Priyanshu Sona Journal of Engineering Research and Application *www.ijera.com*
ISSN : 2248-9622, Vol. 8, Issue 7 (Part -III) July 2018, pp 35-39

RESEARCH ARTICLE OPEN ACCESS

Solar PV Analysis with MPPT and DC Motor Application

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ABSTRACT: As of recent study, the enthusiasm for solar energy has ascended because of surging oil costs and natural concern. In numerous remote or immature regions, guide access to an electric framework is inconceivable and a photovoltaic inverter framework would make life considerably more straightforward and more advantageous. Solar energy, brilliant light and warmth from the sun, has been reined by people since antiquated circumstances utilizing a scope of consistently advancing innovations. Solar brilliant energy represents the majority of the usable sustainable power source on earth. Photovoltaic (PV) is a technique for producing electrical power by changing over solar radiation into coordinate current power utilizing semiconductors that display the photovoltaic impact. In this proposition, the PV cluster is demonstrated and its voltage-current attributes and power-voltage qualities are mimicked and enhanced which is utilized to drive a DC machine engine. The primary encumbrance for the compass of Photovoltaic frameworks is their low proficiency and high capital cost. Here we mean to look at a schematic to draw out most extreme possible solar power from a PV module for use in a DC application. The idea of Maximum Power Point Tracking is to be executed which brings about calculable increment in the productivity of the Photovoltaic System. Diverse plans of MPPT calculations, for example, Perturb and Observe, Neural Network are to be examined and executed. The MPPT calculation therefore proposed will recognize the reasonable duty ratio in which the DC/DC converter ought to be worked to get most extreme power yield. The advantage of this theory is to offer access to an everlasting and contamination free use of energy.
Keywords: MPPT, PID, Solar, DC Motor

Date of Submission: 10-07-2018 Date of acceptance: 24-07-2018

I. INTRODUCTION

The world interest for electric energy is always expanding, and regular energy assets are reducing and are even undermined to be drained. Also; their costs are rising. Therefore, the requirement for elective energy sources has turned out to be essential, and sun powered energy specifically has ended up being to be an extremely encouraging option in light of its accessibility and contamination free nature. One of the significant worries in the power segment is the everyday expanding power request yet the inaccessibility of enough assets to take care of the power demand utilizing the regular energy sources. Request has expanded for sustainable wellsprings of energy to be used alongside traditional frameworks to take care of the energy demand. Inexhaustible sources like breeze energy and sun oriented energy are the prime energy sources which are being used in such manner. The persistent utilization of non-renewable energy sources has caused the non-renewable energy source store to be lessened and has radically influenced the earth draining the biosphere and aggregately adding to a worldwide temperature alteration. [5]

Sun based energy is bounteously accessible that has made it conceivable to gather it and use it appropriately. Sun oriented energy can be an independent creating unit or can be a framework associated producing unit relying upon the accessibility of a lattice close-by. In this manner it can be utilized to power country regions where the accessibility of networks is low. Another preferred standpoint of utilizing sun oriented energy is the versatile operation at whatever point wherever important. [7]

With a specific end goal to handle the present energy emergency one needs to build up a proficient way in which power must be removed from the approaching sunlight based radiation. The power change systems have been extraordinarily lessened in estimate in the previous couple of years. The improvement in power hardware and material science has helped specialists to come up little yet powerful frameworks to withstand the powerful request. Be that as it may, the disservice of these frameworks is the expanded power thickness. Pattern has set in for the utilization of

multi-input converter units that can adequately deal with the voltage changes. Yet, because of high creation cost and the low

proficiency of these frameworks they can scarcely contend in the aggressive markets as a prime power generation source. [1]. PV Diagram is shown in figure 1.

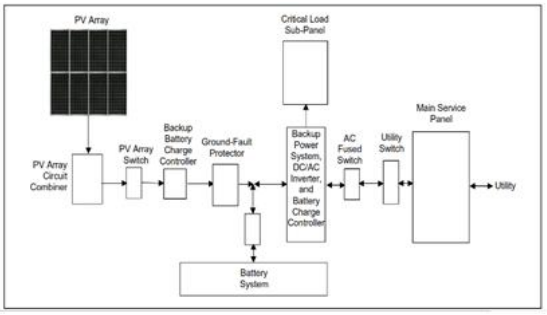

Figure 1: PV Diagram

Proposed Methodology & Simulation Results

Figure 2 shows model for DC Motor in which speed is controlled by the use of ANN (Artificial Neural Networks).

