SOFTWARE ENGINEERING TEAM PROJECT

SSE 4301-2

TASK:

LAB 2: SOFTWARE REQUIREMENTS SPECIFICATION

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PJBUMIHES

Software Requirements Specification

for

LoRa Based Alert System for Aquatank Water Quality (Condition) and Fish Measurement System (LoRaFish)

Prepared by Team LoRaFish

Faculty of Computer Science and Information Technology, UPM

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Revision History

Name	Date	Reason for Changes	Version
SRS for LoRa Based Alert System for Aquatank Water Quality (Condition) and Fish Measurement System (LoRaFish)	04/04/2023	First draft	1.0.0
SRS for LoRa Based Alert System for Aquatank Water Quality (Condition) and Fish Measurement System (LoRaFish)	08/04/2023	Completing document	1.1.0

1 Introduction

The Software Requirements Specification (SRS) is a thorough document that details the functional and non-functional requirements of a software product. It is typically divided into sections like the Introduction, Scope, Functional Requirements, Non-Functional Requirements, User Interfaces, System Features, and Appendices in order to help organise and logically separate the requirements into easily referred-to parts. The software development team uses this document as a blueprint, using it to comprehend clearly what the programme should be able to do, what it should not be able to accomplish, and what restrictions or limitations it must follow in order to satisfy the needs and expectations of the stakeholders.

1.1 Purpose

The purpose of the Software Requirements Specification (SRS) document is to provide a clear and comprehensive understanding of the software requirements to PJBUMIHES that are involved in the software development process. This document serves as a crucial communication tool between stakeholder, and the development team, helping to ensure that everyone is on the same page regarding what the software should do and how it should behave.

The SRS document plays a vital role in the software development process, as it helps to define and document the software's functional and non-functional requirements, user interfaces, system features, and constraints. It also provides a reference point for the development team to use during the software development life cycle (SDLC) to ensure that the software product meets the stakeholder’s expectations.

1.2 Scope

The scope of this project is to develop a web application that enables PJBUMIHES to monitor and analyse data from their aquatanks in order to make informed decisions and optimise their operations. The system will be run on a web application with each user interacting through a web browser. This system is cross-platform and is available to anyone using the web browser. There will be four actors in the use case of the web application: the public, maintenance team, management team, and purchaser. The system will allow for the following functions:

1. Public Actor
    - Register as a user of the system
    - Login to the system
    - View the dashboard

2. Maintenance Team Actor
    - Login to the system
    - View the dashboard
    - Manage sensors
    - Manage Aquatank marine life

3. Management Team Actor
    - Login to the system
    - View the dashboard
    - Manage aquatank water condition
    - Manage alarms
    - Analyse costs

4. Purchaser Actor
    - Register as a user of the system
    - Login to the system
    - View the dashboard
    - Supply Resources

1.3 Definitions and Acronyms

Public	User that uses LoRaFish to view the dashboard.
Management Team	User that manages aquatank water condition, alarm settings and analyses cost of maintenance.
Maintenance Team	User that maintains sensors and aquatank marine life.
Purchaser	User that supply the resources needed to maintain the aquatank.
aquatank	Tank that stores marine life.
LoRaFish	The name of the system.

SRS	Software Requirement Specification
LoRa	Long Range
UI	User Interface

1.4 References

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1.5 Overview

The purpose of this document is to provide a comprehensive overview of the system, including its functional and non-functional requirements, data, and behavioral models. It is divided into three parts: the first part provides a brief introduction to the project and system, including any relevant connections to other project management plans. Part 2 focuses on specific requirements, data, and a behavioral model outlined in sections 3, 4, and 5. Finally, Part 3 includes planning, conclusion, and supporting information related to the system. This document is the Software Requirement Specifications for LoraFish.

2. Overall Description

This section includes the details about what is expected of the LoRaFish system. In addition, assumptions are made to be used in the creation of the system.

2.1 Product Perspective

LoRaFish allows users to track water acidity levels over different time periods (yearly, monthly, weekly, and daily) and displays this data in a dashboard format that can be accessed via any web browser. Additionally, LoRaFish also displays fish length and weight data, providing insights into how water acidity levels affect fish growth and health. It is designed to be user-friendly and accessible to the public, purchasers, maintenance team, and management team. There are no specific hardware or software requirements needed to use LoRaFish beyond a device with a web browser.

2.2 Product Functions

LoRa Based Alert System for Aquatank Water Quality (Condition) and Fish Measurement System (LoRaFish) will provide a number of functions; each is listed on the table below.

