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An Analysis of Automatic Dual Axis Sun Tracking Solar System

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Abstract: Electricity is the key role in developing progress of industries and modern home society. Coal and oil are non- renewable energy of resources, as the population increases the demand of energy can be increases progressively. Due to the increases of global warming and energy depletion, it is required to control and makes use of natural resources. In modern era, mostly countries focus on the renewable energy of resources. Sun is the supreme sources of renewable energy of resources. Solar energy is the most and unlimited natural resources through which more solar power be generated to use sun power, sun tracking solar system has been designed which can contain photovoltaic modules and act as p-n junction. Sun tracking solar system used mostly to increases the efficiency and power. This paper focus on the study of dual axis solar tracking system which attain more energy from the sun and extends the efficiency or gives more accuracy. The dual axis solar tracker system contain the horizontal position and vertical position in which horizontal position can be vary while vertical position remain fixed. In dual axis solar system they continuously track the sun position in both directions. The paper studied the orientation and tilting of solar panel for which maximum energy can be generated.

Keywords: Solar Pannel, Photovotaivc cell, Arduino System, Azimuthal angle, Elevation angle.

I. INTRODUCTION

Due to the increasing global demand of energy, the price of non-renewable energy has been flourishing. Coal and oil are non-renewable energy of resources and they are limited, so there is a scarcity of fossil fuels. It is familiar that as the demand of energy will be developing faster than finding the new feasible fossil fuels [1]. The renewable resources of energy are the best method to solve this problem. The eco-friendly nature and accessibility of renewable resources of energy industries move on to use of renewable energy of sources as it also helps in minimization of their bill management and flaunt gases harmful for living things. Sun, water and wind are the most renewable energy of resources. A foremost probable renewable source of energy is a solar energy. Solar power is most effectively and efficient renewable energy of resources and they gives more power when pointed toward the sun in perpendicular directions, so one of the most everlasting sources of renewable energy is sun which can give about 1.8*1011MW of power to the earth[2]. Solar panel fulfill the continuously demands of renewable energy of sources. The first solar cell system was developed in 1839 by the French physicist Antoine Cesar Becquerel, but encyclopedia Britannica confirmed the first solar panel was built by Charles Fritts in 1883[3], that creates curiosity in developing sun tracking solar system which increases the efficiency of solar panels. Solar system can contain photovoltaic cells, which act as p-n junction. The photovoltaic converts the light coming from the sun into electrical current by photovoltaic effect [4]. The efficiency of photovoltaic is low and the main causes are both of its financial and cost effective conditions of photovoltaic system [5]. To increase the efficiency of photovoltaic system the sun tracking solar system has been developed. So to attain the maximum power from the sun, it is required to make the photovoltaic cells in correct position that is perpendicular to solar radiations [6]. It is essential to improve the sun power for the production of electricity and it is proposed that sun is the main production of electricity by the year 2100 according to the German advisory council on global changes [7].In solar panel, there are solar collector placed, which occupy a maximum sun radiation and the power of solar collector can be maximized by taking the solar tracking system with respect to time and location [8]. The sun tracking solar system can be work when we know about the correct position of sun with respect to the earth. As the sun moves the panel also moves and absorbs maximum radiation. So the movement of the solar panel with respect to the sun is very important. There are many method such as neural network [9], fuzzy logic algorithm and adaptive neuro-fuzzy control scheme has been studied to increases the accuracy of solar tracking system [10]. The another method to attain a maximum accuracy for sun tracking solar system can be classified as open loop tracking

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system and closed loop tracking system[11]. To track the sun with a self-alignment routine and self-adjusting motor with ± 0.1˚ pointing accuracy in closed loop algorithm has been studied [12]. For proper working of solar tracking system the knowledge of inclination angle, elevation angle and azimuthal angle is very important. Elevation angle formed by the line of sight and the horizontal plane for an object above the horizontal and on the other hand azimuthal angle is defined as a horizontal angle measured clockwise from a north base line or meridian. The azimuthal angle and elevation angle can be determined by sun movement with given time, date and geographical position [13]. So inclination angle and the orientation of solar panel can be adjusted carefully. In a studies it is observed that if there is a small degree of misalignment can be occur then only 1 to 5 % of energy loss can be take place[14]. Sun tracking solar system can be divided into two ways such as single- axis solar system and dual- axis solar system. In single axis solar system solar panel can moves into one axis such as from east to west and in dual axis solar system solar panel can move in two axis such as from south to north and east to west. Dual axis solar system has been implemented mostly because it can contain the efficiency up to 40% [15]. The dual axis solar system with orientation and tilting can be studied which increases the solar power and accuracy.

