Sri Lanka Institute of Information Technology

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A Water Tank Monitoring System

Proposal Document

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Table of Content

1. Background

Clean water is one of the essential necessities in the world. Due to various factors, effective water management has become increasingly important. Manual water tank systems often lead to issues such as water wastage and unnecessary consumption of human effort and time. Therefore, there is a growing need for an automated solution to manage and monitor water levels in storage tanks.

Water tanks are widely used for water supply in both industrial and residential buildings. Without a reliable monitoring system, several issues may arise during water storage such as running out of water, overflowing, or not being able to determine water cleanliness. This system is expected to address these problems effectively. Based on customer needs and user applications, several water tank monitoring systems are currently being developed and improved in today's growing market.

- Sintex Water Level Monitoring System
- Aquabrim Smart Water Tank Management System
- Eureka Forbes Smart Water Sensor
- Kritsman Dhruva Water Sensor
- Bluebot Smart Water Monitor

An automated system is proposed for the water tank monitoring process, which enables accurate measurement of water levels. The sensor in the water level controller continuously monitors the level, while the circuit detects any changes either a rise or a fall. Depending on the situation, the controller uses this signal to activate or deactivate the pump motor. If the water level reaches the maximum limit, the pump will automatically stop. An automated water tank monitoring system can be developed using Arduino. This system is designed to offer a smart, reliable and fully automated solution.

2. Problem and Motivation

2.1. Problem statement

Water is a necessity and normally it's stored in tanks. Water tanks are typically used in homes, apartments, schools, hospitals and industrial settings. In the present, most people lead busy lifestyles because of that, manual water tank monitoring systems and pump operation systems are difficult to use. Sometimes it's maybe system failures.

2.1.1. Dry running water pump

When the water supply is empty, the water pump runs without pumping water unnecessarily because of that, the pump may be damaged.

- Overheating of the pump motor
- Permanent damage to components
- Increase maintenance cost and shorter motor lifespan

2.1.2. Power wastage

When the water tank fills up, the water overflows unnecessarily. It resulted in wasting a large quantity of water, wasting electricity and damaging building structures because of, so someone had to check the water level manually.

2.1.3. Low water alert absence

Sometimes, the user uses water without knowing that the water level is so low. Sometimes, water runs out completely but users don't notice until they use it.

2.1.4. Unpredictable supply

At present, sometimes a power cut may happen. Sometimes, without knowing that people don't fill their tanks because of that, the user doesn't have water as needed.

2.1.5. Water quality

Occasionally, water may be mixed with some chemical substances. That affected to user's health.

2.2. Motivation

To solve the above challenges, the user needs an automatic water tank monitoring system instead of a manual system.

2.2.1. Reducing unnecessary maintenance cost

Because of dry running, the pump may be damaged, and users need to repair it again, which is a waste of money. With an automated system, users can reduce that waste.

2.2.2. Save energy

When water overflows unnecessarily, that is a waste of electricity. And the user needs to pay a high electricity bill. By using a system, users can reduce their electricity bill. As well as water is the main component in the environment. In a useful system, users can reduce water waste.

2.2.3. Uninterruptible water supply

As an example, the user needs to take a bath after his daily work, but the water level isn't high enough. In these types of situations, users have to wait until the tank fills up, which is time-wasting. In an efficient system, the user can solve that problem from a low water alert and a power cut alert.

2.2.4. Reducing some health matters

Sometimes, water is mixed with some chemical substances. Because of that user may be affected by some diseases. By using an automated system, users can check the quality of water.

As mentioned above, users can reduce a lot of problems by using an automated water tank system.

3. Aim and Objectives

3.1. Aim

The aim of our project is to design a smart water tank monitoring system that makes the life of people easier, safer and more efficient. It will help people save time, prevent water, and electricity wastage, and also check water quality.

3.2. Objectives

3.2.1. Main Objective

To develop an automated system that is able monitor water level, control the motor automatically and monitor the quality of water in a way that saves users time, water and energy.

3.2.2. Specific Objectives

- Make water level monitoring automatic
  The system will monitor water levels automatically.

- Energy efficiency
  Turn off the motor automatically when the tank is filled with water. It can reduce electricity consumption by stopping unnecessary motor start up.
  Turn off the motor when the water level in the tank is low. That way we can protect the motor from overheating and energy from being wasted.

