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MPPT controller based on Machine learning for stand-alone Photovoltaic array

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Abstract:

The output of solar energy from photovoltaic cells has different functions related to different algorithms. In paper, an efficient algorithm for lifting maximum-power tracking (MPP) track with solar power systems to transform the use of machine learning (ML) to pre-existing and virtual reality (P&O) the way. P&O operates on the basis of various cycles of action by the MPP and is itself the most probable and accurate algorithm. However, the speed of assembly in the MPP is usually small in this way and it varies in different climatic conditions. This paper describes the use of ML in reducing, the downtime results in a significant increase in MPP estimates. Recommended the algorithm predicts MPP based on the fast rates of solar radiation, solar cell temperature and humidity as the input features in the ML multivariate local return model and are used to download the maximum available power (MAP). The learning algorithm and as time goes on, the estimation gets closer available power. The simulation was performed with python and yielded a 99.8% efficiency in the measuring MPP after training for 83 hours. In this paper, we describe the machine learning and cooling system used in the smart home. In particular, we proposed a temperature controller based on machine learning and verified performance using real-time location data. With the experimental results, it is possible that the efficiency of the temperature control using the machine learning was verified. As a result of performance testing, the proposed system shows that there are variations in performance depending on the user's health pattern, and that the system works best if you have a particular lifestyle.

Keywords
Maximum available power, maximum-*power tracking, Tidal energy conversion.*

1. Introduction

To date, the remainder of the group is working to fill 8 percent of the world's energy needs. Fossil fuels are still a renewable source and are available at limited prices and their widespread use will lead to complete use over the next few decades. In addition, global warming is caused by the greenhouse gases are released as natural products due to the coal-fired power plant [1].

So, big time to start looking for other fossil fuels. The sun's power is the most readily available source on earth Energy can turn into a beautiful place and can help solve the energy crisis the world is facing. Photovoltaic cells are used to extract electrical energy from the sun's energy but do not vary inside Features, don't work well. Therefore, it is difficult to extract high energy from the sun PV cells are in extreme weather conditions. The processes of producing high voltage PV cells are known as high voltage tracking (MPPT).

The various MPPT algorithms are similar detailed functions [2], electrical method [3], perturb and store [4], direct logic control [5], etc., have been developed and used in the industry over the years. There is a need for an effective way of quickly guessing the point of the highest potential energy continuously changing the intensity of the sun's rays. A solar energy conversion program is usually done solar PV array, charger controllers and connection frame to provide power output for further distribution. When the solar radiation falls on the PV array, the cells are excited leading to generation of photocurrents which are further directed to load impedances for power consumption.

In this paper, an alternative is described to overcome the limitations of the existing P&O method and other MPPT techniques. The given model uses the ML machine prior to the standard P&O algorithm to estimate the MPP. ML is a type of artificial intelligence that trains a system to learn and does not require manual editing. Its main focus is on the development of systems that can be read on their own and vary with exposure to new information and data sets. The results have been analyzed and compared with existing approaches on the basis of practicality and effectiveness.

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2. Machine leaning based solar energy conversion Model

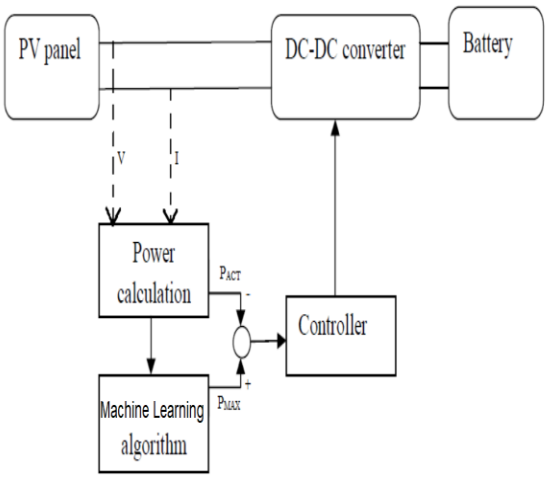

Fig.1. Solar energy conversion model

The system consists of a solar panel integrated with a jack transformer. The brake transformer operates in the sense of rotating circuits using a pulse wide modulation (PWM) signal to control the output voltage output when operating as a step-down DC to DC voltage converter. The PWM signal is managed by the MPPT charger controller.

