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MPPT Based Solar Power System Control Using Optimized Fragmentary Power Prediction Algorithm For Constant Power Application

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ABSTRACT: Maximum power point tracking (MPPT) is used in photovoltaic (PV) systems to maximize the photovoltaic array output power, irrespective of the temperature and irradiation conditions and of the load electrical characteristics. A new **Optimized Fragmentary Power Prediction Algorithm(OFPPA)** MPPT system has been developed, consisting of a dc/dc converter, which is controlled by a microcontroller-based unit. The main difference between the method used in the proposed MPPT system and other techniques used in the past is that the PV array output power is used to directly control the dc/dc converter, thus reducing the complexity of the system. The resulting system has high-efficiency, lower-cost and can be easily modified to handle more energy sources. The experimental results show that the use of the proposed **Optimized Fragmentary Power Prediction Algorithm(OFPPA)** MPPT control increases the PV output power by as much as 15% compared to the case where the dc/dc converter duty cycle is set such that the PV array produces the maximum power. The algorithm is based on combination of the direct pulse width modulation, the sequential permutation PV sources, and the output generation to control the multilevel dc-link inverter. The Optimized Fragmentary Power Predictionalgorithm is applied successfully to a seven-level inverter with separate maximum power point tracking algorithm for each PV source and under non-uniform irradiance (partial shading).

I. INTRODUCTION

Partial shading of individual photovoltaic (PV) sources, which are connected in series, reduces the current and requires incorporation of bypass diodes in order to avoid damage of individual PV sources. Consequently, the power delivered to the load is reduced significantly. When the power sources are connected in series via dc/dc converters, as suggested in the control of duty cycle compensates for reduction of the irradiation of the shaded source which does not then operate at the MPP. Such a control is functional up to the minimum level of irradiation below which the current of the shaded source cannot be kept at the same level as that generated by other non-shaded sources. If the irradiation is reduced below the minimum level, then the shaded source has to be bypassed to allow non-shaded sources to operate at maximum power point (MPP). Such a topology cannot maintain all series-connected PV sources operating at their MPP under partial shading.

Alternative approach, so-called generation control circuit (GCC) structure is based on the multistage buck–boost converter circuit. In this scheme, only one switch is in off-state at any instant, while other switches are bypassed by free-wheeling diodes, and therefore, there is a restriction on non-conduction intervals of other switches. In other words, the switches cannot be independently controlled. Consequently, finding the MPP of one PV source does not mean that other series-connected PV sources operate at their MPP. For this reason, an optimal duty ratio has to be found by "tracking algorithm" in order to deliver the largest power to the load. Introduction of a multilevel inverter in PV power system enables each PV source to be controlled separately. The power of each PV source can be maximized by allocating a maximum power point tracking (MPPT) algorithm for each PV source. This approach has been applied only in an

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experimental model where each PV source was emulated by a series connection of dc source and resistance. Such a representation, however, does not reflect the proper behavior of the PV source, especially under partial shading.

Photovoltaic source simulators can be used to assess the PV energy production, experimentally investigate the dynamic performance of PV systems including stand-alone and load is regardless of environmental conditions, and evaluate different MPPT algorithms' response and efficiency. Photovoltaic source simulators can be classified into different categories based on the design of power stage, control system, and reference generation technique. Power stage design can be configured with a linear or a switching power stage. Linear PV source simulators are excellent in dynamic response but are limited to low power applications. Low efficiency, high heat generation, and bulky size are serious concerns at high power applications where switching power stages are more attractive. To replicate the current-voltage characteristics of a PV cell, the switching power stage should operate in buck mode. Different switching power stages have been reported as PV source simulators such as, single-phase dc-dc buck converter, three-phase ac-dc voltage source and current source rectifier, half and full bridge dc-dc converter, and LLC resonant dc-dc converter Other power stages have been used such as a dc programmable power supply with a current limit, dc power supply with a variable resistor or controlled switch resistor, and active power load.

