

# Automated Water Quality Analysis and Regulation System

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**Abstract:** *This project presents an IoT-based smart water quality monitoring and control system designed to ensure safe and drinkable water. The system continuously monitors important water parameters such as pH level, Total Dissolved Solids (TDS), and temperature using sensors like a pH sensor, TDS sensor, and DS18B20 temperature sensor. These sensors are connected to a microcontroller (such as Arduino or NodeMCU), which processes the data in real-time. If the pH value goes beyond the acceptable range, a water pump is automatically activated to drain the contaminated water from the tank. Similarly, if the TDS level is not suitable for drinking, another pump is used to pass the water through a filtration unit and recirculate it back into the tank. For temperature control, the DS18B20 sensor monitors water temperature, and if it exceeds the defined limit, and if possible to a cooling module is activated to reduce the temperature. All sensor data is displayed on an LCD screen for local monitoring and is also uploaded to the ThingSpeak cloud platform via Wi-Fi module (ESP8266/NodeMCU). This allows users to view real-time data and graphical analysis remotely. The system ensures efficient water quality management using automation and IoT technology, making it reliable and user-friendly.*

**Keywords:** IoT, Water Quality Monitoring, pH Sensor, TDS Sensor, DS18B20 Temperature Sensor, LCD Display, Arduino, NodeMCU Controller, Water Pump, ThingSpeak, Smart System, Real-Time Monitoring, etc

## I. INTRODUCTION

Water is one of the most essential resources for human survival and daily activities. Maintaining water quality is very important to ensure it is safe for drinking and other uses. In many cases, water stored in tanks can get contaminated due to changes in parameters like pH, Total Dissolved Solids (TDS), and temperature. Manual monitoring methods are not efficient and cannot provide continuous results. Therefore, there is a need for an automated system that can monitor water quality in real-time and take necessary actions. This project focuses on developing an automated water quality monitoring and regulation system using sensors, microcontrollers, and IoT technology.

Water quality plays a vital role not only in drinking purposes but also in agriculture, industries, and environmental sustainability. Poor water quality can lead to serious health issues, including waterborne diseases. Hence, continuous monitoring of water parameters is essential to ensure safety and maintain standards. With the advancement of technology, smart systems are being developed to handle such challenges effectively.

In recent years, the use of Internet of Things (IoT) and sensor-based technologies has increased significantly in environmental monitoring. These technologies allow real-time data collection, remote monitoring, and quick decision-



making. By integrating sensors with microcontrollers and cloud platforms, it becomes possible to build intelligent systems that can automatically respond to changes in water quality.

This project focuses on combining automation, sensing, and cloud technologies to create a smart water quality management system. The system not only monitors parameters but also takes corrective actions such as filtration, discharge, and cooling. This ensures that water remains within safe limits without continuous human supervision, making the system reliable and efficient.

### **PROBLEM STATEMENT**

Maintaining safe and clean water quality is a major challenge, especially in storage tanks where parameters like pH, TDS, and temperature can change over time. Manual monitoring is not reliable and may lead to unsafe water consumption. There is a need for an automated system that can continuously monitor water quality and take necessary actions like filtration, cooling, or discharge to ensure safe and drinkable water.

## **II. RESEARCH METHODS**

### **Study Design**

The study is designed as an experimental and system-based approach to develop and evaluate the “Automated Water Quality Analysis and Regulation System.” In this design, real-time data is collected from water sources using sensors and processed through a microcontroller-based system. The system is tested under different conditions by varying parameters such as pH, TDS, and temperature to observe how it reacts and maintains water quality. The study focuses on designing, implementing, and validating the system performance in a controlled environment. This approach helps in analyzing how effectively the system can automatically regulate water quality and respond to unsafe conditions.

