Software Requirement Specifications
IoT-Based Water Quality Monitoring System Using ESP32

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Summary

The IoT-Based Water Quality Monitoring System is designed to continuously measure real-time water parameters—specifically **turbidity** and **temperature**—using sensors connected to an ESP32 microcontroller. The collected data is processed and transmitted to a cloud-based dashboard (ThingSpeak/Blynk/Flask), where users can monitor live readings, view historical trends, and receive alerts when values exceed safe limits.

The system includes hardware components such as ESP32, turbidity sensor, and DS18B20 temperature sensor, along with cloud integration for data visualization and logging. This SRS defines all functional and non-functional requirements, hardware/software specifications, system features, flow diagrams, and future enhancements. It serves as a detailed reference for developers, supervisors, and stakeholders involved in the project.

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1. Introduction

1.1 Purpose

This Software Requirements Specification (SRS) document outlines the functional and non-functional requirements for the IoT-Based Water Quality Monitoring System using ESP32.

The purpose of this document is to provide a comprehensive description of the system for developers, supervisors, and stakeholders involved in the Final Year Project. It will serve as a reference for the design, implementation, and evaluation phases of the project.

1.2 Project Overview

The system is designed to continuously monitor real-time water quality parameters, specifically turbidity and temperature.

The ESP32 microcontroller collects sensor data and transmits it to a cloud-based web dashboard for visualization, data logging, and abnormality detection.

1.3 Intended Audience

- Students and developers
- Academic supervisors
- IoT system designers
- Environmental monitoring agencies

1.4 System Scope

The proposed system measures turbidity and temperature using sensors connected to ESP32 and displays the data on a cloud dashboard. Alerts will be generated when readings exceed safe levels.

The scope includes hardware design, software development, dashboard creation, and cloud integration.

2. Overall System Description

2.1 System Perspective

The system is a standalone IoT solution that integrates hardware (sensors + ESP32) with cloud
services (ThingSpeak/Blynk/Flask).

It provides:

- Real-time monitoring
- Data visualization
- Alerts
- Cloud storage for trends

2.2 System Features Summary

• Turbidity sensing
• Temperature measurement
• Wi-Fi data transmission
• Web dashboard display
• Historical data storage
• Alerts generation