Use Case ID	Name	Brief Description
UC_01	Register	New users can create an account and register their personal information to access the LoRaFish system and view

		dashboard.
UC_02	Login	Registered users can log in to the LoRaFish system using their username and password to access their personalised dashboard and view aquatank's water acidity and fish health data
UC_03	View Dashboard	Authorised users can view their personalised dashboard that displays the water acidity levels and fish health data of their aquatank over a period of time (yearly, monthly, weekly, daily), as well as the fish length and weight data and its correlation with the water acidity levels.
UC_04	Manage Sensors	The maintenance team manages sensor inventory, input, and data structure. They add/remove sensors, manage input, and ensure data accuracy in the database.
UC_05	Manage Aquatank Marine Life	Involves collecting and managing data related to the marine life living inside the aquatanks. This includes recording the type, length, and weight of each fish in the tank.
UC_06	Manage Aquatank Water Condition	Management team manages the water condition in the aquatank in terms of its acidity levels, gases (oxygen, hydrogen, nitrate, carbon dioxide, mercury) content, and temperature. The management team will be able to set the quality threshold based on the tank range and take necessary measures to maintain a healthy and balanced water quality for the marine life in the aquatank.
UC_07	Manage Alarm	The management team set up the critical event condition on aquatank. If a critical event condition has been triggered, the management team views the details of the condition. The management team clears the alarm and resets the critical event condition settings to their default values.
UC_08	Analyse Cost	The management team analyses the cost of maintaining the

		aquatank. This includes the chemicals used to maintain the acidity at an optimum level, the price of sensors used for each tank and other resources used to maintain the tank.
UC_09	Supply Resources	The purchaser will record all the suppliers' databases to keep track of the supply resources needed to maintain the acidity level of each of the aquatank. This includes the chemical substances to neutralise water in the aquatanks.

2.3 User Characteristics

There are mainly four kinds of users of LoRaFish.

Actor ID	Actor/Roll Name	Role Description and Objectives
A001	Public	Public is the person who can use the system and are only view the dashboard about the water quality and condition (i.e. O2, H2, NH3, H2S, CO2, Hg content, temperature and acidity)
A002	Maintenance Team	Maintenance team who will be responsible for managing and maintaining the sensors in aquatanks. This includes checking the number of sensors, adding or removing sensors as needed, where each aquatank is located, and acknowledging what types of fish exist in the aquatank.
A003	Management Team	Management team responsible to monitor the value of water quality and condition in aquatank. View the history of water quality and condition in aquatanks. Analyze the cost of maintaining each aquatank. Sets the value of water quality and condition on the aquatank for any critical events.

A004	Purchaser	Purchaser who will get the database of suppliers for the substances needed for our aquatanks. Get information about the substances needed for aquatanks, such as quantity, quality, and price. Maintain accurate records of purchases and suppliers.

2.4 Constraints

The following are the main constraints,

• The accuracy of the sensors depends on the type and quality of the sensors used.

• The system must have reliable connectivity to ensure that data can be transmitted from the sensors to the monitoring system.

2.5 Assumptions and Dependencies

The following are the main assumptions and dependencies,

• The sensors used in the system are of high quality and accurate.

• The system's accuracy is dependent on the calibration and maintenance of the sensors.

2.6 Apportioning of Requirements

This subsection identifies the requirements that may be delayed until future versions of the system with priority assigned to each of the requirements.

Use Case ID	Use Case Name	Primary Actor	Priority
UC_01	Register	Public, Maintenance Team, Management Team, Purchaser	1
UC_02	Login	Public, Maintenance Team, Management Team, Purchaser	1

UC_03	View Dashboard	Public, Maintenance Team, Management Team, Purchaser	1
UC_04	Manage Sensors	Maintenance Team	1
UC_05	Manage Aquatank Marine Life	Maintenance Team	1
UC_06	Manage Aquatank Water Condition	Management Team	1
UC_07	Manage Alarm	Management Team	1
UC_08	Analyse Cost	Management Team	1
UC_09	Supply Resources	Purchaser	1

3 Specific Requirements

This section provides all the detailed functional and non-functional requirements.

3.1 External Interfaces Requirements

This section provides details of all inputs and outputs including user interface, hardware, software, communication. Software Requirement Specifications for LoRa Based Alert System for Aquatank Water Quality and Fish Measurement System.

