Sri Lanka Institute of Information Technology

# Smart Aquarium System using IOT

## Hardware Requirement Specification

Professional Engineering Practice and Industrial Management - IE2090

Project ID: PEP_30


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20/04/2024

Date of submission

# Table of Contents



# Revision History

| Name | Date | Reason For Changes | Version |
|---|---|---|---|
| Operating Environment | 20/04/2024 | Not give the ranges for sensors | 1 |
| Block diagram | 20/04/2024 | Not connect the power supply | 1 |

# 1. Introduction

## 1.1 Purpose

The Software Requirements Specification (SRS) is an essential communication mechanism for the stakeholders. Termin works as a comprehensive narrative of the intended software system behavior and functionality. It enhances clear understanding, acts as a development roadmap, helps to determine the basis of the agreement, assures that the product will be validated, and helps to reduce risks by detecting possible ambiguities at an early stage of development.

## 1.2 Document Conventions

- Title - font size - 18, bold, Times New Roman
- Subtitle - font size - 14, bold, Times New Roman
- Paragraph - font size - 12, Times New Roman
- Title numbers - font size - 18, bold, Times New Roman
- Subtitle numbers - font size - 14, bold, Times New Roman

## 1.3 Intended Audience and Reading Suggestions

- Developers – developers should be familiar with the system architecture, algorithms, data structures, and restrictions.
- Project managers. They should understand the project scope, timelines, and expenses.
- Marketing stuff – they should have a good understanding of software characteristics and its advantages and competitive advantages.
- End-users – they must be familiar with the benefits of the software and the needs.
- Testers – testers should know what the expected behavior of the software is, and then write test cases to cover as many cases as possible.

- Documentation writers – they usually create user manuals, guides, and technical documentation.

## 1.4 Product Scope

The Smart Aquarium system uses IoT technology to monitor and control vital aquatic life metrics in aquariums. It improves user experience and ensures continuous care by automating tasks such as temperature monitoring, light control, and feeding fish. Automation, remote monitoring, and improved user experience are some of the benefits.

Main Objective

- The creation and use of a modern Internet of Things (IoT) Smart Aquarium system would transform aquarium management by providing the best conditions for aquatic life using smart monitoring and control systems.

Sub-Objectives

- Use IoT devices for real-time control and monitoring functions.
- User-friendly controls may increase the user experience.
- Automate service tasks and simplify feeding schedules.
- Promote the health and safety of marine life by keeping ideal conditions.
- Build the system the best solution in the industry.

# 2. Overall Description

## 2.1 Product Perspective

Using Internet of Things (IoT) technology, the innovative, self-contained Smart Aquarium system covered in this SRS monitors and controls aquarium conditions. Offering automation for jobs like temperature monitoring, lighting management, and fish feeding, it is a trailblazing solution in the aquarium sector. Although it is intended to be used alone, future improvements may take into account integration with more extensive systems or ecosystems. The system is made up of several sensors and actuators that are managed remotely for monitoring and control by an IoT controller. Stakeholders can consult the included diagram, which shows the parts and interfaces of the system, for more information.

## 2.2 Product Functions

There are 4 main key functions in our smart aquarium system.

- **Displaying temperature values.**
  The system continuously monitors temperature using sensors and displays real-time temperature values on the interface.
- **Managing the night light based on ambient light levels.**
  By analyzing data from ambient light sensors, the system adjusts the intensity of the night light to complement ambient lighting conditions.
- **Providing the required amount of food to the fish.**
  Users set feeding schedules and quantities, and the system automates food dispensing based on these parameters, ensuring fish receive the appropriate amount of food.
- **Displaying warnings for water quality issues.**
  Utilizing water quality sensors, the system detects deviations from preset thresholds and displays warnings on the interface to alert users of potential issues with water quality.

## 2.3 User Classes and Characteristics

The system has several user classes with subjective requirements and characteristics. They include Aquarium Professionals, Technicians/Maintenance Staff, Owners/Hobbyists, and Aquarium Educators/Lab Staff. The two main groups are Aquarium Owners/Hobbyists and Aquarium Professionals as they will require improved administrative tools, platforms in a remote location, and simple accessible interfaces. However, each of the other clusters should also have its set of requirements; for instance, aquarium technicians need access to technical documentation and aquarium educators will also need information about equipment when working on research projects. The system can become much larger and more accessible to multiple user groups in case each class of users gets its requirements.

