International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05 | May - 2023 Impact Factor: 8.176 ISSN: 2582-3930

MPPT Based Solar Inverter (Off Grid)

Dr. Devendra Holey[1], Sanjay Nishad[2], Nishant Bijewar, Uday kalaskar[4]

[1]*Assistant Professor Electrical Engineering, Karmaveer Dadasaheb Kannamwar College of Engineering, Nagpur, Maharashtra, India.*
[237]*Student, Electrical Engineering, Karmaveer Dadasaheb Kannamwar College of Engineering, Nagpur, Maharashtra, India,*

[1]devendra.holey@kdkce.edu.in, [2]nishadsanjay987@gmail.com, [3]nishantbijewar01@gmail.com, [4]udaykalaskar870@gmail.com

Abstract

Any environmental modifications place requirements on the generation of electricity from a sustainable power source. Particularly, its effects on solar and wind energy systems are more severe. Additionally, there are issues with (i) shifting climatic circumstances and (ii) grid integration for wind and solar systems [2, 3]. In order to provide a supportable power output, solar PV and wind energy conversion systems now use MPPT processes [4, 5]. Due to this, it is essential to confirm the existence of an MPP in the I-V and P-V curves for varied temperature and irradiation. This MPPT constantly alters its location in response to environmental changes. Therefore, MPPT controllers are a crucial component of the PV system because they are made to maintain the tracking of MPPT solar inverter. The system includes a boost converter that is designed to increase the power coming from the photovoltaic panel. This experimental system allows you complete control over a room with a 1 kW load. It aims to cut down on maintenance expenses. The P&O (Perturb and Observe) method, which is used to track the maximum power point, is given a controller. Utilizing an MPPT controller, the duty cycle for the boost converter's functioning is best controlled. The battery is charged by an MPPT charge controller, which is also fed to the inverter that powers the load. The intelligent MPPT algorithm and the P&O scheme with the fixed variation for the reference current were both able to locate the global Maximum power point, although the MPPT algorithm's performance was somewhat better.

Keywords --- Solar panel, Inverter, Motor, Sensor, MPPT, Solar Tracking System**.**

I. INTRODUCTION

The demand for electrical energy is constantly growing, and conventional energy resources are disappearing and are even vulnerable to be depleted A Maximum Power Point Tracking (MPPT) based solar string inverter is a type of solar power inverter that uses MPPT technology to optimize the power output from a solar panel array. In a solar panel system, the amount of power generated by the panels can vary depending on factors such as the angle of the sun, shading, and temperature. MPPT technology enables the solar inverter to track the optimal operating point of the solar panels, maximizing the power output of the system. This is achieved by constantly adjusting the voltage and current to ensure that the panels are always operating at their maximum power point . A solar string inverter is designed to convert the DC power generated by the solar panels into AC power that can be used by household appliances and fed into the grid. The MPPT technology is integrated into the inverter to optimize the power output of the panels and ensure maximum efficiency. In summary, a MPPT-based solar string inverter is a key component in a solar panel system, enabling the system to generate the maximum amount of power possible and ensuring the most efficient use of the solar energy produced.

II. OBJECTIVE OF THE PROJECT

Our objective is to design and implement the MPPT technique after the solar panel to obtain maximum output power from solar module. Also, to simulate the same in MATLAB and obtain the desired output.

III. BACKGROUND STUDY

String Inverter:

