

# AquaFy: Water Dispenser Monitoring System using IoT with SMS Notification

Angel L. Braña<sup>1</sup>, Warren G. Panes<sup>2</sup>, Metche A. Golez<sup>3</sup>, Judy-An C. Albanes<sup>4</sup>

<sup>1,2,3,4</sup>Iloilo State University of Fisheries, Science and Technology

<sup>1</sup>branaangel@isufst.edu.ph, <sup>2</sup>paneswarren@isufst.edu.ph, <sup>3</sup>golezmetche@isufst.edu.ph

<sup>4</sup>albanesjudy@isufst.edu.ph

**Abstract**— This study developed and evaluated an IoT-based Water Dispenser Monitoring System with SMS Notifications for staff and maintenance personnel. Conducted at Iloilo State University of Fisheries Science and Technology from March to November 2024, the research utilized a descriptive developmental method and the SDLC-Waterfall model. Tools such as Arduino IDE, PyCharm, and Semaphore API were employed, alongside hardware components like the ESP8266 NodeMCU, Coin Acceptor, Water Flow Sensor, Water Pump, and LEDs. Usability was assessed using the System Usability Scale (SUS), involving one staff representative from each ISUFST-SEC course and 306 randomly selected students. The system achieved an outstanding SUS score of 96.27, ranked "A+" within the 96-100 percentile range, indicating exceptional usability. The AquaFy system automates water dispenser operations, reducing labor costs and downtime while enhancing maintenance through real-time alerts and remote monitoring. The results demonstrate that the system is a cost-effective and practical tool for improving operational efficiency, with significant usability and functionality benefits.

**Keywords**—IoT-Based, Monitoring, ESP8266 NodeMCU, SDLC-Waterfall Method

## 1. INTRODUCTION

### 1.1 Background of the Study

As innovation continues, rapid progress and advancements are in several areas, including water management. Controlling water resources has changed due to innovations like artificial intelligence, the Internet of Things (IoT), and real-time monitoring systems. Despite these advancements, institutions still need help with challenges related to water scarcity, especially maintaining stable and reliable water supply levels at on-campus water stations. The issue arises when organizations such as offices, educational institutions, and health centers face disruptions due to empty water coolers. Manual monitoring often delays refilling water tanks, causing inconvenience to users and potential health risks due to water scarcity. Moreover, the need for automated and responsive systems further complicates the issue as organizations need help to ensure continuous and reliable water supply to residents.

Researchers proposed AquaFy: Water Dispenser Monitoring System using IoT with SMS Notifications to solve this urgent problem using IoT and SMS notifications. AquaFy uses cutting-edge technology to monitor the water level in the dispenser in real time. When the water level drops below a predefined threshold, authorized Personnel receive an instant SMS alert prompting timely action to refill the dispenser. This proactive approach eliminates the need for manual monitoring, reduces the risk of water shortage incidents, and promotes a healthier and more efficient facility environment. 1.2

### 1.2 Objectives of the Study

This study aimed to develop the AquaFy: Water Dispenser Monitoring System using IoT with SMS Notification. Specifically, this study aimed to:

1. develop AquaFy: Water Dispenser Monitoring System using IoT with SMS Notification to promptly inform authorized Personnel when the water level in a dispenser falls below a predefined threshold;
2. to integrate an ESP8266-NodeMCU with a water flow sensor to measure the flow rate and track the total amount of water dispensed. and utilize the Semaphore SMS API to send notifications to the authorized Personnel;
3. to assess whether the deployment of the system is economically justified by evaluating if the system's long term benefits, such as cost savings, efficiency improvements, and user satisfaction, outweigh its development and operational costs, ultimately leading to a positive return on investment and
4. evaluate the system in terms of usability.

### 1.3 Conceptual Framework

The conceptual framework of this study used the Input Process-Output (IPO) Diagram. The researcher gathered data in order to conceptualize the problems to be addressed. Using the System Development Life Cycle (SDLC), the researcher was able to define, design, construct and evaluate a system that have addressed the problems that were determined during the data gathering

phase. AquaFy: Water Dispenser Monitoring System using IoT with SMS Notification served as the output in this case. The output system was subjected to evaluation of its usability. Finally, using these Inputs and Processes, the researcher was able to come up with the AquaFy: Water Dispenser 1 Monitoring System using IoT with SMS Notification.

