

A Review On Various MPPT Controller Techniques With PV System

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Abstract: The most prominent renewable resource is the sunlight and is utilized by solar PV technology. This technology is more preferred for the reason of costless availability of sunlight and solar PV's panels simplified structure. Maximum Power Point Tracking Controller (MPPT) is the technique which makes photovoltaic modules to run at optimum rate and extract maximum energy out of it. Various algorithms are designed to achieve high efficiency in power point. Although the MPPT algorithms which are available now are quite effective but most of them have a major drawback of being slow. This paper offers an overview to the work that has been done many authors.

Index Terms - PV MPPT, Fuzzy, BESS.

I. INTRODUCTION

Power sector now-a-days are looking for new resources in order to achieve the present need of power as resources provided by the nature are on the verge of depletion. The important factor for global warming is the carbon content in atmosphere which can be reduced to a greater extent by using renewable sources of energy [1]. The most prominent renewable resource is the sunlight and is utilized by solar PV technology. This technology is more preferred for the reason of costless availability of sunlight and solar PV's panels simplified structure. In this work, the discussion of different forms in the PV panels has been discussed along with the work needed to improvise the design system of PV panels. Maximum Power Point Tracking Controller (MPPT) is the technique which makes photovoltaic modules to run at optimum rate and extract maximum energy out of it. Various algorithms are designed to achieve high efficiency in power point. Although the MPPT algorithms which are available now are quite effective but most of them have a major drawback of being slow. The Incremental Conductance (INC) and Perturbation and Observation (P&O) are the mechanisms of the maximum power point technique paradigms [2].

The energy need has increased exponentially from the time it was introduced to the mankind. Most of the energy is utilized to meet social and economical development and to improve the living conditions of human, along with that the improvisation of energy has also been observed in the health care sector. The energy has very important contribution in serving to the productive processes and improve human living and ensure that the daily basic [3] needs of human life for example lightning, food processing, comfort ability and communication has also been met properly. There been increase in fossil flues usage from 1850. There is dominant position of fossil fuels like gas, oil etc from the past which leads to Rapid growth in carbon dioxide emission. The energy transformation had taken place for human welfare productivity and comfort. Constant supply of energy has significant role in human prosperity as human has become quite dependent on energy. The energy is distributed as follows [4]. 45% of energy utilization is in cooking water heating space heating and drying 10% of the energy issued for high temperature industrial process heat 15% of energy issued to run electric motors and 30% of energy is used for Transport. 80% of the Global emission of CO₂ gas is due to fossil fuels (IEA, 2006b). With the advent of economic growth there is requirement of different types of energies by the world population. The energy demand and economic progress goes side by side [5]. It has been observed in the past years that the countries which are in developing stage are demanding more energy which makes exponential hike in the prices of energy and the price increment will be observed in future. After the oil crises in 1973/74 and 1979/80 the non oil producing countries focused on electricity generation to meet the domestic energy needs. Since oil prices are stable but still the chance of energy supply disruptions is still there. 80 % of the fossil fuel worlds energy supply is reconciled by 80 percent of fossil fuel which is a contradiction to using a low carbon emitting modern energy system (including CO₂ capture and storage (CCS) (IPCC, 2005). The improvement in energy efficiency will be a part of GHG-emission reduction [6].

II. Maximum Power Point Tracking

In order to originate the increased power from the PV method the Maximum power point tracking mechanism is utilized. While varying the operating point electrically of the module the MPPT mechanism operates in order to transfer the high accessible power and no mechanical and transient component is involved to alter the location of the approach [7] in order to straightforwardly face the sun by the mechanism. The only maxima is utilized to present the high power point related to particular voltage and current. This maximum is observed from the power Vs voltage characteristics of the PV module. The overall efficiency of the PV module is quite low (up to 12 %), so it became important to operate it at the optimum power point to obtain the maximum power. Increase in power makes PV modules utilization more effective. The impedance matching between PV module and the circuit is done by DC/DC converter and thus power is transferred to the load. Switching elements varying duty cycle is responsible for the impedance matching [8].