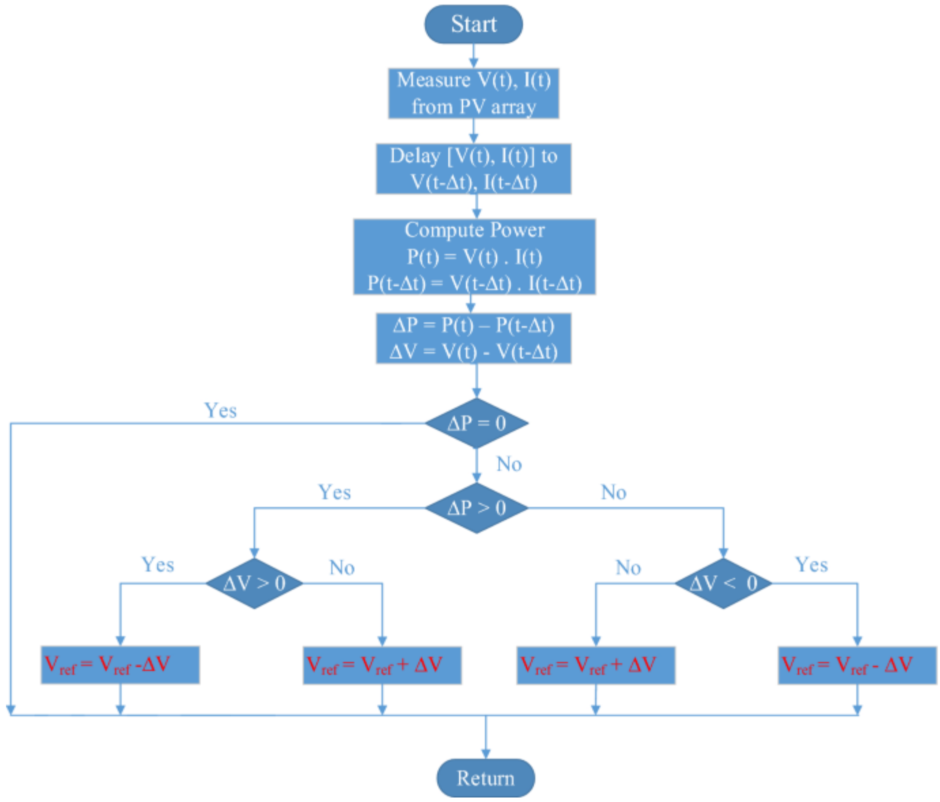
To improve on the drawbacks of the central inverters, the string inverters have been introduced.Each of the PV strings are connected to individual inverters for this configuration. In order to improve the power supplied by individual string to the central inverter, a DC-to-DC converter can be implemented. When this topology is compared to the central inverters where a single inverter is employed, there is better efficiency and reliability of the PV modules and the complete system. The response of the poor performance of a solar panel is limited to its string,thus the whole system is not affected. There is a separate inverter that converts from DC to ACat the output of the individual string, thus, the utilization of a central inverter is excluded. For this configuration, the MPPT control is achieved independently i.e., at each string providing overall energy of better-quality. More power electronic converters need to invested in due to the power mismatches which is still present in this configuration (Bouzguenda et al. 2011; Craciun et al. 2012; Yang & Blaabjerg 2015).

MPPT

MPPT stands for Maximum Power Point Tracking. It is a technique used in photovoltaic (PV) systems to extract maximum power from the solar panels. In a PV system, the amount of power generated depends on the amount of sunlight falling on the panels. However, the output power of the panels is not constant and varies with changes in environmental conditions such as temperature, shading, and the angle of incidence of the sun's rays. The maximum power point (MPP) of the PV system is the point at which the panels produce the maximum amount of power under a given set of conditions. The MPPT technique involves tracking the MPP of the PV system and adjusting the electrical load on the panels to keep them operating at the MPP. This is achieved by using an electronic control circuit that continuously measures the output voltage and current of the panels and adjusts the electrical load to keep the panels operating at the MPPT. By using MPPT, the efficiency of the PV system can be significantly improved, resulting in more power being extracted from the panels and better performance of the system overall. This is particularly important in off-grid systems where every watt of power is critical to the functioning of the system. In the source side we are using a buck convertor connected to a solar panel in order to enhance the output voltage so that it can be used for different applications like motor load. By changing the duty cycle of the buck converter appropriately we can match the source impedance with that of the load impedance. The MPPT technique we are using,

P&O MPPT

The Perturb and Observe (P&O) method is a widely used Maximum Power Point Tracking (MPPT) technique for photovoltaic systems. The basic principle of the P&O method is to perturb the operating point of the PV module and observe the corresponding change in the output power. The perturbation is done by either increasing or decreasing the PV module voltage or current, and the resulting change in the output power is observed. Based on this observation, the MPPT controller decides whether to further increase or decrease the voltage or current of the PV module. The P&O method requires a relatively simple control algorithm and can be easily implemented in hardware. However, it can suffer from oscillations around the MPP, especially under rapidly changing irradiation conditions. To overcome this limitation, several modifications to the basic P&O method have been proposed, such as the Modified P&O (MP&O) and the Improved P&O (I-P&O) methods. These modifications aim to reduce the oscillations and improve the tracking accuracy of the P&O method . Overall, the P&O method is a popular and effective MPPT technique for PV systems, especially for low-cost applications where hardware complexity and cost are important considerations.



