"Solar Floating System with Sun Tracking"

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Abstract - The urgent need for sustainable energy sources has led to the exploration of innovative solutions to harness solar power effectively. This study presents a comprehensive investigation into the implementation of a Solar Floating System with Sun Tracking technology to enhance the efficiency of solar photovoltaic (PV) systems. With the depletion of fossil fuel reserves and the escalating energy demand, the imperative for large-scale renewable energy installations has become increasingly apparent. Traditional land-installed solar panels face challenges related to land usage and maintenance, prompting the exploration of alternative solutions such as floating solar photovoltaic panels. By deploying solar panels on water bodies like lakes, reservoirs, and canals, the system not only maximizes energy production but also mitigates land scarcity issues.

The proposed system incorporates a sophisticated sun tracking mechanism that dynamically adjusts the position of the solar panels to optimize sunlight exposure throughout the day. This innovative approach utilizes hydraulic mechanisms to precisely orient the panels in accordance with the sun's trajectory, significantly enhancing energy generation efficiency. Additionally, the system integrates features such as cooling and concentration, which further contribute to its overall performance. By capitalizing on the cooling effect of water and minimizing algae growth, the floating solar panels maintain optimal operating conditions, resulting in increased power output and prolonged panel lifespan.

***Key Words*:** Solar photovoltaic systems, Panel, Energy, LDR Sensor, DC motors.

1. INTRODUCTION

The modern world's voracious appetite for energy, coupled with the dwindling reservoirs of fossil fuels and growing environmental consciousness, has prompted a profound shift towards renewable energy sources. Among these, solar power stands out as a beacon of hope, offering abundant and inexhaustible energy from the sun's rays. However, the realization of solar energy's full potential has been hindered by several challenges, chief among them being the inefficiency and land-intensive nature of traditional solar installations.

Conventional solar photovoltaic (PV) systems, while promising, suffer from inherent limitations. Their efficiency typically ranges from 15% to 22%, with variations influenced by factors like temperature and shading. Moreover, these systems require significant land resources for installation, posing challenges in land-scarce regions. Recognizing these limitations, innovators have been spurred to explore alternative approaches to maximize solar energy utilization.

2. PROPOSED WORKFLOW

The proposed workflow of the solar floating system with sun tracking entails a comprehensive integration of various components and processes designed to maximize energy generation efficiency while minimizing environmental impact. This workflow encompasses several key stages, from system design and installation to operation and maintenance, each of which plays a critical role in ensuring the system's optimal performance.

The first stage of the workflow involves meticulous system design and planning, taking into account factors such as site selection, solar panel layout, and sun tracking mechanism design. Site selection is a crucial consideration, as it determines the availability of suitable water bodies with adequate sunlight exposure and minimal shading. Additionally, factors such as water depth, water quality, and environmental regulations must be carefully evaluated to ensure compatibility with the proposed solar floating system.

3. LITERATURE REVIEW

Numerous studies have explored the feasibility and benefits of floating solar photovoltaic (PV) systems with sun tracking mechanisms, shedding light on their potential to address key challenges in the renewable energy landscape. These investigations have delved into various aspects of such systems, including their technical performance, environmental impact, economic viability, and scalability.

Paper-1: Design and development of dual axis sun tracking system for floating PV plant

Author: Sendhil Kumar Natarajan, Aman Kumar

Summary: This paper delves into the burgeoning interest in harnessing solar energy through photovoltaic (PV) plants, particularly focusing on the strategic placement of such installations on water bodies like dams, reservoirs, lakes, wastewater treatment plants, and canals. The shift towards utilizing floating PV panels presents numerous advantages over land-based counterparts, with potential enhancements in efficiency through effective cooling and tracking mechanisms. Moreover, situating these panels on water surfaces offers ancillary benefits to aquatic environments, such as mitigating water evaporation rates and curtailing unwanted plant proliferation, thereby enhancing overall water quality.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 05 | May - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Paper-2: Floating Solar Photovoltaic System with Sun Tracker

Author: Mr. Rishikant Sahani, Gaurav Yadav, Rahul kumar Gupta

Summary: This paper introduces a novel approach to solar power generation, known as floating PV plants, which involve placing photovoltaic modules on water surfaces to conserve land while enhancing module efficiency. Additionally, this method aids in water conservation by reducing evaporation from the water body. These plants can be deployed on lakes, reservoirs, ponds, or any other suitable water body. The focus of this study is on floating PV technology with panel rotation, examining various types of floating PV plants and discussing research conducted on some floating solar installations. In India, where there is a high demand for energy and limited available land for solar photovoltaic plants in urban areas, floating PV plant technology offers a promising solution for sustainable energy production.

