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Arduino Based Solar Tracking System

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Abstract

Sun based energy is quickly developing as a fundamental sustainable power source, and sun following further develops energy creation by adjusting sunlight based chargers opposite to the sun's beams. A cost-effective solution is provided in this article, despite the high initial installation cost. We examine the plan and model of a solitary level of opportunity sun powered global positioning framework utilizing light-subordinate resistors (LDRs) to identify daylight. Stepper motors are driven by the control circuit based on the Arduino uno microcontroller to precisely position the panels. The incorporation of temperature, position, and soil dampness sensors, as well as time and date capabilities, further increments framework productivity. These increases streamline the presentation of the boards and work on the utilization of sun powered energy. According to our findings, this precise a solar tracking device might greatly increase the amount of solar energy produced.

Keywords: Sun Based Energy, Light-Subordinate Resistors (LDR), Arduino Uno Microcontroller, Automated Solar Tracking System, Boost Solar Energy Production

INTRODUCTION:

As the world shifts to renewable energy sources, solar energy has become a popular alternative due to its sustainability and environmental benefits. Sunlight is used by photovoltaic (PV) panels in solar power systems to create electricity, but the efficiency with which these systems absorb sunlight greatly affects the amount of energy they can generate. One of the most promising ways to enhance solar energy collection is through sun tracking solar panels. These systems maximize the quantity of sunlight that hits the panels and improve their overall efficiency by continuously tracking the sun's position in the sky throughout the day.

Solar panels are always facing the sun's rays at the ideal angle thanks to sun tracking systems, which modify the panels' orientation to follow the sun's movement. Compared to fixed-panel systems, this optimization leads to a notable increase in energy generation.

This paper analyzes ways to maximize solar energy harvesting by incorporating sun tracking technologies. We go over the many kinds of tracking systems, their functions, advantages, difficulties, and future developments in this field.

Types of tracking system

Sun tracking solar panels are generally classified into two varieties based on the number of axes they move along.

a. Trackers on a single axis (SAT)

- Description: A single-axis tracker follows the sun's horizontal trajectory across the sky, moving the solar panels along a single axis, often from east to west. These systems can boost energy output by up to 25–30% above fixed panels and are easier and less expensive than dual-axis systems.
- Mechanism: The panels rotate along a horizontal or vertical axis, tilting to track the sun's motion throughout the day.

b. DATs, or dual-axis trackers

- Description: Dual-axis trackers use panel angle adjustments to track the sun's position in both vertical (north-south) and horizontal (east-west) directions. This technology optimizes solar exposure all day long and in all seasons.
- Mechanism: Dual-axis trackers move the panels both horizontally and vertically, which allows for more precise tracking and an increase in energy efficiency—up to 40-45% more energy than fixed systems.

Advantages of Sun Tracking Systems

Increased Energy Efficiency

Reduced Land Use

Optimal Performance in Various Conditions

RELATED WORK

Daily variations in daylight accessibility are caused by the day-night cycle, while the world's orbit around the Sun also causes periodic variations. The entire population is developing quickly consistently and energy request is additionally expanding as needs be. Oil and coal, two of the world's main energy sources, are in danger of running out in the coming decades. [1].IoT advances were utilized in this review to follow sun based energy. Data can be collected and sent wirelessly without human intervention in the Internet of Things (IoT). In far off regions where sun powered energy is bountiful, this IoT-based innovation is appropriate [2].The importance of solar energy as a source of renewable energy is growing rapidly. Following the sun permits you to produce more sun oriented energy in light of the fact that the sun powered charger can keep a profile opposite to the sun's beams. Albeit the underlying expense of introducing a sun oriented global positioning framework is high, this article gives a less expensive arrangement. [3].

Single crystal silicon particles now not most effective have incredible lattice shape, high cloth purity, low grain boundary strength, low internal resistance and excessive efficiency, however additionally have uniform color and defects, which improves their appearance. The performance of the device can be accelerated by means of putting sun panels at specific angles relying at the course of the sun. [4]. this article describes the design and implementation of a biaxial sun tracker that permits an established photovoltaic panel to seize maximum solar power all through the day. This device tracks the azimuth and elevation angles of the sun because it passes thru the sky, preserving the photovoltaic panel at once dealing with the sun at all times [5]. To reap greatest electricity production throughout the day, this undertaking develops a biaxial solar photovoltaic (SPV) monitoring system the use of the Arduino Uno platform[6].

For the Windows platform, a solar tracking system with live Internet of Things (IoT) data is being studied. A method for creating a dual-axis tracking system is described in detail in this article. In addition, the design, implementation diagrams, and suitable software suite for the Arduino Mega 2560 microcontroller are presented in this study. [7].Sun oriented power is a type of environmentally friendly power created from sunlight based chargers. Nonetheless, since sun powered chargers are by and large fixed, they don't necessarily in all cases match the place of the sun, which changes over the course of the day. This can diminish energy creation. [8].