The reference current-voltage generation techniques can be either analog or digital based. The analog based simulators are distinguished with simplicity and low cost implementation. Their current-voltage reference curves can be employed in one of three ways: (i) using a small PV cell with a light source. This model presents a new type of PV source simulator. The proposed two-stage PV source simulator is characterized with high power stage efficiency and fast transient response-time. Therefore, the proposed system is adequate for solar power conditioning systems evaluation. Response-time of PV source simulators has been reported to be in the range. The hybrid simulator combines both analog and digital based concepts. This technique decreases digital computational times allowing a higher switching frequency and therefor a higher control loop bandwidth to be selected. The proposed Optimized Fragmentary Power Prediction Algorithm (OFPPA) system extracts real-time current-voltage reference characteristics curves using an actual solar reference-cell with a controllable light source.

II. LITERATURE REVIEW

Solar photovoltaic (PV) systems, including both string and distributed architectures, typically employ DC-DC converters to control the power generation in order to harness the maximum solar power at varying climatic and panel conditions. In addition to high efficiency and low cost, the DC-DC Energy crisis is an alarming issue all over the world The demand of the energy resources minutely converter is required to provide a wide range of output/input voltage change ratios, and fast current and voltage control to facilitate maximum power point tracking (MPPT) [1].

The increased environmental issues and demand of low-cost energy, have generated enormous interest towards the utilization of renewable energy sources such as wind energy, solar energy etc. However, due to moving free, small in size, easy to install and use, the solar photovoltaic (PV) energy is popular for residential users as well as industrial users [2].

The PV array powered agriculture pumps have been progressively widespread and popular in regions where grid supply is not reachable, or is expensive to lay down. Associating the battery storage in the system not only increments the overall price and maintenance, however, it also diminishes the system service span and saving credits[3].

Most of the existing isolated water supply pumps in the world, are directly driven by diesel engine (DE), which is considered costly and pollutant. To overcome these drawbacks, water pumps (WP) should be powered from the new renewable energy sources, which are available locally, such as solar [4]. Solar power generation systems are in widespread use around the globe. In recent years, various types of solar cells, such as thin film solar cells, have been put into practical use in addition to crystalline Si based solar systems. Recently, the efficiency of the process is based solar cells has improved to over 20%, which Energy crisis is an alarming issue all over the world. The demand of the energy resources minutely electricity is facing a rapid increase. Such hasty increase in electricity demand, using conventional electricity generation techniques, such as burning the fossil fuel, is no longer a solution to this crux. Moreover, burning the fossil fuel will result environmental problems. [6].

In the clean electric power generation system, hybrid multi-input dc-dc converter is useful to get the controlled output voltage from the multiple input power sources such as solar array, wind generator, fuel cell and so forth. In this case,

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thematic-input dc-dc converter is useful to integrate the various input power sources and to get the regulated output voltage for the load level, in which their voltage levels and/or their power capability are different [7].

Modern technological developments in photovoltaic (PV) solar generating modules provides the possibility of roof mounted solar array based electric vehicle. They have the obvious advantage of no cost energy input, but the variability in the dc voltage from solar array is limited[8]. Energy harvesting techniques have been widely discussed on wireless sensor networks or portable applications. The most commonly discussed applications include wireless sensor nodes for healthcare, embedded or implanted sensor nodes for medical applications, tire pressure monitoring in automobiles, battery recharging of long-sustainability systems, security or guard systems in housekeeping, and environment change monitor systems [9]. Peak energy harvesting for photovoltaic (PV) panels has become a fundamental requirement to achieve overall conversion performance. Ensuring the PV panel operates at the Maximum Power Point (MPP) is entrusted to the MPP Tracking (MPPT) algorithm. Many contributions have b been implemented in the past years to tackle this problem but some issues remain open. [10]

