Fuzzy Logic Controller Based Maximum Power Point Tracking for PV panel using Boost Converter

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ABSTRACT

Today, the energy crisis in the world has led to the rise in use of renewable energy sources. With the advancement in power electronic technology, the solar photovoltaic energy has been recognized as an important renewable energy resource because it is clean, abundant and pollution free. The efficiency of the photovoltaic system may be increased by using Maximum Power Point Tracker (MPPT). A number of algorithms are developed to track the maximum power point efficiently. Most of the existing MPPT algorithms suffer from the drawback of being slow or wrong tracking. Introduction of intelligent MPPTs in PV systems is very promising. This paper proposes an intelligent control method for the maximum power point tracking (MPPT) of a photovoltaic system under variable insolation conditions. Here in this paper, intelligent control method uses a Fuzzy Logic Controller applied to a DC-DC converter device. The result is compared with the results obtained by using P&O method.

Keywords: *PhotoVoltaic(PV),Maximum Power Point Tracker(MPPT),Fuzzy Logic Controller*.

1.Introduction

Photovoltaic power generation using solar cells that can convert solar light energy directly to DC electricity promises to be a clean, widely applicable renewable energy source. Researchers have shown great interest on photovoltaic (PV) technology over the past decades. Advancement in cell efficiency and system reliability has given wide acceptance of PV power technology for both standalone and grid interactive power generation. Sustainable growth of photovoltaic power generation throughout the world is also reducing dependence and pressure on fossil fuel considerably. The output current vs. voltage curve of a photovoltaic cell shows a non-linear characteristic. From this nonlinear relationship, it can be observed that there is a unique point, under given illumination and temperature, at which the cell produces maximum power, the so-called maximum power point (MPP).

One of the major concerns in the power sector is the day to day increasing power demand but the unavailability of enough resources to meet the power demand using the conventional energy sources. The continuous use of fossil fuels has caused the fossil fuel deposit to be reduced and has drastically affected the environment depleting the biosphere and cumulatively adding to global warming. Demand has increased for renewable sources of energy to be utilized along with conventional systems to meet the energy demand.

2. Literature Survey

Haskew .T.A (2010) explains the advance power electronic technology, direct driven permanent magnet synchronous generators (PMSG) have increasingly drawn interests to wind turbine manufactures. This paper studies and compares conventional and a novel control designs for a direct driven PMSG wind turbine. The paper presents transient and steady-state models of a PMSG system in a d–q reference frame. Then, general PMSG characteristics are investigated in the rotor-flux-oriented frame. A shortage of conventional control mechanisms is studied analytically and through computer simulation. A novel direct-current based d–q vector control technique is proposed by integrating fuzzy, adaptive and traditional PID control technologies in an optimal control configuration.

Comparison study demonstrates that the proposed control approach, having superior performance in various aspects, is effective not only in achieving desired PMSG control objectives but also in improving the optimal performance of the overall system.

Tofighi .A (2011) explains the concept of power management of PV source via passivity based control. The renewable energy resources are desirable for electrical power generation because they are environmentally friendly. Among renewable energy resources, solar energy is now widely used because it is free, abundant, and pollution-free. It is estimated that about 80% of all photovoltaic (PV) systems are utilized in stand-alone applications. Furthermore, power generated by a PV system depends on weather conditions. For example, during cloudy periods and at night, a PV system does not generate any power. Thus, hybrid power sources have been introduced to make the best use of solar energy. Batteries are a secondary source that stores solar energy and is utilized when it is needed based on hybrid system constraints. Power electronic converters play a significant role in hybrid systems. They interface between the Distributed Generation (DG) sources and the other parts of a hybrid system. Recently, some researchers have focused on controlling hybrid power sources..

Lei Zhang (2013)explains the study of the optimal energy management for a wind-battery hybrid power system (WBHPS) with local load and grid connection, by including the current and future information on generation, demand, and real-time utility price. When applying typical dynamic optimization schemes to such a problem with a single time scale, the following dilemma usually presents: it is more beneficial to plan the (battery) storage setpoint trajectory for the longer horizon, while prediction of renewable generation, utility price, and load demand is more accurate for the shorter term. To relieve such conflict, a two-scale dynamic programming (DP) scheme is applied based on multiscale predictions of wind power generation, utility price, and load.

3. Proposed System

Block diagram: Photovoltaic power generation using solar cells that can convert solar light energy directly to DC electricity promises to be a clean, widely applicable renewable energy source.

