International Journal of Enhanced Research in Science Technology & Engineering, ISSN: 2319-7463
Vol. 2 Issue 8, August-2013, pp: (68-71), Available online at: www.erpublications.com

The Design of Electronics Based Solar Tracking System

Joydev Ghosh[1], Abhishek Dey[2], Supratim Sen[3]
[1]Research and Development Lab., The New Horizons Institute of Technology, Durgapur, INDIA
[2]Bengal College of Engineering and Technology, Durgapur, INDIA
[3]Aryabhatta Institute of Engineering and Management, Durgapur, INDIA

Abstract: This paper demonstrates a novel method which will automatically track the sun's position and accordingly change the direction of the solar panel to get the maximum output from the solar cell. As solar energy becomes increasingly popular in all parts of the world, all kinds of solar powered products are flooding the renewable energy market. One of them is the solar panel battery charger, the environment-friendly equivalent to a conventional battery charger. It converts light into a direct current, using solar cell modules i.e. a solar panel of varying volts for different uses.
Keywords: LDR, Comparator (IC LM339), DC Motor, Motor Driver (IC L293D).

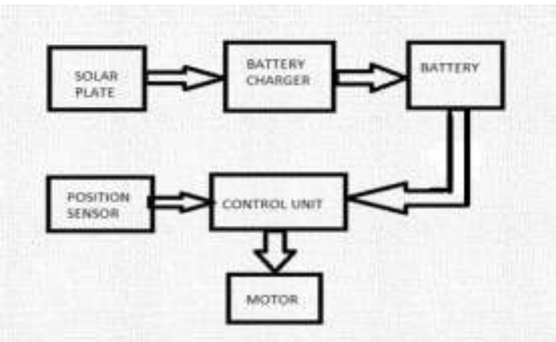
I. INTRODUCTION

Generally, solar panels are stationary and do not follow the movement of the sun [1].Here is a solar tracker system That tracks the sun's movement across the sky and tries to maintain the solar panel perpendicular to the sun's ray, Ensuring that the maximum amount of sunlight is incident on the panel throughout the day till evening [2].
Photovoltaic's is the field of technology and research related to the application of solar cells as solar energy [3]. Solar cells have many applications. Individual cells are used for powering small devices such as electronic calculators. Photovoltaic arrays generate a form of renewable electricity, particularly useful in situations where electrical power from the grid is unavailable such as in remote area power systems, Earth-orbiting satellites and space probes, remote radiotelephones and water pumping applications. Photovoltaic electricity is also increasingly deployed in grid-tied electrical systems.

Solar Energy has been the power supply of choice for Industrial applications, where power is required at remote locations. Most systems in individual uses require a few kilowatts of power. The examples are powering repeater stations for microwave, TV and radio, telemetry and radio telephones. Solar energy is also frequently used on transportation signaling e.g. light houses and increasingly in road traffic warning signals. Solar's great benefit here is that it is highly reliable and requires little maintenance [4].
While the output of solar cells depends on the intensity of sunlight and the angle of incidence, it means to get maximum efficiency; the solar panels must remain in front of sun during the whole day. But due to rotation of earth those panels can't maintain their position always in front of sun. This problem results in decrease of their efficiency. Thus to get a constant output, an automated system is required which should be capable to constantly rotate the solar panel. The Solar Tracking System is made as a prototype to solve the problem, mentioned above. It is completely automatic and keeps the panel in front of sun where we get maximum output.

II. SYSTEM DEVELOPMENT

- East: Initiate the sensor
- During the day tracker function as the usual
- West: tracker function as usual
- At Evening and night tracker doesn't react.



A solar cell, sometimes called a photovoltaic cell, is a device that converts light energy into electrical energy. A single solar cell creates a very small amount of energy (about .6 volts DC) so they are usually grouped together in an integrated electrical panel called a solar panel. Sunlight is a somewhat diffuse form of energy and only a portion of the light captured by a solar cell is converted into electricity.

