UNIVERSITI TEKNOLOGI MARA

JIIICaS 2024
JOHOR INTERNATIONAL INNOVATION, INVENTION COMPETITION AND SYMPOSIUM

PROCEEDINGS OF JOHOR INTERNATIONAL INNOVATION INVENTION COMPETITION AND SYMPOSIUM 2024 (JIIICaS 2024)

"Flourish and Nurturing Sustainable Innovation for a Prosperous Nation"

JIICOS 2024
JOHOR INTERNATIONAL INNOVATION, INVENTION COMPETITION AND SYMPOSIUM

Editorial Board

e ISBN: 978-967-0033-25-9

Published in Malaysia by
Universiti Teknologi MARA Cawangan Johor
Kampus Pasir Gudang
81750 Masai

Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor International Innovation Invention Competition and Symposium 2024 (JIIICaS2024), where JIIICaS2024 is a virtual platform for all creative minds to share and present their invention and innovation. Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students and get some ideas to develop future innovation products.

Foreword Rector

Assalamualaikum warahmatullahi Wabarakatuh, Salam Sejahtera, Salam Malaysia MADANI and Salam UiTM Dihatiku.

In the name of Allah, the Most Gracious, the Most Merciful.

It is a great honor to welcome you to the Johor International Innovation, Invention, Competition, and Symposium 2024 (JIIICaS 2024). This event connects various disciplines, focusing on education and engaging educators, students, researchers, and innovators from all walks of life.

Innovation is not just about ideas; it demands perseverance, creativity, and determination to turn those ideas into reality. The remarkable projects showcased today highlight the dedication and spirit of all participants. Initiatives like this not only explore new technologies but also cultivate skills and leadership among our youth. At Universiti Teknologi MARA (UiTM) Johor Branch, we are fully committed to fostering a dynamic culture of innovation, promoting the commercialization of new products, and encouraging meaningful collaborations with industry and society.

As we celebrate this event, I would like to extend my heartfelt gratitude to all sponsors, judges, the College of Computing, Informatics and Mathematics, UiTM Pasir Gudang Campus as the event organizer, as well as to the researchers and participants for their hard work in making this event a success. Let us continue striving for innovation and excellence. May the ideas presented today inspire us and lay the groundwork for future achievements.

Thank you.

Associate Professor Dr. Saunah Zainon
Rector
Universiti Teknologi MARA (UiTM)
Johor Branch

(A-ST016) AQUAWATER: AN IOT APPLICATION FOR AQUARIUM WATER QUALITY MONITORING

Ahmad Redzuan Bin Mohd Nordin[1], Norkhushaini Binti Awang[1]

[1] College of Computing, Informatics, and Mathematics, Universiti Teknologi MARA 40450 Shah Alam, Selangor, Malaysia

Corresponding author: shaini@tmsk.uitm.edu.my

ABSTRACT

The Aquawater mobile application represents a significant advancement in aquarium management by integrating IoT technology to monitor and control water quality through sensors. Traditional aquarium maintenance often involves labour-intensive tasks such as manual water sampling and frequent water changes, which are essential for the well-being of aquatic life. Aquawater addresses these challenges by offering a mobile application that tracks key water quality parameters, including pH levels, turbidity, and temperature, delivering real-time data directly to the user. This app not only simplifies the monitoring process but also facilitates maintenance tasks, such as water replacement, through convenient features like button-activated and program-based timers. By automating these processes, Aquawater minimizes the risk of exposure to harmful organisms and ensures a healthier environment for aquarium inhabitants. Developed using the Mobile Application Development Life Cycle (MADLC), the application has been proven effective in both monitoring and maintaining water quality. Detailed analysis demonstrates its ability to enhance user convenience while supporting the optimal conditions for aquatic life. Furthermore, the project highlights the benefits of incorporating sensors and real-time data analysis into the application, ultimately showcasing the potential of IoT solutions in addressing everyday challenges. The Aquawater moble application not only enhances user experience but also underscores the value of IoT in creating innovative and efficient tools for routine tasks, offering a smarter approach to aquarium care.

