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"Review on Integrated PV and battery energy conservation of stand alone system with MPPT"

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Abstract—*This paper review on Integrated PV and battery energy conservation of stand alone system with MPPT and power quality improvement features. Grid integration of photo voltaic (PV)/Battery hybrid energy conversion system with MPPT tracking performance of high gain integrated cascaded bidirectional dc-dc Converter with quadratic gain and less current ripple are presented in this paper. The PV side HGICB Converter is controlled by P&O MPPT algorithm to extract the maximum power from the variable solar irradiation. The Charge Controller is a switching device that can connect and disconnect the charger to the battery and it will take control over charging and to stop charging at the correct voltage. This will protect the batteries from damage from over-charging and regulate the power going from the solar panels to the batteries. This paper proposes a modified Instantaneous symmetrical components theory to use in micro-grid applications with following intelligent functionalities (a) to feed the generated active power in proportional to irradiation levels into the grid or connected load (b) compensation of the reactive power, (c) load balancing and (d) mitigation of current harmonics generated by non-linear loads, if any, at the point of common coupling (PCC), thus enabling the grid to supply only sinusoidal current at unity power factor. The battery energy storage system (BESS) is regulated to balance the power between PV generation and utility grid. A new control algorithm is also proposed in this paper for the battery converter with tight DC link voltage regulation capability. A hybrid PV Energy Conversion System is studied and simulated in MATLAB/SIMULINK environment.*

Keywords— *PV (photo voltaic) Source , maximum power point MPP, (P&O) perturbation and observation, DC-DC converter, Solar Photo voltaic (SPV).*

I. INTRODUCTION (*PROPOSED METHOD*)

The electricity demand is increasing and conventional resources cannot fulfilled it, create pollution. Renewable resources create no pollution hence are growing at a fast rate as a source of electricity generation. Renewable resources like sunlight, wind, rain, tides and geothermal energy that can be naturally replenished. Solar energy is one of the most significant renewable energy resources and it is clean, pollution free and available in abundance. Harvesting solar energy is quite easy and it follows the principle of photovoltaic effect to generate electric energy. PV cell is a semiconductor p-n junction diode, formed by sandwiching the n-type and p-type regions. As sunlight strikes junction of PV cell, the transmitted light is absorbed by semiconductor device which causes flow of free electron from low energy level to high energy level this creates the electron and hole pairs all over the Junction, which causes the flow of current. Semiconductor absorbs light energy and this energy excites free electrons from a low energy level to higher energy level In this technical paper, we review the operation of a PV solar panel. A power electronics device, Maximum Power Point Tracker (MPPT), which increases the efficiency of the system. effectively is used here. By using it, the system always operates at its Maximum Power Point (MPP), thereby producing its maximum power output. Thus, an MPPT maximizes efficiency of the array and reduces the overall cost of the system..

Additionally, designing the MPPT with the help of the algorithm of a selected MPPT method, which is called, the "Perturb and Observe" and we will implement it by using a DC-DC Converter. We have researched about the various types of DC-DC converters and we have selected the most suitable converter, the "BUCK" converter, amongst them, for our design. Each and every solar cell, has a point at which, the current (I) and voltage (V) outputs from the cell, result to provide the maximum power output of the cell. In the diagram below,

Fig.1, the curve is an example of the output which is expected from a solar cell, the position of Maximum Power Point, is also marked on the diagram.

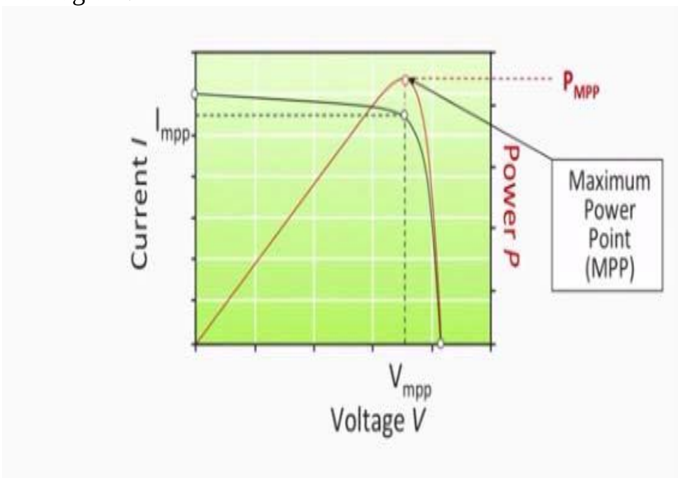

Fig.1. MPPT IV versus PV Curve

II. LITERATURE SURVEY

J. Rocabert, A. Luna, F. Blaabjerg; "Control of power converters in ac microgrids," Micro-grid power converters can be classified into (i) grid feeding ,(ii) grid-supporting, and (iii) grid-forming power converters the efficient extraction of electrical energy from Solar Photovoltaics (SPV). system is being presented. The efficiency of the SPY system may be substantially increased by using Maximum Power Point Tracker (MPPT).