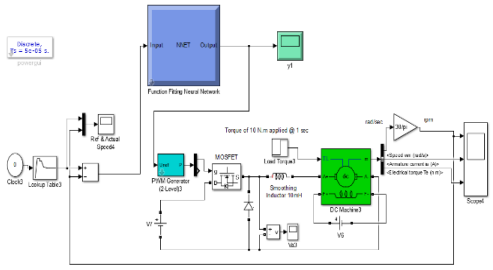

Figure 2: ANN based DC Motor Speed Control Model

In this model, a look up table is used to give reference speed for DC motor in RPM. Then a ANN based fitting network is used to generate a duty cycle. With the help of this duty cycle, a pulse is generated to give input to the gate of MOSFET of DC-DC converter. The DC Machine of the model consists of torque input armature input and supply input, which gives output in the form of speed in radians/sec which is converted in RPM. The other output is armature current and torque. The outputs of the model in Figure 2 are shown in Figure 3 below.

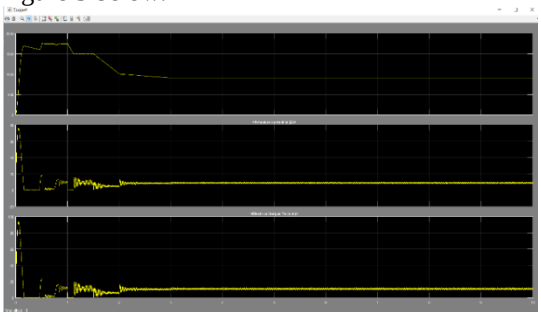

Figure 3: Output for ANN based DC Motor Speed Control

Figure 4 gives model for MPPT in solar PV cell using PandO method, which is used further to control speed of DC Motor. This model consists of pv panel with MPPT using PandO and then fed to a boost converter. The ouput waveforms are shown in figure 5.

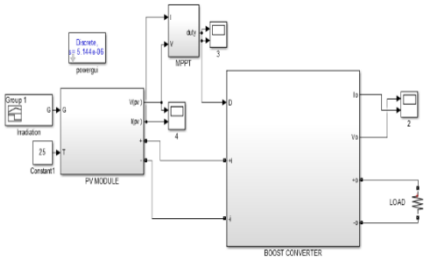

Figure 4: PV Module PandO MPPT Boost Converter

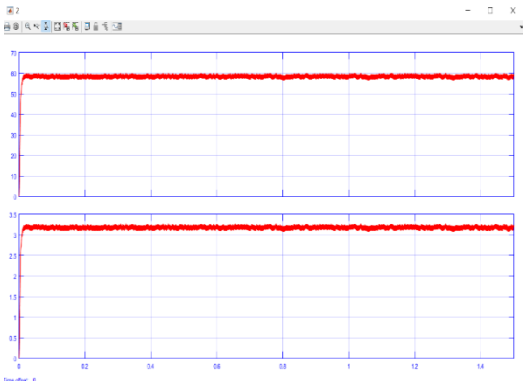

Figure 5: Output of MPPT Solar PV Boost

The output shown in Figure 5 is achieved from the input power shown in Figure 6 waveforms below.

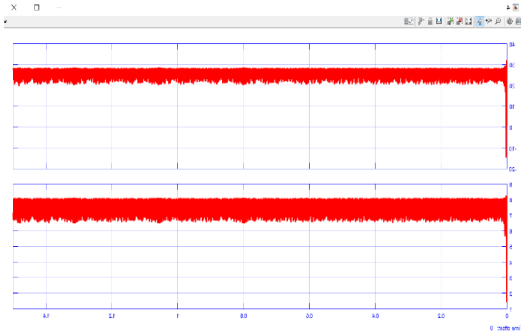

Figure 6: Input Voltage and Current for MPPT

The duty cycle is shown in figure 7 and Figure 8 for DC Motor model and for MPPT model. This can be varied I accordance with the input parameters like irradiance, temperature and input reference speed.

