

Informatics Institute Of Technology

Department Of Computing

(B.Eng. In Software Engineering)

Module: 5COSC009C.2

Software Development Group Project

Module Leader: Mr.Banuka Athuraliya

Gardener

(Guiding Web Application On Modern Home Gardening)

Group Name: Omnisphere

System Requirement Specification

Member	UOW ID	IIT ID
Chanka Sonnadara	W1790805	2018506
Amila Fernando	W1761914	2018420
Ranma Perera	W1790164	2019706
Rushelle Clement	W1790166	2019709
Naduni Kaveesha	W1790036	20191206
Ashen Induwara	W1761741	2018076

Abstract

During this current pandemic situation, many people started implementing home gardening. Today home gardening has become a trend among a lot of people. Usually, people are more enthusiastic to try new trends, but as for the home gardening sector, it is very hard to maintain plants for long term potentials. This is a major problem that a lot of new people(people new to home gardening) face in this sector. There are many applications related to planting sector but there are only a few applications that guide people when implementing home gardening. A lot of applications are mainly focused on the large scale planting sector. This research analyses the location of the people and pick the suitable plants according to the location and gives instructions to maintain the plants at issues like bug attacks and fertilizers. Furthermore, this website guide people from the first day(sowing seeds) to the last day (harvest day). When implementing this website data science and machine learning techniques are used with different code and design technologies. Data sets have been collected through official websites and books published under the department of agriculture Sri Lanka. Furthermore, professionals in home gardening are interviewed for the accuracy of the data sets. The Gardener is a web application to help and motivate people to try home gardening most suitably.

Acknowledgement

First of all, we would like to thank our Gods for giving us the strength and courage to face all the challenges and complete this final document step by step.

Secondly, we would like to thank our families for always believing in us and for, helping us in numerous ways to achieve our life goals by giving us words of wisdom and encouraging us to achieve in a better way.

We would also like to express our heartfelt appreciation and thanks to our lecturers, Mr. Banuka Athuraliya(Module Leader), Mrs. Krishnakripa Jayakumar, Mr. John Sriskandarajah and Mr. Nuwan Jayawardene, along with the group of instructors for their constant support, guidance and supervision throughout this journey of completion of the final document. We also thankful to them for directing us in the correct direction and path, and for their words of encouragement, whenever we were stuck at any point of this group project.

Special thanks to all the domain experts, agricultural officers/owners, industry experts who helped us out with feedback and their research papers. We would also like to appreciate everyone who supported us by participating in the online surveys, questionnaires and interviews to contribute their ideas and feedback needed.

Finally, We would like to acknowledge and thank all our colleagues and friends who have helped us endlessly whenever we needed a helping hand, especially the ones in our group Omnisphere.

Contents

Abstract.....	ii
Acknowledgement	iii
List Of Tables	x
1. Chapter 1 – Introduction	1
1.1 Chapter Overview	1
1.2 Project Background.....	1
1.2.1 Introduction To Problem Domain	1
1.2.2 Problem Definition.....	5
1.2.3 Research Questions	5
1.3 Aim	6
1.4 Scope.....	6
1.4.1 Inclusions	6
1.4.2 Exclusions	6
1.5 Objectives	7
1.5.1 Research Objectives	7
1.5.2 Academic Objectives	7
1.5.3 Operational Objectives.....	7
1.6 Proposed Solution	8
1.6.1 Rich Picture Diagram.....	8
1.6.2 Features Of The Prototype	8
1.7 Resource Requirements.....	9
1.7.1 Hardware Requirements.....	9
1.7.2 Software Requirements	9
1.7.3 Technology Stack.....	10
1.8 Chapter Summary	10
2. Chapter 2 – Literature Review	11
2.1 Chapter Overview	11
2.2 Comparison Of Similar Research, Products & Technologies	11
2.2.1 Krushi Advisor Application	12
2.2.2 AgriApp Mobile Application	13
2.2.3 GoviMithuru Mobile Application	14
2.3 Research Gap	15
2.3.1 Locations In The Country According To The Provinces & Districts	16
2.3.2 Annual Rainfall Of Each Location In The Country	17
2.3.3 Height From The Sea Level In All The Districts	18

2.3.4	Major Short Term Crops Feature In The Web Application	18
2.3.5	Cultivation & Harvesting Productivity Records In Last Five Years.....	19
2.3.6	Records Of The Destructed Amount Of Plants & Causes Annually.....	20
2.3.7	The Suitability Of Soil For Plantation Sri Lanka.....	20
2.4	Research On Approaches & Techniques	21
2.4.1	Plant Suitability Suggestion Using Each Location Of The Country	21
2.4.2	Maintenance Guidance Record Functionality	21
2.4.3	Suggesting Suitable Strategies On Growing A Plant In Any Condition.....	23
2.4.4	Disease Prevention & Control Functionality	23
2.4.5	Blog Functionality.....	25
	25
2.5	Chapter Summary	25
3.	Chapter 3 - Project Management	26
3.1	Chapter Overview	26
3.2	Methodologies.....	26
3.2.1	Research Approach	26
3.2.2	Process Model.....	27
3.2.3	Analysis & Design Approach	28
3.2.4	Programming Methodology	28
3.2.5	Testing Methodology	28
3.2.6	Project Management Method	29
3.2.7	Data Gathering Method.....	30
3.3	Constraints	30
3.4	Communication Plan.....	30
3.5	Risks & Mitigations	31
3.6	Drivers Of The Project.....	31
3.7	Activity Schedule.....	32
3.8	Work Break-Down Structure	32
3.9	Gantt-Chart Diagram	32
3.10	Chapter Summary	32
4.	Chapter 4 – System Requirements Specification	33
4.1	Chapter Overview	33
4.2	Stakeholder Analysis	33
4.2.1	Onion Model	33
4.2.2	Stakeholder Descriptions	33
4.3	Requirements Gathering	34
4.3.1	Techniques For Requirement Gathering	34

4.3.2	Literature Review Outcomes	36
4.3.3	Online Questionnaire Design	36
4.3.4	Meeting Subject Experts	36
4.3.5	Interview With Domain Experts	37
4.4	Analysis Of Gathered Data	37
4.5	Models.....	38
4.5.1	Use Case Diagram.....	38
4.5.2	Use Case Descriptions	39
4.5.3	Domain Model	39
4.6	Functional Requirements	39
4.7	Non-Functional Requirements	40
4.8	Chapter Summary	41
5.	Chapter 5 – Design.....	42
5.1	Chapter Overview	42
5.2	High Level Architecture Diagram.....	42
5.3	Sequence Diagrams.....	43
5.4	Class Diagram.....	44
5.5	Activity Diagram	45
5.6	Wireframes.....	46
5.7	Chapter Summary	47
6.	Chapter 6 – Conclusion.....	48
6.1	Chapter Overview	48
6.2	Dataset.....	48
6.2.1	Dataset For Providing The Suitable Plant Types	48
6.2.2	Dataset For Providing The Compatible Districts & Time Of The Year	49
6.2.3	Dataset For Providing The Maintenance Guidelines	50
6.2.4	Dataset For Recommending The Disease Prevention Strategies	51
6.2.5	Dataset For Calculating The Predicted Harvest	52
6.3	Legal, Social, Ethical & Professional Issues.....	54
6.3.1	Legal Issues.....	54
6.3.2	Social Issues.....	54
6.3.3	Ethical Issues	54
6.3.4	Professional Issues	55
6.4	Plans For Implementation	55
6.4.1	Planning & Sketching The Workflow.....	55
6.4.2	Wire Framing/Prototyping	56
6.4.3	Seeking Early Validation	56

6.4.4	Architect/Build Database	56
6.4.5	Building The Front End	56
6.4.6	Building The Backend	57
References.....		x
Bibliography		xiii
Appendix – Section A – Project Management.....		xv
Appendix - Section A.1 – Work Break-Down Structure		xv
Appendix – Section A.2 – Gantt-Chart Diagram.....		xvi
Appendix – Section B – System Requirement Specification.....		xvii
Appendix – Section B.1 – Onion Model.....		xvii
Appendix – Section B.2 – Questionnaire.....		xviii
Appendix – Section B.3 – Analysis Of Gathered Data.....		xxi
Appendix – Section B.4 – Use Case Descriptions		xxv
Appendix – Section B.4.1 – Receives The Location		xxv
Appendix – Section B.4.2 – Analyse Conditions.....		xxvi
Appendix – Section B.4.3 – View Suitable Plant Types.....		xxvii
Appendix – Section B.4.4 – Providing Maintenance Guidelines.....		xxviii
Appendix – Section B.4.5 – Identifying Possible Plant Diseases		xxix
Appendix – Section B.4.6 – Recommending Disease Prevention Strategies.....		xxx
Appendix – Section B.4.7 – Calculating Predicted Harvest		xxxi
Appendix – Section C – Design.....		xxxii
Appendix – Section C.1 – Sequence Diagrams		xxxii
Appendix – Section C.1.1 – Log In		xxxii
.....		xxxii
Appendix – Section C.1.2 – Registered User.....		xxxiii
Appendix – Section C.1.3 – Sign In		xxxiv
Appendix – Section C.1.4 – Un-Registered User		xxxv
Appendix – Section C.2 – Wireframes		xxxvi
Appendix – Section C.2.1 – Plant Suggestion		xxxvi
Appendix – Section C.2.2 – Plant Suggestion – Conditions.....		xxxvii
Appendix – Section C.2.3 – Disease Prevention.....		xxxviii
Appendix – Section C.2.4 – Weekly Journal		xxxix
Appendix – Section C.2.5 – Weekly Journal - Guidelines		xl
Appendix – Section D – Group Members Contribution Table		xli

List Of Figures

Figure 1. People Coming Into Stores For Buy Seeds.....	2
Figure 2. An Article Showing Government & Social Media Endorsement On Gardening	3
Figure 3. An Article Showing That People Should Maintain Their Plants.....	4
Figure 4. Rich Picture Diagram	8
Figure 5. Technology Stack	10
Figure 6. Krushi Advisor - Mobile Application.....	11
Figure 7. GoviMithuru - Mobile Application	11
Figure 8. AgriApp - Mobile Application	11
Figure 9. Krushi Advisor - Utilities	12
Figure 10. Krushi Advisor - Menu.....	12
Figure 11. AgriApp - Farmer Chat.....	13
Figure 12. AgriApp - Menu	13
Figure 13. GoviMithuru - Utilities	14
Figure 14. GoviMithuru - Title Page	14
Figure 15. District Diversification Of Sri Lanka - (Department Of Census & Statistics)	21
Figure 16. A Collected Dataset.....	22
Figure 17. Growing Short-Term Crops - Handbook	22
Figure 18. Short Term Crop Suitability Chart	23
Figure 19. Destruacted Amount Of Plants In Kurunegala District (AgStat 2019)	24
Figure 20. Destruacted Amount Of Plants In Monaragala District (AgStat 2019).....	24
Figure 21. Disease Control Chart On Short Term Crops In Sri Lanka(AgStat, 2019)	24
Figure 22. A Sample Gardening Blog (HandleGarden, 2019).....	25
Figure 23. Deductive Approach On Plant Suggestion	26
Figure 24. Steps Of Waterfall Model.....	27
Figure 25. Object Oriented Design Approach	28
Figure 26. Testing Methodology.....	28
Figure 27. Summary Of Project Management Methodologies	29
Figure 28. Data Gathering Methods.....	30
Figure 29. Use Case Diagram	38
Figure 30. Domain Model	39
Figure 31. High Level Architecture Diagram	42
Figure 32. Core Sequence Diagram	43
Figure 33. Class Diagram	44
Figure 34. Activity Diagram	45
Figure 35. Core Wireframe Of Gardener Web Application.....	46
Figure 36. Cluster Of Collected Datasets.....	48
Figure 37. Dataset For Providing Suitable Plant Types.....	49
Figure 38. Dataset For Providing Compatible Locations.....	49
Figure 39. Dataset For Providing Compatible Time Of The Year.....	50
Figure 40. Week 1 - Maintenance Guidelines.....	50
Figure 41. Week 2 - Maintenance Guidelines.....	51
Figure 42. Week 3 - Maintenance Guidelines.....	51
Figure 43. Filtering System Of Dataset	51
Figure 44. Plant Treatment Dataset.....	52
Figure 45. Possible Diseases Dataset.....	52
Figure 46. Annual Productivity Records - Dataset	53
Figure 47. Cultivation Extent Records - Dataset	53
Figure 48. Work Break-Down Structure.....	xv

List Of Figures & Tables

Figure 49. Gantt-Chart Diagram	xvi
Figure 50. Onion Model.....	xvii
Figure 51. Sequence Diagram - Log In.....	xxxii
Figure 52. Sequence Diagram - Registered User.....	xxxiii
Figure 53. Sign In - Sequence Diagram.....	xxxiv
Figure 54. Sequence Diagram - Unregistered User	xxxv
Figure 55. Wireframe - Plant Suggestions	xxxvi
Figure 56. Wireframe - Plant Suggestion Conditions	xxxvii
Figure 57. Wireframe - Disease Prevention.....	xxxviii
Figure 58. Wireframe - Weekly Journal	xxxix
Figure 59. Wireframe - Weekly Journal Guidelines	xl

List Of Tables

Table 1. Feature Comparison Chart	5
Table 2. Operational Objectives.....	8
Table 3. Hardware Requirements.....	9
Table 4. Software Requirements.....	10
Table 5. Krushi Advisor - Feature Comparison Chart	12
Table 6. AgriApp - Feature Comparison Chart.....	13
Table 7. GoviMithuru - Feature Comparison Chart.....	14
Table 8 Agricultural Diversification In Sri Lanka	16
Table 9. Annual Rainfall In Sri Lanka - 2017.....	17
Table 10. Annual Rainfall In Sri Lanka – 2018.....	17
Table 11. Height From The Sea Level In Sri Lanka.....	18
Table 12. Major Short Term Crops In Sri Lanka.....	19
Table 13. Ratnapura District Harvesting Productivity Records (HARTI 2015-2019).....	19
Table 14. Badulla District Harvesting Productivity Records (HARTI 2015-2019).....	19
Table 15. Destruacted Amount Of Pumpkin Plants Within Last Five Years (SLIATE, Sri Lanka)	20
Table 16. Destruacted Amount Of Cucumber Plants Within Last Five Years (SLIATE, Sri Lanka)	20
Table 17. The Quality Of Soil In Sri Lanka. (Department Of Agriculture).....	20
Table 18. Reasons For Not Choosing Other Methodology Concepts	27
Table 19. Risks & Mitigations	31
Table 20. Activity Schedule.....	32
Table 21. Stakeholder Descriptions	34
Table 22. Techniques For Requirement Gathering	35
Table 23. Online Questionnaire Design	36
Table 24. Meeting Subject Experts	37
Table 25. Interview With Domain Experts	37
Table 26. Functional Requirements	40
Table 27. Non-Functional Requirements	40
Table 28. Online Questionnaire	xx
Table 29. Analysis Of Gathered Data	xxiv
Table 30. Use Case 01 - Receives The Location	xxv
Table 31. Use Case 02 - Analyse Conditions.....	xxvi
Table 32. Use Case 03 – View Suitable Plant Types.....	xxvii
Table 33. Use Case 04 - Maintenance Guidelines	xxviii
Table 34. Use Case 05 - Identifying Possible Plant Diseases	xxix
Table 35. Use Case 06- Recommending Disease Prevention Strategies.....	xxx
Table 36. Use Case 07 - Calculating Predicted Harvest	xxxi
Table 37. Group Contribution Table.....	xlii

1. Chapter 1 – Introduction

1.1 Chapter Overview

This chapter elaborates the project background in order to provide a clear understanding about the problem domain, the challenges faced by existing solutions as well as the aim of the entire project, objectives, scope and resource requirements based on hardware as well as software requirements for “Gardener” – Guiding Web Application On Modern Home Gardening. The introduction chapter also goes over the designed feature set of “Gardener” web application prototype, which is detailed with a rich picture diagram and the outline of the entire project that details all the areas that will be covered in this dissertation.

