Sun Tracking Solar Panels

Abstract

Solar energy is gaining popularity as one of the best forms of conventional energy due to the rising awareness for the rapid depletion of non-conventional resources. In this paper, a dual axis sun tracking solar panel is designed using ATmega328 microcontroller, 4 LDRs, 2 servo motor and Arduino. The main purpose of this paper to present the solution to the loss of power and solar radiation that is present in a stationary solar cell in an inexpensive way. We aim to present a system that would have an effective alignment with solar to maximize our output. We aimed at gaining a 13-15% in our output than immobile PV systems.

Introduction

Solar energy is clean and available in abundance. Solar technologies use the sun for provision of heat, light and electricity. These are for industrial and domestic applications. With the alarming rate of depletion of major conventional energy sources like petroleum, coal and natural gas, coupled with environmental issues caused by the process of harnessing these energy sources, it has become an urgent necessity to invest in renewable energy sources that can power the future sufficiently. The energy potential of the sun is immense. Despite the unlimited resource however, harvesting it presents a challenge because of the limited efficiency of the array cells. The best efficiency of the majority of commercially available solar cells ranges between 10 and 20 percent. This shows that there is still room for improvement. This project seeks to identify a way of improving efficiency of solar panels. Hence Solar tracking is used. The tracking mechanism moves and positions the solar panel such that it is positioned for maximum power output. Other ways include identifying sources of losses and finding ways to mitigate them.[1]

In the active tracking system; the sun's position during the day is continuously determined by feedback sensors. The sensors will trigger of motor/actuator; which will in turn cause the movement of the mounting system so that the solar panels will always be perpendicular to the sun throughout the day. The drawback of such a system is that it is very sensitive to certain atmospheric conditions and might not be able to continue tracking the sun on a cloudy day. One of the most important factors behind the selection of a tracking system is cost.[2] Active tracking systems; even though popular; are expensive and add on to the capital cost of installing a solar PV system. The paper proposes a microcontroller based active dual axis tracker which is inexpensive; consequently, it can be used extensively. To reduce the cost of the system; Arduino; single-board microcontroller; servo motor instead of Stepper motor/ permanent magnet DC motor with gear arrangement has been used. A servomotor consists of a motor and a sensor and uses position feedback to control its final position and motion. It uses a c1osedloop servomechanism. It consumes power when it rotates to the commanded position; but after that it rests; whereas stepper motors continue to consume power to lock in and hold the commanded position. The servo-motor uses less energy for the same functionality.[3]

We tried to identify and improvise the designing and orientation of our solar cell with that of the sun. We aimed at orienting our cell perpendicular to the solar radiation at almost every moment

for maximum absorption using servo motor and Light Dependent Resistors and gain the improved output power. We also aim to produce sufficient amount of power that could be using in various appliances at home and industrial level.

Solar energy has shown the most exponential growth in conventional sources of energy. India is growing to be the largest country to produce solar generated power due to its location. India being near the equator and having 10 months of clear sky on average in various region shows promising results in the generation of solar energy and this paper focuses on studying and contributing in the respective field.

Methodology

The main component is Arduino ATmega328 microcontroller. ATmega328 is an AVR family micro controller. It is based on advanced RISC architecture. It is an 8-bit controller. It has 32K Bytes of Programmable Flash memory, 1K Bytes of EEPROM and 2K Bytes of SRAM. It has 23 programmable I/O pins. It supports peripheral features like two 8-bit timers, one 16-bit timer, 6 channel ADC with 10-bit resolution, programmable USART, Serial Peripheral Interface, 2 wire serial interface (I2C), etc. It has an open source physical computing platform and a development environment for writing software for the board and is inexpensive. The other main components are Light Dependent Resistors (LDRs); servo -motors; solar panel. The solar tracking is done by Light Dependent Resistor (LDR). Light Dependent Resistors or LDRs are the resistors whose resistance values depend on intensity of the light. As the intensity of light falling on the LDR increases, resistance value decreases. In dark, LDR will have maximum resistance. LDR will output an analog value which should be converted to digital. Four LDRs are connected to microcontroller that acts as the input for the system. These are attached on the edges of the Solar Panel for the same. The analog value of LDR is converted into digital (Pulse Width Modulation) using the built-in Analog to Digital Converter. The values of PWM pulses are applied to move the servomotors. The maximum light intensity captured by the one of the LDRs' input will be selected and the servo motor will move the solar panel to the position of the LDR that was set-up in the programming. There are three points of motor rotation; 0; 90 and 180 degrees. The positions of LDR are divided into four positions; which are right; left; up and down. The 4 positions allow the highest intensity of sunlight that can be detected. The microcontroller gets an analog input from the Light Dependent Resistor (LDR) which is then converted into digital signal by Analog-to-Digital converter. Solar panel consists of photovoltaic cells arranged in an order. Photovoltaic cell is nothing but a solar cell. Solar cell is made up of semiconductor material silicon. When a light ray from Sun is incident on the solar cell, some amount of energy is absorbed by this material. The absorbed energy is enough for the electrons to jump from one orbit to other inside the atom. Cells have one or more electric field that directs the electrons which creates current. By placing metal contact energy can be obtained from these cells. The movement of the solar panel is determined by the output given to the servo motor.[4,8]

Conclusion

Dual axis tracker perfectly aligns with the sun direction and tracks the sun movement in a more efficient way and has a tremendous performance improvement. The experimental results clearly show that dual axis tracking is superior to single axis tracking and fixed module systems. Power Captured by dual axis solar tracker is high during the whole observation time period and it

maximizes the conversion of solar irradiance into electrical energy output. The proposed system is cost effective also as a little modification in single axis tracker provided prominent power rise in the system. Through our experiments, we have found that dual axis tracking can increase energy by about 40% of the fixed arrays. With more works and better systems, we believe that this figure can raise more.

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