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Arduino Based Dual Axis Sun Tracking Solar Panel Using LDR And Servo Motor

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Abstract— *Solar tracking is now becoming very popular. Solar energy is rapidly advancing as an important means of renewable energy sources. "The solar tracking system is a method of generating electricity from sunlight." This method of generating electricity is simple and derived from natural resources. This only requires maximum sunlight. Design and construction of a solar tracking system that detects sunlight using LDR. The solar tracking loop is based on the Arduino-Atmel ATMega 328. It is programmed to detect sunlight through LDR and activate the servo motor to place the solar panel where it receives maximum sunlight. Compared to other motors, servomotors are more controllable, energy efficient, more stable, less expensive and more precise. The automatic tracking and implementation of solar energy can be significantly improved.*
Keywords— *Tracking, Servo Motor, Arduino-ATmega 328, Solar, Sun Tracking, MPPT*

I. Introduction

Energy is a key element in the development of the nation. Every day, in the world society, tremendous amounts of energy are obtained, distributed, transformed and consumed. Demand for renewable energy such as solar, wind, geothermal and tsunami is increasing to ensure a safe world for sustainable power generation and future power generation. Solar panels convert solar radiation directly into electrical energy. Solar panels are mainly made of semiconductor materials. Solar Tracking is a mechanized system for tracking the position of the sun that improves solar panel performance by 30% to 60% over stationary systems. This is a much more cost effective solution than purchasing additional solar panels.

Passive tracking system-Differential heating of two interconnected tubes filled with gaseous refrigerant is used. This tracking system does not use any controls, gears or motors. Therefore, it is called a passive tracking system. Active Tracking System-It uses a motor and gearbox commanded by the controller to respond to sunlight. It is classified into two-axis tracking and one-axis tracking. Uniaxial Solar Tracker tracks the sun's movement from east to waste or north to south every day. Dual Axis Solar Trackers track the movement of the sun from east to west and as well from north to south.

II. types of solar tracker

The sun’s position in the sky varies both with the seasons (elevation) and time of day as the sun moves across the sky. Hence there are also two types of solar tracker:

A. Single Axis Solar Tracker
B. Dual Axis Solar Tracker

A. Single Axis Solar Tracker :

Single-axis solar trackers can have horizontal or vertical axes. The horizontal type is used in tropical areas where there is a lot of sunshine during noon, but the day is short. The vertical type is used at high latitudes where the sun is not too high, but summer days can be very long.

B. Dual Axis Solar Tracker

The dual axis solar tracker has both vertical and horizontal axes, so you can track the apparent motion of the sun all over the world. The two-axis tracker tracks the sun to the east and west and north to south for added power and comfort.

Commercial Purpose of Solar Tracking System

- Increase solar panel power.
- Maximum efficiency of the plate.
- Maximum power per unit area.
- Available energy all day.

III. hardware resources

A. Servo Motor

Servos contain a small DC motor, a gearbox and some control circuitry, and feed on 5 volts at about 100mA maximum, and about 10-20mA when idle. They have a three wire connector, one common wire (0 volt, usually black), one +5v wire (usually red), and one signal wire.

Fig. 1. Servo Motor

In normal use they are controlled by pulses of about 1 to 2 milli-seconds at a repetition rate of about 50 per second. Short pulse makes the servo drive to one end of the travel, a long pulse makes it drive to the other end, and a medium one puts it somewhere proportionally between. Some servos have gear components that allow them to rotate continuously. This method needs the servo to have a feedback potentiometer used by internal circuits to measure the position of the output shaft.

B. LDR

We are using 4 LDR's. A light sensor is the most common electronic component which can be easily found. The simplest optical sensor is a photon resistor or photocell which is a light sensitive resistor these are made of two types, cadmium sulfide and gallium arsenide. The sun tracker system designed here uses two cadmium sulfide photocells for sensing the light. The photocell is a passive component whose resistance is inversely proportional to the amount of light intensity directed towards it. It is connected in series with capacitor. The photocell to be used for the tracker is based on its dark resistance and light saturation resistance. The term light saturation means that further increasing the light intensity to the cells will not decrease its resistance any further. Light intensity is measured in lux; the illumination of sunlight is approximately 30,000 lux.