3.1.1 User Interface Requirements

User Interface (UI) requirements are an important aspect of any software system. In the case of the web application for managing the aquatank, the following UI requirements should be considered:

- The system must have a registration and login page for users to access the system with their respective roles.
- The dashboard should provide clear and concise analytics of data from the sensors in the aquatank, with different time ranges available, including yearly, quarterly, monthly, weekly, and daily.
- The system should have different views for different actors, such as the public, maintenance team, management team, and purchaser. Each view should only display relevant information and functions according to the actor's role.

- The system should allow purchasers to supply the resources from the dashboard.
- The system should have a notification system to inform the maintenance team when the acidity level of the water exceeds a certain threshold.

These UI requirements will ensure that the web application for managing the aquatanks is user-friendly, accessible, and meets the needs of its users

3.1.2 Hardware Interface Requirements

There are several sensors that used to build LoRaFish system:

- Neptune Aqua Farm sensor (honeywell): A device that is designed to monitor and control various parameters related to aquaculture, such as water temperature, pH levels, dissolved oxygen, and salinity. The function of the Neptune Aqua Farm sensor is to provide real-time data on the water conditions in the aquaculture system and alert the user if any of the parameters fall outside the desired range.

- LoRa wireless technology: This device provides long-range and low-power communication between devices (LoRaNet). LoRa devices can be used to collect and transmit data from multiple sensors distributed throughout the aquafarm, providing real-time information on the status of the system.

- Biomass Optical Scanner (BOS): The BOS system uses a high-resolution camera and advanced image processing software to capture images of fish as they swim through a scanning area. The software then analyses the images to determine the length and weight of each individual fish, providing valuable data for aqua farmers to track the growth and health of their fish populations.

- RK500-12 pH sensor: Consists of a glass electrode, a reference electrode, and a temperature sensor, which work together to measure the pH of the water. The glass electrode is sensitive to changes in the pH level of the water, while the reference electrode provides a stable reference potential. The temperature sensor measures the temperature of the water, which is used to compensate for changes in pH due to temperature variations.

- RK500-01 Liquid Temperature sensor: Installed directly in the aquatank or in the water supply line, and it can be connected to a monitoring system or controller to provide

continuous temperature readings. With this data, aqua farmers can make adjustments to the heating or cooling systems to maintain a consistent water temperature, which is essential for fish health and growth.

- RK500-04 Dissolve Oxygen sensor: Use a membrane-covered electrode to measure the oxygen concentration in the water. The sensor can be calibrated to specific ranges of oxygen concentrations and can provide accurate measurements over a wide range of temperatures and salinity levels.

- Arduino Mega: A microcontroller board based on the ATmega2560 microcontroller. It has numerous digital and analog input/output pins, making it well-suited for controlling a variety of components in an aquaculture system.

There is no direct hardware interface specifically for the LoRaFish system. The web application is a client/server system running on an application server hosted in-house on enterprise hardware.

3.1.3 Software Interface Requirements

- User Side: Google Chrome, Safari, Microsoft Edge, Mozilla Firefox - These are the web browsers used by the end-users to access the web application interface.

- System Side: Web-based application - The web application itself is a software system that runs on the server-side and provides the user interface for the end-users to interact with the system. It is designed using HTML, CSS, XAMPP, and Power BI. The back-end of the system is developed using XAMPP, MySQL, and PHP. The front-end of the system is developed using Flutter for UI development.

- Machine Learning - The system will also implement machine learning to analyse the correlation between water acidity level and fish size and weight. For this, the system will use machine learning tools such as Python libraries to build and train the models. The models will be integrated into the web application to provide the analytics and insights to the end-users.

3.1.4 Communication Interface Requirements

- **Web browser** - The system should be accessible through modern web browsers such as Google Chrome, Mozilla Firefox, Safari, and Microsoft Edge. The solution should be designed responsively to ensure that it can be accessed on different devices with different screen sizes.

- **Network server communications protocols** - The system should support the standard HTTP and HTTPS protocols for communication between the client and server.

- **Communication security or encryption issues** - The system should use secure protocols to protect user data, such as HTTPS and also ensure that user authentication and authorization is implemented properly to prevent unauthorised access.

- **Synchronization mechanisms** - The system should provide a mechanism for synchronizing sensor data, such as acidity levels, gases (oxygen, hydrogen, nitrate, carbon dioxide, mercury) content, and temperature of the water in the aquatank. The synchronization mechanism should ensure that the latest version of the data is always available to the user.

