International Journal For Technological Research In Engineering
Volume 4, Issue 6, February-2017 ISSN (Online): 2347 - 4718

ENHANCEMENT FOR EFFICIENCY OF PHOTOVOLTAIC CELL THROUGH PO TECHNIQUE

Suraj Kumar[1], Susanto Gayn[2]
[1]M.Tech , ECE, [2]Assistant Professor (ECE)
Bengal Institute Of Technology & Management, Santiniketan

***ABSTRACT:* Photovoltaic's (PV) is the name of a method of converting solar energy into direct current electricity using semiconducting materials that exhibit the photovoltaic effect, a phenomenon commonly studied in physics, photochemistry and electrochemistry. A photovoltaic system employs solar panels composed of a number of solar cells to supply usable solar power. The process is both physical and chemical in nature, as the first step involves the photoelectric effect from which a second electrochemical process take place involving crystallized atoms being ionized in a series, generating an electric current. Photovoltaic's are best known as a method for generating electric power by using solar cells to convert energy from the sun into a flow of electrons. The photovoltaic effect refers to photons of light exciting electrons into a higher state of energy, allowing them to act as charge carriers for an electric current. The photovoltaic effect was first observed by Alexander-Edmond Becquerel in 1839. The term photovoltaic denotes the unbiased operating mode of a photodiode in which current through the device is entirely due to the transducer light energy.**
***Keywords:* Photovoltaic, photovoltaic effect, photochemistry, electrochemistry, solar power.**

I. INTRODUCTION

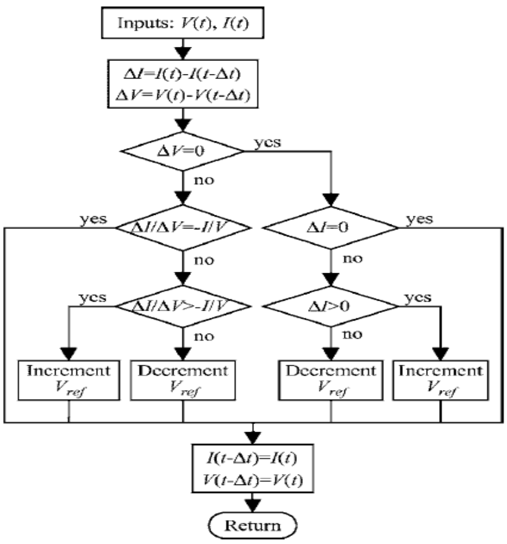
Photovoltaic's (PV) is the name of a method of converting solar energy into direct current electricity using semiconducting materials that exhibit the photovoltaic effect, a phenomenon commonly studied in physics, photochemistry and electrochemisty A photovoltaic system employs solar panels composed of a number of solar cells to supply usable solar power. The process is both physical and chemical in nature, as the first step involves the photoelectric effect from which a second electrochemical process take place involving crystallized atoms being ionized in a series, generating an electric current. Power generation from solar PV has long been seen as a clean sustainable energy technology which draws upon the planet's most plentiful and widely distributed renewable energy source – the sun. The direct conversion of sunlight to electricity occurs without any moving parts or environmental emissions during operation. It is well proven, as photovoltaic systems have now been used for fifty years in specialized applications, and grid-connected PV systems have been in use for over twenty years. They were first mass-produced in the year 2000, when German environmentalists including Euro solar succeeded in obtaining government support for the 100,000 roofs program. Driven by advances in technology and increases in manufacturing scale and sophistication, the cost of photovoltaic's has declined steadily since the first solar cells were manufactured, and the leveled cost of electricity from PV is competitive with conventional electricity sources in an expanding list of geographic regions Net metering and financial incentives, such as preferential feed-in tariffs for solar-generated electricity; have supported solar PV installations in many countries. With current technology, photovoltaic's recoups the energy needed to manufacture them in 1.5 to 2.5 years in Southern and Northern Europe, respectively. Solar PV is now, after hydro and wind power, the third most important renewable energy source in terms of globally installed capacity. More than 100 countries use solar PV. Installations may be ground-mounted (and sometimes integrated with farming and grazing) or built into the roof or walls of a building (either building-integrated photovoltaics or simply rooftop). In 2014, worldwide installed PV capacity increased to at least 177 gigawatts (GW), sufficient to supply 1 percent of global electricity demands. Due to the exponential growth of photovoltaic's, installations are rapidly approaching the 200 GW mark – about 40 times the installed capacity of 2006 China, followed by Japan and the United States, is the fastest growing market, while Germany remains the world's largest producer, with solar contributing about 7 percent to its annual domestic electricity consumption.

