B.M.S. COLLEGE OF ENGINEERING BENGALURU
Autonomous Institute, Affiliated to VTU

Internet Of Things Project Report on

Water Quality Monitoring

Submitted in partial fulfillment for the award of degree of

Bachelor of Technology
in
Computer Science and Engineering

Submitted by:

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B.M.S. COLLEGE OF ENGINEERING DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DECLARATION

We, Shikha Singh (1BM21CS202), Stuti Uniyal (1BM21CS220) and Spoorthi J (1BM21CS218) student of 5thSemester, B.E, Department of Computer Science and Engineering, B.M.S. College of Engineering, Bangalore, hereby declare that, this alternative assessment technical seminar entitled "Water Quality Monitoring" has been carried out under the guidance of Radhika AD, Assistant Professor, Department of CSE, B.M.S. College of Engineering, Bangalore during the academic semester Aug- Jan 2024. I also declare that to the best of our knowledge and belief, the alternative assessment technical seminar report is not from part of any other report by any other students.

Signature of the Candidate

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Abstract

This report presents a comprehensive study on the development and implementation of a water quality monitoring system utilizing an Internet of Things (IoT) based model. With increasing concerns over water pollution and its detrimental effects on human health and the environment, there is a growing need for efficient monitoring systems to ensure water safety. The proposed system integrates IoT technology to collect real-time data on various water quality parameters such as pH levels, dissolved oxygen, turbidity, and temperature. Sensors deployed at strategic locations continuously gather data, which is then transmitted wirelessly to a central server for analysis and visualization. Through the utilization of IoT devices and cloud computing, stakeholders can remotely access the water quality data in real-time, enabling prompt decision-making and timely intervention in case of any anomalies. Moreover, the system facilitates predictive analytics to forecast potential water quality issues, thereby enhancing proactive management strategies. The implementation of this IoT-based water quality monitoring system offers a cost-effective and scalable solution for ensuring water safety and sustainability in diverse environments, ranging from urban water distribution networks to rural freshwater sources.

Chapter 1: Introduction

1.1 Overview

This project aims to develop a water quality monitoring system using IoT technology. By deploying IoT devices equipped with sensors to collect real-time data on key water quality parameters, such as pH levels and temperature, stakeholders can access this data remotely for prompt decision-making. The system incorporates predictive analytics to forecast potential water quality issues, enhancing proactive management. Overall, this project offers a costeffective and scalable solution for monitoring water quality in various environments, contributing to the safety and sustainability of water resources.

1.2 Motivation

The motivation for selecting this topic stems from the critical importance of ensuring clean and safe water for both human consumption and environmental sustainability. Water quality degradation poses significant health risks and environmental challenges, making effective monitoring systems essential. Additionally, advancements in IoT technology offer innovative solutions for real-time data collection and analysis, which can greatly enhance water quality monitoring efforts. By addressing this pressing issue through the development of an IoT-based monitoring system, the project seeks to contribute to the protection and preservation of water resources, ultimately benefiting both present and future generations.

1.3 Objective

The primary objective of this project is to design and implement a water quality monitoring system based on IoT technology. Key objectives include:

1) Developing IoT devices equipped with sensors to collect real-time data on water quality parameters such as pH levels, dissolved oxygen, turbidity, and temperature.
2) Establishing a wireless communication network to transmit collected data to a central server for analysis and visualization.
3) Creating a user-friendly interface for stakeholders to remotely access and interpret the water quality data.
4) Implementing predictive analytics algorithms to forecast potential water quality issues and enable proactive management strategies.

