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A Detailed study of Solar Charging System with MPPT Controller

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***Abstract*—Renewable energy is power derived from natural sources, such as solar, wind, waves, or geothermal energy. As we know the efficiency of solar system is very low, so it is very necessary to deliver maximum output from solar system to load. For this purpose maximum power tracking techniques are used. This article contains a detailed study about the solar system, maximum power point tracking techniques. This paper contains a brief information about the solar energy system and maximum power point tracking methods.**

Keywords—Renewable Energy, Photovoltaic System, Maximum Power System, MPPT Tracking System.

I. INTRODUCTION

The renewable energy are those energy which are received from the natural resources such as solar energy, wind energy, geothermal energy etc. The solar enrgy is one of the most widely used renewable energy source.

Different Constituent Components of Grid Integrated Solar PV Plant These plants have their capacities generally in the lower range which in the form of kilowatts. A grid-integrated solar PV system is described in Figure 1. Its main parts include solar PV Modules which convert sunlight directly to electricity, Inverter is used to convert the DC current supplied by the solar PV modules into the AC current and this AC current is injected into the utility grid. Centralized grid-integrated solar PV applications are in the capacities which ranges from higher kilowatts to the megawatt size. Solar PV is recently the fastest growing power generation technology all over the world. Grid-integrated PV systems constitute majority of these figures. This is the result of government incentives schemes like generation based incentives, feed-in tariff schemes, tax rebates and subsidies on investment. The solar PV plants have also observed great improvement in the efficiency of cell by the use of different technologies. The technology improvement and sustained development of the solar PV market has drastically reduced the cost of solar PV plants in the scenario of global market. A detailed study of different topologies of grid integrated solar PV system and large

sized solar PV plants is available in [15].

The purpose of this paper is to know a brief information about the solar energy system and maximum power point tracking methods.

II. LITERATURE REVIEW

S. K. Kollimalla et al. (2014) Hierarchical Control In hierarchical control, there are three levels of control: primary, secondary, and tertiary. This control architecture increases the flexibility of the system and can connect more distributed power sources. This control strategy is also applicable to various Micro-grid methods: communication models, island methods, load-bearing methods, or reducing power generation .The main control level adjusts the load distribution between the distributed power sources according to the characteristics of the electronic power converter. The second control manages voltage fluctuations and is responsible for resetting and combining the DC band with the other grids. The third level of control is responsible for energy management [1]. The first control uses two methods to adjust the output and power distribution between the distributed generations. These are (i) passive control methods (rapidly declining concepts) and (ii) active load distribution methods. In DC micro-grid applications, droop control is a widely used method to efficiently distribute the load between the power sources connected to the common bus.

Lee et al. (2013) proposed MPPT monitoring technology for solar photovoltaic systems. This technique considers the thermal stress exerted by the semiconductor switch on the converter. As a result, losses are reduced, and overall efficiency is improved. The algorithm works better with climate change changing the environment [2].

Song and Nian (2015) proposed a modular control strategy for wind energy fluctuation systems. Consider two converters, such as an edge converter and a rotor edge converter, and both converters run to achieve MPP. This method is applied in the case of inconsistent and erroneous parameters. The advantage of this method is the elimination of harmful harmonics [3].

Elbehairy et al. (2019) proposed an optimization study to apply a flower pollen optimization algorithm to obtain high yield power in an independent PV system under different shade conditions. The characteristic properties of photovoltaic systems can have multiple power peaks in shady conditions. This may result in the traditional method (MPPT) failure (MPPT) on the local surface without seeing the ground's surface. You can use artificial intelligence (AI) tools to get the highest energy points. The global MPPT method through the shadow measure is introduced. This method is based on simulating random changes through an AI flower pollination algorithm. A simulation was performed on a 100 kW photovoltaic power plant, and the results proved the superiority of this method [4].