Paper-3: Floating Solar System with Solar Tracking and Auto Cleaning Mechanism for Non Interrupted Power Supply.

Author: Mr. A V N S L Narayana, Mr. Ch S K B Pradeep Kumar

Summary: This paper introduces an automated solar panel system with Real Time Clock (RTC) control. RTC blocks detect time, guiding solar panels connected to DC servo motors to maximize sun exposure. A prototype with this system is developed for urban residential areas, tracking the sun for enhanced energy collection. Experimental results demonstrate a 20-23% energy increase while using 33% less space compared to fixed panels. An 8-bit ARDUINO microcontroller manages the system, programmed in Embedded C and uploaded via ARDUINO IDE. The system aims to charge a 12VDC battery by positioning the solar panel to maximize energy absorption.

Paper-4: Floating Solar Panel with Sun Position Tracker

Author: P. Seema Rani1, M. Vamshi Vardhan Reddy, B. Vasanth

Summary: The increasing demand for electricity, coupled with the rapid depletion of fossil fuels and growing environmental concerns worldwide, has prompted the widespread deployment of Solar PV plants. However, traditional land-based installations entail significant land usage, a precious resource in high demand. To address this challenge and conserve both land and water resources, deploying Solar PV systems on water bodies such as oceans, lakes, reservoirs, and canals presents an appealing alternative.

Paper-5: Dual axis solar tracking system

Author: Mugachintala Dilip Kumar, Tenugu Manish Kumar

Summary: In today's era, solar photovoltaic systems are widely embraced for their efficient and eco-friendly energy generation. Among the various solar products available, polycrystalline and monocrystalline silicon modules stand out as the most commonly utilized in the solar industry. Monocrystalline silicon cells, renowned for their flawless lattice structure, high material purity, low grain boundary energy, minimal internal resistance, and superior efficiency, also boast uniform coloration and a spot-free appearance, enhancing their aesthetic appeal.

4. BLOCK DIAGRAM

The block diagram of the proposed model is shown as below:

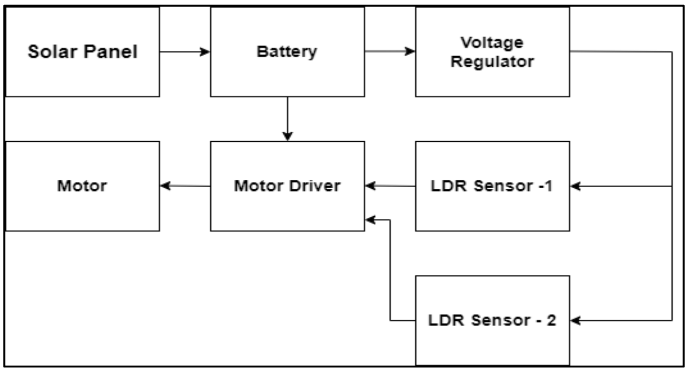

Figure 4.1 Block Diagram

Working of LDR Sensor

The Light Dependent Resistor (LDR) sensor plays a pivotal role in the functionality of the solar floating system with sun tracking, acting as the eyes of the system to detect changes in ambient light levels and provide feedback for precise orientation adjustments of the solar panels. Understanding the working principle of the LDR sensor is crucial to grasp its contribution to the overall operation of the system.

5. CIRCUIT DIAGRAM

The circuit diagram of the solar floating system with sun tracking is a comprehensive schematic representation of the electrical components and connections that enable the system's operation. At its core, the circuit diagram encompasses a network of interconnected components, each serving a specific function in the energy generation and control process.

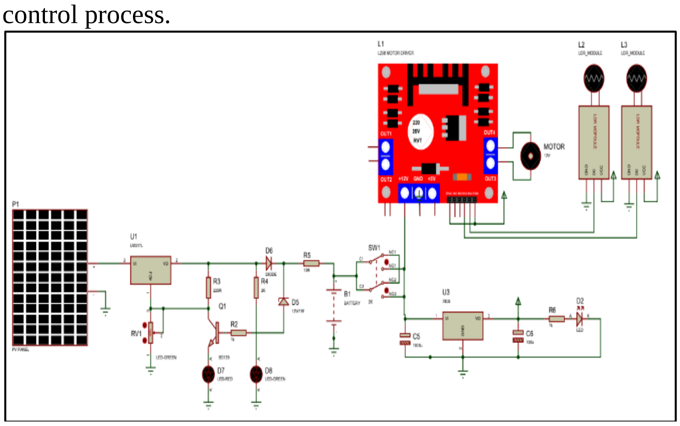

Figure 5.1 Circuit Diagram

6. TOOLS AND TECHNOLOGY USED

The solar floating system with sun tracking relies on a combination of sophisticated tools and technology to harness solar energy efficiently and optimize system performance. Here are some of the key tools and technologies utilized in the system:

6.1. Solar Panels:

- Photovoltaic (PV) panels are the primary technology employed to capture solar energy. These panels consist of semiconductor materials that convert sunlight into electricity through the photovoltaic effect.
- Specifications: Efficiency rating, wattage, dimensions, and material composition.

