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Improving the Efficiency of Pv Module By Using Dc-Dc Boost Converter And Incremental Conductance

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ABSTRACT-
The paper presents a highly efficient DC-DC Boost converter meant for utility level photovoltaic systems.
Solar photovoltaic cells are highly sought-after for renewable energy generation owing to their ability to generate power directly. However, the outputs of solar arrays range in lower DC voltage. It is therefore necessary to make use of DC-DC converters that can boost the output voltage and do so consistently by negating the variations in the outputs of solar panels. The variations arise from inconsistencies in sunlight availability, ambient temperature, and shadows, among other factors. The proposed converter topology is found to offer efficiency that is greater than 95% compared to the traditional DC-DC Boost converter. This configuration's main feature is the implementation of Advanced Perturb & Observation (APO) MPPT algorithm which basically features multiple iterations of perturbation and observation than in conventional P&O MPPT. APO will also minimize the development of oscillations close to the maximum power point in the P-V characteristics compared to the conventional P&O MPPT. The converter will enable drawing consistent and maximum levels of power from solar panels in a more efficient manner. As such, APO's usage in solar systems will be able to provide for a broader range of utility-level applications.

I. INTRODUCTION-

Power has been a major difficulty in the contemporary day since the supply does not keep up with demand. In this case, solar energy is a great choice for generating electricity. The main benefit of solarenergy is that it comes from sources that are efficient, clean, and good for the environment [4]. The energy that the solar panel receives is optical energy, which a converter may transform into electrical energy. DC power is what is being received as electricity. Since the majority of household appliances run on AC power, an inverter is employed. Horace de Saussure, a Swiss physicist, was the first to discover the usage of solar energy, a solar oven was created by. There is no need for power since this solar cooker heats food using the sun's rays.

Solar energy was found in the 19th century when it was discovered that some materials produce measurable current when the sun's light is incident upon them. Philipp von Lenard made the discovery of the fluctuation in electron energy with regard to light frequency in 1901.

Figure 1.1 depicts the fundamental operation of a solar panel. From the illustration, it can be seen that sunlight strikes the solar panel, creating electricity that flows through a charge controller and is then stored in a battery system.

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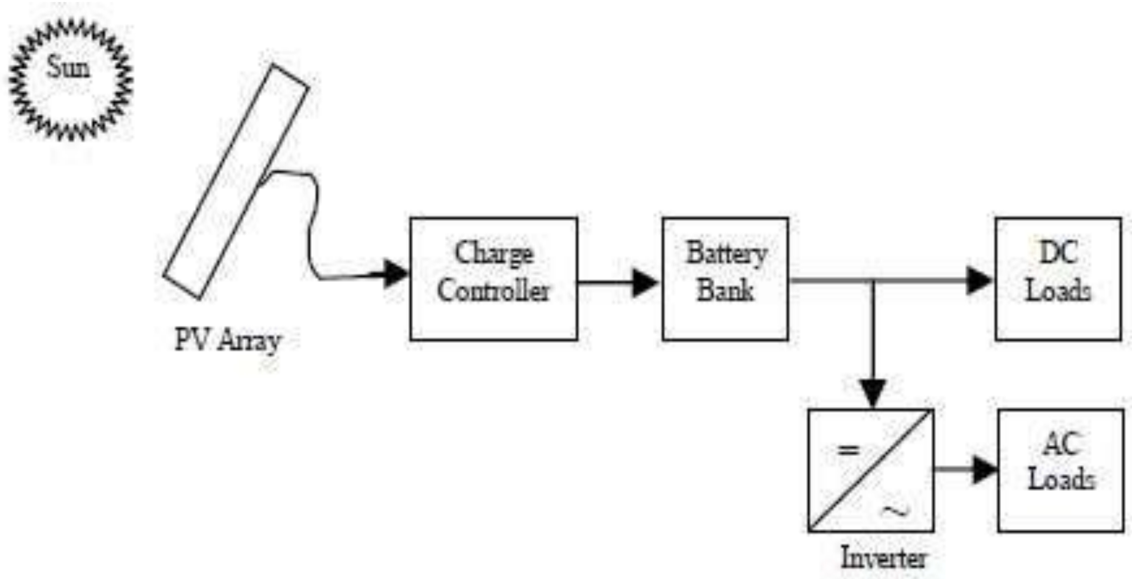