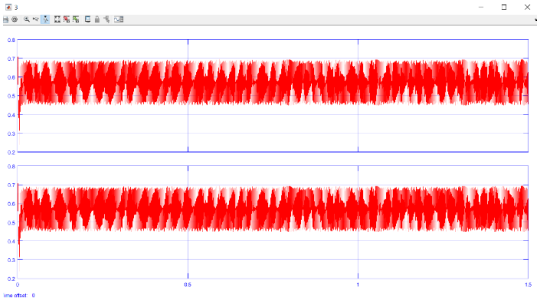

Figure 7: Duty cycle for MPPT model

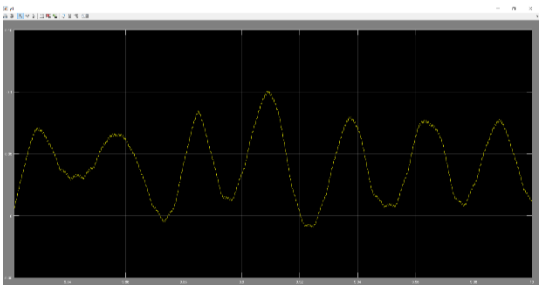

Figure 8: Duty Cycle variations for DC Motor Model

The final model for PV arrays DC motor speed control is shown in figure 8, In this figure, two pv arrays are input to the boost converter which drive the DC motor to the desired speed in accordance to enabling and disabling of the PV arrays as shown in the figure 8. In this a input stream of irradiance is set in such a way to produce maximum stability and maximum output efficiency at the output. The speed control mechanism of the DC motor is controlled by the two PV arrays which are fed with different irradiance duty cycle and produce a combined output. This duty cycle using a PWM generator controls the behaviour of MOSFET gate which in turn controls the output of the boost converter. The output of the boost converter is fed to DC machine to trigger the DC motor, produces the required torque and the DC motor gives the final output in terms of RPM, Armature current and torque of DC motor.

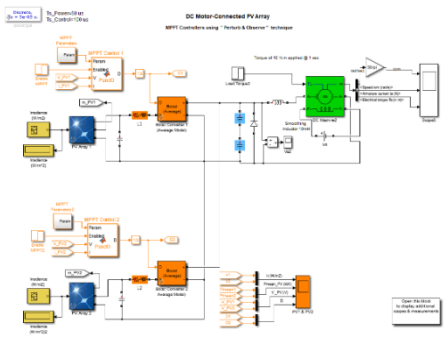

Figure 8: Proposed PV array DC Motor Speed Control Model

The outputs of the PV arrays are shown in figure 9 and 10 of the first pv array and for the second pv array the characteristics are shown in figure 11 and figure 12. The figures 9 and figure 11 shows the output of individual cell and the combined effect of the array is shown in 10 and 12 figures.