II. SYSTEM DESCRIPTION

In this project maximum power has been generated from the sunlight automatically. This system is tracking for maximum intensity of light. When there is decrease in intensity of light this system automatically changes its direction to get maximum intensity of light. Sun tracking solar system can be divided into four parts;

a) Mechanical parts
b) Electrical parts
c) Electronics parts
d) Programming to control the system

A. Mechanical Part

This part contains a mechanical work. There is a structure is made which support the panel with the two degree of freedom that vary the tiltation and orientation of the panel. The vertical and horizontal axis has been designed for the supporting of the panel. In vertical axis they remain stable that is they remain fixed with respect to the panel and the other hand in horizontal axis they can be move from east to west and south to north with tiltation and orientation.

B. Electrical Part

The electrical part contains motor, sensors and gears. The servo motor can be used for orientation and control the axis of the solar panel, it only rotate by 90 degree in either direction for the total 180 degree movement and its wheel can be controlled by the gears attached to it. There are two servo motor can be used, one is moving in east and west and other in south to north direction. LDR sensors have been used in sun tracking solar system. LDR is a variable resistor and its intensity depends upon how much they receive the light. Four LDR sensors have been used for sensing in four different directions to obtain maximum intensity of light. The difference between the outputs of sensor is given to microcontroller unit.

C. Electronic Part

In the electronic part, they contain Arduino which is also called a programmable logic controller. Arduino is easy to use hardware and software electronic device. In sun tracking solar system. Arduino can be used for better working of system.

D. Programming to control the system.

In this part the programming has been done to control the tiltation and orientation of sun tracking solar system. In Arduino simple programming has been written and is very simple 'c' language. There is no extra codes and complex method used for implementation the program in Arduino.

III. ARDUINO SYSTEM INTERFACE

A photovoltaic cell or solar cell is an electrical device that converts the light into electricity. Photovoltaic cell is made of mono-crystalline silicon, polycrystalline silicon, amorphous silicon etc. types of materials. The solar panel is mounted on the fixed vertical position. The vertical position remains fixed and the horizontal position makes the movements of solar panel.

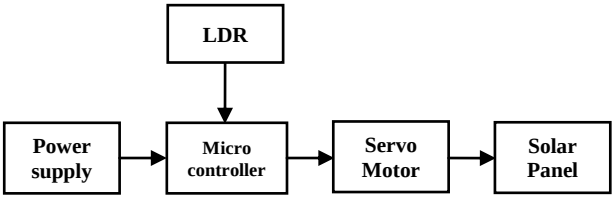

Fig: 1: Block diagram of Sun Tracking System

The four LDR placed on the four direction of the panel which receives the maximum intensity of light, where the sun intensity is high LDR can attain maximum light on that direction. The resistance of LDR is very high. LDR is very reliable and simple in structure. The output from the LDR is given to the Arduino. Arduino is such proficient hardware and software tool through which several of input from the various switchesor sensors has been observed and control the movement of motor and light intensity with accurate output. The programming written in Arduino is very simple and the cost of Arduino is also very low. Arduino can easily interact with environment such as sensors and motors. Servo motor can be used to control the movement of panel. The output from the Arduino is given to the servo motor and servo motor moves the panel where the intensity of light is high. Servo motor contains motor which is attached to a sensor for position feedback. Servo motor very suitable solar tracking system and used mostly electronics devices. It also low cost and reliable.

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TABLE I

Angles used in Solar Technology				
Angles	**Symbols**	**Values**		
Solar Height	γ_s	**H = 0**	**Z = 90**	
Solar Azimuth	α_s	**S = 0**	**E = -90**	**W = + 90**
Superficial Slope	**B**	**H = 0**	**V = 90**	
Superficial Azimuth	**A**	**S = 0**	**E = -90**	**W = + 90**
H - Horizontal, S - South, Z - Zenith, E - East, W – West				

To attain the maximum intensity of light the solar panel can be mounted properly with accurate location and angles. The azimuthal angle, elevation angle and angle of tiltation mostly used in sun tracking solar system. The zenith angle is the angle where the maximum intensity of light from the sun is taken because at this angle the sun is perpendicular to the solar panel.

