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A REVIEW ON MAXIMUM POWER POINT TRACKING CONTROL OF PHOTOVOLTAIC SOLAR POWER GENERATION

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ABSTRACT

The greatest power is generated by a solar panel when it is fully active. In technical jargon, this moment is known as the "maximum power point" (MPP) (MPP). All of the variables that affect a PV panel's maximum power point change with time. The maximum output voltage of the solar panel determines the maximum power output, which varies with the quantity of irradiation. temperature. To guarantee that the PV panel's full power is taken, a boost converter is used. to maintain the highest possible output from the photovoltaic panels in terms of voltage. Renewable energy sources are becoming more important as a solution to the world's energy crisis. There are just about half as many solar panels being harnessed in the United States as India plans to bring online by 2020, when it comes to solar power generating. Solar energy is a valuable but underutilised resource in a country with a tropical climate like ours. Weaknesses in efficiency and high startup costs of solar photovoltaic (PV) systems are preventing their broad implementation. It is the goal of this research to examine a schematic for extracting the maximum amount of power from a PV module and using it in a DC circuit. Maximal Power Point Tracking (MPPT), a novel solar photovoltaic technique, may considerably increase system efficiency..

Keywords: *Photovoltaic, maximum power point tracking, MPPT*

1. INTRODUCTION

Renewable energy sources are becoming increasingly relevant when fossil fuels are depleted owing to their massive consumption. Solar panels are utilised in a broad variety of applications, including water pumping, battery charging, hybrid cars, and grid-connected PV systems. There is a moment at which a solar panel's (Power-Voltage) curve may be assessed when it is most efficient in delivering energy to the load. When it comes to optimal working conditions, temperature and sun irradiation are considerations. The success of a PV array hinges on its ability to monitor its peak production over the internet. Maximal Power Point (MPP) may be measured in several ways (MPPT) (MPPT). The implementation, discovered attributes, necessary sensors, convergence time, and cost of the various approaches [1] varies. [1]. [1]. This basic MPPT approach mentioned in this article does not require open-circuit voltage and short-circuit current measurements. Solar energy may be harvested in two major methods. Heat that is collected may be utilised to produce solar thermal energy for use in space heating. For the most practical usage, incoming solar radiation may be transformed into electrical energy. PV solar cells and CSP solar power facilities may assist with this. There are a variety of methods to connect a number of PV modules in order to suit the demands of the system. There are many different sizes of photovoltaic modules (generally sized from 60W to 170W). Small-scale desalination units, for example, typically need 3,000 watts of electricity to run well. Indonesia's energy demands may be met in large part by the sun's rays. Devices that are very effective The only way to harness this kind of energy is using a photovoltaic (PV) system. This maximum power point, which is controlled by the quantity of sunshine and temperature, is critical to getting the most out of solar panels. It is vital to boost energy output by constructing a PV system capable of monitoring the maximum power point. Temperature and radiation vary constantly, which is why this happens. In particular, the goal of this research was to assess the performance of a maximum power point tracking system based on incremental conductance. In order to maximise MPPT efficiency, the duty cycle of the Buck Boost converter was monitored and regulated by an algorithm built into the semiconductor. Using Simulink, the IC method's performance was compared to the more often used P&O methodology. While oscillating at a lower frequency, for example, the IC technique is more energy efficient. Photovoltaic (PV) systems are among the most promising new energy sources now on the market. However, despite the system's energy conversion efficiency being poor, it is absolutely free to use, does not need maintenance, and does not contaminate the environment. The tracking of the maximum power point is critical to a variety of solar power system components (MPPT). Researchers have developed a new artificially intelligent MPPT controller for use in PV applications. A fuzzy logic controller based on the MPPT technique is created using Hopfield neural networks. Instead of relying on trial and error, an algorithm is utilised to update the FLC membership function automatically. To produce a higher voltage gain coupled inductor soft switching boost converter, the MPPT algorithm was used.

2. LITERATURE SURVEY

P&O algorithm implementation methods are thoroughly examined by Mohammed et al. a thorough examination of the changes in the reference voltage Simulated changes in direct duty ratios implements and analyses the results, and concludes by Both systems have their merits and drawbacks. The P&O's benefits are also discussed in the article, including the fact that it is a company. an easy-to-understand algorithm that's straightforward to implement [2] KunA full-fledged MATLAB/Simulink package was proposed by Ding et al. built a PV module using the P&O method

The findings were compared under both the situations of uniformity and variation.and irradiation that is not uniform.

As a result of its simplicity and ease of implementation, the P&O control method is the most often used MPPT control method, as described by T.Esram and Patrick. Under rapidly changing irradiance, MPPT efficiency declines, which is a major downside of P&O.[4]

A modified Incremental conductance technique with configurable step size has been presented by Qianget al. t is common for the INC technique to function with a set iteration size. In certain studies, the INC step size is varied. However, when the irradiance varies fast, the dynamics of MPPT are dramatically influenced.