Keywords: IoT, aquarium monitoring, mobile application

1.0 INTRODUCTION

Maintaining appropriate water quality in an aquarium is essential for fostering a thriving and visually appealing aquatic ecosystem while safeguarding the health and longevity of its inhabitants. Regular monitoring, timely water changes, and the use of effective filtration systems are critical practices in aquarium husbandry that help mitigate issues arising from suboptimal water conditions. Poor water quality can severely impact the growth and immune systems of aquatic organisms, increasing their vulnerability to diseases such as bacterial, fungal, and parasitic infections. The challenges of maintaining water quality are compounded by the need to monitor multiple parameters, including pH, temperature, turbidity, and water levels, which can be particularly inconvenient for individuals with busy schedules. This inconvenience is further exacerbated during water changes, which are not only time-consuming but can also cause temperature fluctuations that negatively affect aquatic life. To address these challenges, more efficient methods of real-time water quality monitoring and management are required. The

adoption of Internet of Things (IoT) technology offers a promising solution, enabling remote monitoring and control of aquarium systems through real-time updates to a smartphone. This approach not only simplifies the management process but also ensures a healthier environment for aquarium inhabitants, enhancing both user convenience and the well-being of aquatic life.

2.0 PROJECT OBJECTIVES

The project's objective is to develop an automatic water change mechanism and real-time water quality monitoring capabilities into an aquarium system. With a comprehensive solution that minimizes human care efforts and guarantees ideal conditions for aquatic life, this unique design aims to change traditional aquarium administration. The proposed system aims to improve aquarium management processes' overall sustainability, ease of use, and efficiency by utilizing cutting-edge technology, thereby enhancing the health and well-being of the aquatic ecosystem.

The primary objectives of this project are focused on enhancing the management of aquarium environments through the integration of IoT technologies. Firstly, the project aims to develop an IoT-based aquarium system that enables real-time monitoring of water quality parameters, such as pH, turbidity, and temperature. This system ensured that optimal conditions for aquatic life are maintained by continuously analyzing data and making automated adjustments as needed. The second objective of the project is to integrate an automated water change system into the aquarium setup. This feature is specifically developed to reduce the manual work often required for aquarium maintenance while enhancing the overall effectiveness, convenience, and ecological soundness of aquarium care. Together, these objectives aim to revolutionize traditional aquarium management practices, promoting the health and well-being of aquatic environments while significantly reducing the effort required by users.

3.0 PROJECT METHODOLOGY

In developing an advanced aquarium management system, the integration of various sensors and components is crucial to ensure precise monitoring and control. Central to this system is the ESP-WROOM-32 module, powered by the ESP32 microcontroller with a dual-core Xtensa LX6 CPU running at up to 240 MHz, which manages the water pump, pH sensor, temperature module, turbidity module, and ultrasonic sensor. This microcontroller, with its Wi-Fi and Bluetooth connectivity, facilitates seamless communication and control over the aquarium's monitoring system. The system includes a submersible DC water pump, activated by a 5V relay, to automate the water change process, while the DS18B20 temperature sensor ensures accurate monitoring of water temperatures ranging from -55°C to +125°C. Additionally, the water's pH and turbidity levels are monitored using the PH4502C pH sensor and a turbidity sensor module, respectively, ensuring the maintenance of optimal water conditions. The ultrasonic sensor measures the water level by detecting distance, which can be converted into centimetre or meter outputs. Sensor connections are made using various jumpers linked to the ESP32 GPIO pinout on a breadboard, with power supplied through a DC Power Jack Breakout Board. A USB DC cable is used to connect the power module and ESP32 for coding purposes. Finally, a one-gallon water bottle is utilized as a prototype base, providing a practical environment for testing and development. Figure 1 presents a flowchart illustrating the navigational

pathways and interactions within the Aquawater: An IoT Application for Aquarium Water Quality Monitoring. This diagram offers a comprehensive visual representation of the application's user interface, mapping out each step of the user journey from initiation to completion.

