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Floating Dual Axis Sun Tracker Solar Panel

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Abstract- Floating sun tracker solar panel is a solar panel that is mounted on a floating platform and incorporates a sun tracking mechanism. The floating panel allow advantages such as reduced land requirements and minimized water evaporation. The sun tracker mechanism adjusts the orientation of the solar panel to follow the sun's path, maximizing energy generation. This technology offers increased energy production compared to fixed solar installations and can benefit from the cooling effect of water. However, challenges exist in system design, mechanical and electrical issues, and ensuring stability in water environments. Further research is needed to optimize these systems and assess their economic viability

Index Terms- Solar PV, Renewable energy, Floating type mechanism, Efficiency, Cooling effect.

I. INTRODUCTION

Solar Panel is the future of renewable power generation. The problem with solar panel is that they use up a lot of space on rooftops or open areas and are difficult to mount, and clean regularly.

We here by propose a new kind of solar panels that can be mounted on water bodies like lake pools so that they don't occupy any land space. The system aims to maximize the energy output of solar panels by dynamically adjusting their orientation to follow the path. Additionally, the solar panels are moved as per sun position can generate up to 30% to 35% more solar power. By floating the solar panels on water bodies, such as lakes, reservoirs, or oceans, the project aims to utilize the vast surface area available for solar energy harvesting while reducing land usage, i.e., innovative sun tracker and panel movement system to move the solar panels as per sun position and generate more power utilizing arduino UNO microcontroller and LDR to move the sunlight-based boards according to sun position and produce more force.

Fig.1: Floating Solar PV

This allows for increased efficiency of solar panel while at the same time in curring a very negligible power usage required to adjust solar panel movement. Also, it helps environment and save water by minimizing evaporation. Efficiently coasts on water for 24 hours.

Sun position following for the duration of the day automatically changes sunlight-based board position utilizing Arduino UNO microcontroller and also reduces dissipation in water bodies by covering them and keeping them cool. Water is thus used to hold the sun-based boards back from overheating. Easy to clean sun powered boards utilizing lake pool water.

II. WORKING PRINCIPLE

A floating Sun Tracker solar panel project typically employs a system that adjusts the orientation of solar panels to maximize sunlight exposure.

Using sensors and motors, the panels track the sun's position, optimizing energy capture throughout the day. This improves overall energy efficiency compared to fixed solar panel setups. The floating aspect allows for flexible installation on bodies of water, enhancing land use efficiency.

The obstruction of LDR relies upon the light, and it fluctuates as per it. The higher is the power of light, lower will be the LDR opposition and because of this result voltage bring down and when the light force is low higher will be the LDR obstructions and higher result voltage is gotten.

The divider circuit is utilized to get the result voltage from the sensor. The LDR faculties the contribution to voltages and gives a computerized number as result. Presently this will give input to the microcontroller utilizing the Arduino software. The motor position can be constrained by this system which is examined later in hardware model.

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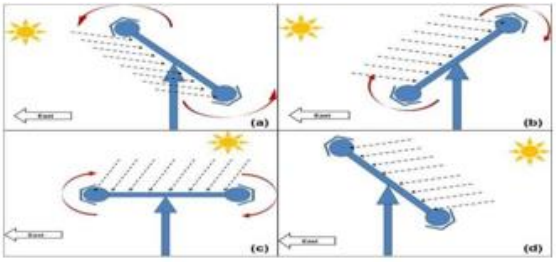