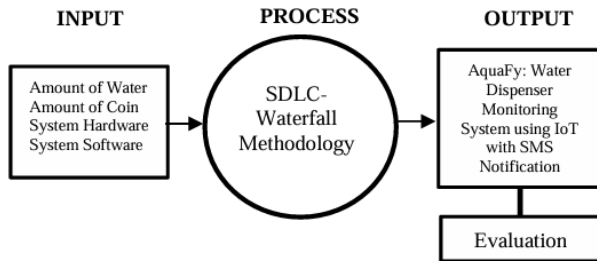


Figure 1 – The Conceptual Framework of the Study

#### 1.4 Significance of the Study

The AquaFy: Water Dispenser Monitoring System using IoT with SMS Notification that was developed benefits the following individuals: Students. The students will benefit from a reliable and continuous water supply, contributing to their health, well being, and overall convenience during their academic activities. Faculty and Staff. The faculty and staff members benefit by having access to well-maintained water dispensers, supporting a healthier and more productive work environment. Maintenance Personnel. The maintenance and support services staff benefit by having a more efficient system for monitoring and responding to water dispenser needs. Entrepreneurs.

Entrepreneurs benefit from this study as it offers a cost-effective, efficient, and convenient solution for managing water dispensers, ultimately improving business outcomes and customer satisfaction. Researchers. This study benefits the researchers by enhancing their knowledge in developing a functional system. Future Researchers. Future researchers use the study's findings to build systems that can act as a guide or origin of creativity for their work in the future.

## II.METHODOLOGY

### 2.1 Research Design

This study used the descriptive-developmental method of research. Descriptive research could be explained as a statement of affairs as they were at the time of the study, with the researcher having no control over variables. Moreover, descriptive studies might have been characterized as simply the attempt to determine, describe, or identify what was. In contrast, analytical research attempted to establish why it was that way or how it came

to be. Three primary purposes of descriptive studies were described, explained, and validated research findings. This type of research was popular with a non-quantified topic.

Descriptive research aims to illuminate current issues or problems through a data collection process, enabling a comprehensive description of the situation. It aims to describe various aspects of the phenomenon and is often utilized to outline the characteristics and behavior of the sample population. This method effectively gathers information to develop hypotheses and propose associations (John Dudovskiy, 2007). 3.2 Waterfall Methodology In developing the "AquaFy: Water Dispenser Monitoring System using IoT with SMS Notification," the researchers used the System Development Life Cycle – Waterfall method. The activities that the researchers performed in each stage were discussed in the following:

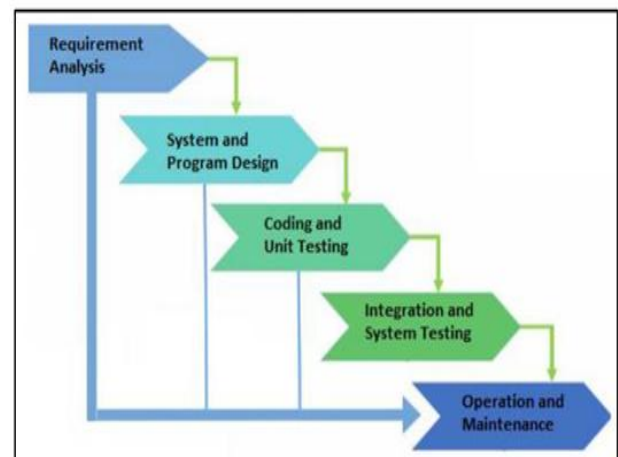


Figure 2. Waterfall Methodology

### 2.2 Overview of Phases

This study used the TeamGantt management tool as a guide in project development. Using the Waterfall Methodology the study went through five (5) phases. The researchers followed the five (5) stages of the Waterfall model to plan and execute the specific task for each phase. The detail discussion and description for each phase are explained as follows:

### 2.3 Requirement Analysis.

In this stage, the researchers requested permission from the campus administrator to use IoT with SMS notification for the AquaFy: Water Dispenser Monitoring System study. Following approval, the researchers met once a week to plan and discuss the system development. A Gantt chart was constructed to help manage the timeframe and identify the precise steps needed to finish the system. This plan allows the researchers to do the necessary assignments and activities in the allotted period.