This constraint was solved by proposing a modified variable step size INC. [5] As opposed to other hill climbing techniques like perturb and observe (PO) or constant voltage MPPT, Mohammed et al. found that INC was less affected by noise and used more energy. The implementation of INC in analogue circuits is also cited as a shortcoming of the algorithm. [6] For tracking in partial shadow, Kok and Saad developed a new IncCond algorithm that makes better use of the PV curve and boosts tracking speed over the traditional INC approach.

Dynamic MPPT approaches, such as Extremum Seeking Control, are classified by Xiao et al as improving transient performance, but static MPPT methods, such as MPPT, do not. Stability and performance difficulties with traditional ESC MPPT systems have also been introduced. They have presented an Adaptive Extremum Seeking Control (AESC) that incorporates certain adjustments to the prior ESC approach in order to address these constraints.

3. METHODOLOGY

Photovoltaic (PV) systems' production is extremely dependent on operating conditions, yet they have seen enormous growth in recent years. PV systems are a good example of this. In most cases, it is difficult to get the most out of your resources. Because of this, control systems for maximum power point tracking (MPPT) are becoming more popular among solar-electric system designers. In terms of tracking speed and complexity and sophistication, these controllers all utilise distinct algorithms. MPPT controllers may currently be divided into two broad categories: those using old techniques and those using more complex ones. Traditional techniques fail to identify partial shade because they cannot tell the difference between local and global peak heights. It is usual practise to utilise advanced tracking systems due to their enhanced efficiency. To address the limitations of both conventional and advanced processes, hybrid approaches are devised. Although it isn't yet obvious which MPPT strategy is the most effective, a review of the methods that have previously been used may help. This study categorises and evaluates every MPPT technique that has been used. This study may be helpful if you're looking to do large-scale MPPT research in the near future.

The nonlinearity of a photovoltaic system is its most important attribute (PV system). This diagram depicts an I-V characteristic, which includes a current source, a power source, and a voltage source. Figure 2 illustrates the I-V characteristic. PV modules have a nonlinear voltage-to-current relationship, which changes depending on how much voltage or current is applied to the device. Dynamic resistance is the term given to this link between voltage and current. PV module's I-V curve linearity fixes dynamic resistance in voltage source region, but it's virtually constant at higher voltages in the power zone. It is difficult to monitor the MPP owing to the significant nonlinearity of the current source dynamic resistance when the MPPT is running at a frequency in the current source range. There must first be a functional MPP in both voltage and power zones in order to improve MPP tracking. [104]. According to the manufacturer, this behaviour should result in the MPPT controller adjusting to the power area. In light of these difficulties, it is challenging to develop a controller for a PV module, given the broad range of current divergence and the large dynamic resistance change with temperature and insolation variation. [105] Traditional MPPT methods like P&O and INC employ the PV panel's P–V characteristics to estimate its output power. The steady-state oscillations caused by this technique to maintaining maximum power point (MPP) enhance the loss of power. Unlike the INC technique, there is no slop at the maximum power point, and theoretically there is no disturbance beyond that point (MPP). Even when the sun's irradiation is quickly increased, it still fails to make an appropriate judgement. A simple resistor transformer with constant efficiency across all voltages is often used in MPPT algorithms for DC-DC converters. Contrarily, the DC-DC converter is far from flawless and has a number of problems. When making a choice, bear it in mind. The efficiency of a DC-DC converter is affected by the duty cycle of the converter. The converter's set-tling time is another critical consideration in the MPPT's efficiency. When it comes to calculations, MPPT uses current and voltage data. It is utilised in the P&O approach to identify the tracking direction, but in the advanced method, it is employed to determine the GMPP. When the MPPT algorithm's step size is less than the converter's settling time, the PV curve will be incorrectly tracked, resulting in inaccurate voltage and current measurements. In order to minimise instability, the controller's architecture, which governs I mppt and V mppt duty cycles, must be carefully examined.

Typically, batteries are linked to a controller in a controller system. A charge controller is used to keep the batteries charged at the right voltage.

By regulating the solar array's input voltage, the charge controller keeps the batteries from being overcharged. A charge controller is put between the array of solar panels and the batteries to control the amount of power produced by the solar panels and stored in the batteries. Solar panels have a far longer useful life than any other kind of power generation device. Solar power has become a viable alternative energy source in the last few years. As a result of its enormous size, lack of pollution, and endless resupply potential.

