"DUAL AXIS SOLAR TRACKING SYSTEM"

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Abstract: *Solar panels are devices that convert light into electricity. Solar panels use sunlight to generate power. Solar panels work best when the sun is shining. As the angle of the sun varies throughout the day and seasons, this affects the amount of electricity a solar power system will generate. To make solar power the systems work more efficiently, this project will include the design and construction of a microcontroller-based solar panel tracking system. Solar tracking allows more energy to be produced because solar array can remain aligned to the sun. In this project, we will design a dual-axis solar tracker that allows solar panels to move on two axes, aligned both north-south and east-west. This type of system is designed to maximize solar energy collection throughout the year. This project will make use of the Light Depending Resistor (LDR) which is important to detect the sunlight by following the source of the sunlight location. Arduino Uno microcontroller is used to control the motors based on LDR. The drastic improvement in power output from the solar panel can be seen on a LCD Display attached to the system. This project discusses the development of a prototype for a dual axis solar tracking system.*

***Keyword Word**: Solar Panel, Arduino Uno, Dual axis, LDR, IR Sensor, LCD*

Introduction

This project will utilize the maximum solar energy through solar panels. To do so, a digital automatic sun tracking system is proposed. The project will help solar panels to get the maximum sunlight automatically thereby increasing the efficiency of the system. In this project, a working dual-axis solar tracker is built by using a balanced concept which is four signals from the different sensors are compared. Light Dependent Resistor (LDR) as a light sensor has been used. The four light-sensors are

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separated by a divider which will create a shadow on one side of the light sensor if the solar panel is not perpendicular to the sun. This will create a variation in light intensities sensed by the light sensors. The difference in these values will Arduino know that solar panel isn’t perpendicular to the sun, Arduino, as a microcontroller; will control the movement of the motors via motor driver IC (L298n). Data will be received from the sensors and then processed by the Arduino. The Arduino will send the processed data to the Bi-directional DC geared motor via motor driver IC (L298n) to ensure the solar panel is perpendicular towards the Sun. Motor driver IC (L298n) controls the rotation of the motor either to rotate clockwise or anticlockwise. The solar panel that attached to the motors will be reacted according to the direction of the motors. To get maximum intensity of light and zero voltage difference (error degree) the position of the panel must always perpendicular to the light source. Uses of Single Axis throughout the year do not maintain the output power. The position of the sun will change from the position of installed solar tracker and make the panel no more perpendicular to the sun which affects the output power. Therefore, dual-axis solar tracking moves the solar panel to be always perpendicular to the sun. The tracker will track the sun throughout the years and maintaining the output power generated by the solar panel.

An LDR is a component that has a (variable) resistance that changes with the light intensity that falls upon it. They are also called as photoconductors, photoconductive cells or simply photocells. Here we have used four LDRs to sense the light falling on the solar panel is perpendicular to all four directions. So, the values of all four LDR should be the same to achieve the correct direction for the solar panel. A DC geared motor is a device that uses DC electricity to produce mechanical energy. The energy in electric current causes the DC geared motor to spin. Any devices attached to the motor can then take advantage of this spinning motion to create another type of motion. In a gear motor, the magnetic current turns gears that are either in a gear reduction unit or an integrated gearbox. A second shaft is connected to these gears. Gear head or gear motor was used in solar tracker which has the advantage of producing high torque to turn the solar panel. Over a period of time, Solar panels gets dust collected on it as a result it doesn’t get proper sunlight because of dust particles covering the panel from getting sunlight. Another Motor is used to run a wiper over the solar panel which is controlled by a switch. Whenever the solar panel is found

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covering in dust, the wiper attached to this motor will clean the solar panel by pressing this switch. A well-designed solar tracking system is necessary to improve the efficiency of the panel in a most economical way. The amount of power available to a solar panel is proportional to the amount of light that reaches it. The lighter it gets, the more power it produces by using a single axis solar tracker can only capture the minimum power tracking sunlight in one direction which is the elevation movements from east to west by rotating the structure along the vertical axis. The use of single-axis tracking can increase the electricity yield by as much as 27% to 32%, but by using a dual-axis solar tracker, it can capture the maximum sunlight in two movements at the same time, so, dual-axis tracking increases the electricity output as much as 35% to 40%. Dual-axis solar trackers allow for two degrees of flexibility, offering a much wider range of motion. The primary and secondary axes work together to allow these trackers to point the solar panels at specific points in the sky.

