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MPPT Method for PV Modules Using Current Control Based Partial Shading Detection

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ABSTRACT: Partial shading conditions are the serious problems in solar modules making them to work under low efficiency when compared with steady state conditions. The required power from the Photovoltaic (PV) is achieved by combining the PV modules in the combination of series and parallel arrangements depending upon the specifications of the converter. Generally single-stage conversion is realized by connecting modules in series to build a high voltage greater than the line voltage of the grid. But highly parallel connected modules shows better performance in the output power when compared with the highly series connected modules during rapid change in partial shading conditions. A Maximum Power Point Tracking (MPPT) method with an ability of detecting the partial shading occurrence on PV array, and employs a current control method for tracking the global maximum between the local maximums.

I. INTRODUCTION

As we know that the natural resources, which has been using for power generation are dwindling fast and energy became very expensive. So the entire world is looking for another option to generate electrical energy. The best option is Photovoltaic energy to generate electrical power.

Solar panel is the fundamental energy conversion component of photovoltaic (PV) systems. Its conversion efficiency depends on many extrinsic factors, such as insolation levels, temperature and load condition. There are three major approaches for maximizing power extraction in medium- and large-scale systems. They are sun tracking, maximum power point (MPP) tracking or both. MPP tracking is popular for the small-scale systems based on economic reasons.

1. Solar Photovoltaic and Renewable Energy

Solar energy is one amongst the other renewable energy source and the vast abundance of solar potential available all over the world makes it very popular .The sun light reaches earth's surface is enough to provide 10 thousand times of global energy consumption. On average, each square meter is exposed to produce 1700 kWh energy every year. From the above figure we can see that Australia has great potential of solar incident falling almost all over the continent. Solar energy has many friendly attributes. Solar energy can be easily install on houses and buildings, and can run with low maintenance after initial setup. It can be very economical in remote areas where grid connection is unavailable or costly. It does not create any sorts of noise and emissions. As all other renewable energy sources, it is independent of fluctuations in price.

Electricity is most popular form of energy and used in homes, businesses, industries and transportation. It is clean, convenient, easily transferable and usable. Such positive attributes of electricity require high demand for electrical energy and as demand rises these energy sources diminish accordingly. First, they are proportionally diminishing against high demand and second they are contributing to the raise of carbon dioxide (CO2) emission gases. These gases are the ground for climate change which causes temperature rising, droughts, floats and hurricanes. The pollution free 'green' energy sources such as solar, wind and thermal are becoming alternative to those black energy sources to tackle these problems.

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2. Current–Voltage Load Curves Resistive Load I-V Curves

When I-V curve for load plotted onto the same graph with the I-V curve for PV, the intersection point is one spot at which both load and PV are satisfied and this is called operating point.

For load,

$$V = I*R$$

when we plot it on the I-V curve, it is a straight line with slope 1/R. As we increase the R, the operating point will move along PV I-V curve from left to right. If we use variable resistance as load and vary its resistance pairs of current and voltage can be obtained. Since the power delivered to the load is

$$P = I * V$$

There will be one particular value of resistance that will provide maximum power. Where Rm and Im are the voltage and current at maximum power point (MPP).

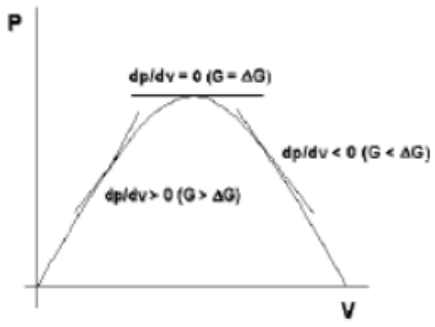
3. Battery Load I-V Curves

A real battery has an internal resistance that can be modelled with ideal battery of voltage VB series with internal resistance Ri. During the charge cycle positive flow into battery can be written as

$$V = VB + Ri*I$$

which can be plotted slightly tilted, straight line with slope 1/Ri. Because of the internal resistance that battery possesses, the applied voltage needs to be greater than VB during charging.

During discharging, the output vc ırve moves back to the left and slope becomes -1/Ri.



II. METHODOLODY

1. EXISTING SYSTEM

The PV array with several shading levels produce several Short Circuit (SC) currents therefore several Maximum Power Points (MPPs) occurs on the P-V curve. The conventional MPPT methods addressed in does a regular scanning to check for the existence of multiple MPPs or light sensors are placed across the PV arrays to check for partial shading. The PV array consists of several modules connected in strings of series/parallel arrangements, but highly parallel connected modules produce higher Global Maximum Power Point (GMPP) than highly series connected modules during partial shading. Highly parallel connected strings produces low voltage and generally two stages are involved in transferring the DC power to the grid.