Syskakis and Ordonez (2019) To build the utilization of miniature and pico-grid systems, simple to utilize dispersed age arrangements that are industrially suitable are required. The multiplication of appropriated wind turbines has speeded up examination and execution as suitable sustainable power arrangements. Refined MPP calculations are not carried out with SWTs for huge breeze turbine establishments as they need turbine

definition and costly sensors like anemometers. Inferable from monetary elements, customary SWTs either don't carry out MPPT or exceptionally straightforward calculations, for example, In Cond, P&O. This paper proposes another and PC proficient SWT MPPT calculation got from the In Cond technique. A control-situated SWT framework model is likewise introduced that works with quick reenactments with programming from customary power hardware. The MPPT calculation proposed offers three significant benefits: 1) evacuation of wind speed calculation disarray, 2) fast, exact following of the MPP and 3) further developing consistent state productivity. The conduct of the proposed calculation is additionally shown and affirmed in reproductions and trial approval utilizing a custom TEP [5].

Javed et al. (2019)The global focus on solar power is due to its clean and renewable nature. However, the limit on solar cell power extraction depends on solar irradiance and temperature. The solar radiation varies throughout the day and thus the generation of solar power fluctuates in nature. The solar energy of the solar panel is therefore always lower than the maximum possible solar panel generation limit. The solution for this problem is the MPPT algorithm, which allows for maximum energy extraction from the solar panel. This paper presents a comparative study of different MPPT techniques under constant and different radiation conditions. This work shows the solar MPPT control by perturbation and observation (P&O), increased conductivity (IC) and FLC techniques. In this work, too, the efficiency comparison for MPPT by these methods was presented. The performance assessment for these techniques was carried out to determine the best possible MPPT technique. The comparative study shows that the FLC is superior to the other FLC technology and to conventional MPPT technologies [6] Ghamrawi et al. (2020) In this plans to make a photovoltaic force framework more productive. The decrease of change misfortunes permits to work on this productivity. In this article we work on the variation venture between sun oriented boards and loads to decrease misfortunes. In the initial step, we will look at a standard DC-DC help converter that is generally utilized in close planetary system with a solitary switch. The goal of this correlation is to show the interest of utilizing high addition quadratic converters in universes. The outcomes show that the quadratic converter is more productive than the norm and furthermore permits to accomplish higher addition esteems for an adequate obligation cycle esteem. The decision of the quadratic converter is supported by thisexamination.Then, another layered MPPT calculation is proposed. The proposed calculation is utilized to control the quadratic converter. The proposed calculation depends on the P&O calculation. P&O is a standout amongst other known and most broadly utilized MPPT strategies, with its disadvantages during fast changes in daylight. The proposed control strategy is a double mode calculation. At the point when the working point is near the MPP, the main mode is dynamic. This mode permits the working point to settle to decrease static motions that happen with P&O. At the point when the working point moves from the MPP, the subsequent mode is actuated. This mode is a shrill P&O mode that permits you to rapidly follow the MPP, subsequently diminishing

misfortunes. The proposed calculation is tried utilizing Simulink/MATLAB reproductions. The reproduction results exhibit the effectiveness and benefit of the proposed calculation over P&O [7].

III. MPPT TECHNIQUES

The MPPT techniques are used to extract maximum output from the solar system.

The P&O method, also known as the trial and error method, works by changing the solar array terminal voltage by one small step ΔV. It then compares whether the array's power output increases or decreases. The ΔV of the next disturbance cycle is deducted or added depending on the outcome. Moreover, because the step size ΔV is a fixed value. Attributing a small value to the step size results in slow but good precision and vice versa if the step size is excessively large. In addition, the P&O process will never achieve the exact MPP, since it continually monitors the power output, i.e. increases and lowers the terminal voltage. Rather, it oscillates around the MPP. The P&O method's overall performance is good. However, the capacity for tracking and accuracy depends on the step size. Moreover, erratic behavior was observed when fast change was tracked and the MPP searched the wrong direction. [10]

The MPP is achieved with the incremental conduction method by measuring the photovoltaic cell's power and voltage output. It then calculates the power derivative for voltage. Know how the power depends on the voltage of a photovoltaic cell.