MPPT Methods for PV System:- Maximum power point controller uses maximum power point tracking technique to take maximum power of PV modules by taking into the consideration the temperature and solar irradiance at that instant. There are multiple techniques for deriving the maximum power. Slow tracking of power reduces the efficiency which is the most common problem encountered in case of MPPT algorithm [9]. The several MPPT control mechanisms such as Perturbation and Observation, Incremental conductance, Artificial Neural Network among back propagation, fuzzy logic controller Intelligent Control among DC to DC converter, Particle Swarm Optimization, Open Circuit Voltage Control, Short Circuit Current Control, feedback of power fluctuation among voltage mechanism and also among the voltage mechanism, single input fuzzy controller for tracking MPP, Ant colony Optimization and Generic paradigm mechanisms are utilized to advance the effectiveness of the solar energy. The presence of multi-crest yield bends of incomplete shading in PV exhibits is normal, where the improvement of a calculation for precisely following the genuine MPPs of the perplexing and nonlinear yield bends is crucial.

III. MPPT TECHNIQUES

A. Incremental Conductance (INC) Based MPPT Techniques

In order to achieve the MPP operating point for an adaptive voltage step alterations on the basis of the PV curve's slope these mechanisms are projected. In the upcoming iteration steps the acceleration and deceleration factors are utilized in order to obtain the alterations in the voltage step value from the PV curve. The atmosphere situation fluctuations are tracked rapidly by enabling the PV method through the adaptive voltage step alterations. That's why from the PV energy mechanisms the solar energy will be produced. For implementation it is very simple and there is no need of necessitated information about I - V features of particular PV panels and it is very simple to tune the parameters. By investigating the peak of the P-V curve the MPP is tracked. For MPPT this paradigm utilizes the instantaneous conductance I/V and dI/dV . The position of the PV module's operating point is firm in the PV curve by the paradigm through illustrating that the PV module performs on the MPP among left and right sides of the MPP in the P-V curve by utilizing these couple of significances.

B. Perturbation and Observation Based MPPT Algorithm

On the basis of the PV array that is perturbed of a radiation of direction the Perturbation and Observation MPPT paradigm is operated and is very simple to execute. The working position fluctuates away from the MPP only if the power exhausted from the array enhances and afterward, ensembles in the same direction so the working voltage. On the other hand the direction has to be overturned of the working voltage perturbation as if the power exhausted from the PV array is reduced and the operating point fluctuates away from the MPP. The demerit of the P&OMPPT mechanism is stable. In the domain of the MPP the operating point fluctuates by which the waste of energy is increased. To reduce the fluctuations in the stable condition the several enhancements of the P&O paradigm has been designed as the speed of the paradigm response is reduced throughout the environmental alterations.

C. Artificial Neural Network Based MPPT Techniques

A multilayered feedback neural network among the back propagation trained system is applied in this mechanism. Among a couple of surged ANNs a two-stage offline trained Artificial Neural Network based MPPT evaluates the temperature and irradiance stages from the current signals and the PV array voltage. Still in the quick altered atmospheric situations for the stable and the transient instants this mechanism offers the enhanced presentation among decreasing the training set generally, a three-layer RBF NN is accepted to execute the PPT.

D. Fuzzy Logic Controller Based MPPT Techniques

In order to map the inferior space to the exterior space the fuzzy logic control is an appropriate method. The fuzzy set theory is utilized in the fuzzy logic in this a variable is a member of one or more groups, among the degree of membership that is précised. Generally three blocks that are fuzzification, inference, and defuzzification involved in the fuzzy logic controller.

E. Particle Swarm Optimization Based MPPT Algorithm for PV System

In order to decrease the stable oscillations to practically zero as the high power point is situated the PSO paradigm is utilized. Moreover, for the tremendous atmospheric situations such as huge variations of insolation and partial fading situation the PSO paradigm has the capacity to track the MPP. On the basis of the Particle Swarm Optimization the MPP tracker for the photovoltaic module arrays is able to track the MPPs that are inclusive of multipeak feature curves there for considering the sixed significances were accepted in the paradigm. The presentation of the tracking the vigorousness is deficient, as the success rates are minimal while tracking the global MPPs. However, the dynamic response speed is less so the MPPs were followed effectively. For the several atmospheric situations such as fully shaded situations and partially shaded situations in order to search the novel global MPP among re-beginning of particles is monitored in the IPSO based MPPT controller paradigm.

