Detailed Software Requirements Specification for Reservoir Management System

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EEY4189-<*COMPONENT*>-DSRS-1.0

Document Revisions

Date	Version	Description	Author
03/11/2022	1.0	SRS	Bluelight Suites

Document Approval

Quality Software Corporation and Irrigation Department have reviewed this document and hereby agree that the contents herein are accurate. Any changes to this document must be communicated in writing and signed off by both parties.

Signature	Signature
Date: **03/11/2022**	Date: **03/11/2022**
Name: **Eng. Nihal Siriwardhana**	Name: **Madhura Prasanna**
Customer: **Irrigation Department**	Bluelight Suites

1 Introduction

1.1 Purpose

This document lists requirements for Reservoir Management System. The purpose of this document is to identify the system requirements and obtain sign-off on all requirements before moving into the design phase. Our team will use this document as the basis for the system design.

After sign-off, requested changes to requirements will be documented including the affect on the project costs, scope and timelines and presented to Director General of Irrigation, Irrigation Department for approval.

These requirements were gathered during extended discussions with The Irrigation Department on 03.10.2022 and from documents provided by The Irrigation Department on 26.09.2022.

1.2 Summary

The Irrigation Department determines the number of paddy acres that can be watered for a season by considering the current water capacity of the reservoir, and the expected water capacity in the future, and the climatic behavior of the previous seasons.

After that, considering the crop water requirement, the required amount of water is released from the reservoir at that time

But under the current system, most of the information resides in top management. Even though this information is essential to the officials working at the ground level, due to the delays and omissions in the flow of that information, they face difficulties in carrying out the proper distribution of the water released from the reservoir.

Also, the farmers who benefit from that water do not have proper awareness of when and how much water they will receive. So, they also face problems in carrying out their crop cultivations properly. Water Management is a major duty of the Irrigation Department and having an accurate and up-to-date data system is very important in making these decisions. Due to the absence of such a system at present, there are times when Management Level Officers are uncomfortable in making scientific decisions.

As solutions to the above-mentioned problems of the project

- The amount of water received to the reservoir
- The amount of water issued by the reservoir
- Amount of water given for crop cultivation
- Water delivery times with the help of a push notification
- Providing with weekly, monthly, seasonal and annual summary reports

are provided.

1.3 Company Overview

Background

Our company name being Bluelight Suites, started on the year 2022 comprising 4 members. Web development specialist, Programming specialist, Analyst and Security Management specialist are the skills of the team members which are unique to each other. This company was started in order to complete a level 4 course Software Design in Group, in the programme Bachelor of Software Engineering in The Open University of Sri Lanka.

Capabilities

- Software Maintenance
- Software Development
- IOT
- Cloud Hosting

Consultancy

- Software Maintain and Management
- Security System Management

Company Vision

To provide quality and reliable, high-end products to clients by utilizing new technology

Company Mission

To educate our future generation with satisfaction, trust, positive conviction, loyalty, commitment, feeling and experience.

Tag Line

"We Are Unique"

Our Goals and Objectives

- Business Plan

  To provide a well updated high quality software solution and become the no.1 software development company in Sri Lanka

- Programs for Strategic Objectives

  - ⋆ To provide a customer friendly service
  - ⋆ To provide the best quality products
  - ⋆ Ensure timely delivery of quality products
  - ⋆ To maintain the system
  - ⋆ Ensure a lifetime service warranty

- System and Solutions

  - ⋆ Software Consulting
  - ⋆ Software Development Outsourcing
  - ⋆ Customer Software Development
  - ⋆ Software Product Development

- Team Management
- Cloud Application Development
- Legacy Software Modernization
- Web Application Development
- IOS and Android Mobile Application Development

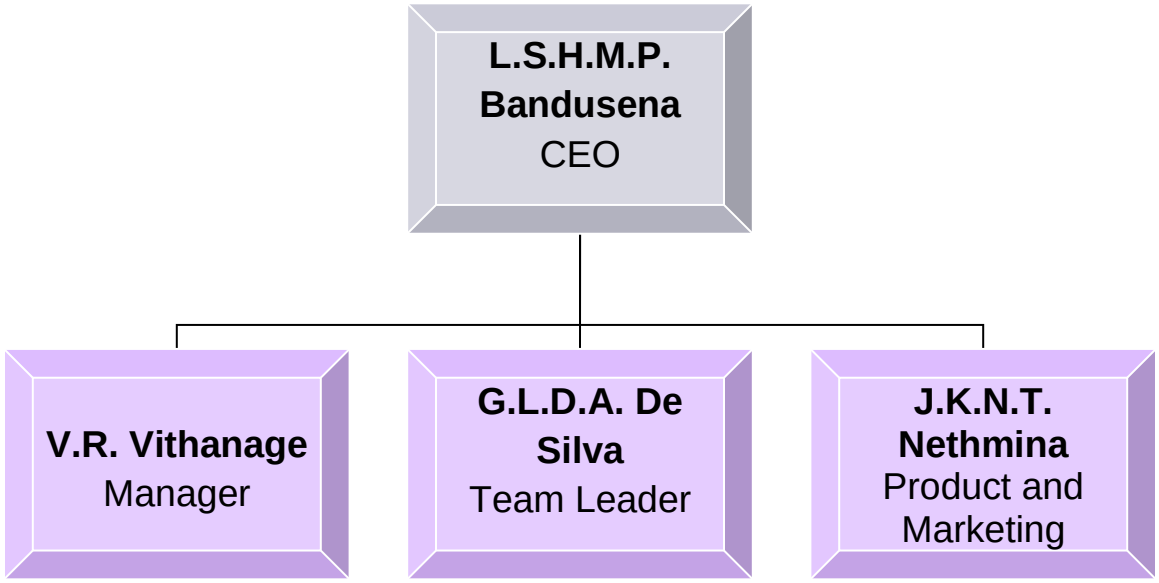
Bluelight suite our IT genius, the progressive culture and core values that we embrace help us to imprint an impressive mark on the offshore software development realm. We respect our core values and ensure that our clients derive maximum benefits from associating with us. The fundamental values that support our vision and help shape our culture are as follows. These values are deeply ingrained in each one of us and guide our decisions and actions.