Figure 3.4 Solar Panel

6.2. Sun Tracking Mechanisms:

Hydraulic or motorized systems are utilized to adjust the orientation of solar panels dynamically. These mechanisms ensure that panels are positioned optimally to maximize sunlight exposure throughout the day.

- Specifications: Type (hydraulic or motorized), precision, speed, and compatibility with the solar panel array.

6.3. Light Dependent Resistor (LDR) Sensors:

LDR sensors detect changes in ambient light levels and provide feedback for the sun tracking system. They play a crucial role in ensuring that solar panels are aligned accurately with the sun's trajectory.

- Specifications: Sensitivity, response time, operating wavelength range, and resistance range.

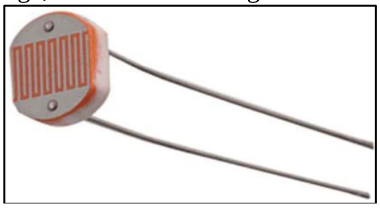

Figure 3.5 LDR Sensor

6.4 Motor Drivers:

Motor drivers translate control signals from the system's control unit into precise motor movements. These drivers regulate the speed and direction of motors responsible for adjusting solar panel orientation.

- Specifications: Maximum motor current output, operating voltage range, PWM frequency range, and protection features.

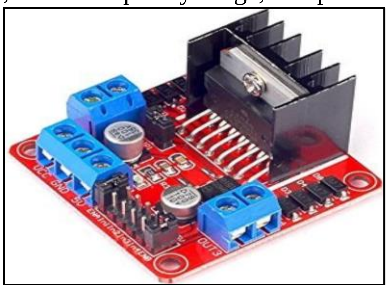

Figure 3.6 Motor Driver

6.5 Motors:

Motors are responsible for physically adjusting the orientation of solar panels based on commands from the motor driver. These motors convert electrical energy into mechanical motion to ensure precise panel alignment.

- Specifications: Type (DC, stepper, servo), rated voltage and current, maximum torque output, speed range, and dimensions.

Figure 3.7 Motor

6.6 Battery Storage Systems:

Battery storage systems store excess energy generated by the solar panels for use during periods of low sunlight or high demand. These systems ensure a reliable power supply and enable the system to operate off-grid.

- Specifications: Capacity, voltage, chemistry, cycle life, and efficiency.

7. IMPLEMENTATION:

Implementing the solar floating system with sun tracking involves a comprehensive and multi-stage process that integrates various components, technologies, and expertise to achieve optimal functionality and performance. The implementation journey starts with meticulous planning and design, where engineers and stakeholders assess site suitability, environmental considerations, and system requirements. This phase involves conducting feasibility studies, site surveys, and environmental impact assessments to identify suitable water bodies, evaluate solar exposure, and mitigate potential ecological risks. Additionally, detailed system design encompasses the layout of floating platforms, placement of solar panels, integration of sun tracking mechanisms, and selection of components such as motors, LDR sensors, and motor drivers.

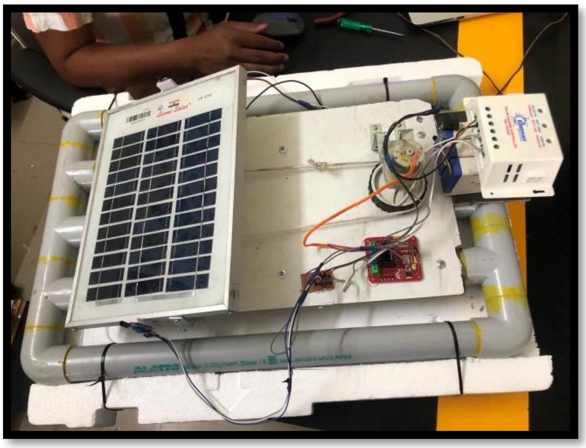

Figure 7.1 Solar Floating System

8. CONCLUSIONS

In conclusion, the solar floating system with sun tracking represents a groundbreaking solution to the pressing challenges of energy generation, environmental sustainability, and climate change mitigation. Through its innovative design, efficient operation, and multifaceted benefits, the system offers a compelling pathway towards a cleaner, greener future powered by renewable energy.

ACKNOWLEDGEMENT

Priyadarshini College of Engineering is a well Established & renowned institute and follows a goal of creating technocrats and brings it into reality, which will perform challenging endeavor in technical field for welfare of human being.

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