

MPPT algorithms in development of Solar Charge Controller

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Abstract

By using different MPPT methods such as Perturb and Observe (P&O), Incremental Conductance and Fractional Open Circuit Voltage methods we complete this project. While doing the project we also can understand about Buck and Synchronous buck converter. Solar Charge Controller is being tested using simulation and results are obtained. For basic purpose we take 1kW,48V,100Ah battery charged. Initial conditions are irradiance and temperature. Generally use this kind of algorithms in golf carts by taking some protective measures.

Keywords: Perturb, Incremental Conductance, Fractional Open circuit, Buck and Synchronous buck, Solar Charge Controller, Irradiance, Temperature.

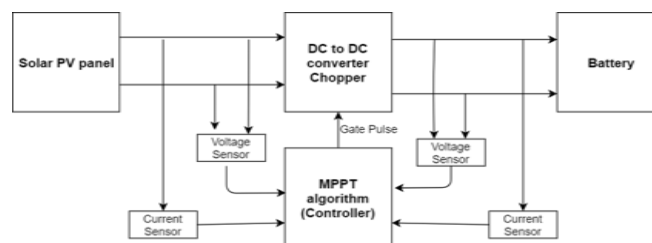
Introduction:

A Solar Charger is a charger that employs solar energy to supply electricity to devices or batteries. As solar charge is abundant and a renewable source of energy we can use it in most of the projects where energy is required whereas in this project we take sun irradiance and temperature as conditions. Over the past decades solar PV panel and its applications have been emerging as a contemporary topic in all the aspects and in this project we use PV panel to get maximum power. Efficiency is most important factor to be discussed here. Here due to less efficiency of PV panel we use MPPT method to get maximum power. After using Solar PV panel, battery, converter and by applying controlling circuit and MPPT method all over performance and efficiency of the system increases. We charge batteries in day time when solar charge is available and use them during night times.[1][2]

Related Work

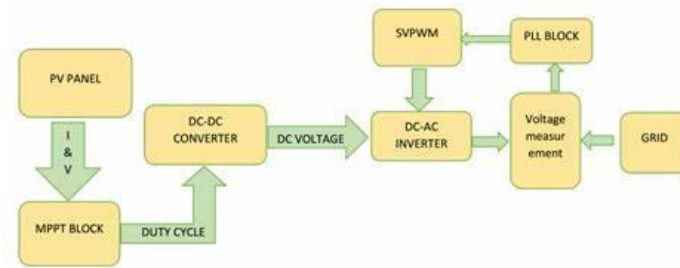
1. 1 MPPT Controller:

Maximum Power Point Tracking (MPPT) is an algorithm implemented in photovoltaic (PV) inverters to continuously adjust the impedance seen by the solar array to keep the PV system operating at, or close to, the peak power point of the PV panel under varying conditions, like changing solar irradiance, temperature and load. MPPT is used to increase capacity of solar panel and electricity. MPPT controller is placed in between solar PV panel and battery which also have sensing parameters.[1][3][4]



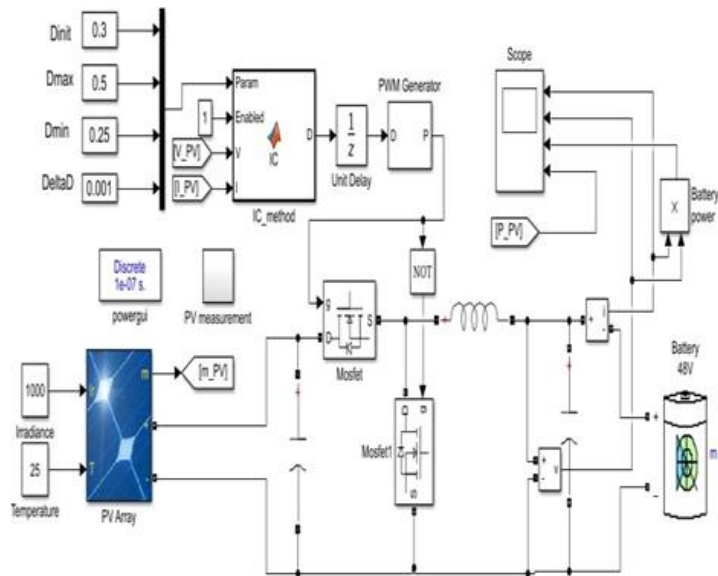
1.2 Solar PV system:

A PV module produces DC power which operates electrical appliances used in households, inverters are used to convert dc power into 220v,50Hz, ac power. An inverter is provided for converting dc power from PV array to ac power.

