International Conference on Science, Technology, Engineering & Management [ICON-STEM'15]

Journal of Chemical and Pharmaceutical Sciences ISSN: 0974-2115

Automatic sun tracker system

N.Saritha* , P.Anuja Prashath Diwan[1], V.Jamuna[2], V.Hariharan[3], J.Hariharan[4]

Department of EEE, Jerusalem College of Engineering, Chennai.

***Corresponding author: Email id:hariharanv99@gmail.com**

ABSTRACT

A solar panel receives more sunlight when it is proportional to sun rays. Therefore to receive the more amount of sun light energy, horizontal single-axis sun tracking system using a light dependent resistor is presented in this paper. Using a gear motor the position of solar panel is controlled and also the control action is taken by the microcontroller which is driven by the sensing circuit. Matlab / Simulink model is used to validate the performance of Photovoltaic (PV) panel.

INTRODUCTION

Solar energy is one of the most abundantly available form of renewable energy. Photo voltaic (PV), is one of the exciting new technologies helping us to harness solar energy and march towards a solar future. The PV panels are usually mounted on the roof of the house or at a near open area to face the sun. The custom is to fix these solar modules position angle to the country latitude angle. If possible, seasonally some people try to adjust the module's direction manually towards the sun. However to collect as much as solar radiations as possible, it is more convenient and efficient to use a sun tracking system. It replaces the conventional fixed solar panels and provides an opportunity for easier installation and portability. For panel installation just the rise and set point of sun is required. It is cost effective and increases the panel efficiency. It replaces the conventional fixed solar panels and provides an opportunity for easier installation and portability. For panel installation just the rise and set point of sun is required. It is cost effective and increases the panel efficiency.

PROPOSED SYSTEM

In this project LDR is used as a tracking cell for sensing purpose. The PIC Microcontroller compares the signal from the LDR and takes the control action by driving the motor either in CW or CCW direction. Therefore the Photovoltaic panel shall receive a maximum light from the sun and its overall efficiency can be increased than the conventional fixed solar panels. The Fig.1 shows the general block diagram of proposed system.

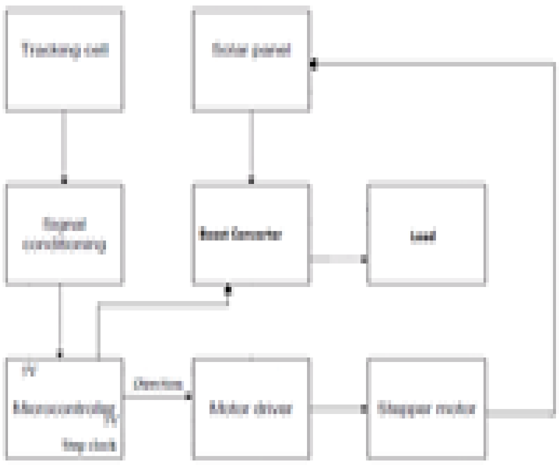


Fig.1.General Block diagram of sun tracking system

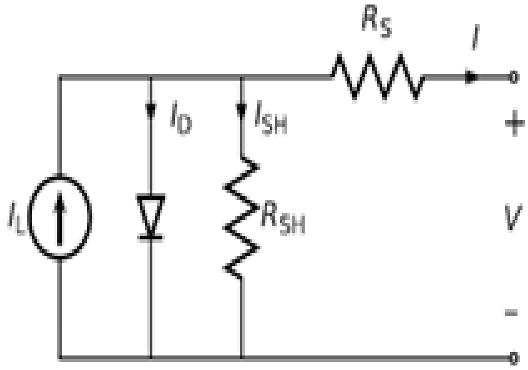


Fig.2.Equivalent Circuit of PV Cell.

The array of photovoltaic cell is connected in series or in parallel combination to form a complete photovoltaic panel. The PV cells can be connected in series so that voltage gets added up and current remains the same. The parallel combination could be opted for higher current requirements.