1.2 Project Background

The software development group project is done mainly as it is a mandatory requirement of the BEng – Software Engineering and BSc – Computer Science degree programs from the University of Westminster at fifth academic level. With the knowledge gained in the first year of study with software development principles, the focus is set to solve a real world problem. Agriculture and plantation domain is the domain studied in this project. The agriculture industry (Dharma, http, 2018) is consider as one of the backbone sources where community receives both consumption and financial supply where it causes an extremely essential impact to economy of the modern world. The motivation and reason to pick the domain of the project is because of the direct impact it made to the lives of general community during the lockdown period.

1.2.1 Introduction To Problem Domain

1.2.1.1 Problem Boundary

Food consumption is a sector where entire globe is concerning when it comes to a pandemic situation. During the past pandemic period due to Covid-19 outbreak, this topic become a role model (Rowan, http, 2020) among the considerable amount of developing countries in the entire globe and more specifically in Asian countries. Asian domestic community are used measure their economical sustainability (Sharfuddin, http, 2020) according to the educational performances that they made. Majority of the population in Asian countries providing their daily meal by working on daily basis jobs. That is why a global pandemic can affect to their daily lives mainly from food issues. This project mainly based on how domestic planting can use to provide the need of food consumption in Sri Lankan community.

During the past three to five months of the global lockdown, most of the people were desperate on their daily work (Susskind, http, 2020) as it was very hard to live without their monthly incomes. Some companies worked using online platforms and some of them went entirely shut down. That was where the problems occurred as people had find another source of their monthly income. Government could provide a very small amount of money for low-income families but it was not good enough. People had to frame into their homes in any sort of work (Sharma, http, 2020) they were tried to do as stepping out was highly prohibited. Community was in need of a solution to find an extra income or any sort of a food to consume while they were at their homes. This is why this developing team picked this incidence as a problem and designed a long-term solution for that.

While the lockdown period, planting short term crops at home gardens become trending, as people understood it is the only solution for providing the food consumption to their families when there is

another lockdown or pandemic outbreak occurs. Even government endorsed this method among the community as they have identified, as it is a costless solution that provide both financial safety as well as a biological output. Planting valuable crops such as fruits, vegetables, and herbal plants was very popular among the housewives during that time. They used costless ways to initiate planting by gardening the desired crops (MarketWatch, http, 2020) with seeds collected from a parent plant or a bud separated from a field. Entire gardening was very popular during the pandemic period and even the elderly and young generation started planting what they can in their home gardens as a way of spending the extra time they received due to the global outbreak.

Actual problem for this plantation concept came right into action when curfew lifted (Keshner, http, 2020) for the countries. People started to walk back for their daily lives and most of them forgotten to treat the crop fields they planted. Even the female community had to step away from plantation, as they were busy with their daily work. Planted crops were destroyed due to non-maintenance. This is where the initiated concept become worthless (HARTI, http, 2020) as people could not receive any actual harvest from what they started planting. Considering this problem, Team developed a concept of a guiding web application that provides the necessary maintenance guidelines to maintain a healthy crop with a more prolific harvest using interesting strategies.

This web application provides the guidelines to pick the most suitable plant to grow in the residency of the user. Then it provides the strategies on how to prepare the field for plantation, maintain the selected plant weekly according to the issues identified from the user as well as recommending the disease prevention strategies with treatments.

1.2.1.2 Examples In The Problem

1. Increase Of Home Gardening During The Lockdown Period In Sri Lanka

Increase of home gardening among the community during the lockdown period is highlighted as several means of encouragement to home gardening is been introduced through digital and electronic media. This came into action when government also popularised this short-term crop planting strategy. Considerable number of web based platforms were also encouraged the community about this new trend on plantation for those who spend more time on their day on google based platforms.



Figure 1. People Coming Into Stores For Buy Seeds

2. Social Media & Government Endorsement For Home Gardening

Social media platforms claimed to be the leading sources of endorsing the home gardening into a major community in the present social network. Several social media platforms launched the strategies like home gardening challenges. Social media influencers promoted the basic idea of domestic gardening by using the strategies like posting the images of them working on their gardens with family members. April-May months claimed to be the time where peak of this gardening process popularised highly among the audience.

Local media rallied behind campaigns such as the "Home gardening challenge," with the country's cricketers — superstars in a country that reveres the sport — showing how they were taking to cultivate their backyards and inspiring people.

Sri Lanka, a tropical Indian Ocean island, has climate variations that enable year-round crop cultivation. [Home gardens in Sri Lanka account for 13%](#) of the total land area. Realizing the value home gardening can contribute to household food security, the government through the [Department of Agriculture \(DOA\)](#) also launched a program called [Saubhya](#) (meaning "prosperity") to promote a million home gardens.

Under this program, officials distributed 2 million seed packets to households. [W.M.W.Weerakoon](#), director-general of the Department of Agriculture, told Mongabay:

"We offer these vegetable seed packets as a means of encouragement to try home gardening. People can find many other things to plant in their gardens like green leaves, so they can expand on their own," he said.

The department also had field staff offering advice on tackling pests and maximizing yields. "The public can contact our agriculture hotline anytime," Weerakoon said.

The department has tried to promote home gardening a number of times in the past, but with little success. The current concerns around household food security have caused a wave of their own, making it likely that this program will succeed, Weerakoon added.

The lockdown has since been eased in 23 of Sri Lanka's 25 districts, so people will need some prodding to retain their interest in home gardening. "We are reminding the public of the value of growing your own food, which is healthier as vegetables available in the markets are often having [high agrochemical residue](#)," he said.

Figure 2. An Article Showing Government & Social Media Endorsement On Gardening

3. Lack Of Knowledge For Plantation Among The Community

Right after the curfew is lifted and schools, workplaces started working, everyone has to move on with their daily routines again. Most of the people who started domestic gardening has to put more attention into their daily work (Daily Mirror, http, 2020) more than a simple hobby they started to work during the lockdown period. This caused the destruction of many plant fields that people initiated and most of the crops couldn't produce the harvest. Major reason for this was the community's lack of knowledge for maintaining a plant in a home garden. Online resources like YouTube provided simple guidelines through guiding videos on how to maintain a plant, but it couldn't stop people from leaving their crop fields behind and getting back to spend the normal lives.

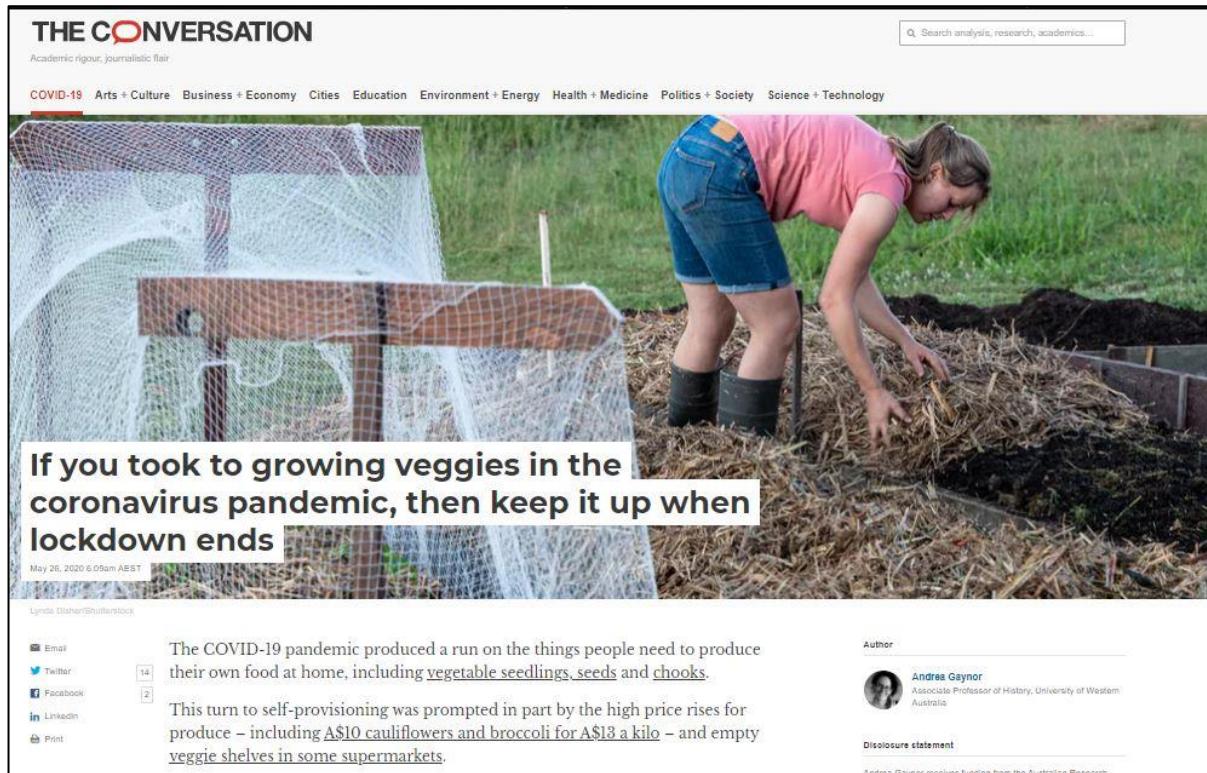


Figure 3. An Article Showing That People Should Maintain Their Plants

1.2.1.3 Attempted Solutions Of The Competitors

Guidance platform for gardening must consist several amount of datasets as well as feature sets where users can receive guidance for any sort of issue without struggling. The platforms accuracy and capacity should highly be considered while developing on this type of subject.

Mainly attempted solution for providing maintenance guidelines for local community on domestic plantation, done by the official website of ministry of agriculture. Government officials provided an option where any user can direct into the planting guidelines section of the website and receive the strategies on the problem that users are facing.

Highlighted issue on that website was the lack of datasets included in their guidelines suggestion functionality. Web application was designed only to provide the maintenance strategies for few high-capacity crops in the country. Most of the feature plant types on the government website, cannot even grow in the domestic environment.

Feature	Agriculture Ministry Website	Gardener
Island Wide Agricultural Information System	✗	✓
Monitoring & Evaluation	✓	✓
Field Planning	✗	✓
Fertilizer Recommendation	✗	✓
Technological Guidance	✓	✓
Disease Prevention Strategies	✗	✓
Community Forum	✗	✓

Table 1. Feature Comparison Chart

1.2.2 Problem Definition

Extreme lack of guiding resources for maintain the domestic home gardens, including the maintenance strategies for productive short-term crops planted in it.

1.2.3 Research Questions

Research for the entire project has been conducted within the following dimensions listed below.

- ✓ Locations of the country according to the provinces & districts
- ✓ Annual rainfall of each location in the country
- ✓ Height from the sea level
- ✓ Major short term crops we will feature on web application
- ✓ Harvesting & cultivation productivity records within last five years in Sri Lanka
- ✓ Records of the destructed amount of plants within last five years in Sri Lanka
- ✓ The suitability of soil for plantation in several locations in the country

Above research, dimensions of the project mainly targeted to solve the following factors listed below.

- ✓ What types of maintenance guidelines should provide for short-term crops
- ✓ What are the major valuable short-term crops planted in the country
- ✓ How to prevent the diseases affect to crops panted in domestic environment
- ✓ Ways to convert domestic garden into a prolific planting field
- ✓ Fertilizers, chemical treatments used in agricultural industry for maintain planting fields

1.3 Aim

To evaluate and implement a software to motivate people to involve more in home- gardening and guide them to implement home gardening in the best way.

With the current pandemic situation in the country, doing home gardening, and having some food as a backup would be very useful for people. But most people don't know the ways to do planting most suitably.

How to do it? How to plant on our own? What type of seed we should use ? What kind of weather does it require? What is the time/season that suits a particular plant? These are the questions that people have when doing home gardening.

This software will provide all the help they need. Such as the types of plants they can select according to their living location, target planting location, details about what are the types of fertilizers that they should use, and what is the actual suitable weather that they should start growing the particular plant.

This will benefit people to implement home gardening in the most suitable and the precise way. In this method, people can supply their day to day meals as well as can transform home gardening into a profitable business.

1.4 Scope

1.4.1 Inclusions

This website is implemented to improve home gardening, motivate people to implement home gardening, and offer more knowledge about home gardening. During the current pandemic situation, many people started home gardening.

But most people gave up home gardening as they don't have the required knowledge to maintain it for the long term. Especially, reasons such as insect attacks, sicknesses, and preserving problems (fertilizer, water). Hence, in this website, we plan to give the required solutions to the problems that people face in home gardening and guide them throughout the period.

According to our researches, many people state that they don't have time to do gardening as most people think gardening is time-consuming. This is a major problem to lose motivation. But from this software, the website will guide the user every day and it will provide information on what should be done on that particular day.

1.4.2 Exclusions

Currently this website is only based on the home gardening sector. But in Sri Lanka, large-scale plants such as paddy, rubber, tea, and coconut are very popular. These plants cultivated areas are very large. This website is not created to support these types of the plantation as there is a lot of government influence over them currently.

Home gardening is a new trend that got popular during the lockdown period. But large-scale cultivators have a lot of experience in the plantation as they have done it for generations. So, at the present, the priority is home gardening as it is a sector that must be improved, but if the required data is gathered about large scale cultivation, the website will be updated for large scale plantation too.

1.5 Objectives

1.5.1 Research Objectives

- To identify the best algorithm to analyse user input data and present the most suitable information
- To learn about machine learning and data science thoroughly
- To understand the community need on the selected subject stream
- To work with a variety of different datasets
- To provide an industry standard product to the user

1.5.2 Academic Objectives

- Gaining knowledge to conduct researches and publish research papers
- Applying knowledge learned to practical demonstrations
- Improving knowledge and understanding of various technologies as machine learning and data science
- Improving teamwork, time management, and project management skills
- Applying various new technologies to present the best output result

1.5.3 Operational Objectives

Objective		Description
OB1	Purpose	<ul style="list-style-type: none"> ✓ Researching about existing research's that involve machine learning and data science ✓ Discussing with experts in agriculture about drawbacks in home gardening ✓ Define the problem domain ✓ Investigating about the competitors ✓ Submit the final document
OB2	Data Gathering	<ul style="list-style-type: none"> ✓ Gather data from websites and books under the department of agriculture Sri Lanka (ex: vegetable book)
OB3	Reviewing Existing Work	<ul style="list-style-type: none"> ✓ Performing a critical literature analysis about the home gardening sector and the areas of machine learning and data science ✓ Evaluating existing solutions for the home gardening sector ✓ Identifying various technologies and select the most suitable technology and the algorithm ✓ Submitting the final literature review document
OB4	Design	<ul style="list-style-type: none"> ✓ Recognising the most suitable technologies to be used ✓ Identifying the functional and non-functional requirements and create the SRS document ✓ Selecting the most suitable design tools and technologies ✓ Identifying the technologies and designing the system ✓ Preparing the final design document and submitting it

OB5	Implement	✓ Developing a prototype for the system using the best techniques to enhance user experience
OB6	Test	✓ Create test case and execute them in the prototype ✓ Fixing bugs where necessary ✓ Creating a report based on the test results
OB7	Evaluate	✓ Evaluate the prototype and verify whether the all requirements are met ✓ Create the evaluation document