## 2.4 Operating Environment

As we are implementing a combination of software and hardware components we are focusing on both requirements

Software Requirements

- Arduino IDE
  - ❖ The software may run on embedded operating systems such as Arduino IDE
- Programming Languages (C/C++)
- Operating System (Windows 10)

Hardware Requirements

- Development Board
- Sensors
  - ❖ Temperature Sensor: Measures water temperature to ensure it remains within optimal ranges for aquatic life. (Best Range22°C to 26°C)
  - ❖ Turbidity Sensor:
    - Low Turbidity: Ideally less than 1 NTU or FTU for clear, transparent water.
    - Moderate Turbidity: 1-10 NTU or FTU is acceptable for most fish tanks.
    - High Turbidity: Levels exceeding 10 NTU or FTU may indicate a high concentration of suspended particles or impurities.

## 2.5 Design and Implementation Constraints

The Smart Aquarium project is subject to several limitations and constraints during its development, such as adhering to governmental and business regulations, hardware constraints, language needs, and security considerations. Certain technologies, tools, and databases may be required, and it's crucial to follow design guidelines and programming standards. Furthermore, while exchanging data, interfaces to other programs can still be necessary, and communication protocols need to be chosen wisely. Meeting client requirements, guaranteeing the efficacy and security of the system, and completing the project all depend on addressing these constraints.

## 2.6 Project Documentation

Project Chater

The Smart Aquarium System project charter outlines objectives, scope, stakeholders, constraints, assumptions, risks, and approval. It aims to develop an IoT-based system for monitoring and managing aquarium environments, with key deliverables including hardware, software, testing, and documentation.

SRS

A summary of all the features and goals of our hardware product. It describes the audience target and the hardware, software, and user interface requirements for the project. It explains the viewpoints of our target market, team, and customers regarding the product. And also its skills.

Final Report

Results and teamwork are compiled in the final report. It should make the problem of the project, the communities or clients it affects, and the suggested or provided remedy very evident. The desired reading experience is that of a formal business paper.

## 2.7 User Documentation

The automation of our Smart Aquarium system is essential to its smooth functioning. Everything is automated, including checking temperature readings, modifying night lights according to light levels in the surrounding area, and even giving the fish the ideal amount of food. Without the need for human involvement, users may rely on the system to maintain ideal conditions for aquatic life. The proactive management that is ensured by warnings for problems with water quality also contributes to the system's increased efficiency and effectiveness.

## 2.8 Assumptions and Dependencies

- Aquarium parameters are not adjusted manually.
- Environmental conditions are stable
- Data logging begins upon system activation
- Feeding is triggered based on preset schedules
- Water quality warnings are generated based on sensor readings
- Temperature values are monitored continuously
- Night lighting is adjusted based on ambient light levels

# 3. External Interface Requirements

## 3.1 Hardware Interfaces

**LDR Sensor Unit**

Used to detect environment light conditions to sense whether to turn on lights or not.

**Servo Motors**

Used for providing the required amount of food to the fish.

**Turbidity Sensor**

The turbidity sensor measures water clarity, enabling the system to detect suspended particles and alert users to potential water quality issues.

**18B20 Waterproof temperature sensor**

The 18B20 waterproof temperature sensor is utilized to accurately monitor water temperature in aquatic environments, ensuring optimal conditions for aquatic life.

## 3.2 Software Interfaces

**Arduino IDE**

Coding the Arduino program

# 4. System Features

## 4.1 Functional requirements

### 4.1.1 System Feature 1

| | |
|---|---|
| Developer | R.A.T.R.Lakshitha |
| Function | Providing the required amount of food to the fish |
| Input | User-defined feeding schedule, quantity of food, current time. |
| Process | Verify schedule, dispense food accordingly, and monitor dispensing. |
| Output | Dispensed food amount, a confirmation signal. |

### 4.1.2 System Feature 2

| | |
|---|---|
| Developer | S.A.H.D.M.Perera |
| Function | Displaying warnings for water quality issues |
| Input | Data from water quality sensors, threshold values for parameters. |
| Process | Continuous data collection, comparison with threshold values, alarm trigger. |
| Output | Alarm notification indicating water quality issues, visual or auditory alerts. |