A photovoltaic cell is basically a semiconductor diode whose p–n junction is exposed to light. Photovoltaic cells are made of several types of semiconductors using different manufacturing processes. The monocrystalline and polycrystalline silicon cells are the only found at commercial scale at the present time. Silicon PV cells are composed of a thin layer of bulk Si or a thin Si film connected to electric terminals. One of the sides of the Si layer is doped to form the p–n junction. A thin metallic grid is placed on the Sun-facing surface of the semiconductor. Fig. 2 roughly illustrates the physical structure of a PV cell. Working of a PV cell is based on the basic principle of photoelectric effect. Photoelectric effect can be defined as a phenomenon in which an electron gets ejected from the conduction band as a consequence of the absorption of sunlight of a certain wavelength by the matter (metallic or non-metallic solids, liquids or gases).So, in a photovoltaic cell, when sunlight strikes its surface, some portion of the solar energy is absorbed in the semiconductor material. If absorbed energy is greater than the band gap energy of the semiconductor, the electron from valence band jumps to the conduction band. By this, pairs of hole-electrons are created in the illuminated region of the semiconductor. The electrons thus created in the conduction band are now free to move. These free electrons are forced to move in a particular direction by the action of electric field present in the PV cells. These flowing electrons constitutes current and can be drawn for external use by connecting a metal plate on top and bottom of PV cell. This current and the voltage (created because of its built-in electric fields) produces required power. In a PV characteristic there is basically three important points viz. open circuit voltage, short circuit current and maximum power point. The maximum powers that can be extracted from a PV cell are at the maximum power points. Usually manufacturers provide these parameters in their datasheets for a particular PV cell or module. By using these parameters we can build a simple model but for more information is required for designing an accurate model.

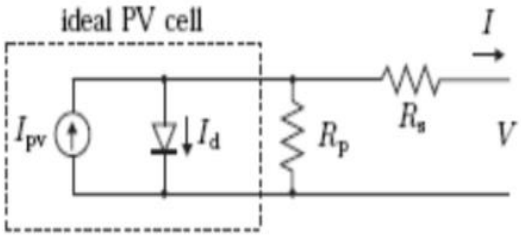

Fig.2. ideal photovoltaic cell

The ideal photovoltaic cell is represented in Fig. 2 as equivalent circuit model. The basic equation from the theoretical operation of semiconductors that mathematically describes the I-V characteristic of the ideal photovoltaic cell is

$$I = I_{PV,cell} - I_{0,cell}\left[\exp\left(\frac{qV}{akT}\right) - 1\right] \qquad (1)$$

I-V characteristic of the ideal PV cell where Ipv,cell is the current generated by the irradiation of sun light, Id is the Shockley diode equation, I0,cell is the reverse saturation or leakage current of the diode, q is the charge of an electron [1.60217646x10−19C], k is the Boltzmann constant [1.3806503x10−23J/K], T is the temperature of the p-n junction in Kelvin, and a is the diode ideality constant.

3. MPPT Algorithm

The maximum power supplied by the photovoltaic panels is not always stable and fixed in the same operating point; it varies with the weather conditions, such as solar irradiation, shadow, and temperature. To extract the maximum power, it is necessary to implement an MPPT algorithm that dynamically adjusts the extraction of the power. Convergence speed is one of the most important features among all different MPPT algorithms. Any improvement in the rise time of MPPT improves the reliability of the system and increases the power extraction and efficiency of the whole system.

3.1. Perturbation and Observation (P&O)

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Perturb and observe algorithm is simple and does not require previous knowledge of the PV generator characteristics or the measurement of solar intensity and cell temperature and is easy to implement with analogue and digital circuits. It perturbs the operating point of the system causing the PV array terminal voltage to fluctuate around the MPP voltage even if the solar irradiance and the cell temperature are constants. Moreover, it is the most widely used and workhorse MPPT algorithm because of its balance between performance and simplicity. However, it suffers from the lack of speed and adaptability which is necessary for tracking the fast transients under varying environmental conditions. It is simple and straightforward technique but degraded performance is achieved due to the trade-off between accuracy and speed upon selecting the step size.