Table 2. Operational Objectives

1.6 Proposed Solution

1.6.1 Rich Picture Diagram

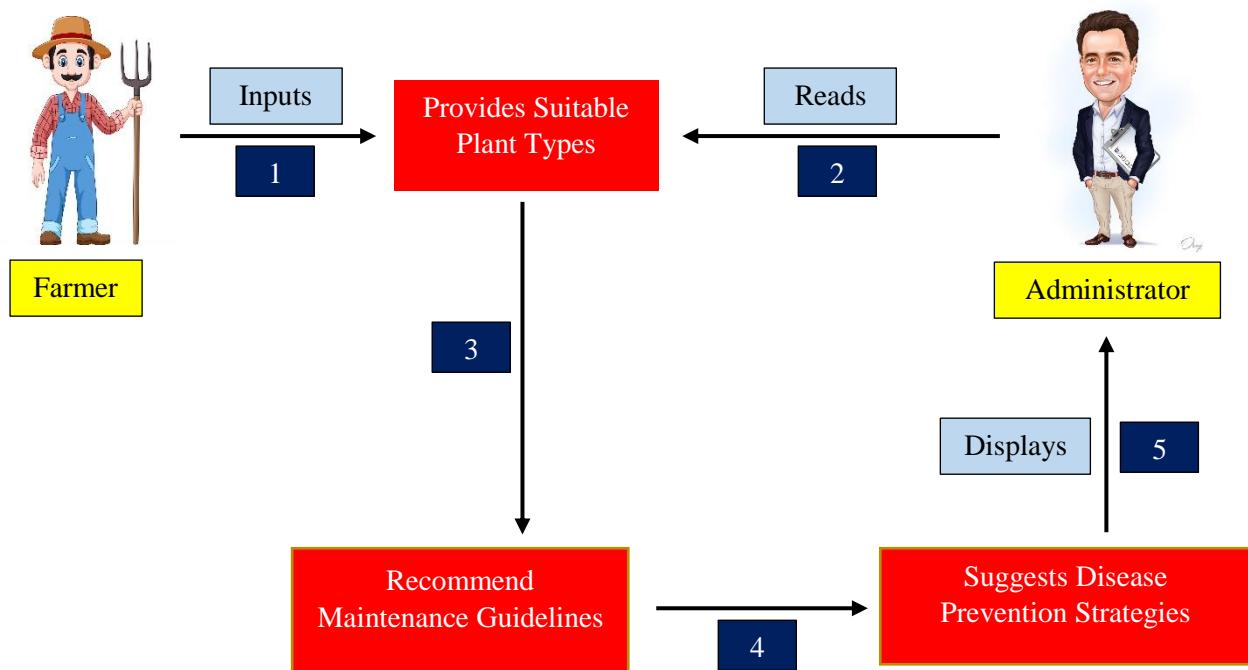


Figure 4. Rich Picture Diagram

1.6.2 Features Of The Prototype

Based on the concept of this guiding web application on modern home gardening - Gardener, the features of the prototype as follows,

1. Providing the suitable plant types for planting based on the resident location of the user
2. Providing maintenance guidelines for selected plant type by the user based on a weekly basis
3. Suggesting disease prevention strategies for the identified disease entered by the user
4. Recommending compatible chemical treatments for the identified diseases with portions
5. Calculating predicted harvest according to the planting field size

1.7 Resource Requirements

1.7.1 Hardware Requirements

Device	Specifications
Lenovo IdeaPad 330s (Primary development system) Choose Windows due to the better performance with development tools and better control over the Unix based system environment.	Windows 10, Core i5 processor, 4GB RAM, 512GB SSD
Desktop PC (Secondary development system) In order to run windows compatible software if necessary and to store large datasets	Windows 10, Core i7 processor, 16GB RAM, 1TB HDD
Dialog 4G router (Internet Connection) Fast Internet connection	Dialog LTE

Table 3. Hardware Requirements

1.7.2 Software Requirements

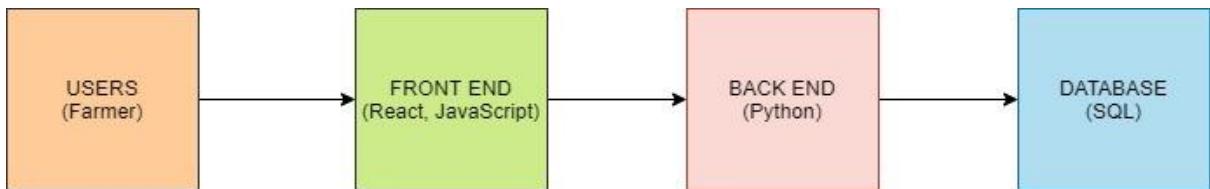
Languages	
Python	For back end
JavaScript, React	For the development of the GUI of web application
IDEs & Other Software	
VSCode	For HTML, CSS programming
PHPMyAdmin	For implementing the backend database while documenting
Pycharm	For programming with python in OOP
Flask	For programming the web application
StarUML	For designing UML diagrams
Microsoft Office Word	For making the reports & other documentation
Google Docs	For managing research document
Gantt-Excel	For making the Gantt chart diagram

WBS Creator	For making the work breakdown structure
Adobe Photoshop	For editing, creating images & wireframes
Google Drive	For managing the documents & data in the cloud
GitHub	Version controlling

Table 4. Software Requirements

1.7.3 Technology Stack

Technology stack of the entire project is the combination of underneath development and design of proposed wireframe. As the total design of the entire web application shows a considerable amount of work in front end languages like HTML, CSS, and JavaScript, understanding the mean of technology stack used in the project is essential for the developing team. Python will be used as the coding language using in the backend of the web application. Below diagram projects a view of the technology stack that will be using in Gardener.

**Figure 5. Technology Stack**

1.8 Chapter Summary

This chapter provided an outline of the designed concept of guiding web application for the modern home gardening sector. This chapter provided the detailed descriptions about the problem domain along with a lot of details on the project background. The high-level features of the prototype were also identified. The aim and objectives which are needed for the successful completion of the project was also provided in detail. It also identified the resource requirements of the project as well.

2. Chapter 2 – Literature Review

2.1 Chapter Overview

This web application mainly focused on initiation to conclusion guiding service for the people who are specifically interested in home gardening. By considering the location of the user, the web application suggests the most suitable plants to grow in the selected places in the country. Most importantly, web application gives a planting day to harvesting day guidance to grow the particular plant with expertise strategies for fighting against the threats affect to the crops from time to time.

2.2 Comparison Of Similar Research, Products & Technologies

Comparison Has Done Considering The Following Summary Of Feature Sets.

- Take the user's location and show them what kind of crops are suitable for their area.
- If they want to cultivate a plant, which is not that, suits with the conditions of their land we suggest the special conditions that user has to afford.
- Continuous guidance until the harvest day: guiding the farmer continuously from the planting day to harvesting day.
- Take the user's size of the land and show them how much harvest that they can earn from it.
- If the farmer wants to improve the harvest of their land we give the guidance that they have to follow.
- User can ask any relevant problems and we give them the answers.
 - ex: they can ask about a disease that is killing their harvest, and the solution for it
- The forum: users can communicate and share information about their farming, harvesting, crop's diseases and insect's problems like relevant issues through the app.
- The blog: use this to share new agricultural trending with our users to keep them update with the agriculture.

There Are Lot Of Apps For The Farming Field But Most Of Them Haven't Done A Great Job At It. Here Are Three Apps To Compare With This Web Application To Prove That This Guiding Application Is More User Friendly And Helpful Than Others.

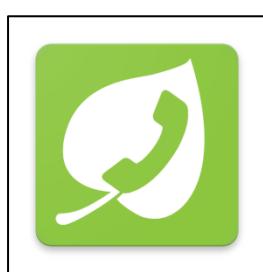


Figure 6. Krushi Advisor - Mobile Application



Figure 7. GoviMithuru - Mobile Application



Figure 8. AgriApp - Mobile Application

2.2.1 Krushi Advisor Application

This app is designed by the department of agriculture in sri lanka. The target group of this mobile app considers farmers, agriculture entrepreneurs, students and other agriculture information seeking stakeholders. This app provides agricultural advisory services for food crops cultivation in sri lanka with a high standard.

Feature	Krushi Upadeshaka	Gardener
Taking user's location and showing them suitable plants	✗	✓
Chosen plant is not that suitable with the conditions of the area but app give suitable advices to successfully plant	✓	✓
Continuous guidance until the harvest day	✗	✓
Calculate and show the amount of harvest user can earn from the size of their land	✗	✓
Guide the user to improve the harvest of their land.	✗	✓
User can ask any relevant problems and we give them the answers	✓	✓
The forum	✗	✓
The blog	✗	✓

Table 5. Krushi Advisor - Feature Comparison Chart



Figure 9. Krushi Advisor - Utilities



Figure 10. Krushi Advisor - Menu

2.2.2 AgriApp Mobile Application

This application provides complete information on crop production, crop protection, smart farming with agriculture and allied services. Agriapp is also an online market place for bringing in farmers, agri input, retailors and fulfilment services on a common digital platform.

Feature	Agriapp	Gardener
Taking user's location and showing them suitable plants	X	✓
Chosen plant is not that suitable with the conditions of the area but app give suitable advices to successfully plant it.	✓	✓
Continuous guidance until the harvest day	X	✓
Calculate and show the amount of harvest user can earn from the size of their land.	X	✓
Guide the user to improve the harvest of their land.	X	✓
User can ask any relevant problems and we give them the answers.	X	✓
The forum	✓	✓
The blog	✓	✓

Table 6. AgriApp - Feature Comparison Chart

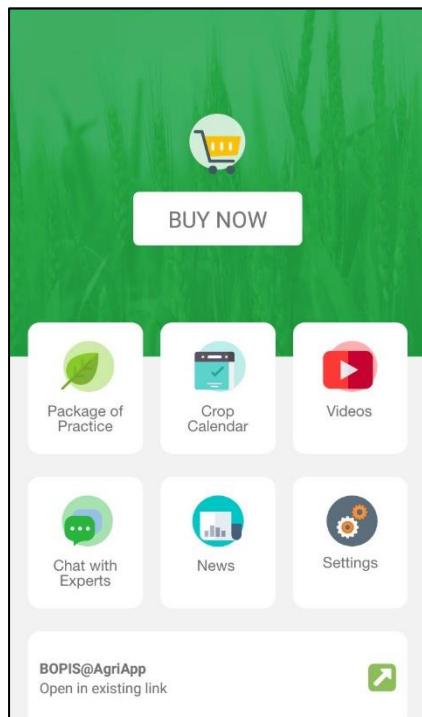


Figure 12. AgriApp - Menu

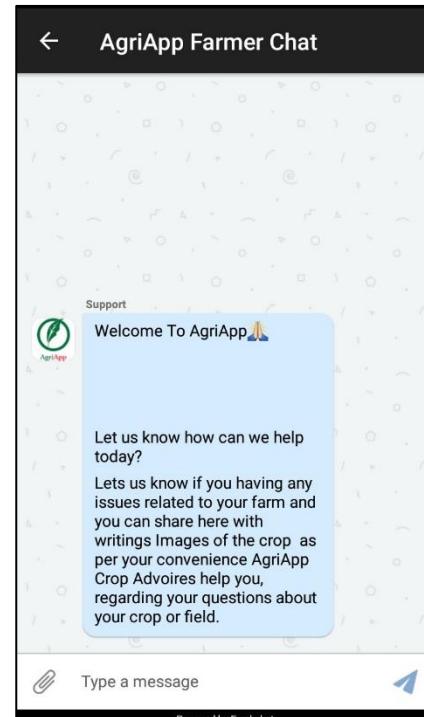


Figure 11. AgriApp - Farmer Chat

2.2.3 GoviMithuru Mobile Application

This application's content is mainly provided by the department of agriculture, sri lanka. Information is provided to home gardeners. Customized as per farmer's need.

Feature	Govimithuru	Gardener
Taking user location and showing them suitable plants	✓	✓
Chosen plant is not that suitable with the conditions of the area but app give suitable advices to successfully plant it.	✓	✓
Continuous guidance until the harvest day	✗	✓
Calculate and show the amount of harvest user can earn from the size of their land.	✗	✓
Guide the user to improve the harvest of their land.	✗	✓
User can ask any relevant problems and we give them the answers.	✓	✓
The forum	✗	✓
The blog	✗	✓

Table 7. GoviMithuru - Feature Comparison Chart



Figure 14. GoviMithuru - Title Page



Figure 13. GoviMithuru - Utilities

2.3 Research Gap

This web application's main purpose is to guide people on how to start growing & maintaining the selected plant type according to their favourable selection, we have started researching on few major sectors which are directly affected in plantation.

The team reserved a considerable space to collect the data on the climate versatility of every location in the country as cultivation & agriculture mainly depend on the geographical location & climate difference.

Provinces & districts in the country separated accordingly to clarifying the geographical difference in the locations. Although the climate difference of each & every districts been collected from considering the zonal clarification reports given by the department of weather in sri lanka according to the annual rainfall & height from the sea level. Detailed explanations & respective example data sets can be found in coming pages.

There Are Two Core Functional Purposes On This Web Application Regarding The Home Gardening Sector.

- One major functional output of this web application will be the beginner to professional level guidance on how to initiate on planting a short term crop & carry the maintenance of the plant until it produces a good harvest.
- Second functionality of this web application is the open source quick guidance for over coming the threats affected into the both home & high capacity cultivation.
- In this functionality, web application serves to any random user who seeks guidance for overcoming the threats appeared in to their crops by suggesting the expertise strategies from new industry treatments for plants.

The main reason to select home gardening for guidance in Gardener web application is the recent lockdown. Considerable amount of people have faced so much difficulties on managing their daily consumption of food even some of them had money as they couldn't reach to the shops to purchase.
(Clin's epidomial global economy, 2014)

That's why development team have put on a heavy percentage from our research to collecting details of commercial plants that can be grown in home gardens. Because when there is another emergency comes up like this in the future, people at least have the chance of surviving by not depending on shopping places (Neha Sharma, 2018)

Therefore, this web application feature the short term crops such as vegetables, fruits & herbs that can be grown in a home garden. Also we have researched on commercial flower plants that can be grown in a home environment as an additional feature.

As (Kerala journal of economic evaluation, 2016) states, most of the people in the community whose having issues on conceding their daily meal on the period of lockdown, were highly interested in consuming the natural food products that can be grown in a smaller environment such as a home garden. The survey states, that most of the people were interested in collecting the vegetable type plant varieties.

Dimensions In The Data Collecting Mechanism On Research Gap

1. Locations of the country according to the provinces & districts.
 - Separated by geographical zone (dry, wet , intermediate)
 - Separated by climate seasons(monsoonal)
2. Annual rainfall of each location in the country (2018-2019)
3. Height from the sea level(which affects the plant growth)
4. Major short term crops we will feature on web application.
 - Vegetables, fruits, herbal plants, flowers
5. Harvesting & cultivation productivity records within last five years in Sri Lanka (2015-2019).
6. Records of the destructed amount of plants within last five years in Sri Lanka (2015 - 2019)
 - To suggest the prevention strategies for sicknesses & bug attacks on short term crops.
7. The suitability of soil for plantation in several locations in the country.

2.3.1 Locations In The Country According To The Provinces & Districts

Complete sri lankan island divides into nine main provinces & twenty five districts according to the geographical location. It is also divide into 3 major zones by considering the annual rainfall.

this clarification is the most important out of all when it specially comes to agricultural statistics in the country.(Department Of Census & Statistics, 2019)

This is more important to our web application as it mainly calculates the suitability of cultivating new plants in a home garden according to the residence location given by the user.

Location will filter through our compatibility database & suggest the best plants to grow in considered location.

Dry zone	Wet zone	Intermediate zone
Jaffna	Kurunegala	Kandy
Kilinochchi	Matale	Kegalle
Mullathiv	Badulla	Nuwara eliya
Vavuniya	Hambantota	Gampaha
Trincomalee		Colombo
Anuradhapura		Kalutara
Polonnaruwa		Galle
Batticaloa		Matara
Ampara		Ratnapura
Monaragala		

Table 8 Agricultural Diversification In Sri Lanka

Provincial & district wise clarifications is specially using to find the most suitable place to grow the picked plants by user more accurately.

that's why the data sets has been collected on geographical locations going to be filtered with the data set of best plants can be grown in a sri lankan home garden & suggest the user with the best possible ways to initiate on planting them.

According to the (Department of meteorology, 2018) country has four main climate season for planting & agriculture. Calculated according to the annual rainfall of the island.

- **First Inter-Monsoon Season - January, February, March, April**
- **South-West Monsoon Season - May, June,**
- **Second Inter-Monsoon Season - July, August, September, October**
- **North-East Monsoon Season - November, December**

Many commercial plants in the country is mainly cultivating by considering the monsoonal seasons given above. The reason is rainfall. (Plantation ministry, 2015)

Because commercial plantings like paddy & wheat constantly needs water supply.

So farmers mainly considering the rainfall by cultivating their crops according to the monsoonal seasons. This prediction system has not been used to predict the plant growth for home gardening sector. Collected data sets on how several plant growths react to the monsoonal seasons & will be using it as a special part in creating this guiding web app's suggestion functionality.

2.3.2 Annual Rainfall Of Each Location In The Country

Data sets regarding the annual rainfall for each & every district in the country have collected from (Department of meteorology, 2019) find which districts are receiving high & less amount of rain throughout the year. This data set gives a proper idea of suggesting the users about the amount of water they should supply manually to their crops. The locations that receiving considerable amount of rainfall throughout the year won't be needing to supply extra amount of water as well as the locations that receiving less amount of rain throughout the year will be needing to supply water manually to their crops. The format we collected the data is shown below in an example.

