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Techniques to enhance energy conservation of Solar panel with Maximum power point tracking system

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Abstract

Consumable and non-consumable source of energy remain the topic of discussion. This paper presents the unique way of expressing the techniques that are effective enough to attain maximum power out of non-consumable energy sources. Solar panels are used to extract the energy from the sun and this energy is then moved to batteries. To determine the best possible approach that generates maximum power, maximum power point tracking is established. The mechanisms that play a critical role in conserving energy and discussed in this literature includes Fuzzification and defuzzification, Clustering mechanism and Shortest charge routing mechanism and each is merged with MPPT (Maximum power point tracking). The comparative results are also presented to determine best possible approach. Fuzzification and defuzzification with MPPT yield best possible result. Battery charge with time is primary metric used to validate the approach.

Keywords: MPPT, Fuzzification, Defuzzification, Battery life, Clustering, Shortest charge routing

I. Introduction

The mechanisms that ensure better stability for the energy attained from non-consumable sources like sun is the primary concern in this paper. The power generated from the solar panel must be stored within the batteries to use them later. The mechanism is devised by the researchers to ensure the better conservation of energy. This paper presents model of preservation and analyse the generated results. The discussed approaches include: fuzzification and defuzzification, clustering based approach and shortest routing-based approach.

Fuzzification and defuzzification is the mechanism in which threshold values of the charge is maintained. In case charge is above the threshold values then it is transferred to the battery. Otherwise, cycle generating charge is rejected. Loss of charge is never going to be an issue with this approach. Clustering approach selects the best possible charge career. The healthier charge career could carry the charge towards battery without distortion. Shortest routing-based mechanism on the other hand ensures quick charging of batteries. However, loss of charge could be an issue.

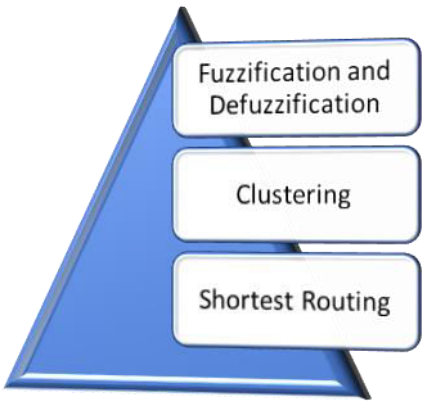

Figure 1: Techniques used to conserve energy using solar panels

All the listed mechanisms will be utilised along with solar panels. The solar panels must accommodate one of these mechanisms to transfer the charge towards destination at faster rate. The Maximum power point tracking will be applied to determine the best possible power generated.

Rest of the paper is organised as under section 1 gives the introduction of the techniques used to achieve maximum power form solar panel. Section 2 gives the literature survey, section 3 presents the result comparison with MPPT, section 4 presents the summary, section 5 gives references.

II. Literature Survey

Abdin in 2020[1]considered a bond graph approach to model a solar photovoltaic-thermal panel (PV/T) system as an alternative to the method used in previous models. Based on the obtained 1d model representing the dynamics of the PV/T to identify transfer functions connecting the air output temperature to the air input flow for different operating points. Further, a PI-type controller is proposed and proven to guarantee good performance. All the techniques presented are illustrated through simulation results.

B.K Bose et. Al in 2018[2] discussed many nonconventional sources available for production of electricity, one of the abundantly available source is the light i.e., Solar radiation through which we can able to produce electricity by means of photovoltaic cells in form of a panel. The panel will receive sunlight and it will convert photons falling over the panel in form of light into electricity and gives output as dc power. Despite of the availability of wind as a renewable source for production of electricity we are opting Solar as a source because of the complexity involved in the construction and commissioning of wind farm. Since theelectrical circuits are to be kept in an open space to produce electricity, they will get heated up due to the continuous operation and continuous exposure to sunlight which will affect the efficiency of the panel.

E.Serban et.al, 2018[3] proposed mechanism that handle the power loss of PV solar system. It firstly analysis the power loss of 3L-TNPC and then the proposed method is applied on it for handling this loss. The results shows that it normalized the power supply by 5%. It can operate in high modulation index and leads to the accurate power loss estimation.

K. E. Madu 2018[4]introduced an audit of PV/T combi-panels and their orders. The study demonstrated various kinds of panel plans (revealed panels, double stream panels, and two-stage panels) and ordered combi-panels into PV/T water gatherer, blend water/Air PV/T authority, PV/T air authority – single pass and PV/T Air gatherer – twofold pass. The creator demonstrated the focal points and disservices of each kind just as named various innovations of every one of them.

P.D.Optimizer 2018[5] describes partial power DC-DC optimizer that is used for controlling voltage of battery. It supports PV string voltage and grid connection that can work in various operating conditions. Its analysis various power stages of inverter and control the voltage for these stages by applying flexible charging of battery.

N. Agarwal et.al, 2017[6] proposed a quasi-health monitoring mechanism of sensor within solar inverter. Result is verified against the scaled down version of grid connected with solar inverter. The mechanism conserve energy along with reliability by ensuring least amount of power is consumed while transmission of power through solar inverter.

S.A.Arefifar et.al, 2017[7] proposed an optimization technique that processes the different PV modules and generate curves for operating areas. It implements the optimization process for solar plant design, and it maximizes total payback time and financial benefits have been increased. It utilizes parameters like sensitivity, average and variance.

T. J. Formica et.al, 2017[8] describes various challenges that are occurred during handling of solar photovoltaic systems and also gives robust technique that handle these challenges also it focus on ROI. It also analysis the failure data and gives reliability concerns for solar PV inverters. It uses key for handling failures in ROI for solar PV inverter and improves reliability of the system efficiently.