III.PROPOSED SYSTEM

Ensuring the PV panel operates at the Maximum Power Point Tracking (MPPT) algorithm. Maximum power point tracking is one of the major concerns in photovoltaic systems and plays a vital role in utilization of these systems for practical applications. Each PV cell has a special point named maximum power point (MPP) on its operational curve in which it can produce maximum possible power. Many contributions have been implemented in the past years to tackle this problem some issues remain open. These operational curves change nonlinearly with changes in irradiance and temperature of environment. So, the nonlinear dependency of MPP to environment parameters has led to development of various maximum power point tracking algorithms. The proposed Optimized Fragmentary Power Prediction Algorithm (OFPPA) function is able to exhibit all desired behaviors both in steady-state and transient situations. The inductor losses are lower for the proposed converter because the reduced input current ripple decreases the peak inductor current, however the converter has more inductors. For this PV application, it is also important to distinguish between the DC to DC converter's efficiency and the overall system efficiency.

The generated power from the PV depends on solar irradiation. The other important element of an MPPT controller is the DC to DC converter that connects the PV array and the load. The output power of the PV is analyzed in the proposed Optimized Fragmentary Power Prediction Algorithm (OFPPA)

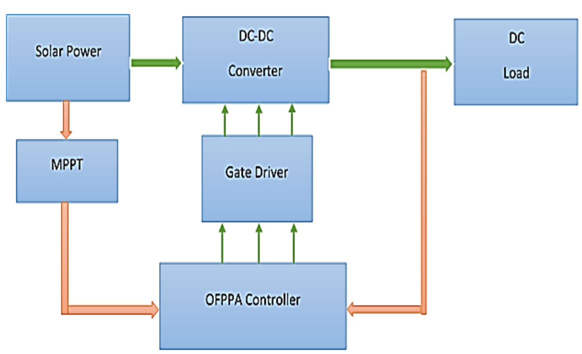

Figure 1: Proposed Block Diagram

and give the proper switching to the Converter.The duty cycle of the DC-DC converter is perturbed to move the operating point of the PV array toward the GMPP through impedance matching. In a DC-DC converter for realizing a comparatively high input / output voltage ratio, a system in which the step-up ratio is increased by using a high-frequency transformer is generally used. Since the DC-DC converter has low voltage and large input current, it is necessary to maintain the resistance of the circuit at a low value.

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3.1 Solar power

The word photovoltaic combines two terms photo means light and voltaic means voltage. Photovoltaic energy is obtained from sunlight in the form of solar energy. The sunlight is made to be focused on solar panels which have the ability to convert the solar energy to electrical energy. The conversion of solar energy to electrical energy is done by solar cells of the solar panel. A solar panel is a compilationofsolar photovoltaic modules electrically connected and attached on a supporting arrangement. A photovoltaic module is a packaged, combined arrangement of solar cells.

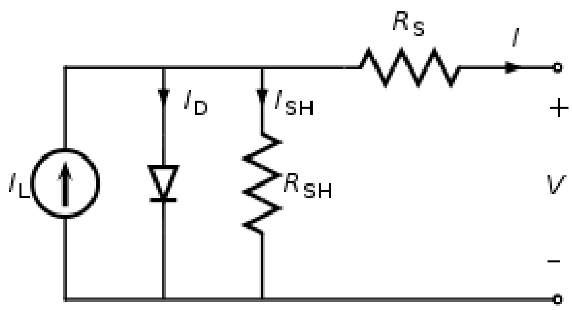

Figure 2: Equivalent Circuit of Solar Cell

The solar panel can be employed as a segment of a larger photovoltaic system to generate and generate electricity in commercial and residential applications. ItsDCoutput power rates each module under standard test conditions (STC), and typically ranges from 100 to 320 watts. The efficiency of a modulelimitsthe area of a module given the same rated outputefficient module will have twice the area of adynamicmodule. A single solar module can provide only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, an inverter, and sometimes a battery and/or solar tracker and interconnectionwiring.

3.2 Maximum Power Point Tracking (MPPT):

The solar power is not an ideal energy source. The solar cell panels can only generate power at certain times of the day. So the most important consideration for using solar power is to maximize the utility of solar power while it is available. The maximum Power Point Tracking is used in this system to observe the maximum power from the solar panel. PV solar systems have different configurations about their relationship with inverter systems, external phases, battery banks, or other electrical loads.