Annual Rainfall, Average Temperature, Average Wind Speed Chart Sri Lanka(2017)			
District	Annual Rainfall(mm)	Average Temperature(C)	Wind Speed(Km/Hr)
Kurunegala	154.0	25.1	6.5
Badulla	206.2	22.3	7.1
Ratnapura	112.1	30.0	5.5
Monaragala	161.4	28.2	5.9
Nuwara eliya	297.3	20.1	6.9
Matara	131.3	29.9	5.6
Ampara	186.5	27.9	4.9

Table 9. Annual Rainfall In Sri Lanka - 2017

Annual Rainfall, Average Temperature, Average Wind Speed Chart Sri Lanka(2018)			
District	Annual Rainfall(mm)	Average Temperature(C)	Wind Speed(Km/Hr)
Kurunegala	158.0	26.2	6.9
Badulla	209.6	22.7	7.2
Ratnapura	112.9	31.1	5.4
Monaragala	162.5	29.4	6.0
Nuwara eliya	289.8	21.8	6.6
Matara	129.5	31.0	5.8
Ampara	190.2	29.1	5.1

Table 10. Annual Rainfall In Sri Lanka – 2018

2.3.3 Height From The Sea Level In All The Districts

Considering location's height from the sea level is one of the most important factors found while researching planting suitability data sets. Because many short term crops will feature in web application reacts to the location's height from its growing speed. Some plants are suitable to grow in lower ground level & some are in higher ground levels. Some example data sets have put on in the below table.

District	Height From Sea Level(Meters)	Suitable Plants To Grow
Galle	500m	Chilli, Tomato
Kurunegala	750m	Brinjal, Pumpkin
Badulla	1200m	Leeks, Carrot
Monaragala	800m	Radish, Plate Brush
Kandy	1000m	Bitter Gourd, Durian
Mullathiv	500m	Capsicum, Beet
Batticaloa	700m	Ridged Gourd, Cucumber

Table 11. Height From The Sea Level In Sri Lanka

2.3.4 Major Short Term Crops Feature In The Web Application

1. **Vegetables** – mainly focused on to feature the vegetable types which can produce harvest in a short period. But this web application also gives guidance to considerable amount of long term vegetables planting in sri lanka as well. If any vegetable plant lasts for 60 days of time since the day it's planted, web application suggests people on maintenance strategies to output a prolific harvest since the day itself.(I.S.H.S, http, 2018)
2. **Fruits** – most fruit types taking around 5-6 months to produce it's harvest after the plantation. As the web application mainly focused on home gardening sector. We have researched on choosing the suitable fruit plants to grow in a home garden environment. Fruit plants need more maintenance guidance as the plants last for a long time & several natural threats & bug attacks are causing. So we collected data on how to solve these problems by natural treatments.(Lakpura, 2015)
3. **Herbal plants** - sri lanka has a variety of herbal plant types & spices that grow in home gardens for conceiving the domestic need. Herbal are using as treatments for smaller diseases & spices are using to make the food much delicious. So, we launched our research to collect data sets about the herbal plants & spices can be grown in a home environment.
(Institute of ayurveda, 2017)
4. **Flowers** – considerable percentage of people in sri lanka does flower planting in their gardens specially including house wives. Some of them have does it for personal favour as well as some are doing it for commercial purposes. It's hard to maintain flower plants without proper treatments & guidance. Our web application reserved a special position for guiding on how to plant commercial flower plants as well.(Lanka view, http, 2015)

Main Plant Types Which Will Feature On Our Web Application			
Vegetables	Fruits	Herbal plants	Flowers
Carrot	Mango	Kathurumurunga	Anthurium
Leeks	Pine apple	Thumba	Gerbera
Cabbage	Dragon fruit	Gotukola	Alstromeria
Cauliflower	Wood apple	Kohila	Chrysanthemum
Ridged gourd	Banana	Anguna	Orchid
Cucumber	Fashion fruit	Niviti	Roses
Snake gourd	Guava	Akkapana	Butterfly pea
Salad leaves	Avocado	Neeramulliya	Lanatana
Chilli	Watermelon	Sarana	Hibiscus
Capsicum	Grapes	Thebu	Jasmine
Brinjal	Rambutan	Japan batu	Kadupul

Table 12. Major Short Term Crops In Sri Lanka

2.3.5 Cultivation & Harvesting Productivity Records In Last Five Years

Harvesting & cultivation productivity records are crucial to this web application as it specially adding a functionality to automatically predict the output of grown plants in their home gardens.

By simple form, this functionality gives users the ability to measure how many resources they have invest on getting the best outcome.

As (Researchgate, http, 2016) stats, here are the examples for main parameters considering for calculating the productivity of a plant type.

- Amount of space needs to reserve for one plant type in their garden
- How many seeds they have to plant
- Amount of fertilizers they need to use for the crop.

Few examples of the data sets which will consider to calculating the above mentioned parameters is shown in the following data tables according to the (HARTI, http, 2018).

Year	District	Cultivation Extent(Ha.)	Annual Production(Mt.)	Export(Ha.)
2015	Ratnapura	1156.16	1258.84	316.6
2016	Ratnapura	1159.28	4309.40	920.85
2017	Ratnapura	1380.43	3899.43	1003.58
2018	Ratnapura	1423.39	3600.31	1223.46
2019	Ratnapura	1446.61	3719.48	1380.50

Table 13. Ratnapura District Harvesting Productivity Records (HARTI 2015-2019)

Year	District	Cultivation Extent(Ha.)	Annual Production(Mt.)	Export(Ha.)
2015	Badulla	335.32	2063.28	436.11
2016	Badulla	313.49	2225.37	580.42
2017	Badulla	320.03	2778.59	800.34
2018	Badulla	329.43	2780.48	812.54
2019	Badulla	342.34	2995.38	930.61

Table 14. Badulla District Harvesting Productivity Records (HARTI 2015-2019)

2.3.6 Records Of The Destructed Amount Of Plants & Causes Annually

Considerable amount of short term plants are destructing from the bug attacks & natural causes annually in sri lanka.(National institute of post-harvest management, 2019)

The reason collected this data set to find out what diseases are causing to each & every crop. This helps to find the solutions to overcome this by using the chemical treatments & more prevention strategies.

Year	Crop	Bug Attacks(%)	Bacteria & Fungus Infections(%)	Lack Of Fertilizers(%)	Animal Attacks(%)
2015	Pumpkin	2.33	1.36	1.21	0.31
2016	Pumpkin	2.41	0.89	1.49	0.36
2017	Pumpkin	1.89	0.76	1.44	0.29
2018	Pumpkin	2.39	0.94	1.51	0.33
2019	Pumpkin	2.56	0.71	1.12	0.41

Table 15. Destructed Amount Of Pumpkin Plants Within Last Five Years (SLIATE, Sri Lanka)

Year	Crop	Bug Attacks(%)	Bacteria & Fungus Infections(%)	Lack Of Fertilizers(%)	Animal Attacks(%)
2015	Cucumber	1.83	1.01	1.88	0.34
2016	Cucumber	1.91	0.91	1.97	0.41
2017	Cucumber	1.95	1.04	1.95	0.39
2018	Cucumber	1.76	1.31	1.42	0.38
2019	Cucumber	1.89	0.97	1.51	0.40

Table 16. Destructed Amount Of Cucumber Plants Within Last Five Years (SLIATE, Sri Lanka)

2.3.7 The Suitability Of Soil For Plantation Sri Lanka

The suitability of soil is very important to plantation as the growth rate & quality of the grown plant & matured harvest fully depends on it.(Plant abiotic stress, http, 2017)

Sri Lanka (Department of agriculture, http, 2019) have produced a detailed chart on soil quality for cultivation in Sri Lanka. We have collected it & clarified it again according to the locations we have divided in district from. In this data set, we can measure which sort of soil belongs to respective districts & suggest the best growing plants to the users on those conditions.

District	Zone Belongs To	Soil Type	Suitable Plants.
Nuwara Eliya	Intermediate Zone	RYP, RBE, LHG	Leeks, Cucumber
Kurunegala	Wet Zone	RBL, Regosol	Cashew, Durian
Badulla	Wet Zone	RYP, Mountain Regosol	Biiter Gourd, Ridged Gourd
Ampara	Dry Zone	RBE, LHG, NCB	Brinjal, Pumpking
Monaragala	Dry Zone	Alluvial, Grumusol	Cabbage, Radish

Table 17. The Quality Of Soil In Sri Lanka. (Department Of Agriculture)

- ✓ **RYP : Red Yellow Podzolic Soil**
- ✓ **NCB : Non-Calcic Brown**
- ✓ **LHG : Low Humeic Gley Soil**
- ✓ **RBE : Reddish Brown Earth**
- ✓ **SRG : Sandy Regosol Gley**

2.4 Research On Approaches & Techniques

The research approaches & techniques were different to each & every functionality provided in the web application. Therefore, a detailed explanation on how the research has made for various functionalities in the web application mentioned in below.

2.4.1 Plant Suitability Suggestion Using Each Location Of The Country

- As this functionality is mainly depend on the location of the user, the data set required for clarifying the locations of the country has collected at first. Then it has been processed into the main diversification format given by the sri lankan government.(Statoids, http, 2009)
- firstly, divided into entire country's nine provinces & then into the 25 districts. The web application will be designed to receive the location input of the user according the particular district they belongs to.

Name	Status	Population	Population	Population	Population
		Census 1981-03-17	Census 2001-07-17	Census 2012-03-20	Estimate 2019-07-01
Central (Madhyama)	Province	2,009,248	2,423,966	2,571,557	2,766,000
Kandy	District	1,048,317	1,279,028	1,375,382	1,476,000
Matale	District	357,354	441,328	484,531	522,000
Nuwara Eliya	District	603,577	703,610	711,644	768,000
Eastern (Kilakku, Negenahira)	Province	975,251	1,419,602	1,555,510	1,729,000
Ampara	District	388,970	592,997	649,402	728,000
Batticaloa	District	330,333	486,447	526,567	575,000
Trincomalee	District	255,948	340,158	379,541	426,000
North Central (Uturumeda)	Province	849,492	1,104,677	1,266,663	1,377,000
Anuradhapura	District	587,929	745,693	860,575	937,000
Polonnaruwa	District	261,563	358,984	406,088	440,000

Figure 15. District Diversification Of Sri Lanka - (Department Of Census & Statistics)

2.4.2 Maintenance Guidance Record Functionality

- As this is the web application's most important functionality, this option gives a perfect maintenance guidance to the user since the plantation day to the harvesting date. More specifically, after web site suggests users to initiate on planting the source, this option works as a journal & gives a weekly update on how to the maintenance.
- Research approach for this functionality has been made through the books written on maintaining short term crops.(Walker, 2016))
- Most of the research for this functionality is based on the hand books published by the agricultural department of the country.(Crops Magazine, http, 2016)

බේර අවශ්‍යතාවය	වැළැ ප්‍රහුණු කිරීම
හෙක්ටොරයකට කිලෝග්‍රැම් 6 කි.	විෂ සිවුවා සහි 3 පමණ ගනවු පසුව මිටර් 2 ක් පමණ උස ගක්තිමත් මැස්සක් (පන්දලමක්) වෙත වැළැ යොමු කරන්න. පන්දලමට පහළින් වැළඳහි හට ගන්නා පාර්ශ්වික අංකුර ඉවත් කරන්න.
පරානාය	
මිටර් 1.5 x මිටර් 1	
බම් සැකසීම	
සෙන්ටීමිටර් 20-30 ක් පමණ ගැඹුරට පස පෙරලා කැට පොඩිකර ගන්න. සෙන්ටීමිටර් 30x30x30 ප්‍රමාණයේ වළවල් නිසි පරානායට සකසා දිරාපත් වූ කාබනික පොගොර හා මතුපිට පස් වලින් පුරවන්න.	
	පොගොර යෝදීම
	වළවල් සැකසීමේදී යෙදු කාබනික පොගොරවලට අමතරව පහත සඳහන් අන්දමට රසායනික පොගොර ද වගාවට යොදාන්න.

Figure 17. Growing Short-Term Crops - Handbook

- After collecting the required data sets such as the weekly maintenance guidelines for short term crops, the data sets been processed into csv file format to implement the data science components.

AI Seed Requirement (Kilograms Per Hactre)	AJ Gap Between Plants	AK Land Preparation	AL	AM	
			Depth Of Holes	Area Of Holes	Seeds Per Hole
6 Kg	1.5m X 1m	20-30cm	30 X 30cm	2-3 Seeds	
4 Kg	1.5m X 1.5m	30cm	30 X 30cm	3 Seeds	
3 Kg	1.5m X 1.5m	30cm	30 X 30cm	3-4 Seeds	
1 Kg	1.5m X 1.5m	30cm	30 X 30cm	2 Seeds	
1 Kg	2.5m X 3m	20cm	20 X 30cm	2 Seeds	
500g	1m X 1m	30cm	30 X 30cm	3-4 Seeds	
6:1 Links Per Hactre	1.5m X 1m	20cm	30 X 30cm	1-2 Links	
200-250g	40 X 50cm	30-40cm	30 X 40cm	3-4 Plants	
5 Kg	25 X 30cm	30-40cm	30 X 30cm	3-4 Seeds	
4 Kg	12 X 15cm	20-30cm	1m Beds	2-3 Seeds	
5-6 Kg	30 X 15 cm	20-30cm	20 X 30cm	1-2 Seeds	
3.75 Kg	1m X 3m	30-40 cm	30 X 30cm	2-3 Seeds	
3Kg	1m X 3m	30cm	30 X 15cm	2-3 Seeds	

Figure 16. A Collected Dataset

2.4.3 Suggesting Suitable Strategies On Growing A Plant In Any Condition

This functionality on the web application provides on how to convert the home garden into a space where any selected plant can be grown. But before the user making use of this functionality, web applications warns about the efficiency of this functionality.

