EXTRACTION OF BOOSTED SOLAR POWER BY BOOST CONVERTER DESIGNED WITH INC TECHNIQUE

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Abstract

The most easy and cost-effective source of energy that may be used to produce power at a load center is solar energy. Additionally, it has a low recurring cost and a modest starting cost. Sustainable electricity extraction is employed. Power extraction must be maximized for the SPV array to be used effectively. This is done by using an incremental conductance-based maximum power point tracking control.

Keywords: PV array, MPPT Boost Converter, Incremental Conductance Technique.

Introduction

The photovoltaic effect, which may transform sunlight into electricity, is what makes PV cells function. They absorb a portion of the solar energy, which causes current to flow between two electrically charged layers that are opposed to one another. The electrical output when numerous solar cells are coupled may be large despite the comparatively low power output of individual sun cells. To provide the required peak voltage output, the cells, modules, and arrays can be linked in series, parallel, or frequently both ways. As a result, in order to evaluate the performance of various devices, the testing settings for efficiency must be properly controlled.

Any environmental changes that affect the generation of energy from a sustainable power source create requirements on the use of an MPPT Controller. Very in solar and wind energy systems, the impact is particularly severe. For solar systems, grid interconnection and shifting weather conditions are additional challenges. Solar PV conversion systems currently employ MPPT methods to deliver a steady power output. Therefore, it is essential to ensure that an MPP is present in both the I-V and P-V curves for a variety of irradiation and temperature.

Statement of the Problem

Under this scenario, solar energy may not be continuously available from the sun, and solar power may only be extracted in constant temperatures of at least 25^0 and $1000kw/m^2$ irradiation levels, however the magnitude of the power may be lower than what is needed. Therefore, we must increase the solar extraction power and rate utilizing the boost converter created using Incremental Conductance Method (INC) technology.

Objectives of the study

- To develop a model of utilizing the solar power.
- To Boost the solar output by using INC based boost converter.

Review of Literature

Chitra Laksmanasamy, and Porkodi Rathinasamy (2017) As the usage of renewable energy sources increased, photovoltaic systems which have more advantages than others were also used more frequently. Because of abrupt changes in solar radiation and other environmental circumstances, it is challenging to monitor the electricity generated by solar panels. Hence, power is extracted using the MPPT method. In this essay. The outcomes of the controller's design using the P&O and incremental conductance algorithms are contrasted. The simulation results show that the incremental conductance approach performs better.

Gomathi B and Sivakami P (2016) By employing adequate DC-DC converters and a highly effective Maximum Power Point Tracking (MPPT) algorithm to harvest the most power from the panel, the efficiency of the panels can be increased. The Incremental Conductance Algorithm, one of many MPPT algorithms available, is very effective since it has Steady State accuracy and is simple to adapt to changing environmental circumstances, enhancing the efficiency of PV systems.

Deepthi Pilakkat and S.Kantha Lakshmi (2020) Initially, while maintaining a constant cell temperature, the P-V (power-voltage) and I-V (current-voltage) characteristics are observed for various solar irradiation levels. Eventually, the features of PV panels have been investigated for a range of temperature values with constant irradiation levels. To comprehend the significance of MPPT approaches in PV systems, the impact of temperature and irradiance on the power, current, voltage, and duty ratio of the PV system with and without The MPPT algorithm is examined.

Research Methodology

For the purposes of the MPP, dp/dv is identical to zero, on which the algorithm of INC in MPPT depends. It was recommended to improve dynamic execution and tracking accuracy under quickly changing conditions. By figuring out the values of V(t) and I(t) at time t, the algorithm initiates the cycle. The instantaneous conductance is compared to INC to get the MPP. The control voltage (V_{ref}) is changed based on a comparison of the output. The associated equation used in this approach. This technique is based on understanding the G, PV conductance fluctuation and how it affects where the operating point is in relation to a Parts Per Meter (PPM).

As a result, the photovoltaic module's conductance is determined by the G PV's current to voltage ratio, as shown below:

The PV circuit's conductance G is:

$$G = \frac{I_{pv}}{V_{pv}}$$

In addition, an elementary change in conductance may be described by:

$$dG = \frac{dI_{pv}}{dV_{pv}}$$

The boost converter is utilised to "step-up" an input voltage to a greater level when a load requires it. This unique characteristic is made feasible by storing energy in an inductor and transferring it to the load at a higher voltage. This short essay lists some of the most prevalent flaws in increase regulators. A boost converter (also known as a step-up converter) is a DC-to-DC power converter that lowers current while raising voltage from its input (supply) to its output (load). At least two semiconductors (a diode and a transistor) and at least one energy storage device, such as a capacitor, inductor, or both, are present in this kind of switched-mode power supply (SMPS). Filters made of capacitors are often attached to such a converter's input (the "load-side filter") and output (sometimes in combination with inductors) in order to reduce voltage ripple (supply-side filter).

