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Arduino Based Solar Tracker

Asst. Prof. Rupalee S. Ambekar, Shubham Saket
Department of Electrical Engineering,
Bharati Vidyapeeth (Deemed to be University)
College of Engineering, Pune,
Maharashtra, India

Abstract- **A solar photovoltaic (SPV) cells based dual axis tracking system on Arduino Uno platform is implemented in this project for achieving maximum power during a day. The key idea of this article is implementing an automatic dual axis solar tracking system. Alignment of solar panel with the Sunlight for getting maximum solar radiation is experimented. This system tracks the maximum intensity of light in terms of maximum power point (MPP). When the light intensity decreases, its alignment changed automatically for catching maximum light intensity. This project shows implementation and analysis of dual axis solar tracker.**

Keywords- **Dual Axis Tracking System, MPP (Maximum power point), Arduino UNO.**

I. INTRODUCTION

The depletion of conventional energy resources has prompted numerous academics to investigate renewable energy alternatives.[1].Solar energy is one of the most promising energy resources. Solar technologies harness the sun's energy to generate heat, light, and electricity. Despite the fact that the resource is limitless, harvesting it is difficult due to the array cells' limited efficiency.

[2],[3].Solar cells were formerly connected with fixed raising angles. They do not follow the sun, hence their efficiency of electricity generation is low. In northern India, for example, the elevating angle of a solar cell for the greatest amount of illumination during the day is 40.5°.

Because fixed-type solar panels cannot obtain ideal sun energy, solar energy transformation efficiency is limited. To have an approximately consistent energy production throughout the day, the photovoltaic panels must change orientation during the day, following the movement of the sun in the sky, which is accomplished with an automatic solar tracker system

The paper [4].Third UKSim Euro-pean Symposium on Computer Modeling and Simulation, depicts in detail the structure and development of a model for a sun oriented following framework with two degrees of freedom, which recognises the daylight utilising photocells. The sun-based tracker's control circuit is based on an Arduino. This is adjusted to detect daylight through photocells and then impel the engine to position the sun-based board where it may acquire the most intense daylight.[5],[6]. The semiconductors of the P-N junctions make up the solar cell. It has the ability to transform light into electrical energy. As a result, we may infer that the electricity generated by sunlight shining on the solar cell can be used in the same way as regular power. There are two types of solar trackers: passive and active. Passive trackers make use of a low boiling point compressed gas fluid heated by solar energy and forced to one side or the other by differential gas pressure, causing the PV array to spin in response to its imbalance. Active trackers use electric actuators (motors and gear trains) to move the PV array in response to the sun orientation, which is controlled by a controller. Solar trackers can be single or dual.

The primary goal of the project work is to build a system for tracking the sun for a solar panel. This was accomplished by employing light sensors (LDRs) capable of detecting the amount of sunshine that reaches the solar panel. The LDRs' output values are compared. It also aims to find ways to improve the efficiency of solar panels. The tracking mechanism moves and adjusts the solar array in order to maximise power output. [7].

Other methods involve identifying the sources of losses and devising strategies to alleviate them. Maximum power point tracking (MPPT) is the practise of maximising the power output of a solar panel by keeping it operational at all times. Solar tracking is a system that is mechanised to track the position of the sun in order to boost power output by 30% to 60% over fixed systems.

II. OBJECTIVE

- The main objective here is to made a modern solar tracking system with the help of arduino (a type of microcontroller),the solar panels are fixed on the structure that moves according to the position of sunT
- The movement of the solar panel will according to the direction of sun, it helps the solar panel to get maximum solar energy and thus the efficiency of the device also increases.

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- It can reduce the number of solar panel need to be install for a specific output power requirement because its efficiency is 25-40 percent more than the fixed solar panel.

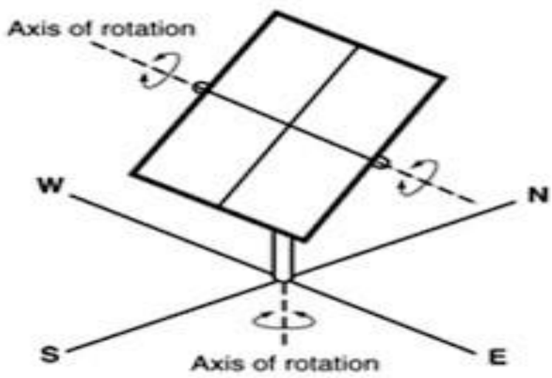

Fig 1.Dual Axis Solar Tracking System.

The solar tracker was designed with the following criteria in mind :-

- Low cost;
- Easy maintenance;
- It is modular.
- Meet technological requirements;
- Simple adjustment in the event of a change in Location.