- Carrot cannot grow in every district (Homeguide, http, 2012)

Plant	Suitable Climate			Plant Varieties					
	Height From Sea Level	Soil							
		Soil Type	PH Value						
Bitter Gourd	1200m Upwards	RBE	5.5 - 7.5	M.C. 43	Thinnaweli White	Matale Green			
Snake Gourd	500m Upwards	NCB	5.5 - 7.5	T.A. 2	M.I. (Short)	–			
Ridged Gourd	500m Upwards	Sandy Regosol	5.5 - 7.5	L.A. 33	Gannoruwa Arie	Asirie			
Cucumber	1000m Upwards	RYB, NCB, RBE	5.5 - 7.5	L.Y. 58	Champion	Hody Green			
Pumpking	500m Upwards	RBL, RYL	5.5 - 7.5	N.K. Ruhunu	Padma	–			
Snake Cucumber	1000m Upwards	RYP, RYL	5.5 - 7.5	–	–	–			
Tomb Bitter Gourd	500m Upwards	Sandy Regosol	5.5 - 7.5	Cylindrical	Spherical	–			
Cabbage	750m Upwards	Low Humeic Gley	6.0 - 6.5	S.S. Cross	K.Y. Cross	Green Hot			
Radish	500m Upwards	RBE	6.0 - 7.5	Beer Radish	Japan Ball Radish	–			
Carrot	1300m Upwards	RYL, RYP	5.5 - 7.5	New Curroda	Lanka Carrot	–			
Beet	Within 500 - 1200m	RBE, RBL, RYL	6.3 - 7.3	Red Ace	Red Eagle	HT 1505			
Leeks	1300m Upwards	RYL, RYP	5.6 - 7.5	Large Long Summer	–	–			
Salad Leaves	1300m Upwards	RBL, RYL	5.5 - 7.5	Lactuca Sativa	Cichorium Endiva	C. Intybus			
Tomato	Within 500 - 1300m	RBE, NCB	5.5 - 7.6	K.W.R.(T 42)	T 245	K.C. 01			
Capsicum	1500m Upwards	RBE	5.5 - 6.8	H.Y.W	C.A. 8	–			

Figure 18. Short Term Crop Suitability Chart

The research approach for collecting data sets for this functionality is also made through the hand books published on the subject. (Briggs, 2017)

2.4.4 Disease Prevention & Control Functionality

- This functionality provides the disease control guidelines & treatments after the disease is entered by the farmer.
- Functionality serves without a scope to both short term & long term farmers in the country as a solution for the major bug attacks & plant disease issues they facing in present
- Research approach for this functionality has made through both online & offline tools
- Firstly, data has collected on the records given by the agricultural department on the amount of destructed plants in every year caused by both bug/insect/disease attacks & natural disasters.
- Secondly, the annual detail report given on the AgStat magazine published by department of agriculture in Sri Lanka

Chapter 2 – Literature Review

Plant Type	Treatment Chemicals(Grams/Millies Per 10 Litres)						
	Flutripol	KHCO3	Kabiriyotop	Krescxrim Methyl	Metalexyl	Dynotofuran	Tri-Chlorophone
Bitter Gourd	10ml	15g	20g	14ml	–	–	–
Snake Gourd	10ml	–	–	–	–	–	–
Ridged Gourd	10ml	10g	–	–	–	–	–
Cucumber	10ml	15g	20g	–	12.5g	–	–
Pumpking	10ml	15g	20g	–	–	–	–
Snake Cucumber	10ml	15g	20g	–	–	–	–
Tomb Bitter Gourd	–			–	–	–	20g
Cabbage	–			–	–	–	–
Radish	–				12.5g	–	20g
Carrot	–					–	–
Beet	–					–	–
Leeks	–	10g	10g			–	20g
Salad Leaves					12.5g	–	–
Tomato						–	–
Capsicum		15g	12g			–	–
Brinjol					12.5g	–	–
Elabatu		15g	12g			–	–
Plate Brush	–					–	–

Figure 21. Disease Control Chart On Short Term Crops In Sri Lanka(AgStat, 2019)

Year	District (Out Of 25 Districts)	Bug Attacks(%)	Bacteria & Fungus Infections(%)	Lack Of Chemicals /Fertilizers(%)	Animal Attacks(%)
2015	Monaragala	2.33	1.36	1.21	0.31
2016	Monaragala	2.41	0.89	1.49	0.36
2017	Monaragala	1.89	0.76	1.44	0.29
2018	Monaragala	2.39	0.94	1.51	0.33
2019	Monaragala	2.56	0.71	1.12	0.41

Figure 20. Destructed Amount Of Plants In Monaragala District (AgStat 2019)

Year	District (Out Of 25 Districts)	Bug Attacks(%)	Bacteria & Fungus Infections(%)	Lack Of Chemicals /Fertilizers(%)	Animal Attacks(%)
2015	Kurunegala	1.83	1.01	1.88	0.34
2016	Kurunegala	1.91	0.91	1.97	0.41
2017	Kurunegala	1.95	1.04	1.95	0.39
2018	Kurunegala	1.76	1.31	1.42	0.38
2019	Kurunegala	1.89	0.97	1.51	0.40

Figure 19. Destructed Amount Of Plants In Kurunegala District (AgStat 2019)

2.4.5 Blog Functionality

- Blog & review forum functionality works as an additional feature given to the web application. This works as a platform where all the users of the web application can share their views, issues, knowledge at once.
- Extended the teams research approach on few industry standard blog features & looking forward to design it with a more user friendly interface.(Handlegarden, http, 2018)
- Looking forward to use technologies like JavaScript & Angular while developing this functionality.

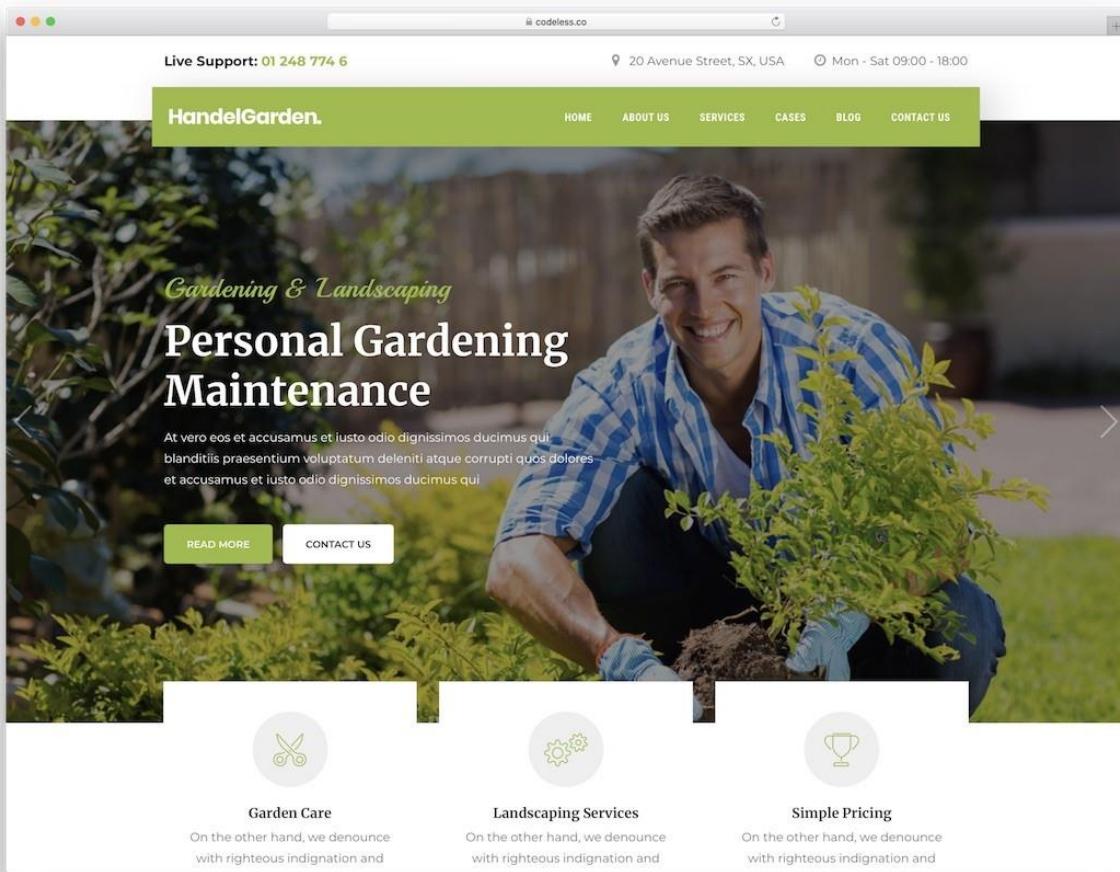


Figure 22. A Sample Gardening Blog (HandleGarden, 2019)

2.5 Chapter Summary

Literature review chapter mainly focused on the detailed explanation on purpose of the web application, aim, target audience, research dimensions, workflow mechanism, scope & the feature sets of the entire application. The web application's main purpose is to help the people who's having a special interest in planting the short term crops in a smaller space like the home garden where can provide a considerable amount of daily food consumption of a family.

3. Chapter 3 - Project Management

3.1 Chapter Overview

This chapter will examine the most suitable project management methodology for this guiding web application on modern home gardening sector. The risks involved as well as mitigation plan for the system are identified. The communicational plan with both target audience and industry professionals also detailed. The most appropriate web application development methodologies are also discussed in detail. The activity schedule and project deliverables are explained. The work break down structure and Gantt chart diagram are also illustrated on this chapter.

3.2 Methodologies

Methodologies for the entire web application explained using seven different sub topics with relative illustrations. This sub-chapter expresses how basic structure of the project is going to implement according the developing procedure along with all the subsequence's of web application. Every methodology component gives a specific idea about each component in the web application along with main feature sets. This expresses the important factors such as research on approach where data science component of the entire project relies.

3.2.1 Research Approach

The research approach can be divide into two categories as inductive approach and deductive approach. The deductive approach aims to prove and test a hypothesis. The inductive approach mainly focused with the generation of a new theory emerging from the data.

This guiding web application will be done using deductive approach as main purpose of the project is to guide people on how to initiate on planting a short term crop and continuously maintaining the plant without facing to bug attacks, diseases and naturally caused diseases until the harvest of the grown plant is extracted from the garden.

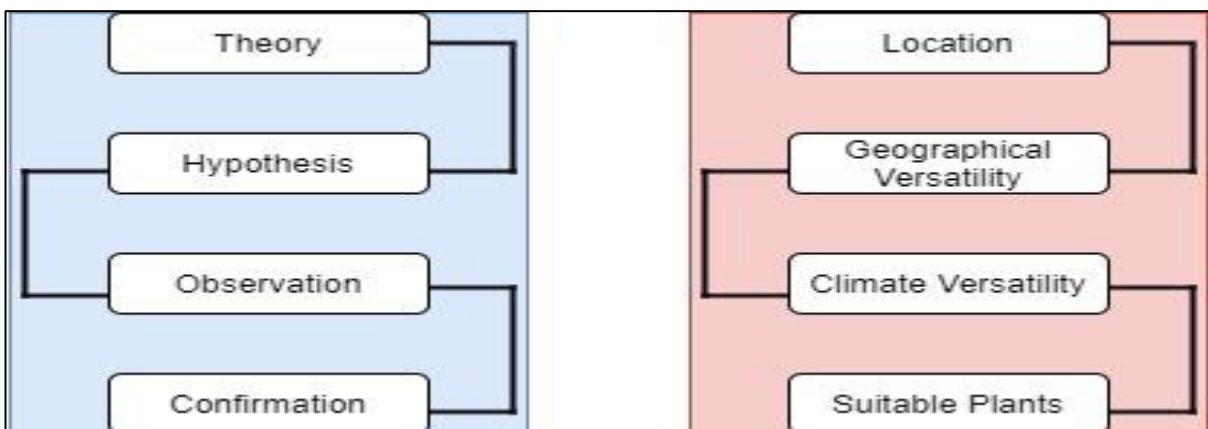


Figure 23. Deductive Approach On Plant Suggestion

3.2.2 Process Model

From the available software process models, waterfall process model will be used for this project. Waterfall model is the most traditional and sequential choice when it comes to software development. It is also helpful to understand the history and structure of the problem. Following figure shows the steps of waterfall model.

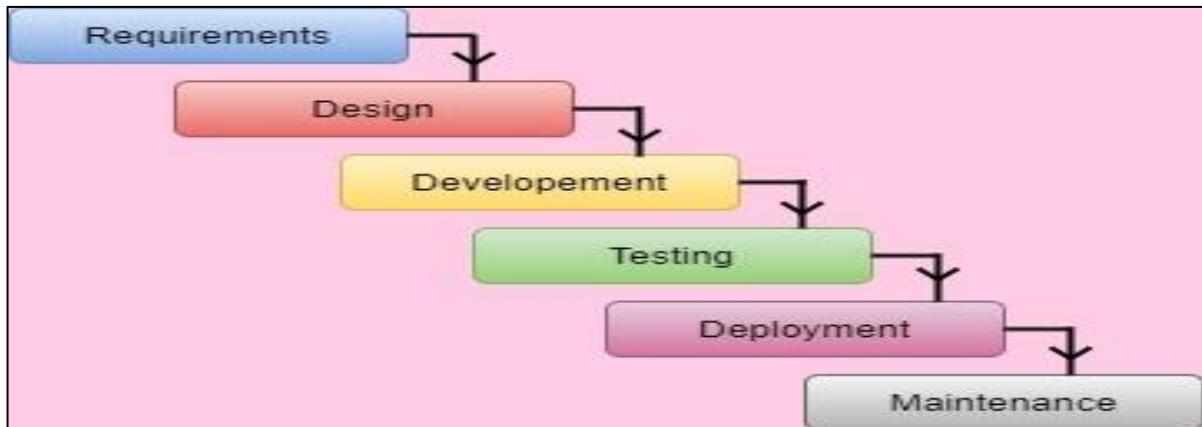


Figure 24. Steps Of Waterfall Model

Using waterfall process model, small set of software requirements will be developed across all components. It is easier to develop & test the application when sequences are small.

Since the we application is developed step by step, defects & bugs can be identified at an early stage. Using the waterfall model, it is possible to gather reliable user feedback from the users of the system as well.

Following table shows why other popular methodology concepts were not chosen.

Model	Reasons For Not Choosing The Model
Scrum	Unknown technologies and unclear requirements are not accommodated
Spiral	More suitable for complex and long term projects
Agile	Minimal emphasis on documentation and difficulty to make additions with iteration
Kanban	The boards must be constantly monitored and there is a potential of the boards being complex
V-Model	Lacks adaptability and possibility for restrictions in the timeline
RAD	High technical knowledge is required
Prototyping	It could be expensive if proper monitoring isn't done

Table 18. Reasons For Not Choosing Other Methodology Concepts

3.2.3 Analysis & Design Approach

The object-oriented design approach is selected for the analysis and design approach. The OOD approach decreases the complication of the system and increases the readability of the code. This approach also adds in the flexibility of reusing components using the object-oriented techniques.

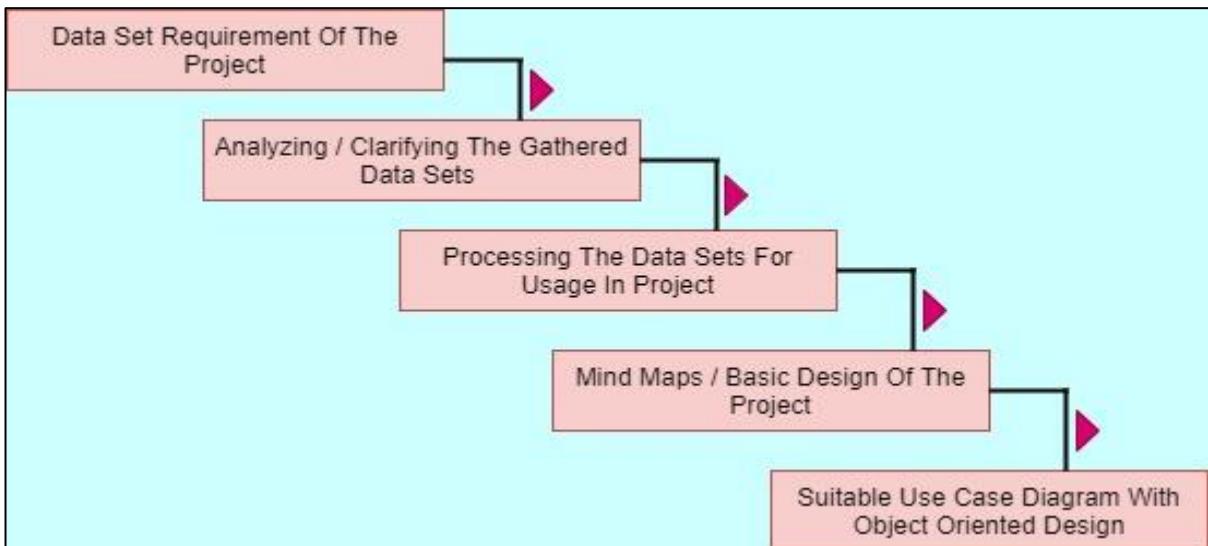


Figure 25. Object Oriented Design Approach

3.2.4 Programming Methodology

Implementation of the prototype for this guiding web application will be done using an object oriented programming methodology that supports the Waterfall process model. Using OOP will help make the code modular and scalable hence maintainability in the long term could be achieved. OOP will also allow to re-use components.

