at which I_{mp} and V_{mp} meet is the maximum power point. This is the point at which maximum power is available from the PV cell. If the 'load line' crosses this point precisely, then the maximum power can be transferred to this load.

A boost converter is used on the load side and a solar panel is used to power this converter.

IV METHODS FOR MPPT

There are many methods used for maximum power point tracking a few are listed below

- Perturb and Observe method
- Incremental Conductance method
- Constant Voltage method
- Constant Current method

V INCREMENTAL CONDUCTANCE METHOD

This method uses the PV array's incremental conductance dI/dV to compute the sign of dP/dV. When dI/dV is equal and opposite to the value of I/V (where dP/dV=0) the algorithm knows that the maximum power point is reached and thus it terminates and returns the corresponding value of operating voltage for MPP. **This method tracks rapidly changing irradiation conditions more accurately than P&O method.** One complexity in this method is that it requires many sensors to operate and hence is economically less effective

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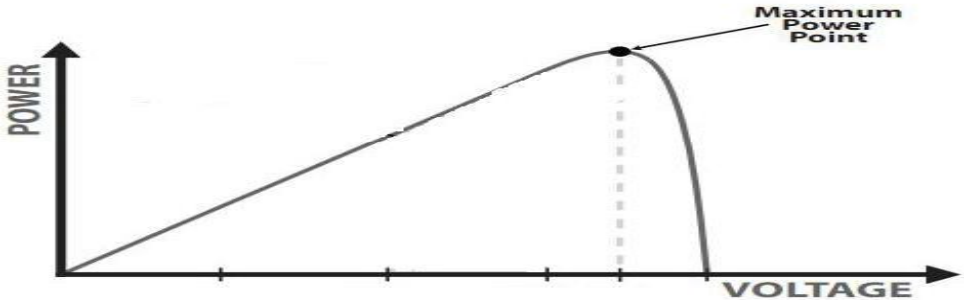

