International Journal of Scientific Research in Science and Technology
Available online at : www.ijsrst.com
OPEN ACCESS
Print ISSN: 2395-6011 | Online ISSN: 2395-602X
doi : https://doi.org/10.32628/IJSRST

Enhancement of Solar PV Panel Efficiency Improvement Using MPPT Control

[1]B. Murugan,[2]S. Arun,[3]K. Kanmani,[4]E. Nallarasan,[5]M. Mohamed Aashik
[1]Sr. Assistant Professor/HOD, [2]UG Scholar
Department of Computer Science and Engineering, RAAK College of Engineering and Technology, Puducherry, India

ARTICLEINFO

Article History:
Accepted: 01 May 2024
Published: 06 May 2024

Publication Issue :
Volume 11, Issue 3
May-June-2024

Page Number :
101-105

ABSTRACT

An embedded system is one kind of a computer system mainly designed to perform several tasks like to access, process, store and also control the data in various electronics-based systems. Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware. One of its most important characteristics of these systems is, it gives the o/p within the time limits. Embedded systems support to make the work more perfect and convenient. So, we frequently use embedded systems in simple and complex devices too. The applications of embedded systems mainly involve in our real life for several devices like microwave, calculators, TV remote control, home security and neighbourhood traffic control systems

Keywords : Renewable Energies, Solar Maximum Power Point Tracking

I. INTRODUCTION

Renewable energies have become integral to everyday appliances that require the most energy from the electricity grid, such as air conditioners. Solar Maximum Power Point Tracking (MPPT) Charge Controller is needed to extract maximum energy from photovoltaics. MPPT controllers, extract the maximum power from solar panels. MPPT controllers use an algorithm to track the PV panel performance and manage the PV panel voltage based on the maximum power point. It checks the PV output and stores it in the battery, then changes it to ac by using an inverter. The extraction of maximum power from the solar panels, using the sliding mode control scheme, becomes popular for partial weather atmospheric conditions due to its effective dynamic duty cycle ratio. However, the sliding mode control scheme was sophisticated with single integral and double integral sliding mode control scheme, which offer enhanced maximum power extraction and support enhanced solar panel efficiency in partial weather conditions. The operation of the sliding mode control scheme depends on the selection of a sliding surface selection based on the atmospheric weather condition, which enables the effective sliding duty cycle ratio operation for the DC/DC boost converter. The duty cycle ratio of the sliding mode control

various maximum power point tracking (MPPT) schemes. The major limitation of the sliding mode control scheme is to achieve the steady state voltage error of the solar panel in minimum settling time duration. The single integral sliding mode control scheme achieves the expected steady state voltage error limit but fails to resembles the usual dynamic behavior to achieve enhanced efficiency compared to the achieve minimum settling time duration.

Existing System

The single integral sliding mode control scheme achieves the expected steady state voltage error limit but fails to achieve minimum settling time duration. The single integral sliding mode control is extended to a double integral sliding mode control scheme to achieve both steady state voltage error limits within the minimum settling time duration.The SISMC is attains very high settling time .It has low efficiency.

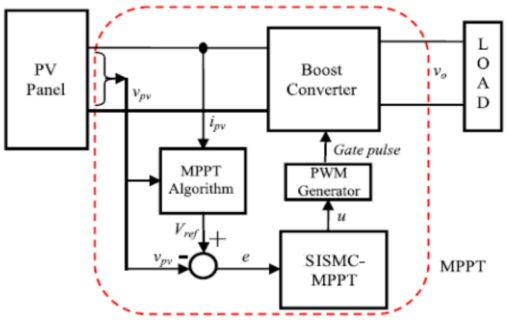


Fig 1 : Block Diagram of Existing System

Proposed System

The DISMC scheme allows us to obtain the higher sliding surface duty cycle ratio which acts as the input signal to the boost converter.This activates the enhanced stable and reliable system operation and nullifies the lacuna of maximum solar panel efficiency under partial weather conditions. The DISMC scheme of the MPPT technique comprised a PWM generator based DCDC boost converter fed from a solar PV panel.It has attains high efficiency and a very less settling time.

