CHAPTER VII

SUMMARY AND RECOMMENDATION

This chapter reviews HydroSense, focusing on its purpose, performance, and potential improvements. It highlights the role of the system in providing accurate water quality monitoring and user-friendly features for real-time and historical data analysis. Based on feedback from testing and evaluation, areas for enhancement have been identified to optimize its usability and scalability further. The recommendations aim to refine HydroSense design and expand its capabilities for broader applications.

7.1 Summary

HydroSense integrates hardware and software to provide a comprehensive water quality monitoring solution. The system offers real-time monitoring, data visualization, and actionable water treatment recommendations by leveraging sensors to measure TDS, pH, turbidity, and temperature. The accompanying web application enhances the user experience by providing historical data storage, interactive visualizations, and educational resources about water management. Testing results and user feedback underscore the effectiveness of the system in providing reliable and accurate data while maintaining ease of use. Overall, HydroSense addresses the global challenge of ensuring access to clean water, aligning with Sustainable Development Goal 6, and empowers users to make informed decisions about water safety and sustainability. The system also supports remote monitoring, allowing users to track water quality anywhere, providing convenience and

flexibility. By offering personalized recommendations and alerts, HydroSense ensures that users are able to take timely actions to maintain water safety and quality.

7.1.1 Planning and Analysis

The planning phase of HydroSense focused on designing a comprehensive solution that integrates sensors with a user-friendly web application for real-time water quality monitoring. A detailed analysis of existing systems revealed the value of combining hardware and software to deliver actionable insights through recommendations and data visualization. The developers prioritized creating a system that addressed user needs effectively while remaining adaptable. Feedback from evaluators played a crucial role in refining the project functionality and improving the hardware and software components. This iterative approach ensured HydroSense met its objectives while addressing potential challenges early in development.

7.1.2 Design and Development

The design and development phase involved using Arduino and ESP32 microcontrollers to create a scalable, efficient, and robust hardware solution for HydroSense. The web application was meticulously designed to provide seamless connectivity and intuitive interfaces, making it accessible across various devices. Challenges such as sensor calibration and dependency on stable internet connections were identified and addressed to enhance the reliability and performance of the system. The developers emphasized building a modular, user-friendly solution for real-time data processing. These design principles allowed

HydroSense to effectively deliver accurate water quality measurements and meaningful insights.

7.1.3 Implementation and Testing

HydroSense underwent extensive testing involving IT professionals, end-users, and other evaluators to validate its functionality and reliability. The system demonstrated high accuracy and efficiency, meeting user expectations for water quality monitoring. Feedback from testers highlighted the need for improved modularity and more comprehensive documentation to facilitate ease of maintenance. The testing phase also revealed HydroSense potential for real-world applications, particularly in areas with limited resources, where access to clean water is critical. This rigorous evaluation process ensured that HydroSense was ready for deployment while identifying areas for future improvement.

7.2 Recommendations

HydroSense is a water quality monitoring system that provides users with real-time data, actionable recommendations, and historical analysis. While the system has demonstrated high performance and reliability, developers, evaluators, and testers have identified areas for improvement to enhance its functionality and scalability. The following recommendations focus on modular design, expanded observability, cloud data storage, and additional sensor integration to ensure HydroSense remains a versatile and comprehensive solution for water quality monitoring. By addressing these areas, HydroSense continue to evolve and meet the growing demands of users and the water quality monitoring industry.

7.2.1 Modular Design Refinement

HydroSense benefited from further modularizing its system components to enhance maintainability and testability. By isolating individual modules, updates and troubleshooting potentially be performed with minimal impact on other parts of the system. This approach reduces interdependencies between hardware and software components, making the system more adaptable to future upgrades. Additionally, modularity is likely to allow for more efficient debugging and testing, enabling developers to focus on specific functionalities without disrupting the overall system. Improved modular design ensures HydroSense remains scalable and reliable in diverse operational contexts.

7.2.2 Expanded Observability Features

By adding detailed error reporting and system logs significantly enhance HydroSense observability and user troubleshooting capabilities. These features enable users to identify and trace issues more effectively, ensuring a better understanding of system behavior. Real-time error detection and logging also contribute to continuous monitoring, even in cases of hardware or software anomalies. These enhancements improve system reliability and user confidence by providing clear and actionable diagnostic information. Observability features also aid developers in optimizing system performance and addressing potential issues proactively. Furthermore, these improvements enable faster issue resolution, minimizing downtime and ensuring seamless system operation. Ultimately, these enhancements contribute to a more robust and user-friendly experience, fostering greater trust in HydroSense performance and reliability.

7.2.3 Data Storing of Historical Data in the Cloud

Currently, HydroSense stores historical data locally, which limits accessibility and scalability. Transitioning to cloud storage for historical data allow users to access their records from any device, enhancing convenience and data security. Cloud storage also provides opportunities for advanced analytics, enabling users to track long-term water quality trends and make data-driven decisions. This feature further enhances HydroSense utility by preserving valuable historical data, regardless of device or location. Moreover, cloud integration facilitates sharing and collaboration among users, expanding HydroSense applications beyond individual use.

7.2.4 Additional Sensors for Enhanced Water Quality Detection

To expand HydroSense capabilities, integrating additional sensors, such as dissolved oxygen (DO) and chlorine sensors, is recommended. Dissolved oxygen is essential for assessing aquatic ecosystem health and determining water's suitability for fish and other organisms. Chlorine sensors are critical for monitoring disinfection levels and ensuring water safety by detecting harmful pathogens. By including these sensors, it is expected to provide a more comprehensive water quality analysis, making HydroSense applicable in a wider range of scenarios, such as industrial water treatment, aquaculture, and environmental monitoring. Incorporating these sensors further strengthens HydroSense role in sustainable water management. These enhancements are likely to significantly broaden HydroSense impact and relevance.