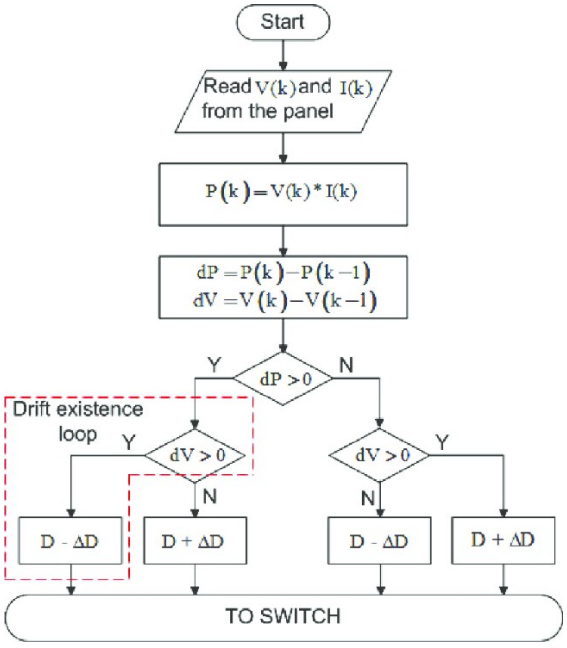

Figure: 2 Perturb & Observe Algorithm

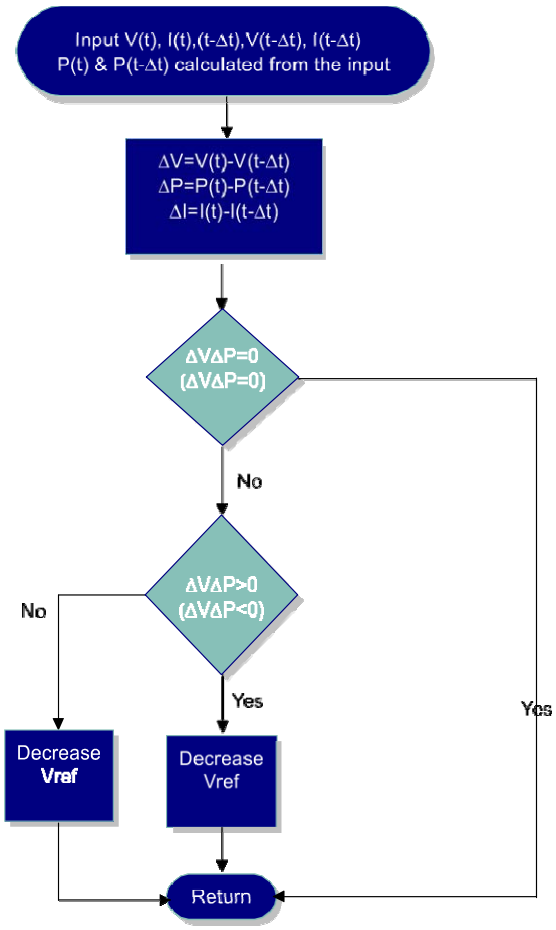

Figure: 3 Incremental Conductance Algorithm

Another obstacle of these two schemes is the circulation of electricity or waves around the MPP in the sustained state [7]. This is due to the failure of the control voltage or current in the MPP are not constantly oscillated. The magnitude of the oscillation depends on the magnitude of the rate of modify of orientation voltage. The more significant is the magnitude of the amplitude of oscillation. However, the speed of MPP acquisition also depends on the conversion rate, and this dependence develops with the magnitude of the power gain. The traditional solution is the consensus: if the rise is slight, the oscillation decreases, and the MPP comes slowly, and vice versa, so there must be a reliable solution. To avoid these shortcomings, solutions have been initiated in recent years regarding rapid changes in environmental conditions. In [30] an improved P&O method called "dP-P & O" has been demonstrated. In which additional measurements were performed without mild and current constraints. In this way, all three consecutive samples can estimate the effect of the (current) power shock and the influence of the change in conditions, so that the power rise used in the algorithm is the following factors produce only the influence:

IV. CONCLUSIONS

Renewable energy is an alternate source of energy for conventional energy resources. Renewable energy sources are the primary energy sources in remote areas where traditional energy cannot be transmitted. FUTURE WORK

The use of more power electronic devices also affects the energy output, which results in fluctuations. In order to overcome power quality problems, it is advisable to use techniques such as the implementation of static compensators and UPQC series LC filters. DSTATCOM helps to remove harmonics, to correct the power factor and to balance the load. STATCOM is used for stability purposes. Advanced methods must be used to record solar and wind data in order to calculate an estimate of power for continuous energy supply. Different MPPT techniques for monitoring resources are available.