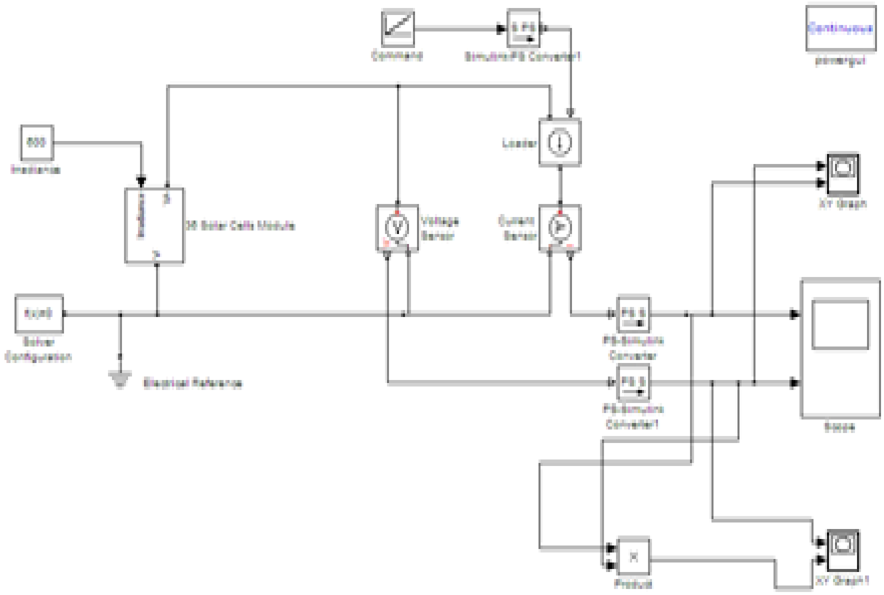


Fig.3. PV panel

The basic simulation of PV panel is shown in Fig.3. and its current(I) versus voltage(V) characteristics is shown in Fig.4.a. The power versus current curve of pv panel is shown in Fig.4.b.

