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ENHANCING SOLAR ENERGY EFFICIENCY WITH SUNFLOWER SOLAR TRACKING SYSTEM

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ABSTRACT

The universe has many galaxies and planets, and Earth is the most habitable. Earth provides many resources that improve human quality of life. One such resource, considered a significant natural asset, is renewable energy. This project focuses on harnessing a specific type of renewable energy and converting it into usable power. Of all the renewable energy sources, solar energy is used, which is one of the abundant and efficient ones. The sun, which has been selected as the source of energy, is inexhaustible; it replenishes every day. Solar energy increases during the daytime, lighting up the planet. Being abundant in energy, this can be converted into electricity, which is the sought-after product of this project. The solar tracker detects the sun at dawn and tracks it throughout the day; it automatically adjusts to reset to the next cycle when the sun returns.

The captured solar energy is used to store the energy. The same energy could be useful either when collecting it or stored in it. This project serves businesses with two or more locations, allowing them to substitute the old power sources and cut electricity costs. If more entities adopt this technology of converting renewable sources into electricity, vast amounts of power can be saved, and cost can be reduced, and low maintenance costs can be retained while generating revenues.

Keywords: Solar energy, Sunflower technology, Dynamic solar panel, Revolutionary impact, Dual-axis solar tracking, Smart solar panels, Renewable energy, Solar power generation, Sustainable energy solution, Automated solar tracking, Sunflower-inspired robotics.

INTRODUCTION

In recent times, sustainable energy solutions from renewable sources have gained increasing popularity. Solar power, specifically, has proved to be one of the most abundant sources. In the recent past, solar technologies have gained acceptance in several fields, ranging from homes, industries, to educational institutions. The efficiency of solar systems and their maximum output have been impressive. Fixed solar panels are quite common at present, but these are less effective than the movable type. A solar tracker is a device that uses light-based or solar sensors to align a solar photovoltaic panel or lens to the sun. The main advantage of solar energy is that it is limitless and clean. For maximum collection of solar energy, the panel needs to be aligned perpendicularly to the sun's rays. The sunflower method is also referred to as solar tracking. It is considered ideal as the alignment of solar panels in a perpendicular position to solar irradiation by tracking the movement of the sun ensures higher efficiency. It is a photovoltaic system designed for enhancing the aesthetic value of solar technology while simultaneously improving the landscape and architecture by making aesthetic considerations. Smart flowers have the shape of sunflowers but include all elements required to create electricity and store it, which include solar panels, inverters, wiring, and batteries. Installation of smart flowers aims at other than generating electricity through solar means to raise public awareness and the uptake of renewable energy. Unlike typical rooftop solar panels, which are usually main energy sources for houses, photovoltaic systems like smart flowers are not normally applied in such a way. In contrast, solar flowers act as additional systems for rooftop solar installations or other green building methods that represent the environmental benefits of renewable energy.

PROBLEM STATEMENT

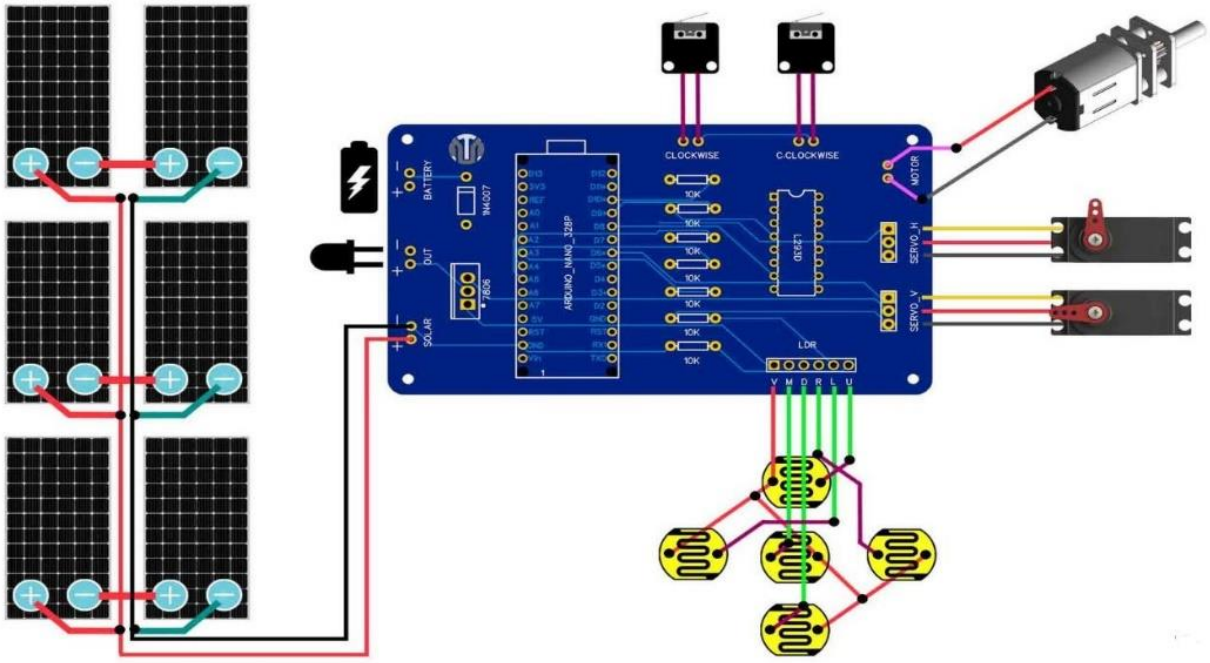
This research aims to address the challenge of maximizing solar energy capture in photovoltaic systems to boost their efficiency and effectiveness. The traditional stationary solar panel setup is limited by its inability to adjust to changing sunlight angles throughout the day, which results in suboptimal energy generation. This inefficiency is particularly evident in areas with fluctuating weather conditions or seasonal variations in sunlight intensity. This will enable the solution of the problem that involves active tracking of solar panel orientation relative to the path of the sun for an enhancement in energy yield and general performance of solar energy systems. Its primary goal is to develop a sun-tracking mechanism, like the Sunflower Solar Tracker System, that would surmount the aforementioned problems and increase its energy output, efficiency, and reliability. Through this problem formulation, the study will address the current pressing need to develop new means of maximizing solar energy harvesting while encouraging the deployment of renewable sources of energy.