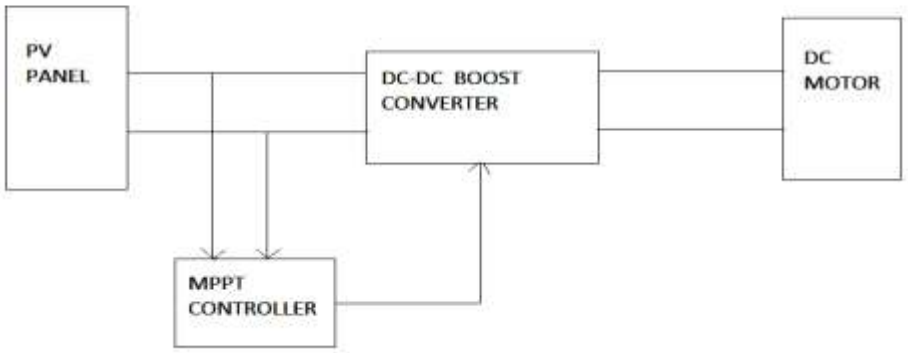

Fig 1.1Block diagram of FUZZY based MPPT

Fig 1.1 shows the block diagram of Fuzzy logic controller (FLC) based Maximum Power Point Tracking for PV system using boost converterThe overall architecture of the proposed system is PV resources with grid. The main sources are PV which are combined with Boost converter and DC sources. This converter is more effective for maximum power point (MPP) tracking in PV modules and for the input current control method used in this grid. Energy storage system (ESS) like Battery is also connected to the main dc bus in order to overcome the intermittent properties of renewable energy sources and to support local power production in an islanded mode particularly during blackouts or natural disasters. Fuzzy logic controller degied energy flow to the grid and charge control. DC voltage is converted into AC voltage by the PWM inverter and then fed to the local AC loads whose voltage is 240Vrms. Three phase utility grid is considered for this analysis which has voltage level of 440V, which is also tied to the three phase 230/440V transformer. LC filter used to reduce the harmonics presented in inverter voltage.

Components used in the FUZZY based MPPT

1.PV panel

Photovoltaic (PV) cells are made of, semiconducting materials that can convert incident radiation in the solar spectrum to electric currents. PV cells are most commonly made of silicon, and come in two varieties, crystalline and thin-film type.