Figure 3.INC algorithm wave form

dp/dv=0 , at MPP

dp/dv>0 ,left of MPP

dp/dv< 0 ,right of MPP

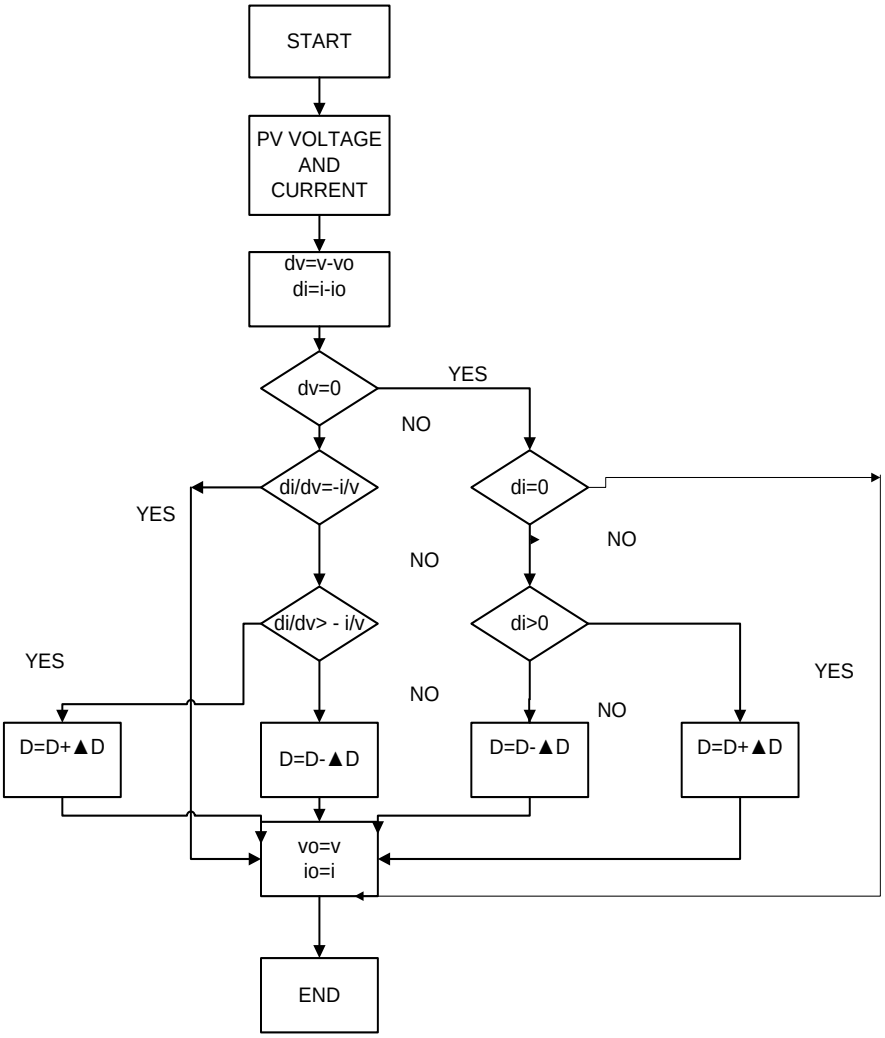

Figure 4 : Flow Chart Of INC Algorithm

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VI BUCK BOOST CONVERTER

It provides an output voltage that may be less than or greater than the input voltage –hence the name "buck-boost" ; the output voltage polarity is opposite to that of the input voltage. This regulator is also known as an inverting regulator

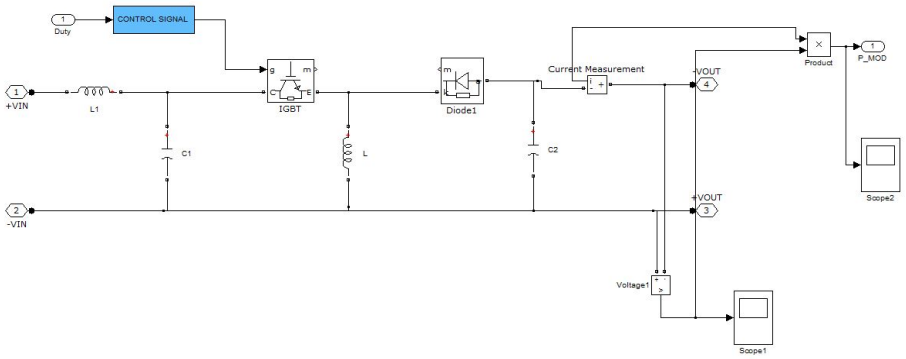

Figure 5 Matlab Model Of Buck Boost Converter.

During Mode 1, IGBT is turn on and diode D is reversed biased.The input current , which rises ,flows through inductor L and IGBT .During mode 2 , IGBT is switch off and the current ,which was flowing through inductor L, would flow through L,C , diode and the load.The energy stored in inductor L would be transferred to the load and the inductor current would fall until IGBT is switched on again in the next cycle.

