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Engineering

AN EFFICIENT WAY TO DRIVE DC MOTOR USING INCREMENTAL CONDUCTANCE METHOD

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ABSTRACT Solar energy is the most promising energy source in this world.So that it increases the demand of solar power.Maximum Power Point Tracking (MPPT) algorithms in PV system is very important because by reducing the number of PV panels required to achieve the desired output power ,it will reduces the PV panel cost.The only problem is efficiency of solar system. Today there are somany methods to track solar power. Photovoltaic systems use a maximum power point tracking technique to continuously deliver the peak power to the load.Incremental conductance(INC) is one of the important MPPT technique in this system .The objective of this paper is an interesting solution for the lack of fossil fuels.

KEYWORDS : Maximum power point tracking ,Incremental conductance

INTRODUCTION

Insufficiency of fossil fuels, increasing energy needs and also rising pollution led the needs of renewable energy sources.Solar energy producing electrical energy anywhere there is sunlight.On the other hand there are some disadvantages like change in environment conditions that may cause to change current, voltage and maximum power point of PV panels.Solar energy doesnot produce pollution and it is easy to maintain.These enormous qualities of solar increases its demands across worldwide[1].

The energy from the sun is not continuously throughout the day.It may vary with change in environmental conditions[2].Change in environment conditions that may cause to change current, voltage and maximum power point of PV panels.The utility needs maximum power from solar pv system. In order to obtain peak power from the solar system several methods are used.Maximum power point is the method which uses several algorithms for tracking maximum power from the sun[4]. Incremental conductance,P and O,fuzzy logic are some of the algorithm for maximum power point technique.So, these will help PV system to increase its efficiency and power. Each mppt technique differ from eachother due to algorithm complexity, implementation cost and sensors used in it.Incremental conductance and p and o methods are most widely used in commercial products.

In p and o method oscillations are present at maximum power point and it doesnot considering irradiation level which is directly depend on INC.In incremental conductance method the array voltage is adjusted according to maximum power point voltage.So incremental conductance is an interesting MPPT method by updating terminal voltage of PV. The incremental conductance (INC) systems are it is an attractive practice to track the MPP by updating the terminal voltage of the PV group in incremental conductance method.

OPERATING PRINCIPLE

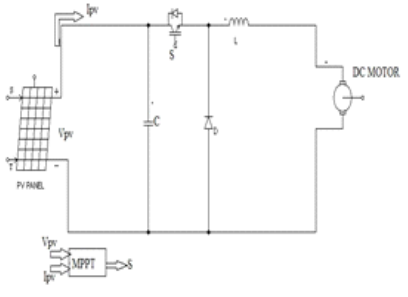

Fig.1 Circuit diagram of the system

The control and logical algorithm of MPPT is shown in figure 1 to extract the maximum power and to maximizes the energy. The circuit diagram consist of a PV panel, simple buck converter and a dc motor.In order to obtain maximum power from PV panel an algorithm is used.Incremental conductance is the mppt method used here. Incremental conductance has zero oscillation at maximum power point. The input to the PV panel are temperature and irradiance.With change in irradiance level there is greater variation in current of PV system.Using incremental conductance method peak power can be tracked at every instant.The output of PV system is decreased by using buck converter.The output voltage is used to rotate a dc motor.

Fig.2 shows the flowchart of the incrementalconductance algorithm. Incremental conductance method has some advantages.Change in intensity of light on pv panel changes the output voltage smoothly.Comparing with P and O method,fluctuations are very less in INC,so this method is better for rapid change in environmental conditions.

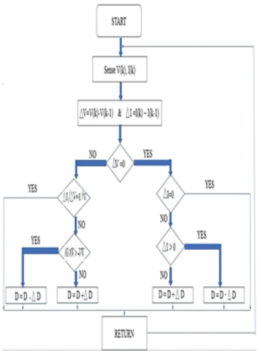

Fig. 2.Flowchart of INC algorithm

The mppt method based on increment in both voltage and current.Inthis method incremental conductance and instantaneous conductance are taken into account and at maximum power point these remains the same.

Maximum power point tracking in this model is carried out inaccordance with INC algorithm which is chosen due to simplicity and the potential to capture maximum energy. Incremental conductance algorithm is more efficient than perturb and observe algorithm. In perturb and observe algorithm, maximum power point oscillates due to lack of consideration of variation in irradiance. But in incremental conductance algorithm, change in current is considered and thereby avoid the shortcomings in perturb and observe algorithm.

DC - DC CONVERTER

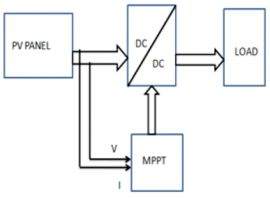

Fig .3 Block diagram of mppt system

For obtaining maximum power from the PV system maximum power point tracker algorithm is used.With change in environmental condition the parameters of PV module will change eventually to get peak power at every instant.