Chapter 2: LITERATURE SURVEY

The literature surrounding water quality monitoring systems utilizing IoT technology is extensive and continually evolving. Key themes and findings from recent studies include:

1) **IoT-Based Sensor Technology**: Numerous studies have explored the development and application of IoT-enabled sensors for monitoring various water quality parameters. These sensors leverage advances in miniaturization, low-power consumption, and wireless connectivity to collect real-time data efficiently.
2) **Data Transmission and Communication Protocols**: Research has investigated different communication protocols such as Wi-Fi, Bluetooth, LoRa, and NB-IoT for transmitting water quality data from remote sensors to central servers or cloud platforms. Studies often compare the performance, range, and energy efficiency of these protocols in diverse environmental conditions.
3) **Data Analytics and Visualization**: Many researchers have focused on developing algorithms and tools for analyzing and visualizing water quality data collected by IoT sensors. This includes techniques such as machine learning, statistical analysis, and data fusion to identify trends, anomalies, and potential water quality issues.
4) **Integration with Geographic Information Systems (GIS)**: Some studies have integrated IoT-based water quality monitoring systems with GIS platforms to provide spatial visualization and analysis capabilities. This integration enables stakeholders to correlate water quality data with geographical features and land use patterns, facilitating more informed decision-making.
5) **Applications in Different Environments**: The literature covers a wide range of applications for IoT-based water quality monitoring systems, including urban water distribution networks, freshwater bodies, wastewater treatment plants, agricultural irrigation systems, and industrial facilities. Case studies highlight the effectiveness and versatility of these systems in diverse environmental settings.
6) **Challenges and Future Directions**: Several studies identify challenges and limitations associated with IoT-based water quality monitoring, such as sensor calibration, data accuracy, power management, cybersecurity, and data privacy.

Chapter 3: DESCRIPTION OF TOOL SELECTED

1)NODEMCU-ESP8266WiFiModule: The ESP8266 is a versatile and affordable WiFi module with an integrated microcontroller. Known for its low cost, it enables wireless connectivity for IoT projects. Programmable using the Arduino IDE, it features GPIO pins, onboard flash memory, and has a robust community for support. With various variants available, the ESP8266 is widely used for its ease of use and compatibility with IoT platforms.

2)TDS Sensor: TDS (Total Dissolved Solids) sensor is utilized to measure the concentration of dissolved solids in water. It works on the principle of electrical conductivity, where the sensor detects the conductivity of ions in the water to estimate TDS levels. This sensor provides crucial information about water quality, indicating the presence of contaminants or minerals dissolved in the water.

3)DS18B20 Temperature Sensor: The DS18B20 temperature sensor is a digital sensor capable of measuring temperature with high accuracy. It operates using the One-Wire communication protocol, making it easy to interface with microcontrollers or IoT devices. This sensor is essential for monitoring water temperature, as temperature variations can affect water quality and biological processes.

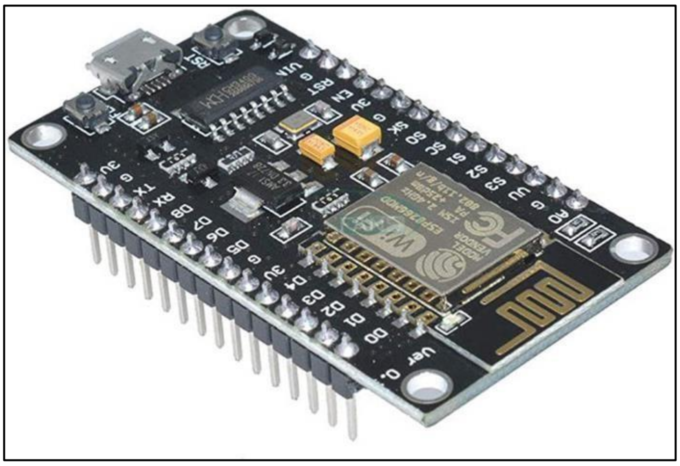
4**)Breadboard**: A breadboard serves as a platform for prototyping and connecting electronic components in the water quality monitoring system. It allows for easy experimentation and modification of circuit designs without soldering. The breadboard provides a convenient way to organize and interconnect the TDS sensor, temperature sensor, OLED display, ADS115 ADC board, and other components.

5)Jumper Wires: Jumper wires are used to establish electrical connections between various components in the circuit. They provide flexibility and ease of assembly, allowing for quick and reliable connections between sensors, the ADC board, display, and microcontroller.Jumper wires come in different lengths and colors to facilitate organization and troubleshooting of the circuitry.

