ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

A Fast-Converging MPPT Technique for Photovoltaic System under Solar Irradiation and Load Resistance

Chandrashekar.M.J[1], Bhoomika.Roy.D[2], Darshini.K.R[3]

Associate Professor, Dept. of EEE, SJB Institute of Technology, Bangalore, Karnataka, India[1]

UG Students, Dept. of EEE, SJB Institute of Technology, Bangalore, Karnataka, India[2,3]

ABSTRACT: Maximum Power Point Tracking MPPT are required to operate PV system at MPP. The P&O algorithm and INC algorithm are commonly used methods to track MPP by adjusting duty cycle of DC-DC converter. The existing methods use PIC microcontroller to implement MPPT algorithm. Under fast varying solar irradiation and load resistance, a fast-converging maximum power point tracking system is required to ensure the photovoltaic system response rapidly with minimum power losses. Traditionally, maximum power point locus was used to provide such a fast response. However, the algorithm requires extra control loop or intermittent disconnection of the PV module. Hence, proposes a simpler fast-converging maximum power point tracking technique, which excludes the extra control loop an intermittent disconnection. In the proposed algorithm, the relationship between the load line and the I–V curve is used with trigonometry rule to obtain the fast response. Results of the simulation and experiment using single-ended primary-inductor converter showed that the response of the proposed algorithm is four times faster than the conventional incremental conductance algorithm during the load and solar irradiation variation. Consequently, the proposed algorithm has higher efficiency.

KEYWORDS: Fast coverging, incremental conductance, maximum power point tracking (MPPT), photovoltaic (PV) system.

I.INTRODUCTION

Energy is required for our life and economy. As the country develops it needs more energy. Nowadays energy is supplied by burning fossil fuels such as coal, diesel. Increased energy demand results in two problems: energy crisis and climate change (global warming).The worldwide energy demand increases ,the energy related green house gases emission increases. It is global challenge to reduce the CO2 emission and provide clean, sustainable and affordable energy. Energy saving is one cost effective solution but does not tackle the worldwide increasing energy demand. Using Renewable energy is good option because it provides clean and green energy, with little or no CO2 emission. Renewable energy is generated from renewable energy sources such as Solar emission, Wind, Tides, geothermal etc. The major renewable energy technologies are Hydropower, wind power generation, biomass and ocean energy. This energy is used in Power Generation, Rural electrification (off-grid) and as transport fuels. Compared to fossil fuels Renewable energy has many advantages. Firstly, the Renewable energy obtained from natural sources so it is sustainable and it will not emit CO2 gas. So renewable energies tackle the green house effect and also provide sustainable energy. To achieve the renewable energy target, more funds will be provided in research and development of renewable energy.

SOLAR ENERGY is gaining popularity in the field of electricity generation. The advantages of solar power, such as no air pollution, no fuel costs, noiseless, and low maintenance,have boosted the demand on this type of energy as mentioned However, the high expense in acquiring the photovoltaic(PV) module has slowed down the adoption of PV system in electricity generation. Furthermore, the power of PV modules is unstable and strongly dependent on solar irradiation and load. Hence, the maximum power point tracking (MPPT) controller is introduced to ensure the PV system always provide high efficiency despite the variation in solar irradiation and load resistance .Many MPPT algorithms have been introduced to improve the efficiency of the PV system, including fractional open circuit voltage,

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

fractional short circuit current, fuzzy logic, neural network, hill climbing or perturbation and observation (P&O),and incremental conductance . Among those algorithm ,P&O and incremental conductance are the most popular algorithms.

II. APPROACH TO THE SOLUTION

A PV module consists of numbers of solar cell connected in series or parallel and the total power generated is the sum of the power contributed by all of the individual solar cells. A few methods exist in modeling the PV cell , and the model is used to model the PV cell . Under different levels of solar irradiation, the PV module produces different levels of power. the I–V curve of PV module under different levels of solar irradiation and also the MPPs which can be connected approximately by a straight line (MPP line) . A load line is generated and it can be imposed on the I–V curve when the PV module supplies power to the load. The power generated by the PV module is the product of the voltage and current of PV module at the intersection point between the load line and the I–V curve. Therefore, the output power of PV module varies according to the solar irradiation (I–V curve) and the resistance of the load (load line). Generally, a dc–dc converter is connected in between the PV module and the load. Then, the MPPT controller is used to regulate the duty cycle of the dc–dc converter to ensure the load line always cuts through the I–V curve at MPP. Fig.1 The proposed PV system with MPPT controller Thus, disconnection of PV module is required to collect the data and the power is wasted during disconnection. Although therefore mentioned algorithms can provide fast response, the complexity of the systems is greatly increased. Therefore, this proposes a modified MPPT algorithm that is able to provide fast response without the requirement of an extra control loop.