Sun oriented trackers can incredibly expand the proficiency of photovoltaic (PV) frameworks for energy creation, the most encouraging type of sustainable power. A double pivot sun oriented tracker is proposed here to show the proficiency of sun powered trackers [9]. Sun based energy is a clean, effectively open and normally plentiful elective energy. There are many benefits of involving this energy for power creation. [10].

EXISTING SYSTEM

In current establishments, sun powered chargers are typically mounted in fixed areas, meaning they can't move to follow the sun. These super durable apparatuses keep the boards set up, making them simple and financially savvy to introduce. However, there is a major drawback to this setup: the panels cannot be adjusted to face the sun directly because the sun moves across the sky during the day. This implies they don't necessarily get the best point to catch daylight, decreasing their productivity and how much power they produce. Solar tracking systems, which can move panels to follow the sun and capture more energy, are required because of this issue.

Disadvantages:

Discussion and issues with the modern device the primary limitation of modern machines is their inability to function without the use of hardware additives. Certain augmented reality-generating structures could also need extra technology, such as sensors, in order for them to function effectively. This may also increase the device's accessibility or usefulness for some customers.

- Lower Proficiency
- Less effort
- Dismal performance at specific times
- Unable to Adapt to the Seasons
- More slow Compensation
- Potential lost.

REQUIREMENT ANALYSIS

Evaluation of the Rationale and Feasibility of the Proposed System

Start by collecting diverse skin images, including cases of both benign and malignant skin cancer, from datasets like ISIC Archive or HAM10000 and annotating them by medical professionals to create a CNN-based system for skin cancer identification. Pre-process the information by normalizing,

normalizing, and increasing pictures with strategies like revolution and scaling, then split the dataset into preparing, approval, and test sets. Use transfer learning with pre-trained models after selecting a suitable CNN architecture like VGG, ResNet, or U-Net. During preparing, tune hyperparameters and use streamlining calculations like Adam to limit the misfortune capability. Utilize accuracy and AUC metrics to evaluate the model's performance on validation and test sets. Create a user-friendly interface for image uploads and predictions before putting the trained model into a clinical setting or application. Constantly work on the model by retraining with new information and integrating client criticism. Maintain equitable performance across demographics, monitor for biases, and ensure the privacy of data. For a reliable CNN-based skin cancer identification system, this methodology strikes a balance between technical, clinical, and ethical considerations.

PROPOSED SYSTEM

By incorporating sophisticated sun tracking mechanisms into photovoltaic (PV) solar panels, the proposed system would maximize solar energy harvesting. It would use either single-axis or dual-axis tracking technologies, powered by intelligent algorithms, to ensure that the panels are always oriented at the best angle to capture the most sunlight throughout the day. It would also include features like real-time monitoring, predictive analytics, and smart energy storage to improve performance and efficiency. The proposed system combines the physical design of tracking panels with intelligent software that controls and optimizes their movement while taking weather and seasonal variations into account.

The ultimate goal is to create a solar energy solution that not only maximizes energy production but also lowers installation and maintenance costs while increasing long-term sustainability.By continuously adjusting panel angles while employing Light Dependent Resistors (LDRs) to track sunlight, the proposed solar tracking system based on Arduino boosts PV solar panel efficiency. A NodeMCU microcontroller controls a stepper engine for exact arrangement with the sun's situation over the course of the day. It additionally incorporates sensors for temperature, area, and soil dampness to streamline board direction in light of current natural circumstances. The time and date functions ensure that the panels are properly aligned throughout the year, maximizing energy capture. By dynamically adjusting panel positions to more effectively capture sunlight, this system aims to increase overall energy output..

Advantages:

The proposed implementation of a digital trial room gadget will permit the consumer to explore billions of alternatives sitting at domestic rather than physically touring shops.

- More Power
- Increased Efficiency
- Increased ROI more quickly
- Continuity in Performance Friendly to the Environment
- Versatile to Conditions (temperature, area and soil dampness ...).

SELECTED METHODOLOGIES

The day-to-day position of solar panels is changed by a solar tracking system to follow the sun's path across the sky. This improves energy efficiency and maximizes sunlight capture. A mounting structure that supports the panels and the tracking mechanism, actuators and motors that adjust the tilt and orientation of the panels, and photovoltaic (PV) panels that convert sunlight into electricity are the system's primary components. The control system coordinates these movements based on sensor data and pre-defined algorithms, and sensors, including sun sensors, detect the position of the sun and assist in adjusting the panels accordingly. Single-axis trackers and dual-axis trackers are the two main categories of solar tracking systems. Single-pivot trackers turn boards around a solitary even or vertical hub, with level hub trackers following the sun's way from east to west and vertical hub trackers shifting boards from north to south to follow the sun's occasional way. Double hub trackers consider turn on both even and vertical tomahawks, empowering the boards to follow the sun's development all the more unequivocally by changing both the east-to-west direction and the slant point to represent the sun's level overhead. Solar power systems' efficiency and energy output are significantly enhanced by this comprehensive approach.

SYSTEM ARCHITECTURE

The description of the overall traits of the software is linked to the definition of the requirements and the established order of a high degree of the gadget. During architectural design, numerous web pages and their relationships are described and designed. Key software components are defined and decomposed into processing modules and conceptual records systems, and relationships between modules are described. The proposed system defines the following modules.