- HELP
  Together we can
- Entrepreneurship
  Every day we do things a little better
- Integrity
  Our word is our Bond
- Openness
  We are open - we speak our minds and listen
- Joy
  Pleasure and laughter, success comes after
- Appreciation
  A pat on the back is better than a kick in the butt

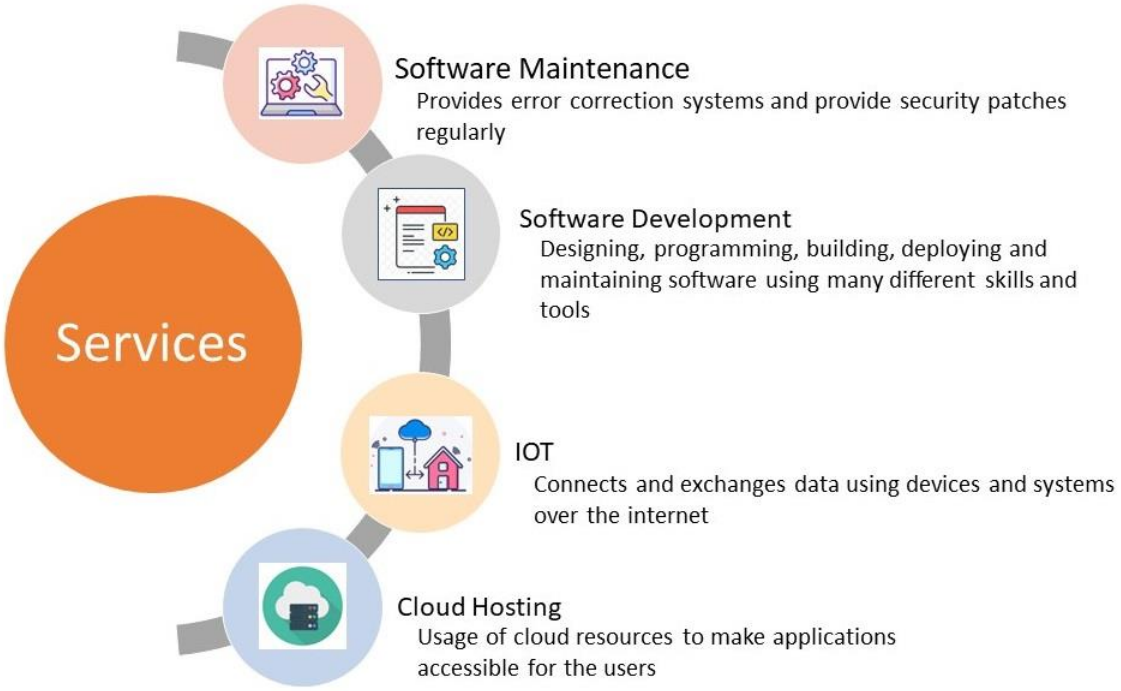
Our Team

- Chief Executive Officer - L.S.H.M.P. Bandusena
- Manager - V.R. Vithanage
- Team Leader - G.L.D.A. De Silva
- Product and Marketing Manager - J.K.N.T. Nethmina

Organizational Structure



Our Services



1.4 Project Overview

Water from a reservoir is mainly used for the following purposes

- For drinking purposes
- For water and electricity
- For agricultural purposes

The main sources of water to a reservoir are:

- Spring water
- River water
- Rainwater
- Drainage water

But the water capacity of the reservoir changes due to, absorption of water into the ground, evaporation and water leakages

The water capacity of most of the reservoirs in Sri Lanka, is not sufficient to supply water to all the crops that receive water from that particular reservoir. Therefore, the number of crops that can be cultivated is determined by observing the climatic conditions of the past years and calculating the expected rainfall.

Considering the nature of the cultivation, the amount of water that should be issued is determined according to the crop water requirement. In here, the water released, depends on the amount of the sluice opened. The amount of water released from the sluice is either uniform or varied depending on the crop water requirement.

1.5 Scope

The purpose of this Reservoir Management System is to inform the Management Level and Water Management officials in the Irrigation Department, and the farmers benefiting from reservoir water, with real time data about the water levels in the reservoirs in Sri Lanka, amount of water released from the reservoirs, amount of water that can be released in the future, and cultivable crop area.

This software is updated by the authorized officials and has been prepared to gain an understanding of the operational activities taking place in a reservoir.