### **Materials**

The materials used in this project include both hardware and software components. The hardware components consist of sensors such as pH sensor, TDS sensor, and DS18B20 temperature sensor for data collection. A microcontroller (Arduino or Raspberry Pi) is used as the main processing unit. Other components include water pumps for discharge and filtration, a Peltier module for cooling, an LCD display for showing real-time data, and connecting wires and power supply. The software components include embedded programming (Arduino IDE or Python), IoT platform (ThingSpeak) for cloud data storage and visualization, and basic data processing algorithms to analyze sensor readings. These materials work together to build a complete automated system.

### **Methods**

The method used in this project involves collecting real-time water quality data through sensors and processing it using the microcontroller. First, sensors measure parameters like pH, TDS, and temperature at regular intervals. Then, the collected data is compared with predefined threshold values stored in the system. If the pH level is outside the acceptable range, the discharge pump is activated to remove water from the tank. If TDS is not suitable, the filtration system is triggered to purify the water. If the temperature exceeds the limit, the Peltier module is activated to cool the water. All readings are displayed on an LCD and also uploaded to the ThingSpeak cloud platform for remote monitoring. This method ensures automatic decision-making and control.

### **Methods of Analysis**

The analysis of the system is done by evaluating sensor readings and system responses under different test conditions. The accuracy of sensors is checked by comparing readings with standard values. The system’s performance is analyzed based on how quickly and correctly it reacts to changes in water quality. Graphical analysis is done using ThingSpeak to visualize trends of pH, TDS, and temperature over time. The efficiency of the system is measured by observing whether it maintains water within safe limits. Any errors or delays in response are recorded and improved. This analysis helps in validating the reliability and effectiveness of the system.



### **Outcome of the Study**

The outcome of the study shows that the developed system is capable of monitoring and regulating water quality automatically and efficiently. The system successfully detects changes in pH, TDS, and temperature and takes appropriate actions such as discharging, filtering, or cooling water. It reduces manual effort and provides real-time updates through LCD and cloud platforms. The results indicate that the system is reliable, cost-effective, and suitable for real-world applications. It also demonstrates the usefulness of IoT-based solutions in improving water management systems and ensuring safe and clean water for different uses.

### **III. SYSTEM OVERVIEW**

The “Automated Water Quality Analysis and Regulation System” is an intelligent system designed to monitor and maintain the quality of water automatically using sensors and IoT technology. The system continuously checks important water parameters such as pH level, Total Dissolved Solids (TDS), and temperature using dedicated sensors. These sensors are connected to a microcontroller (such as Arduino or Raspberry Pi), which acts as the brain of the system. It collects real-time data from all sensors, processes it, and compares the values with predefined safe limits. Based on this comparison, the system takes automatic actions to ensure that the water remains safe and suitable for use. The system consists of multiple modules working together. The sensing module collects real-time data from water using pH, TDS, and temperature sensors. The processing module analyzes this data and makes decisions. The control module activates devices such as water pumps and a Peltier cooling system when any parameter crosses its safe limit. For example, if the pH level is too high or too low, the system activates a discharge pump to remove water from the tank. If the TDS level is not suitable for drinking, a filtration process is triggered using another pump. If the temperature rises beyond the limit, the Peltier module is used to cool the water. These automatic actions ensure continuous regulation of water quality.

In addition to monitoring and control, the system also provides user interaction and remote access features. An LCD display is used to show real-time values of pH, TDS, and temperature directly to the user. At the same time, all data is uploaded to the ThingSpeak cloud platform using IoT technology. This allows users to monitor water quality remotely through graphs and data visualization. The system is designed to be efficient, cost-effective, and easy to use, making it suitable for homes, industries, agriculture, and water treatment systems. Overall, this system provides a smart solution for maintaining safe and clean water through automation and real-time monitoring.

### **IV. PROPOSED WORK**

The proposed system is an automated water quality monitoring and regulation system using sensors and IoT technology. It continuously measures pH, TDS, and temperature levels of water in the tank using appropriate sensors.

