

PROJECT ABSTRACT

Automatic Water Tank Pump Controller with Level Monitoring and Dry-Run Protection

An ESP32 water-tank controller that runs a refill pump by level, cuts it on dry-run with a buzzer alarm, and shows live level plus pump state on an LCD. Delivered built-to-order with working prototype, firmware, wiring diagram, report, PPT and viva kit.

01. Title

Automatic Water Tank Pump Controller with Level Monitoring and Dry-Run Protection

02. Introduction / Background

Water tanks filled by hand overflow and waste water; pumps run against an empty source burn their motors out. Both failures are common in hostels, farms and apartment buildings where nobody watches the tank, and both are expensive — a replacement pump costs far more than the electronics that would have protected it. A level sensor plus a controller closes the loop: the pump runs only while the level is safe, and a dry condition cuts power before damage occurs. This project implements that protection on an ESP32 with a debounced level input, relay switching, hysteresis between cut and resume, and a live LCD that always shows the control state.

03. Problem Statement

Manual tank management depends on a person noticing the level in time; bare float switches chatter on ripples and give no status. The project addresses this with a designed control system: firmware-debounced level sensing, a relay-driven pump with dry-run priority cut, hysteresis between the low-cut and resume points, and an LCD plus buzzer that make the fault and recovery sequence visible and audible — the full protection loop demonstrable by simply moving the level sensor.

04. Objectives

- Read tank level with a debounced sensor input on the ESP32.
- Run the refill pump through an opto-isolated relay only within the safe level band.
- Cut the pump within the debounce window on a dry condition (dry-run protection).
- Raise a repeating-pattern buzzer alarm until the level recovers.
- Show live LEVEL and PUMP state on a 16x2 LCD.
- Deliver threshold tuning notes plus the complete student kit.

05. Proposed Methodology

The build proceeds in three stages. (1) Sensing: the level sensor is polled on a short cycle and passed through a firmware debounce filter that rejects ripple-induced toggling; the low-cut and resume thresholds are set as constants with hysteresis. (2) Protection logic: the dry condition carries priority — on confirmed low level the relay opens, the buzzer

starts, and the LCD switches to the LOW indication; recovery past the resume point clears the alarm and resumes automatic control. (3) Demonstration: the sensor is moved between wet and dry positions so the examiner watches fill, cut, alarm and resume in one continuous sequence.

06. System Architecture / Working

The level sensor feeds a digital input on the ESP32; the firmware polls it roughly every second and applies the debounce window before accepting any state change. In normal operation the controller holds the pump relay according to the level band, updating the LCD each cycle. A confirmed dry reading opens the relay immediately, starts the buzzer pattern and flags LOW on the display. When the sensor reports the resume point, the alarm clears and automatic control continues without any button press — the state machine is closed and self-recovering.

07. Hardware / Software Requirements

- ESP32 development board
- Tank level sensor with mounting bracket
- Opto-isolated relay module
- DC refill pump
- 16x2 character LCD
- Piezo buzzer
- Arduino IDE (C/C++ firmware)
- Tank-mount sensor bracket

08. Expected Outcomes

- A working prototype that runs the pump by level and cuts it on dry-run.
- Audible plus visible alarm with automatic recovery on refill.
- A documented threshold-tuning procedure for the buyer's tank.
- A complete report, PPT and viva Q&A; on debounce, hysteresis and protection logic.

09. Applications

- Pump protection for overhead and farm water tanks.
- Teaching debounced sensing and relay-driven actuation.
- Demonstrating protection state machines with hysteresis in embedded firmware.

10. Future Scope

- Continuous ultrasonic level gauging with percentage display.
- Multi-point level staging (low/mid/high) with staged pump control.
- GSM alert on dry-run for remote notification (optional extension).
- Flow-rate monitoring on the pump outlet as an added health channel.