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Dual Axis Solar Tracking System Using Arduino

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ABSTRACT— Solar energy is a revolutionary technology which offer tremendous, prolonged benefits. Solar cells turn the solar power into electric power. Solar tracing device is the most effective technology for improving productivity and performance by using the solar cell to optimize solar energy. In the production of hardware, we use LDR's as photo sensing device and servomotors to guide the solar panel location. The algorithm part is employed by Arduino Nano with code written in "Clanguage".

Keywords— Solar tracking system, LDR, Servomotor, Arduino Nano, Microcontroller.

I. INTRODUCTION

The tool used here is a solar tracker which guide the solar panel to the sun using the light-dependent sensor attached to the system using a motor, during the day sun changes its position so this setup helps in aligning the panel towards the sun. The main goal of this tracker is to turn the solar panel to the sun's movement because for maximum output panel is perpendicular to the sun. This setup ensures the full exposure of the solar panel to the sunlight by moving it in a dual-axis movement. All monitoring system uses two schemes of working that is the single-axis and dual-axis systems. Single-axis moves inonlyonedirectioneitherEasttoWestorNorthtoSouth , but Dual-axis move in both directions and gives more output than the single-axis system.[1]

II. SOLAR TRACKERTYPES

A. Single AxisTracker

Horizontal or vertical, this will rotate in one direction. Despite the less complex design, it is least productive in collecting the sunlight. Trackers with single axes are not as productive as trackers with double shafts.

B. Dual AxisTracker

Itmovesintwodirections.Normally,thosesh aftsare regular to one another. The shaft fixed in relation to the base regarded as a primary axis. A secondary axis can be considered the axis which is referenced to the primary shaft. This will move in both X plane and Y plane simultaneously and point panel always towards the sun. Because of this dual movement this system is highly productive in terms of efficiency. This system tracks the sunfor extra poweroutputandease,both Left(west) to Right(east) and Up (North) and Down (South).[2]

III. DUAL AXIS SOLARTRACKER

A. Working and BlockDiagram

The Arduino [3] is in control for all the logical operation that the device needs to do as intended. The Arduino is equipped with a 7- or 9-Volt battery, analog output from LDR's is given to analog pins of Arduino (A0, A1, A2, A3) [4]. LDR analog output signals are analyzedbyanArduinoaccordingtothedirectionofthe sun. According to the resistance of LDR different current flows through the potential divider circuit and flows to the Arduino and according to the algorithm Arduino differentiates on which LDR additional light is incident. Then, this difference is converted into analog values and send to the motor input signals. The servomotors, which are attached to the panel, are responsible for the panel's dual-axis motion. This moves the panel pane to the direction calculated by Arduino and guarantees the light falls on solar panel is maximum andconvertlightenergyto electricalenergy.

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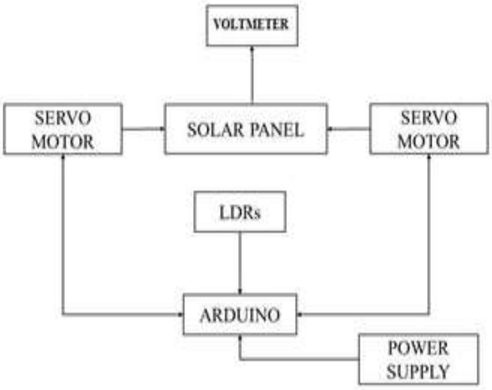

Fig.1 The whole design block diagram to incorporate an Active Dual Axis Solar Tracker.

B. Software Program writing of the Arduino Nano

Algorithm –

Step1: Start, give power supply to Arduino, Servomotor, Potential DividerCircuit.

Step2: Set all necessary data to default conditions.

Step3: Assign analog output from potential divider circuit to Arduino.

Step4: Comparison of input analog voltages by Arduino by using two conditions-

I. It compares the voltage of top LDR with the voltage of down LDR. And if there is difference between these two voltages more than a threshold voltage, then the digital signal in the form ofPWM was given to vertical movement servomotor which moves the solar plate upward or downward as per requirement.