If the pH value goes beyond the safe range, the system automatically activates a pump to discharge the water. If the TDS level is not suitable for drinking, another pump circulates water through a filtration system and returns it to the tank. For temperature control, a DS18B20 sensor measures the water temperature, and if it exceeds the limit, a Peltier plate is activated to cool the water.

All sensor data is displayed on an LCD screen and also uploaded to the ThingSpeak cloud platform for graphical analysis and remote monitoring.



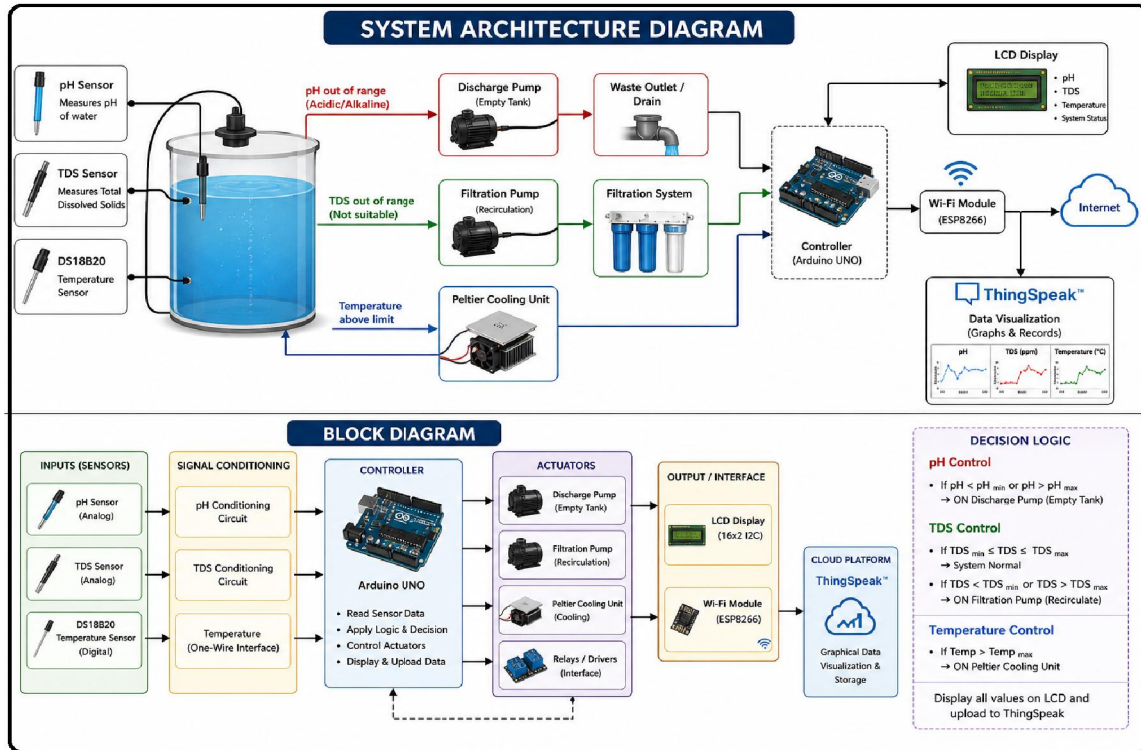


Fig.1: System Architecture Design

## V. CONCLUSION

The proposed system successfully demonstrates how modern technology can be used to monitor and maintain safe water conditions in an efficient and intelligent way. In this project, important water quality parameters such as pH level, Total Dissolved Solids (TDS), and temperature are continuously monitored using sensors. Based on the collected data, the system automatically takes necessary actions like discharging contaminated water, filtering unsuitable water, and cooling overheated water using pumps and a Peltier module. This automation reduces human effort and ensures quick response to any change in water quality. The integration of an LCD display and cloud platform like ThingSpeak further enhances the system by providing real-time data visualization and remote monitoring, making the system more reliable and user-friendly.

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