

**Microcontroller-based Industrial Applications**

**Project**

**Title: Automated Sludge detection system for Water tanks.**

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1. **PROBLEM STATEMENT:**

* **In many agricultural regions, water resources are improperly used due to a lack of real-time data. People rely on manual water tank cleaning, which is inefficient and unhygienic when sludge levels are high. Regular monitoring is difficult, leading to cleaning delays. This project aims to develop an automated sludge detection system that can alert users in real time to ensure timely maintenance.**

1. **SCOPE OF SOLUTION:**

* **The primary objective of this project is to design and develop an automated sludge detection system for water storage tanks, aimed at improving water quality, monitoring, and maintenance efficiency.**
* **The system will use appropriate sensors, such as ultrasonic sensors, turbidity sensors, or sludge level sensors, coupled with a microcontroller (like Arduino or ESP 32) to detect the presence and accumulation of sludge within the tank.**
* **The collected data will be processed in real time to assess sludge levels and alert users when cleaning or maintenance is required.**
* **This solution is targeted at small to medium-scale water storage systems typically used in residential blocks, schools, or industrial units.**
* **It focuses on reducing manual inspection efforts, preventing overflow or contamination and enabling timely sludge removal to maintain water hygiene.**
* **A visual alert mechanism (like LEDs, buzzer, or display screen) and optional data logging or wireless notification system may be integrated to enhance usability.**
* **The scope of this project does not include chemical analysis of sludge, advanced filtration mechanisms, or integration with large-scale water treatment facilities.**
* **However, the modular nature of the design allows for future upgrades, such as IOT connectivity, or integration with automated tank cleaning systems.**
* **The current aim is to deliver a cost-effective, low-maintenance prototype that provides reliable sludge detection using basic electronics and programming.**
* **In future iterations, the sludge detection system can be enhanced with IOT capabilities to enable remote monitoring and real-time alerts via mobile or web interfaces.**
* **It can also be integrated with an automated sludge mechanism, eliminating the need for manual cleaning.**
* **Advanced features like data logging, cloud connectivity, and predictive maintenance using machine learning can further optimise hygiene and maintenance schedules.**
* **The system may be scaled for use in larger or underground tanks, upgraded with high-precision sensors to detect sludge composition, and adapted for solar-powered or battery-operated setups to support rural or off-grid environments.**

**These improvements would broaden the system's applicability across residential, commercial, and municipal water infrastructure.**

1. **REQUIRED COMPONENTS TO DEVELOP SOLUTIONS:**

* **Microcontroller board: Arduino Uno/Nano: to control the system logic and process sensor data to trigger alerts.**
* **Ultrasonic sensor: HC-SR04: it is non-contact and waterproof for such environments.**
* **Turbidity sensor: SEN0189: to measure clarity and an increase in sludge level.**
* **Buzzer/ LED indicator: to alert the user when sludge exceeds a certain level.**
* **Waterproof casing or probe mounts: to protect sensors inside the tank from corrosion or damage.**
* **Power supply: options are 9 V battery or USB, or DC adapter.**
* **Other supplies like breadboard, jumper wires and resistors: to prototype and check the connection between components.**
* **IDE: Arduino IDE**
* **Simulation software: Tinker CAD & Fritzing**