Design of Solar Tracking System for Capturing Maximum Amount of Solar Energy

Rishi Sikka

Abstract - This paper proposes a design of solar tracking system for capturing maximum amount of solar energy by rotating the solar panel. From sun rise to sun set, the sun changes its direction several times due to which the static solar panel fails to capture maximum solar energy throughout the day. Therefore, it is required to develop a system that is capable of generating electrical energy by making use of maximum amount of solar energy. This paper discloses about the rotatable solar tracking system capable of rotating along the sun direction for tracking maximum amount of solar energy. This advanced technology not only utilize the solar energy more effectively but also improves the efficiency of whole system.

Keywords- Rotatable solar panel, solar tracking system, solar energy, static solar panel.

I. INTRODUCTION

With the rapid growth in the use of solar energy it is also very important to improve the efficiency of the solar panel [1]. The increasing growth rate in each and every country rises the energy demand with a very high rate [2]. For the fulfilment of such energy demands, the conventional energy sources are depleting at a very fast rate. Hence, by seeing the present scenario it is require to develop the device which enhance the use of solar energy by harnessing it from the sunlight and converting it into the electrical energy. The solar energy is available in abandon in the environment and is free of cost [3],[4]. The solar energy is easily extracted from the sun coming to the earth by capturing the sun radiation through the solar panel [5],[6].

The position of the sun changes continuously throughout the day as the sun rises from east and set to west direction. Due to this the position of sun rays also changes therefore, to track the sun rays in a most efficient manner it is very important to place a solar panel at a particular direction or at the maximum point at which maximum rays can be captured [7]. The amount of generation of electricity is depends on the amount of solar radiation captured by solar panel. If the amount of solar energy is less than the generated electricity will also be low. Thus, we can say during rainy season the cloud is all over the sky and a very little number of solar rays falls on the earth surface [8]. During this condition a very less amount of electrical energy is produced. In summer times and winter times more sun rays are available that falls on the earth surface that's why the electrical energy generated during these seasons are much more than during rainy season.

Conventionally, various types of solar panels are used to improve the conversion efficiency. But due to the limitations of immovable solar tracker, it is very difficult to capture the sun rays continuously as the direction of the sun went on changing [9],[10]. Therefore, it is required to develop a system that is rotatable and tracks the maximum solar energy continuously by moving at the different angle. By installing such type of tracking device, the efficiency of the energy conversion increases up to 40%. The energy conversion means the amount of solar energy required by the solar panel to convert into the electrical energy. If the amount of solar energy received by panel is converted into electrical energy in same proportion then it is said to be high rate of energy conversion ratio.

II. DESIGN OF PROPOSED SOLAR TRACKING SYSTEM

For achieving un interrupted power supply during day time, the rotatable solar panel is installed in the system that is capable of extracting solar energy and converting it into electrical energy. During the period of sun rise and sun set, the sun changes its position several time. Due to which it becomes difficult to track sunlight continously. Therefore, for tracking the sunlight at different angle the advanced movable solar tracker is developed.

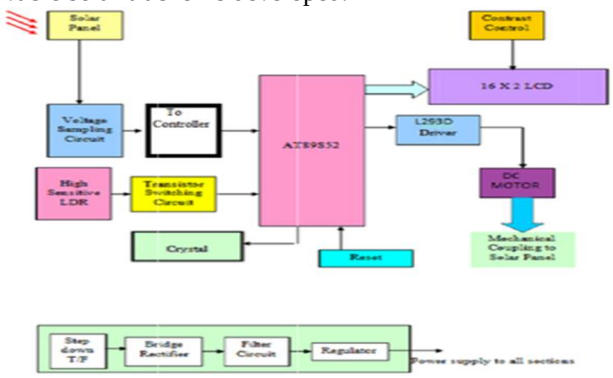

Fig.1 Block Diagram of Proposed System

The proposed solar tracking system is based on light dependent resister (LDR). The light dependent resistor [11] is attached to the solar panel, when the sun changes its direction from time to time the LDR mounted on the solar panel detects the sun lights and moves in the direction in which the sun moves. The LDR sense the presence of light and sends the signal to a microcontroller. The microcontroller controls the rotating movement of solar panel by sending the signal to a motor driver. The motor driver is used to run the stepper motor and the main function of stepper motor is to rotate the solar panel in a particular direction as required by the user. The LCD display [12] is

Revised Manuscript Received on 14 September, 2019.
Rishi Sikka, Department of Electronics Engineering, Sanskriti University, U.P. India.(Email: sanpubip@gmail.com).

also available for showing the energy data and different angle at which the maximum solar energy is tracked by the panel.