VII SOLAR PV MODULE _MPPT BUCK BOOST CONVERTER WITH R LOAD

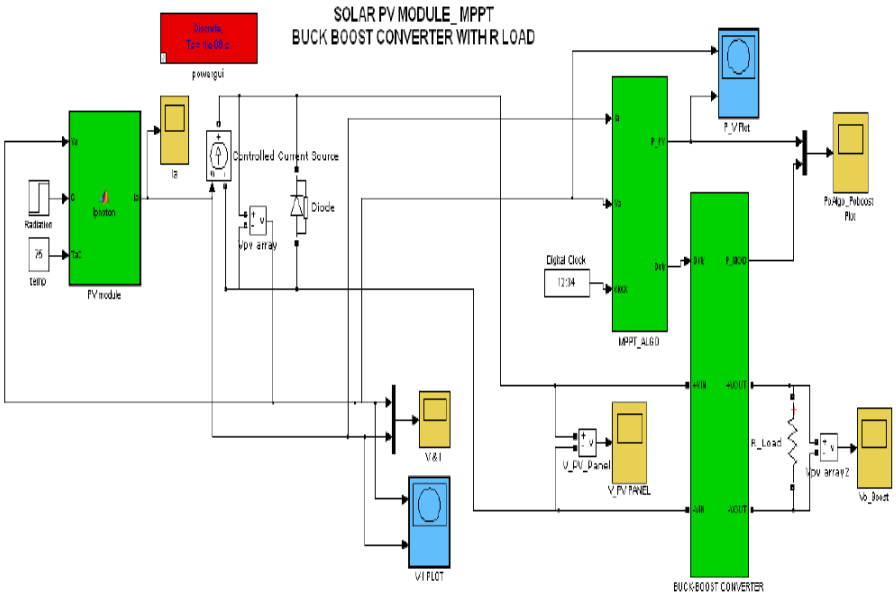

Figure 6: Simulink Model Incremental Conductance Method

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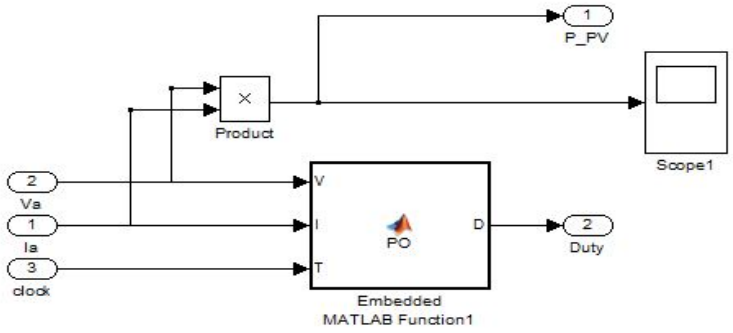

Figure 7: Matlab Embedded Function For INC Algorithm

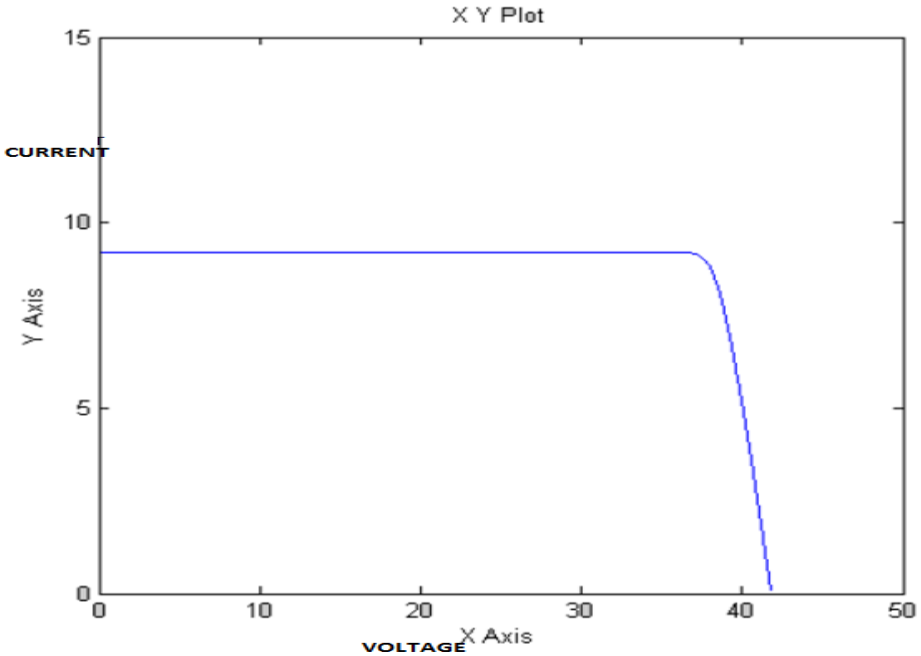

Figure 8: V-I Plot Of Solar Cells

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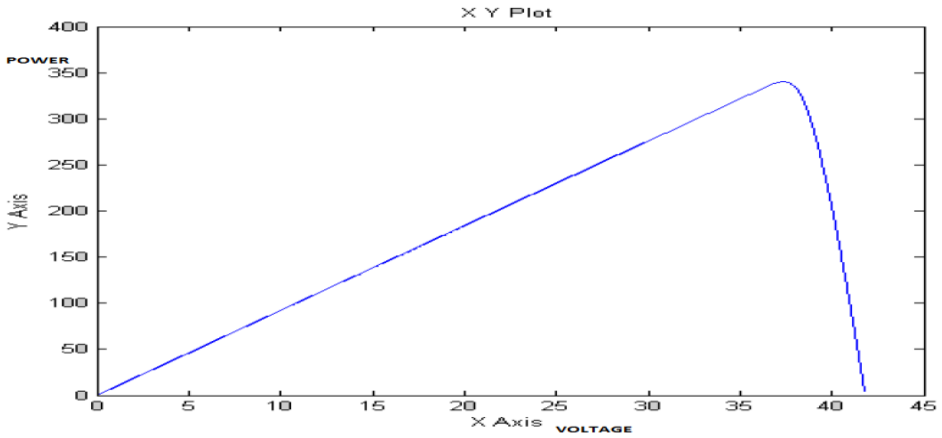