4. BLOCK DIAGRAM

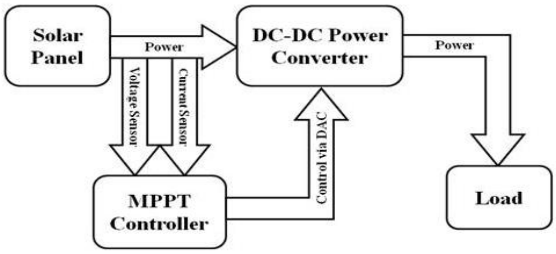

Fig 1 .Block Diagram of overall system

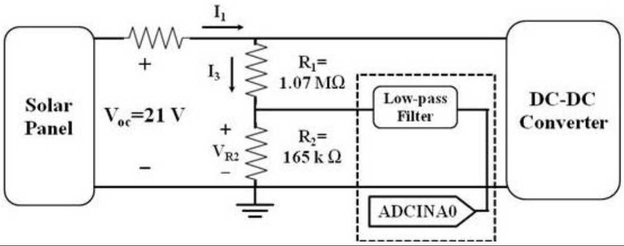

Fig 2 Equivalent circuit

R1 and R2 resistors are coupled to the solar panel in order for the MPPT controller to monitor solar panel voltage.

First, an ADC driver circuit must be utilised to get the voltage across the voltage divider R2 to the ADCINA0 channel of the MPPT controller (op-amp in a voltage follower configuration feeding into a low-pass filter).

If R1 and R2 are set at 1.07 M and 165 K, the amount of current diverted from the load is so little even in the worst-case scenario.

In the past several years, there has been a surge in interest in alternative energy sources. A bright future is ahead for alternative energy sources like solar panels. In the near future, photovoltaic (PV) technology will be used to generate renewable and ecologically beneficial power. Even while each solar cell only creates approximately a half-volt of electricity, when hundreds of them are linked together, they produce more power than if they were all put separately. Arrays of PV modules may be arranged in series, parallel, or both orientations. Grid-tied PV systems need a power conditioner and a load (or grid tie) in order to be connected to the grid.

Low efficiency and unpredictable output make photovoltaic (PV) power production systems an issue. Photovoltaic systems have been the subject of a plethora of research in an attempt to improve their efficiency. The maximum power point (MPP) should be used to maximise the efficiency of a PV system. PV power generating systems must include MPP tracking (MPPT) in order to run at their greatest efficiency at all times.

An MPPT algorithm and a DC-DC boost converter are employed in any PV system to identify the converter's operating point as near to the module's maximum power point (MPP) as feasible. PV array efficiency can only be maximised by using an MPPT boost converter to optimise power production from PV systems under a range of scenarios. Numerous novel topologies for the boost conversion process have been devised in an effort to raise its efficiency. On and off phases of the classic boost converter are characterised by a rapid transition of voltage and current in semiconductor switching devices.

5. DESIGN CONSIDERATIONS

The System's State of Health There is a lot of potential in solar electricity. During the day, this may be doable, but the wet season may change this. Based on this research, infrared sensors may be a possible solution to this issue. The output power of solar cells may be significantly affected by changes in ambient circumstances because of its mathematical model. [2] Variations in ambient light intensity and cell surface temperature have the greatest impact on the output characteristics of photovoltaic cells. One way to improve the overall efficiency of a photovoltaic power generation system is to develop new materials with low cost and high photoelectric conversion efficiency. However, the cost of photovoltaic cells is still high, accounting for 50-60% of the total cost of the system. Photovoltaic cells. Another alternative is to control solar output by monitoring temperature and light intensity changes in real time. In order for the system to run at its maximum power point, an artificial control mechanism is in place. This implies that the system is constantly modifying its output based on the current environmental circumstances. It is possible to boost solar power production by applying suitable MPPT control technology, which decreases the seasonal and other natural factors on output power. efficiency of photoelectric conversion by maximising solar energy utilisation. Maximizing the quantity of energy generated by solar cells is the most basic need for photovoltaic power generation. What's going on [3-5] If the solar array is to continue to produce at its full capacity, it must be addressed. This means that in order for the photovoltaic battery to produce its maximum output under current circumstances, the rate at which solar energy is consumed should be raised.

6. CONCLUSION

It is a favourable quality that the output power of photovoltaic cells decreases as the light intensity of the photovoltaic cell varies at a given temperature. When the temperature goes over a certain threshold, the solar cell's output power declines. A solar cell's output power increases as its temperature decreases. Using Matlab/Simulink simulations of solar cells, the output characteristics may be better understood. The feasibility of the MPPT model was tested using simulated models of solar power output based on boost circuit MPPT management under conditions of constant temperature and constant light intensity." The maximum power point tracking (MPPT) model incorporated into a solar cell has been shown to be able to monitor a cell's maximum power output.

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