By integrating these tools into the IoT-based water quality monitoring system, stakeholders can effectively collect, process, and visualize data related to TDS levels, temperature, and other parameters, enabling informed decision-making and proactive management of water resources.

Chapter 4: DETAILED DESCRIPTION OF MODULES IMPLEMENTED

In implementing the water monitoring system, We began by integrating the NodeMCUESP8266 WiFi module as the central component for communication. The NodeMCU was configured to connect to a WiFi network, enabling the system to transmit data over the internet. With the ESP8266WiFi library, We established a reliable connection and implemented errorhandling mechanisms to ensure robust communication. The system was designed to periodically read data from the TDS sensor and DS18B20 temperature sensor, process the information, and create a JSON payload for transmission. The NodeMCU's capability to connect wirelessly facilitated real-time monitoring and remote accessibility, crucial for water quality assessment.



For measuring total dissolved solids (TDS), We integrated a TDS sensor into the system. This analog sensor was connected to a designated pin on the NodeMCU, and its readings were obtained using the analogRead function. Calibration factors specific to the sensor were implemented to convert raw analog data into meaningful TDS values. This module provided a critical metric for assessing water purity, helping to identify potential contaminants or deviations from desired water quality levels. The TDS data was incorporated into the overall data payload sent by the NodeMCU to the server, ensuring comprehensive water quality monitoring.

The DS18B20 temperature sensor was seamlessly integrated into the water monitoring system to provide accurate temperature readings. Utilizing the One-Wire protocol, the sensor communicated with the NodeMCU, delivering precise temperature values. The readings, obtained in Celsius, could be easily converted to Fahrenheit if required. Monitoring water temperature is essential for various applications, such as aquaculture or industrial processes, and integrating this sensor into the system provided valuable insights into the thermal conditions of the monitored water. The collected temperature data was then included in the transmitted payload, contributing to a comprehensive assessment of the water's environmental conditions.

Chapter 6: NEW LEARNINGS FROM THE TOPIC

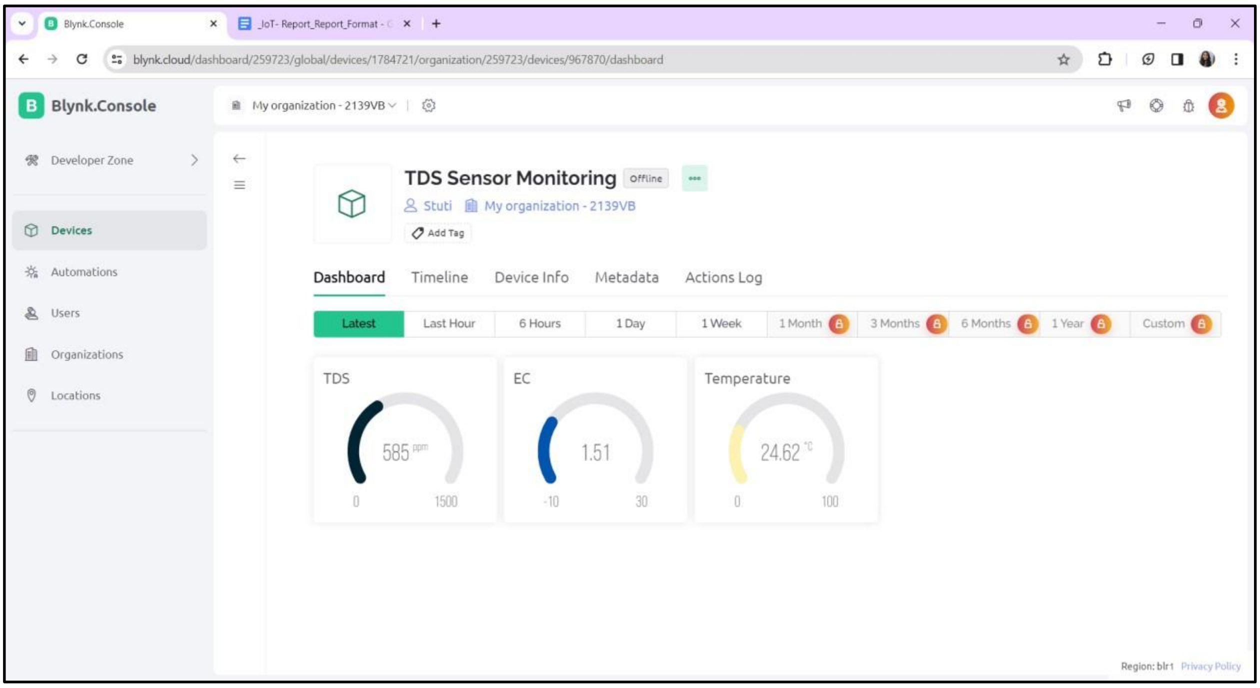
The topic of developing a water quality monitoring system using IoT technology provides numerous opportunities for new learning and insights. Here are some potential new learnings that one might gain from working on this project:

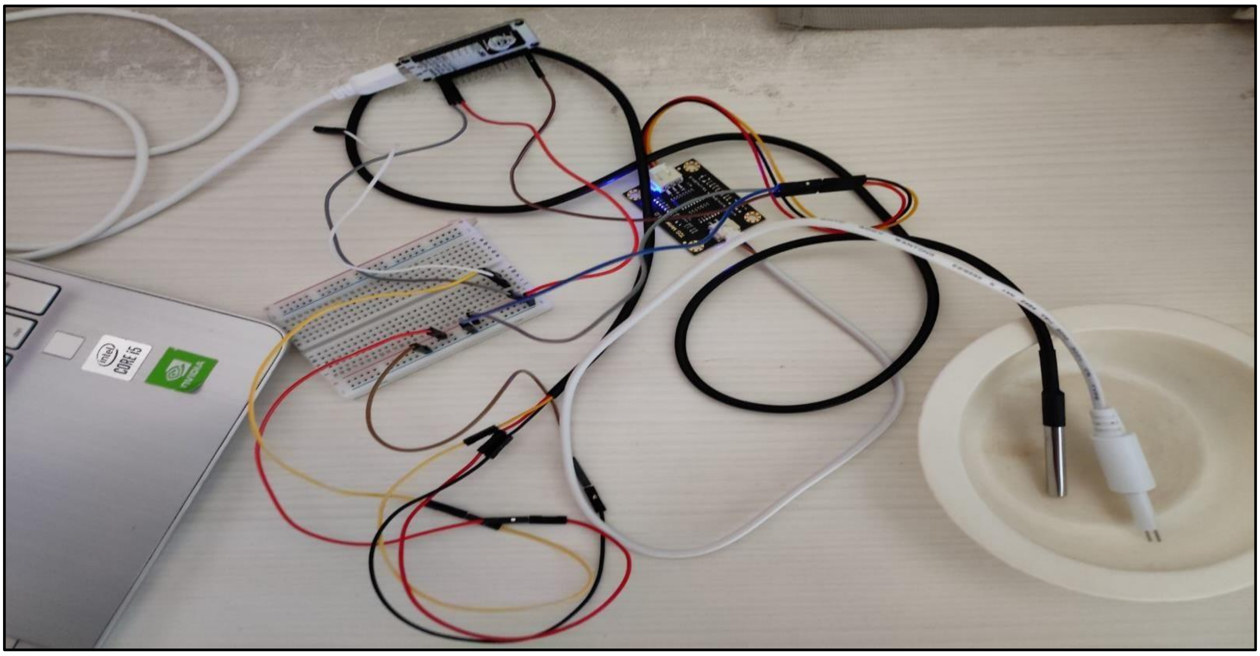
1) **Understanding of IoT Technology:** Working on this project offers a deep dive into IoT technology, including sensor integration, wireless communication protocols, and data analytics. You'll learn how to leverage IoT devices to collect real-time data and transmit it to central servers or cloud platforms for analysis.
2) **Water Quality Parameters:** You'll gain a better understanding of various water quality parameters such as Total Dissolved Solids (TDS) and temperature and their significance in assessing water quality. This includes learning about the factors affecting these parameters and their implications for human health and environmental sustainability.
3) **Sensor Calibration and Accuracy:** Calibration of sensors, such as the TDS sensor and temperature sensor, is crucial for accurate measurement of water quality parameters. Through this project, you'll learn about sensor calibration techniques and methods to ensure data accuracy and reliability.
4) **Data Visualization Techniques:** Developing an IoT-based water quality monitoring system involves visualizing the collected data in a meaningful way for stakeholders. You'll explore different data visualization techniques and tools to present water quality data effectively, enabling stakeholders to interpret and analyze the information easily.
5) **Predictive Analytics**: Implementing predictive analytics algorithms allows for the forecasting of potential water quality issues based on historical data and trends. You'll learn how to develop and apply predictive models to anticipate and mitigate water quality problems proactively.
6) **Interdisciplinary Knowledge**: This project integrates knowledge from various disciplines, including environmental science, engineering, computer science, and data analytics. You'll gain interdisciplinary skills and insights by working collaboratively across these domains to address complex water quality challenges.
7) **Practical Application**: One of the most valuable aspects of this project is the opportunity to apply theoretical knowledge to real-world problems. You'll gain handson experience in designing, implementing, and testing an IoT-based water quality

