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Modified Algorithm for Drift Avoidance in PV System using Neural Network

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Abstract - As the Photovoltaic System uses the solar energy as one of the renewable energies for the electrical energy production has an enormous potential. The PV system is developing very rapidly as compared to its counterparts of the renewable energies. The DC voltage generated by the PV system is boosted by the DC-DC Boost converter. The utility grid is incorporated with the PV Solar Power Generator through the 3-ı PWM DC-AC inverter, whose control is provided by a constant current controller. This controller uses a 3-ı phase locked loop (PLL) for tracking the phase angle of the utility grid and reacts fast enough to the changes in load or grid connection states , as a result, it seems to be efficient in supplying to load the constant voltage without phase jump. An artificial neuron is a device with many inputs and one output. By using artificial neuron networks, the control algorithm implemented in the boost converter enhances by reducing the response time and hence, transient response for this converter is improved.

Keywords: PV system, DC-DC Boost converter, artificial neuron networks, utility grid.

1.1 INTRODUCTION

1.2 Renewable Energy Sources

Renewable energy is generally defined as energy that comes from resources which are naturally replenished on a human time scale such, as sunlight, wind, rain, tides, waves and geothermal eat.Renewable energy replaces conventional fuels in four distinct areas: electricity generation, hot water/space heating, motor fuels, and rural (off-grid) energy services. Photovoltaic (PV) technology converts one form of energy (sunlight) into another form of energy (electricity) using no moving parts, consuming no conventional fossil fuels, creating no pollution, and lasting for decades with very little maintenance.

PV panels tend to work much better in cold weather than in hot climates (except for amorphous silicon panels). Add a reflective snow surface and the output can sometimes exceed the rating for the panel. Array currents up to 20% greater than the specified output have been reported. In general, PV materials are categorized as either crystalline or thin film, and they are judged on two basic factors: efficiency and economics. For remote installations where the actual space available for PV panels is often quite limited, the greater conversion efficiency of crystalline technology seems to have the advantage. It is also worth noting that the conversion efficiency of thin-film panels tends to drop off rather rapidly in the first few years of operation. Decreases of more than 25% have been reported. This performance deterioration must be taken into account when sizing the array for a multi-year project.

1.3 PV System

A photovoltaic system, also solar PV power system, or PV system, is a power system designed to supply usable solar power by means of photovoltaic. It consists of an arrangement of several components, including solar panels to absorb and convert sunlight into electricity, a solar inverter to change the electric current from DC to AC, as well as mounting, cabling and other electrical accessories to set up a Working system. It may also use a solar tracking system to improve the system's overall performance and include an integrated battery solution, as prices for storage devices are expected to decline. Strictly speaking, a solar array only encompasses the ensemble of solar panels, the visible part of the PV system, and does not include all the other hardware, often summarized as balance of system (BOS).

Operating silently and without any moving parts or environmental emissions, PV systems have developed from being niche market applications into a mature technology used for mainstream electricity generation. A roof-top system recoups the invested energy for its manufacturing and installation within 0.7 to 2 years and produces about 95 percent of net clean renewable over a 30-year service lifetime.

1.4 Solar array

Conventional c-Si solar cells, normally wired in series, are encapsulated in a solar module to protect them from the weather. The module consists of a tempered glass as cover, a soft and flexible encapsulate, a rear back sheet made of a weathering and fire-resistant material and an aluminium frame around the outer edge. Electrically connected and mounted on a supporting structure, solar modules build a string of modules, often called solar panel. A solar array consists of one or many such panels. A photovoltaic array, or solar array, is a linked collection of solar panels. The power that one module can produce is seldom enough to meet requirements of a home or a business, so the modules are linked together to form an array.
Most PV arrays use an inverter to convert the DC power produced by the modules into alternating current that can power lights, motors, and other loads. The modules in a PV array are usually first connected in series to obtain the desired voltage; the individual strings are then connected in parallel to allow the system to produce more current. Solar panels are typically measured under STC (standard test conditions) or PTC (PVUSA test conditions), in watts. Typical panel ratings range from less than 100 watts to over 400 watts. The array rating consists of a summation of the panel ratings, in watts, kilowatts, or megawatts.The operating point on the characteristics of the PV module primarily depends on the impedance matching of the PV module with respect to the connected load. A DC-DC converter between the PV module and load acts as an interface to operate at MPP by changing the

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duty cycle of the converter generated by the MPPT controller and a general block diagram of PV system.