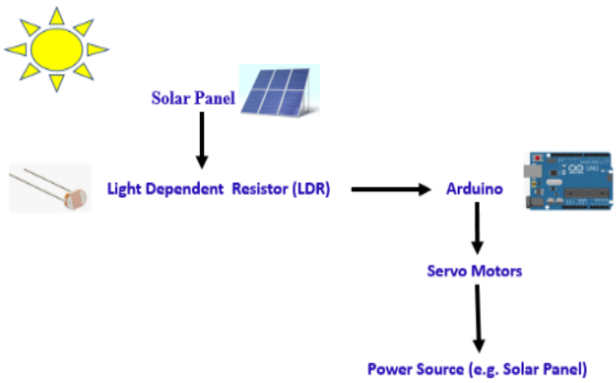


Fig 1: System Architecture.

MODULES

1. Gather Components
2. Assemble Hardware
3. Upload Arduino Code
4. Calibration and Testing
5. Optimization
6. Integration and Monitor
7. Continuous Maintenance

1. Gather Components

Acquire all the necessary components including Arduino Uno board, SG 885 servo motor, tact switch, LDRs (2 Nos), solar plate, and a 5-to-12-volt power supply.

2.Assemble Hardware

Connect the SG 885 servo motor to the solar plate. Ensure that the servo motor can rotate the plate in both clockwise and counterclockwise directions. Connect the tact switch to the Arduino Uno board. Decide on its placement for convenient access. Connect the LDRs to the analog input pins (A0 and A1) of the Arduino Uno board. Ensure proper orientation and placement on the solar plate to detect sunlight accurately. Connect the power supply to the Arduino Uno board and the servo motor. Make sure the voltage is within the operating range of all components.

3.Upload Arduino Code:

Write or download the Arduino code that controls the servo motor based on the readings from the LDRs. Include functionality to read the state of the tact switch for reset or calibration purposes. Upload the code to the Arduino Uno board using the Arduino IDE.

4.Calibration and Testing:

Place the solar tracking system in an outdoor location with ample sunlight. Power on the system and observe the movement of the servo motor in response to changes in sunlight intensity. Test the functionality of the tact switch for resetting or calibrating the system. Fine-tune the code and servo motor angles to ensure accurate tracking of the sun's position.

5.Optimization:

Experiment with different sampling intervals and servo motor speeds to optimize the tracking performance while minimizing power consumption. Consider implementing additional features such as sleep modes to conserve power when sunlight is not detected.

6.Integration and Mounting:

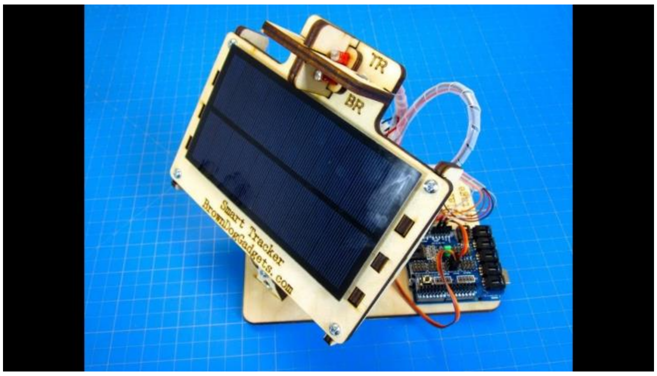
Once the system is calibrated and optimized, integrate all components into a sturdy enclosure. Mount the solar plate securely in a location where it can receive maximum sunlight throughout the day.

7.Regular maintenance and continuous monitoring

Regularly monitor the performance of the solar tracking system to ensure proper functionality. Periodically check for any wear and tear on components and perform maintenance as needed. Keep the solar panels clean to maximize energy harvesting efficiency.

RESULTS AND DISSCUSION

Solar panels can generate more energy and operate more efficiently if a solar tracker is optimized with an Arduino. The following are some findings and conversations from studies on optimizing solar trackers with Arduino



An increase in energy production

Solar panels that track the sun's position throughout the day generate more electricity than fixed-tilt solar panels. The panels receive the most amount of sunlight since they are always aligned with the sun.

Better oversight and control

In order to make solar energy a more sustainable and ecologically friendly resource, solar trackers can assist in controlling and monitoring its use.

Cost-effective

An affordable platform for managing solar panel movement is the Arduino microcontroller.

Versatile

The ideal tilt angle for the solar panel can be determined by programming algorithms into the Arduino micro-controller.

CONCLUSION

In conclusion, by always positioning PV solar panels with their faces toward the sun, the solar tracking system based on Arduino increases their efficiency. The system ensures that panels capture as much sunlight as possible by adjusting panel angles throughout the day and utilizing sensors for temperature, location, and soil moisture. This lifts energy creation as well as makes the framework more solid and practical in various atmospheric conditions. Overall, this technology has a lot of promise for improving the efficiency of solar energy and making the environment cleaner in the future.

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