- Water Conservation
  When the water is low, we will notify users by signal. This will help them to manage water more responsibly.
  Prevents water wastage.

- Simple User Interface (UI)
  Blynk mobile app is used to control and monitor the system.
  Users can turn the motor ON/OFF and set a timer.

- Cost Saving
  Reduction in monthly electricity bill.
  Avoid people spending money on expensive repairs.

4. System Diagram

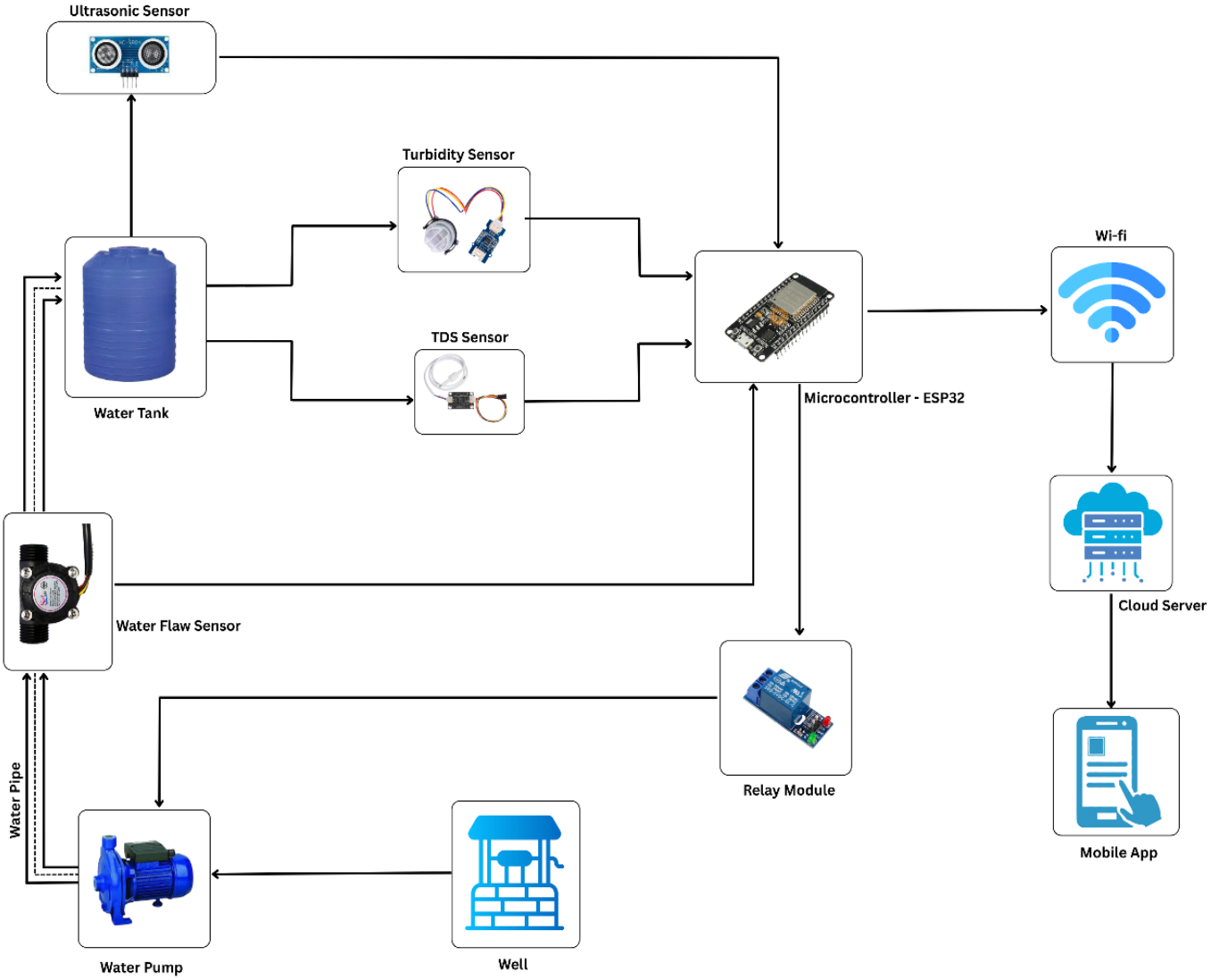

Figure 1. System Diagram

5. Methodology

This section outlines the methods, tools, and technologies used to design and implement a smart water tank monitoring system capable of monitoring both water level and water quality. The system will utilize sensor-based data collection, an ESP32 microcontroller for data processing and wireless communication for remote monitoring.