1.5 Existing System

1.5.1 Perturb and Observe

In this method the controller adjusts the voltage by a small amount from the array and measures power; if the power increases, further adjustments in that direction are tried until power no longer increases. This is called the perturb and observe method and is most common, although this method can result in oscillations of power output. It is referred to as a hill climbing method, because it depends on the rise of the curve of power against voltage below the maximum power point, and the fall above that point. Perturb and observe is the most commonly used MPPT method due to its ease of implementation. Perturb and observe method may result in top-level efficiency, provided that a proper predictive and adaptive hill climbing strategy is adopted.

The operating point on the characteristics of the PV module primarily depends on the impedance matching of the PV module with respect to the connected load. A DC-DC converter between the PV module and load acts as an interface to operate at MPP by changing the duty cycle of the converter generated by the MPPT controller and a general block diagram of PV system.

1.5.2 Flowchart of Perturb and Observe

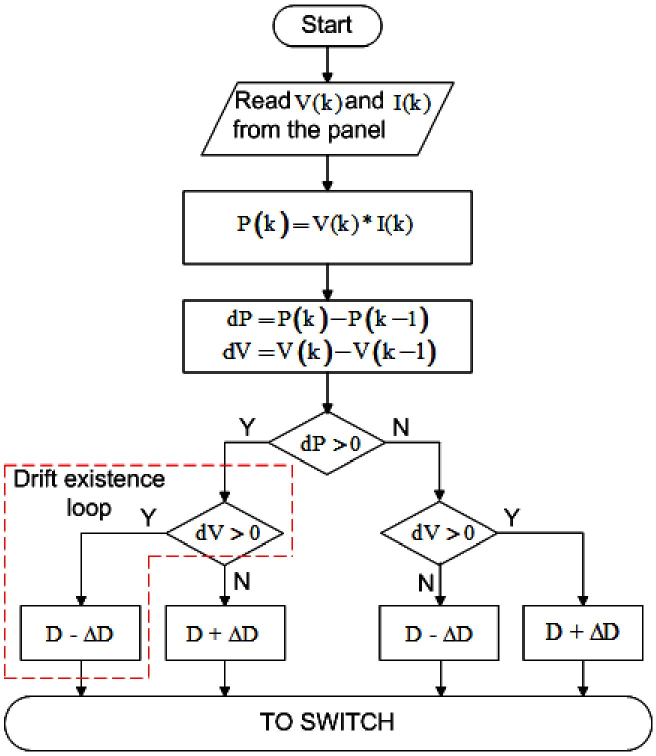

Fig.1 Flow of chart perturb and observe

1.5.3 Drawbacks of existing systems

- Drift problem occurs for an increase in insolation and it will be severe for a rapid increase in insolation which generally occurs in cloudy days.
- Drift problem is due to the lack of knowledge in knowing whether the increase in power is due to perturbation or due to increase in insolation.
- The existing system MPPT algorithm has been tested for a step change in insolation level from 270 W/m 2 to 480 W/m 2 at 1.01s.

1.5.4 Objective of the Project

The PV system is developing very rapidly as compared to its counterparts of the renewable energies. The DC voltage generated by the PV system is boosted by the DC-DC Boost converter. The utility grid is incorporated with the PV Solar respond time improved. By using artificial neuron networks, the control algorithm implemented in the boost converter enhances by reducing the response time and hence, transient response for this converter is improved.

