A LITERATURE SURVEY OF MPPT TECHNIQUES OF SOLAR PHOTOVOLTAIC SYSTEM WITH DC-DC CONVERTER

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ABSTRACT- Solar Photovoltaics plays an important role in meeting the power requirements of the current generation. Photovoltaic (PV) Systems have increased important attention due to its advantages like lavish availability, environmental nature and low maintenance required. The P-V characteristic of the solar panel has a different Maximum Power Point (MPP). The cost of electric power from the PV array is more expensive than the electric power from the other non- renewable sources. Maximum power point tracking (MPPT) is used to extract the maximum power from the solar panel and soft computing techniques are Artificial Intelligence-based fuzzy logic control, Neural network, etc…. Boost converter rises output voltage of thecosmological panel and converter output voltage be determined by upon the duty cycle of the MOSFET present in the boost converter. But the difficultascendswithpicking the suitable MPPT as each MPPT has its own merits and demerits. A paper presents a comprehensive review of MPPT techniques.

Keywords- MPPT, Artificial intelligence, DC-DC Converter, Photovoltaic systems.

1. INTRODUCTION

Photovoltaic (PV) generation systems have increasedthe importance due to increasing power demands and the reduction of fossil fuels. Renewable energy resource offers various advantages like plentiful availability, being environment-friendly and possibility of standalone installations. The power generated from the PV module mainly depends on the solar irradiance and the cell temperature.Renewable energy sources, the frontrunner is Wind energy followed by Solar Photovoltaics. Solar energy is the most lavish and Solar Photovoltaics (PV) is the best-known method of converting the incoming solar radiation directly into electrical energy. The output of a PV module is non-linear as it is hooked on the environmental conditions. So we make use of some procedures so that the maximum power at each instant can be effectively tracked from the PV system. These are known as Maximum Power Point Tracking Algorithms or Techniques. MPPT techniques range from simple, tough to highly complex. Most of the techniques sense the voltage/current or power; however, some methods sense temperature and irradiance level to achieve the MPP. The characteristics of a PV module that regulates the operating points for different operating conditions are the Power – Voltage Curve (P-V) and Current-Voltage curve (I-V). The max power is extracted while operating at the intersection of the I-V, P-V curve namelyV_{MPP} and I_{MPP}.
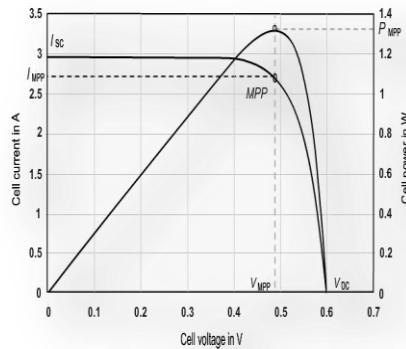
Fig 1 Power – Voltage curve and Current-Voltage Characteristics of solar cell

For tracking the maximum power present at any specific instance, we make use of MPPT techniques

Photovoltaic system with DC/DC converter

Solar or photovoltaic (PV) cells convert sunlight into useful electrical energy. When a cell is irradiated and it generates carriers to produce an electric current. DC/DC converter which is developed to maximize the energy harvest for photovoltaic system and wind turbines said to be power optimizers. DC/DC converter is said as a step-up or PWM boost converter. The DC-DC converter is used in an application where an average output voltage is higher or lower than the input voltage.
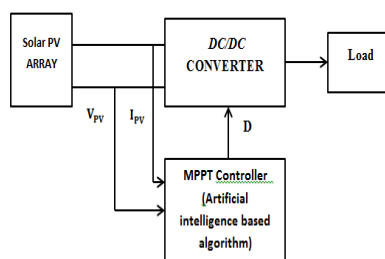