1.6 Assumptions

- Since the effective rainfall is hard to calculate and there is no specific method in calculating it, the seasonal schedule is to be prepared by considering that there will be no rain in the particular season
- Assuming that there is no wastage of water when issuing water to the canals
- Assuming that there is no extra water requirement
- Assuming that there are no evaporation occurs
- Assuming that there is no effect on the total capacity of the reservoir regardless of the silt in the reservoir

1.7 Definitions, Acronyms and Terminology

1. Crop water requirement – The amount of water required when the crop needs the water
2. Scheme duty – The amount of water required to cultivate a unit of that scheme under the respective project
3. Area capacity diagram – A graph showing the variation between the area of a reservoir with the capacity
4. Cultivation plan – The plan for cultivation such as the start and end dates. It is discussed in a meeting with farmers and officials.
5. Water plan – The way of providing water during the season
6. Forecast – A note indicating possible weather conditions in the future. It can be done through calculation or prediction.

1.8 References (Optional)

- Area Capacity Diagram

2 Project Scope and Impact

This system mainly monitors how water is managed in the reservoirs of Sri Lanka, and based on the crop water requirement, the dates and times of water issue are given to the concerned people through the software, and real time data is available in this system. Also, through this software it is possible to get the real time capacity of the reservoir, along with the amount of water received in the reservoir. It shows how much water was released for water needs, and the

requirement can be known by considering the cultivated area. Through this, reports on water use can be used for research purposes. Usage of excess water can be informed through an alert, and the farmers can get real time information about the dates and times of receiving water.

2.1 Scope Inclusions

- Calculating the crop water requirement
- Seasonal schedule of water requirement assuming there is no rainfall
- Warning message to supply the crop water requirement without any delay
- Summary sheet for the scheme
- Forecast to show the amount of water issued weekly and monthly basis
- Report generated weekly, monthly, seasonally and annually
- Excess usage of water using a graph

2.2 Scope Exclusions

- Maintaining a centralized database to store the data of all the reservoirs
- Calculating the effective rainfall
- Duty scheme of the reservoir week by week
- Warning message for excess usage of water or the remaining water that can be given for the particular field.

2.3 Impact on other systems

Our system is a Reservoir Management System, and it is being developed for The Irrigation Department. The Water Management is mainly in charge of handling and supplying of water to the reservoirs and also, they have a website with all the information about the reservoirs. With the help of our system, they will be able to inform the officials as well as the farmers regarding the crop water requirements, and the scheduled date and time the farmers will receive the water, and also the system will send a notification to the officials to provide the necessary crop water requirements on time, without any delay. Lastly we will be able to create a centralized database to collect all the information of the reservoirs, and by coupling our system to the Irrigation Department website, they will be able to carry out their duties effortlessly.

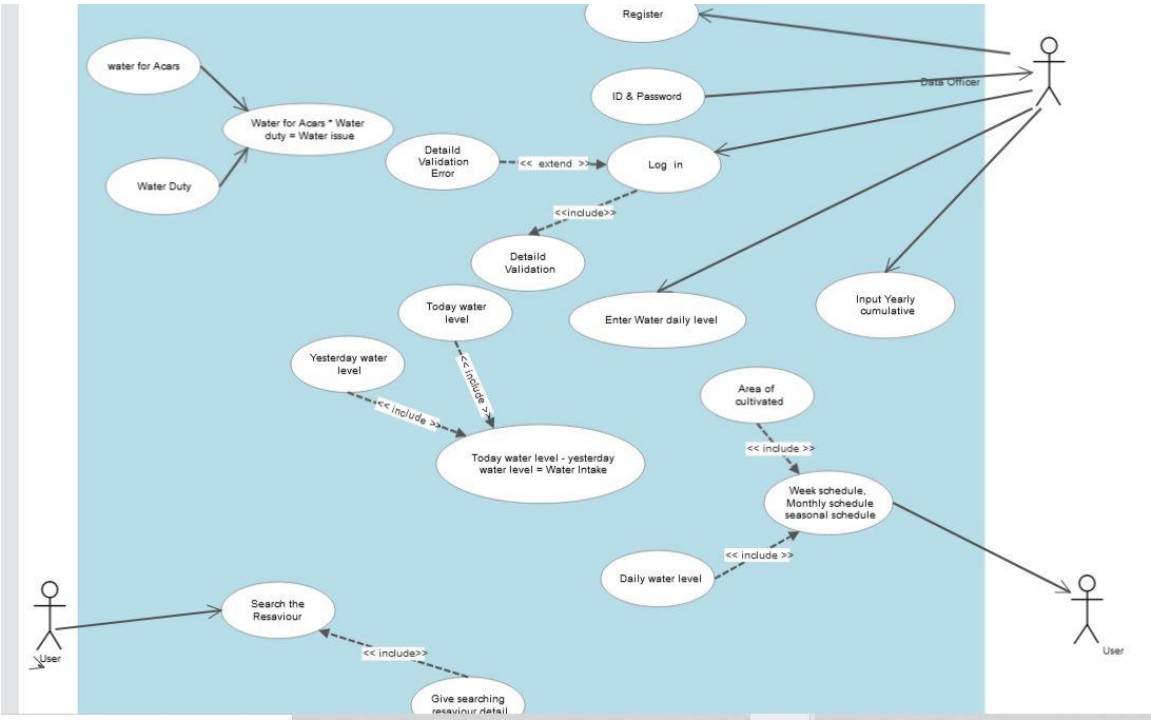
2.3.1 Affected by Other Systems

The Irrigation Department website will use the data from our system to daily update the necessary information, such as the water capacity of the reservoir before 12.00 p.m.