METHODOLOGY

Smart Sun flower system has many key elements in its methodology: the system, which is built with an unique shape allowing it to trace the sun movement through the whole day to achieve peak energy production.This smart Sun flower system has a network of sensors and motors to track the sun's motion in such a way that it

will automatically adjust the positioning of the photovoltaic according to the actual position of the sun. It is also advanced in monitoring technology, allowing users to monitor their energy production in real-time and optimize their energy usage. It is also weather-resistant and easy to install, having modular components that can be easily assembled and relocated if necessary. Lastly, the smart Sun flower system comes in various sizes and configurations, making it suitable for a wide range of applications, from residential to commercial. Overall, the smart Sun flower system is very effective in methodology, flexible, and accessible, and hence a viable and attractive alternative to conventional solar panel systems.

CIRCUIT DIAGRAM



COMPONENTS USED

1. Solar Panel
2. Li-ion Battery
3. Arduino Nano
4. L293D
5. Buck Converter
6. 10K Resistor
7. Light Dependent Resistor
8. Servo Motor
9. Male and Female Header
10. N20 Gear Motor

1. Solar Panel

A solar panel converts sunlight into electrical energy using photovoltaic cells. It's the primary component for harnessing renewable solar power in the system.

2. Li-ion Battery

A lithium-ion (Li-ion) battery stores energy generated by the solar panel. It's rechargeable, compact, and provides consistent power to the system when sunlight is unavailable.

3. Arduino Nano

The Arduino Nano is a compact microcontroller used to process sensor inputs and control components. It's programmable and serves as the system's brain for automation.

4. L293D

L293D is a motor driver IC that allows low-power control signals to manage motors. It's essential for powering and controlling the movement of motors in the system.

5. Buck Converter

A buck converter reduces the voltage from the solar panel to a suitable level for powering the system components, ensuring stable and efficient energy use.

6. 10K Resistor

The 10K resistor is used to regulate current, stabilize voltage, or form part of voltage dividers in circuits, protecting components from damage.

7. Light Dependent Resistor (LDR)

An LDR senses light intensity and adjusts its resistance accordingly, helping the system track sunlight by detecting the brightest direction.

8. Servo Motor

The servo motor provides precise angular movements to adjust the solar panel's position, improving efficiency by keeping it aligned with the sun.

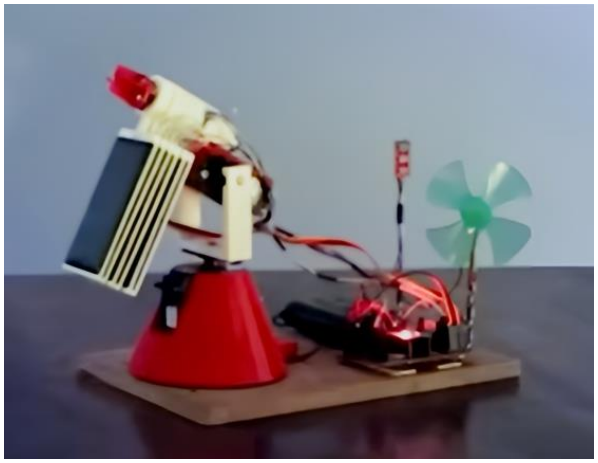
9. Male and Female Header

Male and female headers are connectors used to assemble and disassemble circuits easily. They provide a reliable way to link wires or components.

10. N20 Gear Motor

The N20 gear motor is a small, high-torque motor used for adjusting the solar panel's position. It ensures reliable mechanical motion in the tracking system.

RESULT



FUTURE SCOPE

1. **Enhanced Productivity**: Technological advancements in sensors and control algorithms can boost the accuracy of solar tracking systems, resulting in higher energy output and improved efficiency compared to existing setups.

2. **Smart Grid Compatibility**: The next generation of solar trackers can be synchronized with smart grid systems, facilitating more effective solar energy distribution and utilization, while also providing instantaneous data for superior energy administration.

3. **Decreased Expenses**: Continuous research and innovation efforts can reduce the production costs of solar tracker parts, making this technology more economical and widely available for various applications, ranging from home installations to large-scale industrial projects.

4. **Improved Longevity**: Advancements in material science and engineering can enhance the resilience and operational lifespan of solar tracking systems, minimizing maintenance needs and boosting reliability in challenging environmental settings.

CONCLUSION

The smart technology of the flower's solar panels is an incredibly efficient, scalable, and highly customizable sustainable solution for generating renewable energy. Having the capability of tracking the path of the sun, the efficiency of energy that Smart Flower generates is greater than those of the normal fixed-position solar panels. They become a more economic and environment-friendly option for a residential, commercial, public, or even remotely located space. User-friendly aesthetic software platform. The pleasing design further adds value to the solar panels of Smart Flower, but their use as an emergency power source adds immense value to the customers. With much still needing to be done in terms of affordability and accessibility, Smart Flower has established itself as a leader in the field of sustainable energy generation and has a very bright future ahead.

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