Fig2 block diagram of the proposed system

The input from the PV panel or solar cell will be varied based on the weather condition or irradiation level. Voltage and Current from the solar panel are given to MPPT Controller. MPPT controller had the much-advanced technique andartificial intelligence is the best technique among them. Fuzzy logic control, Neural network, Ant colony optimization, etc.,are based on Artificial intelligence. A transformer is not used in the Boost converter or non-

isolated DC/DC converter. The main apparatus of a boost converter are an inductor, a diode, and a high-frequency switch. The boost converter is working in two modes of operation. The working is based on the opening and closing of the switch.
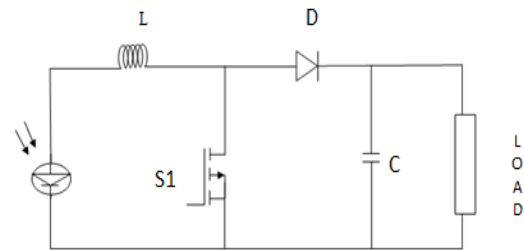

Fig 3 circuit diagram of the boost converter

In the first mode, switch s1 is closed; this is known as the charging mode of operation the inductor is charged by the source through the switch. The charging current is exponential yet simplicity is thought to be directly changing. The diode confines the progress of the current from source to the load and interest of load is met by the releasing of the capacitor. In the second mode, switch s1 is open; this is known as the discharging mode of operation and the diode is forward one-sided. The inductor presently releases and together with the source charges the capacitor and satisfies the load needs. The load current variety is extremely little and by and large is expected consistent all through the activity.

MAXIMUM POWER POINT TRACKING

For obtaining the most extreme accessible power at every moment, we utilize the MPPT procedure. In ordinary load line based MPPT strategies, the calculation facilities either voltage, current or the intensity of a PV Array and follows up on the ideal calculation. In any case, in artificial intelligence-based MPPT techniques, there is no restriction in detecting the parameters. It can act in understanding the parameters, for example, Temperature, Insolation level and so forth and expect the voltage, current or power. Man-Made thinking based strategies need not require any data on the general PV structure. Be that as it may, if AI

is applied similarly as if there should be an occurrence of load line based on techniques, it is seen as increasingly productive. So in this work, the information for preparing depends on the voltage, current or intensity of the PV array.

A.MPPT BASED FUZZY LOGIC CONTROL

Fuzzy logic controller (FLC) works with inaccurate input, it does not need a perfect mathematical model and it can handle nonlinearity well. FLS is a more robust link to the conventional nonlinear controller. The operation of FLC has four types namely, Fuzzification, rule base, inference engine, De-Fuzzification. Inputs of FLC are changing in power (ΔP_{PV}), change in current (ΔI_{PV}) at sample time k from the solar cell is used while the output of FLC is ΔV_{pv}^* or V_{pv} reference voltage to produce error signal E(k) and change in the error signal. The assigned membership plots for input and output. The two input variable is explained by

$$E(K) = \frac{P_{pv}(k) - P_{pv}\ (k-1)}{I_{pv}(k) - I_{pv}(k-1)}$$

Change in the error signal

$$dE(k) = E(k) - E(k-1)$$

During the Fuzzification process, the input variables are altered into linguistic variables based on crisp sets of the membership function. In this method, nine fuzzy levels namely - NB (Negative Big), NM (Negative Medium), NS (Negative Small), NZ (Negative Zero), ZE (Zero), PZ (Positive Zero), PS (Positive Small), PM (Positive Medium) and PB (Positive Big). The next one is the inference part, the most widely used method is Mamdani's s method. The final stage is the defuzzification will be a reverse process of fuzzification.
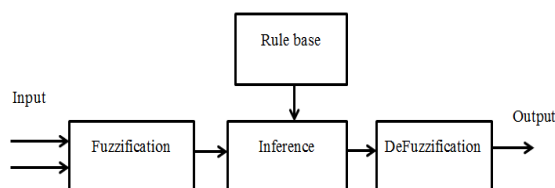

Fig 4 Fuzzy Logic Controller

The benefit of a fuzzy-based system is that it offers enhanced performance, strong and also it doesn't require the acceptance of the specific system to act upon. It cares to increase the response of the photovoltaic system The main drawback of this process is that the efficiency of the full system based on the operator performance and precision of the instructions.