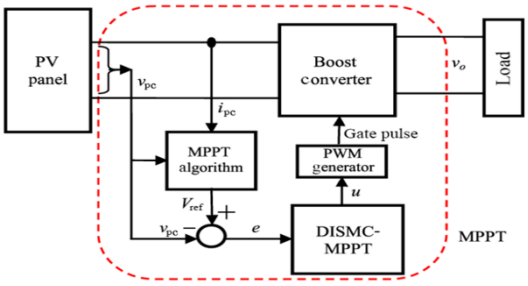


Fig 2: Block Diagram of Proposed System

Double Integral Sliding Mode Control

The DISMC scheme of the MPPT technique comprised a pulse width modulation (PWM) generator based DC boost converter fed from a solar PV panel [14, 15] . A holding circuitry with integrators receives the PWM information. The integrator produces a ramping response that size is inversely proportionate towards the pulse duration whenever the affirmative side of the pulses occurs. The proposed DISMC scheme was designed to enable the enhanced sliding surface switching actions so that the effective sliding surface duty cycle ratio obtains the constant potential to the DC-DC boost converter and the schematic view of this proposed DISMC scheme operation is observed in Fig. 1. There are two types of direct current to direct current operation modes: linear and switching. DC-DC conversions come in two flavors: switching and continuous. A switched-mode DC-DC converter operates by regularly holding the energy required and then transferring it towards the outcome at a higher-voltages than a linear DC-DC conversion, which creates and regulates a production value via a resistance power dissipation. A linear DCDC converter produces and regulates a certain output.Schematic view of solar PV system model with DISMC. voltage through the use of a resistive voltage drop, whereas a switched-mode DC-DC converter converts by accumulating input energy periodically and then releasing it to the output at a variable voltage. High energy converting circuitry known as DC converters utilizes inductive loads, transducers, or

capacitance to reduce voltage fluctuations and produce controlled DC outputs. Maximum power point (MPP) monitoring is among the crucial tasks that DC-DC conversion machines are capable of carrying out. The goal is to maintain the continuous operation of the solar energy system at its maximal power. The constant input-based DC-DC boost converter then generates the required power supply to the load under partial shading conditions with minimum settling time constraints. Therefore, the higher the effective dynamic sliding surface duty cycle ratio, the higher the solar panel efficiency observed. Enhanced cellular technologies, anti-reflective coverings, oxide layer coatings, reverse connection modules, concentrating solar cells, monitoring systems, along with thermal control, are some techniques to enhance and raise solar energy production. A nonlinear controller composite that combines backstepping and sliding mode controllers for DC-DC boost converters (DDBCs) fed by constant power loads (CPLs). A DCDC converter's order to sustain the desired output voltage when the input voltage varies is known as voltage regulating. The inductance in the series resistance has an unanticipated variation in the input signal, which is how the DC-DC conversion functions. The inductor absorbs power from the input while the switching is on and retains electromotive force. The power escapes if the valve is engaged.