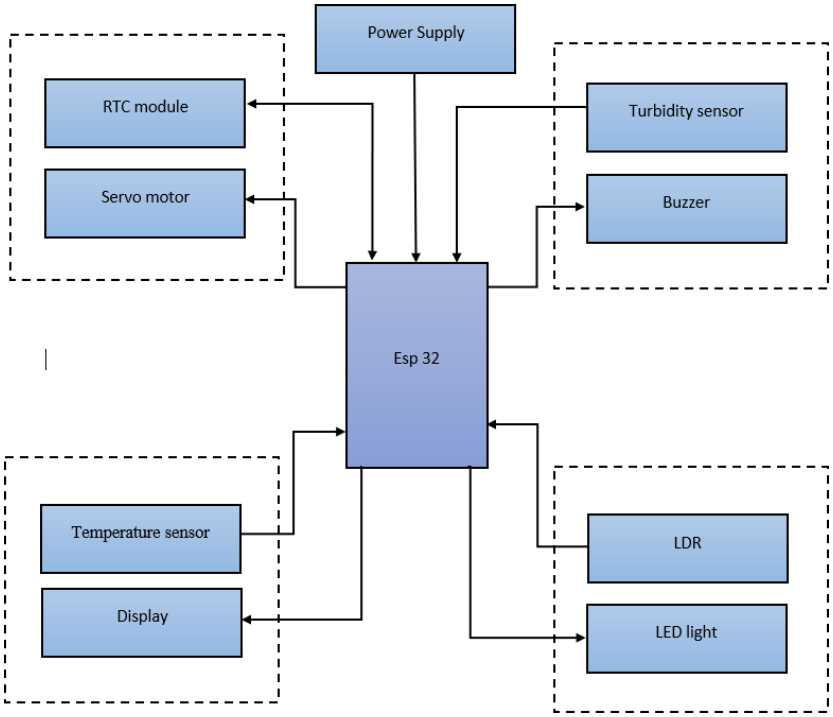
### 4.1.3 System Feature 3

| | |
|---|---|
| Developer | R.M.D.E.Rajapaksha |
| Function | Displaying temperature values. |
| Input | Data from temperature sensors. |
| Process | Continuous data collection from temperature sensors. |
| Output | Display of temperature values on the screen. |

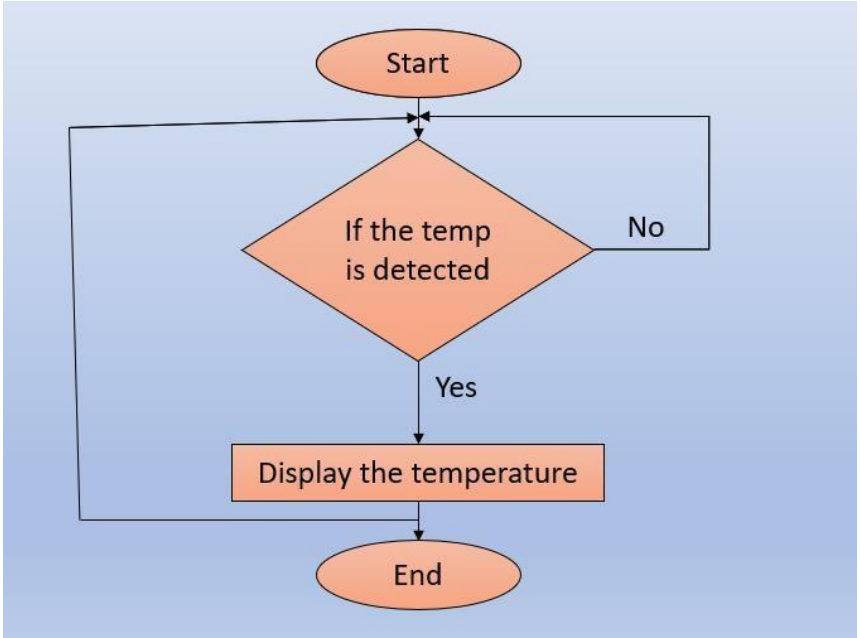
### 4.1.4 System Feature 4

| | |
|---|---|
| Developer | A.J.M.S Sithumini |
| Function | Managing the night light based on ambient light levels |
| Input | Data from ambient light sensors. |
| Process | Continuous monitoring of ambient light levels. |
| Output | Adjustment of night light intensity based on ambient light levels. |