3.2 Functional Requirement

This section provides details of all major functionalities supported by LoRa Based Alert System for Aquatank Water Quality (Condition) and Fish Measurement System.

1. Register: This function allows users to register for an account in the system by providing their personal details and contact information.
2. Login: This function enables users to securely login to their account and access the features of the system.
3. View Dashboard: This function allows users to view analytics and data visualisations of the aquatank conditions, such as acidity levels, temperature, and water quality.
4. Manage Sensors: This function enables the maintenance team to manage the sensors in the aquatanks and set threshold levels for alerts and notifications.

5. Manage Aquatank Marine Life: This function enables the maintenance team to monitor the marine life living inside the aquatanks, capture their images using image processing, and estimate their weight based on length and type.
6. Manage aquatank Condition: This function enables the management team to manage and maintain the ideal condition of the water in the aquatank and take necessary actions if the aquatank conditions, such as acidity levels, gases (oxygen, hydrogen, nitrate, carbon dioxide, mercury) content, and temperature exceed the set threshold.
7. Manage Alarm: This function enables the management team to set alarms and notifications for any critical events, such as exceeding acidity levels or any abnormality in the aquatank.
8. Analyse Cost: This function enables the management team to analyse the costs of managing and maintaining the aquatanks and its resources.
9. Supply Resources: This function enables the purchaser to purchase the supply resources required to maintain and manage the aquatanks, such as chemical substances to maintain the ideal pH levels of the water.

These functionalities are designed to provide the stakeholders with comprehensive and accurate data about the aquatank and its marine life, enabling them to make informed decisions about managing and maintaining the system.

