Embedded Systems and Internet of Things (ES&IOT) Lab

Drinking Water Quality Monitoring System

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Problem Statement

The IoT-based Drinking Water Quality Monitoring System presented in this project offers a cutting-edge solution to the critical issue of ensuring safe and clean drinking water. By incorporating advanced technology such as the ESP32 microcontroller and specialized sensors, this system enables real-time monitoring of key parameters like TDS levels and water temperature. The integration of IoT capabilities allows for seamless data collection and analysis, providing users with actionable insights to maintain the purity of drinking water efficiently.

❖ Problems to be Addressed in the Drinking Water Quality Monitoring Project:

- **Limited Real-time Monitoring**: Traditional methods of water quality monitoring lack the capability to provide real-time data on key parameters such as TDS levels and temperature.
- **Inefficiency in Detection**: The current monitoring systems may not promptly detect deviations in water quality, leading to potential health risks for consumers.
- **Delayed Response to Contamination**: Without real-time monitoring, there is a risk of delayed responses to water contamination events, jeopardizing public health.
- **Cost and Resource Constraints**: Implementing continuous monitoring systems for water quality can be costly and resource-intensive, especially in remote or underserved areas.
- **Lack of Data Accessibility**: Access to timely and accurate data on water quality is limited, hindering effective management and maintenance of drinking water systems.

By addressing these challenges through the IoT-based drinking water quality monitoring system, we aim to enhance the efficiency, reliability, and accessibility of monitoring drinking water quality, ultimately safeguarding public health and well-being.

Proposed Solution

The proposed solution is an IoT-based drinking water quality monitoring system that leverages cutting-edge technology to ensure the safety and purity of drinking water. By combining the capabilities of the ESP32 microcontroller, TDS sensor, temperature sensor, OLED screen, and Thing Speak server, this system provides a cost-effective, reliable, and efficient method for continuous monitoring of key water quality parameters.

❖ Working

- **Data Acquisition**: The TDS sensor and temperature sensor are used to measure the conductivity and temperature of water, respectively. The ESP32 microcontroller collects this data from the sensors.
- **Data Display**: The collected data is displayed on an OLED screen attached to the system, allowing users to view real-time information on TDS levels and water temperature.
- **Data Logging and Transmission**: The system is programmed to upload the data to a Thing Speak server, enabling remote monitoring and data storage for further analysis.
- **Alert System**: If the TDS levels exceed preset thresholds or if any anomalies are detected, the system can be configured to trigger alerts for immediate action.

❖ Key Components

- ESP32 Microcontroller Board
- TDS Sensor
- Temperature Sensor
- Resistor 4.7k
- Connecting wires
- Breadboard

❖ Unique and Innovative Aspects of Iot Based Drinking Water Quality Monitoring System

- **Real-time Monitoring**: The system provides real-time monitoring of TDS levels and water temperature, allowing for prompt action in case of deviations from the defined thresholds. This proactive approach ensures timely intervention to maintain water quality standards.
- **Integration of Advanced Technology**: By leveraging cutting-edge components such as the ESP32 microcontroller, TDS sensor, OLED screen, and ThingSpeak server, the system combines hardware and software elements to create a comprehensive solution for water quality management.
- **User-Friendly Interface**: The inclusion of the OLED screen enables users to easily view essential data on TDS levels and water temperature, making the system accessible and user-friendly for operators and stakeholders.
- **Remote Access and Data Storage**: The integration with the ThingSpeak server allows for remote access to real-time data and historical trends, facilitating informed decision-making and enabling stakeholders to monitor water quality from anywhere.
- **Customizable and Scalable Design**: The system's design enables customization and scalability to meet the specific requirements of different water systems, making it adaptable for various applications and settings.
- **Alert System for Immediate Action**: The system's alert system, triggered by predefined threshold values for TDS levels, ensures that users are notified promptly of any water quality issues, enabling quick and effective responses to maintain water safety.
- **Potential for Data Analysis and Insights**: The collected data can be analysed and used to generate insights into water quality trends, potential risks, and system performance, facilitating continuous improvement and optimization of water quality management practices.
- **Contribution to Public Health and Environmental Sustainability**: By ensuring the safety and purity of drinking water through continuous monitoring and management, the system contributes to public health protection and environmental sustainability, addressing critical concerns related to water quality and safety.