3.2.5 Testing Methodology

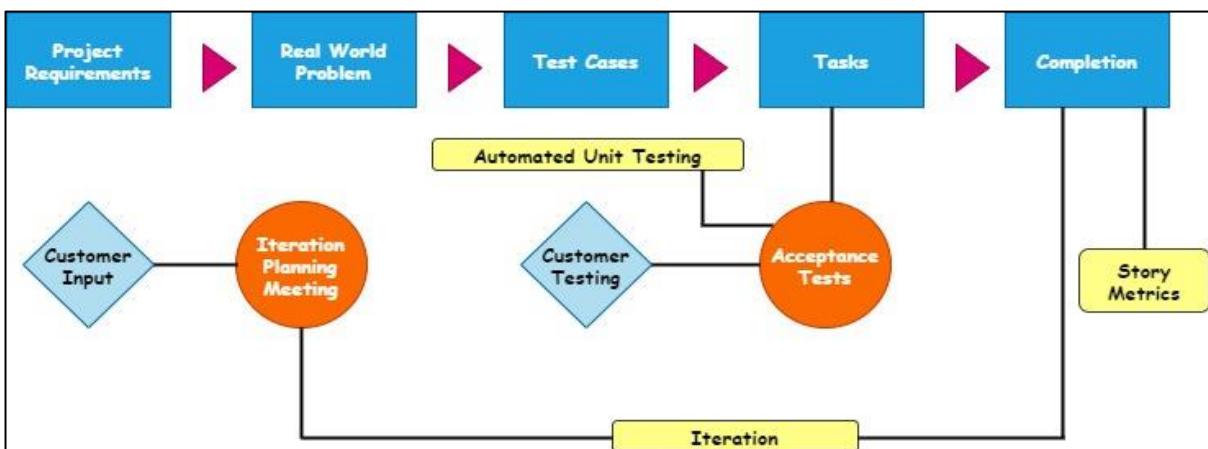


Figure 26. Testing Methodology

The waterfall methodology test plan template will be used to carry out the testing for the project and some of the testing methodologies that will be used are, unit testing, performance testing, usability testing, compatibility testing.

3.2.6 Project Management Method

There are many popular project management methodologies like Agile, Scrum, Kanban, Scrum, Lean, XP, Waterfall and Prince2. This project will be managed using the waterfall model methodology since it is a fully sequential. Waterfall is a process-oriented methodology where ‘Waterfall’ stands for projects in sequentially controlled environment.

(The digital project manager, 2017)

As this is a research project, waterfall method will help manage any deviations in the current project plan. Waterfall will also help in detecting any issues at an early stage of the project, which will be extremely useful. Main reasons for selecting Waterfall Model as the project management method for this project are,

- The ability to suit any product
- The focus on product quality
- Better time management

Following illustration shows about few major project management methodologies.

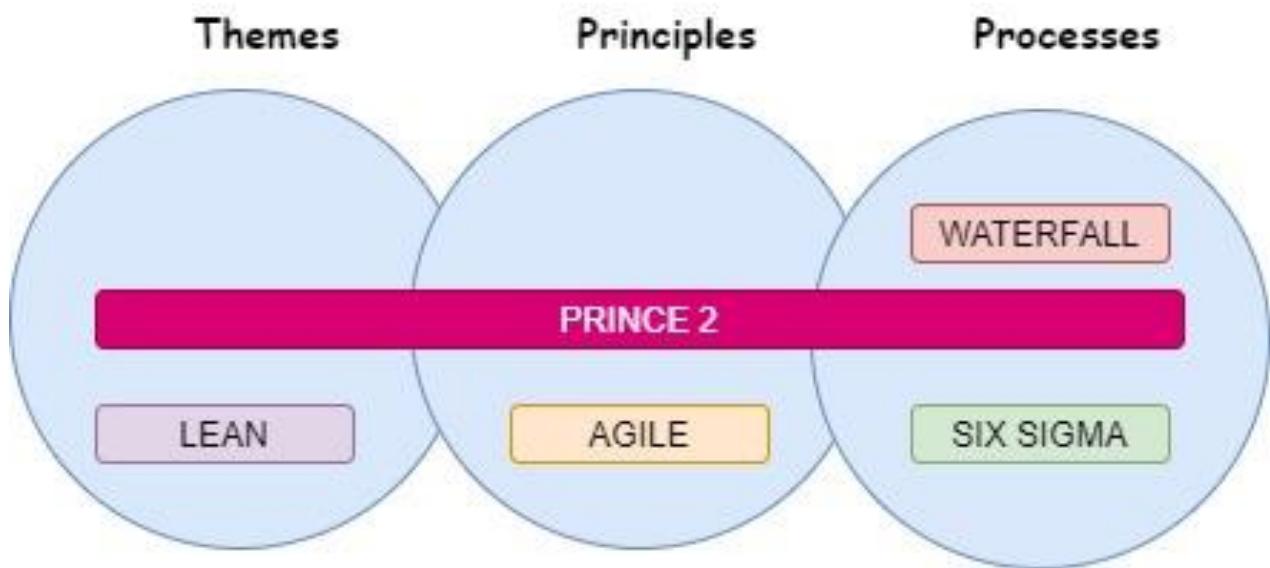


Figure 27. Summary Of Project Management Methodologies

3.2.7 Data Gathering Method

There are different data gathering methods available and listed below are some of the data gathering methods that will be used for this project.

- Questionnaire – by sending a questionnaire to the target audience, it will be possible to gather a lot of necessary data which will be important to the project
- Interviews – interviews will be conducted to gather necessary information for the project
- Existing documents – existing documents on the web, books, papers & other articles on plantation sector will be used
- Observations – observations will be made to the hospitality and tourism domain to gather necessary data.
- prototyping – wireframes will be designed to get ideas from the end users in order to identify how system design can be enhanced.



Figure 28. Data Gathering Methods

3.3 Constraints

Project constraints must be handled well to avoid issues with the project in the future. If the constraints are not handled properly, it might affect the final result of the project or cause difficulty in completing the project in the limited time schedule. The constraints identified for the project includes following topics.

- Lack of exposure & skills: the lack of prior knowledge & skills especially in the research areas such as machine learning & natural language processing can affect the quality of the product.
- Time constraint: due to the limited time given for the completion of the project to research & implement, it could be difficult to meet the deadline.

3.4 Communication Plan

Weekly tutorials were conducted with the supervisors to update on the status of the project, to revise the scope, discuss about the challenges and to come up with solutions. Apart from the weekly meetings, email communication was done throughout the duration of the project to clarify concerns whenever necessary.

3.5 Risks & Mitigations

The possible risks involved with the project & the mitigation instances for each is detailed in the table given below.

No	Description	Possibility	Impact	Mitigation Action
1	Lack of knowledge in technologies and techniques	High	High	Getting advice from experts and constant self studying on the related research domain
2	Hardware/software product failures	Medium	High	Making a cloud backup of everything related to the project including the documentation & prototype daily to avoid data loss. Have a backup computer if the primary system breaks
3	Scope creep when adding new requirements to the system	Medium	High	Monitoring the scope of the project whenever new requirements need to be added & prioritize the requirements
4	Missing deadlines due to the complexity of the project	High	High	Prioritizing the tasks & avoid scope creeping
5	Problems with implementation	High	High	Prioritize the requirements & implement the most important parts first. Look for alternatives if software incompatibilities are found
6	Getting sick	Low	High	Planning to complete the objectives ahead

Table 19. Risks & Mitigations

3.6 Drivers Of The Project

Stakeholders: The agricultural department will provide the feedback to improve the project solutions.

Developers: Multiple developers will work on research & implementation

Supervisors: The supervisors will assist the developers in order to successfully complete the research & implementation.

3.7 Activity Schedule

Date	Activity	Time Frame
30th Of September, 2020	Finalizing the project topic	3 Weeks
07th Of October, 2020	Presenting the project idea	1 Week
16th Of October, 2020	Submission of the draft project proposal	2 Weeks
23rd October, 2020	Submission of the project proposal	2 Weeks
30th October, 2020	Feedback on the initial literature review	1 Week
22nd November, 2020	Submission of the literature review	3 Weeks
29th November, 2020	Making of the project management chapter	1 Week
06th December, 2020	Making of the SRS chapter	1 Week
13th December, 2020	Making of the conclusion chapter	1 Week
20th December, 2020	Making of the introduction chapter	1 Week
04th January, 2020	Final submission of system requirement specification	2 Weeks

Table 20. Activity Schedule

3.8 Work Break-Down Structure

Work Break-Down Structure Diagram Moved Into Appendix Section A.1

3.9 Gantt-Chart Diagram

Gantt-Chart Diagram Moved Into Appendix Section A.2

3.10 Chapter Summary

The project management chapter gave an evaluation of the project management methodologies and the iterative model was selected as the process model. The risks involved as well as the mitigation plan for the system were identified. The most appropriate software development methodologies and project management methods were also discussed in detail. The activity schedule and project deliverables were also detailed. The work breakdown structure and Gantt chart diagram were also illustrated in this chapter. The next chapter is system requirements specification, which discusses the requirement engineering phase of the project.

4. Chapter 4 – System Requirements Specification

4.1 Chapter Overview

The previous chapter based on the project management methodologies and activity schedule for developing the entire web application. This chapter is about the software requirement specification which goes over the appropriate stakeholders, requirement elicitation techniques, analysis of gathered data with functional and non-functional requirements along with their priority levels. Use case diagram, use case descriptions and domain model for this web application are also described in this chapter for the ease of designing purposes.

4.2 Stakeholder Analysis

4.2.1 Onion Model

Onion Model Moved Into Appendix Section B.1

4.2.2 Stakeholder Descriptions

Stakeholder Role	Stakeholder	View Point
Fictional Beneficiary	Local Administrator	Wants to monitor the behaviour of the users and the way this product works
	Viewer	Wants to view the solutions provided by the product and satisfy the user to the fullest
Social Beneficiary	Tech Leads	Wants to use this product as the example to see and learn the technology, methods and the user experiences in order to build their own product in the same area or a different area
Negative	Similar Software	Want to build a better system than this guiding website for modern home gardening
	Hackers	Wants to disrupt the normal functioning of this guiding website for modern home gardening
Regulatory	Authorities	Wants to make sure that this product will perform according to the expectations and does not input any false information
	Public	Wants to raise their concerns or opinions about our product and to ensure that false results are not given through this

Operational Roles	Software Developers	Wants to be able to benefit from more users being satisfied with the experience at the product using moments.
		Wants to integrate with this product to provide user reviews regarding the quality, user experiences and the facilities
Neighbouring Systems	Social Media	Social media will aid the system to be more mainstream and more effective to the end user .
Experts	Industry Experts	Wants to help out the developer to implement the system in the best possible way
End Users	Home Gardeners	Wants the system to be reliable and easy to use. Wants to use this product to search about the most suitable plants they should grow according to their environment and should guide them until user stops.

Table 21. Stakeholder Descriptions

4.3 Requirements Gathering

4.3.1 Techniques For Requirement Gathering

Method 1	Literature Review
<ul style="list-style-type: none"> ✓ Literature review technique provides a very informative idea to initiate the foundation of project in specific terms. ✓ Strategies such as comparing the feature sets of similar research products in the industry helps to implement a unique product. ✓ Even developers of the project can utilize their basic developing methodology through object oriented concepts discussed in literature review as well. ✓ Another valuable advantage of literature review is clarification between the main and sub functionalities of web application as it gives a specific idea on what should and should not include in the prototype. 	
Method 2	Questionnaire Designed For Local Community
<ul style="list-style-type: none"> ✓ Online questionnaire survey has designed to collect the data about the specific subject points discussed on the project from the local community. 	

<ul style="list-style-type: none"> ✓ Survey has launched to the community with very simple questions but all the required data sets need to gather including in it. ✓ Major target of questionnaire was to prove the highlight problem background of the project by the responses from community. ✓ Survey was also helpful in clarification of featured content of the project such as various plant types as well. 	
Method 3	Meeting Subject Authorities
<ul style="list-style-type: none"> ✓ Meeting with subject authorities in agricultural sector made a huge impact to the project as it provided the factors in very specific formats. ✓ This was very important in figuring the project scope and exploring the research gap within best parameters. ✓ Agricultural department provided the main sources for collecting the data sets for project such as handbooks, magazines and research papers. ✓ Authorisation for work in the project with unlimited access and guidance on building an industry level product. 	
Method 4	Interview With Industry Experts
<ul style="list-style-type: none"> ✓ Interviewing industry experts is vital on project installation as they base most of the recommendations, suggestions and calculations in mechanism of entire web application on the professionally developed concepts. ✓ Developing team has visited agriculture research institute and faculty of agriculture in university of peradeniya for collecting the expertise knowledge before project installation. ✓ These field visits helped lot more than digitally collected knowledge for building the main concept of the project. ✓ Special features in the web application such as farmer review forum and these industry experts introduced blog functionality. 	
Method 5	Observations
<ul style="list-style-type: none"> ✓ Concept for the project has developed by observing the behaviour of community between the lockdown period and non-lockdown period of the country. ✓ Total project is depend on how the web application is observing the growth of plant as responses provided by the behaviour of the selected crop. ✓ Considerable amount of observation from the developing team is also need to forming the datasets in correct order for implementing an efficient product. 	
Method 6	Brainstorming
<ul style="list-style-type: none"> ✓ Brainstorming sessions can conduct with the developing team for conceptualizing, designing and implementing the system. ✓ This is vital for the entire project as everyone in the team gets to contribute their unique ideas on developing the system. ✓ Personal brainstorming sessions while working on the individual tasks of the system is essential for adding new functionalities as well. 	
Method 7	Prototyping
<ul style="list-style-type: none"> ✓ Prototyping will be effective to provide the best user experience to users. ✓ When the basic concept of the system can be made easily with this concept ✓ At the earliest stage of development, ideas can gather from stakeholders to further improving the system as well. ✓ Prototyping helps with testing the system when initiating to develop the major functionalities. 	

Table 22. Techniques For Requirement Gathering

4.3.2 Literature Review Outcomes

Working in literature review have produced considerable amount of strategic outcomes for conceptualizing the project. Most of the core functionalities needs to provide on the web application is found and additional feature sets are also revolved. Research on approaches for project unveiled the some vital ways for designing and implementing the project. Main strategic outcomes for implementation during the literature review is listed below.

- Making use of mind maps for building the basic concept of the project
- Using object oriented programming methodologies
- Usage of use cases, class diagrams for design purposes
- Behaviour of similar research products
- Expected functional output for present industry standards

4.3.3 Online Questionnaire Design

Online questionnaire survey sent out among local community, industry experts and developing colleagues to gather data sets for the projects. One of the most important outcomes of the survey is research team able to justify the both the problem and problem background caused to the main concept of project through this questionnaire.

Goal	Question
To figure out whether people started gardening short term crops during the lockdown period.	When did you start gardening? (during lockdown/way before lockdown)
For making sure that they are still doing gardening even after the lockdown period	Are you still doing gardening?
Clarifying the plant types that people are growing in their gardens	What are the plant types that you are growing?
For making sure the type of guidance needs for a farmer	What are the difficulties that you are facing while gardening?

Table 23. Online Questionnaire Design

4.3.4 Meeting Subject Experts

Developing team conducted a meeting with the agricultural ministry for the purpose of collecting the verified details on the agricultural industry in country. Findings of the meeting is listed below.

Featured Section – Short Term Crop Management Division	
Aim	To identifying the value of home gardening. To sorting out the most valuable types of plant to grow in domestic environment.
Meeting Hosts	Mrs: kanthi athukorala (director – short term crop division)
Findings	Home gardening covers considerable amount in family food consumption Home gardening can provide a financial outcome Home gardening helps to conserve many endemic short term crops in sri lanka

	Many climate depended plant types are also transform to plant in domestic conditions
--	--

Table 24. Meeting Subject Experts

4.3.5 Interview With Domain Experts

The interview sessions were conducted with agricultural experts from the agricultural department situated in university of peradeniya. Developing team mainly explored the information on the major functionalities which are about be implemented in the web application such as disease prevention strategies, crop treatments and farmer review forum. Outcomes of the interview is listed in below table.