3.2.1 Use Case Diagram

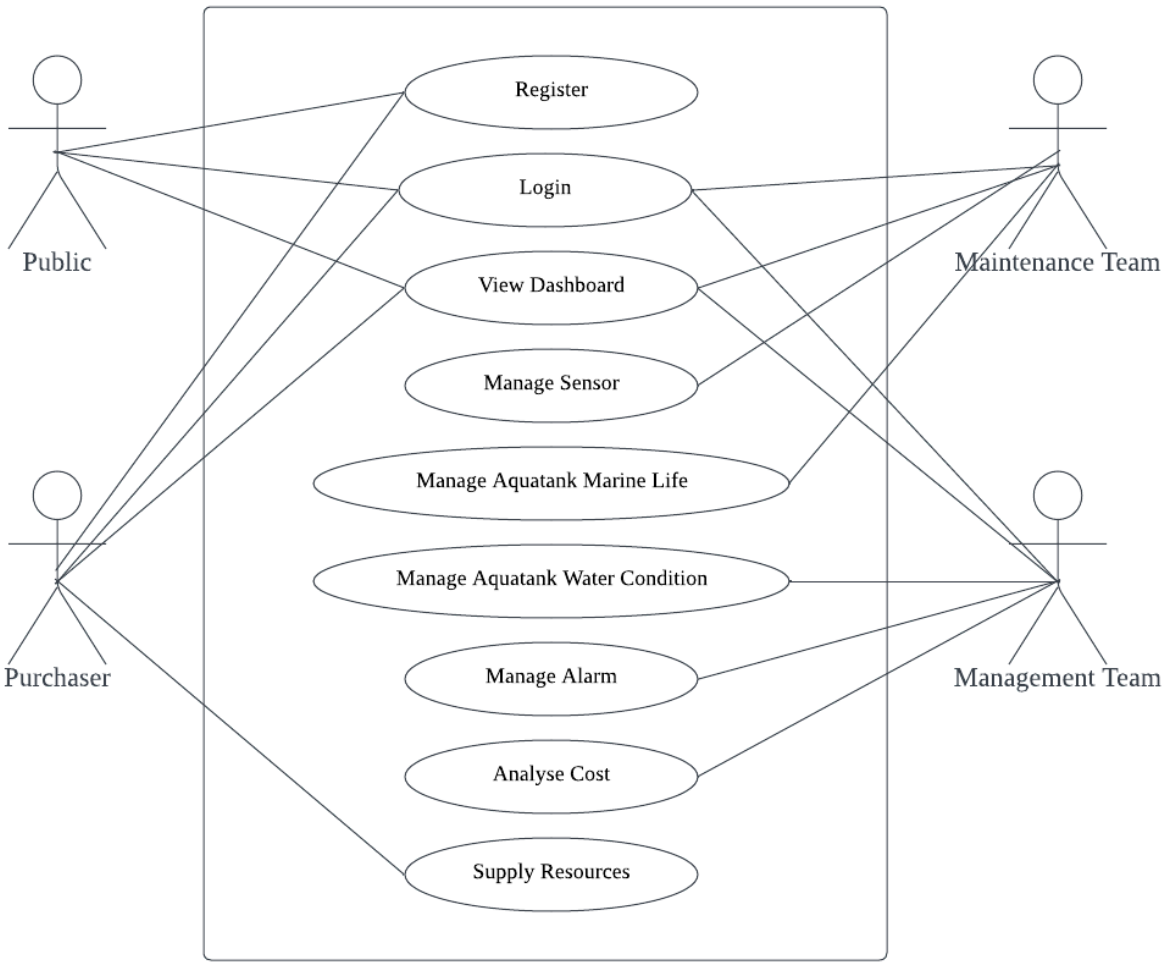

Figure 1 Use Case Diagram

3.3 Use Case Description

3.3.1 Register

Description	The Register use case describes the process by which a new user creates an account and registers their personal information in order to access the LoRa Based Alert System for Aquatank Water Quality and Fish Measurement System.
Actors	Public, Maintenance Team, Management Team, Purchaser
Preconditions	● The user has not yet registered for a LoRaFish account.
Basic Flow	1. The new user navigates to the registration page and enters their personal information, including their name, email address, and a password. 2. The system validates the information entered and creates a new account for the user. 3. The system sends a confirmation email to the user to verify their account. 4. The user receives the confirmation email and clicks on the verification link to activate their account. 5. The user gains access to the LoRa Based Alert System for Aquatank Water Quality and Fish Measurement System.
Alternative Flow	1. If the user enters invalid or incomplete information during registration, the system prompts the user to correct the errors and resubmit the information. 2. If the user does not receive the confirmation email, the system provides the option for the user to request a new email be sent.
Post-Condition	The user successfully registers for a LoRaFish account and gains access to the system.
Exception Flow	1. If the user enters an invalid email address, the system displays an error message and prompts the user to enter a valid email address.

	2. If the user's chosen password does not meet the system's password requirements (e.g., minimum length, special characters), the system displays an error message and prompts the user to choose a stronger password. 3. If the user decides to cancel the registration process, they can simply close the registration page or navigate away from it.

3.3.2 Login

Description	The user needs to log in to get full authorised access to the LoRaFish.
Actors	Public, Maintenance Team, Management Team, Purchaser
Preconditions	● The user has registered for a LoRaFish account.
Basic Flow	1. The user navigates to the login page and enters their username and password. 2. The system validates the information entered and verifies that the user is a registered user. 3. The system grants the user access to the LoRaFish system and redirects them to the dashboard page.
Alternative Flow	1. If the user enters an invalid username or password, the system prompts an error message for the user to correct the errors and resubmit the information. 2. If the user forgets their password. 2.1. The system provides the option for the user to reset their password by sending a password reset link to their email address. 2.2. The user clicks the reset password link on their email. 2.3. The user reset their password.
Post-Condition	The user successfully logs into their LoRaFish account and gains access to the system.
Exception Flow	N/A

3.3.3 View Dashboard

Description	This use case describes the process of accessing the dashboard in the LoRaFish system. The primary actor is an authorised user, such as a public, purchaser, maintenance team, or management team member, who wants to view the aquatank's water acidity and fish data in a visualised form through the dashboard.
Actors	Public, Maintenance Team, Management Team, Purchaser
Preconditions	● The user has registered for a LoRaFish account and has been authenticated to access the system.
Basic Flow	1. The authorised user logs into the LoRaFish system. 2. The system authenticates the user's credentials and grants access to the system. 3. The user navigates to the dashboard page and selects the desired aquatank. 4. The system retrieves the aquatank's water acidity and fish data from the database and displays it in a dashboard format. 5. The user can view summary statistics of the fish length and weight data and their relationship with the water acidity levels. 6. The user can interact with the dashboard, filtering data by specific parameters, such as time periods or fish species, and customising the display format.
Alternative Flow	1. If the user encounters any technical issues while accessing the dashboard, they can contact customer support for assistance.
Post-Condition	The user successfully accesses the LoRaFish dashboard and can view the summary statistics of their aquatank's water acidity and fish health data.
Exception Flow	N/A