Figure 2 represent the flow diagram for the working of solar tracking system. Initially all the data is shown in the LCD display unit. If the sun's angle changes then the light dependent resistor installed in the solar PV module detects any changes in the sun angle and sends the sense signal to the microcontroller. The microcontroller up on detecting any changes sends the controlling signal to the motor driver. The motor driver rotates the stepper motor during a command given by the controller. The earth receives sunrays at different angle of sun [13] which is shown by figure.3

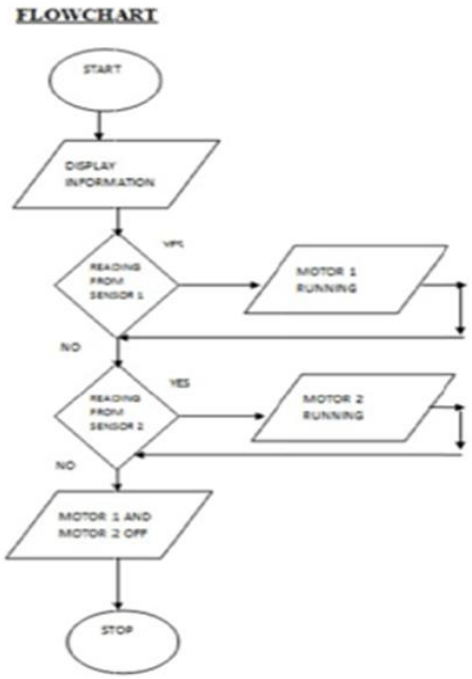

Fig.2 Flow chart of Proposed System

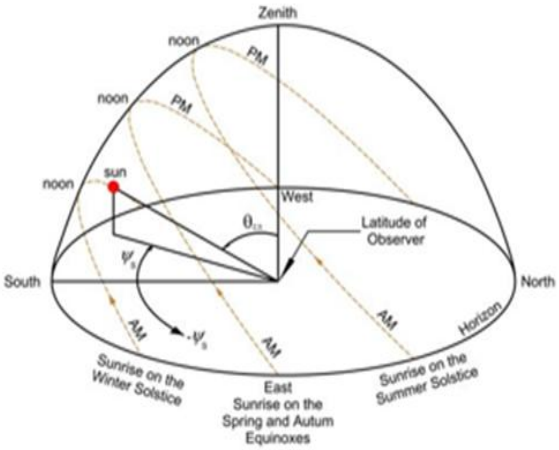

Fig.3 different angle of sun rays

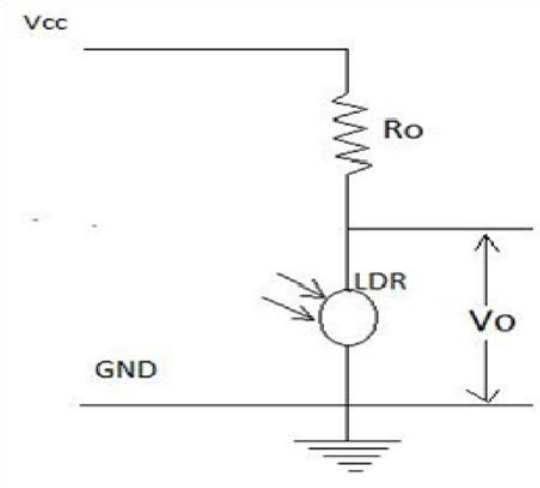

Fig.4 Working of LDR

There are mainly two Light Dependent Resistor (LDR) that are acting as a sensor. The function of such LDR is that it senses the high amount of light density. The solar panel rotates towards the high light density area through stepper motors. Light dependent resistor is preferably a passive transducer that uses potential circuit for obtaining the value of resistance in the form of voltage. The light intensity is inversely proportional to the resistance or it can be said that the higher is the brightness the lower is the value of resistance and if lower is the light intensity, higher will be the resistance.

III. RESULTS

The prototype of proposed model is shown in fig.5. It consists of large number of solar cells connected in series to make a solar array. The solar array or solar panel is mounted on the flame at the angle of 23 degree for capturing maximum beam of solar radiation, two light dependent resistors is connected to the panel for detecting the light intensity, a dc motor is coupled with the solar panel for rotating the solar in a particular direction.

Fig.5 Proposed Model of Solar Tracker

The stepper motor is actuated by a microcontroller while receiving the signal from the LDR sensor whenever there is a change in the intensity of sunlight, the LDR detects the resistance in the form of voltage. Due to change in voltage the microcontroller sends signal to the motor and the motor start rotating. The rotation stops when the LDR again absorbs high intensity of light.