2.3.2 Affects on Other Systems

- Irrigation Department official website

3 Functional Requirements



3.1.1 Function 1

01 – Data Input

Here, the user should update the system once a day if the water is released by filling the tank in our system with the following information. For that, it is necessary to upload the following information

1. Rainfall Received on Date (Daily)
2. Water capacity received in the reservoir (every morning)
3. Issue amount of water (If released on the day, the amount and time the sluice is opened here is a variable of the opening amount, it should be updated in the system)

4. Crop Water Requirement and its Podcast (Daily and Weekly)

02 - Calculation

According to the calculations, we have made the request of the client

1. Reservoir capacity
2. Amount of water received in the reservoir
3. Amount of water released
4. Cultivable Paddy Acres
5. Productivity of the season's harvest

The calculations should be done. For that

01 - Reservoir capacity

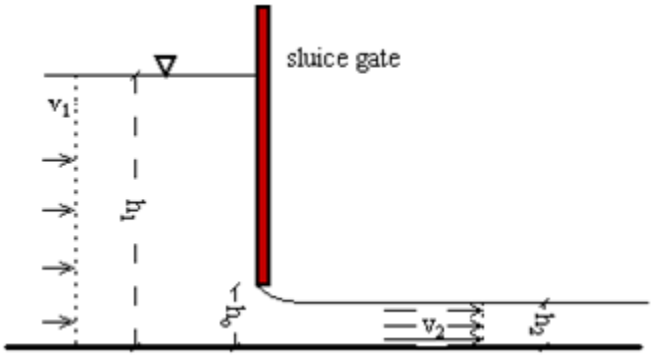
To calculate this, the Irrigation Department has prepared an area capacity curve for every lake and using it, the calculation is done using that curve according to the water level of the lake.

02 - Amount of water received in the reservoir

The following equation is used for this
WATER INTAKE = WLT - WLY
WLT - Today water level
WLY - Yesterday water level

03 - Amount of water released

The sluice gate flow rate measurement is based on the Bernoulli Equation and can be expressed as:



$1/2\ \rho\ v1^2 + \rho\ g\ h1 = 1/2\ \rho\ v2^2 + \rho\ g\ h2$ (1)

where

h = elevation height (m)
ρ = density (kg/m3)
v = flow velocity (m/s)

The pressure components in the equation are generally irrelevant since pressure upstream and downstream are the same (p1 - p2 = 0).

Assuming uniform upstream and downstream velocity profiles - the Continuity Equation gives:

$q = v1\ A1$

$= v2\ A2$ (2)

where

q = flow rate (m3/s)

A = flow area (m2)

(2) can be modified to:

$q = v1\ h1\ b$

$= v2\ h2\ b$ (3)

where

b = width of the sluice (m)
h1 = upstream height (m)
h2 = downstream height (m)

Combining (1) and (3), gives the "ideal" equation:

$q = h2\ b\ [2\ g\ (h1 - h2) / (1 - (h2 / h1))]^{1/2}$ (4)

Assuming h1 >> h2 (4) can be modified to:

$q = h2\ b\ [2\ g\ h1]^{1/2}$ (5)

This is approximately true when the depth ratio h1 / h2 is large, the kinetic energy upstream is negligible (v1 is small) and the fluid velocity after it has fallen the distance (h2 - h1) ≈ h1 - is:

$v2 = [2\ g\ h1]^{1/2}$ (6)

The ideal equation (3) can be modified with a discharge coefficient:

$q = cd\ h0\ b\ [2\ g\ h1]^{1/2}$ (7)

where

cd = discharge coefficient

The discharge coefficient depends on different parameters - such as upstream and tail-water depths, gate opening, contraction coefficient of the gate and the flow condition.

In practice the typical discharge coefficient is approximately 0.61 for free flow conditions and depth ratios ho / h1 < 0.2.

04 - Acreage of paddy fields and cultivated paddy

For this purpose, considering the amount of paddy cultivated under the reservoir and the amount of water in the lake, the amount of paddy acres that can be cultivated with the water capacity of the reservoir is decided.
For that
Cultivable Paddy Acres = Tank Capacity / Cultivation Water Requirement

05 - Productivity of the season's harvest

This information is matched with the yield per acre of previous seasons using a comparator.

Average yield = total yield / acres of cultivated paddy

03 - Schedule

The system should be able to display the weekly, monthly, seasonal, yearly schedules with the processed information

04 - Information Display

The system should be able to Display

01. Climate Details in Current Day, Yesterday and next day
02. Water Intake
03. Water Capacity in Current Day and Yesterday
04. Water Issue for Agriculture, Drinking Water and Electricity
05. Water Issue Forecast
06. Water Issue Time and Dates

05 - Generate Report

The following reports should be created through the database as per the client's request. After taking the necessary time for this, the relevant report should be generated, and it should be able to be downloaded as a print or soft copy.

1. Daily release of water for a day, for a week, for a month, for a cropping season or for a year
2. The amount of paddy cultivated, and the amount of water released to them per water shift or season.
3. Cultivated paddy acreage, yield and amount of water given to a reservoir or reservoir system should be given separately.

06 – Warning Message

If water is released more than the planned amount of water, a warning should be displayed on the home page of the system. For this, the system compares the amount of water released and the water requirement and automatically displays the warning at that time.