2. PROPOSED SYSTEM

A control method automatically detecting the partial shading with the change in power conditions without periodic scanning and light sensors is proposed. The current based method controlling a single-stage grid connected

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current source converter which can control very low voltage with highly parallel connected PV modules is employed to transfer the DC power to three phase AC power with high power factor. Thus the proposed hybrid algorithm is tested in MATLAB simulation and verified on a developed hardware of the solar PV system, which consists of multiple peaks in voltage-power curve. Moreover, the tracking ability is compared with the state of the art methods. The satisfactory steady-state and dynamic performances of the new hybrid technique under variable irradiance and temperature levels show the superiority over the state of the art control methods. Our proposed method describes the efficient method which overcomes the existing methodology.

WODE ALGORITHM

As a matter of first importance, this segment presents the conduct of whales presumably, particularly the conduct of whales chasing.
At that point, the subtle elements of Whale Swarm Algorithm are introduced.

A. Conduct of whales

Whales with extraordinary scholarly and physical limits are totally oceanic warm blooded creatures, and there are around eighty whale species in the immense sea. They are social creature and

live in gatherings. For example, pregnant females will assemble with other female whales and calves in order to improve safeguard abilities. Also, sperm whales are frequently seen in gatherings of somewhere in the range of 15 to 20 people, as appeared in Fig. 1. The whale sounds are excellent tunes in the seas and their sound range is wide. Up to this point, researchers have found 34 types of whale sounds, for example, shrieking, squeaking, moaning, yearning, thundering, chattering, clicking, humming, churring, talking, trumpeting, clopping et cetera. These sounds made by whales can frequently be connected to vital
capacities, for example, their movement, bolstering and mating designs. Additionally, a huge piece of sounds made by whales are ultrasound which are past the extent of human hearing. What's more, whales decide sustenances azimuth and keep in touch with each other from an extraordinary separation by the ultrasound.

PROPOSED SYSTEM BLOCK DIAGRAM:

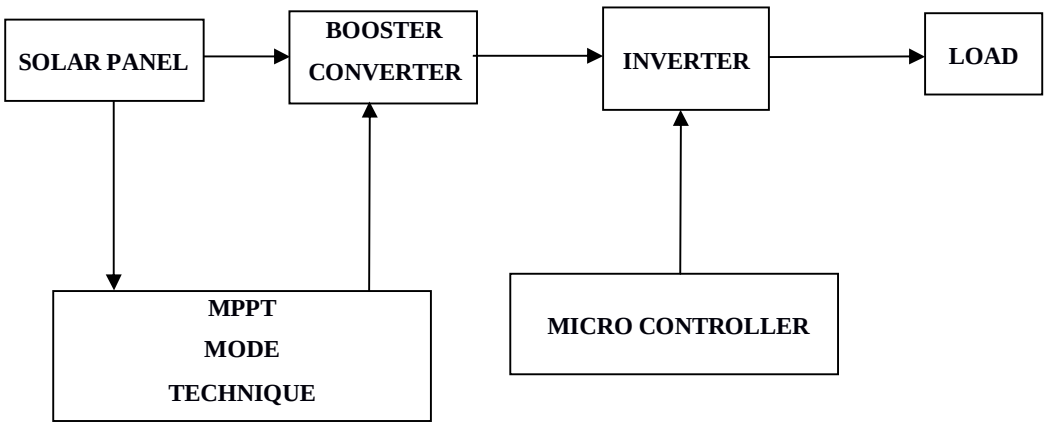

Figure 1.2 Block Diagram

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III. EXPLAINATION

In our design implementation a humpback whale hunting behavior influenced whale optimization with differential box evolution (WODE) technique this established tracking algorithm for the idea power point tracking in the dynamic as well as the steady-state conditions of any partially shaded photo voltaic photovoltaic (PV) system. This method of 'WODE' technique is employed for quick and oscillation-free monitoring of the global best peak position in a few steps. The unique benefit of this algorithm for maximum power point monitoring (MPPT) in partially in the shade condition is as, it is free from common and generalized problems of other evolutionary techniques, like longer convergence duration, a sizable volume of search particles, with regular state oscillation, heavy computational burden etc., which creates power loss and amplitude. This type algorithm is tested in MATLAB simulation and validated and tested on developed hardware of the solar PV system, which includes multiple attracts in voltage-power curve. In addition, the tracking ability is compared with your art methods. The adequate steady-state and dynamic shows of the new type's technique under variable irradiance and temperature levels show the superiority over the state-of-the-art control methods.

IV. ADVANTAGES

i) In this proposed method the current-based controller detects the partial shading from the levels of output power and voltage during transition period
ii) This which saves power than the other methods which uses regular scanning for partial shading at particular intervals.
iii) The converter controls the low voltage from PV array during change in shading making the system to produce continuous supply to the grid.
iv) The simulations results varies the concept under low and high percentage of multiple shading.

