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Research Paper

Review on various strategies for maximum efficiency of solar panels

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Abstract

Solar modules are used to convert sunlight directly into electric current. Certain parameters of the module decreases the overall efficiency of the module. These parameters include temperature, soiling, tilt angle. As the temperature increases the output current increases exponentially voltage decreases linearly. To overcome these problems simple,robust,cheap techniques are used to increase overall efficiency of the module.These techniques include MPPT,temperature control, nanowire solar cells and varying tilt angle in summer and winter seasons.

Keywords: *MPPT; Temperature Control; Anti Soiling; Increase Efficiency; Nanowire Solar Cell MPPT.*

1. Introduction

As the demand of the energy is increasing day by day, conventional sources are limited .so they cannot meet the increasing demand of the energy the only way to meet the increasing demand is the use of non-renewable energy sources.[1] The solar radiations coming from sun is one of the solution to the increasing demand. Solar energy production has increasing exponentially from the beginning of the century. [2] To make the solar energy a major contributor, it is necessary to increase the solar module conversion efficiency. But the solar modules depends upon the output of module changes linearly with the temperature. [3] The solar module temperature depends upon the various factors like wind velocity, radiation falling on the module and material of the module. [4]
Lot of research have been done to increase the efficiency of the solar modules;like anti reflecting coatings,glass covers with least absorptivity,dust repulsive coatings and photovoltaic thermal hybrid system. efficiency can also be increased by the use of heat exchangers using a specific fluid . this fluid can be used for other purposes. But due to high cost and complicated design they are not used.[5][6]
Unfortunately places which receive the most amount of sunlight faces problems of temperature increase of the panel. The output of a silicon based solar module decreases with the rise of temperature. Analysis was done over 18 solar power plants over five countries to understand the effect rise of temperature. it was concluded that sufficient cooling is necessary to decreases the power losses.
Thus lowering the temperature of the solar module is to increase the input to output conversion efficiency. In this novel various solutions are given to achieve the higher input to output conversion efficiency [7].

2. Proposed solutions

Maximum power point tracking:
Nowadaysmuch attention is being forwarded towards the study of photovoltaic modules and their conversion efficiencies. In order to draw maximum power under varying loads from a solar module it is necessary modules should be provided with Maximum Power Point Tracking controllers. The main advantage of using maximum power point tracking controllers is decreasing the number of solar panels to obtain desired output. The overall performance of the system depends upon the local irradiance and temperature conditions. MPPT control depends upon the terminal current of PV module. MPPT control methods are based on measuring the short circuit current. it can be calculated by using the following relation.

$I_{MMPT} = K_1 I_{sc}$

I_{sc} = short circuit current

$K_1 = .91$

Methods of maximum power point tracking:
There are various algorithm methods to improve the efficiency of the PV systems. The perturb and observe is one of the algorithms used for the commercial PV products [8].
Incremental conductance algorthim:
This method finds the derivative of output power to the output voltage. Maximum power can be gained when dP/dV approaches to zero. The controllers used measure the calculate the dP/dV by measuring the output power and voltage. If dP/dV is not close to zero the controller adjust the voltage by varying the duty cycle until dP/dV approaches to zero [9].
MMPT are the algorithms used to extract maximum power from solar panel under certain conditions. These conditions include solar radiations, panel temperature and ambient temperature. The principle upon which the solar panel works is that the controller compares the output voltage of the panel send it to charge the battery at best power. MPPT's are more efficient at cold temperature.

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3. Nano wire solar panel

The process of converting the sunlight into electricity is caused due to the absorption of o sunlight. The unique feature of nanowires that makes it different from the other solar cells is geometry dependent absorption characteristics .it is well established that array of sub wavelengths can absorb more light than a thin film of same material. Nanowires structures is of two types vertical and horizontal .Vertical nanowires absorb more light than horizontal from the large area than their cross-sectional area. The vertical array is efficiency depends upon the following four parameters nanowire diameter, nanowire length, array pitch and array symmetry.

The nanowire array acts as an antireflection layer. So these types of solar cell are designed in such a way that the top of the layer absorbs the light above its bandgap and acts as an anti-reflecting coating for the non-absorbed wavelengths transmitted. So the efficiency of the panel increase because due to anti reflecting surface the temperature of the panel remains constant. The performance of solar nanowires have been improved from last two years. III–V solar cells are most efficient solar cells in the planar structure .but due to high cost their use is limited. To mitigate the effect of heat and dust settlements a simple system have been proposed which can be retrofitted easily with the existing system [1].

4. Mitigating the effect of heat and dust

In this system a D.C fan is used that produces the air draft. The air flow due to the fan is equally distributed on top and bottom side of the panel. The system has only one moving part so the wear and tear are less hence system is efficiency is high and system life is also high. The solar panels are also provided with solar dust repelled coatings. Due to continuous flow of air the settlements of bigger dust particles is reduced. The flow of air will have strong wind velocity due to nozzle effect. This technique is effective in efficient heat dissipation and to remove the dust particles[12]. This technique uses air as cooling medium, so the efficiency of the system is increased by decreasing the temperature of the panel. Anti –reflective coatings used for the solar panel are not too much efficient to thermal resistance. This model can be used under varying environmental conditions[13].

5. Tilt angle

The orientation and tilt angle of PV panels determine the light intensity which receives the panel. When solar panels are installed in northern hemisphere they might be oriented facing to south side. For the equator regions 10^{o} tilt angle is necessary in order to evacuate the rain water and gain the maximum efficiency [14].

6. Conclusion

To gain the maximum efficiency of the solar panel the various methods discussed in this novel can be used in different conditions. The MPPT can be used anywhere but the MMPT algorithms are slow in process and MMPT used in oscillating mode also lead to fluctuation of the output. In nanowire based solar panels with the low material use, high absorption the efficiency is increased.however the biggest challenge in nanowire solar panels is synthesis control needed to obtain uniform arrays with optimized charge carrier separation and collection properties. To gain uniform this the nanowire based panels patterned substrate is essential. Cost reduction is also needed in substrate and cost efficient manufacturing methods for growth of nanowires PV cells.

In conclusion, a strong and continued research effort is motivated and required to realize the full potential of solar based power plants.

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