III. BLOCK DIAGRAM

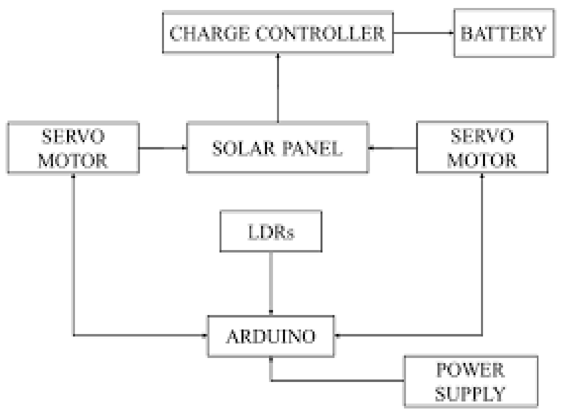

Fig 2. Block Diagram of Arduino Based Solar Tracker.

A solar panel, an Arduino microprocessor, and sensors make up the solar tracking system. Light must be emitted by the sun for this system to function. The LDRs act as sensors, detecting the amount of light entering the solar panels. The LDR then transmits data to the Arduino microcontroller. The servo motor circuit is then built. The servo has three pins, the positive side of which is connected to the +5v of the Arduino microcontroller.
The servo's negative is connected to ground. The servo's data point is linked to the microcontroller's analogue point. A potentiometer is attached to control the servo motor's speed. Figure 2 depicts the tracking system's block and flow chart diagrams.

IV. CIRCUIT DIAGRAM

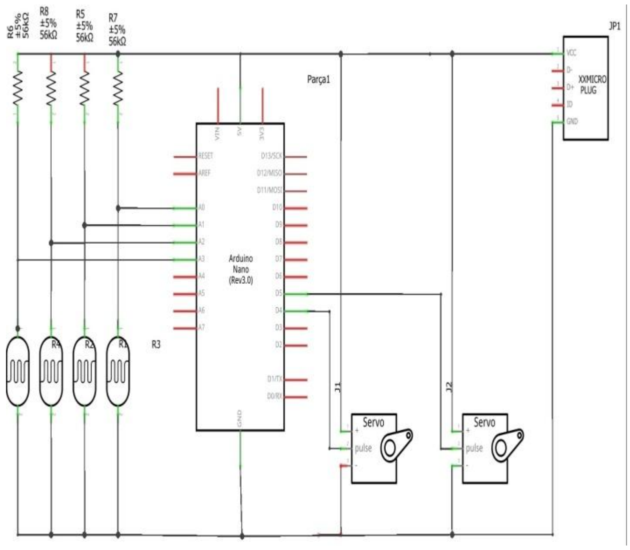

Fig 3. Circuit diagram of Arduino Based Solar Tracker.

The Arduino Solar Panel Tracker is powered by a 9V battery, and all of the other components are powered by the Arduino. The Arduino suggested input voltage range is 7 to 12 volts, although we may power it between 6 and 20 volts, which is the limit. Try to keep the input voltage within the specified range. Connect the positive battery wire to the Vin of the Arduino and the negative battery wire to the ground of the Arduino.

V. METHODOLOGY

1. Working Principle:
A solar panel, an Arduino microprocessor, and sensors make up the solar tracking system. Light must be emitted by the sun for this system to function. The LDRs act as sensors, detecting the intensity of light entering the solar panels and sending data to the Arduino microcontroller. The servo motor circuit is then built; it has three pins, the positive side of which is linked to the +5v of the arduino microcontroller. The servo's negative is linked to ground. The servo's third pin i.e, data point is linked to the microcontroller's analogue point. A potentiometer is attached to control the servo motor's speed.

2. Maximum Power Point Tracking (MPPT):
The idea behind maximum power point tracking is to gather the most power possible by adjusting the most effective voltage in the PV module. The comparison is made between the output voltages and the battery voltage. They take the high voltage electricity from the PV modules and alter them so that they can charge lower voltage batteries. The power is now converted to the best

voltage possible in order to get the greatest current in the battery.

3. Flow Chart and Algorithm:
To operate and monitor the solar tracker test bench, the embedded software will be implemented in the hardware (Arduino Uno). The embedded software is intended to meet the specifications.