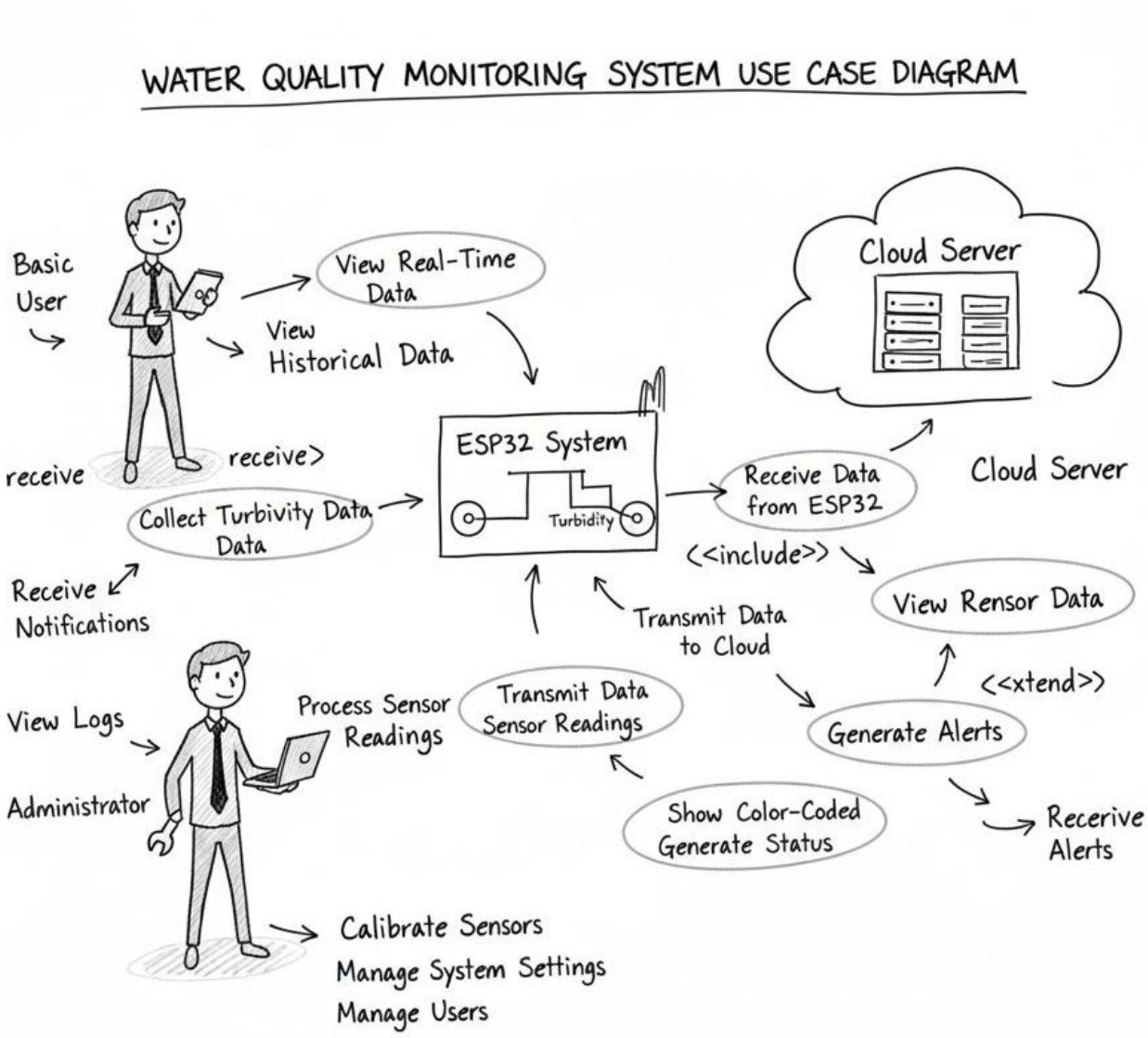
2.3 User Classes

• Basic users – homeowners, water plant workers
• Administrators – technical staff managing the system

2.4 Constraints

• Requires stable Wi-Fi
• Accuracy depends on sensor calibration
• Limited by cloud platform API quotas

Use Cases and Flow of Processes



3. Functional Requirements

3.1 Sensor Data Collection Module
FR-1: The system shall collect turbidity data from the turbidity sensor.
FR-2: The system shall collect temperature data using DS18B20.
FR-3: The ESP32 shall process raw sensor readings.

3.2 Data Transmission Module
FR-4: The system shall transmit sensor data to a cloud server every defined interval.
FR-5: The system shall support HTTP/MQTT protocols for communication.

3.3 Dashboard Module
FR-6: The system shall display real-time readings.
FR-7: The dashboard shall show historical graphs.
FR-8: The dashboard shall display color-coded indicators based on safe levels.

3.4 Alerts & Notifications Module
FR-9: The system shall notify users when turbidity exceeds safe limits.
FR-10: The system shall log all sensor data in cloud storage.

4. Non-Functional Requirements

4.1 Performance Requirements
• The system must update dashboard data every 5–10 seconds.
• The ESP32 must process readings within 200 ms.

4.2 Security Requirements
• Secure communication using API tokens.
• Role-based access for dashboard login.

4.3 Reliability
• 24/7 stable operation required.
• Redundant data logging in case of connection failure.

4.4 Usability
• The dashboard must be user-friendly and easy to navigate.

5. Hardware Requirements
• ESP32 microcontroller
• Turbidity sensor
• Temperature sensor DS18B20
• Power supply 5V
• Wi-Fi network

6. Software Requirements

• Arduino IDE (C/C++)
• Cloud platform (ThingSpeak/Blynk/Flask)
• Firebase/MySQL for database
• Libraries: WiFi.h, HTTPClient.h, OneWire.h, DallasTemperature.h

7. System Flow

1. Sensor collects turbidity & temperature
2. ESP32 processes the readings
3. ESP32 sends data via Wi-Fi
4. Cloud dashboard visualizes data
5. Alerts generated when values exceed thresholds

8. Future Enhancements

• Add pH, TDS sensors
• Solar-powered system
• Mobile app
• Machine learning prediction model

9. Conclusion

This SRS covers all aspects of the IoT-Based Water Quality Monitoring System, including functional
and technical requirements necessary for implementation and evaluation.