monitoring system, preparing you for future projects and career opportunities in related fields.

Overall, working on this project provides an enriching learning experience that combines technical skills with environmental awareness and practical problem-solving abilities, ultimately contributing to your personal and professional growth.

Chapter 7: RESULTS AND CONCLUSION





1. **TDS and EC readings**: The page displays the current TDS (Total Dissolved Solids) value, which represents the total amount of dissolved solids in a water sample. This value is measured in parts per million (ppm). The page also displays the EC (Electrical Conductivity) value, which represents the electrical conductivity of the water. This value is measured in microsiemens per centimeter (µS/cm).

2. **Temperature readings**: The page also shows the temperature of the water or solution being monitored, which is measured in Celsius or Fahrenheit.

3. **Graphical representation**: The page includes a graphical representation of the TDS and EC values over time, allowing for easy visualization of any trends or changes in the water quality. This can be useful for identifying any issues or identifying patterns in the water quality.

4. **Automatic updates**: The page is designed to be updated automatically, with new readings being displayed every few seconds. This ensures that the displayed data is always up-to-date and reflects the current conditions of the water being monitored.

5. **Water quality monitoring**: The TDS and EC sensors are typically used in water quality monitoring systems, such as those used in water treatment plants, to ensure the water being treated meets quality standards.

6. **User-friendly interface**: The page is designed to be user-friendly, with easy-to-read displays and intuitive controls. This makes it accessible to users with varying levels of technical expertise.

In summary, this page provides a convenient and user-friendly interface for monitoring the water quality of a water system or solution using a TDS sensor and EC sensor. It allows for easy visualization and review of current and historical water quality data, making it a valuable tool for water quality monitoring and management.

```
16:03:42.411 -> ==================================================================
16:03:42.411 -> |TDS in water(measured in PPM) | Suitability for drinking water   |
16:03:42.411 -> ==================================================================
16:03:42.411 -> |Between 50-150                | Excellent for drinking           |
16:03:42.411 -> |------------------------------|----------------------------------|
16:03:42.411 -> |150-200                       | Good for drinking                |
16:03:42.450 -> |------------------------------|----------------------------------|
16:03:42.450 -> |250-300                       | Fair for drinking                |
16:03:42.450 -> |------------------------------|----------------------------------|
16:03:42.450 -> |300-500                       | Poor,not good for drinking       |
16:03:42.450 -> |------------------------------|----------------------------------|
16:03:42.450 -> |Above 1200                    | Unacceptable                     |
16:03:42.450 -> ==================================================================
16:03:42.706 -> TDS:585
16:03:42.706 -> EC:1.51
16:03:42.706 -> Temperature:24.63
16:03:42.706 -> Poor for drinking
16:03:44.190 -> ==================================================================
```

REFERENCES AND ANNEXURES

- Step by step procedure for water quality monitoring : electroniclinic.com

- Circuit and code : how2electronics.com