PROJECT ABSTRACT

IoT Touchless Tap Controller with Hand Detection

A touchless tap controller: an IR hand-detection sensor and ESP32 drive a 12 V solenoid valve so water flows only while hands are present, with usage counted and reported to a Wi-Fi dashboard. Delivered built-to-order with the controller, valve assembly and viva kit.

01. Title

IoT Touchless Tap Controller with Hand Detection

02. Introduction / Background

Public and shared taps are touched by hundreds of hands a day, and every touch is a hygiene risk — one more reason touchless fixtures have moved from airports into schools, hostels and hospitals. Commercial sensor taps are expensive and need a plumber; this project builds the same idea as a student retrofit: an infrared hand-detection sensor, an ESP32 controller and a 12 V solenoid valve that opens the water only while hands are present. Because every activation is timed and counted, the controller also reports usage to a Wi-Fi dashboard, turning the build into a water-saving demonstration: water flows only on demand, never left running. It is an honest prototype — bench-demonstrated, with estimated (not metered) water volumes.

03. Problem Statement

Shared taps spread pathogens through touch, and manually operated taps waste water through inattention — left running during soaping, or opened wider than needed. Institutions want both hygiene and conservation but balk at the cost of commercial sensor taps and the plumbing work they imply. The project addresses this with a low-cost retrofit controller: IR hand detection, solenoid valve actuation with a safety timeout, and Wi-Fi usage telemetry that quantifies the saving — installable on a standard tap inlet without modifying the tap itself.

04. Objectives

- Build the controller: ESP32, IR proximity sensor, relay/MOSFET valve driver and 12 V solenoid valve in a splash-resistant housing.
- Implement hand detection with adjustable range/sensitivity and configurable flow timing.

- Implement a hard safety timeout that closes the valve even if the sensor stays triggered.
- Count and time every activation and report usage to a Wi-Fi dashboard with daily totals and a water-use estimate.
- Document retrofit installation on standard tap inlets with adapter guidance.
- Deliver the complete student kit: hardware, firmware, report, PPT and viva Q&A.

05. Proposed Methodology

The build follows four stages. (1) Sensing: the IR proximity module is mounted and its detection zone characterized at the intended mounting geometry. (2) Actuation: the normally-closed 12 V solenoid valve is plumbed via the retrofit adapter and driven through the relay/MOSFET stage, with flyback protection. (3) Firmware: the ESP32 implements detection debouncing, flow timing, the safety timeout, activation logging and Wi-Fi telemetry to the dashboard. (4) Testing: the documented procedure verifies detection range, valve response, timeout behaviour and dashboard reporting, with the water-use estimation method and its limits written up openly in the report.

06. System Architecture / Working

The IR proximity sensor continuously watches the hand zone under the tap outlet. When hands enter the zone, the sensor output goes active and the ESP32 wakes the valve driver; the relay/MOSFET stage energizes the 12 V solenoid valve, which opens and water flows. The ESP32 times the activation; when hands leave the zone, the valve closes immediately. If flow reaches the configured safety timeout, the valve closes regardless of sensor state until the zone clears — this guards against a stuck sensor or an object left in the basin. Each activation's duration is logged and sent over Wi-Fi to the dashboard, which shows counts, total open time and the estimated water volume.

07. Hardware / Software Requirements

- ESP32 development module
- IR proximity/obstacle sensor module
- 12 V DC normally-closed solenoid valve with retrofit plumbing adapters
- Relay/MOSFET driver stage with flyback protection
- 12 V DC adapter (mains) or battery pack
- Blynk or local web dashboard for usage telemetry
- Splash-resistant prototype housing
- Tap mock-up/demo rig for bench demonstration

08. Expected Outcomes

- Working touchless tap: water flows only while hands are detected, with immediate close on hand removal.

- Verified safety timeout and configurable flow timing.
- Dashboard showing activation counts, open time and estimated water use.
- Retrofit installation documented for standard tap inlets.
- Complete documentation: firmware, drawings, report, PPT and viva Q&A.

09. Applications

- Hygiene retrofit for school, hostel and office washbasins (prototype scope).
- Water-conservation demonstration with quantified usage telemetry.
- Teaching platform for sensor-actuator IoT: IR sensing, solenoid driving, ESP32 telemetry.
- Reference build for other touchless retrofits (soap, sanitizer).

10. Future Scope

- Flow-meter integration for metered (not estimated) volumes.
- Temperature mixing control with a second valve.
- Leak detection with an under-basin moisture sensor.
- Battery-optimized variant with solar trickle charging.

11. References

- IR proximity sensor module datasheet — detection principle and range.
- Solenoid valve manufacturer data — pressure rating and duty cycle.
- Espressif ESP32 datasheet — GPIO drive and Wi-Fi operation.
- Blynk/local dashboard documentation — telemetry visualization.