V. MATLAB SIMULATION

If you are new to MATLAB, you should start by reading Manipulating Matrices. The most important things to learn are how to enter matrices, how to use the: (colon) operator, and how to invoke functions. After you master the basics, you should read the rest of the sections below and run the demos. At the heart of MATLAB is a new language you must learn before you can fully exploit its power. You can learn the basics of MATLAB quickly, and mastery comes shortly after. You will be rewarded with high productivity, high-creativity computing power that will change the way you work.

(i) Introduction MATLAB system.

Development Environment – introduces the MATLAB development environment, including information about tools and the MATLAB desktop. Manipulating Matrices - introduces how to use MATLAB to generate matrices and perform mathematical operations on matrices. Graphics - introduces MATLAB graphic capabilities, including information about plotting data, annotating graphs, and working with images. Programming with MATLAB - describes how to use the MATLAB language to create scripts and functions, and manipulate data structures, such as cell arrays and multidimensional arrays.

VI. SIMULINK

Simulink is a software package for modeling, simulating, and analyzing dynamical systems. It supports linear and nonlinear systems, modeled in continuous time, sampled time, or a hybrid of the two. Systems can also be multi rate, i.e., have different parts that are sampled or updated at different rates. For modeling, Simulink provides a graphical user interface (GUI) for building models as block diagrams, using click-and-drag mouse operations. With this interface, you can draw the models just as you would with pencil and paper (or as most textbooks depict them). This is a far cry from previous simulation packages that require you to formulate differential equations and difference equations

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in a language or program. Simulink includes a comprehensive block library of sinks, sources, linear and nonlinear components, and connectors. You can also customize and create your own blocks. After you define a model, you can simulate it, using a choice of integration methods, either from the Simulink menus or by entering commands in MATLAB's command window. The menus are particularly convenient for interactive work, while the command-line approach is very useful for running a batch of simulations (for example, if you are doing Monte Carlo simulations or want to sweep a parameter across a range of values). Using scopes and other display blocks, you can see the simulation results while the simulation is running.The simulation shows the performance of WO has exceptionally effective seeking and