5.1. Methods

The following methods will be used to build the system:

5.1.1. Sensor Integration

- Ultrasonic sensor to detect water level. [1]
- TDS sensor to measure dissolved solids.
- Turbidity sensor to check water clarity.
- Water flow sensor to measure flow rate.

5.1.2. Data Processing:

- Use the ESP32 microcontroller [2] to read and process sensor data.
- Convert raw sensor signals into readable values.

5.1.3. Threshold Detection and Alerts:

- Compare and contrast sensor readings to predefined thresholds.
- Trigger alerts if water level is too low/high according to the defined level default or water quality is poor.

5.1.4. Wireless Data Transmission:

- Use built-in Wi-Fi of ESP32 to send processed data to the Blynk [3] IoT platform.

5.1.5. Remote Monitoring:

- Display data on a mobile interface using Blynk.

5.1.6. Testing and Calibration:

- Adjust the sensors to make sure they give correct readings.
- Test the built system under different water conditions to ensure reliable performance.

5.2. Tools and Hardware Components

- **ESP32 Microcontroller**: Handles sensor input, data processing, and wireless communication
- **Ultrasonic Sensor (HC-SR04):** Measures water level based on distance from the sensor to the water surface.
- **TDS Sensor:** Detects the total dissolved solids to evaluate water purity.
- **Turbidity Sensor (SEN0189):** Measures the cloudiness of water caused by particles.
- **Water Flow Sensor (YF-S201):** Calculates the flow rate of water in liters per minute.
- **Power Supply:** Use Power Supply and a battery

5.3. Software and Technologies

- Arduino IDE: For coding and uploading programs to Arduino.
- ESP32 Board & Libraries: For enabling device support and Wi-Fi communication.
- Blynk IoT Platform: For real-time data monitoring via mobile.
- Serial Monitor: For debugging and checking sensor values during development.

5.4. System Integration Process

1 Connect all sensors to the ESP32 board.

2 Develop and upload firmware using Arduino IDE.
3 Configure Blynk with ESP32 for IoT communication.
4 Monitor water level and quality remotely via the mobile app.
5 Trigger alerts when sensor values exceed safe limits.

6. Evaluation Method

We will evaluate the system in the following ways to ensure its accuracy, reliability and usability:

6.1. Sensor Accuracy Testing

6.1.1. Compare sensor readings (water level, TDS, turbidity, flow rate) with known values or manual measurements.

6.1.2. Repeat measurements with different water conditions (water quality and level) to verify consistent results.

6.2. Alert functionality Testing

6.2.1. Simulate different levels (low water level or dirty water) to confirm if alerts (send notification to user's mobile phone) activate as expected.

6.3. Real-Time Monitoring Verification

6.3.1. Check if data is correctly sent from ESP32 to Blynk.

6.3.2. Ensure that the mobile dashboard updates in real time.

6.4. Connectivity Testing

6.4.1. Test the system under stable and unstable Wi-Fi conditions.

6.4.2. Check if it reconnects automatically and keeps uploading data.

6.5. Power Reliability Test

6.5.1. Evaluate performance with power supply.

6.6. User Interface Feedback

6.6.1. Ask users (SLIIT Matara Center students) to interact with the mobile app.

6.6.2. Collect feedback from users

6.7. Estimated Budget

Item	Cost (LKR)
Ultrasonic Sensor / HC-SR04	250.00
TDS Sensor / DFRobot Gravity Analog TDS Sensor	2000.00
Turbidity sensor module / SEN0189	2500.00
Water flaw sensor / YF-S201	1000.00
ESP 32	4000.00

Relay Module	800.00
Water pump	1000.00
Power Supply / Battery Pack	3000.00
Casing / Enclosure Box	1200.00
Jump Wires	1000.00
Total	**16750.00**

Table 1. Estimated Budget

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