The boost converter can be powered by any suitable DC source, including batteries, solar panels, rectifiers, and DC generators. One DC voltage to another DC voltage is accomplished through a process known as DC-DC conversion. Boost converters are any DC-DC converters having an output voltage greater than the source voltage. A boost converter may also be referred to as a step-up converter because it "steps up" the source voltage. Because power (P=VI) must be maintained, the output current is lower than the source current. Voltage-lift type boost converters are a special form of boost converters used in solar photovoltaic (PV) systems. These power converters combine the diode, inductor, and capacitor components of a boost-passive converter to improve power quality and boost the efficiency of the complete PV system.

The boost converter is created with a few specifications as stated in the Table I below in order to maximize the power taken from the PV panel and solar energy that is to be fed to the MPPT designed boost converter.

TABLE I. SPECIFICATION OF BOOST CONVERTER

S. No	Parameters	Values
1.	Input Voltage, (V_i)	124V
2.	Output Voltage (V_o)	426V
3.	Duty Cycle, (D)	0.709
4.	Ripple Voltage, (V_{ripple})	1% of V_o
5.	Ripple Current, (I_{ripple})	10% of I_o
6.	Inductor, (L)	8.5 mH
7.	Capacitor, (C)	5.250 mf

Simulation model

The simulation of a solar PV array and a boost converter using MPPT is displayed in Fig. 1 below. Due to the sun's variable irradiation during the day, the output voltage of solar panels is not constant. Here, we have assumed a constant temperature of 25^0 C and an irradiance of 1000 w/m^2. To extract 120V from the SPV cell in the simulation circuit shown in the above figure. consequently, we are joined the SPV cell two series solar cells and eight parallel strings, and that voltage is fed to the MPPT boost converter designed with INC technique. boost converter generates 426V of boosted solar output you could use that improved solar output.

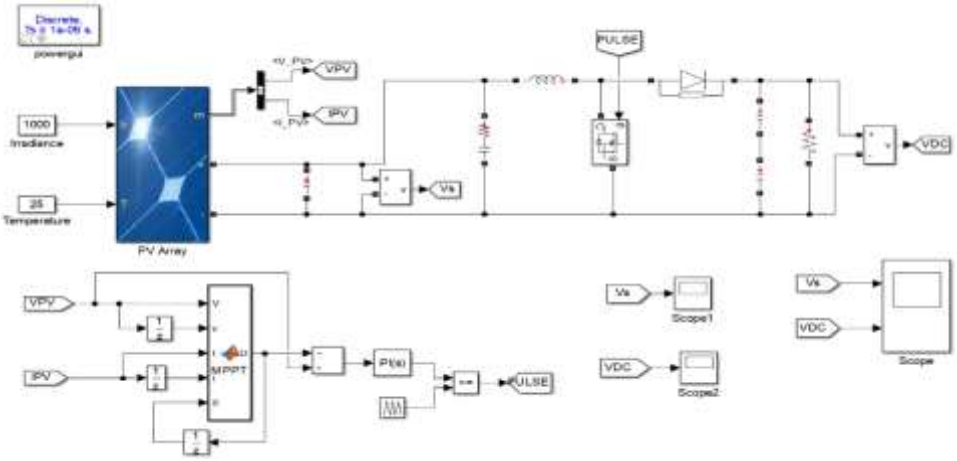

Fig. 1. Simulation Circuit of Solar Photo Voltaic Array with MPPT Boost Converter.

Results and Discussion

The Boost converter receives the PV output below displays the solar photovoltaic array's output voltage waveform in Fig 2.

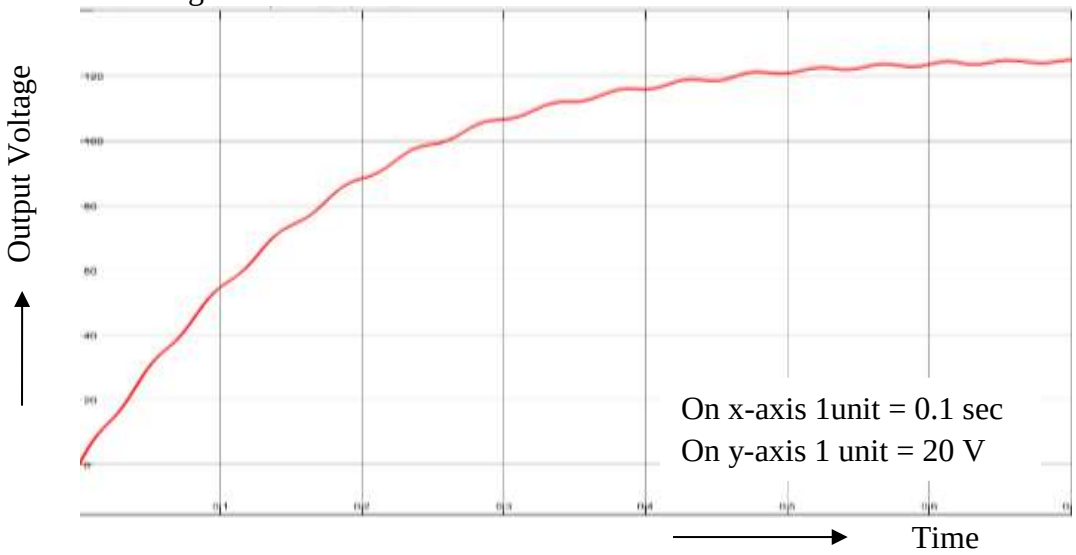

Fig. 2. Output Voltage Waveform of Solar Photo Voltaic Array.