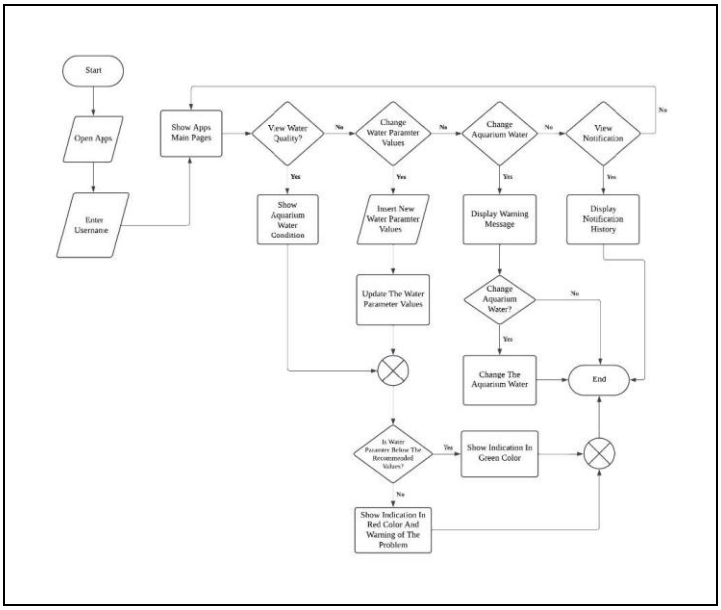

Figure 1: Project Flowchart

4.0 PROJECT RESULTS

The homepage of the Aquawater mobile application provides users with an interactive interface to monitor and manage their aquarium's water parameters. Users can view a chart displaying selected water parameters over time and can switch between different charts using the "Change Chart" button. Additional features on the homepage include a notification button, a water change button, and a floating plus button, which, when interacted with, reveal options to edit or schedule water changes. Initiating a water change prompts a confirmation pop-up, requiring users to confirm or cancel the action. Upon confirmation, the application sends a signal to the aquarium to proceed with the water change, as depicted in Figure 2. The scheduling page allows users to set water change schedules for specific days and times, with the option to select multiple days using the same timer, or to create additional schedules for different times, as shown in Figure 3. The parameter page displays default target values for water quality, which users can customize according to their needs. Changes can be saved or reset to default values, with an information button available to display an illustration of the water parameter, as illustrated in Figure 4.

