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Solar power plant with MPPT algorithm

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ABSTRACT

This Document presents the Solar Power plant with MPPT algorithm. The increase in usage of Electrical energy has encouraged the growth of different types of conventional power generating systems like hydro electric, thermal, wind, solar, nuclear, geo thermal etc., In this project we developed solar panels with MPPT algorithm to operate the photovoltaic modules in a manner to extract the Maximum power from the system. This method can increase the tracking efficiency. The MPPT can be achieved by modifying the output voltage or current. MPPT is a most effective under cold weather, cloudy and hazy days.

Keywords—*Renewable Energy System, Solar PV Energy, MPPT Algorithm, Interfacing Of MPPT*.

1. INTRODUCTION

Electricity is one of the most important gift that science has given to mankind and it is difficult to imagine the world without it. Still large chunk of population is deprived of it. It is not only the remote tribal locations but many villages and semi-urban localitiesare not able to get power more than quarter of the day. Many of such locations have ample renewable energy (RE) resources to supplement their electricity requirement.

Solar is the most important commercial RE source. Solar energy is the energy obtained by capturing heat and light from the Sun. Energy from the Sun is referred to as solar energy. Technology has provided a number of ways to utilize this abundant resource. It is considered a green technology because it does not emit greenhouse gases. Solar energy is abundantly available and has been utilized since long both as electricity and as a source of heat.Solar Photovoltaic system (SPVS) is other important and fastest growing renewable energy source. It consists of an arrangement of several components, including solar panels to absorb and convert sunlight into electricity, a solar inverter to convert the output from direct to alternating current, as well as mounting, cabling, and other electrical accessories to set up a working system.

It may also use a solar tracking system to improve the system's overall performance.

Strictly speaking, a solar array only encompasses the ensemble of solar panels, the visible part of the PV system, and does not include all the other hardware, often summarized as balance of system (BOS). As PV systems convert light directly into electricity, they are not to be confused with other solar technologies, such as concentrated solar power or solar thermal, used for heating and cooling. PV systems range from small, rooftop-mounted with capacities from a few to several tens of kilowatts, to large utility-scale power stations of hundreds of megawatts. Nowadays, most PV systems are grid-connected, while off-grid or stand-alone systems account for a small portion of the market.

Here we use MPPT tracking algorithm and it is a technique used commonly with wind turbines and photovoltaic (PV) systems to maximize the power extraction under all conditions. Although it primarily applies to solar power, the principle applies generally to sources with variable power : for example, optical power transmission and Thermophotovolatics.

This work is divided in five sections. Section-II presents an overall scheme of the system with its major components. Section-III presents the control algorithm of the system used in the system. Finally simulation and experimental results are presented in Section-IV.

2. SYSTEM COMPONENTS AND DESIGN

An ideal PV cell can be presented by a current source with a diode connected in parallel. In the ideal case, the series and shunt resistances are considered to be zero and infinite, respectively. However, in real system, both the series and shunt resistances have finite values and must be considered. In Fig. 1, both the ideal and practical equivalent circuits of a solar cell are shown. From Fig. 1b the generated current (I) by the PV cell is given by.

$$I=Isc-Id-Ish. \quad (1)$$

$$I=Isc-(V+IRs/Rsh)-(Io(e^{(V+IRs/nVT)}-1). \quad (2)$$

Where Vt is the thermal voltage, Rs and Rsh represent the internal series and parallel resistances, respectively. Isc is the short circuit current, Io is the reverse saturation current, Vd is the voltage

across the diode, is the voltage across the diode, I is the current output and n is the ideality factor of the diode (1~2).

A simplified model after neglecting the shunt resistance is shown in Fig.1a, and accordingly the following equation can be derived.

I=Isc-Io(e^(V+IRs/nVt)-1). .....(3)

PV cell output voltage can be found by considering

t=KT/q

Substitute t value in equation 3 we will get over all equationof current.

