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Simulation of Solar PV based Charger Employing Zeta Converter

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Abstract:- This paper compromises of an electric vehicle [EV] which is based on the zeta converter. we are going to use zeta converter only due to its non-inverted output or continuous power low. The zeta converter controls the maximum power from photo voltaic [PV] array. the given model is simulated on MATLAB software. This paper includes the result of simulation.

I. INTRODUCTION

This paper composes of an electric vehicle battery charger which is based on the zeta converter only due to its non-investing output or continuous power flow. The zeta converter controls the maximum power from photovoltaic (PV) array the given model is simulated on MATLAB software, this paper includes the result of simulation.

Photons present in sun rays are converted into current by the solar cell or photovoltaic cell (PV). The elements causing the present generation of PV cells include efficiency, size, and the amount of sunlight that strikes the surface. However, changes in irradiance, temperature, or shadow effects will have an impact on how well the PV system performs overall, which will result in a reduction in the output power of the solar cell.

This project's goal is to keep the output voltage constant despite changes in irradiance. The duty cycle (D), which is dependent on both the output voltage from the PV module and the reference voltage, changes as a result of the change in irradiance, which also changes the output voltage from the PV panel.

This paper discusses the simulation model in MATLAB.

II. SIMULATION DESIGN

Block diagram shows the flow of system design in simulation MATLAB in following figure

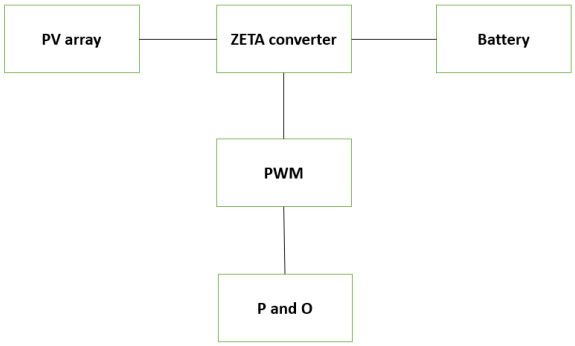

Fig 1 Block Diagram

- *PV Array Block*

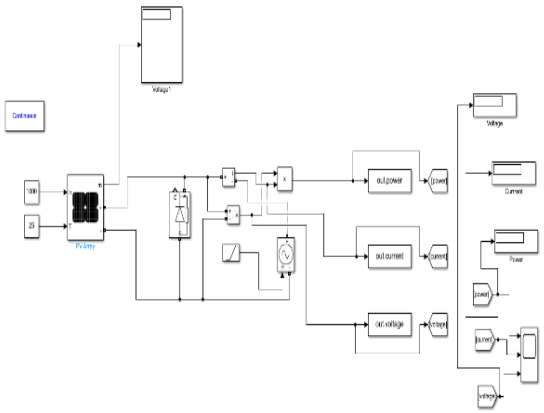

Fig 2 MATLAB Simulation for PV Array

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In the above figure 02 voltage, power and current is tracked at different radiation shown in Table 02, at maximum radiation of 1000 and minimum radiation at 200.

Parameter used in PV array	Rating
Number of Parallel String	2
Number of Series string	6
Modul	User defined
Max power	249.9
Cell per module	96
Open circuit voltage	43.0
Short circuit	7.75
Voltage at maximum power point	35
Current at maximum power point	7.14

Table 1 Parameter used in PV Array

Table 1 represent the parameters and rating of the Solar panel used for the simulation and used for tracking the voltage and current at different radiation

➢ *Set To P-V Characteristic of The Modeled PV Array*

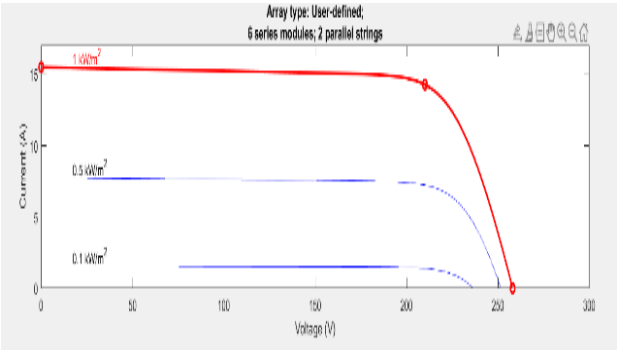

Fig 02 Graph of current(A) vs voltage(V)

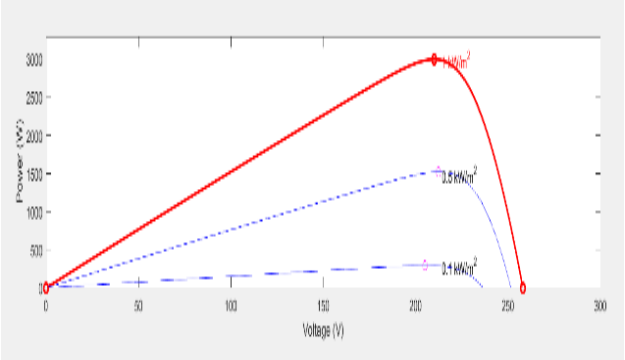

Fig 03 Graph of Power(w) vs Voltage (v)

Fig 2 and fig 3 shows the graph of current vs voltage and power vs voltage respectively.

