PROJECT ABSTRACT

Solar Water Heater with IoT Temperature Monitoring

A flat-plate solar water heater with IoT monitoring: glazed collector with copper coil, thermosiphon loop to an insulated tank, four DS18B20 probes and an ESP32 dashboard showing live loop temperatures and daily energy. Delivered built-to-order with hardware, firmware, dashboard, report, PPT and viva kit.

01. Title

Solar Water Heater with IoT Temperature Monitoring

02. Introduction / Background

Solar water heating is the oldest practical solar technology — a black plate in a glass box, water, and the sun — yet most students know it only as a rooftop rectangle. The engineering is in the loop: cold water sinks, hot water rises, and thermosiphon circulation runs with no pump while the tank sits above the collector. And the measurable question: how much useful heat did today deliver? This project builds the complete small system — flat-plate collector with copper coil, insulated tank, four DS18B20 probes, light sensor, ESP32 dashboard — and answers it from data.

03. Problem Statement

Solar thermal is taught as collector theory while the loop dynamics, instrumentation and energy accounting stay on paper. Students rarely fabricate a collector, instrument the loop, or run the clear-day experiment that turns sunshine into a measured number. This project provides the full build plus the experiment procedure.

04. Objectives

- Fabricate a flat-plate collector: glazed insulated box, black absorber, copper coil.
- Plumb a thermosiphon loop to an insulated tank mounted above the collector.
- Instrument four loop points with DS18B20 probes plus a light sensor for irradiance.
- Stream readings over Wi-Fi from an ESP32 to a live dashboard.
- Render the live loop diagram, day temperature curves and computed daily energy.
- Implement a differential controller with pump backup for stalled circulation.
- Deliver a clear-day heating experiment procedure with data sheets.
- Deliver the complete student kit: hardware, firmware, dashboard, report, PPT and viva Q&A.

05. Proposed Methodology

The collector is fabricated and the loop plumbed with the tank on its stand; probes are clipped at the four points and wired to the ESP32; firmware covers sensing, MQTT and the differential controller; the dashboard renders the loop, curves and energy total. The student runs the clear-day experiment from morning start to afternoon and reports the heating curve and total energy.

06. System Architecture / Working

Sunlight heats the absorber and the copper coil water; hot water rises to the tank top while cooler water sinks to the collector inlet — thermosiphon, no pump. Probes publish temperatures every few seconds; the dashboard draws the live loop, appends to the day's curves, and integrates temperature difference into delivered energy. If delta-T stays too low, the differential controller starts the backup pump until circulation recovers.

07. Hardware / Software Requirements

- Flat-plate collector (design approx. 0.5 sq m), glazed, insulated
- Insulated water tank on stand
- 4x DS18B20 temperature probes
- BH1750-class light sensor
- ESP32 development board (Wi-Fi)
- Small DC pump (differential-controller backup)
- Copper/plastic plumbing with insulation
- MQTT broker + web dashboard (HTML/JS)
- Arduino IDE (C/C++ firmware)

08. Expected Outcomes

- A working solar water heater with live IoT temperature monitoring.
- A clear-day heating curve and delivered-energy total from student data.
- A tuned differential controller with working pump backup.
- A complete report, PPT and viva Q&A on solar-thermal engineering.

09. Applications

- Renewable-energy teaching laboratories.
- Demonstrating thermosiphon and solar-thermal measurement.
- A platform for student experiments on collector performance.

10. Future Scope

- Flow-meter addition for true calorimetric energy measurement.

- Selective-coating absorber comparison study.
- Overnight heat-loss characterization.
- Larger collector array as a scaled-up build.