Technology and Tools

1. **ESP32 Microcontroller**: The main component responsible for data collection, processing, and communication with external devices.
2. **TDS Sensor**: Measures Total Dissolved Solids (TDS) in water to provide insights into water quality and purity levels.
3. **Temperature Sensor**: Monitors water temperature, a crucial parameter in assessing water quality and safety.
4. **OLED Screen**: Displays real-time data on TDS levels and water temperature in a user-friendly interface.
5. **Wi-Fi Connectivity**: Enables communication between the system components and the internet for data transmission.
6. **ThingSpeak Server**: A cloud-based platform for data storage, visualization, and analysis, facilitating remote access to water quality information.
7. **Arduino IDE**: Software development environment used for programming the ESP32 microcontroller.
8. **C/C++ Programming**: Programming languages used for coding the functionalities of the IoT system.
9. **ThingSpeak API**: Allows integration with the ThingSpeak server for data transmission and storage.
10. **IoT Protocols (e.g., MQTT)**: Communication protocols that enable data exchange between IoT devices and servers.
11. **Breadboard and Jumper Wires**: Tools for prototyping and connecting electronic components in the system.
12. **USB Cable**: Used for power supply and programming of the ESP32 microcontroller.
13. **Computer/Laptop**: Required for programming the microcontroller and interfacing with the system components

Implementation Plan

Levels of Implementation:

Hardware Components Needed:

- ESP32 microcontroller
- TDS sensor
- Temperature sensor (e.g., DS18B20)
- OLED display
- Breadboard and jumper wires

Software Components Needed:

- Arduino IDE
- Required libraries for ESP32, TDS sensor, temperature sensor, OLED display

Steps to Implement:

1. Circuit Connection:

Connect the ESP32 microcontroller, TDS sensor, temperature sensor, and OLED display on a breadboard using jumper wires as per the circuit.

2. Programming:

1.Open Arduino IDE and install necessary libraries for ESP32, TDS sensor, temperature sensor, and OLED display.

2. Write the code to read data from the TDS sensor and temperature sensor, display it on the OLED screen, and send it to the ThingSpeak server.

3. Implement temperature compensation in the code for accurate conductivity measurement.

3. Wireless Data Transmission:

1. Configure the ESP32 to connect to your Wi-Fi network.

2. Use the Wi-Fi module on the ESP32 to send sensor data to the ThingSpeak server using HTTP POST requests.

Impact and Benefits

The IoT-based drinking water quality monitoring system presented in the video offers several potential benefits:

Improved Lives:
1. Real-time Water Quality Monitoring: The system provides continuous monitoring of water quality parameters like TDS and temperature, allowing users to be informed about potential issues in real-time. This empowers individuals to make informed decisions about their water consumption, ensuring safer and healthier drinking water.
2. Early Detection of Contamination: By continuously monitoring water quality, the system can detect potential contamination early on, allowing for timely intervention and preventing health risks. This is particularly important in areas with unreliable water infrastructure or potential contamination sources.

Social Impact:
1. Increased Awareness: The system can raise awareness about water quality issues and promote responsible water management practices. This can lead to better public health outcomes and a more informed citizenry.
2. Empowerment of Communities: The system can empower communities to take ownership of their water quality and advocate for improvements in water infrastructure and sanitation.

Economic Impact:
1. Cost Savings: Early detection of water quality issues can help prevent costly repairs and replacements of water infrastructure.
2. Reduced Healthcare Costs: Improved water quality can lead to reduced healthcare costs associated with waterborne illnesses.

Environmental Impact:
1. Sustainable Water Management: The system can promote sustainable water management practices by providing data that can be used to optimize water usage and reduce waste.
2. Reduced Pollution: By monitoring water quality, the system can help identify and address sources of pollution, contributing to a cleaner environment.

Overall, the IoT-based drinking water quality monitoring system has the potential to improve lives, promote social well-being, stimulate economic growth, and protect the environment.

Budget

Projected budget includes costs for hardware components, software development, testing, manufacturing, and initial deployment phases, with allowances for contingencies and scalability.

Components	Prices(Approx)
ESP32 Board	500 Rs
TDS Sensor	571 Rs
Temperature Sensor	100 Rs-200 Rs
Resistor	5 Rs
Connecting Wires	300 Rs
Breadboard	170 Rs

Our estimated budget for this project could be nearby 2000-2500 Rs Approx.

Thank You