Fig.2: PV Tracking Position

1. Block Diagram of Hardware Model

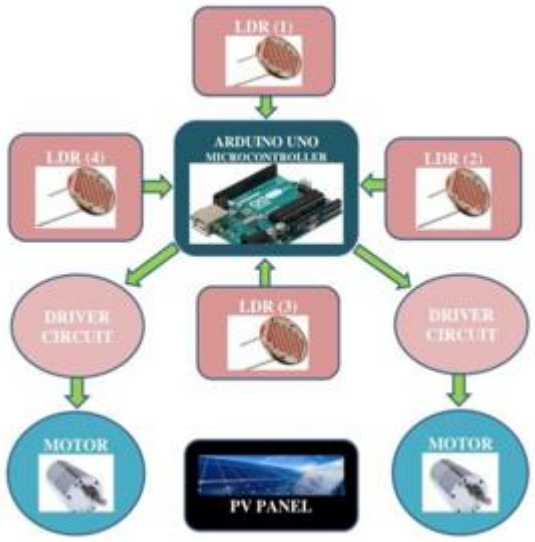

Fig.3: Block diagram of solar tracking system

The model "Floating Sun Tracker Solar Panel" consist of basic components i.e -

- Solar Panel
- Arduino UNO
- LDR Sensor
- Battery
- Motor
- Voltage & Current Meter
- Resistor
- Supporting frame & rods

2. Dual Axis Movement of Solar Panel in water

Implementing a dual-axis movement for a solar tracker in water involves several considerations due to the floating nature of the system. Here's a general overview of how you can achieve dual-axis movement in a floating solar tracker project:

Floating Mechanism Design

Design a floating platform that can support the weight of the solar panel & the tracking mechanism. Consider using buoyant material like foam or plastic to provide flotation.

Dual Axis Tracking Mechanism

Install two servo motor to control the azimuth and tilt angle of the solar panel on the floating platform.

Use the sturdy mounting system to connect the servo motor to the solar securely.

Sun Position Calculation

Implement algorithm to calculate the sun's position based on date, time & geographical location. Consider using formula like solar azimuth and altitude calculations or employing pre built libraries for sun position calculation.

Sensor Placement

Position light sensors, such as LDRs or photodiode on the floating platform to detect the sun position accurately. Ensure the sensor are shielded from direct sunlight or reflections that may affect the reading.

Software Programming

Utilize the Arduino UNO to control the servo motor and process the sensor data.Read the analog value from the light sensor to obtain the light intensity.

Convert the light intensity reading into the desired azimuth and tilt angle for the solar panel. Use the servo motor to move the solar panel to the calculated azimuth and tilt angle.

Feedback Control

Implement feedback control mechanism to continuously adjust the solar panel orientation based on the sensor reading.

Use PID (Proportional Integral Derivative) control or other control algorithm to fine tune the tracking and compensate for external factor like wind or water currents.

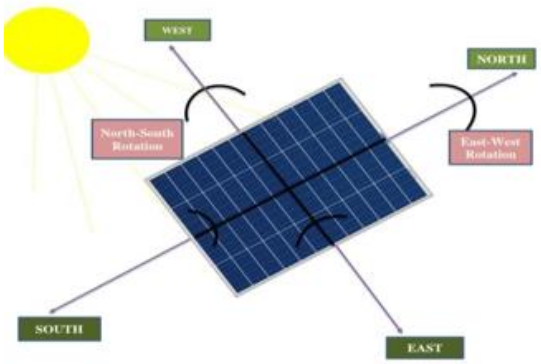

Fig.4 Dual Axis Movement

It's important to note that implementing the dual axis solar tracker in water can be more challenging than on land due to stability, buoyancy and environment factors. Careful to design, water proofing and protection against corrosion and crucial for long term.

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Consider consulting with expert in electrical engineering, mechanical engineering and control system to ensure the project successful.

III. OBSERVATION & RESULT

1. Observation

The observation of floating dual axis sun tracker will depend on various factors, including the design, location, and environmental conditions. Here are some possible observations and outcomes you may expect from a floating sun tracker solar panel:

Increased Energy Generation

A floating sun tracker solar panel is designed to track the sun's movement throughout the day, optimizing the angle of incidence and maximizing solar energy capture. As a result, you would observe an increase in energy generation compared to fixed solar panels.

Improved Efficiency

By continuously adjusting the position of the solar panel to face the sun, the floating sun tracker can achieve higher efficiency in converting solar energy into electricity. This increased efficiency would be reflected in
the improved power output

Enhanced Performance in Diffused Light Conditions

The ability of the sun tracker to follow the sun's path helps the solar panel capture a higher percentage of sunlight, even in diffused light conditions (e.g., cloudy or hazy days). This feature allows for improved performance and energy generation compared to fixed solar panels.