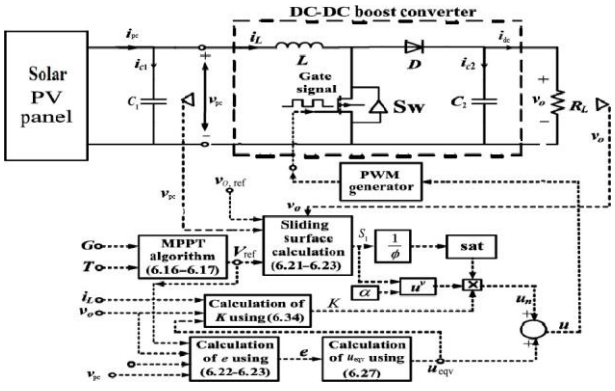


Fig 3 : DISMC-based MPPT design

The charge controller is employed to produce electrical outputs that are greater than the voltage being converted. In the interest of preserving the same load power, P D VI , a continuous power load is built to continuously regulate the power flow proportionally with the voltage waveform. In assessing the performance of models, like that of a changing type electrical supply, this inverted feature of a continuous power load is frequently helpful. Therefore, we need to provide energy to the feedback path to guarantee continuous power rather than supply current. The terminal voltage is then driven by the amplifier circuit to keep them identical after comparing a sampling of maximum output towards the standard. The nonlinear dynamical model is transformed into a simpler linear system with canonical form using an accurate feedback linearization technique Dynamic models use continuous translations or normal dynamical systems to model the time dynamics of a parameter value. The responses to these problems or transformations, as well as how they rely on the variables or beginning circumstances, are studied in the dynamical systems approach. A DC microgrid (DCMG) nonlinear decentralized double-integral sliding mode controller (DI-SMC). Ultimately, the DISMC program's utilization of two integral sections assures that every steady-state mistake that could exist can be eliminated, regardless if it is brought on by disruptions or modeling uncertainty. This DCMG comprises a hybrid energy storage system with a battery and supercapacitor energy storage technologies. Power generated by solar photovoltaic (SPV) devices meets the load requirement[19]. PWM does not decrease voltage or current; instead, it decreases averaging current as well as voltage by altering the ratio of on to off duration. This action lowers total energy, while immediate authority is determined by the combination of the two variables. The necessary action can be conducted to confirm the efficacy of the suggested DISMC-based MPPT system: modeling, comparing with other MPPT techniques, simulation results, and risk assessment. To contrast their performances and show the benefits of the SISMC

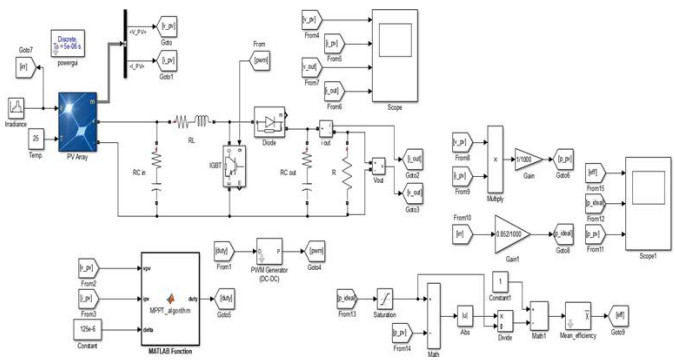
system over the SMC system, the SISMC system has been evaluated alongside the SMC method mentioned previously. The proposed DISMC scheme uses two integral blocks to minimize the steady-state error voltage of the PWM generator and the corresponding equations related to this DISMC scheme are given below to obtain the constant potential and current for non-linear type of load consideration conditions. PWM's primary benefit is the extremely low power loss in switching components. There is nearly no current when a switch is turned off, and almost no voltage drops across the switch when it is turned on and power is transmitted to the load.

Advantages of System-Level Modeling and Simulation

With system-level models and simulation, you represent your power converter as a behavioral model, based on combinations of algebraic and differential equations. This approach lets you:

- Employ various levels of fidelity depending on the application, from fast ideal switching behavior to more detailed transistor models that capture thermal and loss behavior
- Model circuit and control algorithms using a block diagram, a natural environment for control engineers
- Capture the dynamic response of the control system to varying power inputs and load outputs
- Validate control algorithms before coding and testing on hardware

Final MPPT Simulation Block Diagram:



Result:

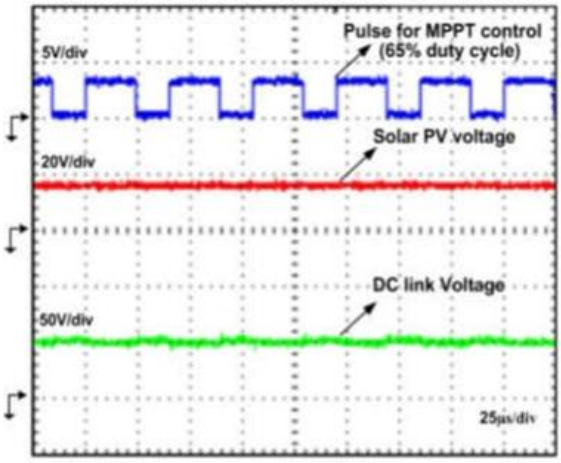


Fig 4 : Output diagram of MPPT

As contrasted with other methods already in use, the suggested P & O performance assessment achieves 99.10% effectiveness. Moreover, it achieves a very fast 0.035 s settling time.

