PROJECT ABSTRACT

IoT Septic Tank Gas and Sludge-Level Monitor with Safety Dashboard

An ESP32 monitor for septic tanks tracking methane and sludge level, auto-running an exhaust fan past 10% LEL, with a live safety dashboard. Delivered built-to-order with demo tank rig, node, dashboard, report, PPT and viva kit.

01. Title

IoT Septic Tank Gas and Sludge-Level Monitor with Safety Dashboard

02. Introduction / Background

Septic tanks generate methane as waste decomposes, and it accumulates in the sealed headspace; manual inspection without testing the atmosphere has caused asphyxiation accidents. Separately, nobody knows a tank needs desludging until it overflows. Both are sensing problems: continuous gas and level measurement with automatic ventilation at a gas threshold. This project builds that on an ESP32 with an MQ-4 methane sensor, an ultrasonic level sensor and a relay-driven exhaust fan, demonstrated on a sealed model tank with a live safety dashboard.

03. Problem Statement

Tank maintenance today is manual, infrequent and hazardous: gas is never measured before opening, and desludge scheduling is guesswork. The project addresses this with a student-built monitor that tracks methane against a 5,000 ppm (10% LEL) action threshold with automatic fan ventilation, measures sludge level ultrasonically, estimates the next desludge date, and presents everything on a safety dashboard — with the sensor's limits stated honestly.

04. Objectives

- Track headspace methane continuously with an MQ-4 sensor, shown in ppm with a 6-hour trend.
- Auto-start the exhaust fan at 5,000 ppm (10% LEL, design target) and stop it at the reset band.
- Measure sludge level as a percentage of tank capacity with an ultrasonic sensor.
- Extrapolate the fill trend into a days-to-desludge estimate on the dashboard.
- Include headspace temperature (DS18B20), since sensor response varies with temperature.
- Provide a buyer-run calibration procedure: clean-air baseline and fan-trigger verification.
- Deliver demo tank rig, node, dashboard, report, PPT and viva Q&A.;

05. Proposed Methodology

The system has three parts. (1) Sensing: the MQ-4 in the sealed headspace is read against a calibrated baseline and converted to indicative ppm; the ultrasonic sensor

measures sludge depth. (2) Control: firmware compares methane against the 5,000 ppm action threshold and drives the fan relay, with a 3,500 ppm reset band. (3) Display: the node publishes gas, level, temperature and fan state to the dashboard every 10 seconds, logging every fan start/stop and threshold crossing.

06. System Architecture / Working

Methane ppm, sludge percentage, temperature and fan state update live on the dashboard, with the 6-hour gas trend chart marking the fan-trigger line. At 5,000 ppm the relay starts the exhaust fan and the banner switches to ventilation-active; below 3,500 ppm the fan stops. The desludge estimate divides remaining capacity by the measured fill rate, and the event log timestamps every gas and fan event.

07. Hardware / Software Requirements

- ESP32 development board (monitor node)
- MQ-4 methane gas sensor
- HC-SR04 ultrasonic level sensor
- DS18B20 temperature sensor
- Relay-driven 12 V exhaust fan
- Sealed demo tank rig with sensor/fan mounting
- HTML/CSS/JavaScript safety dashboard
- Arduino IDE (C/C++ firmware)

08. Expected Outcomes

- A working monitor with automatic fan ventilation at the gas threshold.
- A safety dashboard with gas trend, tank gauge, fan state and event log.
- A documented calibration and fan-trigger verification procedure.
- A complete report, PPT and viva Q&A; on gas hazards and sensor limits.

09. Applications

- Teaching gas sensing, LEL concepts and relay control.
- Sanitation-safety awareness demonstrations.
- Academic study of indicative vs certified gas detection.

10. Future Scope

- Hydrogen-sulphide (H2S) second gas channel.
- GSM alert to the maintenance team on high gas (optional extension).
- Multi-tank dashboard for apartment complexes.
- Automated desludge-service booking reminder.