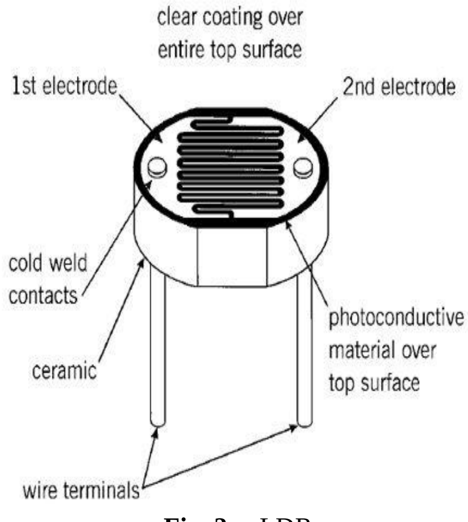

Fig. 2. LDR

C. Arduino UNO

Fig. 3. Arduino UNO

Arduino UNO Is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. Anyone can tinker with UNO without worrying too much about doing something wrong, worst case scenario anyone can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

ARDUINO UNO SPECIFICATION

- Microcontroller: ATmega328P
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Inout Voltage (limit): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- PWM Digital I/O Pins: 6
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB (ATmega328P) of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328P)
- EEPROM: 1 KB (ATmega328P)
- Clock Speed: 16 MHz
- LED_BUILTIN: 13
- Length: 68.6 mm
- Width: 58.4 mm
- Weight: 25 g

D. Solar Panel

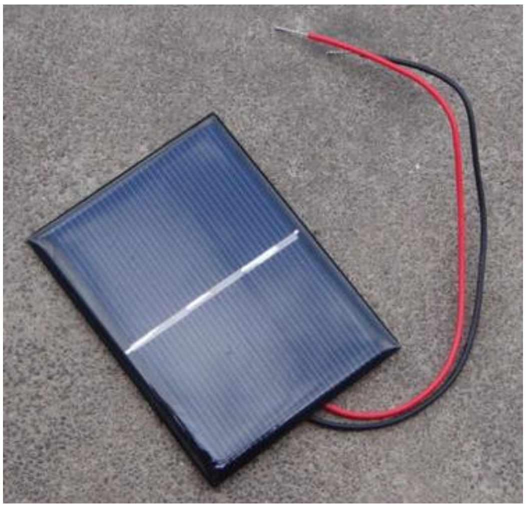

Fig. 4. Solar Panel

Solar energy is the photovoltaic cell which converts light energy received from sun into electrical energy. The name behind "solar" panel is they grab high powerful energy emitted from the sun. The solar panel finds its applications in street lights, domestic and industrial areas.

IV. Hardware Implementation

In this section, we will elaborate the block diagram, working principle and different components required for the implementation of our solar tracking system.

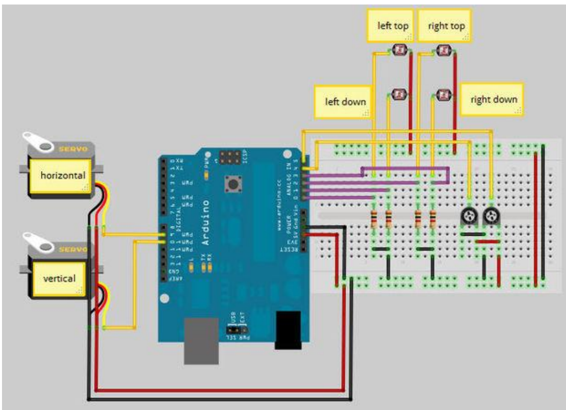

Fig. 5. Connection Scheme of Proposed Model

A dual-axis tracker means that it is tracked in both the X and Y axes. It goes up, down, left and right to make it even easier. In other words, with this Sun Tracker configuration, the sun tracker follows the sun, so no changes or adjustments are required.