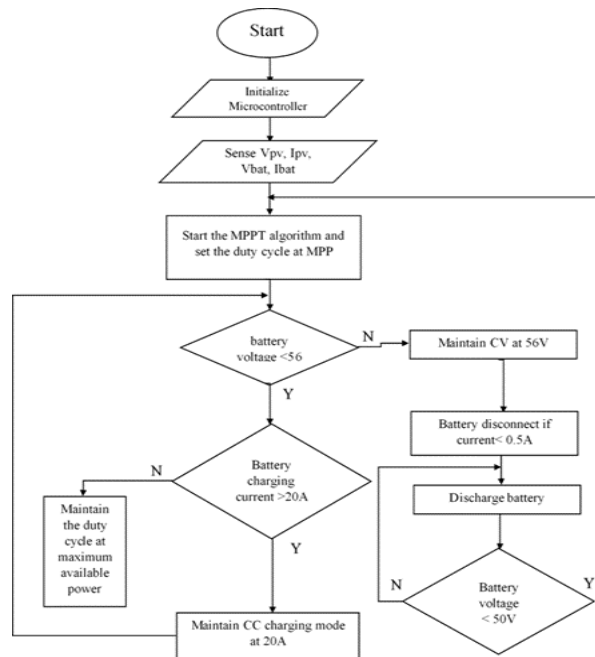


2. Software Simulation

2.1 Basic Model



2.2 Basic Flowchart :

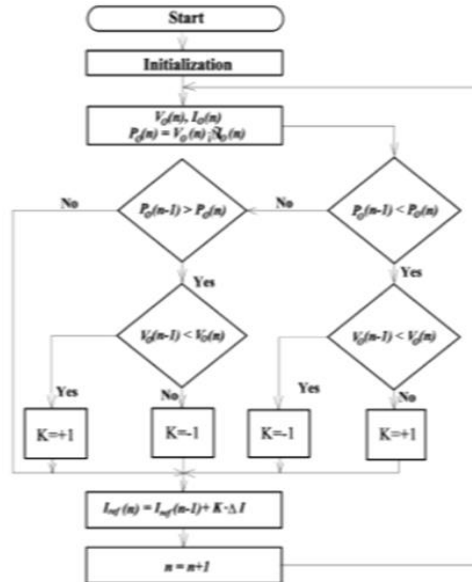


3. MPPT Algorithms:

3.1 Perturb & Observe Method (P&O):

Perturb and Observe algorithm is a procedure in which a variable is perturbed and the effect of the change on another variable is monitored. Present output of solar panel is measured and compared with previous outputs. Output power of solar panel increases and the process continues otherwise perturbation gets reversed.[1][3][5][6]

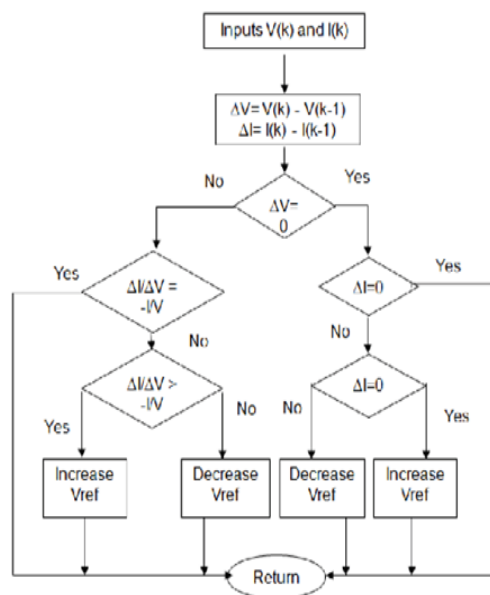
3.2 Flowchart of P&O:



3.3 Incremental Conductance method (IC):

The main drawback of perturb and observe while measuring maximum power with irradiance and temperature has been overcome in IC method. The main point here is at which the slope of PV panel power curve is zero which is called maximum power point.[1][6][7][8][4]