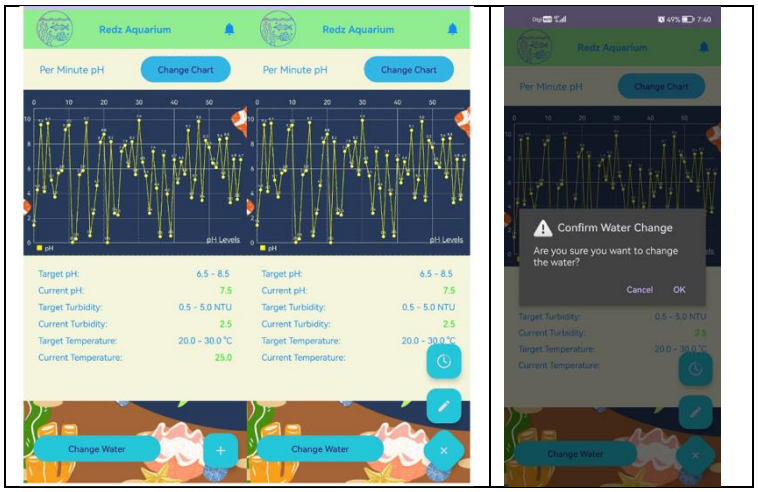

Figure 2: Main Page for Aquawater Mobile Application

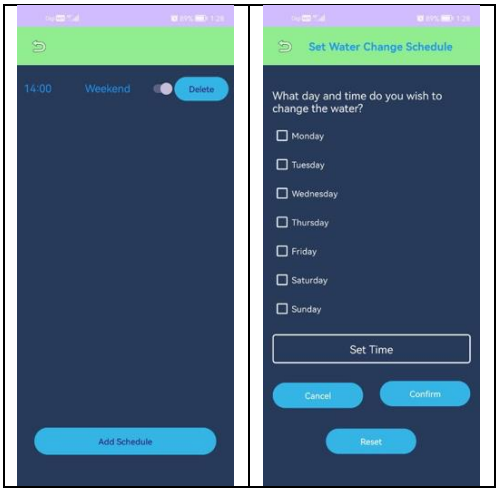

Figure 3: Scheduling Water Change for Aquawater Mobile Application

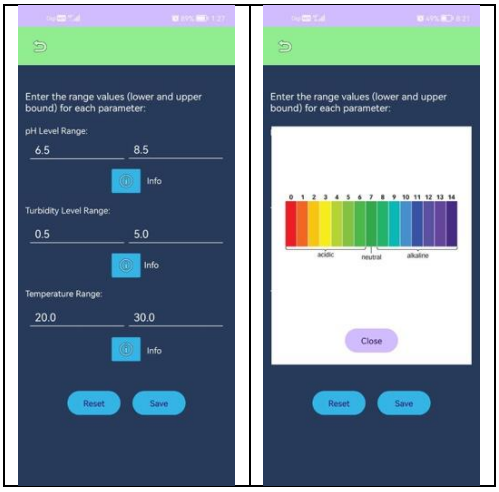

Figure 4: Customizing and Managing Water Quality

The notification page provides updates on the water change process and alerts users if any water parameters fall outside the desired range. Users can also filter graphs by selecting specific parameters using the "Change Chart" button, as demonstrated in Figure 5.

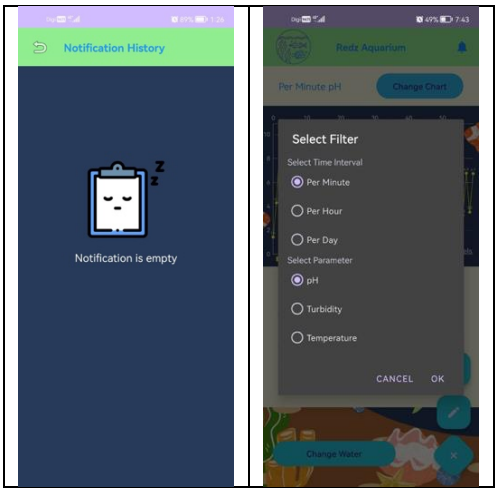

Figure 5: Water Change Updates and Parameter Notification

The AquaWater: An IoT Application for Aquarium Water Quality Monitoring prototype comprises several key components essential for its functionality. These include the ESP32 microcontroller, two relay modules, two water pumps, and sensor modules for monitoring water temperature, pH levels, turbidity, and water level via an ultrasonic sensor. Each of these components is integrated to work cohesively, allowing for comprehensive real-time monitoring and control of aquarium conditions. The assembly of these components in the prototype is depicted in Figure 6, demonstrating their configuration and interaction within the system.

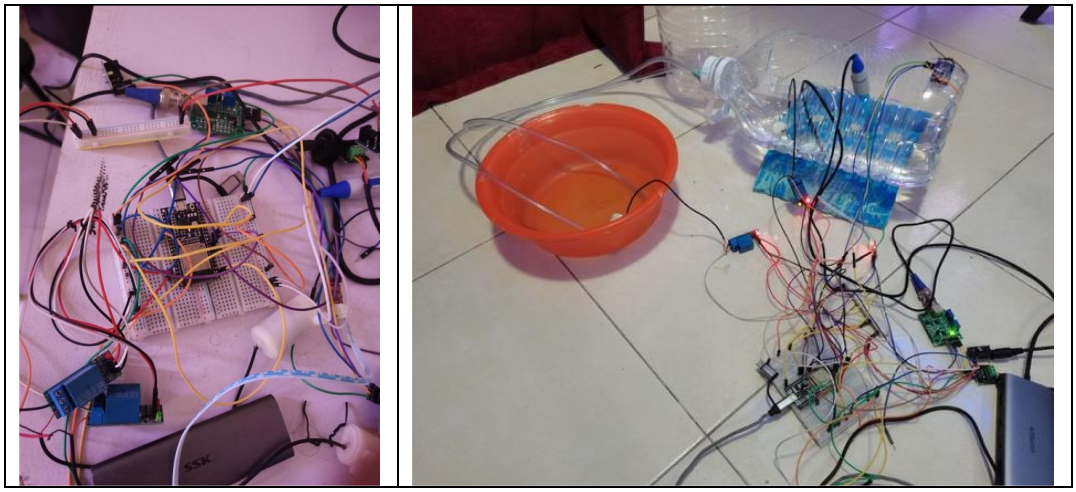

Figure 6: Project Prototype

5.0 CONCLUSION

In conclusion, the integration of an ESP32 microprocessor with various sensors such as pH, temperature, turbidity, and ultrasonic modules, enables comprehensive monitoring and management of aquarium water parameters. The sensor data is processed and stored in a database, allowing the mobile application to display real-time water quality information, set target values, and automate water changes through a 5V relay and water pump. This system offers aquarium hobbyists an efficient and user-friendly tool for maintaining optimal water conditions and ensuring the health of their aquatic environments.