07 – Logging Control

If water is released more than the planned amount of water, a warning should be displayed on the home page of the system. For this, the system compares the amount of water released and the water requirement and automatically displays the warning at that time. The data system is controlled under an administrator for the system and he should check and be accountable whether the data is entered in the system at the right time and another quality control officer has permission to check the data to control the accuracy and quality of the data. Also the data entry officer will only be able to enter the data and submit it

3.1.2 Data Archival and Retention

- ⋆ Must be reusable when needed.

- Data should be stored accurately so that necessary calculations can be easily performed.
- Subsequent update possible

3.1.3 User Profiles, Roles and Privileges

Here the user can access the web page through the website link. After accessing the web page, the user can get the required amount of water in the reservoir today, the amount of water released and other information.

3.1.4 Reporting Requirements

Here we need to manage the application as reports,

1. Rainfall received on date (daily) report
2. Water capacity received in the reservoir reports
3. Issues amount of water report
4. Crop water requirement and its podcast report

First of all, we need the report that Rainfall received on date (daily) information because we need to know how much water received in the reservoir. And then we need to manage the software that includes the water capacity of the reservoir and the data of the lake. And if water is released, we also need records that include data such as the amount and time the sluice is opened. Finally, we need reports of daily and weekly releases of water for crop water needs to manage this system.

4 Non-Functional Requirements

4.1.1 Performance and Load Requirements

Example:

Current User Load	0
Expected Growth	100%
Number of concurrent users	50
Transaction Size (files sizes etc.)	660MB
Maximum Average Transaction Time Acceptable	20 minutes

4.1.2 Compatibility Requirements

HTML Versions to be supported	HTML5, HTML4
Browser Versions to be supported	Google Chrome, Mozilla Firefox, Microsoft edge, Opera Mini
Database Versions to be supported	My SQL, Oracle,
Communication Protocol	HTTP, TCP/IP
Platform Version to be supported	Mac, Windows, Android
Any other external systems or standards	-

4.1.3 External Interface Requirements

Hardware Interfaces Requirements

- ⋆ Intel I5 or I7 Processer with Laptop or Desktop
- ⋆ 20Gb Memory with 8GB or Higher Ram
- ⋆ Internet Connections

Software Interfaces Requirements
1. Describe the connections of your software with other operating systems: the software is developed for HTML Supported Mobile Devise , windows 7, windows 8, windows 10 or Higher versions

2. Describe the connections of your software with other libraries:

- Python Libraries
- Wakanda Framework
- Ext JS
- JsRender/JsViews
- qooxdoo
- PureMVC
- Express.js
- Cappuccino
- Google Web Toolkit
- JavaScriptMVC
- SproutCore