B.MPPT BASED NEURAL NETWORK

A Neural Network is a group of electrical neurons related to numerous topology. The neural network consists of proof of identity and displaying the system using nonlinear and difficult task. Thus the knowledge of NN, the weight (W_j) is resolute. The NN experiences a variation cycle, through which the weight is modernized until the network influences a state of stability. It exactly recognizes the MPP using NN's the Wi has to be determined properly based on the bond between the input and the output of the PV system. The input signal to every neuron is either the signal established from nearby neurons or the NN input variables connected from the nonlinear system under study. In the application of NNs to MPPT, the input variables can be PV array limits like VOC and ISC, atmospheric data like irradiance and temperature, or any grouping of these.
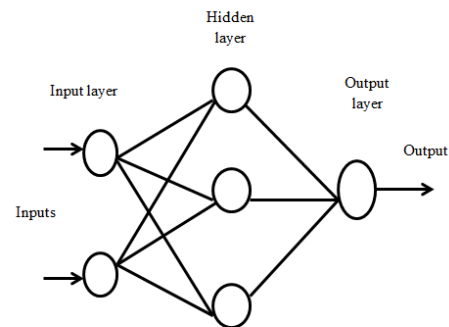

Fig 5 Neural Network

The output of NN is habitually one of the numerous reference signals, the most common of which is the duty cycle signal used to drive the power converter to operate at or handy to the MPP. The concert of the NN is contingent on the tasks used by the unknown layer and how well the neural network has been trained. The relations between the nodes are all weighted. The burdens are changed in the training method. To implement this training method, data of the designs between inputs and

outputs of the neural network are noted completely for a long period, so that the MPP can be reached exactly.

C.MPPT based Antlion Optimization Algorithm

The antlions fit the family of the Myrmeleontidae. Their names initiate from exceptional chasing style. For chasing, antlions make a vertical cone-shaped pit in send by burrowing towards the back. The diameter and size of the cone depend on the quantity of starvation and the size of the moon. In the full starvation or full moon, the diameter is enormous. As soon as the trap has been accomplished, antlions postpone at the bottom of the send for ants or any other bugs to drop into the setup. When creatures drop into the end of the pit, then antlion goes to pull by tossing sand.
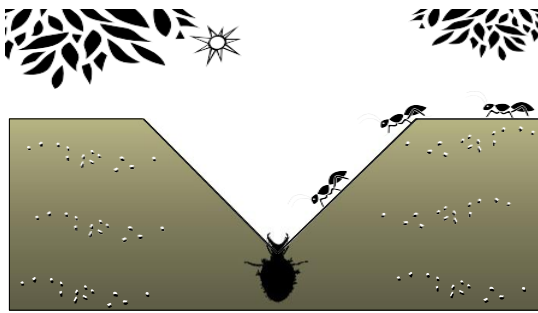

Fig 6 Hunting behavior of antlion

The basic operation of antlion algorithms like Random walk of ant, building a trap, Trap in antlion pit, sliding of ant towards the antlion, Catching the prey and rebuilt the trap and elitism. A random walk is performed by the ant for searching the food and its natural behavior. Antlion will build the trap in vertical cone based on the hunger of antlion and the hunger is high that vertical cone size will be varied. Antlion will wait at the bottom of the trap to an ant or other creatures will fall in the tap is said to be trap in antlion pit. Sliding of ant is used to reduce the random walk of an ant bysliding to reach the antlion. Catching the prey from sliding of ant and antlion will catch the ant from the bottom. After catching the prey, the antlion will create the new trap for catching the ant.Meanwhile, the leading is a suitable antlion, it should be able to disturb the actions of all the ants during repetitions. Consequently, it is expected that each and casually walks around every antlion by the roulette wheel and the leading.

The benefit of the Antlion algorithm is high tracking efficiency under normal conditions. It can able to track the global maximum power point (GMPP). The system has a fast response and reduces the settling ripple. The weakness of the system will be high cost and tough to implement.

CONCLUSION

The review and analysis of different MPPT technique used in the system have been discussed. The advantage and disadvantages of each MPPT method can be understood. From this paper suitable MPPT technique can be nominated and executed as per the necessity.

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