Featured Section – Faculty Of Agriculture, University Of Peradeniya.	
Aim	Identifying the major short term crops in the country
	Major crop diseases affected in domestic environment in the country
	Proper gardening strategies for smaller capacity gardening.
	Treatment chemicals and diseases for fungus, bacteria, virus related plant diseases
Meeting Hosts	Professor h.h.s.m. nandadasa (dean – faculty of agriculture) Dr. Hemalatha mendis (lecturer – faculty of agriculture)
Findings	Received handbooks, magazines and research papers about domestic commercial plants in the country
	Received access to annual report of major plant diseases in the country and statistics.
	Introduced the new trending of reforming domestic environment into professional planting farm
	Provided the treatments using for preventing the plant diseases in the present industry with places to find them

Table 25. Interview With Domain Experts

4.4 Analysis Of Gathered Data

Analysis Of Gathered Data Table Moved Into Appendix Section B.3

4.5 Models

4.5.1 Use Case Diagram

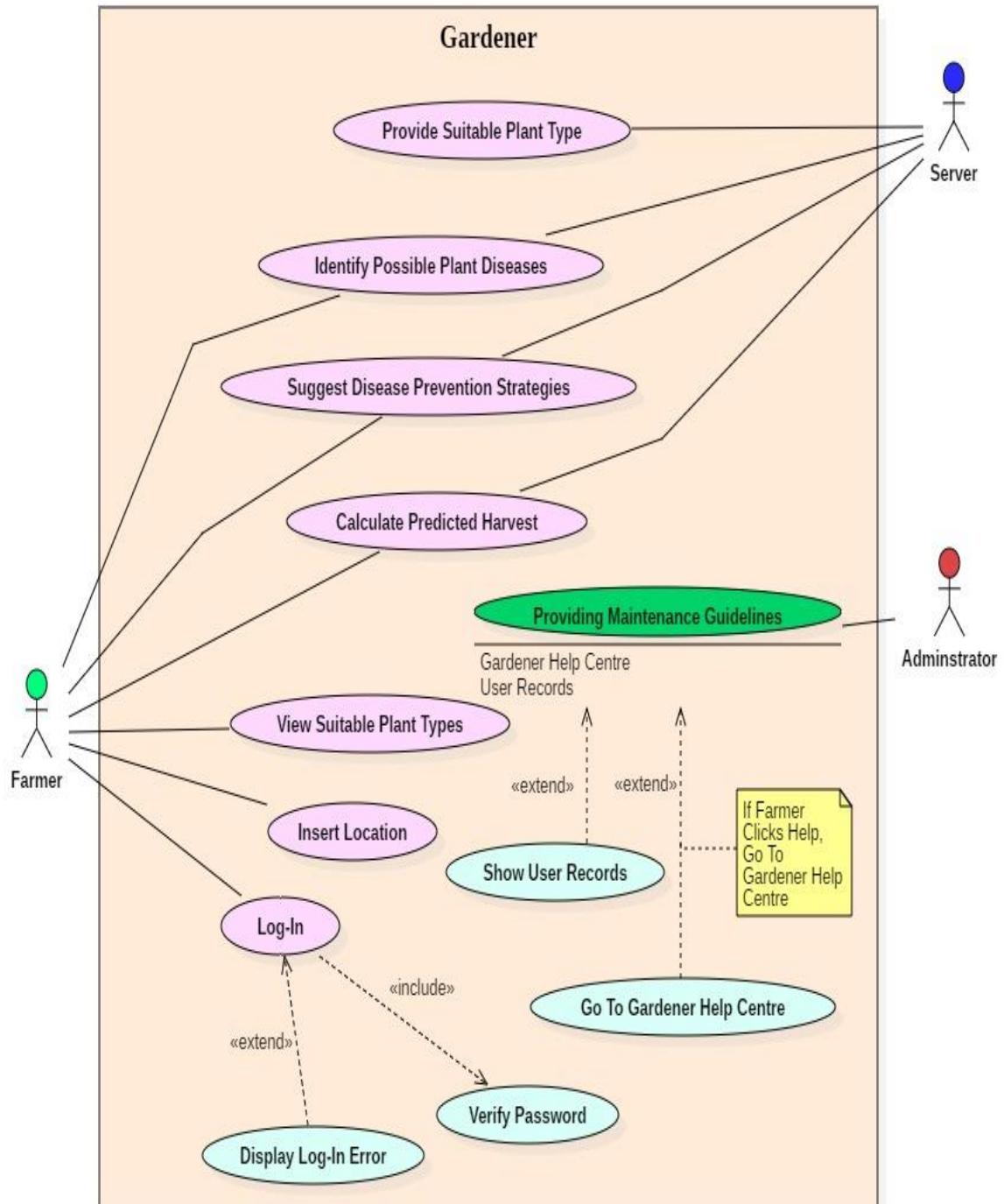


Figure 29. Use Case Diagram

4.5.2 Use Case Descriptions

Use Case Descriptions Moved Into Appendix Section B.4.

4.5.3 Domain Model

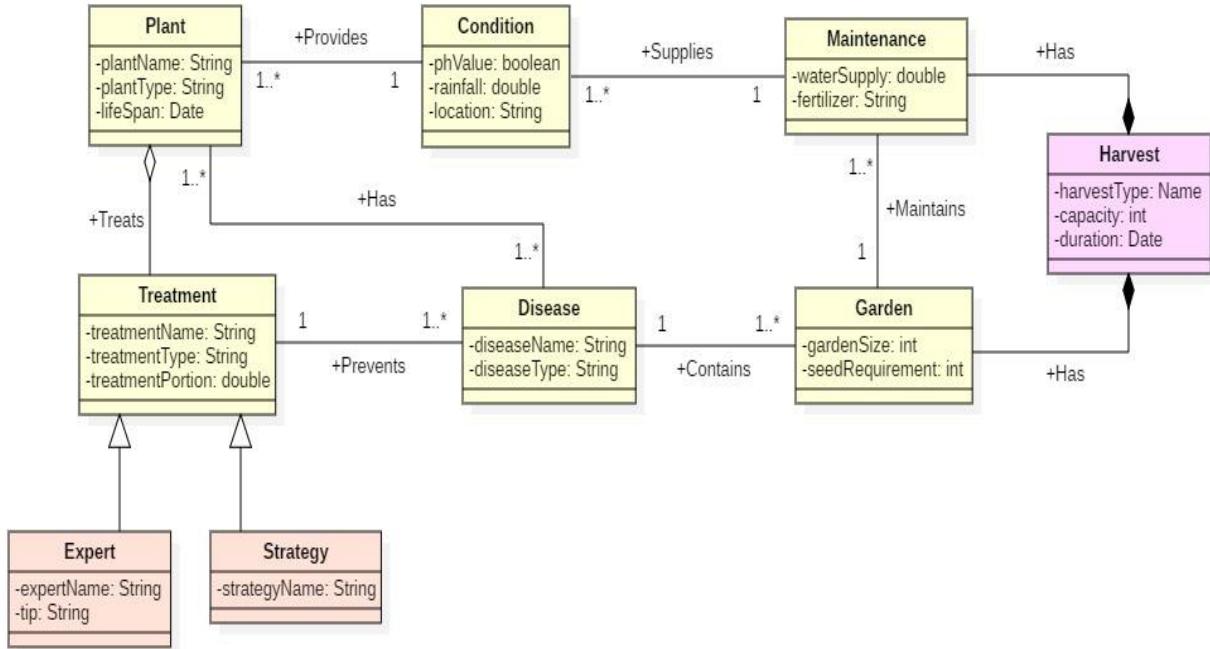


Figure 30. Domain Model

4.6 Functional Requirements

Functional requirements of this web application given below with their priority levels.

- Critical: The requirements that are critically needed in the successful completion
- Desirable: The requirements that can add value, but are not required immediately
- Luxury: The requirements that would add luxury to the system

Requirements		Priority Level	Description
FR1	Analyse the data entered by the user	Critical	The system should be able to analyse the data that user has entered to present the required information to the user
FR2	Identify whether the user is a beginner or not for home gardening	Desirable	By identifying this data, the system can guide the person or helps the user to do home gardening more effectively.
FR3	If the user is a beginner identify the exact location and the plant type	Luxury	By analysing these inputs, the system should be able to identify the most

			suitable plants for home gardening as the user requirements
FR4	Guide the user throughout the period of time	Luxury	The system should be able to guide the users (beginners) throughout the time period of day 01 to harvest day of the plant
FR5	If the user is not a beginner identify the problem the user is facing	Critical	By analysing these inputs, the system should be able to identify the problems the user face when implementing home gardening
FR6	Identifying the exact problem by analysing data and give the solutions	Luxury	By analysing the user input data, the system should be able to give the necessary solutions. For example, if the user is facing some bug attacks, the system should provide the necessary chemicals to prevent it
FR7	Every user must be accessible to the blog	Luxury	The system give access to every user to use the blog as people can share knowledge with each other and learn new trends
FR8	Enter reviews to the blog	Critical	The user should be able to enter their opinions
FR9	View expert videos	Desirable	The user can watch videos of experts about home gardening for gain more knowledge about this sector

Table 26. Functional Requirements

4.7 Non-Functional Requirements

Requirement List		Priority Level	Description
Nf1	Performance	Critical	High level performance of all consisting functionalities in the entire web application must be critical for making use of an industry level web product
Nf2	Scalability	Desirable	Scalability of web application depends on how further developers are looking forward to extend the scope of feature sets in the web application
Nf3	Availability	Critical	Web application must be available for any sort of a user without framing into certain criteria to providing the best service
Nf4	Recoverability	Critical	Recoverability of the web application is crucial for providing a professional service when major issues are causing such as network breakdowns and system failures

Table 27. Non-Functional Requirements

4.8 Chapter Summary

System requirements specification chapter mainly looked at the appropriate stakeholders, requirement elicitation techniques with functional and non-functional requirements along with their priority levels. Also this chapter featured Use case diagram, use case descriptions and domain model for explaining the basic mechanism of entire web application. Comparison of components that should mainly cover on the feature set of the entire product has given a wide optimisation for the project as well.

5. Chapter 5 – Design

5.1 Chapter Overview

The Previous Chapter Focused On The System Requirements Specification. This Chapter Is The Design Chapter Which Defines The The Design Of Gardener Web Application. The High Level And Low Level Design Of Gardener Will Be Discussed. This Design Chapter Will Present The High-Level Architecture Diagram, Class Diagram, Sequence Diagrams, Activity Diagrams And Wireframes For Gardener.

5.2 High Level Architecture Diagram

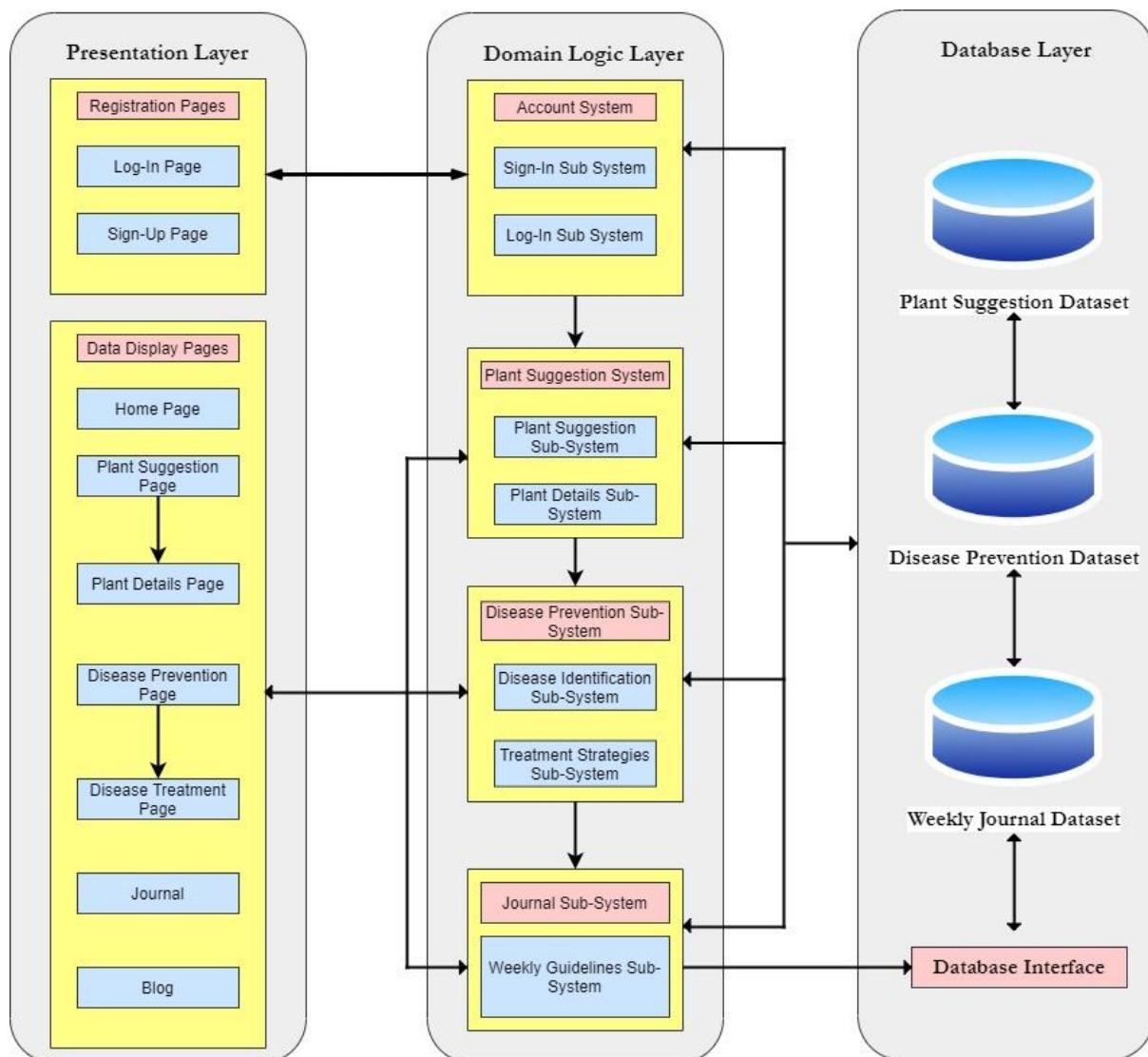


Figure 31. High Level Architecture Diagram

5.3 Sequence Diagrams

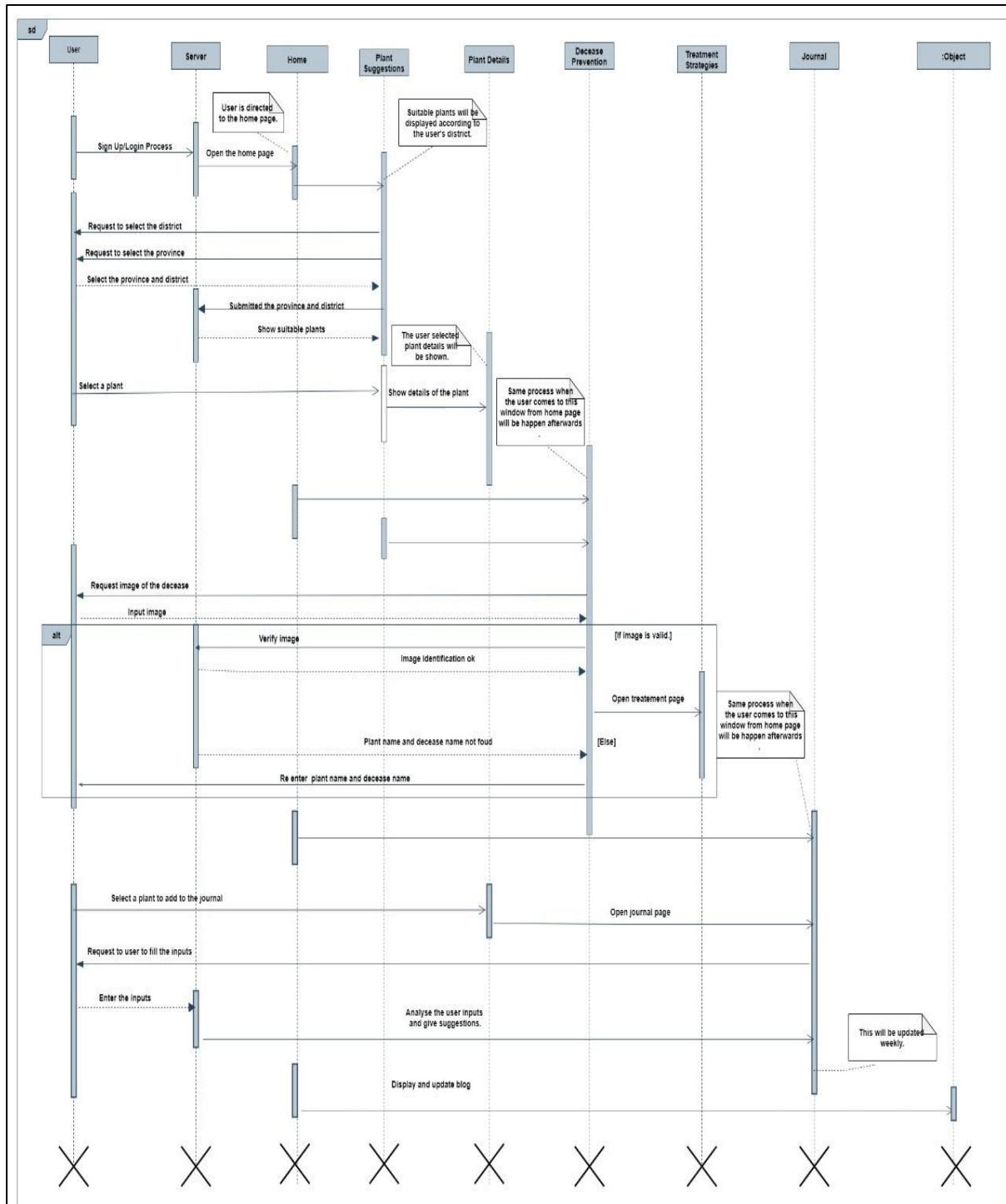


Figure 32. Core Sequence Diagram

Above image illustrates the core functionality & main mechanism of the gardener web application.