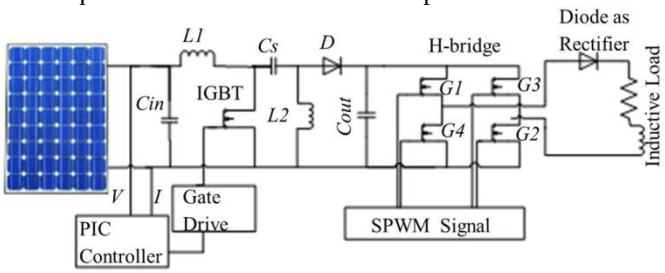

Fig.1 The proposed PV system with MPPT controller.

Thus, disconnection of PV module is required to collect the data and the power is wasted during disconnection. Although the aforementioned algorithms can provide fast response, the complexity of the systems is greatly increased. Therefore, this proposes a modified MPPT algorithm that is able to provide fast response without the requirement of an extra control loop.

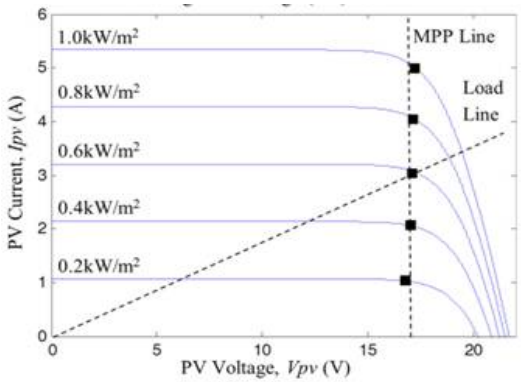

Fig.2 The MPP line and load line on the I-V curves for different levels of solar irradiation.

The variation in the voltage and current of PV module during the variation in solar irradiation or load as must be considered by the MPPT controller. If the duty cycle of DC–DC converter is fixed, the variation in solar irradiation will

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

either increase or decrease both the voltage and current of PV module simultaneously. Meanwhile, load variation will increase (decrease) the voltage and decrease (increase)the current of PV module. Variations in the voltage and current is always in opposite direction under load variation as in Fig.2 The MPP line and load line on the I-V curves for different levels of solar irradiation.

III.FINAL MODEL

Under varying solar irradiations the current and voltage is sensed by the sensor provided at the input circuit .The mechanism is to track Mpp and to boost up the voltage for the designed system. For the current designed model as shown in fig.3, the output of voltage is equal to 24 volts.

Fig.3 PV model with MPP technique.

IV.SIMULATION MODEL AND RESULTS

Using the software version of matlab 2014a the PV model is designed as shown in the fig.4, and the MPPT technique is built in through the model ,Thus the outcome of the simulation model is obtained by the graphical way of solar irradiation,current,voltage and power in their respective units as shown in the fig.5.and the simulation design of PV model of MPPT technique.

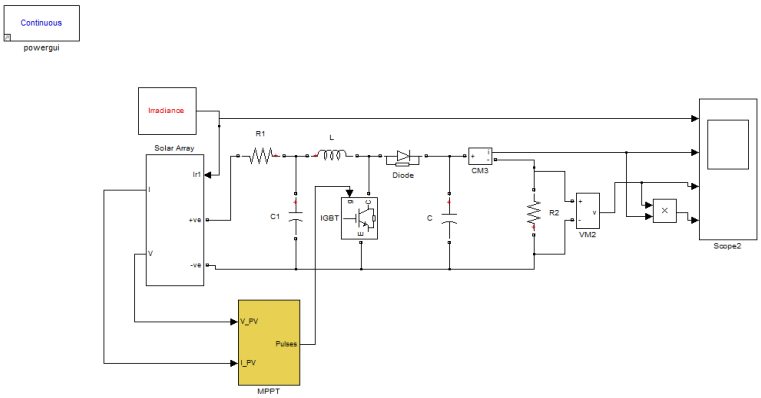

Fig.4 MATLAB simulation of MPPT controller.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