Figure 1.1: Basic working system of solar panel

In this dissertation, the design of a photovoltaic module is the main topic. A DC-DC boost converter and incremental conductance MPPT are used to increase the module's efficiency. Many MPPT techniques have been utilised in the recent years, some of which are simple and some of which are difficult. Incremental conductance MPPT is one of the sophisticated MPPTs with excellent efficiency, and DC-DC boost converter is utilised due to its simplicity.

DC-DC BOOST CONVERTER

The selection of a suitable converter is strongly advised in order to make a solar module operate effectively. Because of its ease of use and excellent efficiency, the DC-DC boost converter was chosen for this dissertation. A DC-Dc boost converter's primary function is to increase voltage while simultaneously decreasing current. The boost converter is driven by the inductor's propensity to reject current by creating or destroying a magnetic field. A boost converter's benefit is that it ensures that the output voltage always exceeds the input voltage.

There are several further varieties of converters, like Cuk Converter and Sepic Converter. Due to the use of an inductor at the output stage, the Cuk Converter has reduced switching losses and formerly offered a better output current characteristics graph [1]. However, despite all these benefits, there are some drawbacks as well. For example, the Cuk Converter is a complicated converter, and losses are higher due to the usage of more capacitors and inductors than usual.

A form of DC-DC converter known as a sepic (single ended primary inductance converter) converter produces a positive, controlled output voltage from an input voltage. The primary benefit of the Sepic converter is its versatility; it may function in three various modes, including continuous, discontinuous, and conduction. Sepic converters are extremely helpful in applications where it is necessary to increase or decrease the battery voltage. However, as the Sepic converter employs more inductor and capacitor, losses are also higher.

Because the output voltage of a DC-DC boost converter is always larger than or equal to the input voltage, it is also known as a step up converter [9]. Due to its simplicity, the DC-DC boost converter has a very low error rate compared to other converters

A solar module with a DC-DC boost converter's fundamental construction is seen in Figure 2.4. A DC- DC boost converter is made up of at least one storage component, such as a capacitor or an inductor, and at least one semiconductor, such as a diode or a transistor