C.F.Inverter et.al, 2017 [9] proposed modified SOP modulation technique that is used for implementation of controlling voltage boost of inverter. It utilizes simple conversion methods and gives effective result. It maintained

the operating power below 5% and the frequency of switching is 350 Hz. It utilizes conversion method for handling waveform of quasi-sine along with operational constraints.

R.Kumar et.al, 2017[10] describes technique for handling single stage solar PV generation . The technique uses BLDC motor driven water pumping system that describes various stages of 1 PVgeneration. It provides DC-DC converter that uses current sensing element and gives cost effective drive. The results shows that it handles the power of water pump and gives cost effective drives.

J. Meyer et.al ,2017[11] surveys various techniques used for PV installation on power quality. The analysis shows the many techniques has low installed PV capacity and it also includes PV frequency range more than 2Khz. It configures that the proper use of PV installation is not done, and the emission of power is more.

T.G.P.V Systems 2017[12] proposes a cost effective sensor less power reserve technique that is used for handling power supply in grid connected PV systems. It utilizes MPPT operations that routinely checks the available power and after that estimates have been calculated. It set up a limit for extracting PV power and minimizes the power fluctuation during this process. The results shown that it has high performance and cost effective.

A. H. Al-Waeli 2016[13] analyzed the impacts of bifacial air based Photovoltaic Thermal authority (PV/T) under the principal law of thermodynamics. The creators planned four bifacial modules comprising of two-way types which are a solitary way and a twofold way parallel stream. The investigation found that the two parallel ways have the best proficiency around 45 to 64 %.

D.Schwanz 2016[14] describes a stochastic method that estimate the contribution of single phase PVI . It includes the uncertainty and calculate the impact of induction motor. The network can operate in any condition and the risk of single-phase size is reduced. It can control the connected power links of the PVI of single phase.

The next section presents the comparative analysis of the result obtained by applying the clustering, shortest routing and fuzzification and defuzzification.

III. Comparative analysis

The comparative analysis of the techniques with MPPT yield fuzzification and defuzzification as best possible mechanism. The result is expressed in the form of charge time which is least for fuzzification and defuzzification. Table 1 represents the result of the discussed mechanisms.

Parameter	Clustering with MPPT	Shortest Routing with MPPT	Fuzzification and defuzzification with MPPT
Charging time (Ms)	15	18	10
Maximum Power(W)	200	210	220
Transfer Rate(m/s)	15	12	20

Table 1: Result comparison

The plot for the table 1 is given as under

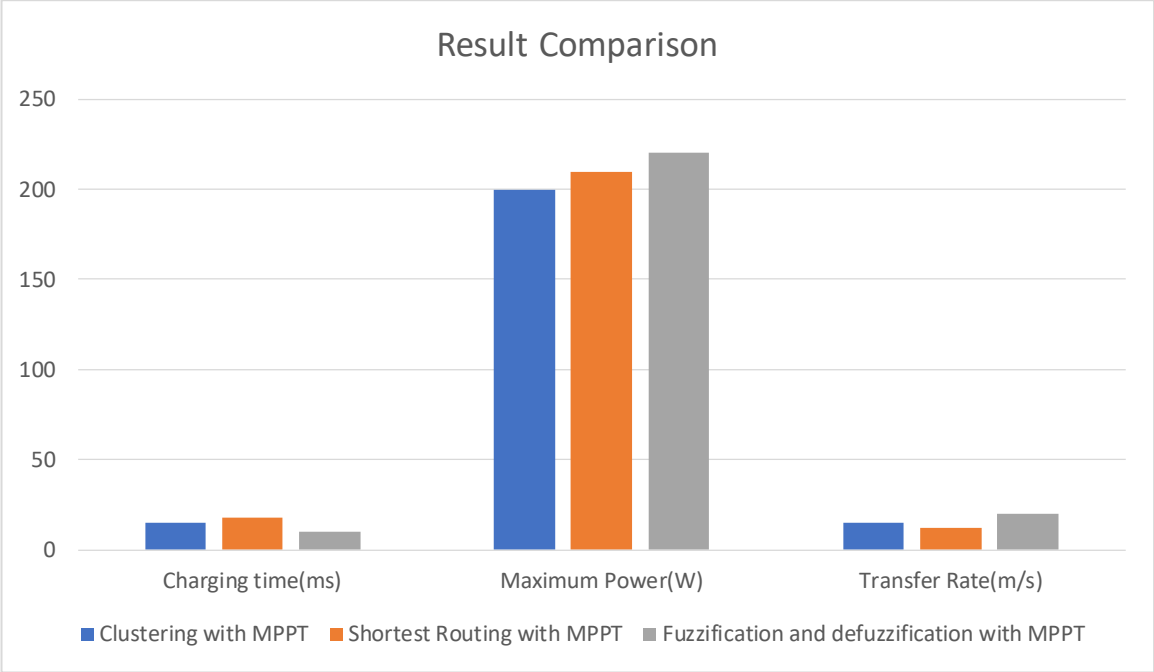

Figure 2: Result Comparison

IV. Summary

The discussed mechanisms ensure the shortest time to charge the battery using solar panels. The charge obtained will be transmitted towards the battery. Maximum conservation is achieved with the fuzzification and defuzzification mechanisms. The overall result obtained in-terms of transfer rate, speed of charging and maximum power is obtained with the fuzzification approach. Stability could be an issue which can be resolved using Schmitt trigger. The mechanisms are validated using maximum power point tracking mechanism.

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