REFERENCES

[1] S. K. Kollimalla, M. K. Mishra, and N. L. Narasamma, “Design and analysis of novel control strategy for battery and supercapacitor storage system,” IEEE Trans. Sustain. Energy, vol. 5, Oct. 2014, pp. 1137–1144.

[2] S. Lee, G. Son, and J.-W. Park, “Power management and control for grid-connecteddgs with intentional islanding operation of the inverter,” IEEETrans. Power Systems, vol. 28, May 2013, pp. 1235–1244.

[3] Elbehairy, Nourhan&Swief, R. &Abdelsalam, T &Abdin, Amr & Abdel-Salam, Tarek, Maximum Power Point Tracking For a Stand Alone PV System Under Shading Conditions Using Flower Pollination Algorithm vol. 39, Jan 2019, pp. 234-245.

[4] T. Syskakis and M. Ordonez, "MPPT for Small Wind Turbines: Zero-Oscillation Sensorless Strategy," 2019 IEEE 10th International Symposium on Power Electronics for Distributed Generation Systems (PEDG), 2019, pp. 1060-1065.

[5] M. R. Javed et al., "A Comparative

Study of Maximum Power Point Tracking Techniques for Solar Systems," 2019 22nd International Multitopic Conference (INMIC), 2019, pp. 1-6.

[6] A. Ghamrawi, J. -P. Gaubert and D. Mehdi, "A New Dual-Mode MPPT Algorithm Applied to a Quadratic Converter in a Solar Energy System," 2020 22nd European Conference on Power Electronics and Applications (EPE'20 ECCE Europe), 2020, vol. 34, pp. P.1-P.9.

[7] S. Jagwani, G. K. Sah and L. Venkatesha, "MPPT Based Switched Reluctance Generator Control for a Grid Interactive Wind Energy System," 2018 7th International Conference on Renewable Energy Research and Applications (ICRERA), 2018, pp. 998-1003.

[8] C. Fu, T. Pan, H. Liu, D. Wu, Y. Shen and Z. Hao, "MPPT Control Based Fuzzy for Wind Energy Generating System," 2018 37th Chinese Control Conference (CCC), 2018, pp. 7465-7470.

[9] N. R. B. Saravia, J. H. G. Gamarra, J. A. A. Infantes, S. L. R. Jimenez and J. R. M. Zamata, "MPPT Design and Control of a Small Power Autonomous Photovoltaic Solar System: Application to a 90W Two-Axis Autonomous Solar Photovoltaic Module," 2019 IEEE International Autumn Meeting on Power, Electronics and Computing (ROPEC), 2019, pp. 1-6.

[10] W. Obaid, A. Hamid and C. Ghenai, "Hybrid PEM Fuel-Cell-Solar Power System Design for Electric Boat with MPPT System and Fuzzy Energy Management," 2019 International Conference on Communications, Signal Processing, and their Applications (ICCSPA), 2019, vol. 56, pp. 1-7.

[11] M. Dabboussi, A. Hmidet and O. Boubaker, "An efficient Fuzzy Logic MPPT Control Approach for Solar PV System: A Comparative Analysis with the Conventional Perturb and Observe Technique," 2020 6th IEEE International Energy Conference (ENERGYCon), 2020, vol. 76, pp. 366-371.

[12] Layachi Zaghba, Messaouda Khennane, Amor Fezzani, Abdelhalim Borni & Idriss Hadj Mahammed (2019) Experimental outdoor performance evaluation of photovoltaic plant in a Sahara environment (Algerian desert), International Journal of Ambient Energy, vol. 32, 2020, vol. 22, pp. 602-605.