Flowchart of the P&O algorithm

Boost converter

A boost converter is a type of DC-DC converter that steps up the input voltage to a higher output voltage. The boost converter operation involves a switch (typically a MOSFET or a BJT) that is turned on and off at a fixed frequency by a control circuit.

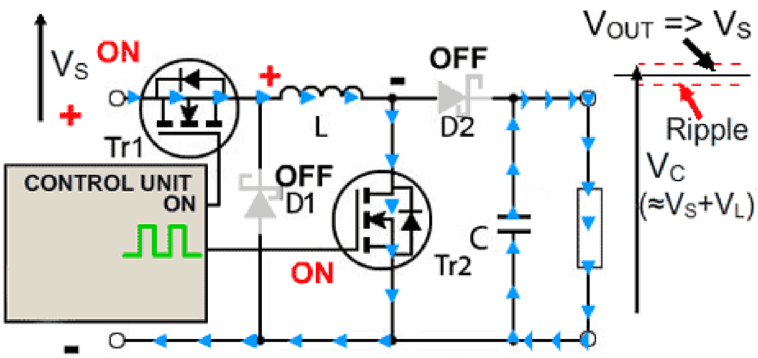


Fig.2.1. Operation as a Boost Converter During Tr2 'on' Period

In Boost Converter mode, during the on period of the switch, the input voltage is applied across an inductor (L) and the switch, which causes current to flow through the inductor and store energy in its magnetic field. During the off period of the switch, the inductor current continues to flow through a diode and charges a capacitor (C) to produce the output voltage. Now, during the on period of Tr2, the input voltage is applied across the primary winding of the transformer, which is connected to the switch (Tr1). The current flows through the primary winding of the transformer and stores energy in its magnetic field. At the same time, the secondary winding of the transformer (which is connected to the load) also stores energy in its magnetic field . When Tr2 turns on, the energy stored in the secondary winding of the transformer is transferred to the output capacitor (C) and load. This energy transfer causes the output voltage to rise, and the voltage across the primary winding of the transformer to fall. The voltage across the primary winding of the transformer is proportional to the input voltage, so as the voltage across the primary winding falls, the input voltage appears across the inductor (L) and Tr1. This causes current to flow through the inductor and store energy in its magnetic field . During the off period of

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05 | May - 2023 Impact Factor: 8.176 ISSN: 2582-3930

Tr2, the voltage across the primary winding of the transformer reverses polarity, and the energy stored in the magnetic field is transferred to the secondary winding of the transformer. This energy transfer causes the output voltage to remain higher than the input voltage, and the cycle repeats . Therefore, during the on period of Tr2, the boost converter operates by storing energy in the magnetic field of the transformer and transferring it to the output capacitor and load during the off period. The voltage across the primary winding of the transformer falls, which causes the input voltage to appear across the inductor and Tr1, and the cycle repeats.