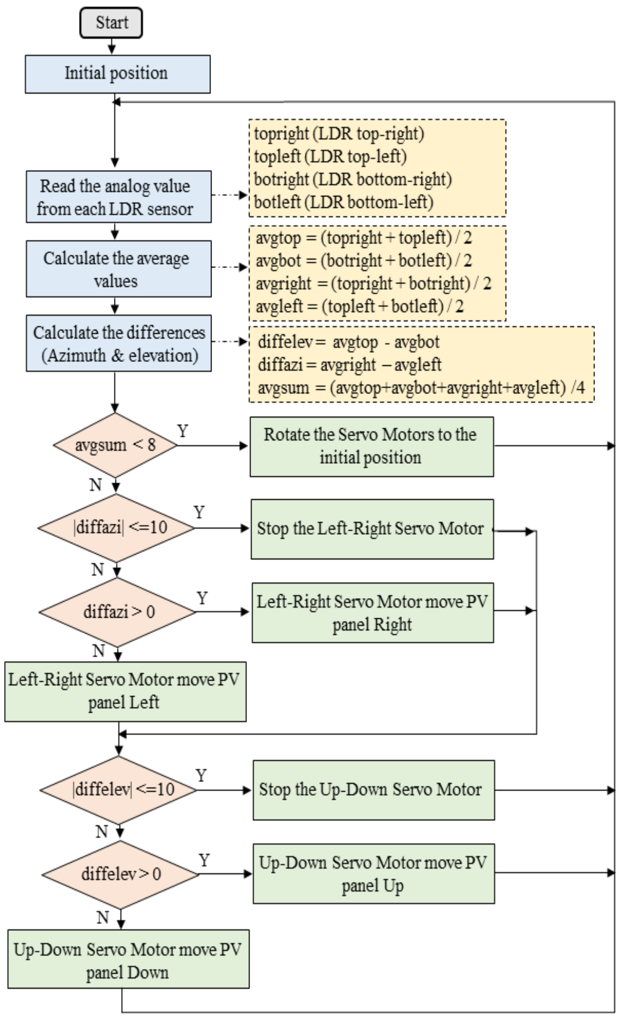

Fig 4. Flow Chart of the Algorithm used in Automatic mode of Solar Tracker.

The flow chart shows that the position of both motors is initially set, and then the voltage of the LDR is verified. Following this procedure, the sun's direction is calculated, based on which the sunlight falls on the LDR.

There are four LDRs utilised on the four sides of the solar panel where sunlight falls; two of them function for horizontal movement and the other two work for vertical movement of the panel. The voltages of the x and y axis sensors are compared, and as a consequence, the panel moves clockwise/anticlockwise or upward/downward.

The panel's movement is constantly in the direction of optimum solar light. As a result, high efficiency is provided by solar tracker.

4. Software Implementation:
Two software are used in this project :-

- Proteus
- Arduino Coder

The solar panel tracking system simulation was performed using a Proteus software. Simulation process revels the exact circuit diagram and connection of the system.

VI. COMPONENT DESCRIPTION

1. Arduino UNO R3 [A000066]:

- Memory size-8kb
- Series Rev
- Hardware interface-USB

2. Servo Motor (SG90):

- Operating speed: 0.12second/ 60degree (4.8V no load)
- Stall Torque (4.8V): 17.5oz /in (1kg/cm)
- Operating voltage: 3.0V~7.2V
- Temperature range: -30 to +60
- Dead band width: 7usec

3. LDR (Light Dependent Resistor):

- 5 Mohm
- Quantity 4

4. Resistors:

- 330 ohm
- Quantity 4

5. Solar plates (Polycrystalline DIY Solar Panels):

- The solar input consists of a solar panel and two photo

6. Battery 9 volts
7. Solar Charge Controller

VII. RESULT AND ANALYSIS

Through the implementation of this model, the Proteus programme uses level functional of tracker for electric scheme. The written code and software are both compiled in the Arduino compiler.Input sensors are represented by four LDRs with their findings, which are simulated for five different scenarios, while the H-bridge supplies the sensors' output voltage.

When LDR1 at position 1 (right and bottom) receives sunlight, it sends a signal to Arduino, which is then received by both DC servo motors, causing both (bottom and top) to revolve in a clockwise direction.

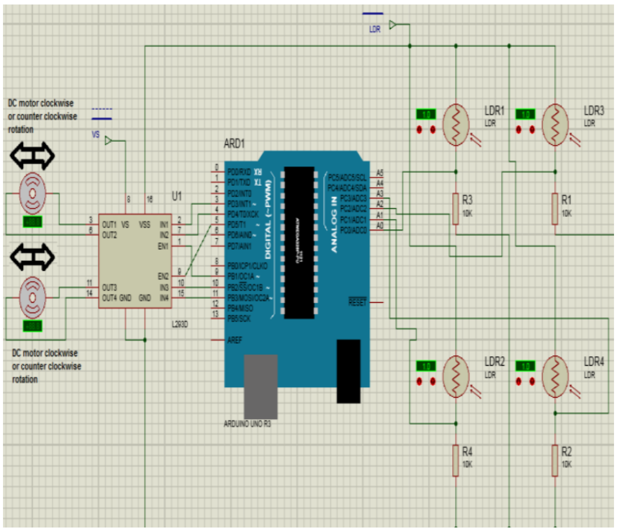

Fig 5. Circuit representation of all cases of solar tracking system simulated by using Proteus.