## 2.4 System Design.

During this phase, the researchers used a prototype, activity diagram, deployment diagram, and use case diagram to help design and develop the system. A physical model prototype was created to represent the final project visually.

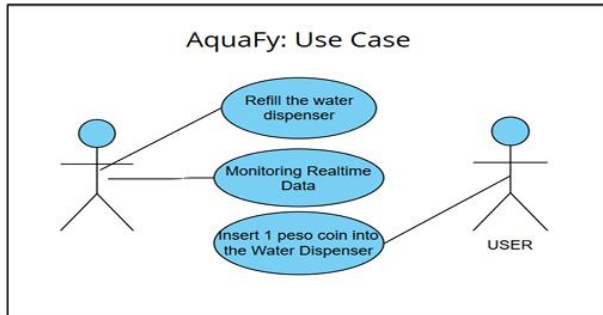


Figure 3. The Use Case Diagram of AquaFy

This study used a Use Case Diagram to describe how the User and the Admin interact with the system. It describes and signifies an interaction over time with meaning for end-users (person, machine, or other system).

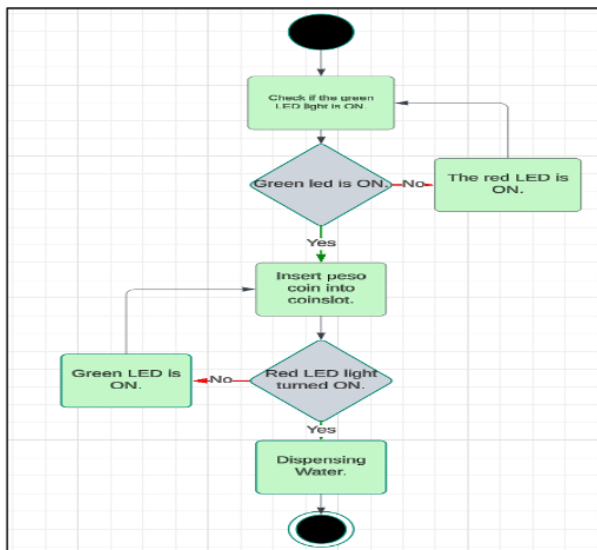


Figure 4. Activity Diagram for User of AquaFy

The diagram (Figure 4) showed a detailed visual description of the actions the user can perform when interacting with the system. First, the user must check if the green LED light is ON. The green LED indicates that the system is ready to accept a coin and dispense water. If the green LED is not ON, it means the system is not currently available, and the red LED will be ON to signal that the dispenser cannot be used at the moment.

## 2.5 System Architecture.

This study utilized system architecture in AquaFy serves to provide a structured framework that ensures the system operates efficiently and effectively. It defines the major components, such as the water dispenser, NodeMCU ESP8266, moisture sensor, water flow sensor, coin acceptor, and Semaphore SMS API, and outlines how these components interact. The design streamlines the workflow for features like coin detection, water flow measurement, and SMS notifications, enabling seamless operation.

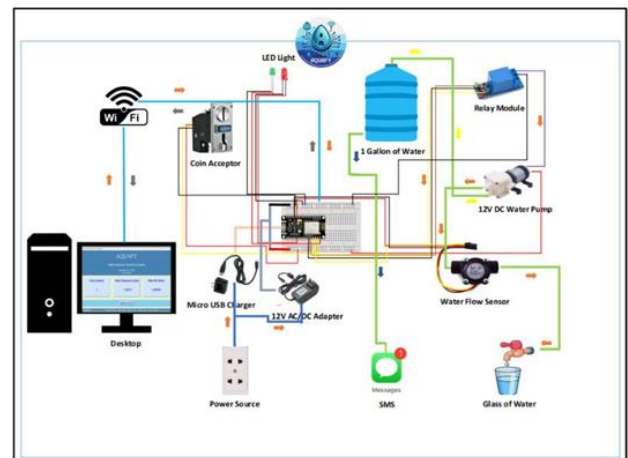


Figure 7. The System Architecture of AquaFy

## III. RESULTS AND DISCUSSION

### 3.1 The Developed AquaFy

Water Dispenser Monitoring System using IoT with SMS Notification The Developed AquaFy: Water Dispenser Monitoring System using IoT with SMS Notification was developed using a desktop program to track the System's real-time activities and automate the monitoring of water dispensers through SMS notifications.