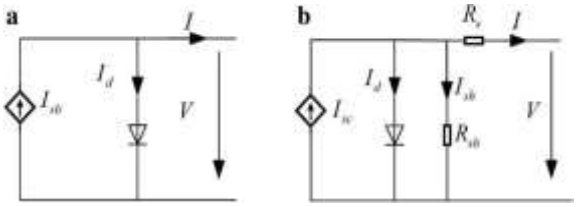


Fig.1a and Fig. 1b are ideal and practical circuits respectively

The maximum electrical power one solar cell can deliver at its standard test condition. If we draw V-I characteristics of a solar cell maximum power will occur at the bend point of the characteristic curve. It is shown in the V-I characteristics of solar cell by Pmax or Pm.

The ratio between product of current and voltage at maximum power point to the product of short circuit current and open circuit voltage of the solar cell.

Fill factor=Pmax/(Isc*Voc).....(4)

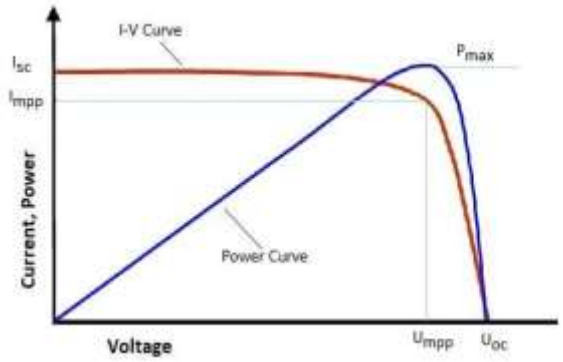


Fig. 2 PV and VI Characteristics of PV cell

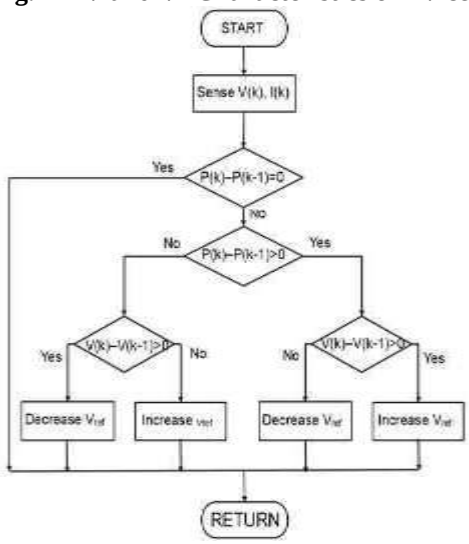


Fig. 3 flow chart of P&O algorithm

This paper proposes a solar tracker and modified Perturb and Observe (P& O) algorithm for the standalone solar photovoltaic system. Proposed algorithm confines the search space of the power curve to 10% area that contains Maximum power point (MPP) and starts perturbation and observation within that limited search space. The proposed P&O algorithm was simulated in MATLAB/ Simulink. Solar tracker makes sure the availability of uniform and maximum irradiance to the solar module throughout the course of the sun during the day. Integration of the solar tracker and improved P&O MPPT algorithm provided the better quality and conditioned electricity to the load.