Regardless of the ultimate goal of solar power, the central problem is addressed by the MPPT that the solar cell power swap capacity depends on both the amount of solar light and load power properties falling in the solar panels. The size of the sun is variable, the ability of the system to be optimized when the load traits can be switched to high efficiency, resulting in greater power transfer capabilities. This burden is called the maximum efficiency point (MPP) attribute, and the MPPT is the process of keeping the load attribute where this point is found. Electric circuits present voltage loads, voltage and other devices or systems to present voltage loads, and can be designed to provide the MPPT efficiency.

3.3 DC to DC Converter:

The DC-DCconverters are used to convert the unregulated dc input to a controlled dc output at the desired voltage level. They generally accomplish the conversion by employing a dc voltage across an inductor or transformer for a duration of time (usually in the 20 kHz to 5 MHz range) which begins current to passing through it and store energy magnetically, then switching this voltage off and producing the stored energy to be assigned to the voltage output in a controlled manner.

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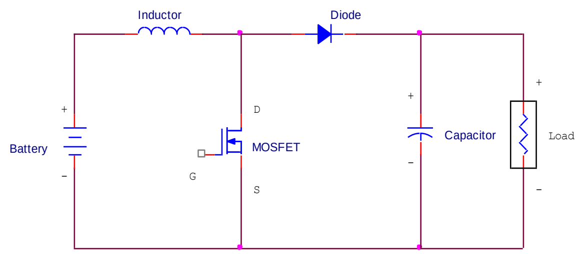

Figure 3: Converter Circuit Diagram

The output voltage is controlled by regulating the ratio of on/off time. This is achieved using switched mode circuits whose elements dissipate negligible power. Pulse width modulation provides control and regulation of the total output voltage. It is considered as the response of the power supply. Thus it will change the overall execution of the power supply system.

3.4 OFPPA Controller:

In this work, Optimized Fragmentary Power Prediction Algorithm (OFPPA)algorithm was developed to find out the best operating point of a Maximum Power Point Tracking (MPPT). The proposed Optimized Fragmentary Power Prediction Algorithm (OFPPA) function is able to exhibit all desired behaviors both in steady-state and transient situations. The inductor losses are lower for the proposed converter because the reduced input current ripple decreases the peak inductor current, however the converter has more inductors. For this PV application, it is also important to distinguish between the DC to DC converter's efficiency and the overall system efficiency.The proposed controller is realized for each source individual and simultaneous operation is supported.

IV RESULT AND DISCUSSION

The present modeling approach of a Mat lab-based toolbox for developing and testing the Predictive Power Control Algorithm under various operational conditions. The proposed new Optimized Fragmentary Power Prediction Algorithm (OFPPA) model is development in mat lab environment. The Renewable Energy both PV system is produce energy power source of the system has different form of power generation. Insufficient source of energy will be regulated by converter which improves voltage in source side. To optimization the system power control algorithm is needed for regulating power .here stochastic controller is used for optimization.