II. BACKGROUND

The topic of solar energy utilization has been looked upon by many researchers all around the globe. It has been known that solar cell operates at very low efficiency and thus a better control mechanism is required to increase the efficiency of the solar cell. In this field researchers have developed what are now called the Maximum Power Point Tracking (MPPT) algorithms. Mummadi Veerachary has given a detailed report on the use of a SEPIC converter in the field of photovoltaic power control. In his report he utilized a two-input converter for accomplishing the maximum power extraction from the solar cell [3]. M. G. Villalva in his both reports has presented a comprehensive method to model a solar cell using simulink or by writing a code. His results are quite similar to the nature of the solar cell output plots [1]-[2]. P. S. Revankar has even included the variation of sun's inclination to track down the maximum possible power from the incoming solar radiations. The control mechanism alters the position of the panel such that the incoming solar radiations are always perpendicular to the panels [9].M. Berrera has compared seven different algorithms for maximum power point tracking using two different solar irradiation functions to depict the variation of the output power in both cases using the MPPT algorithms and optimized MPPT algorithms [8]. Ramos Hernanz has successfully depicted the modeling of a solar cell and the variation of the current-voltage curve and the power-voltage curve due the solar irradiation changes and the change in ambient temperature [10].Studies show that a solar panel converts 30-40% of energy incident on it to electrical energy. A Maximum Power Point Tracking algorithm is necessary to increase the efficiency of the solar panel. There are different techniques for MPPT such as Perturb and Observe (hill climbing method), Incremental conductance, Fractional Short Circuit Current, Fractional Open Circuit Voltage, Fuzzy Control, Neural Network Control etc. Among all the methods Perturb and observe (P&O) and Incremental conductance are most commonly used because of their simple implementation, lesser time to track the MPP and several other economic reasons. Under abruptly changing weather conditions (irradiance level) as MPP changes continuously, P&O takes it as a change in MPP due to perturbation rather than that of irradiance and sometimes ends up in calculating wrong MPP[11]. However this problem gets avoided in Incremental Conductance method as the algorithm takes two samples of voltage and current to calculate MPP. However, instead of higher efficiency the complexity of the algorithm is very high compared to the previous one and hence the cost of implementation increases. So we have to mitigate with a trade off between complexity and efficiency.It is seen that the efficiency of the system also depends upon the converter. Typically it is maximum for a buck topology, then for buck-boost topology and minimum for a boost topology. When multiple solar modules are connected in parallel, another analog technique TEODI is also very effective which operates on the principle of equalization of output operating points in correspondence to force displacement of input operating points of the identical operating system. It is very simple to implement and has high efficiency both under stationary and time varying atmospheric conditions [12].

III. ALGORITHMS USED

$$\begin{cases} dP/dV = 0, & \text{at MPP} \\ dP/dV > 0, & \text{left of MPP} \\ dP/dV < 0, & \text{right of MPP.} \end{cases} \quad (1)$$



Since

$$\frac{dP}{dV} = \frac{d(IV)}{dV} = I + V\frac{dI}{dV} \cong I + V\frac{\Delta I}{\Delta V}$$

(1) can be rewritten as

$$\begin{cases} \Delta I/\Delta V = -I/V, & \text{at MPP} \\ \Delta I/\Delta V > -I/V, & \text{left of MPP} \\ \Delta I/\Delta V < -I/V, & \text{right of MPP.} \end{cases}$$

IV. PROPOSED WORK

1. Several MPPT techniques taken from the literature are discussed and analyzed herein, with their pros and cons. It is shown that there are several other MPPT techniques than those commonly included in literature reviews. The concluding discussion and table should serve as a useful guide in choosing the right MPPT method for specific PV systems.

2.Since pertub and observe algorithm is quite simple and easy to implement but this is slow as compared to Incremental conductance. Implementation complexity of P&O low as compared to IncCond algorithm. Because we have to use complex circuitry like.-Comparator, integrator, differntiator etc.