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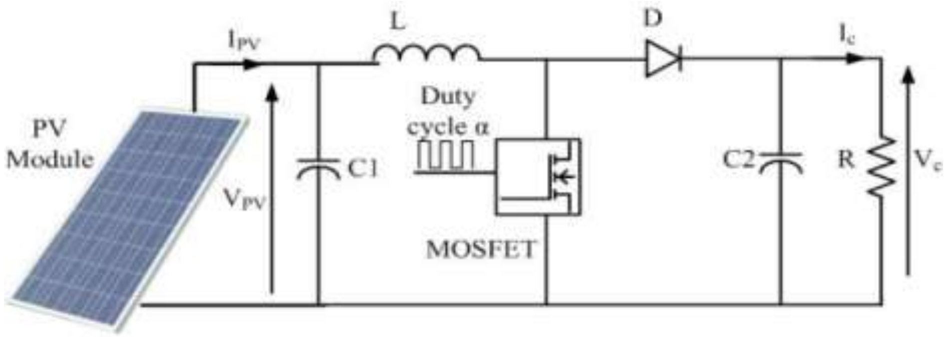
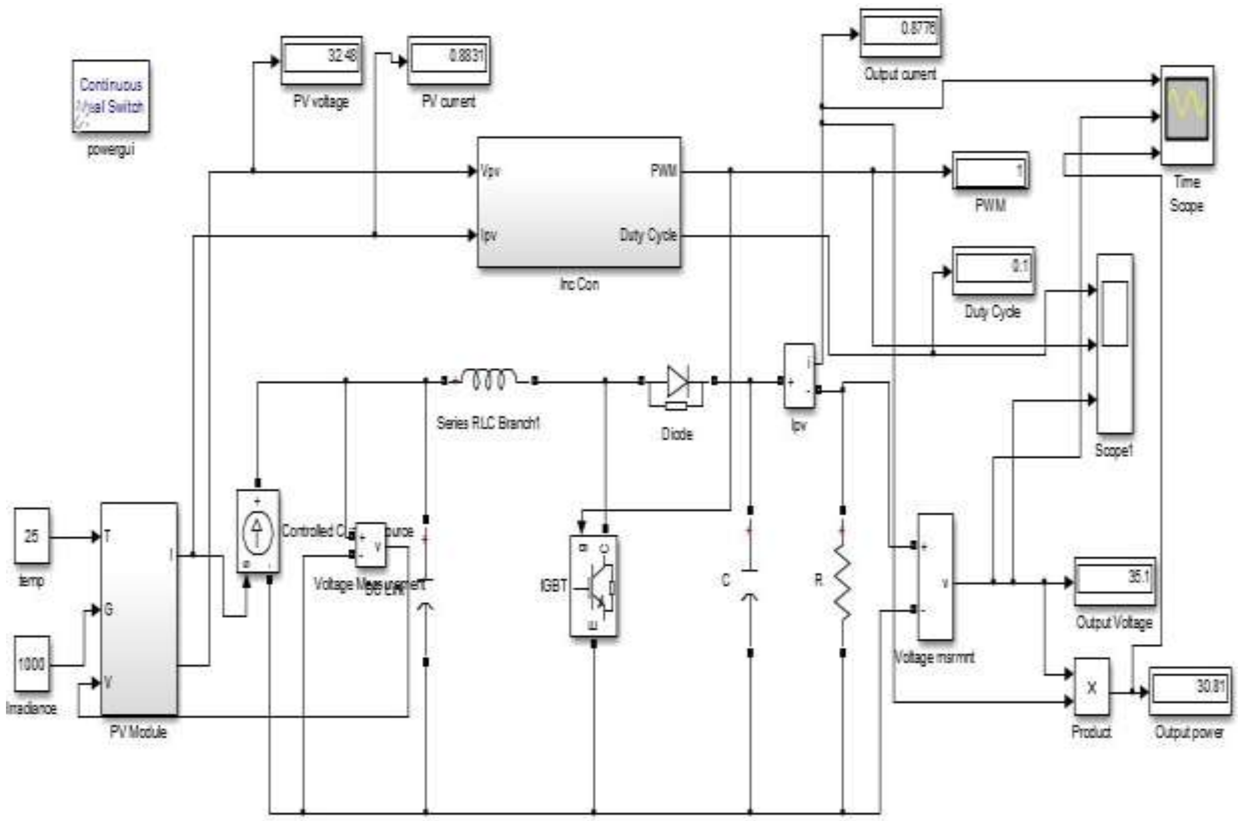


The Routing is dependent on the optical list of solution, taking into account the quality of the communication. The packet delay time and the remaining power of the sensor nodes as the nest hop. The proposed mechanism has been successfully studied and verified through the model, and the actual implementation of the state trials.

SIMULATION OF PHOTOVOLTAIC MODULEUSINGMPPTAND CONVERTER

Figure shows a experimental setup of photovoltaic module with the connection of incremental conductance maximum power point tracker using a DC-DC boost converter.

Figure : Experimental setup of PV module using incremental conductance MPPT and DC-DC boost converter



II. CONCLUSION

In this dissertation, two photovoltaic modules' performance has been examined after they were constructed, simulated, and tested using MATLAB/SIMULINK software. The objective of this study is to use a DC-DC boost converter and incremental conductance MPPT to increase the solar module's efficiency. Both modules were created utilising a DCDC boost converter and an incremental conductance maximum power point tracking method. The suggested system was built and simulated, and the concept's viability was established. (Paper1 is discussed in chapters 4.2 through 4.6, while Paper2 is described in chapter 4.7.)

A photovoltaic module's subsystem was developed and created in the first stage. After the PV module was built, it was simulated for various irradiations at constant temperature without attaching the Inc MPPT and DC-DC boost converter, and its output power was tabulated as well as characteristic graphswere shown.