Adaptation to Changing Environmental Conditions

Floating sun trackers are designed to handle changing environmental conditions, including water currents, waves, and wind. The tracker's ability to adjust the position of the solar panel ensures optimal orientation and reduces the impact of external factors on energy generation.

Maintenance and Stability

Floating solar panels may require regular maintenance to ensure they remain in optimal condition. Observations related to maintenance could include periodic cleaning to remove debris or checking the stability and alignment of the sun tracker mechanism.

Longevity and Durability

Floating solar panels are typically designed to withstand water exposure, including UV radiation and moisture. The observation would involve monitoring the panel's longevity and its ability to withstand the environmental conditions of the water body

Reduction in Water Evaporation

If the floating solar panel covers a significant area of the water surface, you may observe a decrease in water evaporation rates. This effect can help conserve water resources in areas where water loss through evaporation is a concern

Environmental Impact

Observations related to the environmental impact may include monitoring the impact on aquatic life and water quality. It is important to assess the potential benefits and drawbacks of the floating solar panel project on the local ecosystem

2. Results

The results of this project were gotten from LDR's for the solar tracking system and the panel that has a dual axis mechanism. The result were recorded and tabulated. To collect the result, it possible to collect data from LDRs after every one hour. The outputs of LDRs were dependent on the light intensity.

Table 1: PV array outputs

Time(Hr)	PV array output(V)
10:00	15.73
11:00	16.41
12:00	16.79
01:00	17.01
02:00	16.65
03:00	16.45
04:00	16.02

Comparison land mounted PV array output & floated PV array output:

Table 2: Comparison land mounted & floating PV array output

Time(Hr)	Land V mounted P array output (V)	Floating PV array output (V)
10:00	15.66	15.73
11:00	15.75	16.41
12:00	15.93	16.79
01:00	16.15	17.01
02:00	16.18	16.65
03:00	15.93	16.45
04:00	15.65	16.02

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It's important to note that the specific observations and results will vary depending on the project's design, implementation, and the unique conditions of the installation site. Regular monitoring, data collection, and analysis will provide valuable insights into the performance and effectiveness of the floating sun tracker solar panel system.

IV. CONCLUSION

In conclusion, the floating sun tracker solar panel project offers several advantages and promising outcomes. By combining the benefits of floating solar panels and sun tracking technology, this project aims to maximize energy generation and efficiency. Here are the key points to consider:

Increased Energy Generation
The floating sun tracker solar panel system is designed to optimize solar energy capture by continuously tracking the sun's movement. This results in higher energy generation compared to fixed solar panels.

Improved Efficiency
The ability of the sun tracker to adjust the panel's orientation ensures that it is always facing the sun at the optimal angle of incidence. This maximizes the conversion of sunlight into electricity, enhancing overall system efficiency.

Utilization of Water Bodies
By deploying solar panels on water bodies such as reservoirs, lakes, or ponds, the project utilizes otherwise unused space. This optimizes land use and offers a sustainable solution in areas where land availability is limited or expensive.

Environmental Benefits
The project contributes to environmental sustainability by reducing greenhouse gas emissions and air pollution associated with conventional power generation. It also helps in conserving water resources by reducing evaporation from the water surface.

Economic Viability
While the initial investment in the floating sun tracker solar panel system may be higher compared to fixed solar installations, the long-term cost savings from increased energy generation and reduced maintenance can offset the upfront costs

Technological Advancements
The integration of sun tracking technology with floating solar panels demonstrates the continuous advancements in the field of solar energy.

Ongoing research and development can further improve the efficiency and cost effectiveness of such systems.

V. FUTURE SCOPE

Ensure maximum energy generation while considering factors like water depth, water quality, and environmental impact.

Remote Monitoring and Control
Implementing remote monitoring and control systems would allow for real-time monitoring of system performance, tracking efficiency, and maintenance requirements. This can facilitate proactive maintenance and troubleshooting, improving overall system performance and lifespan.

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