IV. RELATED WORK

Ram Naresh Bharti et.AI. had simulated the complete work flow of solar power generator in which power is generated using solar energy. It had shown how photovoltaic system converts the solar energy to electric DC power. Author used DC-DC boost converter to boost the low DC voltage generated by the photovoltaic system. The boosted DC provided maximum power by the application of the MPPT technique and then the duty ratio of the waveform is boosted by Perturb and Observe technique.

Priety et. Al. This work had given more emphasis on the usage of the renewable resources especially on the use of the solar energy and its conversion to electric energy by the usage of the photovoltaic cell. This work had also addressed an important issue of variation of the maximum power obtained by solar energy conversion due to solar irradiation and temperature along with non linear I-V and P-V characteristics. For the solution the author had provided several MPPT techniques to tackle the same issue and the differences between different MPPT techniques had been reviewed.

Pawan D Kale et Al. This paper had explained the issue of difficulty in tracking the maximum power due to several factors and had elaborated some of the ideas and techniques to overcome this difficulty. Author had proved the efficiency of the open circuit and slope detection tracking system in the context of tracking speed and accuracy and also had proved this technique to be the most power efficient.

Chandni Sharma et. Al lay emphasis on the maximizing the power of the PV system output power by analyzing different MPPT techniques along with their elaborative studies. The main factors on which different MPPT techniques had been examined were simplicity, convergence speed, digital or analogical implementation, requirement of sensors, cost effectiveness and other aspects.

Raju P et. Al In this work, Hybrid power systems (HPS) had been discussed along with MPPT controller and how this technique enhances output power of the PV system. This paper focused on the usage of standalone power system and its effective application in the rural areas.

Rashid Al Badwawi et. Focused on solar and wind hybridized power and the challenges in making them as a fully fledged energy resource. The two major concerns regarding the hybrid power system, voltage fluctuation and frequency fluctuation were discussed and methods like proper designing, advance response control facilities, hybrid system optimization were purposed to remove these flaws. This work focuses more on the enhancement of the overall structure design to make the hybrid system to work at its peak power. Two systems, grid-connected and stand alone hybrid system were compared and reviewed in this work

Anil Kumar Kashyap et.Al This paper examined two factors, Quick Reaction and High tracking Accuracy as the major design requirement in MPPT control to enhance its power and make it work to its optimum level. Author also had explained the utilization of the MPPT algorithm to improve the power of PV system. The Hybrid power system was reviewed and more focus was drawn on standalone power system and its best suitability for the rural areas.

Parveen Shukla et. Al. This paper analyzed different maximum power point tracking technique on the basis of their three categories that are Power Signal Feedback method, Hill Climb Search and Tip Speed Control method. This paper examines the impact of MPPT techniques on the turbine system to make it more faster and better for wind energy conversion and its ability to obtain the optimal operating point for maximum power transfer.

S. Marmouh et. Al. To extract the large amount of power for the broad array of the wind speed the Wind Energy Conversion Method (WECS) was utilized and experimental results are obtained. The MPPT control paradigm was utilized on the Permanent Magnet Synchronous Generator (PMSG) that was contained in this mechanism. With the help of the AC-DC-AC converter the stator of PMSG linked to the grid. While influencing the Grid Side Converter (GSC) the smooth DC link voltage flow is assured within a couple of converters. The work was first simulated then results were collated by practical implementation.

Xiangjun Li et. Al. This work purposed the control method to reduce the fluctuation in the output power wind/PV hybrid system and regulation of battery SOC under typical conditions. Matlab and Simulink were used as tools for simulate of wind/PV hybrid system and effectiveness of smoothing circuit was observed by calculating the improvement in the fluctuating output power of hybrid system.

V. CONCLUSION

The PV modules maximum power is extracted using MPPT techniques. At particular instant irradiance and temperature is considered which extracted using MPPT controller. By applying several projected paradigms the effective maximum power point is tracked. The slow tracking is the main drawback of most of the existing algorithms of MPPT that results in reduced efficiency utilization. The PO algorithm used in the existing systems to track the power require modification as number of advanced techniques have been introduced that can produce effective results. Moreover, the existing system do not use any storage system for the power as the remaining power after completing the requirement can be restored for upcoming constraint. The several hybrid MPPT mechanisms are used for the uncertain situations like non-uniformity, partial shading by utilizing the merits of MPPT mechanisms that is reviewed in this paper. The several researchers have been utilized these mechanisms for specific situations due to the simplicity and the advantages of these techniques.

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