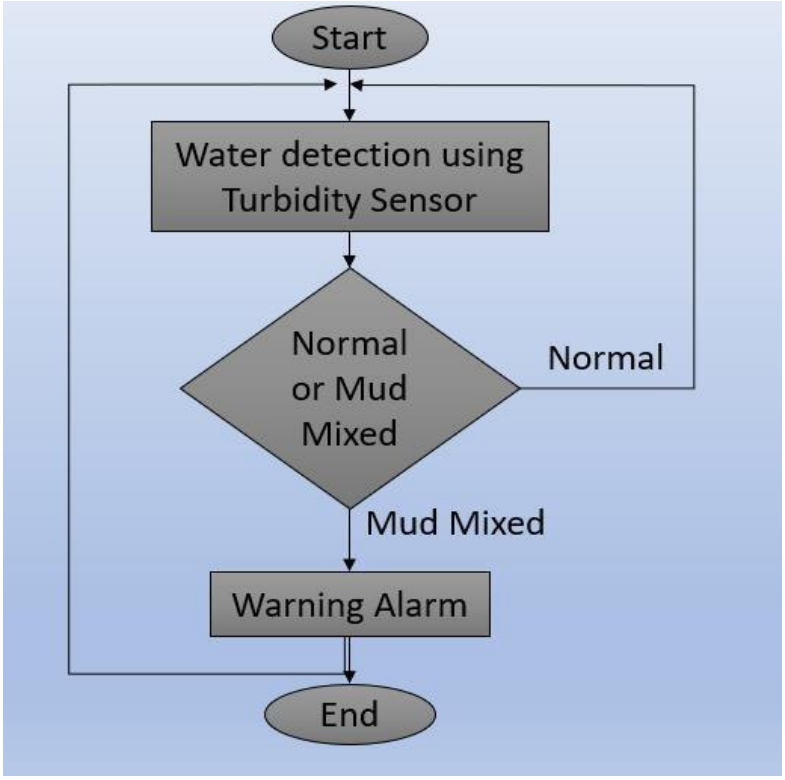
## 4.2 System Feature 2 - Block Diagram



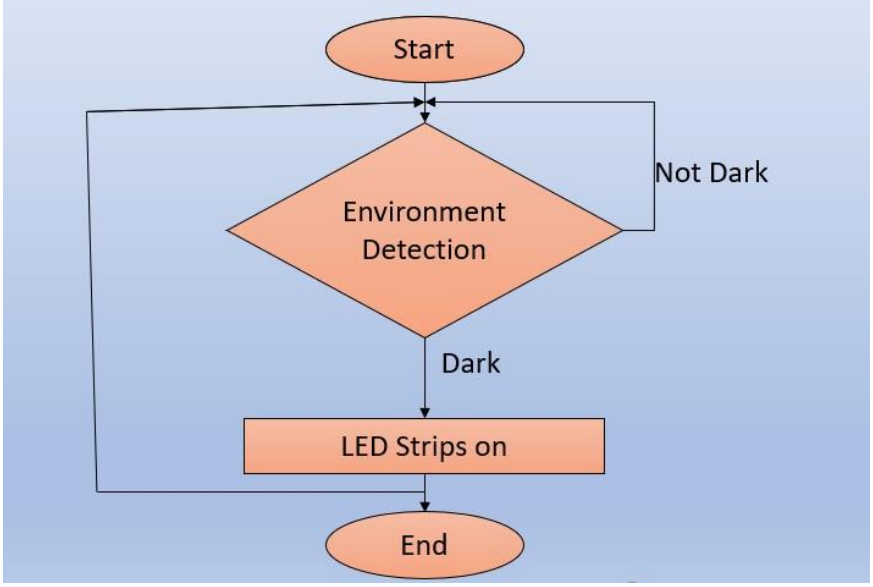

## 4.3 System Feature 3 - Flow chart for Displaying Temperature Values



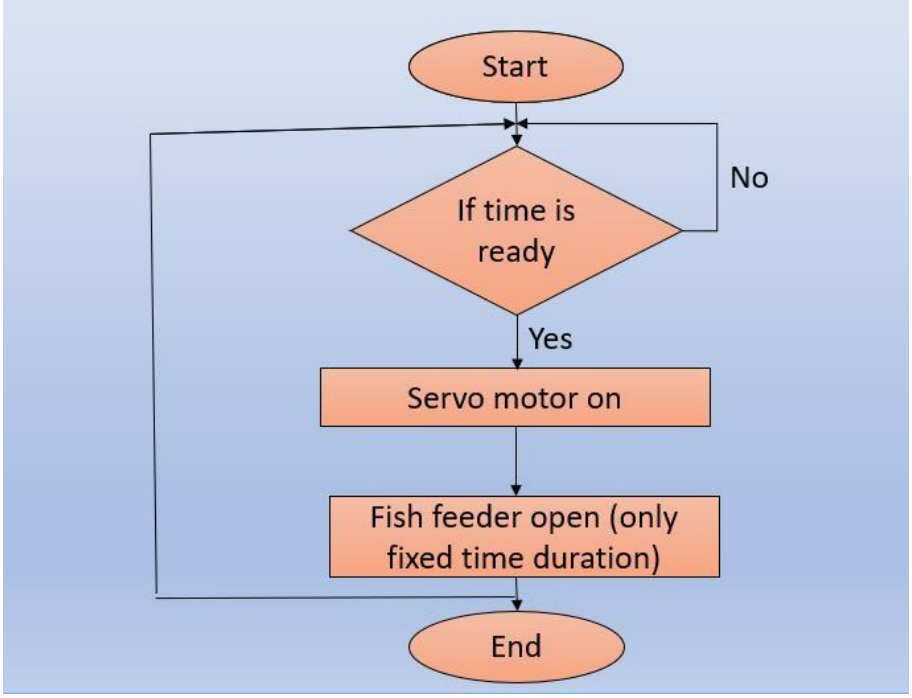
## 4.4 System Feature 4 - Displaying warnings for Water Quality Issues.




## 4.5 System Feature 5 - Flow chart for managing the light using LDR



## 4.6 System Feature 6 - Flow chart for Providing the required amount of food to the fish



# 5. Other Nonfunctional Requirements

## 5.1 Performance Requirements

The Smart Aquarium system requires real-time monitoring and management of crucial parameters for aquatic life. It must update sensor data every 5 seconds, respond to commands within 2 seconds, trigger alarms within 30 seconds of detecting issues, detect faults within 1 minute, and maintain a high availability of 99.5%. Additionally, it should prioritize energy efficiency to minimize operating costs and environmental impact.

## 5.2 Safety Requirements

The Smart Aquarium system must prioritize safety to prevent potential harm to aquatic life and users. This includes monitoring and controlling water temperature and quality, implementing safeguards for actuator movements, ensuring electrical safety, waterproofing electronic components, complying with safety regulations, and obtaining necessary safety certifications. These measures aim to ensure the safe and responsible use of the product.