The block diagram of P&O algorithm with Boost converter shown in Fig. 4

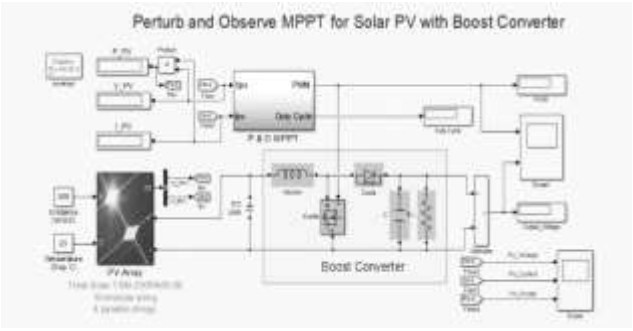


Fig. 4 Block diagram of P&O algorithm with boost converter

3. CONTROL ALGORITHM WITH SIMULINK

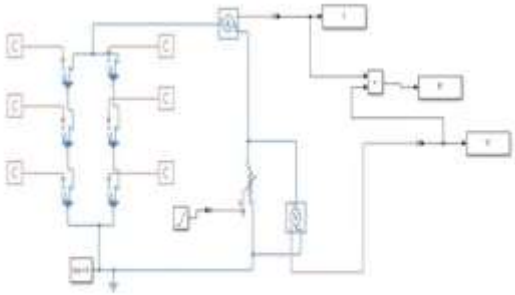


Fig. 5 Simulink diagram of P-V and V-I characteristics

The Simulink diagram of P-V and V-I characteristics Contains three solar photovoltaic cells in two branches and the solar cells takes input that is irradiation depends on which we get voltage and current. In order to feed the Irradiation we need to take power system constant is considered as 1000. Lets take irradiation be 1000 W/ m^2 and duplicate it for all solar cells. A variable resistor and voltage and current sensors and ramp are required to get output. A solver and ground also connected to circuit. Now we need to note power, current and voltage. After readying the simulation we need to run and check for the simulation for error. If not we can proceed. Now open the command window for program.

```
>>plot(V,I) we get VI curve
>>hold on
>>plot(V,I)
>> xlabel("Voltage")
>> ylabel("Current")
>>hold off
>>plot(V,P)
>>hold on
>>xlabel("Voltage")
>>ylabel("Power")
```

Then we get the PV and VP curves of solar photovoltaic cell.

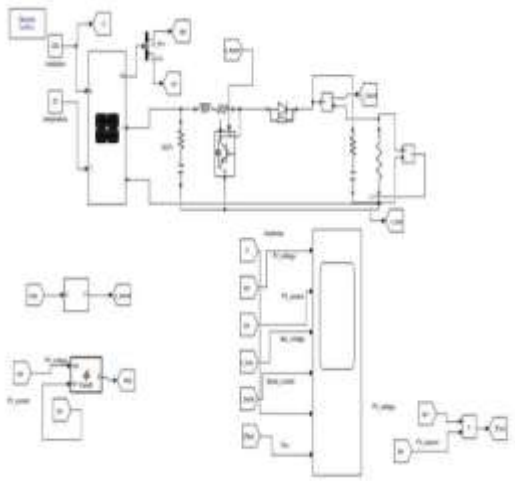


Fig. 6 Simulink diagram of PV system using MPPT with Boostconverter

The Fig. 6 shows the Simulink diagram of PV system using MPPT with Boost Converter. Firstly we need to Take power and make it discrete and give sample time. Then take PV array and give parallel and series settings as 5 and 1 respectively and check plot once for characteristics. Now we take and take two goto block and connect it to the bus and name the goto blocks. Give irradiance of 300W/m^2 and irradiance of temperature is 25°C and connect RC circuit to PV array and connect RL circuit in And give values of RC and RL. Then we need a IGBT and give gating pulse to IGBT and place diode and RC branch parallel with boost converter. Take resistive load and voltage measurement block to measure the voltage across resistance and current measurement block also to measure the current in the load and connect goto block to the load. Now get scope to measure all the parameters.