R. Kadri, J.-P. Gaubert, and G. Champenois; "An improved maximum power point tracking for photovoltaic grid-connected inverter based on voltage-oriented control," There are many control schemes reported in the literature such as synchrounous reference theory, power balance theory, and direct current vector control.

M. de Brito, L. Galotto, L. Sampaio; "Evaluation of the main MPPT techniques for photovoltaic applications," In order to utilize the PV source optimally, it becomes necessary to use techniques to extract the maximum power from these panels, in order to achieve maximum efficiency in operation. Under uniform solar irradiation conditions, PV panels exhibits a unique operating point where PV power is maximized.

W. Li and X. He; "Review of non isolated high-step-up dc/dc converters in photovoltaic grid connected applications," The DC/DC converters are widely used in regulated switch mode DC power supplies. The input of these converters is an unregulated DC voltage, which is obtained by PV array and therefore it will be fluctuated due to changes in radiation and temperature. In these converters the average DC output voltage must be controlled to be equated to the desired value although the input voltage is changing.

III. PROPOSED SYSTEM DEVELOPMENT

A. Model of PV cellt

PV begins from two separate words – photo, which implies light, and voltaic, which alludes to the production of power . Subsequently, the term PV brings the significance of producing power specifically from the sun. A sun-powered array comprised several combinations of sun-based modules, where every module comprised various solar cells . Solar cells comprise p–n diodes manufactured in a thin layer of semiconductor . They resemble p–n diodes and their attributes are additionally comparative. displays the equivalent circuit of a perfect PV cell . This ideal structure is sufficiently precise to comprehend the PV attributes and the reliance of the PV cell on varying climatic conditions . Solar panel is formed by connecting many solar cells in series and parallel so as to get the desired output power under nominal conditions. While designing the panel on Proteus a solar cell is considered in its equivalent form.

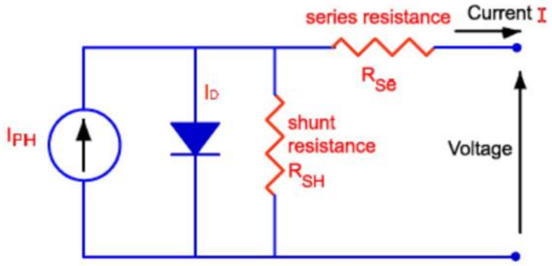

Fig.2. Equivalent circuits of solar cell

Applying node equation in where,
IPH, RSE and RSH diodes are meeting together. The current equation is given as:

$$I = I_L - I_0 \left\{ \exp\left[\frac{q(V+IR_S)}{nkT}\right] - 1 \right\} - \frac{V+IR_S}{R_{SH}}.$$

(1)

B. MPPT controller

Power is termed as the MPPT controller. If the controller works deliberately at MPP, independent of the climatic condition, the efficiency of the PV system is enhanced. This should be possible by legitimately coordinating PV source with the load for any climate condition to accomplish maximum power production. There are two processes by which maximum power can be extricated from the PV array and they are: mechanical and electrical tracking. In mechanical tracking, the PV panel direction changes according to the changes of months and seasons throughout the year, while in electrical tracking, the I − V curve is used for locating MPP. MPPT is an integral component of modern power systems, which ensures the penetration of maximum power to the load/batteries/motors and the power grid, for off-grid and on-grid applications, respectively. Since the conversion rate of sun energy to electrical energy of PV arrays is still low and the solar irradiance is not always uniform, the MPPT controller finds its widespread application in PV plants. A brief discussion on the necessity of the MPPT controller is presented in Section.

B. Need for an MPPT controller

It is necessary to ensure that there exists an MPP in I – V and P − V curve for variable irradiation and temperature. This MPP continuously moves its position when any environmental change happens. Therefore, MPPT controllers are designed to continue the tracking of MPP and they form an indispensable piece of the PV system. The presence of a controller adequately modifies the resistance seen by the panel and consequently, urges the panel to work nearer to MPP . Efficient MPPT controllers are essential to modify the operating point of the load associated with changing the duty cycle of the converter.

C. Selection parameters of the MPPT controller

For tracking the true MPP of the PV system, numerous MPPT methods have been presented in numerous research literature. For finding the best one among others, the selection parameters of the MPPT controller play a vital role. The selection parameters provide essential information about which method is better for a particular application. These selection parameters are used only for making comparison among the methods of each categorised MPPT method, not to classify the methods into categories. Eleven selection parameters are considered here for the comparison of different methods in each category. The brief details of each selection parameters and a comparison among generally used analog/digital MPPT ICs or microcontrollers.

D. DC-DC Buck Converter

A buck converter is a DC - DC converter in which the output voltage is always lower or same as the input voltage. It is MOSFET's switching is controlled by controller.