LDR is used as the main light sensor. Two servomotors are attached to the structure that holds the solar panel. The program for Arduino is uploaded to the microcontroller. LDR senses how much sunlight hits them. The four LDRs are divided up, down, left and right. East-west tracking compares the analog values of the two upper LDRs and the two lower LDRs. As the top LDR set receives more light, the vertical servo moves in that direction. The connection method of the proposed model is shown in Fig.5.

When the lower LDR receives more light, the servo moves in that direction. The analog values of the two left and right LDRs are compared for the angular deviation of the solar panel. If the left LDR set receives more light than the right, the horizontal servo will move in that direction. As the right LDR set receives more light, the servo moves in that direction.

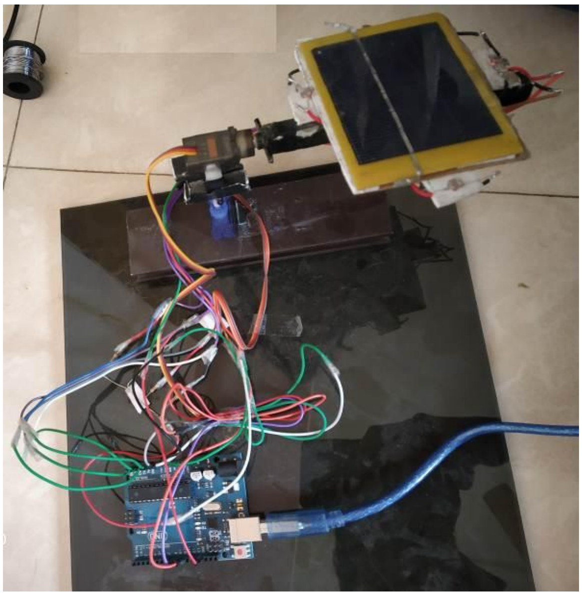

Fig. 6. Implemented Hardware of Proposed Model

Fig. 6 shows the implementation hardware of the proposed model. A cardboard was taken. There are 4 holes in the center and 4 holes on 4 sides to fit the LDR. We glued the solar panel to the cardboard and pulled two wires from the panel as shown. Next, I used these four LDRs in four holes as shown. Apply glue to the LDR and secure it. Solder two LDR cables and connect four LDR cables with wires.

You now have a bus line to connect the outputs of the four LDRs to the Arduino board. We soldered 4 wires at each point between the LDR and the resistor with 4 LDRs. This time the servomotor with screw is connected to the perforated plate. Next, place the solar panel and the first servomotor setup on the second servomotor metal strip as shown.

V. Result Analysis

The readings of solar panel were recorded with and without tracking of system and in both the conditions different output is obtained. The obtained readings are given in Table 1.

Table 1: Solar panel output voltage with and without tracking of system

Time	Solar Panel Voltage	
	Without Tracking	With Tracking
09:00	0.51	0.78
10:00	0.64	0.89
11:00	0.72	0.96
12:00	0.91	1.12
13:00	1.05	1.20
14:00	1.02	1.20
15:00	0.80	1.11
16:00	0.68	1.03
17:00	0.54	0.91
18:00	0.41	0.78

We used 1.5V, 500mA solar module for our solar tracker. Table.1 shows comparison between solar module output voltage of with and without solar tracking system. Thus we observed that minimum 20% increment in the output voltage thus results in increment in output power.

VI. Conclusion and Future Scope

Since the proposed prototype is a miniature of the main system, there are some limitations that may be mitigated by future developments. Turn a small box inside the system and use 12V solar panels for analysis. As a miniature system, it works well. Better solar panels need to be integrated into the system for better results and cost analysis. Our research and statistical analysis show that a solar tracking system with uniaxial degrees of freedom can increase energy output by about 20%. The prototype can make additional mechanical improvements to two-axis tracking. This impresses the people of the party because everyone can follow the flashlight in the area. This method gives the best results for power generation. The Duel Axis Tracker eliminates the need for monthly adjustments by tracking the daily motion of the sun with one axis and the seasonal motion with another axis. Single-axis solar tracker improves solar performance by about 20% and dual axis (biaxial) tracker by about 30-40%.

VII. Acknowledgment

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