In future work, we may focus on improving the efficiency and settling time of the proposed method by adding novel techniques.

II. CONCLUSION

In this regard developing more efficient charge controller is a progressive step to fulfil the need of power generation using green energy. For that purpose, it is our wish to continue further study on making the PV module more efficient.

(1) The proposed DISMC MPPT scheme is achieved enhanced solar PV panel efficiency for nonlinear load variations compared to SMC and SISMC MPPT schemes.

(2) The sliding surface duty cycle ratio of the proposed DISMC MPPT scheme achieves approximately unity which results in effective dynamic switching surface operations in partial shading conditions compared to other SMC and SISMC MPPT schemes.

(3) The settling time of the proposed DISMC MPPT scheme demonstrates the stable and enhanced reliable

operation compared to the SMC MMPT scheme and SISMC MPPT scheme.

(4) Therefore, the proposed DISMC scheme offers enhanced solar PV panel efficiency under partial shading weather conditions compared to other existing MPPT schemes.

(5) As contrasted with other methods already in use, the suggested DISMC's performance assessment achieves 99.10% effectiveness. Moreover, it achieves a very fast 0.035 s settling time. In future work, we may focus on improving the efficiency and settling time of the proposed method by adding novel techniques.

III. REFERENCES

[1]. Choudhary, dhananjay and saxena, anmol ratna (2014) 'DC-DC buck converter for MPPT of PV system', International Journal of Emerging Technology and Advanced Engineering, 4(7).

[2]. Kotak, V.C. and Tyagi, P. (2013) 'DC To DC Converter in Maximum Power Point Tracker', International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 2(12).

[3]. radio-electronis.com (no date) Available at:http://http://www.radioelectronics.com/info/power-management/switching-mode-power-supply/step-down-buck-regulator-converter-basics.php (Accessed: 10 July 2016).

[4]. Harjai, A., Bhardwaj, A. and Sandhibigraha, M. (no date) 'STUDY OF MAXIMUM POWER POINT TRACKING (MPPT) TECHNIQUES IN A SOLAR PHOTOVOLTAIC ARRAY', .

[5]. Putri, R.I., Wibowo, S. and Rifa'i, c M. (2015) 'Maximum power point tracking for Photovoltaic using incremental Conductance method ☆', Energy Procedia, 68, pp. 22–30. doi: 10.1016/j.egypro.2015.03.228.

[6]. Micro Systems, A. (2016) Allegro Micro Systems - ACS712: Fully integrated, hall-effectbased linear current sensor IC with 2.1 kV RMS voltage isolation and a low-resistance current conductor. Available at: http://www.allegromicro.com/en/Products/Current-Sensor- ICs/ZeroTo-Fifty-Amp-Integrated-Conductor-Sensor-ICs/ACS712.aspx (Accessed: 7 August 2016).

[7]. Kumari, S.J., Babu, C.S. and Professor, A. (2011) 'COMPARISON OF MAXIMUM POWER POINT TRACKING ALGORITHMS FOR PHOTOVOLTAIC SYSTEM',International Journal of Advances in Engineering & Technology ©IJAET, 1(5), pp. 133–148.

[8]. Keeping, S. (2014) Voltage- and current-mode control for PWM signal generation in DCtoDCswitchingregulators.Availableat:http://www.digikey.com/en/articles/techzone/2014/oct/voltage-and-current-mode-controlfor-pwm-signal-generation-in-dc-to-dc-switching-regulators (Accessed: 8 August 2016).92

[9]. Rahman, S., Sultana, N. and Masud, Q. (2012) Design of a Charge Controller Circuit with Maximum Power Point Tracker (MPPT) for Photovoltaic System.These is Report, BRAC University (2012), Available at:

[10]. http://dspace.bracu.ac.bd/xmlui/bitstream/handle/10361/2389/Design%20of%20a%20Charge%20Controller%20Circuit.pdf.pdf?sequence=1&isAllowed=y (Accessed: 15 May 2016).

[11]. Purschel, M. (2009) Automotive Power. Available at: http://www.infineon.com/dgdl/Reverse-Batery-ProtectionRev2.pdf?fileId=db3a304412b407950112b41887722615 (Accessed: 11 August 2016).