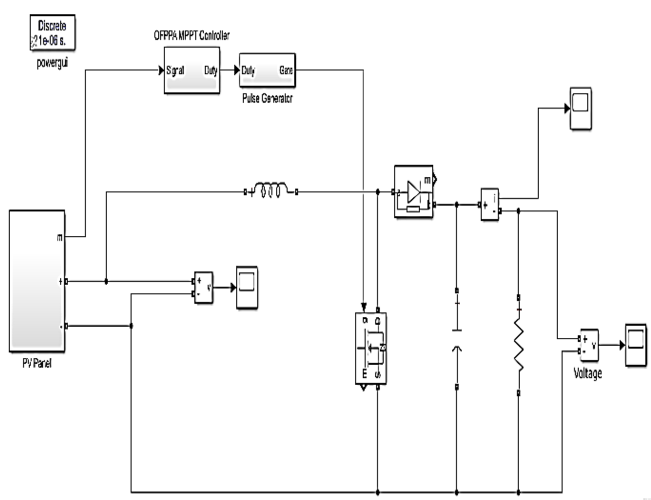

Figure4:Simulation Diagram of the Proposed System

4.1 Solar Output Voltage:

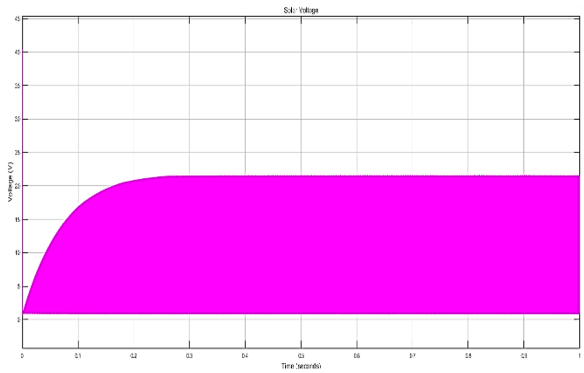

Figure5: Solar Output Voltage

4.2 Output voltage

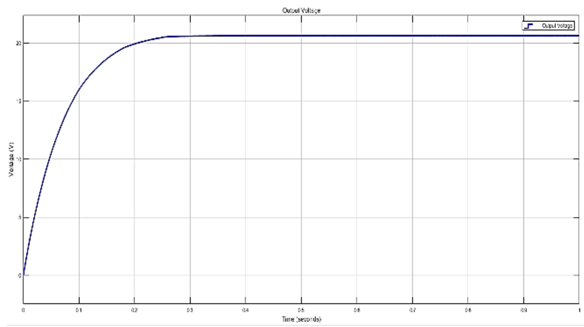

Figure 6: Output voltage

Figure 6 shows the output voltage is denoted here amplitude of the converter is V=25 which is indicating in the y-axis. X-axis represent the time period in second. The regulating the input power source the boost converter is implemented for regulating the variation of the power source to the stabilize one.

4.3Output Current

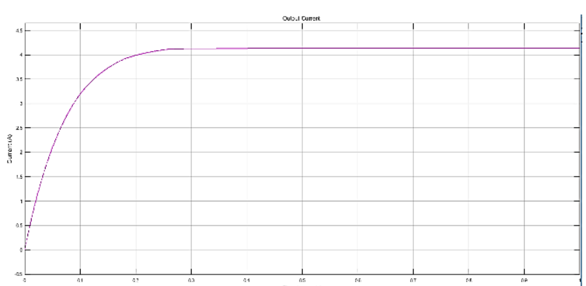

Figure 7: Output Current

Figure 7 shows the output current of the dc to dc converter in the proposed Optimized Fragmentary Power Prediction Algorithm (OFPPA) system.

4.4 ADVANTAGES:

- The large input power ripple is limited.
- In this system simple and cost effective.
- This controller is give constant output to the DC load.
- Noise less.
- Achieve high power efficiency.

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4.5 APPLICATION:

- It is used in the domestic and industrial applications.
- This system is used to control the water pumping system.
- It is used in various drives to get a stability output.

V. CONCLUSION

An experimental implementation of a new with enhanced MPPT for standalone solar photovoltaic based system has been presented, indesigned and practically implemented an Optimized Fragmentary Power Prediction Algorithm (OFPPA) with a view to drive a load at rated power even under insufficient solar radiation. The controller boosts up unregulated solar panel terminal voltage to a regulated at the load side. MPPT controllers are used to obtain maximum available power from the solar panel and to control the dc to dc converter. Using constant voltage control method in this converter, a constant output is obtained irrespective of the varying input voltage given as input to the converter. The effectiveness of the controller is tested for load at different solar radiations. It is found that the proposed controller provides constant power at the load side with almost constant efficiency and it is independent of solar radiation. It is expected that the implemented OFPPA can be used to drive solar driven loads in real time at rated power even under insufficient solar radiation. The distorted and varying input voltage to the loads may damage or affect them and this proposed converter may reduce this risk.

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BIOGRAPHY

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