IV. SIMULATION MODEL

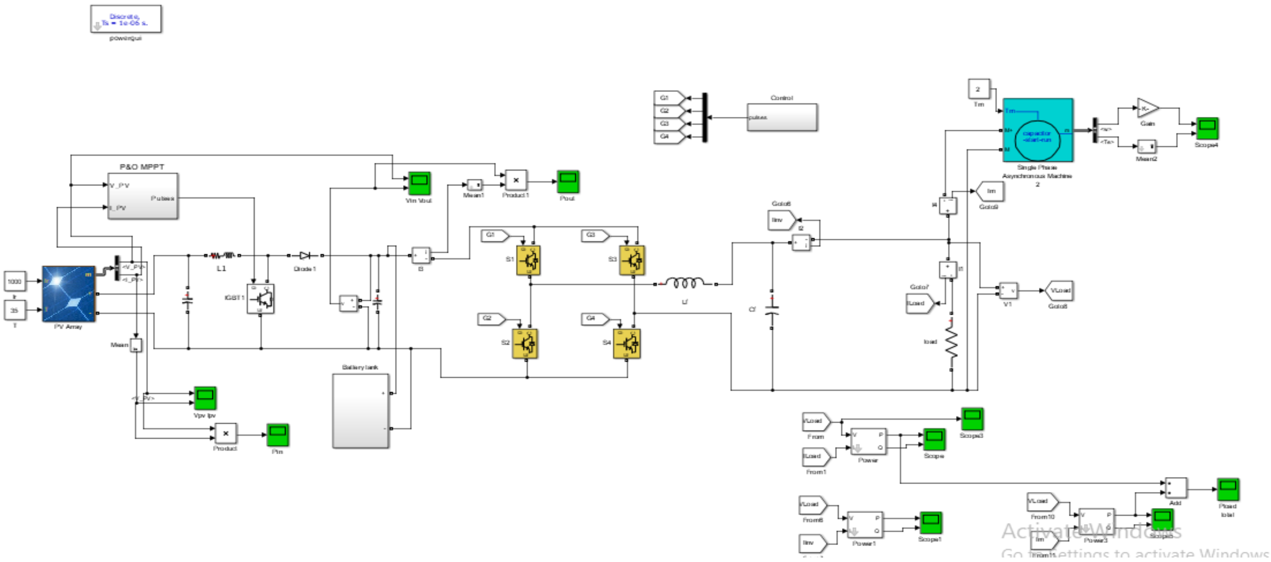


Fig.4.1. **Modeling of test system**

The above is the modeling of the proposed system with PVA. The solar inverter is connected with single phase 1HP induction motor load and 200 Watt resistive load.