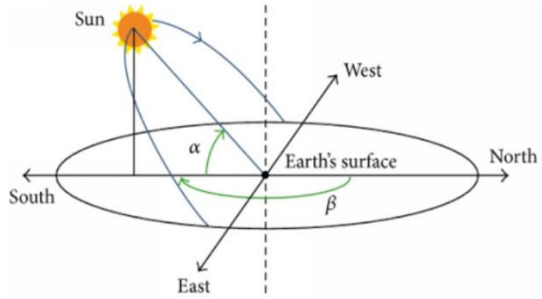

Fig: 2: Sun path across the sky from sunrise to sunset

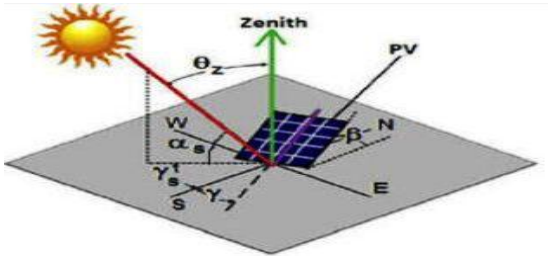

Fig: 3: Solar angles with solar panel

In the studies, the angle of optimal tiltation is equal to the 90 degree subtract the angle of the sun. The angle of tiltation varies from 0 to 90 degree and angle of tiltation changes in summer days and winter days because in summer days the intensity of light is high than winter days. Solar tracking system is popular renewable energy to produce electricity. Solar tracker system is most advanced technology used in modern era. Through the solar tracking system more energy efficient electricity is produced which is more suitable for environment. Solar tracking system has some problems such as they have high cost and complex in nature. Solar panel requires high maintenance which is very costlier for any company wealth.

IV. CONCLUSION

The main benefaction of this paper is to present an intelligent dual axis sun tracking solar system. Sun tracking system with orientation and tiltation increases the power or efficiency of solar panel up to 40 %. To obtain the maximum energy from the sun the panel has to move in correct direction with correct angle and make the panel perpendicular to the sun. The sun tracking solar system was designed in that way that minimum number of component can be used and they can be fit into the small package so that the cost of system is less expensive.

The proposed of this system is to obtain the maximum energy from the sun and make the system eco-friendly with the environment. The power consumption is less used by sun tracking solar system. Sun tracking solar system is reliable and mostly used for production of high efficiency in most of the countries.

REFERENCES

[1] S. Khan, N., Mariun, Z., Saleem, N., Abas, N. "Fossil Fuels, New Energy Sources and the Great energy Crisis". Renewable and Sustainable Energy Resources, doi: 10.1016/j.rser.2007.

[2] Dhanalakshmi.V, Lakshmi Prasanna.H.N, Priyanka.V, Rani.K.J. "Dual Axis Solar Tracker Using Arduino Uno", International Journal On Recent and Innovation Trend in Computing and Communication, vol. 4, pp. 386-388, 2016.

[3] Dolara, A., Grimaccia, F., Leva, S., Mussetta, M., Faranda, R. and Gualdoni, M. "Performance Analysis of a single-axis tracking PV system". IEEE Journal of Photovolatics, vol. 2, no. 4, 2012

[4] Liu, K.H. "Dynamic characteristics and graphic monitoring design of photovoltaic energy conversion system." WSEAS Transaction System. Vol. 10, pp. - 239-248. 2010

[5] Sadyrbayev, S.A., Bekbayev, A.B.,Orynbayev, S and Kaliyev, Z.Z. "Design and research of dual axis solar tracking system in conditions of town almaty ." Middle-East journal of scientific research, vol. 17, no. 12, pp 1747-1751, 2013

[6] Jing-Min Wang and Chia-Liang Lu "Design and Implementation of Sun Tracker with a Dual-Axis Single Motor for an Optical Sensor-Based Photovoltaic System." Mdpi sensor journals, 2013

[7] German Advisory Council on Global change, 2003.(http:// www.wbgu.de)

[8] Chiang C.M, Lee C.Y, Hwang W.J., and Chou P.C. "Solar Orientation Measurement System with integrated Solar cells" The open construction and building Technology Journal, vol. 2, pp 280-286, 2008

[9] Brown D.G. and Stone K.W., "High accuracy/low cost tracking system for solar concentrators using neural network", in Proceedings of 28th Intersociety Energy Conversion Engineering Conference, Atlanta, USA, Aug. 1993.

[10] Yousef H.A., "Design and implementation of fuzzy logic computer-controlled sun tracking system", in Proceeding of IEEE International symposium on Industrial Electronics, Bled, Slovenia, Jul. 1999.

[11] Nayak, S.R.; Pradhan, C.R. Solar tracking applications. IOSR J. Eng. 2012, 2, 1278-1281.

[12] Maish, A.B., "Performance of a self-aligning solar array tracking controller", in Proceeding of 21st IEEE Photovoltaic Specialists Conferences, Kissimimee, USA, May 1990.

[13] F. Duarte, P.D. Gaspar and L.C. Goncalves, "Two Axis Solar Tracker Based On Solar Maps, Controlled by a Low-Power Micro controller", Journal of Energy and Power Engineering, vol. 5, pp. 671-676, 2011.

[14] Blanco-MURIEL, M., Alarcon-Padilla, D.C., Lopez-Moratalla, T., Lara-Coira, M. "Computing the solar vector." Solar Energy, pp. - 431-441, 2001.

[15] RanaShrishti, "A Study on automatic dual axis solar tracker system using 555 timer", International\Journal of Technical Research and Application, e-ISSN: 2320-8163, vol 1, issue 4, pp. 77-85, 2013.