## 5.3 Business Rules

The Smart Aquarium system enforces business rules to govern user roles and permissions, scheduled tasks, threshold alerts, emergency protocols, maintenance procedures, and data logging/reporting. These rules ensure efficient and effective management of aquatic environments while adhering to best practices and user requirements.

# 6. Other Requirements

- Power Supply: Adequate power source.
- Enclosure: Secure housing for components.
- Mounting Hardware: Screws, brackets, etc.
- Internet Connectivity: For remote monitoring/control.
- Data Storage: SD cards, cloud storage, etc.
- User Interface: Buttons, switches, touchscreen.
- Documentation: User manuals, guides.
- Safety: Insulation, grounding, compliance.
- Testing Equipment: Multimeters, oscilloscopes.
- Maintenance: Updates, replacements, support.

# Appendix A: Glossary

- **Smart Aquarium:** A system utilizing IoT technology to monitor and manage various parameters crucial for aquatic life.
- **IoT:** Internet of Things; a network of interconnected devices that communicate and exchange data.
- **Sensors:** Devices that detect and measure physical properties such as temperature, water quality, and ambient light levels.
- **Ambient Light**: The natural light present in the aquarium environment.
- Threshold Values: Predefined limits or ranges used to determine acceptable levels for parameters such as temperature and water quality.
- **Alarm:** A notification triggered by the system to alert users of potential issues or deviations from normal conditions.
- **Real-time System:** A system that processes and responds to input within a specified timeframe, often with strict timing requirements.