2. PROPOSED SYSTEM

2.1 Block Diagram

The operating point on the characteristics of the PV module primarily depends on the impedance matching of the PV module with respect to the connected load. A DC-DC converter between the PV module and load acts as an interface to operate at MPP by changing the duty cycle of the converter generated by the MPPT controller and a general block diagram of PV system.

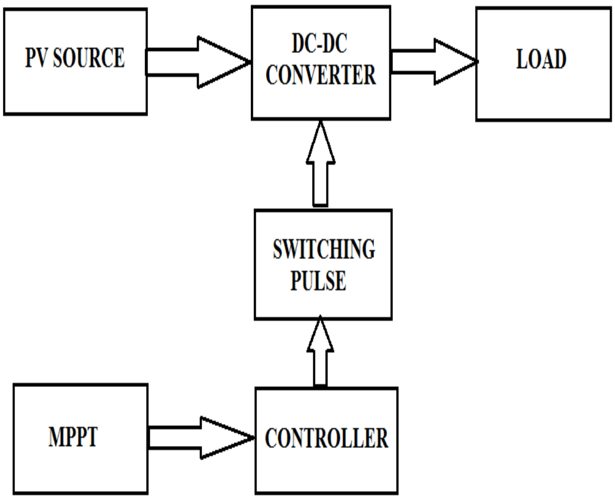

Fig 2. Block diagram of proposed system

2.2 Description of Block Diagram

Perturb and Observe (P&O) maximum power point tracking (MPPT) algorithm is a simple and efficient tracking technique. However, P&O tracking method suffers from drift in case of an increase in insolation (G) and this drift effect is severe in case of a rapid increase in insolation. Drift occurs due to the incorrect decision taken by the conventional P&O algorithm at the first step change in duty cycle during increase in insolation.

A modified P&O technique is proposed to avoid the drift problem by incorporating the information of change in current (I) in the decision process in addition to change in power (P) and change in voltage (V). The drift phenomena and its effects are clearly demonstrated in this paper for conventional P&O algorithm with both fixed and adaptive step size technique. SEPIC converter is considered to validate the proposed drift free P&O MPPT using direct duty ratio control technique. The two vital parameters in any MPPT algorithm are perturbation time and perturbation step size and the criteria for choosing these two parameters are described.

