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Maximum Power Extraction from Solar Panel with SEPIC Converter under Variant Weather Conditions

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***Abstract*:- In this paper, the maximum power point tracking (MPPT) command used is a combination of two efficient and robust controls the PV generator is associated with INC and hybrid based MPPT technique to determine the voltage at which the power of the system PV is maximum (Vref). The hybrid control used allows the system to generate the maximum power by sending the exact duty cycle corresponding to the DC-DC converter. The studied system consists of a photovoltaic generator, DC-DC converter (SEPIC) and a resistive load. This approach has very good accuracy (low tracking error) and rapid response to varying atmospheric conditions. To examine the effectiveness of the proposed hybrid control in terms of performance, tracking speed and tracking accuracy, the system is developed in the Matlab Simulink environment.**

Keywords: Solar System, MPPT, SEPIC, DC-DC, Hybrid Controller

1. INTRODUCTION

The massive release of CO2 and its dangerous influence on the environment has become a major issue for the international committee. For this reason, renewable sources of energy acquire growing importance due to its enormous consumption and exhaustion of fossil fuel [1]. Energy policies are starting to replace fossil fuels with other renewable and green ones. Several renewable energy resources today are available, among those solar energy resources. Solar energy has grown very fast due to its availability, it also clean and efficient. The IC can determine that the MPPT has reached the MPP and stop perturbing the operating point [2]. The MPPT methods are therefore used by researchers, classical techniques such as perturbed and observer (P&O). The INC based MPPT technique will reduce the oscillations over the conventional P&O method.

The hybrid based control is also increases the accuracy of MPPT tracking as well as reference voltage accuracy. The use of SEPIC converter can both buck and boost the voltage without changing the input and output polarity. Energy produced in the electrical network or to supply isolated sites such as battery charging, home lighting, and the pumping system [3]. The atmospheric conditions, temperature and irradiation influence strongly on the production of energy by the photovoltaic system, these factors are so random. When the light increases the power of the generator increases the power of and when the temperature increases the power decreases this variation of the power according to the atmospheric conductions force the use of the techniques to continue the maximum power MPPT. Researchers still continue to improve and develop MPPT techniques [6].

2. EXISTING SYSTEM

The atmospheric conditions, temperature and irradiation influence strongly on the production of energy by the photovoltaic system, these factors are so random. When the light increases the power of the generator increases and when the temperature increases the power decreases this variation of the power according to the atmospheric conductions.

The maximum power for that radiation is hard to obtain from the solar panel. Likewise the connection of load straightly to the solar panel which will not generate the maximum power from the panel rather than it will supply only the power required to the load. The use of boost converter has the drawbacks of not bucking and boosting up the voltage. The MPPT tracking efficiency is also low. Several MPPT methods are therefore used by researchers, classical techniques such as Perturbe and Observer (P&O) which is based on the moving the operating point towards the point of maximum power by periodically increasing or decreasing the output voltage of the photovoltaic generator Vpv.

3. PROPOSED SYSTEM

The use of these MPPT techniques is to continue the maximum power. So that the system always works with its maximum power which whatever the value of the temperature and the irradiation. Researchers still continue to improve and develop MPPT techniques.

Several MPPT methods are therefore used by researchers, classical techniques such as Perturbe and Observer (P&O) which is based on the moving the operating point towards the point of maximum power by periodically increasing or decreasing the output voltage of the photovoltaic generator Vpv. The INC based MPPT technique will reduce the oscillations over the conventional P&O method. The hybrid based control is also increases the accuracy of MPPT tracking as well as reference voltage accuracy. The use of SEPIC converter can both buck and boost the voltage without changing the input and output polarity which is major drawback of the conventional buck-boost converter.

4. METHODOLOGY

MPPT-Maximum power point tracking technique

➢ ***BLOCK DIAGRAM***

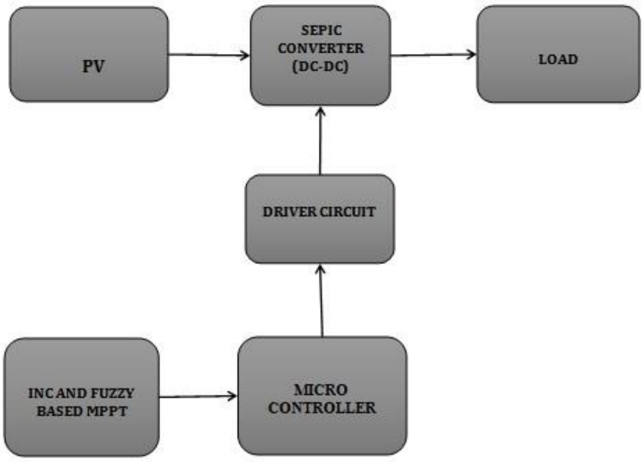

Fig.1 Flowchart of MPPT

The proposed block diagram consists of 100kw panel which is connected to the load with the help of SEPIC converter. The use of SEPIC converter is connected between the inverter for the maximum power point .the use of SEPIC converter fives the same polarity output from the input as well as single MOSFET switch is needed. The SEPIC converter switching pulses are given by the INC and hybrid based MPPT. The MPPT gives the necessary duty cycle to the PWM generator [8]. The PIC microcontroller is for generating necessary pulses to the converter to operate the PV in maximum power point. The output voltage of the SEPIC converter is controlled by controlling the duty cycle of MOSFET. SEPIC is a converter followed by a buck-boost converter; output has the same polarity as the input, coupling capacitor transfer energy from the input to the output.

