PROJECT ABSTRACT

Dual-Axis Solar Tracker using LDR Array

A dual-axis solar tracker with 4-LDR quadrant sensing, servo azimuth/elevation drive, deadband control and tracked-vs-fixed comparison logging. Delivered built-to-order with prototype, firmware, docs, report, PPT and viva kit.

01. Title

Dual-Axis Solar Tracker using LDR Array

02. Introduction / Background

A fixed solar panel only faces the sun directly for a short part of the day; the rest of the time the light arrives at an angle and the cosine law quietly eats the output. Utility plants solve this with trackers, but students usually meet tracking only as a textbook diagram — the sensing, the control loop and the mechanical drive are never in their hands. The gap is a bench-scale tracker demonstrating the full loop honestly: quadrant light sensing, a readable control algorithm, a two-axis drive the student assembled, and a side-by-side comparison against a fixed panel under the same sky.

03. Problem Statement

Published tracker-gain figures vary wildly with location and weather, yet student reports often quote them as fact. The project addresses this by making the comparison the experiment: a dual-axis tracker with LDR-quadrant sensing, deadband control and panel output logging, where the only gain number in the report is the one the student measured against their own fixed reference panel.

04. Objectives

- Sense sun direction with a 4-LDR quadrant array behind a cross shade divider.
- Drive a small PV panel in azimuth and elevation with two servos.
- Implement deadband control with night-park homing and manual jog mode.
- Log panel voltage/current against a fixed reference panel under identical conditions.
- Provide the tracked-vs-fixed comparison experiment with logging sheets.
- Deliver the complete student kit: prototype, firmware, docs, report, PPT and viva Q&A.

05. Proposed Methodology

The panel mounts on a servo pan-tilt head; the LDR quadrant sits beside it under a cross divider. The Arduino compares left/right and up/down pairs to compute azimuth and elevation error, stepping the servos when the error exceeds the deadband. Dark detection parks the panel east at night. A voltage/current sensing stage logs the tracked panel alongside a fixed reference panel; the student runs the comparison experiment on clear days and analyzes the measured difference.

06. System Architecture / Working

The quadrant LDRs report differential light; the controller computes the error vector and drives the servos toward the brighter direction within the deadband. The loop repeats at the configured interval through the day. At dusk the panel parks east; at dawn tracking resumes. During the experiment the student logs both panels' output, producing the tracked-vs-fixed dataset that is the report's core result.

07. Hardware / Software Requirements

- Arduino-class microcontroller
- 4-LDR quadrant sensor array with cross divider
- 2 servo motors (pan-tilt mount)
- Small PV panel (design 5–10 W class) + fixed reference
- Voltage/current sensing stage
- Push-buttons + 16x2 LCD
- Outdoor-rated mounting pole/base
- Arduino IDE (C/C++ firmware)

08. Expected Outcomes

- A working dual-axis tracker following the sun through the day.
- A student-measured tracked-vs-fixed output comparison.
- Tuned deadband and homing behavior documented in the report.
- A complete report, PPT and viva Q&A on PV theory, tracking geometry and control.

09. Applications

- Renewable-energy teaching laboratories and solar practicals.
- Demonstrating sensor-based closed-loop control.
- Student experiments on tracking strategies.

10. Future Scope

- Astronomical (clock-based) tracking as a sensorless comparison.
- Wind-speed input driving automatic stow.
- Larger panel with linear-actuator elevation drive.
- Cloud logging of the comparison dataset.