3.3.4 Manage Sensor

Description	This use case describes the process of managing sensors in the LoRa Based Alert System for Aquatank Water Quality and Fish Measurement System.
Actors	Maintenance Team
Preconditions	● The maintenance team has access to the web application and is authorised to manage sensors. ● The sensors are connected to LoRa technology for long-range communication with the system. ● The sensor data is stored in a database managed by the system.
Basic Flow	1. The maintenance team accesses the web application and navigates to the sensor management section. 2. The system displays a list of all existing sensors with their current status. 3. The maintenance team selects the option to add a new sensor and provides the necessary details such as sensor type, location, and identifier. 4. The system validates the sensor details and adds the new sensor to the list of existing sensors. 5. The maintenance team selects an existing sensor and updates its input values such as acidity level, temperature level, and water quality. 6. The system validates the input values and updates the sensor data in the database. 7. The maintenance team selects an existing sensor and removes it from the list of sensors. 8. The system removes the sensor from the list of sensors and deletes its data from the database.
Alternative Flow	1. If the maintenance team enters invalid or incomplete details while adding a new sensor, the system displays an error message and prompts the user to enter valid details.

	2. If the maintenance team enters invalid input values while updating the sensor data, the system displays an error message and prompts the user to enter valid values. 3. If the maintenance team selects a non-existing sensor while removing it, the system displays an error message and prompts the user to select a valid sensor.
Post-Condition	The maintenance team has successfully managed sensors by adding new sensors, removing existing sensors, and updating the sensor input.
Exception Flow	1. If the system fails to validate the sensor details or input values, it displays an error message and prompts the user to enter valid details or values. 2. If the system fails to add, update or remove a sensor due to technical issues, it displays an error message and prompts the user to try again later.

3.3.5 Manage Aquatank Marine Life

Description	This use case involves managing the marine life living inside the aquatank. The actor will be able to view and manage the fish data such as type, length and weight. This includes updating the information on the fish, adding new fish data, and removing fish data if necessary.
Actors	Maintenance Team
Preconditions	The maintenance team has logged into the web application.
Basic Flow	1. The maintenance team selects the Aquatank they wish to manage. 2. The system displays a list of marine life living inside the selected Aquatank. 3. The maintenance team can view the details of each fish, such as type, length, and weight. 4. The maintenance team can update the details of each fish, such as length and weight, as needed. 5. The maintenance team can add new fish to the Aquatank.
Alternative Flow	**A1: Invalid Input Data** 4.1. If the data is invalid, the system prompts the actor to enter valid data. 4.2. If the data is valid, the system saves the new fish data and updates the dashboard with the new information. 4.3 The use case resumes from the basic flow.
Post-Condition	The maintenance team has successfully updated and managed the marine life living inside the selected aquatank.
Exception Flow	1. If the maintenance team is unable to log in to the web application, they cannot manage the marine life in the aquatank. 2. If there are no fish living inside the selected aquatank, the maintenance team cannot update or manage the marine life data.

3.3.6 Manage Aquatank Water Condition

Description	This use case involves the process of managing the water condition and quality in the aquatank in terms of its acidity levels, gases (oxygen, hydrogen, nitrate, carbon dioxide, mercury, hydrogen sulfide) content, and temperature. The actor will be able to set the quality threshold based on the tank range and take necessary measures to maintain a healthy and balanced water quality for the marine life in the aquatank.
Actors	Management Team
Preconditions	The management team has logged into the web application and is authorised to manage the aquatank water condition.
Basic Flow	1. The management team selects the aquatank they want to monitor and manage. 2. The system displays the current acidity levels, gases (oxygen, hydrogen, nitrate, carbon dioxide, mercury, hydrogen sulfide) content, and temperature of the water in the selected aquatank then compares it to the set threshold. 3. If the acidity levels, gases (oxygen, hydrogen, nitrate, carbon dioxide, mercury, hydrogen sulfide) content, and temperature of the water is within the range, the management team can choose to exit the system and select another tank or continue monitoring the tank. 4. If the acidity levels, gases (oxygen, hydrogen, nitrate, carbon dioxide, mercury, hydrogen sulfide) content, and temperature of the water exceeds the set threshold, the system sends an alert to the management team indicating that the water needs to be cured. 5. The system continues to monitor the acidity levels, gases (oxygen, hydrogen, nitrate, carbon dioxide, mercury, hydrogen sulfide) content, and temperature of the water in the aquatank and alerts the management team if the levels exceed the threshold again.
Alternative Flow	1. If the acidity levels, gases (oxygen, hydrogen, nitrate, carbon dioxide, mercury, hydrogen sulfide) content, and temperature of the water remains

	above the threshold after the first cure, the system sends a second alert to the management team and the team can choose to adjust the threshold or take other necessary actions to maintain the desired water quality level.
Post-Condition	The management team has successfully managed the water condition of the selected aquatank.
Exception Flow	1. If the management team is unable to log in to the web application, they cannot manage the water condition of the aquatank. 2. If the system fails to display the acidity levels, gases (oxygen, hydrogen, nitrate, carbon dioxide, mercury, hydrogen sulfide) content, and temperature of the water, it will display an error message.