The hybrid controller is applied to the SEPIC converter to mimic the new reference signal coming from the MPPT. The new duty cycle δ(k)of the SEPIC converter switch was adjusted either by adding or subtracting the previous duty cycle δ(k−1)with duty cycle's perturbation step size. Equation (1) presents the relation between the present and previous duty cycles, i.e.,

$$\delta(k)= \delta(k-1)\pm \Delta\delta \quad (1)$$

where Δδ is the change in duty cycle, resulting from the change of reference signal. The MPPT control technique is used to gain a new reference voltage for the hybrid controller witch changes the duty cycle of the PWM signal for the SEPIC converter. The typical solar panel converts about 30% –40 %of the incident solar isolation into electric energy [6]. The MPPT technique is used to improve the efficiency of solar panel. According to the maximum power theorem, the power output of circuit is maximum when the venin impedance of the circuit matches with the load impedance. There are several techniques to track the MPPT, but this paper deals with the incremental conductance. The incremental conductance method uses information of source voltage and current to find the desired operating point. From PV curve of PV module in Fig.2, it is clear that slope is zero at maximum point [6] so the formulas are as follows

$$(dP/dV)_{mpp} = (dVI/dV) \quad (2)$$

$$0 = I + V (dI/dV)_{mpp} \quad (3)$$

$$(dI/dV)_{mpp} = -I/V \quad (4)$$

Equation (4) is the condition to achieve the maximum power point, when the variance of the output conductance is equal to the negative of the output conductance, the module will work at maximum power point. The flow chart of the incremental conductance is shown in Fig.1. In this flow chart ,V(k) is the new detection voltage and I(k) is the new detection current, V(k-1) and I(k-1) is previous detection values. When the new value is read in the program, it calculates the previous value compared with the new one, and then determine the voltage differentials is zero or not, according to voltage differentials is zero, the current difference can be determined zero or not. If both of them are zero, it shows that they have the same value of impedance and the value of duty ratio will remain the same as before. If the voltage differential is zero, but the current differential is not zero, it shows that the isolation has changed. When the difference of the current value is greater than zero, duty ratio will increase, when the difference of the current value is less than zero, duty ratio will decrease [10]. If the voltage differential is not zero determine it weather satisfy the eq.(4) or not, when eq.(4) is satisfied, the slope of power curve will be zero that means the system is operating at MPP, if the variance of conductance is greater than negative conductance value, it means the slope of power curve is positive and the duty ratio is to be increased, otherwise it should be decreased[7].The motive is to automatically find the voltage Vmpp or current Impp at which a PV module should operate to obtain the maximum power output Pmpp under given temperature and irradiance.

5. SIMULATION RESULTS

The practical implementation of the proposed SEPIC fuzzy controller for the single phase inverter has been verified by applying the simulation on the MATLAB/Simulink.

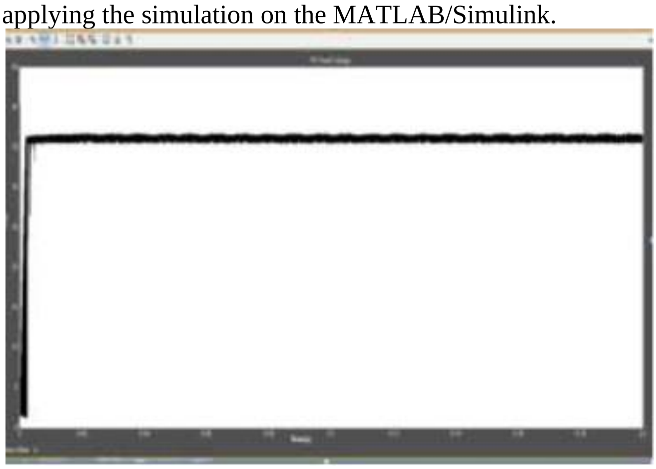

Fig.2 Output voltage signal of PV panel.

The output voltage and current signals of PV panel are shown in Fig.2 and Fig.3.respectively.Voltage of PV panel is 35V and current is around 9A.The output voltage and current signals of the proposed hybrid based MPPT at constant load condition are shown in Fig.3. It is noticeable that the signals were not smooth; on the contrary, they carried a component of the maximum power between voltage and current. The voltage range changed from 250v to 350v.

The controlled hybrid PWM signal can achieve two advantages to the inverter; first, it produces smooth error-free sine wave, and second, it achieves a smooth transition for the current signal and constant transition for the voltage signal.

Fig.3. Output current signal of PV panel

- ***ADVANTAGES***
  - The proposed algorithm extracts the maximum power efficiently from the solar panel.
  - Efficiency is high
  - Speed of response and accuracy is more.

6. CONCLUSION

In this paper is presented an MPPT technique is designed to control the photovoltaic system. This command takes into consideration the random change of the atmospheric conditions. The system studies include a 100 KW photovoltaic panel a DC-DC SEPIC buck boost converter, and a resistive load. The proposed MPPT technique and applies to convert DC-DC its duty cycle in order to follow the maximum power. The results of the simulation clearly showed the performance of this approach (speed of response, robustness and accuracy) to track the MPP under variant and non-uniform weather conditions.

7. REFERENCES

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