CIRCUIT DIAGRAM:
The figure shows the overall simulation Circuit diagram design

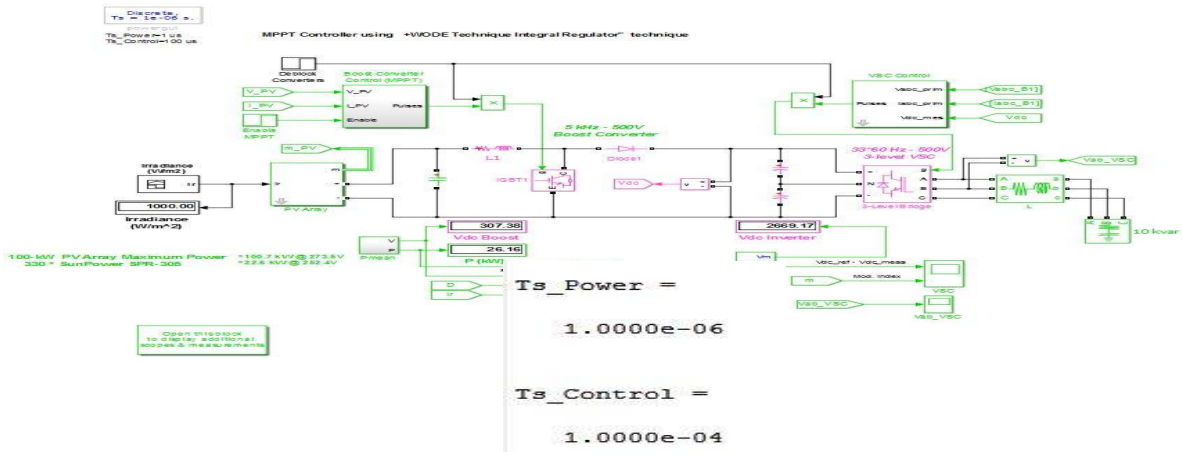

Figure1.3 Overall Circuit diagram MATLAB design

RESULTS OUTPUT VERIFICATION

The figure shows the simulation output voltage

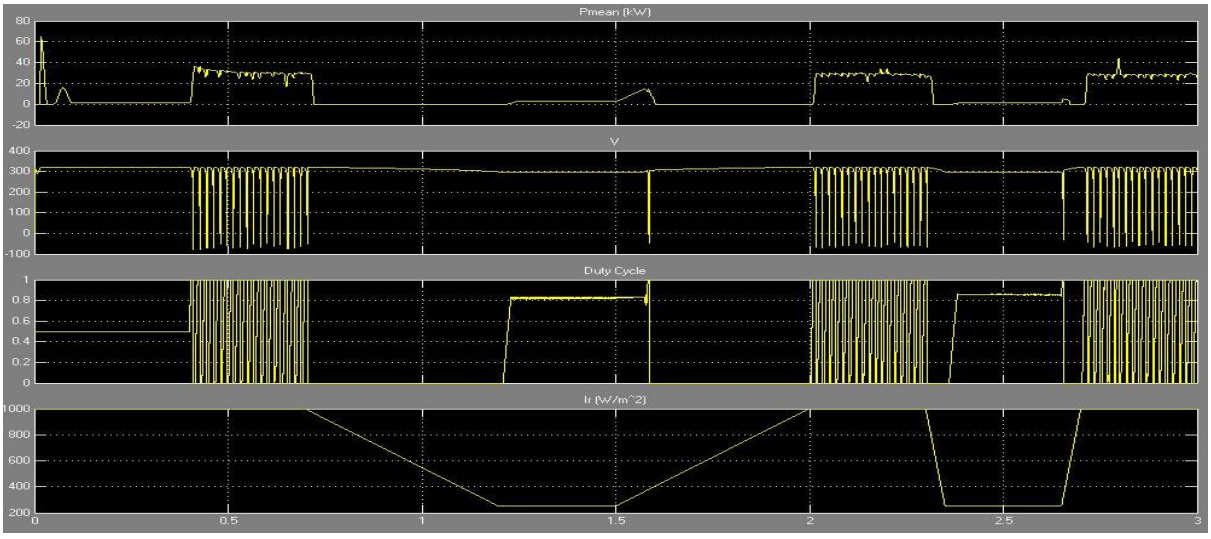

Figure1.4 simulation output

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In addition, DE has solid relative investigations and ideal area looking or creating capacity in characterized locale. These benefits of the DE are extremely appropriate for lessening the quantity of cycle and in addition for constraining to the bounce out from the stagnation on LMPP issue by finding an ideal area for whale toward the finish of each cycle. In detail, it is talked about in area. The consolidated impact of the two calculations can be found by hybridizing of both, known as WODE calculation. Here, DE is incorporated into arrangement with WO. Where, WO begins looking on a roundabout way and toward the finish of each round of the looking, it passes all data to the DE. DE examination finds finds a solitary best place and idealplace of the whale by utilizing three arrangements of area data, which is chosen by WO. This joined execution decreases the impacts of irregular constants and meta heuristic nature of the calculation by expanding the joining speed. In addition, computational weight and stagnation issues are evacuated through change, hybrid, and determination procedure of the DE. And in addition, it definitely lessens the quantity of emphasis, which is appeared in wave form.settling capacity of nonlinear issue, yet it requires countless or emphases and sometimes, it is stagnated on LMPP (which is to a great degree nearer to the GMPP) because of straight movement of whale amid contracting circle with half likelihood.

VII. FUTURE ENHANCEMENT:

The following scenario statements some of the future scope of our proposed design. The developed model and controller for the PV inverter can be used for the following future research work, This work aimed to propose a fast and stable MPPT technique for tracking maximum power under partial shading conditions. At present condition, the PV inverter has to be disconnected from the grid when any abnormal conditions occurs the transmission system. Thus a control scheme has to be developed and investigated to make inverter operate between grid tied and islanding modes. Thus the Increasing shoot through duty ratio results in more inductor current ripple and thus further investigation is required for inverter shoot through control techniques. For the further investigations of different grid current controllers, for e.g. the P+resonant controller, and repetitive control for cancellation of harmonic currents will be interesting. Effect of partial shading condition on the performance of MPPT is to be considered. The advantage of the proposed technique over conventional techniques is high efficiency, speed, stability and affordable cost. We are currently working on PV array system layout optimization techniques to further minimize shading effect.

VIII. CONCLUSION

In this project, our system proposes the method of current-based controller detects the partial shading from the levels of output power and voltage during transition period which saves power than the other methods which uses regular scanning for partial shading at particular intervals.

The converter controls the low voltage from PV array during change in shading making the system to produce continuous supply to the grid. The simulations results vary the concept under low and high percentage of multiple shading energy management. The design methodology will follow the procedure and the optimization process developed. The main advantages of the proposed technique over conventional techniques are high efficiency, with speed and stability and affordable cost.

We are currently working on PV array system layout optimization techniques to further minimize shading effect. Our control method automatically detecting the partial shading with the change in power conditions without periodic scanning and light sensors is proposed. The current based method controlling a single-stage grid connected current source converter which can control very low voltage with highly parallel connected PV modules is employed to transfer the DC power to three phase AC power with high power factor. The advantage of the proposed technique over conventional techniques is high efficiency, speed, stability and affordable cost. We are currently working on PV array system layout optimization techniques to further minimize shading effect.

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