3.3.7 Manage Alarm

Description	This use case describes the process of setting up the critical event condition on aquatank.
Actors	Management team
Preconditions	The management team has logged into the web application and is authorised to set up the condition of aquatank that will trigger the alarm. The aquatank must be set up with sensors and connected to the system. The alarms must be properly configured in the system.
Basic Flow	1. The management team logs in to the system. 2. The management team navigates to the alarm settings page. 3. The management team views the current status of all alarms. 4. The management team updates the critical event condition settings, such as changing the threshold value of acidity, oxygen, hydrogen, nitrate, carbon dioxide, mercury, temperature, hydrogen sulphide of aquatank. 5. If a critical event condition has been triggered, the management team views the details of the condition. 6. The management team clears the alarm and resets the critical event condition settings to their default values. 7. The system continues to monitor the sensor data for the selected aquatank and triggers the alarm if the sensor data exceeds the threshold value for the critical event condition again.
Alternative Flow	If there is an error while managing the alarm, such as an invalid input or a system error, the system displays an error message and prompts the management team to try again.
Post-Condition	The alarm settings for the aquatank are updated and the system is actively

	monitoring the sensor data.
Exception Flow	1. If the management team is unable to log in to the web application, they cannot manage the acidity level of the aquatank. 2. If the system fails to validate the water acidity levels, it will display an error message.

3.3.8 Analyse Cost

Description	This use case describes the process of analysing the cost of maintaining the aquatank.
Actors	Management Team
Preconditions	The management team has logged into the web application.
Basic Flow	1. The management team views the current status of each aquatank. 2. The system will prompt the condition of water in each aquatank (acidity, level of oxygen, hydrogen, nitrate, carbon dioxide, mercury, hydrogen sulphide and the temperature.) 3. If any maintenance needs to be done on the tank, the management team will analyse and calculate the cost of purchasing the resources needed based on information prompted by the system. 4. The maintenance team shall calculate and analyse the cost of sensors if a new sensor is needed. 5. The analysed information will then be used by the purchaser to buy resources needed.
Alternative Flow	If the sensor is broken and does not prompt accurate information of each aquatank, the process of analysing costs cannot be done until the sensor is repaired.
Post-Condition	Purchaser received the lists of resources needed to be purchased.
Exception Flow	1. If the management team is unable to log in to the web application, they cannot analyse the cost of maintenance for each aquatank. 2. If the sensor of a specific tank is broken, cost analysis for that particular tank cannot be done.

3.3.9 Supply Resource

Description	This use case describes the process of purchasing resources required to maintain the acidity level of each aquatank, including chemical substances used to neutralise water in the tanks. The purchaser is responsible for recording all suppliers' databases to keep track of resources needed.
Actors	Purchaser
Preconditions	1. The purchase has logged into the web application and is authorised to access the resources suppliers' database. 2. The purchaser must have access to a list of approved suppliers or must be able to search for potential suppliers. 3. The purchaser must have the authority and budget to purchase the required resources.
Basic Flow	1. The purchaser reviews the inventory levels of resources required for maintaining the aquatank's acidity level. 2. The purchaser searches for potential suppliers who can provide the necessary resources. 3. The purchaser contacts the selected suppliers to request quotes for the required resources. 4. The suppliers respond with their quotes, which the purchaser reviews. 5. The purchaser selects the supplier with the most favourable quote and places an order. 6. The supplier delivers the ordered resources to the aquafarm. 7. The purchaser receives the delivered resources and checks them for quality and quantity. 8. The purchaser updates the inventory records to reflect the new resources received.
Alternative Flow	2a. If the purchaser already has a list of approved suppliers, they can skip

	the supplier search step. 3a. If a selected supplier cannot provide the required resources, the purchaser contacts other suppliers until a suitable supplier is found. 5a. If no supplier offers a favourable quote, the purchaser negotiates with the suppliers to reduce the price or looks for alternative resources.
Post-Condition	The purchased resources have been checked for quality and quantity upon delivery.
Exception Flow	3b. If a selected supplier does not respond to the request for a quote, the purchaser contacts them again or selects an alternative supplier. 7a. If the delivered resources are of poor quality or do not meet the required quantity, the purchaser contacts the supplier to resolve the issue.