Sunlight is made up of packets of energy called photons. When the photons strike the semi-conductor layer (usually silicon) of a solar cell a portion of the photons are absorbed by the material rather than bouncing off of it or going through the material. When a photon is absorbed the energy of that photon is transferred to an electron in an atom of the cell causing the electron to escape from its normal position. This creates, in essence, a hole in the atom. This hole will attract another electron from a nearby atom now creating yet another whole, which in turn is again filled by an electron from another atom.

One of the problems with solar power is that the output of the solar panel is variable. These solar systems are designed to extract the maximum amount of power available from the solar panels and deposit it in the battery. These solar charge controllers also protect your panels from discharging through the batteries after the sun goes down.

Talking of the design of solar panel battery chargers, solar panel battery charger manufacturers use thin film second generation technology to create these devices. This is to take advantage of the flexible nature of this kind of solar cell technology. Solar battery chargers used on boats and on water can be found in waterproof prototypes. Solar panels used to capture and convert energy from the sun into electrons are offered in various volts gradations; a solar panel battery charger is available from 2 watt to 30 watt range.

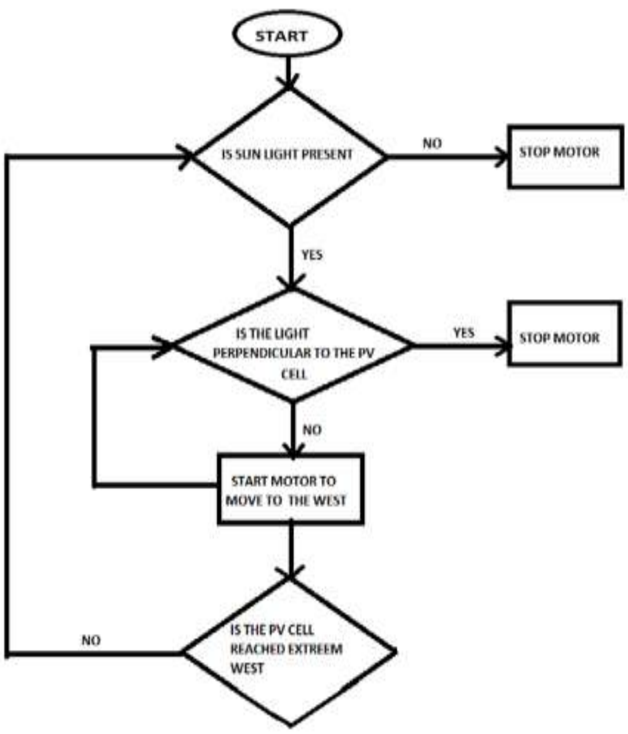
Table 1: Voltage and Current Specification

Discrete Components	Ratings
Lead Acid Battery Voltage	12 VDC
Maximum Solar PV panel open circuit voltage	18 VDC
Continuous charge/load current	800mA
Maximum solar charge current (5 min)	850mA
Voltage across terminals (PV to Battery)	0.6 V
Voltage across terminals (Battery to Load)	0.3V

An LDR (Light dependent resistor), as its name suggests, offers resistance in response to the ambient light. The resistance decreases as the intensity of incident light increases, and vice versa. In the absence of light, LDR exhibits a resistance of the order of mega-ohms which decreases to few hundred ohms in the presence of light. It can act as a sensor, since a varying voltage drop can be obtained in accordance with the varying light. It is made up of cadmium sulphide (CdS).

An LDR has a zigzag cadmium sulphide track. It is a bilateral device, i.e., conducts in both directions in same fashion.