Radiation	Voltage
1000	**15.7**
800	**12.56**
600	**9.425**
400	**6.285**

Table 2 Tracking voltage at different radiation

➢ *Zeta Converter*

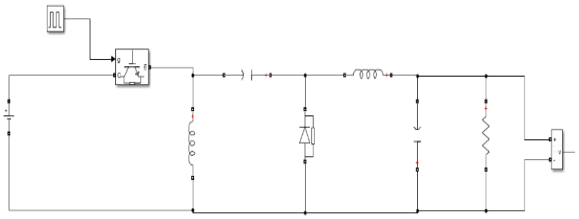

Fig 03 Basic circuit diagram for zeta converter

The components used in zeta converter are Capacitance (C1, C2), Inductance (L1, L2), Diode(D1), resistance or load. The PWM pulses are given to switches such as IGBT, MOSFET etc. which switches the ON and OFF to IGBT so that voltage can be adjusted as per requirement. Like Buk boost converter and Cuk converter it does not give inverting voltage, the output voltage is of same polarity and can be increases or decreases depending on the switches.

The output of zeta converter is given by
Vo = (Vin * D)/(1 - D)
Where,
D = Duty cycle of PWM pulses.
Vin = input voltage given to zeta converter.

➢ *Working*

When the IGBT is turned ON the current tries to flow from Switch(Q1) , L1 , Vin . Initially inductance (L1) resists the current but after some time its impedance decreases and current start flowing and L1 start charging.

When the Switches is OFF the L1 induces the fly back voltage which has magnitude of
V = L di/dt
Where,
L = inductance
di/dt = change in current with respect to time.

Due to this inductance current remains the same. as the switch is OFF the inductance changes the polarity and D1 gets forward bias and current start flowing form D1, C1 , L1 and thus C1 get charged. When switch is ON the current start flowing through Vin, L1, C1, L2, load by this flow L1, and L2 is charger when the switch is OFF the inductance L1 and L2 changes the polarity and current start flowing through D1, C1, L1, and L2, load.

Parameter used in zeta converter	Rating
Inductance	0.0016
Capacitance (1,2)	0.000720, 0.000015
Resistance	10ohm
voltage	17v

Table 03 parameter for zeta converter

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III. RESULT

This following figure 04 shows the Simulation output for zeta converter connected at 17v DC battery

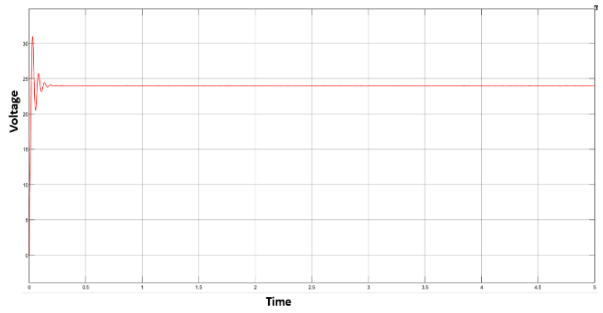

Fig 4 result of simulation for zeta converter

➢ *MPPT P&O*

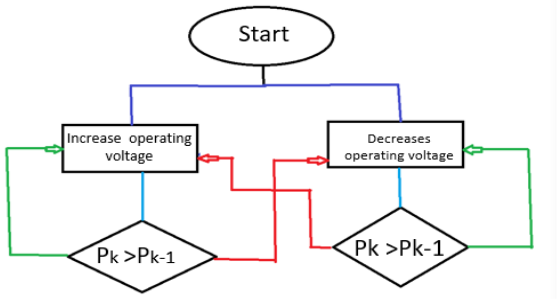

Fig 5 Algorithm for P&O technique

Fig 5 imposes the MPPT controller with zeta converter and PV medium MPPT detects the instantaneous voltage and current at the terminals of PV source afterward P&O algorithm This P&O algorithm produces references PV voltage if fastening of the tracking of MPPT of the PV array, through this the PI controller adjust the control signal of the advance zeta converter

➢ *Circuit Diagram For Simulation*

The following figure shows the simulation of MATLAB

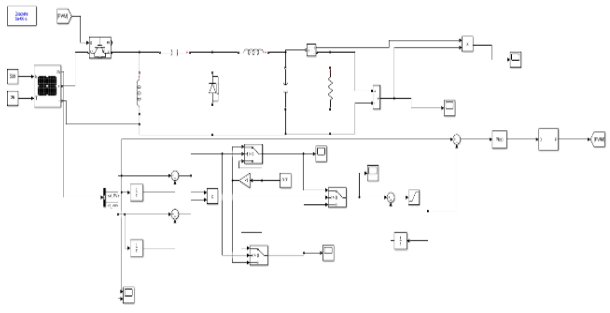

Fig 6 MATLAB Simulation

The fig 06 simulation was performed by above mentioned parameters by giving a supply as discrete 5e-06 s.

We have taken 25 degree Celsius as a constant temperature and 1000kw/m^2 as a highest radiation. in which we have get the output as 252 voltage as shown in fig 07 as a constant voltage with very minimum harmonics as we have implemented a MPPT through P&O block so we are getting a constant output.

➢ *Result For Simulation*

This following figure shows the output of the above figure simulation at 1000 radiation and 25 degree Celsius. We can regulate radiation and temperature as per our requirement to track the exact voltage level at different radiation as well as temperature.

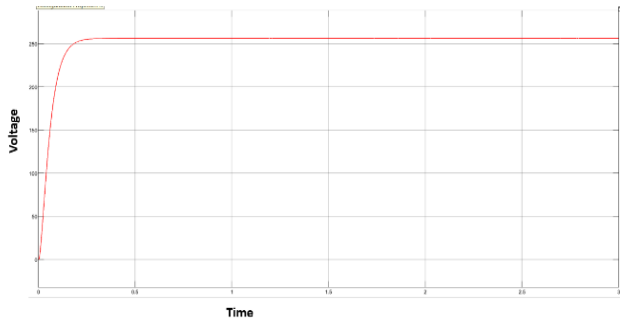

Fig 7 result for MATLAB simulation

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