II. Similarly, it compares the voltage of left LDR with the voltage of the right LDR. And if there is difference between these two voltages more than a threshold voltage, then the digital signal in the form of PWM was given to horizontal movement servomotor which moves the solar plate leftward or rightward as perrequirement.

Step5: Repeat step 4 after fixed time. Step6: End.

C. Hardware Implementation of Dual Axis SolarTracker

The Dual Axis Solar Tracker consists of the solar panel, four LDR sensors, two servomotors, and the Arduino Nano board.

1. Solar Panel- Solar panels are those devices that convert the solar energy into DC power without any intermediate step. The PV panel used in this setup have the ability of producing 0.3W of electrical power, and it generates a voltage of 8V.
2. Light Dependent Resistor- LDR [5] is a passive transducer. It works on the photoconductivity principle. Its resistance changes according to thelight falling on it. Resistance is inversely proportional to the light falling on it, i.e., more the light falls lesser theresistance.
3. Servomotor- Actually, servomotor consists of four main parts: a standard DC motor, a gear reduction mechanism, a position-sensor, and a control panel. Arduino sends the control signal to the servo motor which has the desired output position of the motor shaft and then power is applied to DC motor and the shaft is moved to the desired position. The position-sensor is used to decide the shaft's rotational orientation and moves the shaft to the ordered location. The servomotor has three connection points: power, ground, andcontrol.
4. Arduino Nano- We can power the Arduino Nano board either by Universal Serial Bus connection or 5V DC supply. Arduino has 14 digital IO pins with 6 analog input pins. It works on the ATMEGA328 processor and has 32 kilobytes of flash memoryand has a clock speed of 16MHZ.

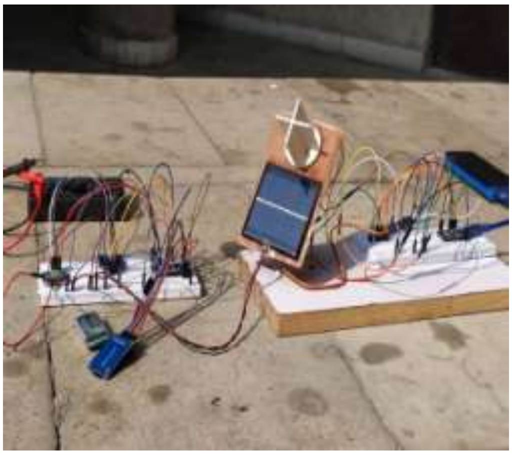

Fig.2 Final Experimental Setup

TABLEI. TESTING RESULTS

Time	Fixed Panel Voltage	Dual Axis Voltage
10hrs	4.0	5.7
11hrs	4.5	6.1
12hrs	5.2	6.4
13hrs	5.9	6.7
14hrs	6.3	6.8
15hrs	5.6	6.3

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16hrs	4.4	6.1
	Average = 5.1	Average = 6.3

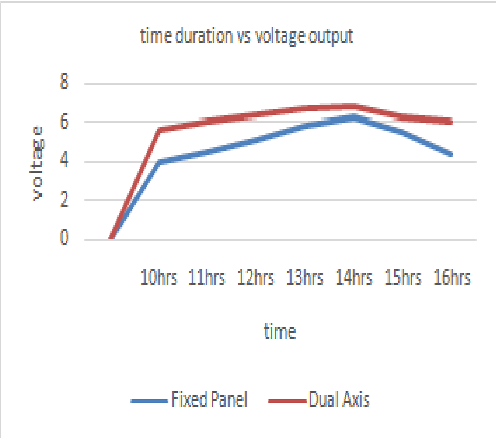

FIG.3 GRAPHICAL COMPARISON OF FIXED PANEL AND DUAL AXIS

IV. CONCLUSION

With the aid of microcontrollers [6] and LDR sensors, this project provided a means of monitoring the sun's location. Specifically, it demonstrates a working software solution to optimize the efficiencyof solar cells by placing a solar panel at the highest light intensity level. In addition, the tracker can initializethe starting position itself which eliminates the need for additional photo resistors. The developed solar tracker's [7] attractive feature is simple mechanism for control of thedevice.

Through our evaluation we found that the dual axis tracker can extract 23 per cent more power than the fixed panel.

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