In the next phase, a DC-DC boost converter is used to link the solar module to the incremental conductance maximum power point tracking system. The job of an MPPT is to maximise power, whereas the job of a DC-DC boost converter is to simultaneously increase voltage while decreasing current. In chapter 4, it is demonstrated that the power obtained by the photovoltaic module employing Inc MPPT and DC-DC boost converter is superior than the power obtained by the PV module without connecting them. After the PV module has been simulate.

For instance, employing Inc MPPT and a boost converter results in an output power of 12.16 watts for an irradiation of 950 W/m^2, whereas doing so without both results in an output power of 12.24 watts. Similar to this, when 37 cells are connected, and an irradiation of 800 W/m2, we receive 11.26 watts using Inc MPPT and boost converter, whereas 11.29 watts is the output power when not using Inc MPPTand boost converter.
Two photovoltaic modules with various cell counts and parameter values have been constructed in this dissertation. By maintaining a constant temperature of 25^o C, their performances under various irradiations have been examined.

Following the simulation and obtained results, it was confirmed that the use of incremental conductanceMPPT is simple and easily produced to achieve a desirable degree of effectiveness in a PV module's efficiency. The suggested system's outcome further demonstrates that it is suitable for implementing the maximum power. The various irradiations have produced the expected results.

III. FUTURE SCOPE

There is always a chance to increase the solar module's efficiency even after the usage of so many different technologies. Since incremental conductance is a type of MPPT that performs well under rapid changes in atmospheric conditions, but the change in the atmosphere changes the solar irradiations and temperature, or even both, so the solar irradiations and temperature can be given as variable inputs in the MATLAB/SIMULINK model rather than constant values as given in this dissertation.

REFERENCES

[1] Rumburg, J.P. Energy-based module ratings compared with field performance of single crystal, polycrystalline, and ribbon silicon photovoltaic modules. United States: N. p., 1984. Web.
[2] Nann, S., and K. Emery. “A Numerical Analysis of PV-Rating Methods.” The Conference Record of the Twenty-Second IEEE Photovoltaic Specialists Conference - 1991, doi:10.1109/pvsc.1991.169317.
[3] Knaupp, W. “Standardization of Data Sheet and Nameplate Specifications of Photovoltaic Modules.” Conference Record of the Twenty Fifth IEEE Photovoltaic Specialists Conference - 1996, 1996, doi:10.1109/pvsc.1996.564372.
[4] Yamashita, H., et al. “A Novel Simulation Technique of the PV Generation System Using Real Weather Conditions.” Proceedings of the Power Conversion ConferenceOsaka 2002 (Cat. No.02TH8579), doi:10.1109/pcc.2002.997629.
[5] Park, Minwon, and In-Keun Yu. “A Study on the Parameter Evaluation Method of Solar Cell.” 30th Annual Conference of IEEE Industrial Electronics Society, 2004. IECON 2004,doi:10.1109/iecon.2004.1431886.
[6] Koizumi, H., and K. Kurokawa. “A Novel Maximum Power Point Tracking Method for PV Module Integrated Converter.” IEEE 36th Conference on Power Electronics Specialists, 2005., doi:10.1109/pesc.2005.1581919.
[7] Roman, E., et al. “Intelligent PV Module for Grid-Connected PV Systems.” IEEE Transactions on Industrial Electronics, vol. 53, no. 4, 2006, pp. 1066–1073., doi:10.1109/tie.2006.878327.
[8] Gil-Arias, Omar, and Eduardo I. Ortiz-Rivera. “A General Purpose Tool for

Simulating the Behavior of PV Solar Cells, Modules and Arrays." 2008 11th Workshop on Control and Modeling for Power Electronics, 2008, doi:10.1109/compel.2008.4634686.

[9] Zakaria, Zakaria & Chen, Bai-Chao & Hassan, M.O.. (2008). Modeling of photovoltaic power plants. 3835 - 3839.

[10] So, Jung-Hun, et al. "Comparison Results of Measured and Simulated Performance of PV Module." 2009 34th IEEE Photovoltaic Specialists Conference (PVSC), 2009, doi:10.1109/pvsc.2009.5411771.