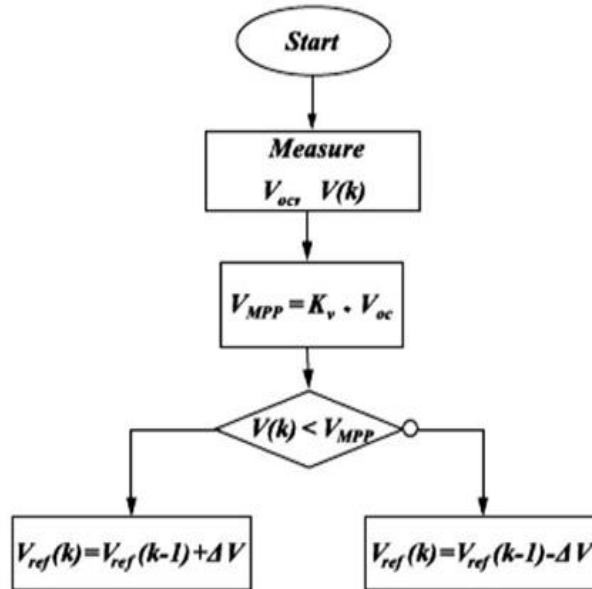
3.4 Flowchart of IC:



3.5 Fractional Open Circuit Voltage Method(FOCV):

It is an indirect method which helps to understand about maximum power point tracking method. This algorithm is based on principle that the maximum power point voltage is always a constant fraction of open circuit voltage.

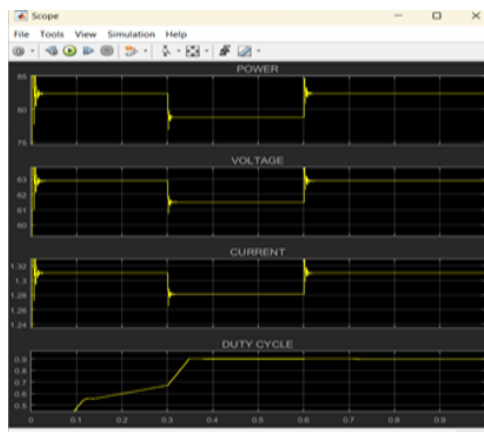
3.6 Flowchart of FOCV:



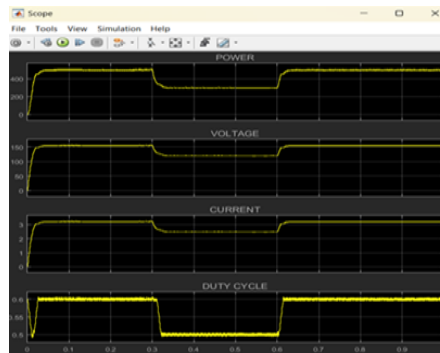
4.Results:

Solar array simulator is set to 1kW to charge 48V, 100 Ah battery. System is analysing with 1kW power and with different irradiance condition. Below shows the solar sun simulator software interface with 1kW power while running. Also, P-V and I-V curve of solar PV panel is shown. Red dot on curve shows the operating point of system so by looking at the operating point it is observed that system is running at maximum power point. Solar panel voltage, current, power and tracking efficiency is also displayed on the screen. Two MPPT method have been tested with 1kW system. Testing results of IC and P&O method with synchronous buck converter at different irradiance condition is stated in the Table III. and Table IV respectively. Experimental data of the irradiance condition, panel voltage, panel current, panel power, battery voltage and current, efficiency and device temperature while running is shown.

3.7 Results with IC:



3.8 Results in P&O:



4. Conclusion:

By following different MPPT methods such as Perturb and Observe(P&O), Incremental Conductance (IC), Fractional Open circuit Voltage (FOCV) methods with converters such as buck and synchronous buck converted is studied and stimulated by MATLAB. Incremental conductance is the best method in MPPT with synchronous buck dc to dc converter is best for solar charge controller. Even this can be implemented in hardware and tested and can know that incremental conductance MPPT method gives desirable results. We can charge up to 45 V battery with 15 A current with 85% efficiency.

6.References:

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