3.4 Performance Requirements

The following are the key performance requirements

1. Throughput (User limit): The system must be able to handle a maximum of 10 concurrent users without significant decrease in performance.
2. Response Time: The system must process and analyse data from each sensor in real time, with a maximum response time of 1 second.
3. Throughput (Data transmission duration): The system must be able to handle 24 hours of continuous data transmission from each sensor without significant decrease in performance.
4. Reliability: The sensors must have a minimum lifespan of 5 years and must be replaced or re-calibrated only as needed.
5. Security: The system must implement appropriate security measures, such as encryption and access controls, to protect user data and the system from potential threats.
6. Availability and Reliability: The system must have an availability of at least 99% and a maximum downtime of 5 hours per month for maintenance and upgrades.

3.5 Design Constraints

The system developed adhere to the following standards:

- The user interface of the system should be designed in accordance with the latest design principles and guidelines.
- The system should be developed using the latest version of HTML and CSS.
- The system should follow the Web Content Accessibility Guidelines (WCAG-W3C, ISO, IEC) to ensure accessibility is followed including keyboard navigation, alternate titles for images, etc.
- The system should adhere to standard security protocols and encryption techniques to ensure the safety and security of user data.
- The system should be compatible with all major web browsers, including Google Chrome, Mozilla Firefox, Safari, and Microsoft Edge.

3.6 Software System Attributes

The non-functional requirements are the following:

3.6.1 Reliability

The following reliability standards should be followed,

- The system should have multiple sensors or components to measure water quality and fish measurement. If one component fails, the other component can continue to provide data.
- The sensors should be calibrated regularly to ensure that they are providing accurate measurements.
- The system shall keep the database information consistently.
- The application part of the system shall never fail. On the database side, failures should be minimal and there should be crash recovery systems in order not to lose information in a potential database failure.
- The system shall display informative messages when its component does not work properly.
- The system should log all data, including sensor readings, system status, and any errors or malfunctions that occur. This data can be used for troubleshooting and analysis.

3.6.2 Availability

The following availability features should be supported,

- The system shall be available for 7 days and 24 hours.
- On the database side, in case of a failure, the system shall recover any information of the aquatank.

3.6.3 Security

There are several security standards that should be followed to ensure the web application is secured:

- Authentication and authorization: Implementing user authentication and authorization mechanisms, such as username and password, two-factor authentication, or OAuth, to ensure only authorized users can access the application and its features.
- Secure communication: Using secure communication protocols, such as HTTPS or SSL/TLS 1.3, to ensure data is transmitted securely between the client and the server.
- Input validation: Validating all user input to prevent malicious data input, such as SQL injection or cross-site scripting (XSS) attacks.
- PHP code injector blocker: Prevent unauthorised code injection into a web application's PHP code

- Password storage: Storing user passwords securely using strong encryption algorithms, such as password hashing, to prevent password cracking and data breaches.
- Access control: Limiting access to sensitive information or resources based on user roles or permissions.
- Code reviews: Conducting regular code reviews and security audits to identify and fix potential security vulnerabilities in the application code.
- Regular updates and patches: Keeping the application and its dependencies up-to-date with the latest security patches and updates to prevent known vulnerabilities.

3.6.4 Maintainability

The following maintainability features should be supported,

- All code artifacts shall have proper documentation.
- All parts of the code shall have a detailed comment to make the code easier to understand and read.
- Use consistent coding practices and adopt industry standards to make the code easy to read and understand.
- Document the code to describe how the software works and provide clear documentation for each component of the system.
- Regularly test and assure software quality to catch any issues or bugs early on.

3.7 Business Rules

In LoRaFish

- Only registered users can access the LoRaFish system.
- The system will provide the option for users to pay for the service to stabilise the water acidity level of their aquatank.
- The system will only allow authorised users, such as the purchaser, to access the payment function.
- No cash payment is allowed.
- The system will maintain the confidentiality and integrity of user data and comply with applicable data protection regulations.
- The system will maintain a record of all payment transactions for auditing purposes.

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