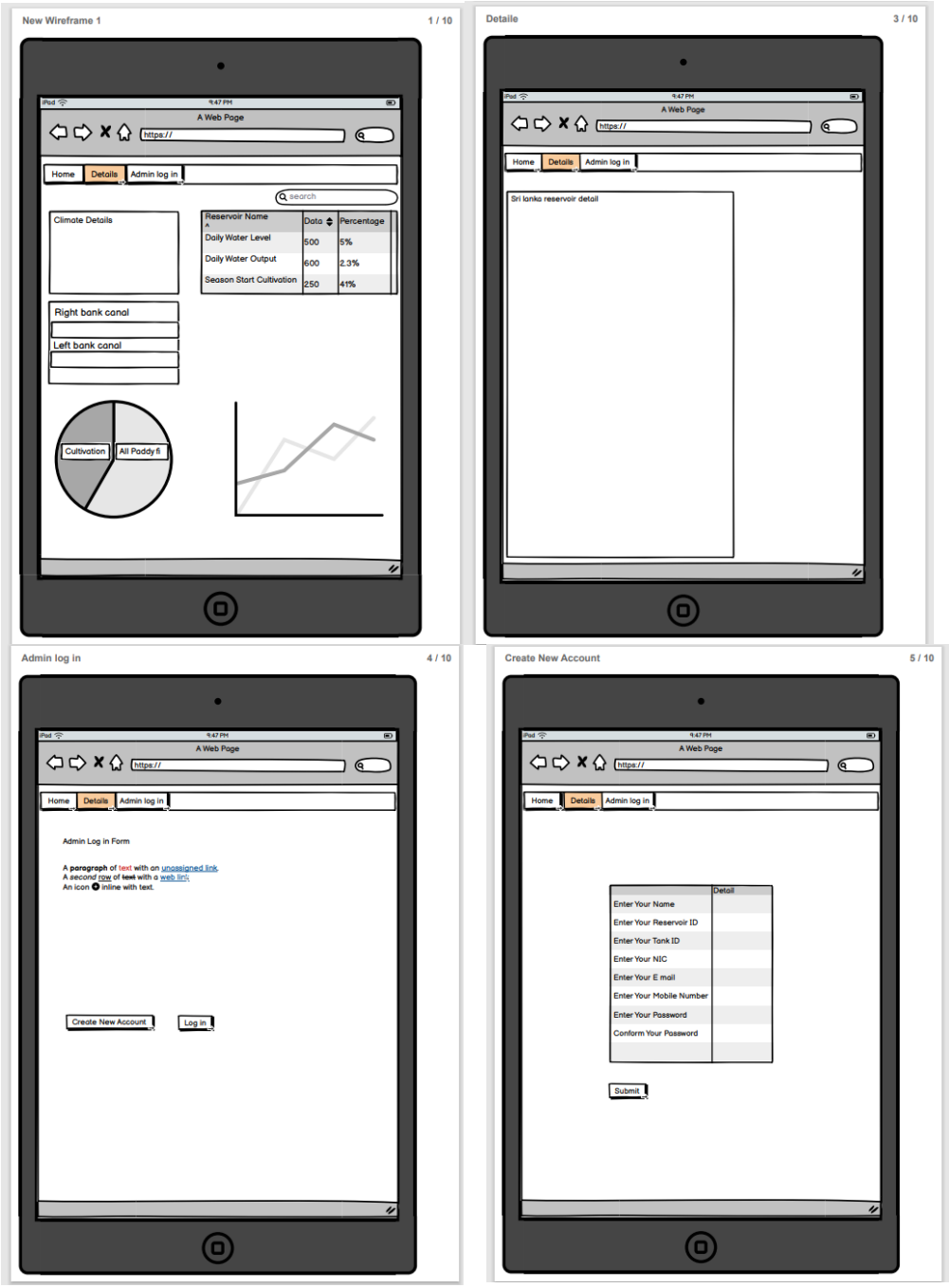
Communications Interfaces Requirements

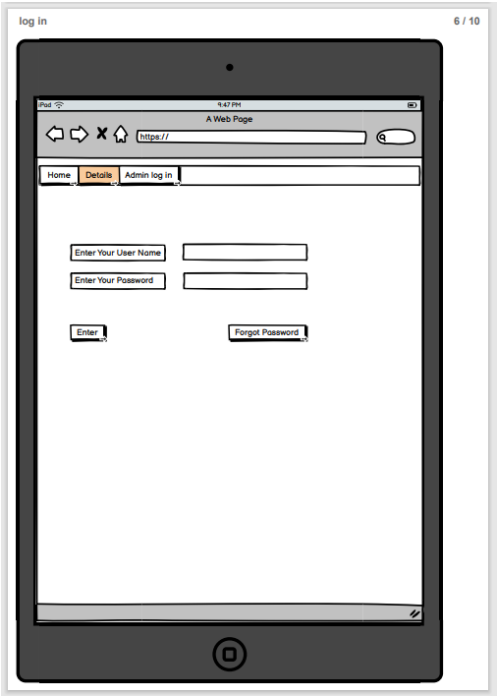
1.Web browser:
Opera, Chrome Firefox and Internet explorer

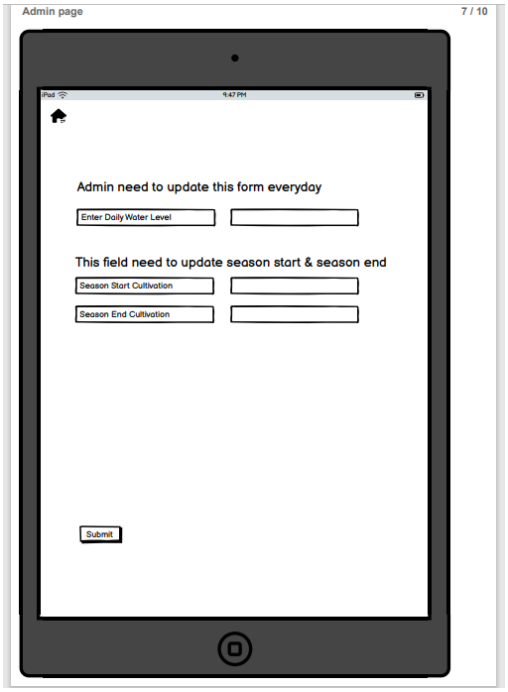
2. Communication standards and Network server communications protocols:
HTTP, HTTPS, or FTP

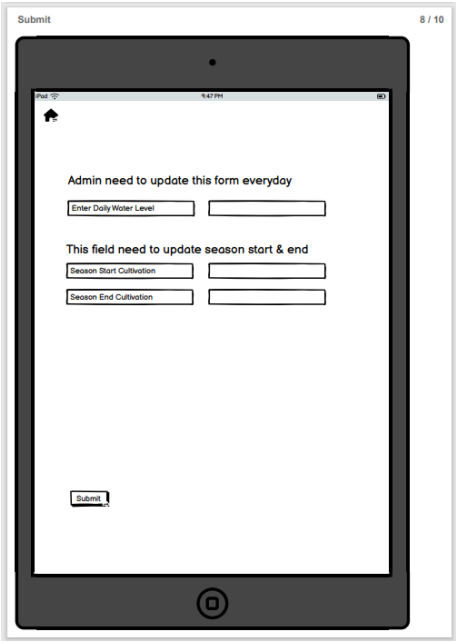
3. Data transfer rates:
maximum file size of 16 MB.

