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Design of Arduino Based Solar Tracker for Renewable Energy

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Abstract - *A solar tracker is a mechanized solar panel that actually moves with the sun to collect its full power. A tracking system's primary advantage is its ability to collect solar energy throughout most of the day and with the most accurate alignment as the Sun's position changes with the seasons. There are two different degrees that the Arduino Axis Tracker uses as its rotational axis The best technique to increase a PV system's ability to produce power is solar tracking. Solar energy is an endless supply of power that, if correctly handled, will allow mankind to replace the traditional energy sources he has long relied upon. This was taken into consideration when designing the project to increase the effectiveness of solar energy harvesting.An open hardware test bench for solar trackers is presented in this project. The suggested prototype is built on a dual-axis solar tracker that is controlled by an Arduino Uno, an open-source prototyping platform with user-friendly hardware and software. Using the use of Light Dependent Resistor (LDR) sensors, the solar tracker can be operated automatically, or manually witha potentiometer. The hardware used has been selected to be inexpensive, small, and adaptable.*

Key Words: **Arduino Uno, Solar Tracker, Servo Motor, Temperature, Solar panel, IOT, tracking, Arduino IDE.**

1. INTRODUCTION

This article was created for the Arduino Based Solar Tracker project. Here, we've created a model that can follow the sun's path. We used a servo motor, an Arduino Uno, and other components in this. Because fossil fuels are now used more frequently to generate electricity, especiallyin rural regions, the cost of living has significantly increased, due to the use of fossil fuels that are ex-pensive nowadays. In addition, the use of fossil fuels has contaminated the environment, endangering human health. It releases CO2, which helps to cause the greenhouse effect. Deforestation of the land and pollution of the air and water are the results ofthis Since solar energy only comes from the sun and doesn't produce any carbon dioxide, it prevents the greenhouse effect. The occupational risks associated with work in the renewable energy sector are fewer than those associated with coal mining and coal extraction. Solar energy is gradually becoming one of the most reliable sources of electricity due to its abundance and environmental friendliness. The location of the sun can be determined nonlinearly by a system that follows the sun. It is important to control the system's operation separately. When a solar PV panel is angled directly toward the sun, it generates the most electricity. Making an Arduino-based solar tracking system for solar panel energy optimization is the aim of this project.

2. LITERATURE SURVEY

In the previous study and the research, there are many articles published. The paper by Prachi Rani, Omveer Singh, and Shivam Pandey gave an analysis of the Arduino- based Single-axis Solar Tracker. In this article, they have implemented an automatic single-axis solar tracking system. The use of this system tracking of maximum intensity of light. Whenever the intensity of light decreases, the alignment of the system changes automatically to catch maximum light. As today there are many systems available, this paper shows how to implement and analyze single-axis solar trackers. After the implementation of this project, they mentioned some improvements that any investigator can apply extra capable sensors but due to this, it will increase the price and also take a low amount of energy [1].

The next approach made was by online mode i.e., simulator based. the authors implemented their idea on the proteus software environment. This model depends on the angle of the sun's rays of the active energy given here. The power system of the Proteus software is being modeled on the system. As this was done online mode, it took a lot of time and effort to test the two-axis solar system in real objects and also get the desired results. They have faced many errors in the interpreting system and then writing it into the software. But as this system was implemented virtually it was easy to correct the error [2].

Due to the enormous environmental and economic potential it offers, the renewable energy sector is quickly becoming a new area of growth for many nations. Solar as a primary source of energy, energy plays a significant role, particularly in rural areas. The design and construction creation of a highly effective dual-axis solar tracking system with the Arduino platform. In addition, the long-term goal of this research aims to identify the largest source of solar energy to power the solar cell. Five light-dependent resistors (LDR) were employed in the hardware development to

capture as much light as possible. The solar panel was moved using two servo motors when the light source location detected by LDR was at its highest level [3].

This is a dual axis monitoring system, and during this process, the system's measurement of the sun's course is made. The purpose of optimization is to maximize the quantity of energy generated by photovoltaic systems while taking the tracking system's usage into account. The determination of the tilt angle and azimuth angle trajectories is described as a nonlinear and bounded optimization problem. Since non-renewable energy sources will soon be severely depleted, we must find alternatives. To increase the efficiency of solar energy collecting, we employed sensors (LDR) to follow the sun's course and ensure that the panel should be put in MPPT- (maximum power point tracking) to observe higher efficiency panel should be placed in MPPT point [4].