Block Diagram

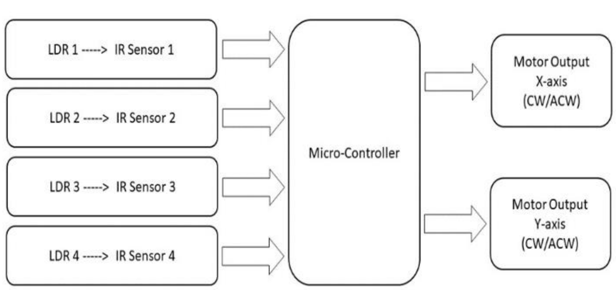

Fig.1: Block diagram

Components

The various components used in designing the project are

i) Arduino Uno AT mega328p microcontroller ii) LDR iii) IR sensor iv) DC gear motor v) Motor Driver (L28N) vi) Solar Panel (10W, 12V) vii) 9V Battery viii) LCD Display (16*2)

Working

The system uses four LDRs which are separated by a divider (made of wood or any opaque material) to locate the correct position of direct sunlight. If the direction of sun rays is not perpendicular to the four LDR setup, the LDR of one side will get illuminated and due to divider, a shadow will fall on the LDR of the other side. This will create a difference in resistance values of the LDR which will help in the movement of the solar panel in the direction in which the intensity of the sun rays are maximum.

The four LDR setup will act as the photo-sensor for this tracker system. LDR act as input and sense the sun position. The resistance of LDR falls with increasing light intensity. When the LDR receives the light, the resistance becomes low and the signal is sent to the IR sensor. In this project, the photodiode or phototransistor of the IR-sensor module is replaced with LDR. The IR-sensor module sends an output signal whenever it's

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photodiode or phototransistor generates any signal. But here we have replaced its photodiode or phototransistor by LDR, so whenever LDR generates a signal, an output signal is sent by the IR-sensor module to the Arduino microcontroller

The Arduino is programmed to respond according to the signal it receives from the IRsensor module. The Arduino will run the motors towards the direction depending on the LDR inputs, such that all LDR starts receiving the maximum sunlight. As a result, making the solar panel directly perpendicular to sunlight. The Arduino is programmed in such a way that if the input of all LDRs is high, it will stop the motors and keep the solar panel stationary facing directly towards sunlight.

Fig. 2 Prototype model

Advantages

- Simple and Low cost
- Eco-Friendly
- Tracking accuracy is more
- Reduce the usage of power from power grid
- Trackers generate more electricity than their stationary and single axis tracker due to increased direct exposure to solar rays.
- Can give 40% more electricity than a non-moving solar panel

Disadvantages

- Lots of moving parts makes it more likely for components to fail
- Lower lifespan and lower reliability
- Unreliable performance in cloudy or overcast weather

Results

The proposed model of the dual axis solar tracker is capable of tracking the sun throughout the year. The dual axis tracker provides higher output power when compared to single axis tracker and fixed panel. According to the measured readings the efficiency of the dual axis tracker is found to be 81.68% higher than that of fixed panel.

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Table 1: Results

Hours	Static panel			Dual axis		
	V	mA	mW	V	mA	mW
08:00 AM	8.2	0.7	5.74	10.22	2.90	2.3
09:00 AM	8.4	1.15	9.66	10.40	3.0	31.2
10:00 AM	8.7	1.29	11.2	10.45	3.02	31.55
11:00 AM	9.8	1.88	18.4	10.5	3.20	33.6
12:00 PM	9.8	2.23	21.8	10.3	3.18	33.8
01:00 PM	10.4	2.50	26	10.81	3.33	35.99
02:00 PM	10.7	2.96	31.6	10.75	3.38	36.33
03:00 PM	9.9	2.75	27.2	10.40	3.31	34.42
04:00 PM	8.4	2.6	21.8	10.53	3.30	34.74
05:00 PM	8.2	2.12	17.3	10.40	3.10	32.24
06:00 PM	8.0	1.42	11.3	10.30	2.90	29.87
Average Power			18.3			33.03

Summary

The aim of this project was to design a dual axis tracking system which can sense the incident solar light on the panel and move it in the direction of maximum solar light incident. The tracking controller is implemented by means of AT mega328p microcontroller. The necessary software is developed via Arduino Uno IDE. In building the solar tracking system, LDRs (Light Dependent Resistors) are used to determine solar light intensity and an LCD to display the power output from the solar panel. The proposed solar tracking system can track sun light automatically.

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