2.3 flowchart of modified p&omppt

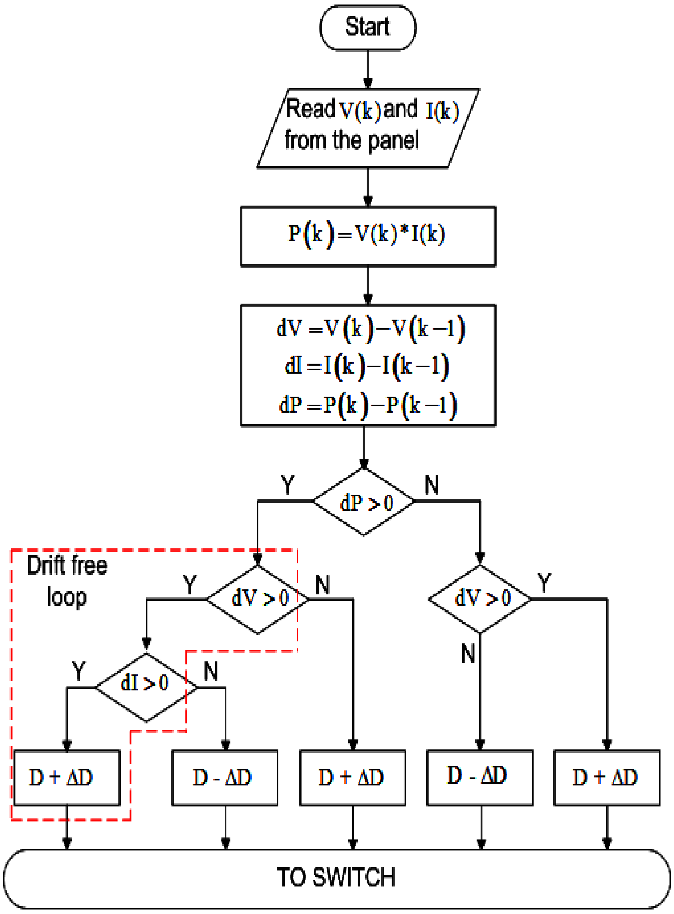

Fig. 3. flowchart of modified p & omppt

2.4 Modified Circuit Diagram

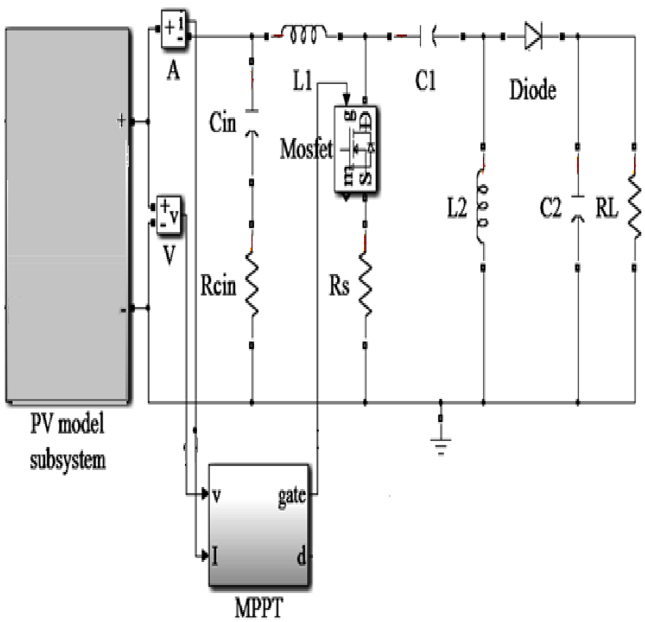

Fig.4 .modified circuit diagram

The operating point on the characteristics of the PV module primarily depends on the impedance matching of the PV module with respect to the connected load. A DC-DC converter between the PV module and load acts as an interface to operate at MPP by changing the duty cycle of the converter generated by the MPPT controller and a general block diagram of PV system. Where V and I are PV voltage and current respectively. The equivalent input resistance (R) of the converter as seen by the PV module. it can be noticed that by changing the duty cycle the operating point can be changed as Req changes and the MPPT controller should change the duty cyclein order to track the peak power.Perturb and Observe (P&O) maximum power point tracking (MPPT) algorithm is a simple and efficient tracking technique. However, P&O tracking method suffers from drift in case of an increase in insolation (G) and this drift effect is severe in case of a rapid increase in insolation. Drift occurs due to the incorrect decision taken by the conventional P&O algorithm at the first step change in duty cycle during increase in insolation.

MPPT

Maximum power point tracking (MPPT) is a technique that charge controllers use for wind turbines and PV solar systems to employ and maximize power output. PV solar comes in different configurations. The most basic version is one where power goes from collector panels to the inverter (often via a controller) and from there directly onto the grid. A second version might split the power at the inverter. This is called a hybrid inverter. The apportionment of how much power goes to each at any given moment varies continuously.A variation on these configurations is that instead of only one single inverter, micro inverters are deployed, one for each PV panel. This allegedly increases PV solar efficiency by up to 20%. For the sake of completeness it should be mentioned that there are now MPPT equipped specialty inverters (mostly from China) that are designed to serve three functions. They grid-connect wind power as well as PV solar power and branch off power for battery charging.