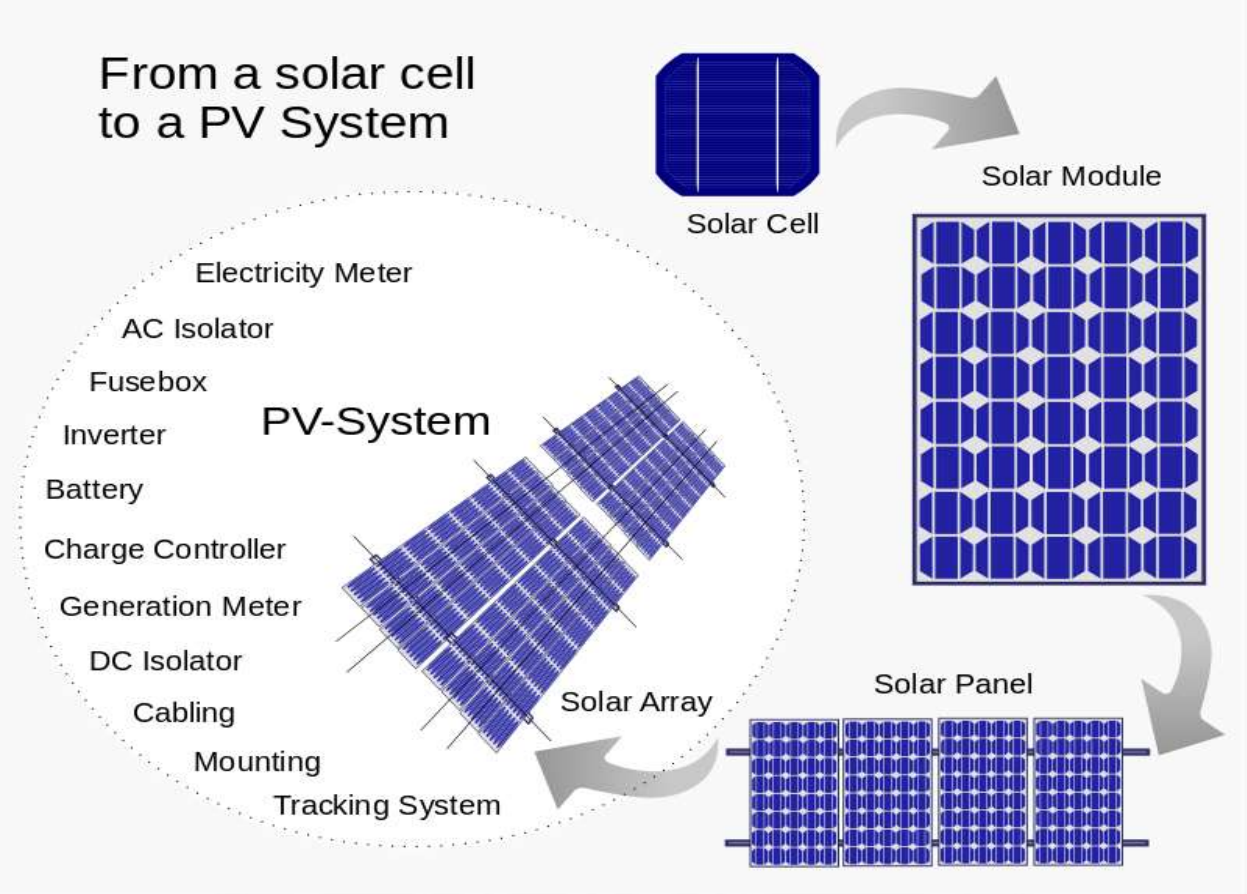

Fig 1.2 schematic diagram of PV panel

Fig 1.2 shows the schematic diagram of PV panel. When a photon is absorbed by a semiconducting material, it increases the energy of a valence band electron, thrusting it into the conduction band. This occurs when the energy of incident photons is higher than the bandgap energy. The conducting band electron then produces a current that moves through the semiconducting material.

2. Boost converter

A **boost converter** (**step-up converter**) is a DC-to-DC power converter that steps up voltage (while stepping down current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).

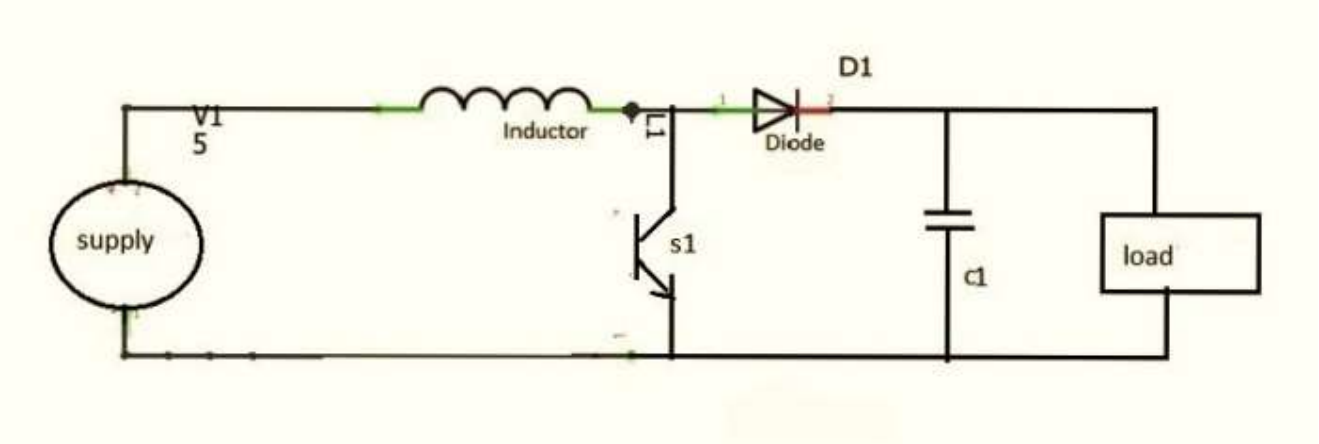

Fig 1.3 circuit diagram of boost converter

Fig 1.3 shows the circuit diagram of boost converter and the modes of operation.When the switch is closed, current flows through the inductor in clockwise direction and the inductor stores some energy by generating a magnetic field. Polarity of the left side of the inductor is positive.

When the switch is opened, current will be reduced as the impedance is higher. The magnetic field previously created will be destroyed to maintain the current towards the load. Thus, the polarity will be reversed (means left side of inductor will be negative now). As a result, two sources will be in series causing a higher voltage to charge the capacitor through the diode D.

3. Fuzzy logic controller

In this project ,FLC is been used as the maximum power point tracking method.In the existing method perturb and observe method is been used.The fuzzy rule representation is based on linguistic. Thus, the input is a linguistic variable that corresponds to the state variable under consideration. In fuzzy logic control, the term "linguistic variable" refers to whatever state variables the system designeris interested.