V. Simulation Result

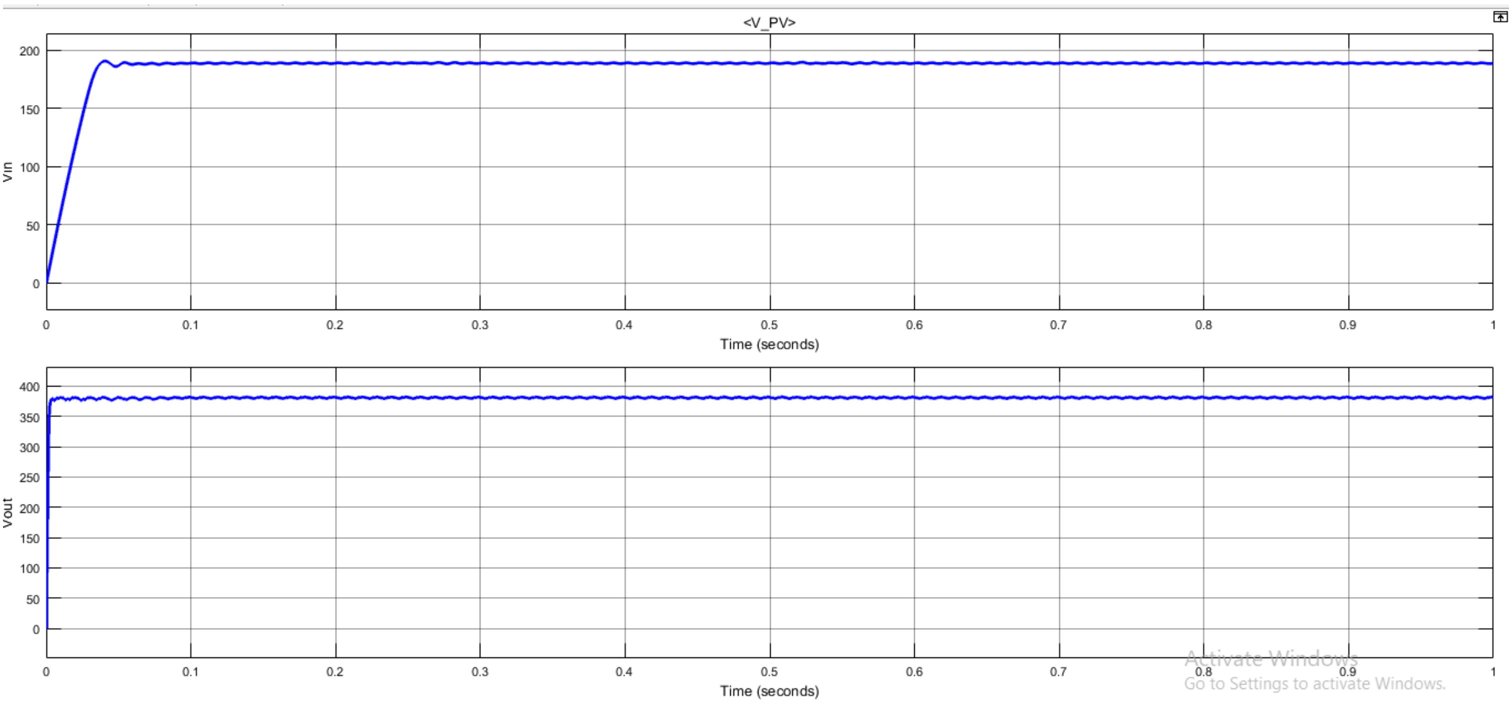


Fig.5.1. Input voltage of PV panel and output voltage of booster converter

The input voltage and output voltage of the DC-DC booster converter is shown above which is 150V to 300 V boosting. The below is the output power 1KW of the DC-DC booster converter.

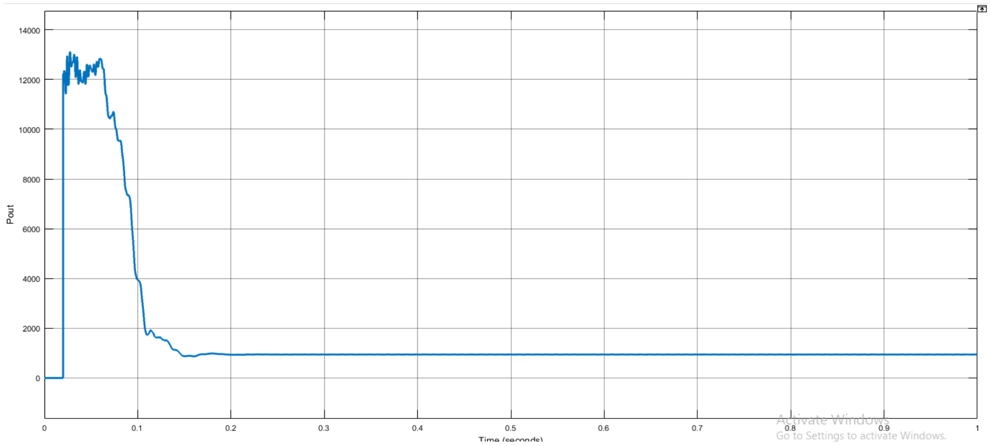


Fig.5.2. Output power of booster converter

The total power from the PVA is shared to the static load and dynamic IM load. The below are the characteristics of the IM for the given mechanical torque.