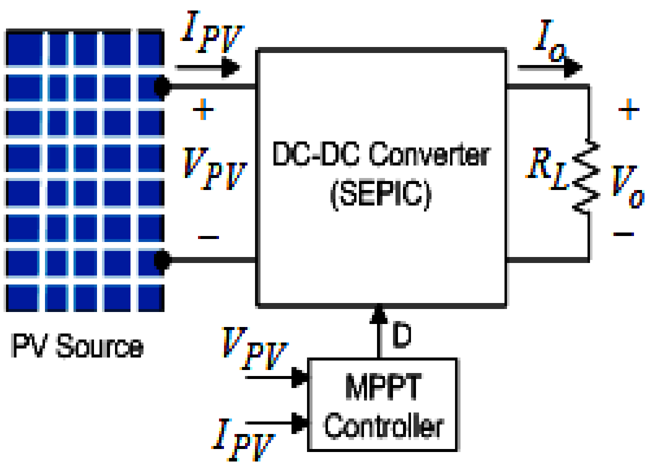

Fig.5.MPPT controller

This article about the application of MPPT concerns itself only with PV solar. Solar cells have a complex relationship between temperature and total resistance that produces a non-linear output efficiency which can be analyzed based on the I-V curve. It is the purpose of the MPPT system to sample the output of the PV cells and apply the proper resistance (load) to

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obtain maximum power for any given environmental conditions MPPT devices are typically integrated into an electric power converter system that provides voltage or current conversion, filtering, and regulation for driving various loads, including power grids, batteries, or motors.

2.5 Neural network

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well. A feed forward neural network is an artificial neural network where connections between the units do not form a directed cycle. This is different from recurrent neural networks. The feed forward neural network was the first and simplest type of artificial neural network devised. In this network, the information moves in only one direction, forward, from the input nodes, through the hidden nodes (if any) and to the output nodes. There are no cycles or loops in the network. Feed-forward ANNs allow signals to travel one way only; from input to output. There is no feedback (loops) i.e. the output of any layer does not affect that same layer. Feed-forward ANNs tend to be straight forward networks that associate inputs with outputs.