4. RESULTS

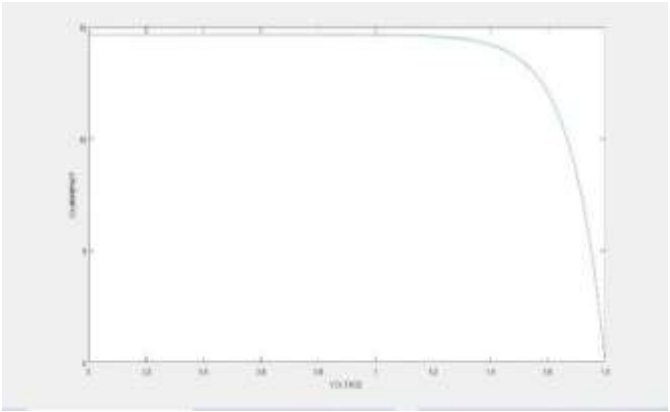


Fig. 7 VI characteristics of PV cell

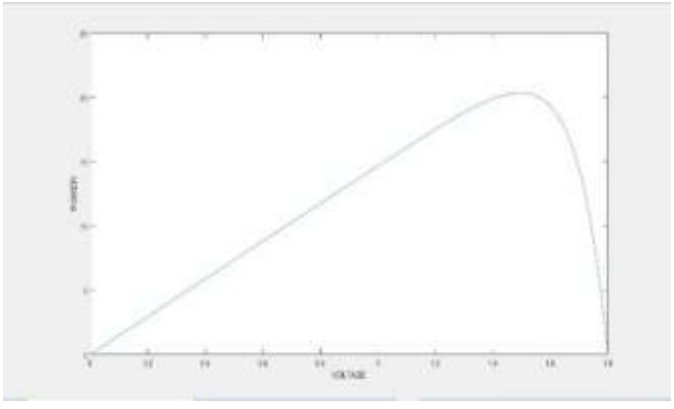
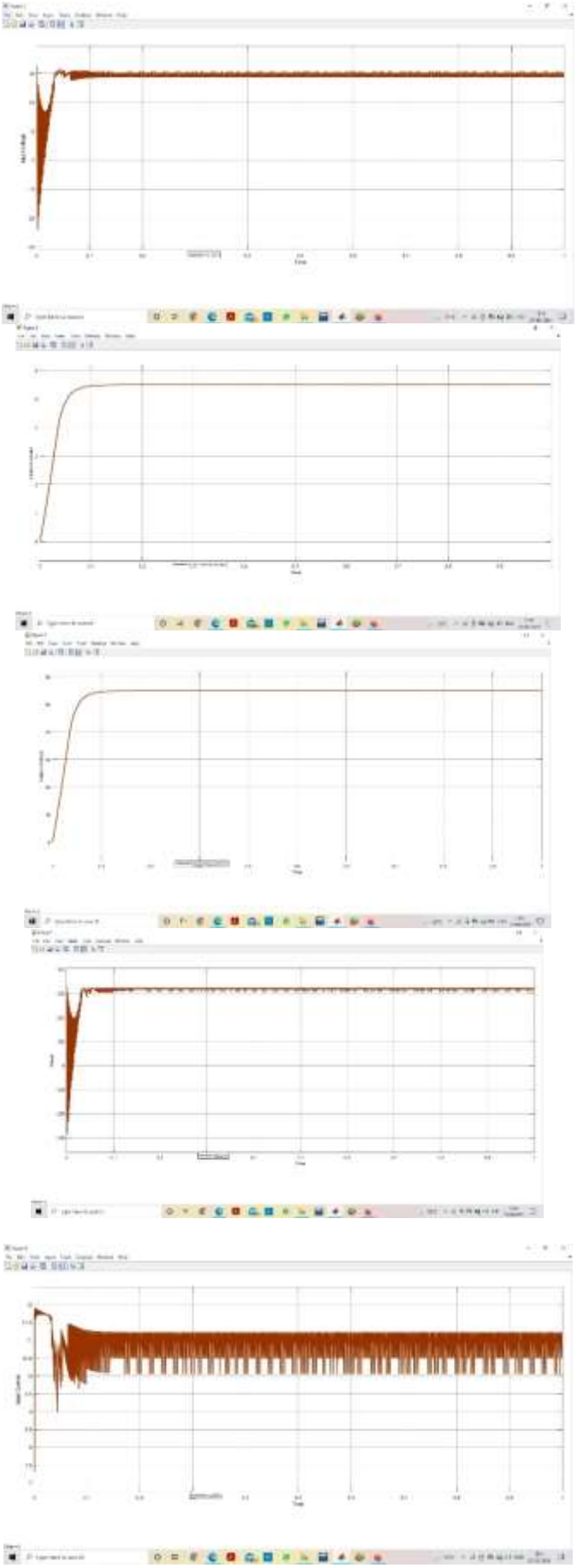


Fig. 8 PV characteristics of PV cell



5. CONCLUSIONS

The world's population and demand of electricity is increasing rapidly ,so it is necessary to use solar power and extract more power from it, MPPT is one of the technique to done efficiently and effectively. As it discussed that parasitic capacitance technique is good from both P&Q and increment Conduction

method by power output. So as the population is increasing, there is need to use the renewable source. Therefore, solar energy is gaining popularity. To extract maximum power, it is desirable to use MPPT algorithm. Comparative analysis on the basis of the advantages and disadvantages, voltage ripples, average power obtained, time response is done.

6. ACKNOWLEDGMENT

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