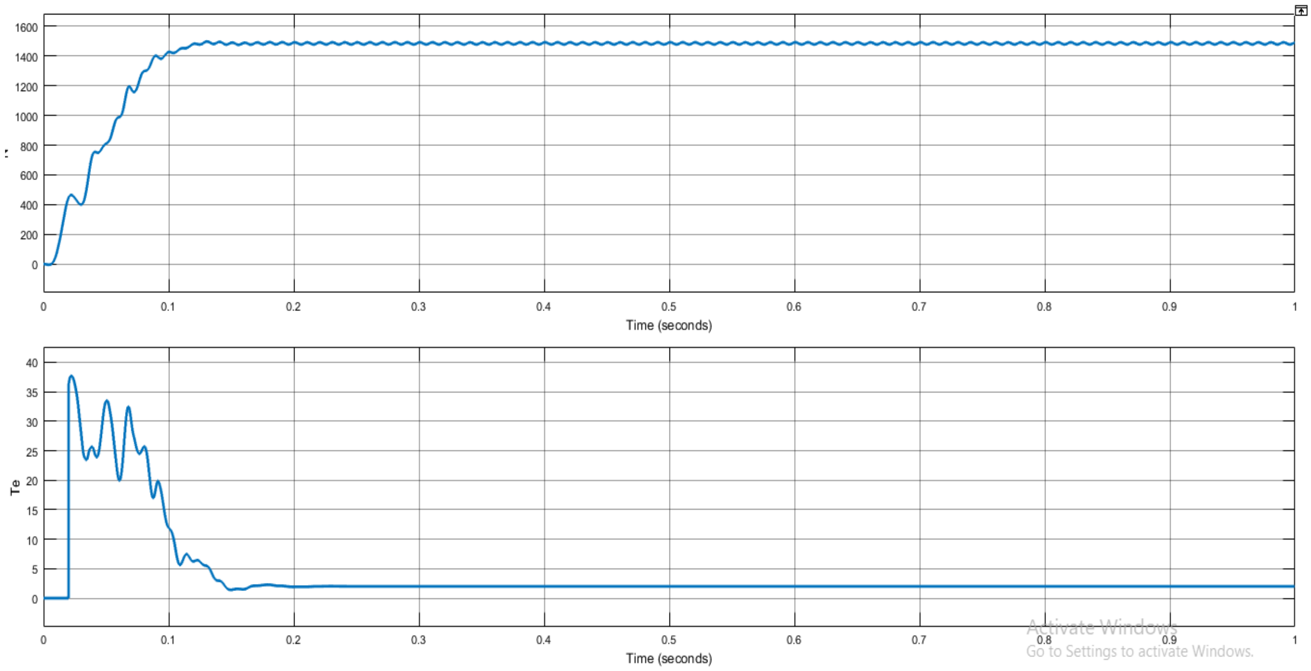


Fig. 5.3 Induction motor characteristics

VI. CONCLUSION

In this project, a PV MODULE, Boost converter, and P and O algorithm are used to simulate an MPPT solar controller setup. To increase the working efficiency of a solar PV panel, a perturb and observe MPPT technique has been devised. Studies using the Simulink solar PV model demonstrate the nonlinear I-V and P-V characteristics of the PV panel under various solar irradiation conditions, including 1000 W/m2, 800 W/m2, and 600 W/m2 and cell temperatures of 25, 50, and 75°C. As the irradiance level drops and the operating temperature of the PV cells increases, the output power of the PV system decreases. The P&O MPPT technology, which is employed to maximum the output power of the PV panel, can successfully run the system at a position extremely near to zero .The percentage deviation of the PV output power from the ideal PV power is about 10% for the tested operating condition of solar irradiance and cell temperature.

VII. REFERENCE

1. M. G. Simoes and N. N. Franceschetti, IEE Proc.-Electr. Power Appl., 146, no. 5, (September 1999)
2. Reisi, A.R., Moradi, M.H., Jamasb, S.: ‘Classification and comparison of maximum power point tracking techniques for photovoltaic system: a review’, Renew. Sustain. Energy Rev., 2013, 19, pp. 433–443
3. Salam, Z., Ahmed, J., Merugu, B.S.: ‘The application of soft computing methods for MPPT of PV system: a technological and status review’, Appl. Energy, 2013, 107, (6), pp. 135–148
4. Ram, J.P., Babu, T.S., Rajasekar, N.: ‘A comprehensive review on solar PV maximum power point tracking techniques’, Renew. Sustain. Energy Rev., 2017, 67, pp. 826–847
5. Kumar, D., Chatterjee, K.: ‘A review of conventional and advanced MPPT algorithms for wind energy systems’, Renew. Sustain. Energy Rev., 2016, 55, pp. 957–970
6. (September 1999) 2. N. S. D’Souza, L. A. Lopes and X. Liu, Concordia University Department of Electrical and Computer Engineering, IEEE, (2005)
7. M. Alata, M..A. Al-Nimr, Y. Qaroush, Energy Conversion and Management, 46 (2005) 1229– 1245
8. W. Batayneh, A. Owais, M. Nairoukh, Elsevier, Automation in Construction 29 (2013) 100–106
9. Advanced Algorithm for control of Photovoltaic systems - C. Liu, B. Wu and R. Cheung
10. A new Analog MPPT Technique: TEODI - N. Femia, G. Petrone, G. Spagnuolo, M. Vitelli