III. FLOW CHART



IV. DESIGN AND WORKING PRINCIPLE

Fig. 2 shows the circuit of the solar tracking system. The solar tracker comprises comparator IC LM339, H- bridge motor driver IC L293D (IC2) and a few discrete components. Light dependent resistors LDR1 through LDR4 are used as sensors to detect the panel's position relative to the sun. These provide the signal to motor driver IC2 to move the solar panel in the sun's direction. LDR1 and LDR2 are fixed at the edges of the solar panel along the X axis and connected to comparators A1 and A2, respectively. Presets VR1 and VR2 are set to get low comparator output at pins 2 and 1 of comparators A1 and A2 , respectively, so as to stop motor M1 when the sun's rays are perpendicular to the solar panel

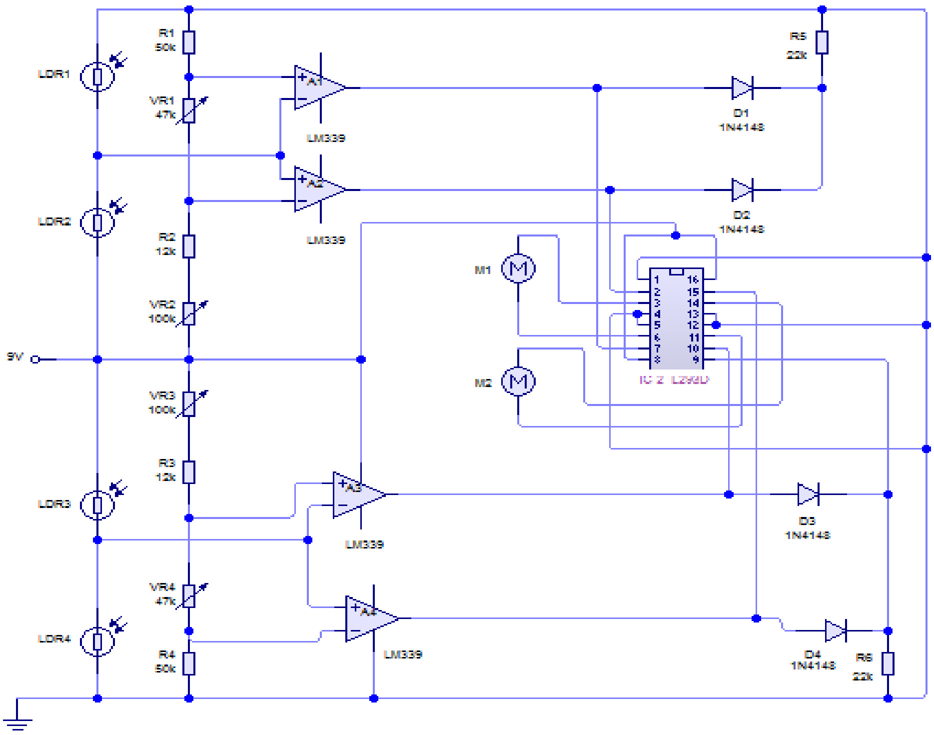


Fig. 2: Circuit of solar tracking system

When LDR2 receives more light than LDR1, it offers lower resistance than LDR1, providing a high input to comparators A1 and A2 at pins 4 and 7, respectively. As a result, output pin 1 of comparator A2 goes high to rotate motor M1 in one direction (say, anti-clockwise) and turn the solar panel.

When LDR1 receives more light than LDR2, it offers lower resistance than LDR2, giving a low input to comparators a1 and A2 at pins 4 and 7, respectively. As the voltage at pin 5 of comparator A1 is now higher than the voltage at its pin 4, its output pin2 goes high. As a result, motor M1 rotates in the opposite direction (say, clock-wise) and the solar panel turns.

Fig. 3: Proposed assembly for the solar tracking system

Similarly, LDR3 and LDR4 track the sun along Y axis. Fig.3 shows the proposed assembly for the solar tracking system.

V. MATHEMATICAL ANALYSIS

Here we have use dc geared motor of 10 R.P.M, 12 Vdc, to rotate the solar panel from east to west and reverse direction.

The circuit takes 24mA at 12 Vdc. So, the required Power= 24mA*12V = 288mW/sec.
For 6 sec, The required power=288*6=1728mW=1.8W.