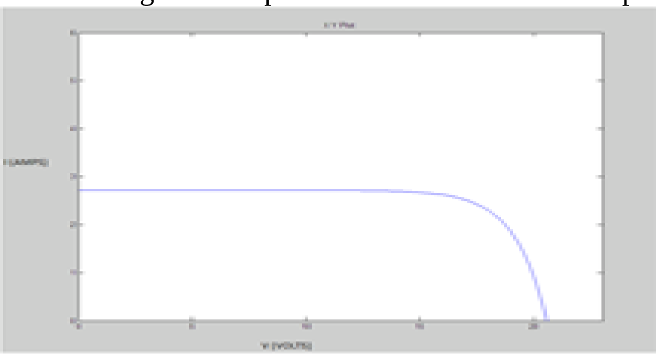


Fig.4.a.I-V Curve of PV cell

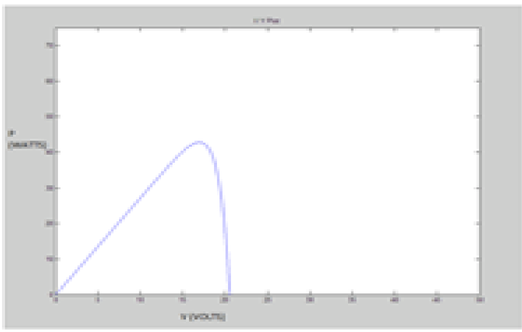


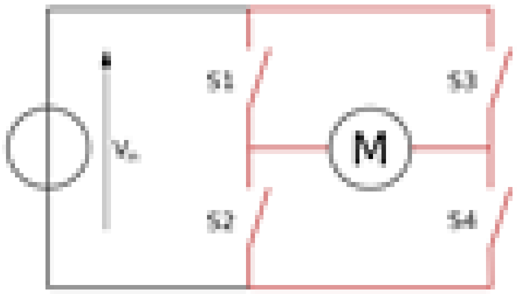
Fig.4.b.I-V Curve of PV cell

SENSING PART

The tracking system must operate in a closed loop for this purpose controller needs to sense the light through the light sensor. Here LDR is used as a light sensor. LDR consists of a disc of semiconductor material with two electrodes on its surface. In the dark the material of disc has relatively small number of free electrons, these free electrons carry electric charge. This means that it acts as a high resistive element. But under light condition more number of free electrons would be released and provides low resistive path. LDR used here has a dark resistance of 1kΩ. And has a light resistance of 0.04Ω.The table 5.1 shows the LDR's behavior under various light conditions.

Table.1.LDR testing under various light intensity

CONDITION	Resistance (kΩ)
Under dark condition	1
Under normal light condition	0.7
Under medium light condition	0.3
Under heavy light condition	0.04



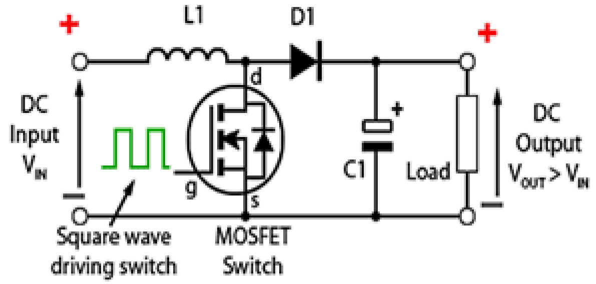


Fig.5 Circuit diagram of H-bridge driver

Fig.6.Equivalent circuit diagram of boost converter

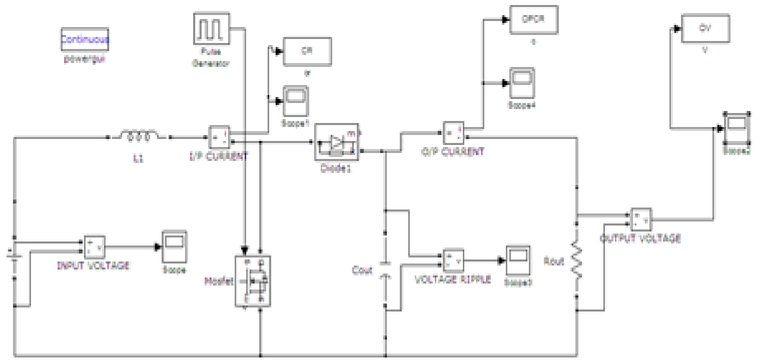
DC-DC CONVERTER

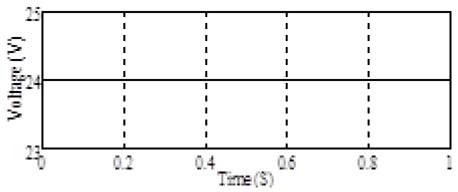
Boost converter is used to amplify the voltage to the required level of the load. Here the output voltage can be obtained by varying the duty cycle D. The MOSFET equivalent diagram is shown in Fig.6.

Here the energy is supplied to the load both by the inductor and capacitor therefore the desired amplified output voltage will be available across the load.

$$V_{out} = [1/(1-D)]*V_{in} \quad \text{.....................................(2)}$$

In the above equation, V_{out} = Output voltage, V_{in} = Input voltage D= Duty ratio=T_{ON}/T.