4.1.3.1 User Interfaces




log in
6 / 10
A Web Page
https://
Home
Details
Admin log in
Enter Your User Name
Enter Your Password
Enter
Forgot Password


Admin page
7 / 10
Admin need to update this form everyday
Enter Daily Water Level
This field need to update season start & season end
Season Start Cultivation
Season End Cultivation
Submit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Admin need to update this form everyday
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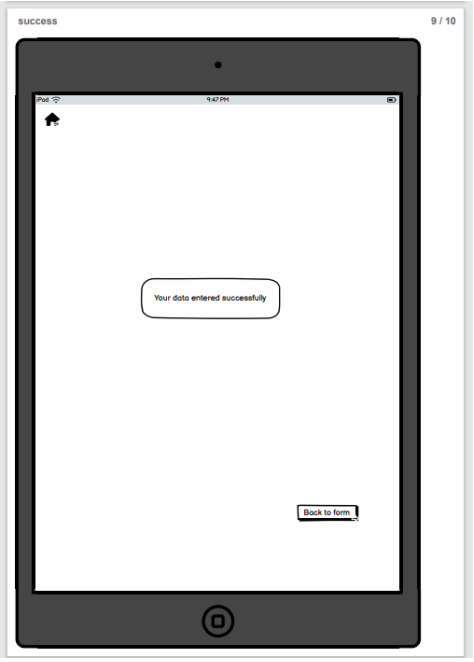
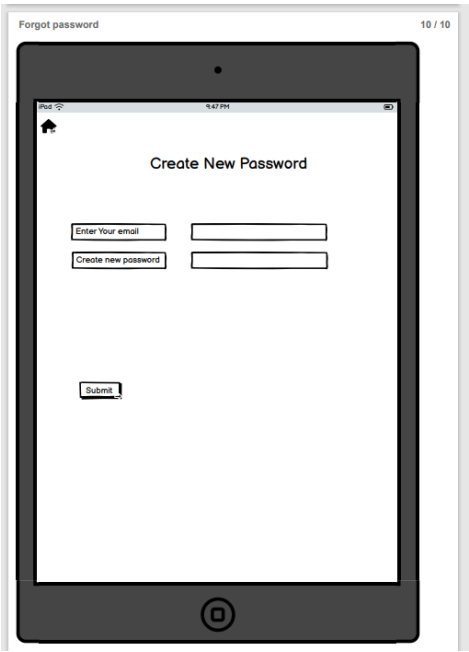

success
9 / 10
Your data entered successfully
Back to form



4.1.3.2 Hardware Interfaces

An internet connection is required to allow the browser to connect to the internet and access the files of the Reservoir Management System software interface since the application must run over the internet. All the hardware which is required to connect to the internet, will be hardware interfaces for the system. When running an application on the internet, the computer's hardware interface needs to connect with the hardware, through the internet, on behalf of the system. For this, Modem, router, WAN, LAN, ethernet cables are used.

4.1.3.3 Software Interfaces

Any popular operating system will allow the user to view and download the webpage by using any modern browser. The Reservoir Management System shall communicate with the data entry officer. The system should send a message automatically to the admin officers regarding the daily updates.

4.1.3.4 Communications Interfaces

The Reservoir Management System shall use the HTTP protocol for communication over the Internet, and for the intranet communication, it will be

through TCP/IP protocol. The system should send a message regarding daily updated to the admins automatically.

4.1.4 Security and Authentication requirements

4.1.4.1 Data Storage Security

Only numbers can be stored inside the system database. The reservoir data can be entered only by the official who is in charge of the particular reservoir. The system has given him a unique id and a password. To obtain the id and password the official must first register through the website.

Data servers are being used in storing data, and the data is encrypted before saving in the database.

4.1.4.2 Data Communication Security

- Post method is used in the input fields

4.1.5 Quality Assurance Requirements

4.1.5.1 QA Test Scope

Functional Testing

The detailed documents that define the testing scope and the test activities are prepared to take a sign-off. We execute the cases based on the priority and ensure the root test average to unveil the errors in our application

Security Testing

Our Team has analyzed the requirements of the system and have identified the strengths and weaknesses. Then our team works to find solutions to the weaknesses in the system.

4.1.5.2 QA Environment

QA Tools

Infrastructure

- Released Management Source Control

Code Reviews

- Code Analysis

Testing

- Bug Issue Testing
- Visibility Testing
- Load Testing

Multi Browser Testing Tools

- Sauce Labs

4.1.5.3 QA Data

- Water level capacity - irrigation department How many peoples use the reservoir water
- Secretary office

4.1.6 Development Requirements

4.1.6.1 Development Environment

There are 4 members in our team. The tools that are being used to develop this project are Visual Studio, MySQL, Java/Python, GitHub, Eclipse, Asure. We use multi-monitors, setups, updated computer RAM, SSD as hardware devices.

Environmental Requirements

For development process, we use our development Environment as the Toolkit Environment. Toolkit Environment offers a collection of tools including language independent support, configuration management and version control.

4.1.6.2 Development Data

- The amount of the area of the earth that the reservoir has been spread.
- Amount of paddy acres that is being cultivated from the reservoir.
- Number of people who are dependent on the reservoir.

- Number of sluice gates in the reservoir.
- The volume of water discharged per minute from the sluice gates.
- Annual rainfall.

Data Sources

- Irrigation Department
- The divisional secretariat to which the reservoir belongs

4.1.6.3 Coding Standards

- The code should be obvious and understandable
- The comments are used to explain why the code is used and how it is used
- Usage of design patterns
- The codes are written in unit cases
- Usage of class fields
- The package types are written in lowercase method and field types are written in uppercase separated by an underscore.
- Local variables are of typed case

4.1.6.4 Implementation Packaging Requirements

- Microsoft Excel
- Python
- Visual Studio

4.1.7 Deployment Requirements

4.1.7.1 Installation Packaging Requirements

Our application is not installed in a computer because it is a web application. Our web application is stored on a web server so it can be accessed by the user over the internet.