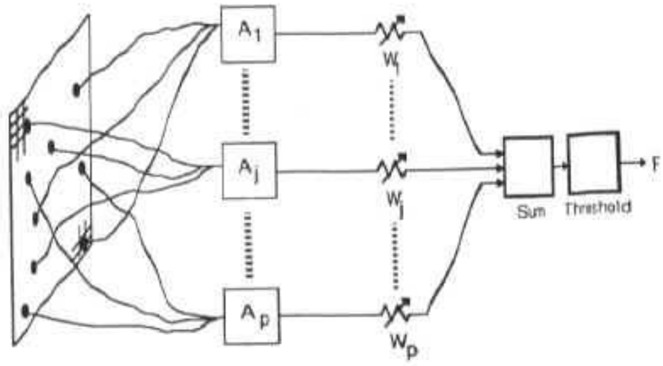

Fig.6. Configuration of neural network

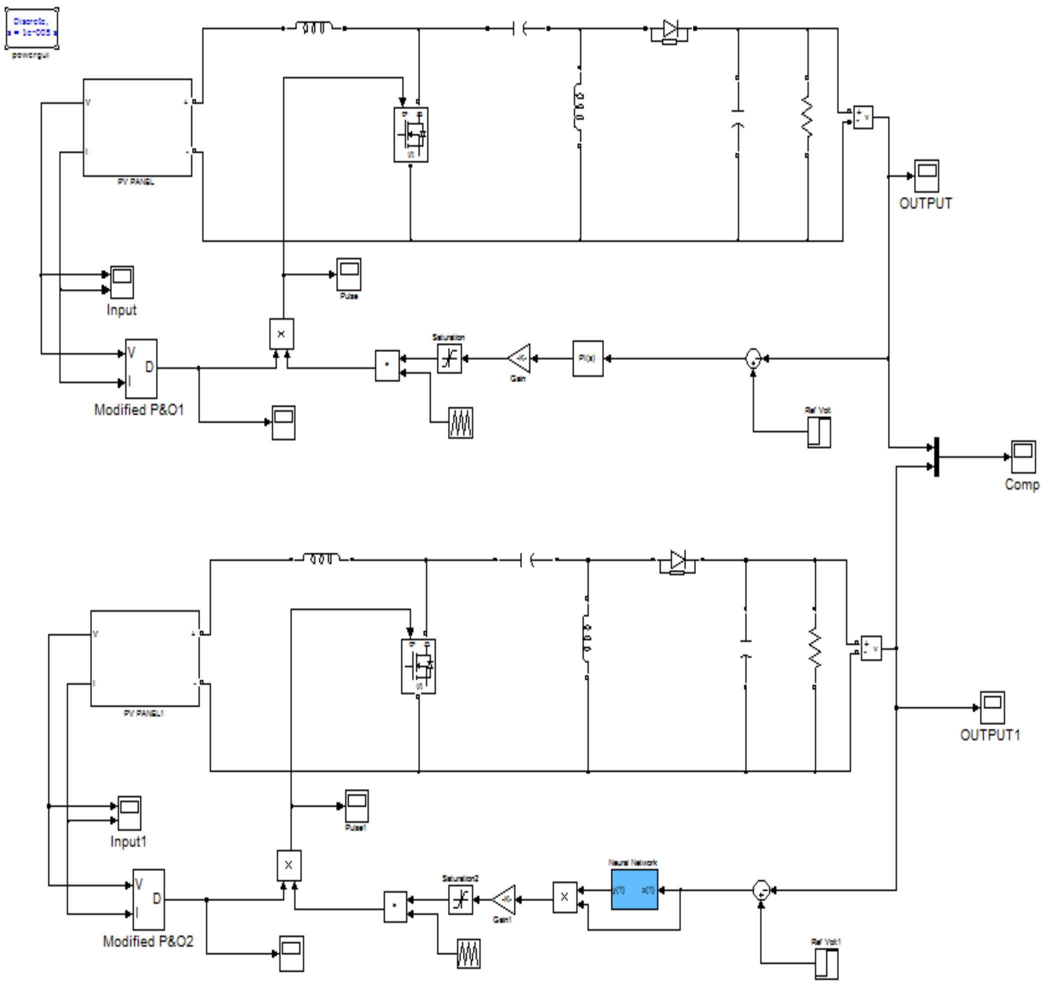

Fig.7. Simulation for proposed system

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Simulation Result for Proposed System

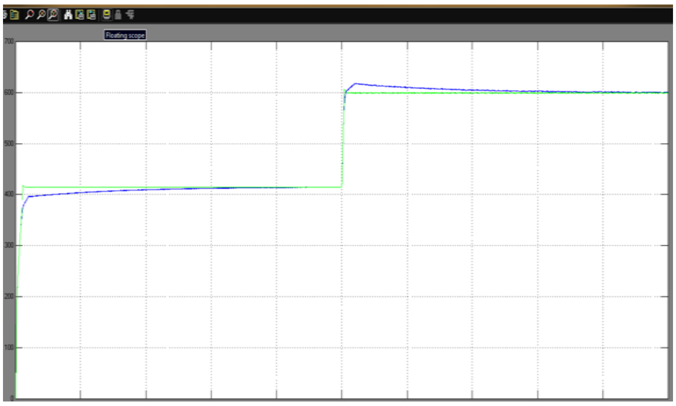

Fig.8.Simulation result for proposed system

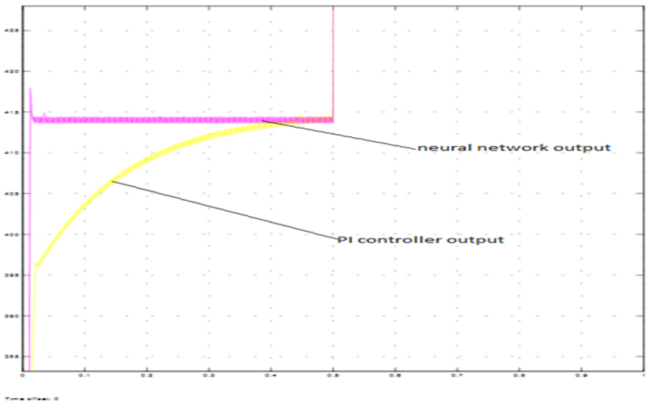

Fig.9.simulation result for proposed system difference of tme duration

Table 1: Comparison

Parameter	Respondent point in (v)	Respondent time in (s)
PI controller	380 to 414	0.01 to 0.5
ANN controller	414 (constant)	0.01 (constant)