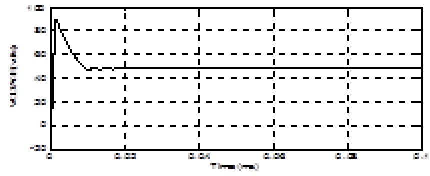


Fig.7. Simulation of boost converter

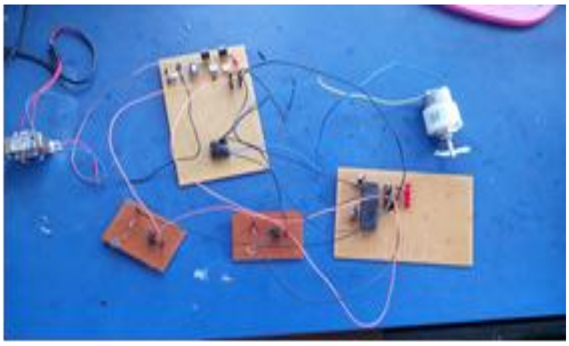
Fig.8.a. Input Voltage to boost converter.

Fig.8.b.Output voltage of boost converter.

The simulation of DC-DC boost converter is shown in Fig.7. The input and output waveform of boost converter is 24V as shown in the above Fig.8.a and Fig.8.b.

HARDWARE IMPLEMENTATION

The prototype model of sun tracker system is as shown in Fig. 9.When sun light is received by sun tracker system, it rotates in clockwise and in a anti clockwise direction depending on the light intensity from the sensing circuit. The control action is carried out by the PIC microcontroller. The mechanical structure of sun tracker system is shown in Fig.10.The Fig.11. shows the comparison chart of performance of sun tracker system.



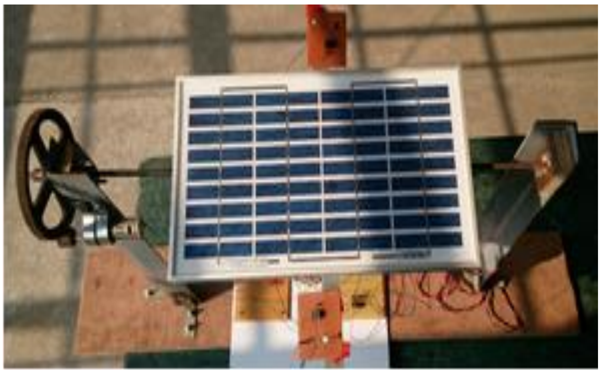


Fig.9. Prototype model of sun tracker system **Fig.10.mechanical structure of sun tracker**

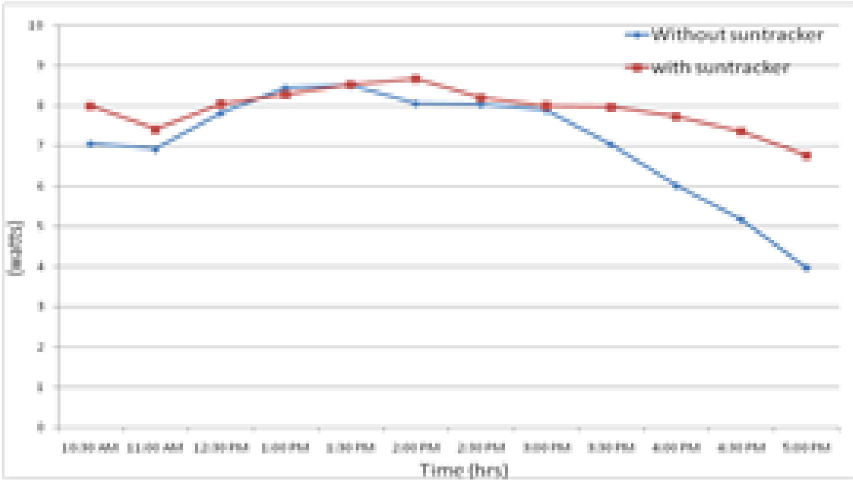


Fig.11. Power Vs. Time curve by comparing system with and without suntracker system

CONCLUSION

In order to achieve the optimal operation efficiency of solar energy PV module we could go for horizontal single axis tracker. It would be more beneficial in case of large solar farm .In future it is planned to extend our module for dual-axis tracking purpose and making it feasible for house hold and small scale industry to use this sun tracking panel.

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