4.1.7.2 Deployment Requirements

Having a development plan which is followed every time is the best way to carry out the development process as smoothy as possible. We ensure that everything is done the same way, each time changes are made, because it is helpful, when multiple users are working on the same project.

Our system is first developed by gathering the requirements from the Irrigation Department. Then we created the project proposal, and then created the use case diagrams which is needed to create the Software Requirement Specification. Then all the 4 members of the team proceeds to the coding process which is the development process. The testing is done as the final part. In that system errors are identified and fixed. The web application allows selected users to login to the system and collects user requirements.

4.1.7.3 Documentation requirements

- Should provide the communication among team members
- Should act as an information repository
- Should provide sufficient information to the management in order to get the approval from them for our project

4.1.8 Special Documentation Requirements

The information provided here is directly received by the Irrigation Department and all other rights are owned by our company

4.1.9 Applicable Standards

This section describes by reference any applicable standard and the specific sections of any such standards which apply to the system being described. For example, this could include legal, quality and regulatory standards, industry standards for usability, interoperability, internationalization, operating system compliance, and so forth.

Examples of applicable standards:
Legal and regulatory: FDA, UCC
Communications standards: TCP/IP, ISDN
Platform compliance standards: Windows, UNIX
Quality and safety standards: UL, ISO, CMM

4.1.10 On-line User Documentation and Help System Requirements

Describes the requirements, if any, for on-line user documentation, help systems, help about notices, and so forth.

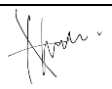
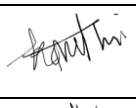
4.1.11 Usability Requirements

- People can easily navigate the system using help desk
- The interface is easy to learn and navigate the website

5 Future Requirements (Optional)

6 Appendix –

7 Meeting 01 – Discussion with the Irrigation Department about the Reservoir Management System

Meeting Information			
Meeting Date/Time	Date - 03.09.2022 Time - 2.00 p.m.		
Participants	Director General of Irrigation Contact No. - +94 714 447 276 Email - dgi@irrigation.gov.lk, dgiirrigation@gmail.com		
	Director Training of Irrigation Contact No. - +94 718 008 048 Email – training.irrigation@gmail.com		
	L.S.H.M.P. Bandusena		
	V.R. Vithanage		
	G.L.D.A. De Silva		
	J.K.N.T. Nethmina		Absent
Estimated Time	45 minutes	Actual Time	30 minutes
Special Notes			
Call/Location Information	Irrigation Department, Bauddhaloka Mawatha, Colombo 07		
Supported Documents			

Agenda:

1. Introduction of the team members
2. Presenting our idea about the project that we are planning to develop
3. Presenting the idea of the Water Management officials what they expect from the system and the data they already have
4. Presenting the idea of the Director General of Irrigation about the system and the data the director expects from the system
5. End of the meeting

Notes/Clarifications:

1. Area capacity curve should be calculated by using an equation, and for that the data should be calculated separately using the area capacity diagram.
2. Since the effective rainfall is hard to calculate, the seasonal schedule is made by assuming that there will be no rain for the respective season.

3. Since the water issued through the sluice is automatically monitored daily, the system has the ability to send a warning message for the excess usage of water.
4. A warning message is to be sent to the admins of the system to supply the crop water requirement when needed.

Meeting Minutes:

1. Calculating the area capacity curve by using an equation.
2. The system is agreed to be made for one reservoir first and demonstrate it to the department officials, and then it is applied to other reservoirs as well.
3. The system is discussed to be coupled to the web so that the data can be obtained through the web.
4. Seasonal schedule for crop water requirements is asked to be made for all the stages such as the development stage, matured stage etc.
5. The seasonal schedule is to be made assuming that there is no rainfall.
6. Calculation of the water balance in the tank is discussed.
7. Duty of the respective schemes' week by week is requested.
8. A warning message to indicate the excess usage of water is requested.
9. Summary sheets for all the schemes is requested.
10. Requested for information of the total capacities of the reservoirs as of today.
11. Methods of calculating the number of crops cultivated as of today is discussed.
12. Ability to get an idea about up to which extent the duty schemes and the forecasts tally with each other.
13. Discussion regarding the ability to generate reports weekly, monthly, seasonally and annually.
14. Discussion regarding the amount of yield produced in the respective periods.
15. Discussion regarding the amount of paddy generated with that yield.
16. Discussion regarding the yield percentage in Sri Lanka with the requirement.

Action Items:

Action item	Decision made by
Calculating the seasonal schedule by assuming that there is no rainfall	Director General of Irrigation
Calculations need to be done to obtain the crop water requirement	Water Management
Providing with a warning message to fulfill the crop water requirement	L.S.H.M.P. Bandusena
Calculations to be done when calculating the water capacity	Director General of Irrigation

Providing the excess usage of water by using a graph	
Connecting all the details of the reservoir into a centralized database	L.S.H.M.P. Bandusena
Providing a summary sheet for the schemes	
Providing weekly, monthly, seasonal, annual reports	
A forecast to display the amount of water issued in a week	
Displaying the duty schemes weekly	
Coupling our Reservoir Management System to the Irrigation Department website	L.S.H.M.P. Bandusena

Approved - Lahiru Fernando