Figure 9: P-V Plot Of Solar Cells

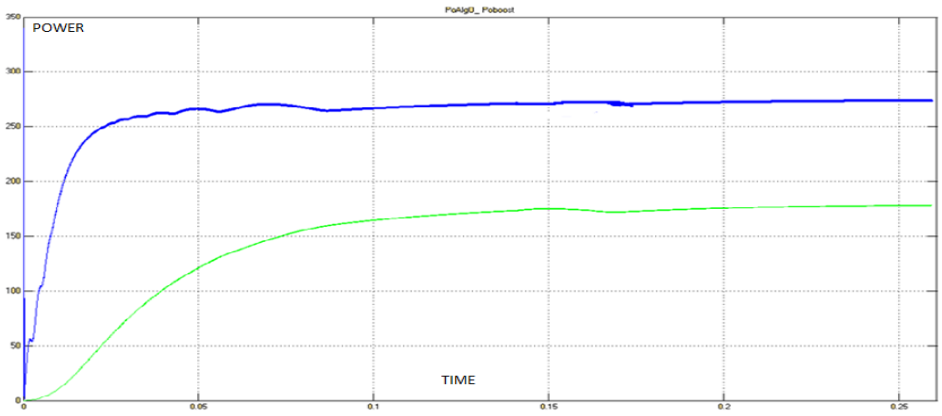

Figure 10 Power Output Of MPPT And Buck Boost Converter

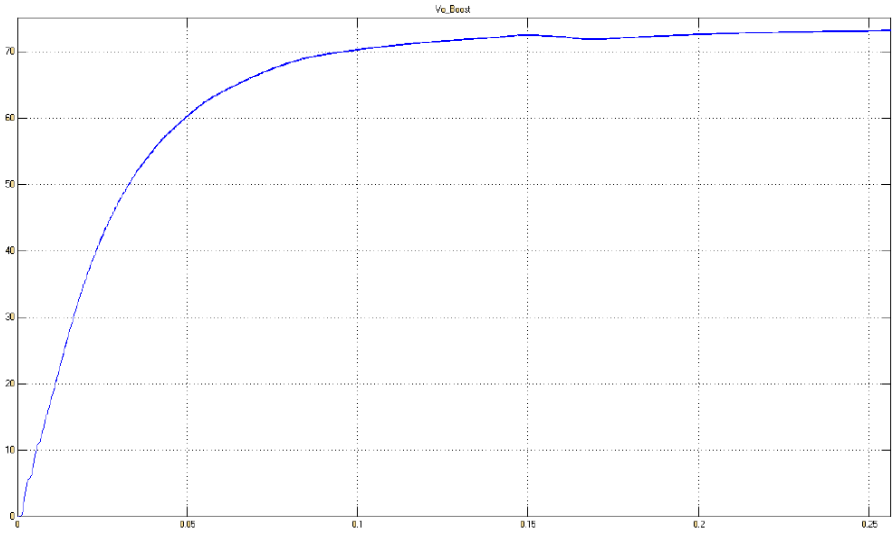

Figure 11: Voltage Output Of Buck Boost Converter

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VIII CONCLUSION

According to the Simulink model of solar cell with boost converter and MPPT system using INC method we conclude that The MPPT controller adjusts the duty cycle of the boost converter on the event of any change in the irradiance to deliver maximum power possible. Even though the P&O and INC method tracks the maximum power under varying atmospheric condition, the INC method tracks the maximum power efficiently than P&O method. The MPPT method simulated is also able to improve the dynamic and steady state performance of the PV system.

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BIOGRAPHY

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