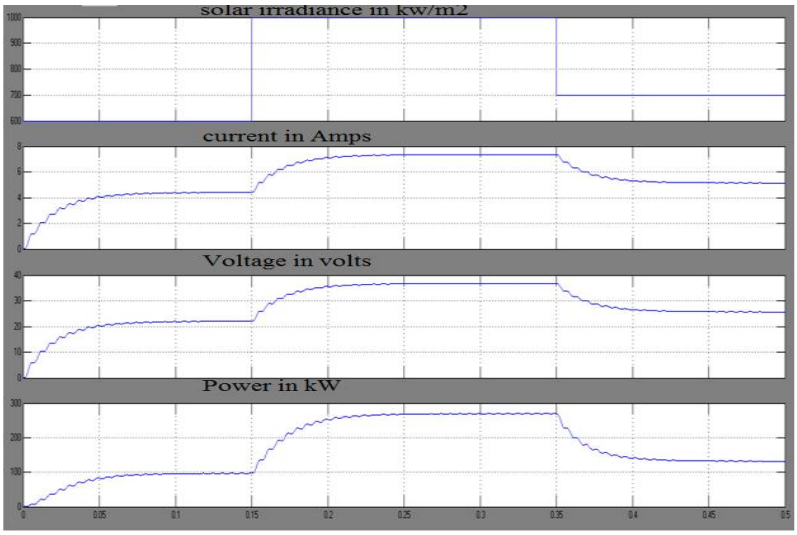

Fig.5 Simulation waveforms of solar radiation,current,voltage &power in Mpp technique.

V.FUTURE SCOPE

The future scope of the system is to reduce the response time of the solar according to solar irradiation. In this author presented an accurate PV module electrical model based on Shockley diode equation. The method of parameter extraction and model extraction and model evaluation is demonstrated in MATLAB for 60W solar panel. This model is used to investigate the variation of MPP with insolation levels and temperature. The author has made comparison between buck and boost converter topology for MPPT, connected to battery. the matlab model for patial shading condition is proposed. Which is useful in large scale PV installation. Also it is useful for interfacing PV module to model of power converter. The comparative study of widely adopted MPPT algorithms is done on the basis of simplicity, convergence speed, cost, digital or analogical implementation, sensors required and in other aspects. Their performance is evaluated on the energy point of view.Different mppt methods are discussed from various literature dating back to present days. At least nineteen methods are introduced in this literature survey.Useful for people who wish to work in the field of photovoltaic power generation. Author has done comparison of various mppt techniques based on implementation, cost and parameters to be sensed for particular mppt.

VI. CONCLUSION

Solar power continues to prove its potential as revolution for renewable energy. As companies continue research into the solar power, technology for them is becoming more and more useful. One of the main concerns for fixing problems involved with solar panel is of solar panel efficiency. A major goal for this solar panel application design was to optimize efficiency whenever possible. This was done through careful examination of product data sheets to obtain most desirable part, mainly with least amount of associated power loss. Continuous effort to maximize the efficiency should always be taken when we designing solar power applications to increase the solar energies usability and value. The design of maximum power point. Tracking system proved to be serious design challenge. There are so many factors involved when designing circuit that depends on both digital and analog aspects of the circuitry. There are inherently many problems when designing system that relies heavily on digital circuitry. Errant code writing is one such problem, and can only be remedied through trial and experience.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

REFERENCES

[1] S. Mekhilef, R. Saidur, and A. Safari, "A review on solar energy use in industries," Renew. Sustain. Energy Rev., vol. 15, pp. 1777–1790, 2011.
[2] C. Paravalos et al., "Optimal design of photovoltaic systems using high time-resolution meteorological data," IEEE Trans. Ind. In format., vol. 10, no. 4, pp. 2270–2279, Nov. 2014.
[3] M. N. Kabir, Y. Mishra, G. Ledwich, Z. Y. Dong, and K. P. Wong, "Coordinated control of grid-connected photovoltaic reactive power and battery energy storage systems to improve the voltage profile of a residential distribution feeder," IEEE Trans. Ind. In format., vol. 10, no. 2, pp. 967–977, May 2014.
[4] R. A. Mastromauro, M. Liserre, and A. Dell'Aquila, "Control issues in single-stage photovoltaic systems: MPPT, current and voltage control," IEEE Trans. Ind. Informat., vol. 8, no. 2, pp. 241–254, Apr. 2012.
[5] E. Mamarelis, G. Petrone, and G. Spagnuolo, "An hybrid digital-analog sliding mode controller for photovoltaic applications," IEEE Trans. Ind. Informat., vol. 9, no. 2, pp. 1094–1103, Jan. 2013
[6] M. Sokolov and D. Shmilovitz, "A modified MPPT scheme for accelerated convergence," IEEE Trans. Energy Convers., vol. 23, no. 4,pp. 1105–1107, Dec. 2008.
[7] S. Patel and W. Shireen, "Fast converging digital MPPT control for photovoltaic(PV) applications," in Proc. Power Energy Soc. Gen. Meeting, 2011, pp. 1–6.
[8] A. Chatterjee, A. Keyhani, and D. Kapoor, "Identification of photovoltaicsource models," IEEE Trans. Energy Convers., vol. 26, no. 3, pp. 883–889, Aug. 2011.
[9] K. Ishaque, Z. Salam, and S. Syafaruddin, "A comprehensive MATLAB Simulink PV system simulator with partial shading capability based on two-diodemodel,"Solar Energy, vol. 85, pp. 2217–2227, 2011.