### 3.2 Result of System Usability Evaluation.

The AquaFy: Water Dispenser Monitoring System using IoT with SMS Notification was evaluated by one (1) staff of every course and three hundred six (306) students from ISUFST-SEC. Results showed that the System got a System Usability Scale Score of 96.27, which means it received a grade of A+, it is within the 96- 100 Percentile Range, it is described as "Best Imaginable," "Acceptable" as to Acceptability, and got a Net Promoter Score described as "Promoter" which means that the respondents promoted the evaluated System.

### 3.1 Findings

The study revealed the following:

1. The system AquaFy: Water Dispenser Monitoring SDLC technique is employed to develop an IoT system with SMS notifications.
2. The system got a SUS score of 96.27.
3. The system is graded "A+"; that is scored better than the 90-95 percent of the systems that had been tested for usability.
4. The system is described as "Best Imaginable"; that it is "Acceptable" in terms of acceptability.
5. Based on Net Promoter Score, it earned the status of "Promoter", meaning that the respondents promoted the evaluated system.
6. The system demonstrates financial viability, as the owner can recover the initial cost by selling just 223 water containers.

### CONCLUSIONS

The study concluded that the AquaFy: Water Dispenser Monitoring System using IoT with SMS Notification using the SDLC Waterfall Methodology. The target users found the system to be acceptable in terms of usability.

### RECOMMENDATIONS

The following recommendations were made based on the study's findings and outcomes:

1. The AquaFy: Water Dispenser Monitoring System using IoT with SMS Notification may be utilized for business and market expansion.
2. Future researchers who will conduct the same study may improve the features of the system by adding analytics.
3. Future researchers who will conduct the same study may improve the system by adding a hot and cold feature.

### REFERENCES

- [1] Abu-Bakar, H., & Hallett, S. H. (2021). Flow sensor. ScienceDirect. <https://www.sciencedirect.com/topics/engineering/flow-sensor#:~:text=These%20sensors%20work%20based%20on,proportional%20to%20the%20flow%20velocity> Arduino. (n.d.). Arduino IDE v1 basics. <https://docs.arduino.cc/software/ide-v1/tutorials/arduino-ide-v1-basics>
- [2] Chou, S.-Y., et al. (2021). An automatic energy-saving strategy for a water dispenser based on user behavior. ScienceDirect. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S1474034621002524>
- [3] Gunasinghe, A., & Tharmaseelan, J. (2019). Smart water dispenser. International Journal of Innovative Science and Research Technology. Retrieved from <https://ijisrt.com/wp-content/uploads/2019/05/IJISRT19AP195.pdf>
- [4] Guenther, P. M., et al. (2010). Update of the healthy eating index: HEI-2010. Nutrition Reviews, 68(8), 439–444. <https://doi.org/10.1111/j.1753-4887.2010.00344.x>
- [5] Magdum, S. S., Varude, M. P., Patil, S. B., Patil, O. D., & Murgunde, S. S. (2024). Hot and cold water dispenser using coin acceptor. International Journal of Advanced Research in Innovative Engineering, 10(1). Retrieved from [https://ijariie.com/AdminUploadPdf/HOT\\_AND\\_COLD\\_WATER\\_DISPENSER\\_USING\\_COIN\\_ACCEPTOR\\_ij\\_ariie22482.pdf](https://ijariie.com/AdminUploadPdf/HOT_AND_COLD_WATER_DISPENSER_USING_COIN_ACCEPTOR_ij_ariie22482.pdf) Pump Solutions. (n.d.). A brief history of water pumps and how they have affected the world. Retrieved from <https://pumpsolutions.com.au/a-brief-history-of-water-pumps-and-how-they-have-affected-the-world/>