In a day the panel (or we can say motor) moves east to west and back to east.
For 10 rotations the motor takes 1 min/ 60 sec.
Therefore, for 1 rotation (360 degree) the motor takes (60/10) =6 sec.
To rotate from east to west (180 degree) the motor takes 3 sec.
So, for 10 degree displacement it takes (3000ms*10degree)/180degree= 167msec.
In general, the moves from east to west i.e. 180degree in 12 hours (6am to 6pm) or 720mins.
For 10degree displacement, the sun takes 720/180= 40 mins.
So, in 2 hrs the sun travels 30degree. To cover this 30degree displacement the panel takes (167*3) msec= 501msec.

VI. RESULT

Each and every project is never complete as new things are learned further modifications can be done. Thus we have tried to make an automated solar tracking system which will increase the efficiency of the solar panel system available. Although there is higher initial cost involved we have tried to make the system cost effective .This is just the beginning, we can add different enhancements to make the system more efficient so that it will work round the year. The solar panels using this system compared with the system prevalent at present has many advantages.
In the present system, solar panels used are stationary which gives less output and hence decrease the efficiency. But by making use of tracker solar panels we can increase efficiency of solar system.

- The operator interference is minimal since the system is automated this increases efficiency of the stationary solar system.
- Each project will get better than previous one as practice can make us perfect.

VII. FUTURE SCOPE

There are always remains an infinite scope of improvement to a system design. It's only the time and financial constraints that impose a limit on the development. Following are the few enhancements that may add further value to the system.

- During rains, rainfall sensors can be used to keep the system working.

VIII. CONCLUSION

A solar tracker is designed employing the new principle of using small solar cells to function as self-adjusting light sensors, providing a variable indication of their relative angle to the sun by detecting their voltage output. By using this method, the solar tracker can be successful in maintaining a solar array at a sufficiently perpendicular angle to the sun. Solar tracking is by far the easiest method to increase overall efficiency of a solar power system for use by domestic or commercial users. By utilizing this simple design, it is possible for an individual to construct the device themselves.

REFERENCES

[1]. Toby Peterson, Justin Rice, Jeff Valane, "Solar Tracker", ECE 476, spring 2005.
[2]. A.K. Saxena and V. Dutta, "A versatile microprocessor- based controller for solar tracking", IEEE Proc., 1990, pp. 1105 - 1109.
[3]. N. Barsoun, "Implementation of a Prototype for a Traditional Solar Tracking System", The Third UKSim European Symposium on Computer Modeling and Simulation, pp. 23-30, 2009.
[4]. C. Jaen, J. Pou, G. Capella, A. Arias, and M. Lamich, M, "On the use of sun trackers to improve maximum power point tracking controllers applied to photovoltaic systems", The IEEE conference on Compatibility and Power Electronics, pp. 67-72, 2009.
[5]. A. Stjepanovic, F. Softic, Z. Bundalo and S. Stjepanovic, "Solar Tracking System and Modelling of PV Module", MIPRO 2010, Opatija, Crotia.
[6]. Z. Xinhong, W. Zongxian and Y. Zhengda, "Intelligent Solar Tracking Control System Implemented on a FPGA", Institute of Electrical Engineering, Yuan Ze University.
[7]. N. Barsoum, "Implementation of a prototype for a traditional solar tracking system", 2009 Third UKSim European Symposium on Computer Modeling and Simulation.
[8]. International Energy Agency, [Online]. Available: http://www.iea.org/extbase/nppdf/free/2009/key-stats-2009.pdf.
[9]. Piao, Z.G. Park, J. M. Kim, J. H. Cho, G. B. Baek, H. L, " A study on the tracking photovoltaic system by program type," Intl. Conf. on Electrical Machines and Systems, vol. 2, pp. 971-973, Sept. 27-29, 2005.
[10]. Dr. Marsh, A and Csroline Raines, June 2000, "Solar Position Calculator", Square One research and the Welsh School of Architecture at Cardriff University.