

PROJECT ABSTRACT

Smart Water Vending Machine with RFID Payments and Usage Dashboard

A smart water vending machine with RFID prepaid payments, flow-metered dispensing and a live sales dashboard. Delivered built-to-order with vending rig, firmware, dashboard, report, PPT and viva kit.

01. Title

Smart Water Vending Machine with RFID Payments and Usage Dashboard — cashless, metered water dispensing with full sales telemetry.

02. Introduction / Background

Community RO plants and water ATMs run on cash and trust: operators dispense manually, record sales on paper, and nobody knows the real daily volume or when the tank runs dry. This project automates the last mile on a demonstration rig: an RFID prepaid-card reader authorizes dispensing, a YF-S201 flow sensor meters every litre through a solenoid valve, and an ESP32 debits the card balance, logs the sale and publishes it over Wi-Fi via MQTT. The dashboard shows the live sales log, litres and revenue totals, tank level from an ultrasonic sensor and filter-life tracking, while a 20x4 LCD guides the user at the machine.

03. Problem Statement

The project addresses unaccountable manual water vending by demonstrating the complete payment-metering-logging loop with genuine flow sensing. It keeps the demo honest: measured dispensing volumes are real, while the RO purification stage is represented as the supply tank — stated plainly in the report.

04. Objectives

- Authorize dispensing with RFID prepaid cards and debit per litre.
- Meter every litre with a YF-S201 flow sensor and close the solenoid at the purchased volume.
- Publish each sale immediately over Wi-Fi via MQTT.
- Render a live sales log, daily litres/revenue totals and hourly graphs on a dashboard.
- Monitor tank level ultrasonically, pausing sales gracefully on low level.
- Track filter life against rated throughput with replacement alerts.

05. Proposed Methodology

Card tap authenticates the prepaid card and checks balance; the user selects a volume on the LCD; the ESP32 opens the solenoid and counts flow pulses, converting to litres in real time and closing the valve at the purchased volume before debiting. Each sale publishes immediately as JSON over MQTT. The dashboard updates the transaction table, totals and hourly graphs. The tank sensor is polled continuously with low-level sales pause and refill alerts; throughput accumulates against the filter rating for life tracking.

06. System Architecture / Working

The ESP32 drives the MFRC522 reader, flow sensor input, solenoid driver, tank sensor and LCD on the vending rig, publishing to an MQTT broker. The dashboard backend persists sales and serves the transaction log, revenue views, tank and filter panels. A prepaid card issue/top-up utility supports the demonstration.

07. Hardware / Software Requirements

- Hardware: ESP32 development board, MFRC522 RFID reader with prepaid cards, YF-S201 flow sensor, 12 V solenoid valve with driver, ultrasonic tank sensor, 20x4 LCD with I2C backpack, water rig with supply tank.
- Software: Arduino IDE (C/C++ firmware), MQTT broker, web dashboard (HTML/CSS/JS), card issue/top-up utility.

08. Expected Outcomes

- A working vending rig with RFID payment and metered dispensing.
- A live dashboard with sales log, revenue totals, tank and filter tracking.
- Demonstrated per-litre debiting with user guidance LCD.
- A documented flow calibration procedure.
- Complete documentation: report, PPT, viva Q&A and setup guide.

09. Applications

Water ATM demonstrations, campus drinking-water stations, and the payment-metering pattern transfers to any pay-per-volume dispensing (fuel, chemicals).

10. Future Scope

UPI/payment-gateway integration, real RO stage integration with TDS monitoring, multi-tap machines, and remote price management.