3. CIRCUIT DIAGRAM OF THE PROPOSED MODEL

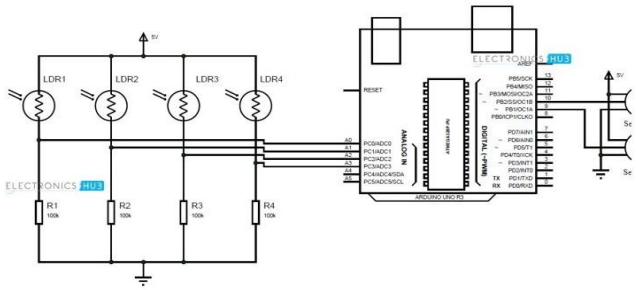

Fig. 1. Circuit diagram of Arduino Solar Tracker

3.1 Description of Circuit diagram

The main light sensors were used are LDRs. For holding the solar panel two servo motors are fixed to that structure. The Arduino UNO R3 is used as main controller for the system. The amount of sunlight hitting them is detected by LDRs. There are four LDRs: top, bottom, left, and right. In series with LDRs are four 100-ohm resistors.

3.2 Component requirement of the project

1) Servo Motor (sg90)
2) Panel
3) Arduino Uno R3
4) LDR's X 4 (Light Dependent Resistor)100K
5) Resistor's X4
6) 6.Battery (4.5v to 6v)

4. PROCEDURE FOLLOWED WHILE DESIGNING

- The main light sensors were used are LDRs. For holding the solar panel two servo motors are fixed to that structure.
- Uploading of program for Arduino is done to microcontroller.
- LDRs can detect how much light is shining on them. Splitting into the four directions up, down, left, and right arethe four LDRs that detect the light.
- For the purpose of East West tracking the comparison of two top LDRs and other two bottom LDRs of analogue values is done, and the vertical servo will move in that direction ifthe result comes that top set of LDRs receives more light,
- For the servo motor to travels down, the result shouldcome as the bottom LDRs are receiving more light.
- For the purpose of angular deflection of the solar panelthe comparison between the analogue values from two left LDRs and two right LDRs is done.
- If the left set of LDRs detects more light than theright set, then horizontal servo will move to the left direction.

5. WORKING

Photovoltaic cells are used in solar panels (PV cells). Following the measurement of the light intensity by the PV cells, the solar panel tracker modifies the direction of the solar panel to track the Sun's position in the sky. The tracker adjusts the solar panel every time so that more sunlight shines on it and less light is reflected. As a result, it takes in more energy that can be turned into power.

In this prototype, we used servo motors to automatically rotate the panel while also using the Arduino microcontroller to monitor the light (sun) intensity using an LDR sensor. The motor is controlled by an Arduino Uno board using the LDR sensor's output.

Here, we have created the tiny components that are essential to the movement. To create this fixture for your project, you can use any material, including cardboard, wood, and plastic. This was the last part we put together for the rotating solar panel framework. To move in both the horizontal and vertical directions, we used two servo motors. To measure the intensity of the sun (or light), we have installed four LDR (light-dependent resistors) on the upper side.

6. OUTPUT OF THE PROJECT

Fig. 2. Output Images

7. RESULT AND APPLICATIONS

The two rotation axes that makeup dual-axis trackers, the" main axis" and the" secondary axis," are each spaced two degrees apart. The rotational axis may move downward or upward throughout the day to compensate for the Sun's angular variations.

Dual-axis tracking enables the most precise orientation of the solar device and is thought to deliver a 40% increase in output through energy absorption. Although these solar trackers are more expensive and complex. Dual-axis trackers can travel in two directions, ensuring that they are always facing the Sun. Tip-tilt and as-imuth-altitude are the two different categories of altitude based dual-axis trackers.

Vertical and horizontal pivots are needed by the solar tracker that can work as a control system similar to solar telescopes. The person who sells solar energy systems can utilize them normally because they are quite pricey. n focused solar applications exact tracking of solar trackers is being utilized, an example can be given as mirrors that concentrate sunlight and convert it to heat.

8. PRO'S AND CON'S

8.1 Pro's of the designed system

- The proposed system's trackers continuously detect the Sun's direction and offer constant power production throughout the day.
- In situations when the grid connection's limited power capacity is an issue, these solar trackers offer a workable solution.
- These trackers require less area to be fitted and offer you the chance to utilize the extra space nearby for domestic household purposes activities like car parking, gardening, etc.

8.2 Con's of the designed System

- Due to the higher technical complexity of the solar tracker, this makes it a potential reason for the glitches.
- The system which we designed has a shorter lifespan and sometimes can be less reliable.
- Poor performance when it's cloudy or overcast outside.

CONCLUSION

The microcontroller and stepper motor used in the proposed solar tracker system allowed it to follow the sun's path. No matter the location or weather, this system can function well. According to our needs, we can modify the trackers thresh-old voltage. Once the sun has set, it can also reset the starting position. Additionally, the solar panel faces the ground at night, which shields it from dust and lengthens its lifespan. The solar tracker's designed prototype has some drawbacks because it is a miniature of the larger system. For the practical case, the number of LDRs should be increased. Additionally, we have taken into account the tracker rotating in one dimension. Therefore, in our ongoing research, we plan to expand this tracker's degrees of freedom.

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