[11] Kwon, Cheol-Soon, et al. "Maximum Efficiency Point Tracking Algorithm for Photovoltaic Power Generating System." 2010 Second Pacific-Asia Conference on Circuits,Communications and System, 2010, doi:10.1109/paccs.2010.5627020.

[12] Ngan, Mei Shan, and Chee Wei Tan. "A Study of Maximum Power Point Tracking Algorithms for Stand-Alone Photovoltaic Systems." 2011 IEEE Applied Power Electronics Colloquium (IAPEC), 2011, doi:10.1109/iapec.2011.5779863.

[13] Safari, A., &Mekhilef, S. (2011). Simulation and Hardware Implementation of Incremental Conductance MPPT With Direct Control Method Using Cuk Converter. IEEE Transactions on Industrial Electronics,58(4), 1154-1161. doi:10.1109/tie.2010.2048834.

[14] Banu, I. V., and M. Istrate. "Modeling of Maximum Power Point Tracking Algorithm for Photovoltaic Systems." 2012 International Conference and Exposition on Electrical and Power Engineering, 2012, doi:10.1109/icepe.2012.6463577.

[15] Rathinadurai Louis, Josephine &Padmabeaula, A &Dhayal Raj, A & Helen Catherine, R.L.. (2013). Simulation of incremental conductance MPPT with direct control and fuzzy logic methods using sepic converter. Journal of Electrical Engineering. 13. 99-106.

[16] P.vitalrao, Dr.K.R.Sudha, S.Prameela Devi(2013). Incremental conductance (IncCond) algorithm for maximum power operating point(MPOP) of Photo-Voltaic (PV) power generation system . American Journal of Engineering Research (AJER), e-ISSN:2320-0847 p- ISSN:2320-0936.

[17] Li, H., Zhao, C., Wang, H., Xie, S., & Luo, J. (2014). An improved PV system based on dual axis solar tracking and MPPT. 2014 IEEE International Conference on Mechatronics and Automation. doi:10.1109/icma.2014.6885696.

[18] Abdulkadir, Musa, and Abdul Halim Mohammed Yatim. "Hybrid Maximum Power Point Tracking Technique Based on PSO and Incremental Conductance." 2014 IEEE Conference on Energy Conversion (CENCON), 2014, doi:10.1109/cencon.2014.6967514.

[19] Basoglu, Mustafa Engin, and Bekir Cakir. "A New Maximum Power Point Tracking Approach for Decreasing Convergence Time." 2015 IEEE 15th International Conference on Environment and Electrical Engineering (EEEIC), 2015, doi:10.1109/eeeic.2015.7165536.

[20] Hossain, M., Rahim, N., &Selvaraja, J. (2016). Comparative Performance Analysis of Maximum Power Point Tracking Technique for Large Scale Photovoltaic System. 4th IET Clean Energy and Technology Conference (CEAT 2016). doi:10.1049/cp.2016.1305.

[21] Soriano, L. A., Ponce, P., & Molina, A. (2017). Analysis of DC-DC converters for photovoltaic applications based on conventional MPPT algorithms. 2017 14th International Conference on Electrical Engineering, Computing Science and Automatic Control (CCE). doi:10.1109/iceee.2017.8108884.

[22] Nademi, H., Soghomonian, Z., &Norum, L. (2017). A robust predictive MPPT strategy: An enabler for improving the photovoltaic conversion source. 2017 IEEE 6th International Conference on Renewable Energy Research and Applications (ICRERA). doi:10.1109/icrera.2017.8191223.

[23] Bimenyimana, S., Asemota, G. N., & Li, L. (2017). Maximum power point performance tracking comparison between incremental conductance with perturb and observe algorithms in photovoltaic power systems. 2017 2nd International Conference on Power and (ICPRE).

[24] Kechiche, O. B., Barkaoui, B., Hamza, M., &Sammouda, H. (2017). Simulation and comparison of P&O and fuzzy logic MPPT techniques at different irradiation conditions. 2017 International Conference on Green Energy Conversion Systems (GECS). doi:10.1109/gecs.2017.8066266