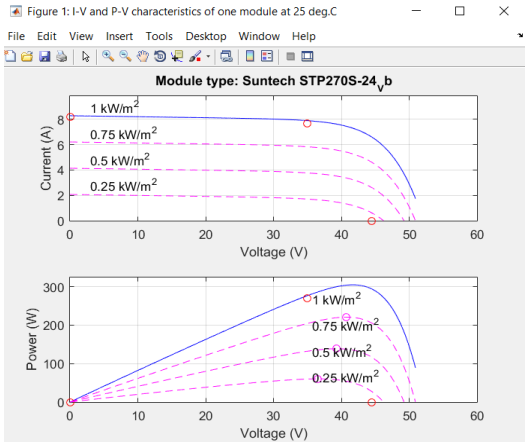

Figure 9: I-V and P-V of one PV1 module

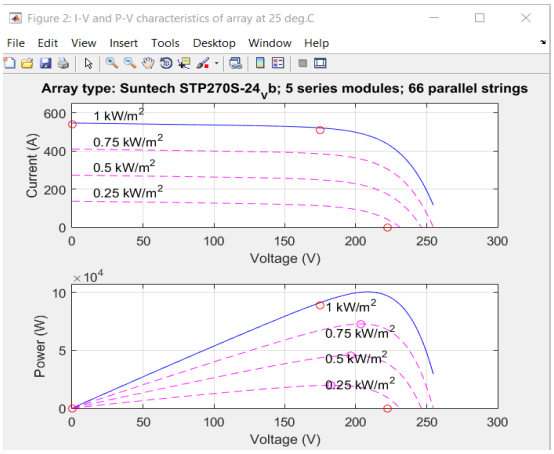

Figure 10: I-V and P-V of one PV1 array

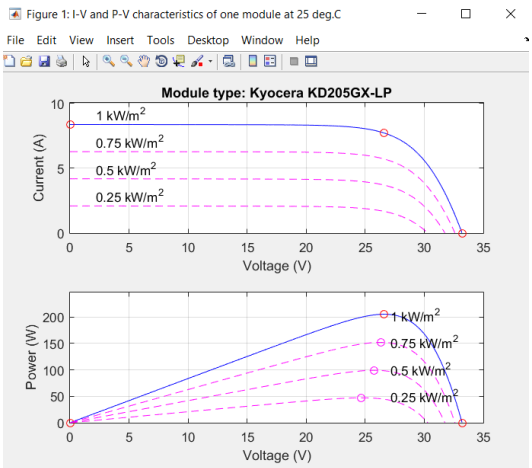

Figure 11: I-V and P-V of one PV2 module

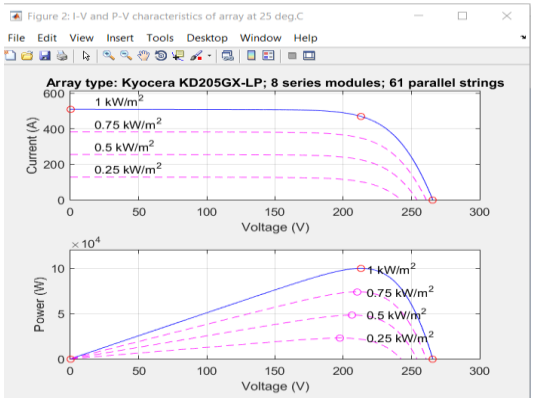

Figure 12: I-V and P-V of one PV1 array

Figure 13 shows the output of the PV arrays for different irradiance, power, duty cycle and voltage outputs are also shown.

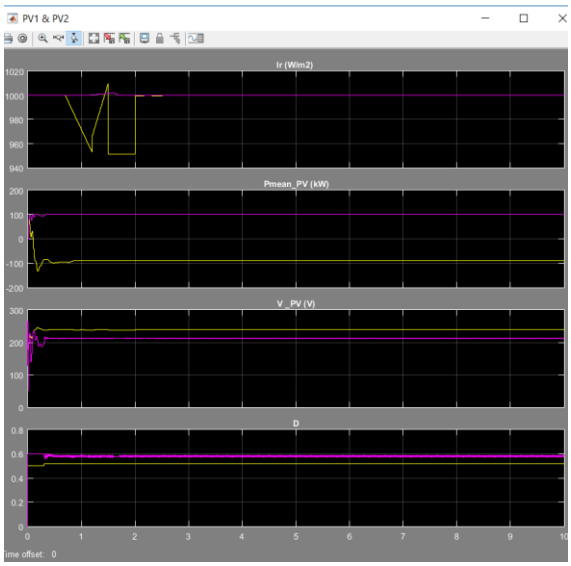

Figure 13: PV1 and PV2 arrays outputs

Figure 14 shows the output of DC motor in terms of RPM, armature current and torque. From the figure it is analysed that the stability is increased for DC motor in terms of speed, torque and armature current.

Figure 14: Final PV array DC Motor Outputs

II. CONCLUSION

In this mathematical model of a photovoltaic panel has been developed using MATLAB Simulink to drive DC motor with a specific speed. The P&O and Incremental conductance MPPT algorithms are discussed and their simulation results are presented. It is proved that this method has better performance than simple ANN based DC motor model. These algorithms generally improve the parameters dynamics and steady state performance of the photovoltaic system as well as it improves the efficiency of the BUCK BOOST converter system. The stability period of DC motor is improved by 68.9% improving the efficiency of the system.

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Priyanshu Sona "Solar PV Analysis with MPPT and DC Motor Application "International Journal of Engineering Research and Applications (IJERA) , vol. 8, no.7, 2018, pp.35-39