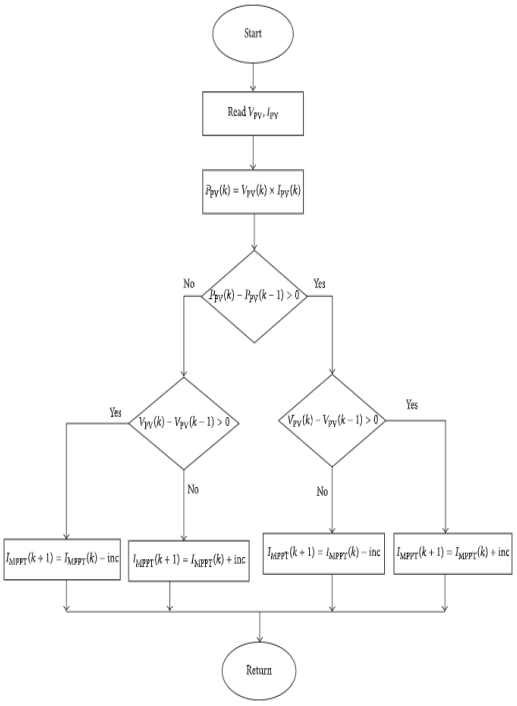

Fig.3. P&O algorithm diagram

4. Simulation Results

The proposed method is efficient and extracts the maximum power but it needs two sensors to measure the irradiation and temperature variation. This method needs only the knowledge of the I - V characteristics. It has also the faster response.
IncCond has the highest rise time as it can be seen in Figure 5. We can see also, in steady state, that RC and P&O have the higher oscillation around the maximum point Figure 4.

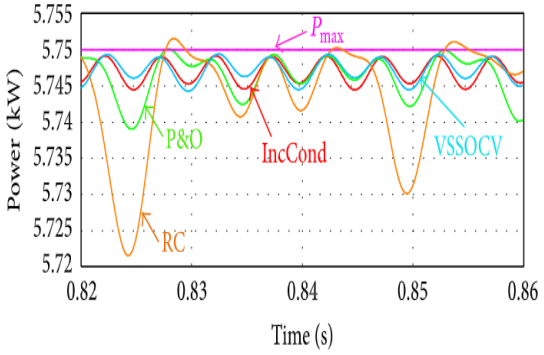

Fig.4. oscillation around the maximum point

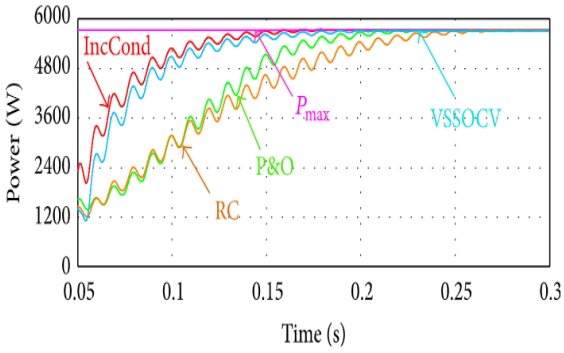

Fig.5. Highest rise time of solar system

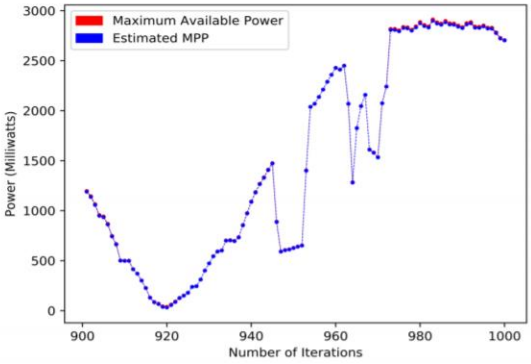

Fig.6. Variation of MAP and MPP with respect to time

The proposed model learns faster and is more efficient compared to the same AI algorithms artificial neural networks and deep learning. In addition, they do not offer high performance as well increasing accuracy. Poor cleaning of input data with simple input of small signals can be easy confusing such techniques that lead to wrong price forecasts. This breakdown occurs always because of the constant change in weather conditions. But in a proposed way, learning is unaffected by the addition of supervised reading. Complex results about the estimated duration of the simulation is directly affected by the function of the neural networks in the added hidden layers

5. Conclusion

The purpose of the MPPT is to extract maximum energy from the PV particles.An effective way to track the force of gravity under different weather conditions has been described in this paper. Python simulation of the solar power conversion system was performed to verify the proposed MPPT method. Analysis shows that the proposed MPPT method measures MPP High frequency. The observations indicate the effectiveness and accuracy of the proposed method It is not affected by variations in the input data, or by minor variations, and not during pleasant and rapid times climate change. With each variation the useless time is reduced. The proposed algorithm in turn reads and inserts new data at the end of each iteration. Machine learning is suggested. The model overcomes the often overlooked nature of other AI-based artificial intelligence algorithms Neural networks and other deep learning algorithms. The main advantages of the proposed MPPT regulation are Path connects faster in MAP, with its AI (ANN) counterparts, capabilities, Ability to learn from previous data regardless of time of year. Therefore, the greatest convergence speed is obtained from the proposed algorithm used and transformed The P&O type can be distinguished from existing P&O devices by simple setup. In particular, the performance of each method is considered over various irradiation conditions. It is shown that the proposed system is able to extract the maximum power available from solar PV panels through the proposed MPPT-based machine

6. References

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