V. FUTURE SCOPE

The model is simulated using SIMULINK and MATLAB. The plots obtained in the different scopes have been analyzed. The simulation was first run with the switch on no MPPT mode, bypassing the MPPT algorithm block in the circuit. It was seen that when we do not use an MPPT algorithm, the power obtained at the load side was around 95 watts for a solar irradiation value of 85 Watts per sq. cm. It must be noted that the PV panel generated around 250 Watts power for this level of solar irradiation. Therefore, the conversion efficiency came out to be very low. The simulation was then run with the switch on MPPT mode. This included the MPPT block in the circuit and the PI controller was fed the Vref as calculated by the P&O algorithm. Under the same irradiation conditions, the PV panel continued to generate around 250 Watts power. In this case, however, the power obtained at the load side was found to be around 215 Watt, thus increasing the conversion efficiency of the photovoltaic system as a whole. The loss of power from the available 250 Watts generated by the PV panel can be explained by switching losses in the high frequency PWM switching circuit and the inductive and capacitive losses in the Boost Converter circuit. Therefore, it was seen that using the Perturb & Observe MPPT technique increased the efficiency of the photovoltaic system by approximately 126% from an earlier output power of around 95 Watts to an obtained output power of around 215 Watts. Finally this research concludes as below.

REFERENCES

[1] Hohm D.P., Ropp M.E.: “Comparative Study of Maximum Power Point Tracking Algorithms Using an Experimental, Programmable, Maximum Power Point Tracking Test Bed”. Photovoltaic Specialists

Conference, 2000. Conference Record of the Twenty-Eighth IEEE 15-22 Sept. 2000 Pages:1699 – 1702

[2] Femia N., Petrone G., Spagnuolo G., Vitelli M.: “Optimizing sampling rate of P&O MPPT technique” Power Electronics Specialists Conference, 2004. PESC 04. 2004 IEEE 35th Annual. Volume 3, 20-25 June 2004 Pages: 1945 - 1949 Vol.3

[3] Femia N., Petrone G., Spagnuolo G., Vitelli M.: “Optimizing duty-cycle perturbation of P&O MPPT technique” Power Electronics Specialists Conference, 2004. PESC 04. 2004 IEEE 35th Annual Volume 3,20-25 June 2004 Pages: 1939 - 1944 Vol.3

[4] Hussein K.H., Muta I., Hoshino T., Osakada, M.: “Maximum photovoltaic power tracking: an algorithm for rapidly changing atmospheric conditions”. Generation, Transmission and Distribution, IEE Proceedings-Volume 142 Issue 1, Jan. 1995 Pages: 59 – 64

[5] Brambilla A., Gambarara M., Garutti A., Ronchi F.: “New approach to photovoltaic arrays maximum power point tracking”. Power Electronics Specialists Conference, 1999. PESC 99. 30th Annual IEEE Volume 2, 27 June-1 July 1999 Pages: 632 – 637 vol.2

[6] Yeong-Chau Kuo, Tsorng-Juu Liang, Jiann-Fuh Chen: “Novel maximum-power-point-tracking controller for photovoltaic energy conversion system” Industrial Electronics, IEEE Transactions on Volume 48, Issue 3, June 2001 Pages: 594 – 60

[7] Kobayashi K., Takano I., Sawada Y.: “A study on a two stage maximum power point tracking control of a photovoltaic system under partially shaded insolation conditions” Power Engineering Society General Meeting, 2003, IEEE Volume 4, 13-17 July 2003

[8] Liu X., Lopes L.A.C.: “An improved perturbation and observation maximum power point tracking algorithm for PV arrays” Power Electronics Specialists Conference, 2004. PESC 04. 2004 IEEE 35th Annual Volume 3, 20-25 June 2004 Pages: 2005 - 2010 Vol.3

[9] Swiegers W., Enslin J.H.R.: “An integrated maximum power point tracker for photovoltaic panels” Industrial Electronics, 1998. Proceedings. ISIE '98. IEEE International Symposium Volume 1, 7-10 July 1998 Pages: 40 - 44 vol.1

[10] Wenkai Wu, Pongratananukul N., Weihong Qiu, Rustom K., Kasparis T., Batarseh I.: “DSP-based multiple peak power tracking for expandable power system” Applied Power Electronics Conference and Exposition, 2003. APEC '03. Eighteenth Annual IEEE Volume 1, 9-13 Feb. 2003 Pages: 525 - 530 vol.1

[11] Miyatake M., Inada T., Hiratsuka I., Hongyan Zhao, Otsuka H., Nakano M. “Control characteristics of a Fibonacci-search-based maximum power point tracker when a photovoltaic array is partially shaded”. Power Electronics and Motion Control Conference, 2004. IPEMC 2004. The 4th International Volume 2, 14-16 Aug. 2004 Pages: 816 - 821 Vol.2

[12] Miyatake M et al: “A simple maximum power point tracking control employing Fibonacci search algorithm for photovoltaic power generators”. EPE-PEMC’02, No. T6-003, 2002

