

IoT-Based Smart Water Quality Monitoring System Using ESP32 and Blynk

Ghaliya Wahby

Abstract

Water quality monitoring has become increasingly important due to industrialization, environmental pollution, and rapid urban growth. Traditional laboratory-based water testing methods are expensive, time-consuming, and unsuitable for real-time monitoring applications. This paper presents the development of an IoT-Based Smart Water Quality Monitoring System using ESP32 and the Blynk IoT platform. The system uses a Turbidity Sensor, TDS Sensor, and DS18B20 Waterproof Temperature Sensor to monitor water quality parameters in real time. The ESP32 processes the sensor data and sends the information wirelessly to the Blynk cloud platform through Wi-Fi. The proposed system provides a low-cost, portable, and efficient environmental monitoring solution suitable for homes, fish farms, agriculture, industries, and educational applications.

Keywords

IoT, ESP32, Blynk, Water Quality Monitoring, TDS Sensor, Turbidity Sensor, DS18B20, Environmental Monitoring.

1. Introduction

Water is one of the most important natural resources required for life and environmental sustainability. Monitoring water quality is critical for ensuring safe drinking water, agricultural productivity, and ecosystem health. Water contamination caused by industrial waste, sewage, chemicals, and environmental pollutants can result in severe health risks and ecological damage. Traditional water quality monitoring systems depend on laboratory analysis and manual sample collection. Although these methods provide accurate measurements, they are costly and not suitable for continuous real-time monitoring. The advancement of the Internet of Things (IoT) has enabled the development of smart environmental monitoring systems capable of collecting and transmitting data remotely. This project focuses on the development of an IoT-Based Smart Water Quality Monitoring System using ESP32 and Blynk. The system continuously measures water temperature, turbidity, and TDS values and transmits the information to a mobile dashboard for remote monitoring.

2. Objectives

- To monitor water temperature using the DS18B20 sensor.
- To measure water turbidity using a turbidity sensor.
- To measure Total Dissolved Solids (TDS) using a TDS sensor.
- To develop an IoT-based real-time monitoring system.
- To send sensor data to the Blynk cloud platform.

- To classify water quality conditions.
- To create a low-cost and portable monitoring solution.

3. Literature Review

Several studies have explored IoT-based environmental monitoring systems using wireless communication and cloud platforms. Water quality monitoring systems commonly monitor parameters such as pH, temperature, TDS, conductivity, turbidity, and dissolved oxygen. The ESP32 microcontroller has become highly popular due to its built-in Wi-Fi and Bluetooth capabilities. Blynk is a widely used IoT dashboard platform that supports remote monitoring, graphical visualization, notifications, and cloud storage. Researchers have demonstrated that IoT-based systems improve monitoring efficiency while reducing operational costs.

4. Hardware Components

Component	Quantity	Specification	Purpose
ESP32	1	Wi-Fi enabled MCU	Main controller
TDS sensor	1	0–1000 ppm	Dissolved solids
Turbidity sensor	1	Analog sensor	Water cloudiness
DS18B20	1	Waterproof sensor	Temperature
4.7 kΩ resistor	1	Pull-up resistor	Stable communication
Breadboard	1	Prototype board	Circuit assembly
Jumper wires	Several	Male–female	Connections

5. Methodology

The system consists of sensors connected to the ESP32 microcontroller. The turbidity sensor measures water cloudiness, while the TDS sensor measures dissolved particles in water. The DS18B20 sensor measures water temperature. The ESP32 reads sensor values through analog and digital GPIO pins. The collected data is processed and transmitted to the Blynk cloud server using Wi-Fi communication. The user can monitor water quality readings remotely through a smartphone dashboard.

6. System Architecture

System Flow: Sensors → ESP32 → Wi-Fi → Blynk Cloud → Mobile Dashboard

7. Experimental Results and Analysis

Figure 1 shows temperature monitoring over time. The temperature graph demonstrates stable operation of the DS18B20 sensor. The temperature increased gradually from 24°C to approximately 26.2°C

during testing. Figure 2 shows TDS sensor readings. The TDS graph indicates increasing dissolved solids concentration from 120 ppm to 950 ppm. Higher TDS values represent higher contamination levels. Figure 3 shows turbidity sensor analysis. The turbidity graph demonstrates decreasing sensor voltage with increasing cloudiness and suspended particles.

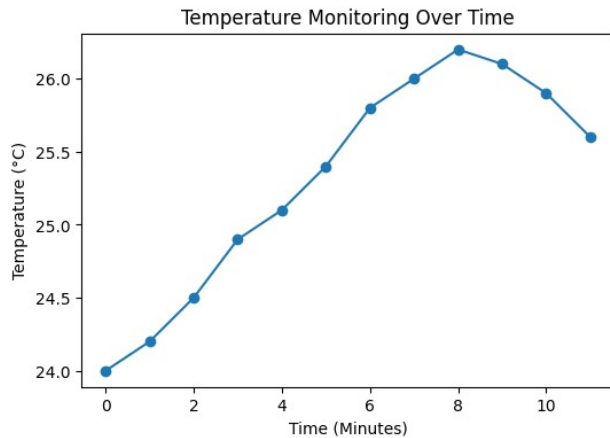


Fig. 1. Graph reproduced from the supplied manuscript.

8. Experimental Data

Water sample	Temperature (°C)	TDS (ppm)	Status
Clean water	24.5	120	Clean
Tap water	25.1	350	Acceptable
Muddy water	25.8	720	Poor
Salt water	26.2	950	Highly contaminated

9. Advantages

- Real-time monitoring
- Remote access using smartphone
- Portable and scalable design
- Low-cost implementation
- Easy integration with IoT platforms
- Useful for educational and environmental applications

10. Future Improvements

Future improvements may include the addition of pH sensors, dissolved oxygen sensors, AI-based prediction systems, solar-powered outdoor deployment, cloud database storage, and automatic purification systems.

11. Conclusion

This paper successfully demonstrated the development of an IoT-Based Smart Water Quality Monitoring System using ESP32 and Blynk. The system effectively monitors water temperature, turbidity, and TDS values in real time and transmits the information wirelessly to the cloud. The proposed system provides a low-cost, efficient, and scalable environmental monitoring solution suitable for multiple applications.

References

- [1] Espressif Systems, ESP32 Technical Reference Manual, ver. 5.7. [Online]. Available: https://documentation.espressif.com/ESP32_Technical_Reference_Manual_en.pdf
- [2] Blynk, Blynk IoT Documentation. [Online]. Available: <https://docs.blynk.io/>
- [3] Analog Devices, DS18B20 Programmable Resolution 1-Wire Digital Thermometer, datasheet. [Online]. Available: <https://www.analog.com/en/products/ds18b20.html>
- [4] Arduino, Arduino Documentation. [Online]. Available: <https://docs.arduino.cc/>