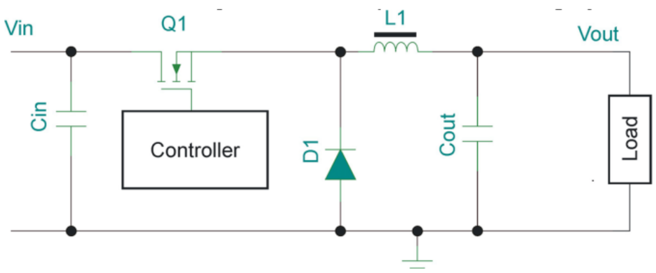

Fig.3. Buck converter

While designing the buck converter we need to find out the values of capacitor and the inductor used in it. It is a very crucial part in designing since the efficiency of the converter depends upon these values. The value of inductance and capacitance that calculated assuming the panel is working at full capacity.

E. Review of various MPPT algorithms

Owing to its versatile use, researchers attempted a lot to soak up the maximum amount of power from the panel. Until now, a lot of MPPT methods have been developed. Each technique has its own types of operation processes, advantages, disadvantages, and applications. To classify the available methods there is no proper assessment since one might be useful for a particular application and not for other, again one can be extremely efficient but another is not. In this review work, the discussed 50 methods that are classified into eight groups based on their tracking nature.

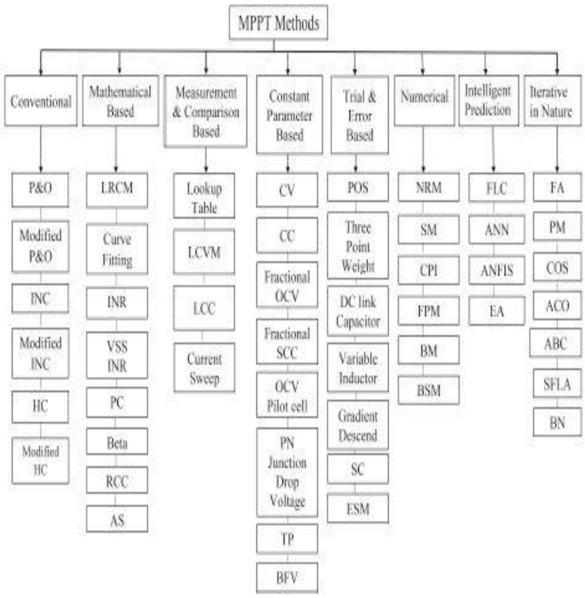

Fig.3. MPPT Methods

F. Configuration of proposed system

A practical PV array consists of several connected PV modules formed by Ns solar cells connected in series and Np cells connected in parallel. Therefore, which presents a single PV module should be amended into to obtain the PV array current. where Ms is the number of PV modules connected in series and Mp is the number of PV modules connected in parallel. Utilization of renewable energy resources is the demand of today and the necessity of tomorrow. Due to the electric power crisis globally, it is to be thought about the optimized utilization of these resources. In this paper, the efficient extraction of electrical energy from Solar Photo voltaic (SPV).system is being presented. The efficiency of the SPY system may be substantially increased by using Maximum Power Point Tracker (MPPT). MPPT is a power electronic system which tracks the maximum power point on the characteristic curve of PV module throughout the day in varying solar insolation. Basically MPPT is a highly efficient DC-DC converter. which is controlled by A typical Photovoltaic (PV) system consists of a PV module and some electrical load. This may also have a Power conditioning unit (PCU) which may comprising of a Inverter (to convert dc into ac), charge controller (to prevent reverse flow of current during dark) and most importantly from the efficiency point of view the Maximum Power Point Tracker (MPPT).In this paper, the MPPT is emphasized for better efficiency of PV system by using improved MPPT with advanced P&O algorithm.

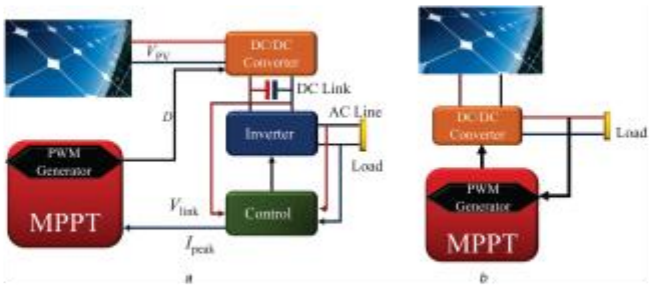

Fig.4. Configuration of proposed system

Make sure that the system operates close to the MPP when it is subjected to changing in environmental conditions. Provide high conversion efficiency. It maintain tracking for wide range of variation in environmental conditions. Provide an output interface compatible with the battery charging requirement .It instantaneous PV voltage and current and provides the reference current..

IV. CONCLUSION

Improvements in the efficiency of the solar PV system by extracting maximum power is presently one of the key challenges in research sectors of renewable energy. In that sense, the concept of the MPPT controller is found to be a valuable concept as it maximizes the output power delivered by the solar PV module. A lot of articles have been already published for presenting the detailed analysis of several MPPT methods. In this review work, the discuss methods are classified into different categories based on the nature of the algorithm. The MPPT methods are detailed in this study along with their pros and cons, which signify that the selection of the MPPT technique should be based on the specific application and requirement of the utility. MPPT selection according to satisfy the prerequisites of both operators and consumers.

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