

PROJECT ABSTRACT

Hostel Water Usage Monitoring and Leak Detection System

An ESP32 sensor network that instruments a hostel's water system: flow sensors on each floor main and ultrasonic level sensors on the overhead tanks feed a dashboard showing consumption, hourly patterns, per-floor usage, tank levels and anomaly alerts — including a suspected-leak flag on continuous night flow — built-to-order with hardware, firmware, dashboard, report, PPT and viva kit.

01. Title

Hostel Water Usage Monitoring and Leak Detection System

02. Introduction / Background

Hostel water waste is invisible: a leaking flush tank dribbles for months, an overhead tank overflows every refill cycle, and nobody knows which floor uses what. Wardens manage by the monthly tanker bill — a single number that explains nothing. This project instruments the water system at the right granularity: YF-S201 flow sensors on each floor's main and HC-SR04 ultrasonic level sensors on the overhead tanks, reporting to an ESP32 network. The dashboard shows today's consumption (31,240 L for the 240-resident demo block, ≈ 130 L/resident/day against a ≤ 135 target), hourly patterns, per-floor usage bars, live tank levels and anomaly alerts — including a suspected-leak flag when a floor shows continuous night-time flow with zero occupancy pattern, and an overflow event that auto-closes the inlet valve. It turns invisible waste into numbers the warden can act on.

03. Problem Statement

Without per-floor metering, conservation is exhortation: wardens cannot find leaks, cannot compare floors, and cannot tell whether a retrofit (like tap aerators) actually worked. Manual meter reading is too coarse in time and space. The project provides continuous, per-floor, per-hour data with an anomaly detector that catches the classic signatures — night flow (leak), tank overflow, sudden usage jumps.

04. Objectives

- Meter water flow per floor with YF-S201 sensors and tank levels with ultrasonic sensors on an ESP32 network.
- Display today's consumption, current flow rate, tank levels and a 7-day anomaly count on a live dashboard.
- Render hourly consumption charts and per-floor usage bars.
- Detect anomalies: suspected leak on continuous 01:00–05:00 flow, overflow events with inlet-valve auto-close.
- Maintain an alerts and events log (leak flags, overflow, retrofit savings, node health).
- Provide a buyer-run jug-calibration procedure for flow accuracy ($\pm 10\%$ design target after calibration).

05. Proposed Methodology

Each floor main carries a YF-S201 turbine flow sensor (1–30 L/min range); each overhead tank carries an HC-SR04 ultrasonic level sensor (2–400 cm). Nodes report every 60 seconds. The dashboard aggregates: today's total, per-resident daily figure against the 135 L benchmark, hourly bars revealing the morning/evening peaks, and per-floor bars where an outlier (Floor 3 at 7,480 L in the demo) is highlighted. The anomaly engine watches the night baseline window: continuous flow above a trickle threshold with no occupancy pattern raises a suspected-leak alert and notifies the warden. The overflow sensor closes the tank inlet valve automatically and adjusts the refill timer. Flow accuracy of approximately $\pm 10\%$ after the buyer's jug-calibration is a design target, not a measured claim.

06. System Architecture / Working

Sensor nodes (6 floor flow nodes + 3 tank level nodes, ESP32, battery-backed) → 60-second reports → dashboard (KPI cards, hourly consumption chart, tank-level gauges, per-floor usage bars, alerts & events log). The working flow is: install sensors on floor mains and tanks → calibrate flow with the jug procedure → watch daily patterns emerge → investigate anomaly alerts → measure retrofit impact (the demo shows Floor 6 down 18% after an aerator retrofit) → report the findings.

07. Hardware / Software Requirements

- 6 × YF-S201 flow sensors; 3 × HC-SR04 ultrasonic level sensors
- ESP32 node boards with battery backup; inlet-valve actuator for overflow auto-close
- Plumbing fittings for sensor insertion on floor mains
- Dashboard web app (included); Wi-Fi or local telemetry link
- Measuring jug + stopwatch for the calibration procedure

08. Expected Outcomes

A working water-monitoring dashboard for the demo hostel block: today's consumption and flow rate, hourly peaks at 07:00–09:00 and 17:00–20:00, per-floor bars flagging the Floor 3 outlier, three tank gauges, and an alert log with the suspected Floor 3 leak, the Tank 3 overflow auto-close event, and the aerator-retrofit saving — exactly the evidence a warden needs to act.

09. Applications

- Hostel and campus facility management
- Water-conservation audits and retrofit measurement
- Plumbing-maintenance prioritisation
- Environmental-engineering coursework on demand-side management

10. Future Scope

- Per-room metering for finer granularity
- Automatic leak shut-off valves per floor
- Tank refill scheduling optimisation from usage history

- Integration with campus building-management systems