B. Results

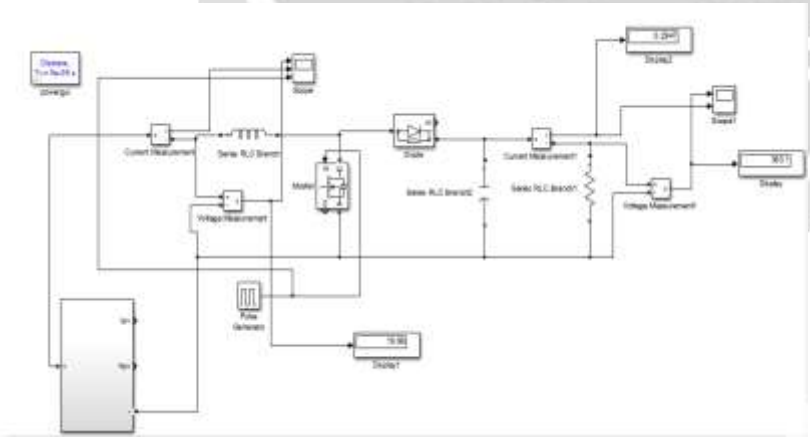

Fig 1.4 Implementation of open loop system

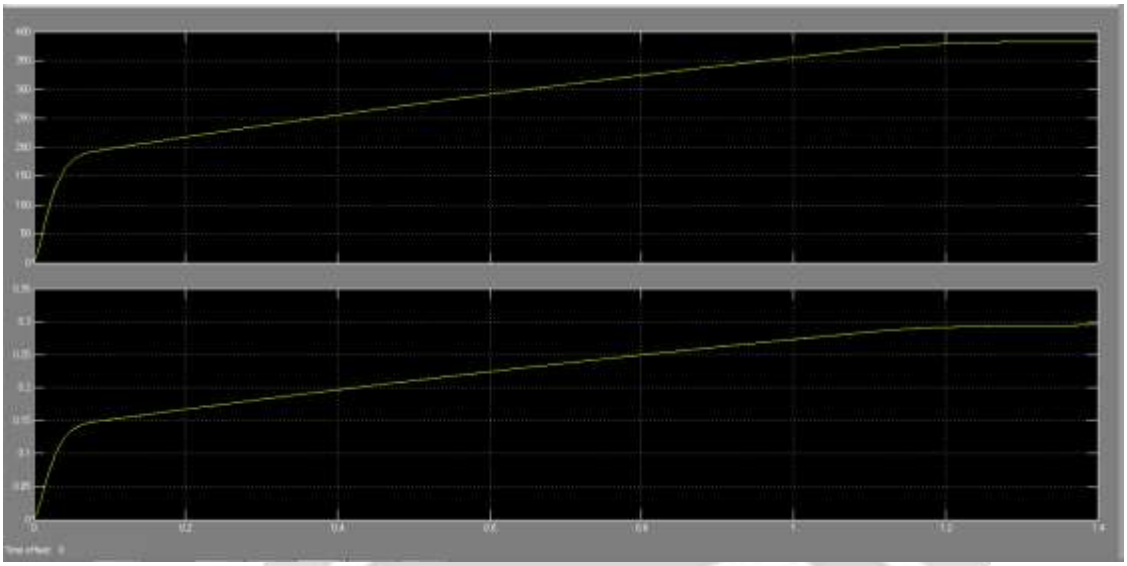

Fig 1.5 Output Voltage Waveform of the Boost Converter

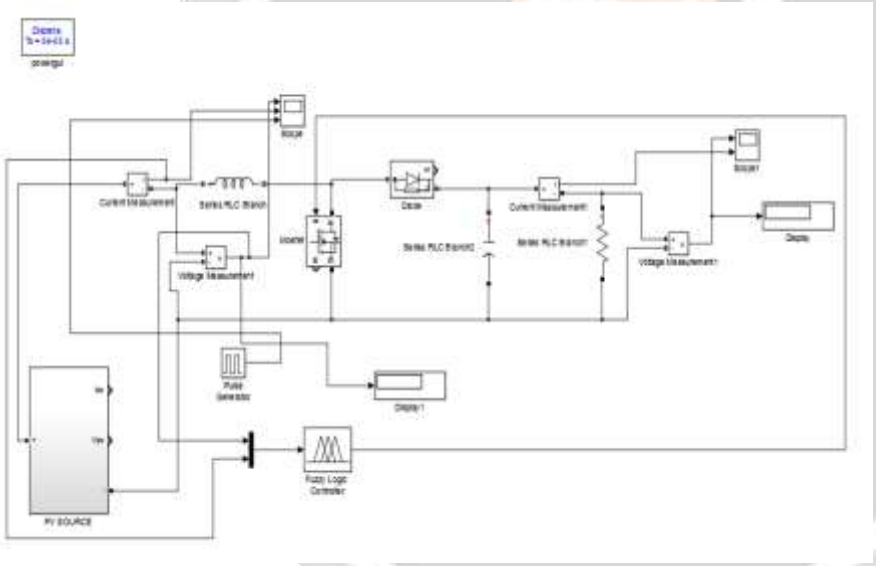

Fig 1.6 Implementation of closed loop system

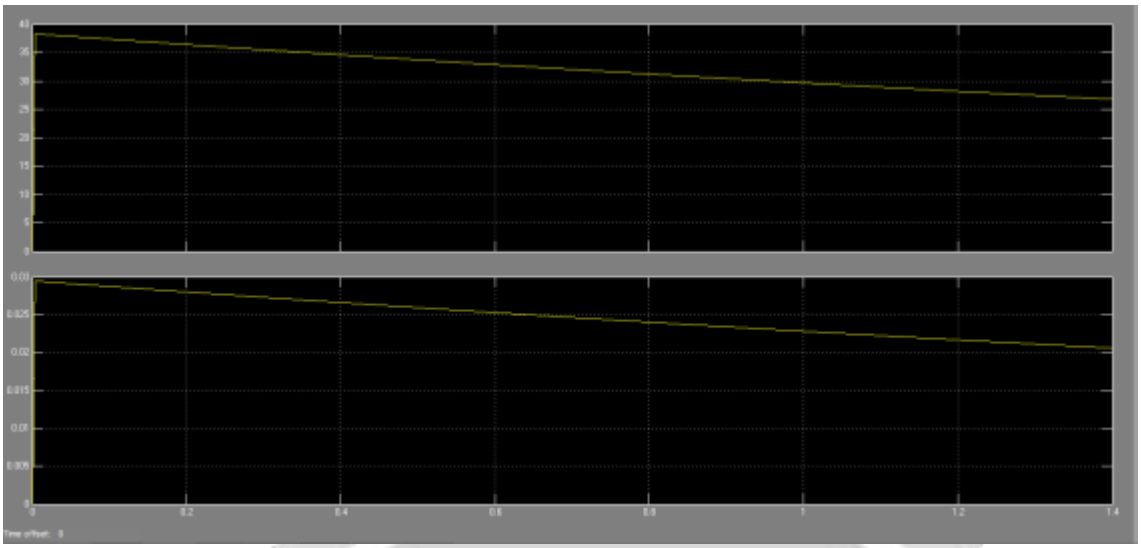

Fig 1.7 Output of overall system

Conclusion

A complete generalized model of PV array along with fuzzy logic based MPPT controller is developed in Matlab/Simulink in this paper. Fuzzy logic toolbox of Simulink is used to achieve the FLC. The specialty of this FLC is that the rule base is very simple which increases the speed of computation of the processor. That is why the proposed FLC can track the MPPT very fast and accurately even if the environment changes abruptly. The performance of the proposed controller is compared with that of a conventional P&O controller and the worth of the fuzzy controller is obvious. The proposed controller can be used in any real PV system with the help of digital signal processor to get good results.