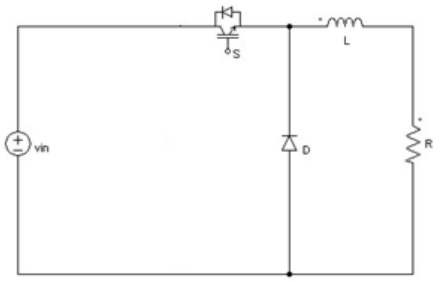

Fig.4 circuit diagram of buck converter

A nonisolated DC-DC converter (here step down) ensures maximum power to the load.Controlling part of the converter is given by MPPT algorithm.The core of the Maximum Power Point tracker is buck converter. To Regulate the input voltage at MPP and to provide load matching for the maximum power transfer dc dc converters are used. . For a buck converter output voltage equation is,

$$Vo = DVin$$

$$\frac{Vo}{Vin} = D$$

Where *Vo* and *Vin* are output and input voltages.D is the dutycycle of the conveter.

DESIGN OF PROPOSED SYSTEM

PV module is designed with 36 cells connected in series and it has output voltage 21.4V and short circuit current of 3.2A.The voltage at maximum power is 17V and maximum power is 47V.

For the buck converter,

$$Duty\ cycle,\quad D = \frac{TON}{TON+TOFF} \qquad (1)$$

$$D = \frac{Vo}{Vin} \qquad (2)$$

Here V_{dc}=17V, Vo=12V

$$= \frac{1}{frequency} = \frac{1}{20*1000} = 5 * 10^{-6}s \qquad (3)$$

$$L = \frac{VdcD(1-D)T}{\delta IL} \qquad (4)$$

$$L = \frac{.705(1-.705)*5*10^{-5}}{2*20*1000} = .42 * 10^{-3}H \qquad (5)$$

$$C = \frac{VdcD(1-D)T^2}{8L\delta VO} \qquad (6)$$

$$C = \frac{.7053*(1-.705)*17*5*10^{-5}}{8*.42*10^{-3}} = 7.3 * 10^{-6}F \qquad (7)$$

Design of inductor winding is given by,

$$N = \frac{L * Im}{Ac * Bm} \qquad (8)$$

$$N = \frac{.42*10^{-3}*4.368}{2.01*100*10^{-3^2}*.27} = 33.8 \qquad (9)$$

From this N=33.8 so take this as N=34

SIMULATION RESULTS

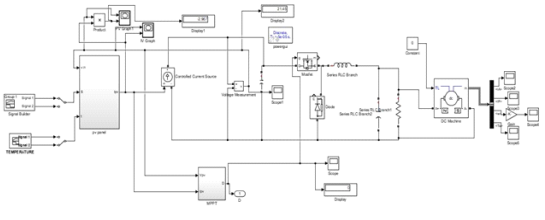

Fig.5 simulink model of the PV system with DC motor

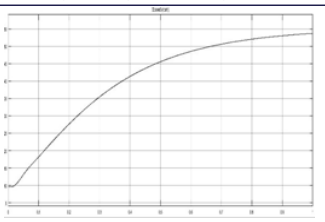

Fig.6 Output speed of the motor

The graph 5.2 shows the speed obtained from the dc motor at no load. Speed obtained is about 60 rpm.

TABLE-1PV PANEL ELECTRICAL SPECIFICATION

PARAMETER	SPECIFICATION
Power	47 w
Open circuit voltage	21.4V
Short circuit current	0.527A
Voltage at maximum power	17V
Number of cells	36

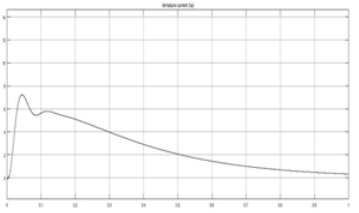

Fig.7 Output current of the motor

This is the current obtained from the dc motor at no load condition.Here the current is 0.2A

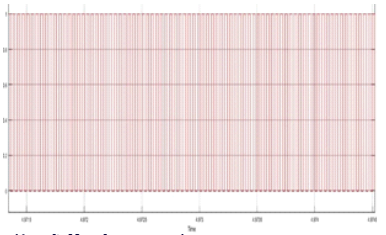

Fig.8 Duty ratio of Buck converter

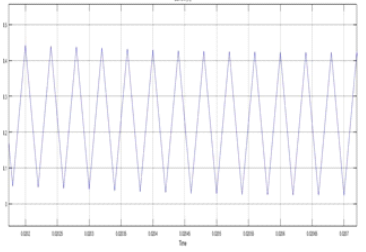

Fig.9 Inductor current

Duty ratio obtained from INC algorithm which is used as switching pulse for the semiconductor switch in the Buck converter. Here duty ratio is obtained as 0.7 and is demonstrated in figure 5.4.

TABLE-2 DC MOTOR SPECIFICATION

Parameter	Specification
Voltage	12V
Noload current	.2
Speed	5000rpm

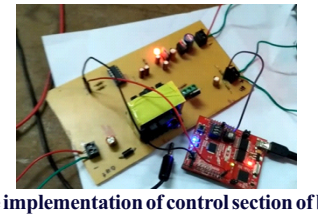

Fig.9 Hardware implementation of control section of buck converter

CONCLUSION

Modelling and simulation of PV panel with DC motor is analyzed and presented using MATLAB/SIMULINK tool.The solar energy has been considered as one of the significant renewable energy sources in this world.Here the control of buck converter is achieved by mppt method.The proposed model of PV system shows effect of MPPT method on the PV module.Irrespectiveof environmental conditions incremental conductance method can track the maximum power point with greater accuracy and speed.

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