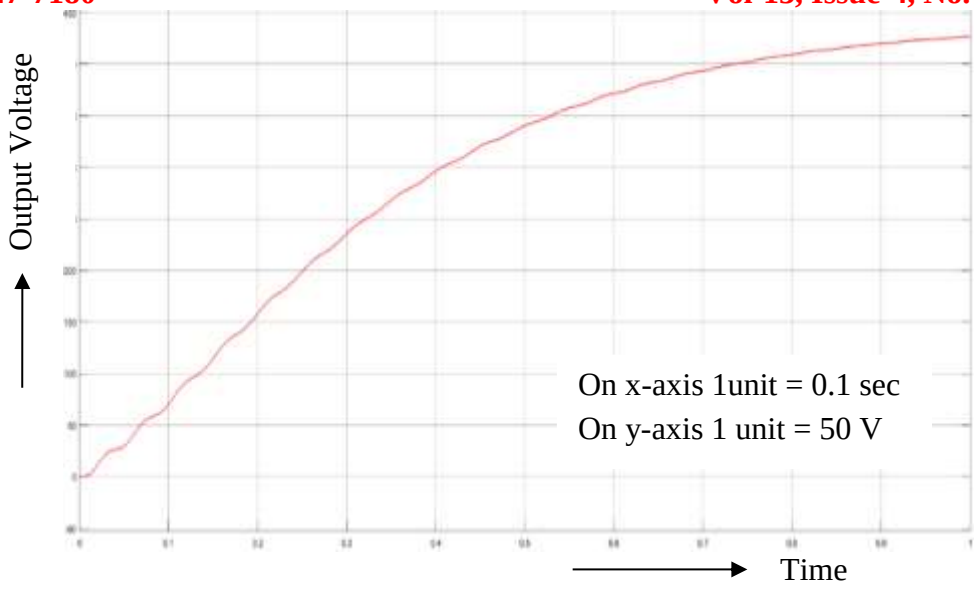

Fig. 3. Output Voltage Waveform of Boost Converter.

By using maximum Power Point Tracking(MPPT) Boost Converter Output Voltage. The boost converter takes the output from the MPPT technology, which extracts the greatest power from the solar array. The PV output voltage is increased from 125V to 426V by the boost converter's ultimate output voltage. Fig 3 depicts the Boost converter's DC output voltage waveform.

Conclusion

Maximum Power Point Tracking with Incremental Conductance is used to extract the most power from solar irradiation, and the output voltage of the solar photovoltaic cell is fed into the MPPT Boost converter, which then boosts the DC voltage. Circuit for solar simulation and DC output.

References

[1] Chitra Laksmanasamy, and Porkodi Rathinasamy, "Design and Simulation of Boost Converter with MPPT Techniques," IJACEE volume: 02 Issue: 05, May 2017, pp. 01 -06

[2] S.Narendiran, Sarat Kumar Sahoo and Raja Das, "Control and Analysis of MPPT Techniques for Maximizing Power Extraction and Eliminating Oscillations in PV System," International Energy Journal 16 (2016) 107 - 118

[3] Sohel Aziz Syed and Dr.Alice N.Cheeran, "Modelling and Simulation of Maximum Power Tracking Based PV Array and Utility Grid Interconnected System," International Conference on Recent Innovations in Electrical,Electronics & Communication Engineering –(ICRIEECE) 2018 IEEE.

[4] Gomathi B and Sivakami P, "An Incremental Conductance Algorithm based Solar Maximum Power Point Tracking System," IJEE Volume 9, Number 1 (2016), pp. 15 - 24.

[5] Deepthi Pilakkat and S.KanthaLakshmi, "Study of the Importance of MPPT Alogorithm for Photovoltaic Systems under Abrupt Change in Irradinance and Temperature Conditions," WSEAS TRANSACTIONS on POWER SYSTEMS DOI : 10.37394/232016.15.2 volume 15, 2020

[6] Shuhui Li, Senior Member, IEEE and Huiying Zheng, "Energy Extraction Characteristic Study of Solar Photovoltaic Cells and Modules," 978-1-4577-1002-5/11©2011 IEEE

[7] Pronab Kumar Adhikari and Rajat Goel, "INC-MPPT based Optimization of Solar Energy Harvesting System for WSN Nodes," Dogo Rangsang Research Journal Vol-11 Issue-01 – 2021.