The FLC based MPPT controller is been used in this project in order to achieve the accurate power that is been tracked in the panel. In the existing project P&O is been used. In that method the tracking speed and accuracy is very low.

References

1. X. Li, K. Dong, H. Wu, "Study on the Intelligent Fuzzy ControlMethod for MPPT in Photovoltaic Voltage Grid System", *3rd IEEE*
Conference onIndustrial Electronics and Applications, pp.708-711,2008.
2. G. Zeng, Q. Liu, "An Intelligent Fuzzy Method for MPPT of Photovoltaic arrays", 2nd International Symposium on Computational
Intelligence and Design, IEEE, 2009.
3. Z. M. Salameh, D, Fouad, and A. William, "Step-down maximum
power point tracker for photovoltaic systems," *Solar Energy*, Vol. 46,
No. 5, pp. 279-282, 1991.
4.TrishanEsram, and Patrick L. Chapman, "Comparison of Photovoltaic
Array Maximum Power Point Tracking Techniques," *IEEE Transactions on Energy Conversion*, vol. 22, No. 2, pp. 439-449, June.2007.
5. P. S. Revankar, W. Z. Gandhare, A. G. "Maximum Power Point
Tracking for PV Systems Using MATLAB/Simulink", *2nd International*
Conference on Machine Learning and Computing, IEEE, pp. 8-11, 2010.