When LDR2 is exposed to sunlight, the identical procedure is carried out at position 2 (left to bottom). When LDR3 receives sun light and its voltage is larger than the other three LDRs voltages, the identical procedure will occur at position 3 (left and top). When LDR4 delivers a signal to Arduino and both DC servo motors receive it, the process is reversed, as opposed to positions 1 and 2, where both DC servo motors (top and bottom) rotate in the opposite direction. The Arduino is programmed in the C programming language.

The direction of rotation of DC motors is determined by LDR circumstances, and two DC servo motors are utilised in the tracking dual axis system, with one motor (MOTOR X) controlling elevation and the other controlling azimuth (MOTOR Y). Because of the low intensity where these data were collected on a sunny day, the sensor LDR voltage output is not steady.

Table 1. Output Voltages of The LDR Sensors.

Reading NO.	LDR1	LDR2	LDR3	LDR4
1	0.69	0.91	2.63	0.94
2	0.92	1.19	2.78	1.16
3	3.54	2.12	1.9	0.55
4	2.14	2.54	2.71	3.22
5	2.35	2.37	2.75	2.38
6	2.77	2.77	2.86	2.65
7	2.42	2.42	2.78	2.13
8	2.51	2.57	2.94	2.75
9	2.53	3.57	3.25	3.48
10	2.77	2.75	2.71	2.61
11	2.60	2.58	3.15	2.32
12	2.64	2.79	3.19	2.61
13	3.71	3.77	3.22	3.85
14	2.72	2.70	3.27	2.73
15	2.65	2.64	3.51	2.80

VIII. ADVANTAGES

Due to increased direct exposure to sun rays, Arduino based trackers generate more power than stationary equivalents. Depending on the geographic location of the tracking device, this increase might be as high as 25% to 40%. Dual axis Solar trackers produce more power in about the same amount of area than fixed-tilt systems, making them excellent for land use optimization.

It have the maximum density of PV panel deployment per square and are the best choice for locations where solar productivity is hampered. A complex ground structure, intricate terrain, stone protrusions, a drop to the north, and others might represent some of these locations..

The movable solar tracker technology may be utilised in a solar thermal electric plant, which uses solar energy for a variety of applications ranging from solar heating to electrical power generation. Solar thermal collectors, such as solar hot water panels, are frequently employed in household and light industrial applications to create solar hot water.

IX. CONCLUSION

Sun energy is an essential main source of energy that can be successfully utilized using solar cells. The effectiveness of solar cells is determined by the sun's position and intensity of light. As a result, solar tracking may be used to increase the efficiency of solar panels. We used the Arduino platform to create a unique system of a cheap automated microcontroller-based scaled down solar tracker. Even if it was a little torch light in a dark room or the sun's rays, the current tracking method successfully drew the light source.

This solar tracker is suited for rural use due to its low cost and high dependability. The goal of this project's renewable energy was to provide a fresh and sophisticated concept to assist the people.

REFERENCES

[1] 2018, 3rd IEEE International Conference on Recent trends in Electronics Information andcommunication technology (RTEICT) authors N.Raghu and S.Yashsawini
[2] "Implementationof a Prototype for a Traditional Solar Tracking System" by Nader Barsoum, published in the 2009 Third UKSim Euro-pean Symposium on Computer Modeling and Simulation.
[3] Ashok Kumar Saxena, V.Dutta. "A Versatile Microprocessor Based Controller For Solar Tracking". Proc. IEEE, 1990', pp.1105-1109.

[4] Suria A K and Idris R M, 2015 "Dual-axis solar tracker based on predictive control algorithms," in Proc. IEEE Conf. on Energy Conv. (CENCON).
[5] Ravi T and Chetan S. S (2010). 360° Sun Tracking with Automated Cleaning System for Solar PV Modules. IEEE, 2010.
[6] Poulek, V. (1994): Testing the New Solar Tracker with Shape Memory Alloy Actors. Proceedings of the Conference Record of the IEEE Photovoltaic Specialists Conference
[7] Falah I Mustafa, Sarmid Saikh 9th IREC Date Added to IEEE Xplore**:** 24 May 2018
[8] 2008 International Conference on Information Management, Innovation Management and Industrial Engineering Added to IEEE **Xplore:** 06 January 2009
[9] 2017 IEEE International Conference on Power, Control, Signals and Instrumentation Engineering (ICPCSI)
[10] Proceedings of the IEEE (Volume: 90, Issue: 6, June (2002)