3. CONCLUSION

In this paper, the drift phenomenon for widely used P&O MPPT algorithm is thoroughly discussed and then a modification to the existing algorithm is proposed to avoid the drift. The basic principle of the algorithm is to use an extra checking condition (_I) in the traditional P&O algorithm to avoid the drift and the mathematical justification of checking this extra condition is also proved. The simulation validations of the proposed method are done by considering SEPIC converter topology with direct duty ratio control. The algorithm has been validated by means of numerical simulations, considering the PV panel that has been experimentally identified and characterized. Moreover, laboratory tests have been performed on a low power solar panel to validate the effectiveness of the proposed algorithm. The simulation results prove that the proposed modified P&O MPPT technique is free from drift and is accurately tracking the maximum power from the PV panel. The proposed algorithm improves the efficiency of the PV system by gaining the extra power during drift compared to the conventional P&O algorithm. Considerable amount of energy gain can be achieved over the life cycle of the PV panel by using the proposed method. Finally, the simulation results are presented.

References

[1] N. Femia, G. Petrone, G. Spagnuolo, and M. Vitelli, “Optimization of perturb and observe maximum power point tracking method,” IEEETrans. Power Electron., vol. 20, no. 4, pp. 963–973, Jul. 2005.

[2] Pandey, N. Dasgupta, and A. K. Mukerjee, “High-performance algorithms for drift avoidance and fast tracking in solar mpptsystem,”IEEE Trans. Energy Convers., vol. 23, no. 2, pp. 681–689, Jun. 2008.

[3] M. A. Algendy, B. Zahawi, and D. J. Atkinson, “Assessment of perturb and observe mppt algorithm implementation techniques for pv pumping applications,” IEEE Trans. Sustain. Energy, vol. 3, no. 1, pp. 21–33,Jan. 2012.

[4] S. B. Kjaer, “Evaluation of the hill climbing and the incremental conductance maximum power point trackers for photovoltaic power systems,” IEEE Trans. Energy Convers., vol. 27, no. 4, pp. 922–929,Dec. 2012.

[5] T. Esram, J. W. Kimball, P. T. Krein, P. L. Chapman, and P. Midya,“Dynamic maximum power point tracking of photovoltaic arrays usingripple correlation control,” IEEE Trans. Power Electron., vol. 21, no. 5,pp. 1282–1291, Sep. 2006.

[6] E. Mamarelis, G. Petrone, and G. Spagnuolo, “Design of a sliding mode controlled sepic for pvmppt applications,” IEEE Trans. Ind. Electron.,vol. 61, no. 7, pp. 3387–3398, Jul. 2014.

[7] M. A. G. de Brito, L. Galotto, L. P. Sampaio, G. A. e Melo, and C. A. Canesin, “Evaluation of the main mppt techniques for photovoltaic applications,” IEEE Trans. Ind. Electron., vol. 60, no. 3, pp. 1156–1167,Mar. 2013.

[8] H. S.-H. Chung, K. K. Tse, S. Y. R. Hui, C. M. Mok, and M. Ho,“A novel maximum power point tracking technique for panels using asepic or cuk converter,” IEEE Trans. Power Electron., vol. 18, no. 3, pp.717–724, May. 2003.

[9] F. Paz and M. Ordonez, “Zero oscillation and irradiance slope tracking for photovoltaic mppt,” IEEE Trans. Ind. Electron., vol. 61, no. 11, pp.6138–6147, Nov. 2014.

[10] D. Sera, R. Teodorescu, J. Hantschel, and M. Knoll, “Optimized maximum power point tracker for fast-changing environmental conditions,”IEEE Trans. Ind. Electron., vol. 55, no. 7, pp. 2629–2637, Jul. 2008.