Table V – Components list

S.No	Components name	Rating	Quantity
1	Solar panel	$70W_p$	1
2	Induction otor	415vac, 3Ph,50Hz	1
3	VFD	AC 200-230,0.5Hp	1
4	Gear Box	25 : 1	1
5	IC- OP AMP	UA741	2
6	LDR		2
7	Contactor	12VDc	2
8	Transistor	BC107	2
9	Stand assembly		1
10	Regulated power supply IC	7812 & 7912	2

Table 1. discloses about the information of components that are used in designing the proposed system. It includes the component name, rating and quantity of component used for designing rotatable solar trackering system.

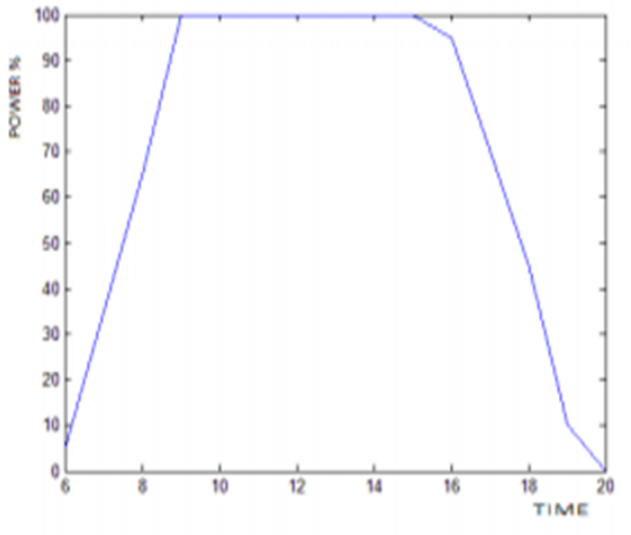

Fig.6 Experimental Result

Fig.6 represents the output waveform of rotatable solar panel tracking system. It is observed that the capturing power of panel is increased as the panel receives countinous light intensity by performing rotation along with the sun angle.

IV. CONCLUSION

The prototype of rotatable solar tracking system is successfully designed. The output result of solar tracking system is shown by fig. 6 in which the maximum output power is achieved after installing the LDR based solar tracking system. In conventional solar panel the continuous supply of solar light is not possible as the conventional solar panels are static and can not capture maximum amount of solar energy due to it fixed position. Therefore, the new solar tracking system is designed which has a capability of changing its position according to the direction of sun rays thereby improving the performance of the system. This advanced technology not only utilize the solar energy more effectively but also improves the efficiency of whole system.

REFERENCES

1. U. Aswathanarayana, “Solar energy,” in Green Energy: Technology, Economics and Policy, 2010.
2. International Renewable Energy Agency (IRENA), Renewable Power Generation Costs in 2017. 2018.
3. M. Kazici et al., “Solar Cells,” in Comprehensive Energy Systems, 2018.
4. R. Lauge-Kristensen, “Renewable energy,” in Sustainable Practices in the Built Environment, Second Edition, 2008.
5. N. A. Lee, G. E. Gilligan, and J. Rochford, “Solar Energy Conversion,” in Green Chemistry: An Inclusive Approach, 2017.
6. G. R. Timilsina, L. Kurdgelashvili, and P. A. Narbel, “Solar energy: Markets, economics and policies,” Renewable and Sustainable Energy Reviews. 2012.
7. A. K. Yadav and S. S. Chandel, “Tilt angle optimization to maximize incident solar radiation: A review,” Renewable and Sustainable Energy Reviews. 2013.
8. M. R. Maghami, H. Hizam, C. Gomes, M. A. Radzi, M. I. Rezadad, and S. Hajighorbani, “Power loss due to soiling on solar panel: A review,” Renewable and Sustainable Energy Reviews. 2016.
9. P. G. Jordan, “The Economics of Solar Power,” in Solar Energy Markets, 2013.
10. T. Tudorache and L. Kreindler, “Design of a solar tracker system for PV power plants,” Acta Polytech. Hungarica, 2010.
11. E. Efficiency, E. Circuit, L. Dependent, and R. Circuits, “Light dependent resistor (ldr),” Energy, 2010.
12. D. Ibrahim, Using LEDs, LCDs and GLCDs in Microcontroller Projects. 2012.
13. S. Khanna, S. Singh, and S. B. Kedare, “Effect of angle of incidence of sun rays on the bending of absorber tube of solar parabolic trough concentrator,” in Energy Procedia, 2014.