Remaining Sequence Diagrams Can Be Found Under Appendix Section C.1

5.4 Class Diagram

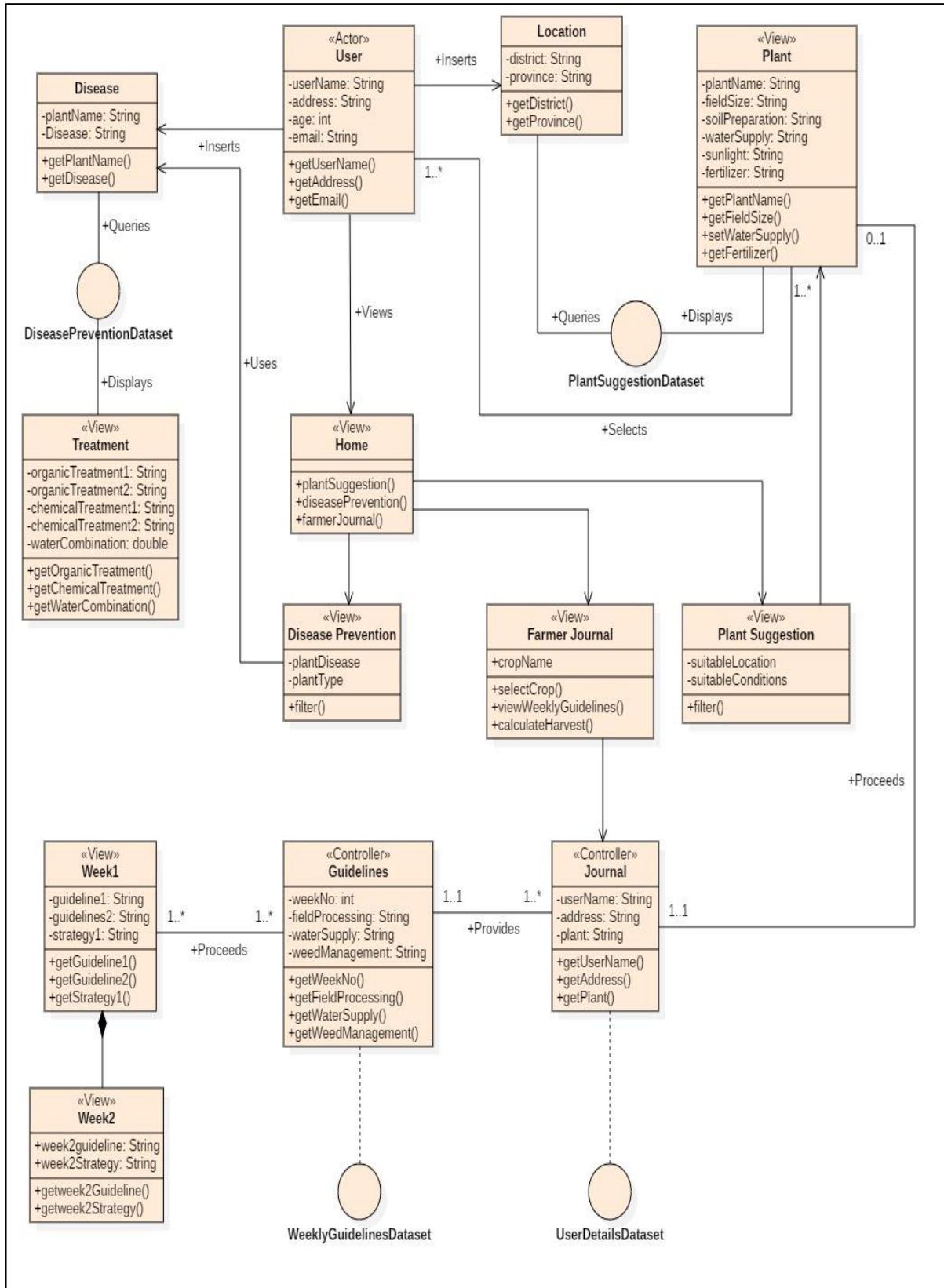


Figure 33. Class Diagram

5.5 Activity Diagram

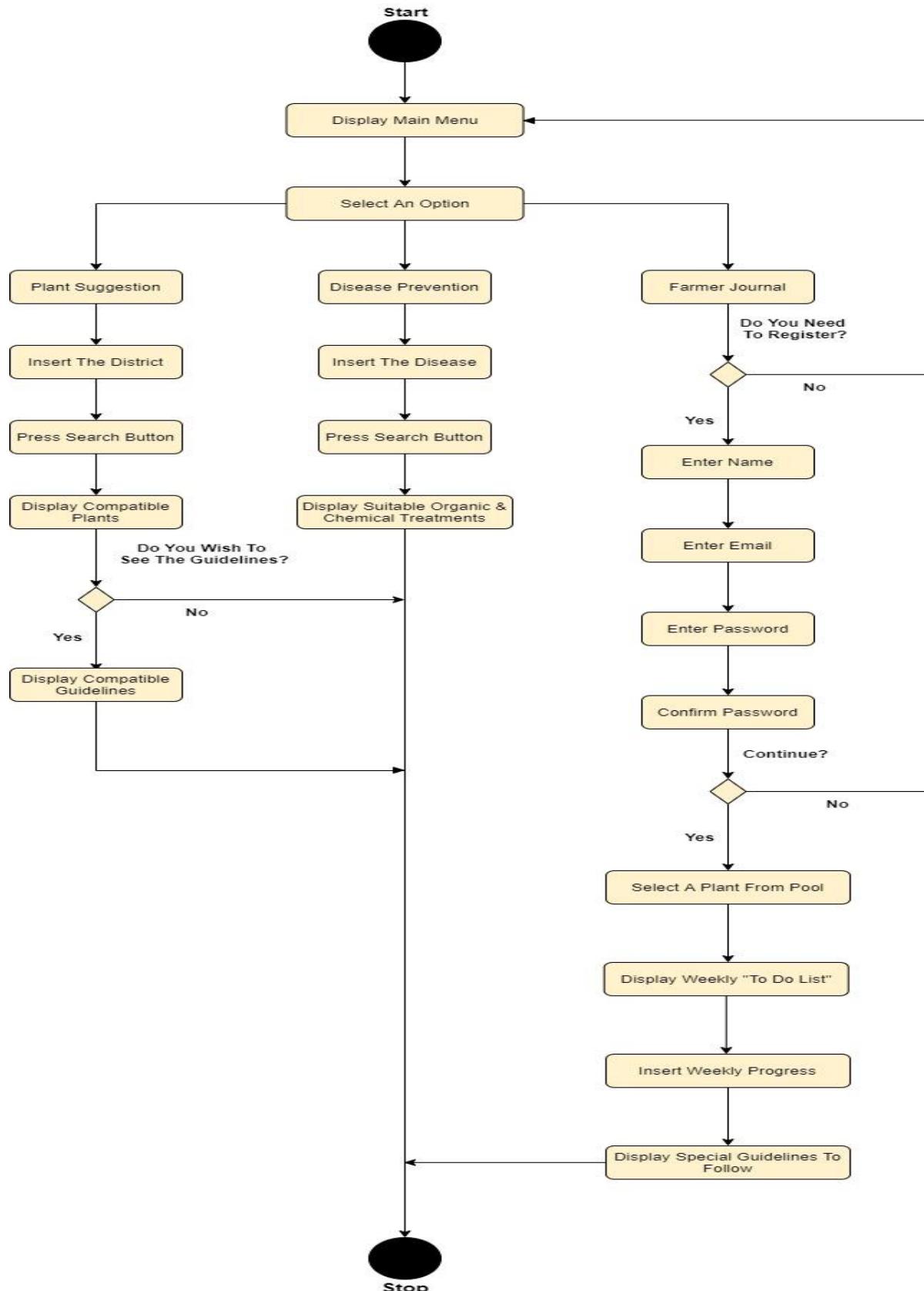


Figure 34. Activity Diagram

5.6 Wireframes

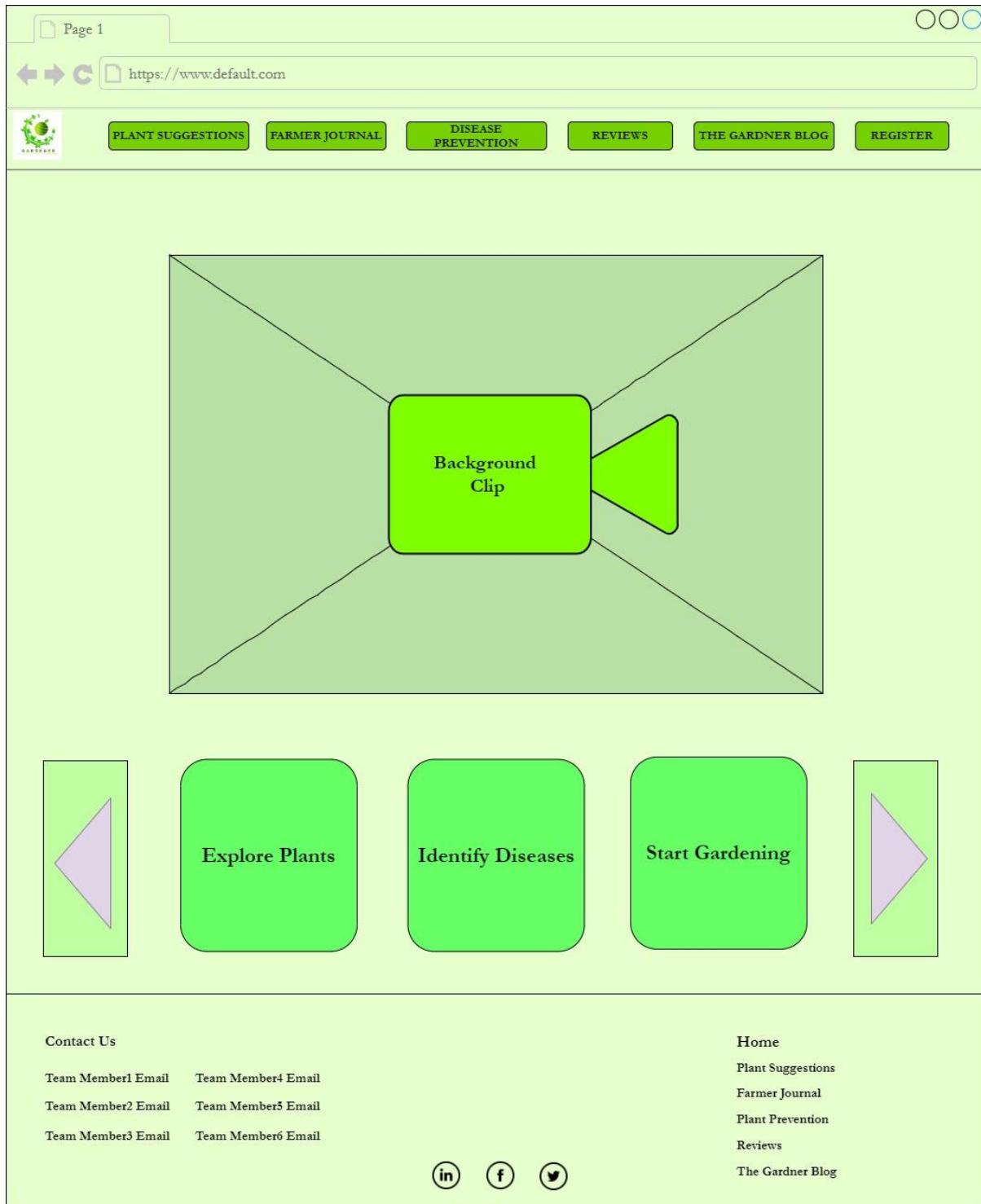


Figure 35. Core Wireframe Of Gardener Web Application

Above image illustrates the wireframe of home page for Gardener web application system.

Remaining Wireframes Can Be Found Under The Appendix Section C.2

5.7 Chapter Summary

Design chapter illustrated the high-level and low-level design of Gardener web application including the high-level architecture diagram, sequence diagrams, class diagrams, activity diagrams and proposed interface of the final prototype using wireframes. The UML designs will aid in developing the system of the Gardener web application in a reliable way.

6. Chapter 6 – Conclusion

6.1 Chapter Overview

The previous chapter discussed the findings derived from system requirement specification of the web application. This chapter will discuss the conclusion of the project by emphasizing the on the successful completion of the aims and objectives specified. The challenges and problems specified in different stages of the project will also be mentioned. Learning outcomes of the project and the future enhancements that can be done to this web application along with quality of the project will also be discussed.

6.2 Dataset

Five different type of datasets collected according to the main functionalities in the web application. A general dataset which represents the components of basic functionalities in the system is already formatted and converted into an usable source. Planned functionalities to implement in the system are based on a specific plant type as the applications main purpose to produce maintenance guidelines for domestic planting. This is why all types of datasets collected can be represented from a one processed dataset. Nevertheless, all the collected different datasets for producing designed functionalities will be explained in detail at this section of the document. Collected datasets according to the proposed functionalities of the system is listed below.

- Dataset for providing the suitable plant types
- Dataset for providing the compatible districts and time of the year
- Dataset for providing the maintenance guidelines
- Dataset for recommending the disease prevention strategies
- Dataset for calculating the predicted harvest

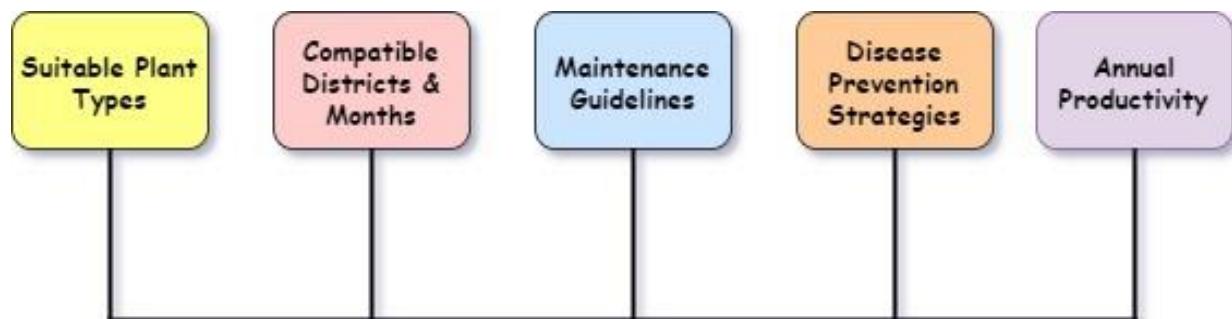


Figure 36. Cluster Of Collected Datasets

6.2.1 Dataset For Providing The Suitable Plant Types

Main functionality of the designed system is to provide the suitable plant types when user enter the location. Which is why this data set plays a major role in the entire data science component of the project. Special Cluster of this dataset is the variety of plant that will feature on the system. Variety of the selected plant types, height from the sea level and quality of the soil according to the PH values are considered mainly on formatting this dataset into usable manner.

Plant	Suitable Climate				Plant Varieties		
	Height From Sea Level		Soil				
	Soil Type	PH Value					
Bitter Gourd	1200m Upwards	RBE	5.5 - 7.5	M.C. 43	Thinnaweli White	Matale Green	
Snake Gourd	500m Upwards	NCB	5.5 - 7.5	T.A. 2	M.I. (Short)	-	
Ridged Gourd	500m Upwards	Sandy Regosol	5.5 - 7.5	L.A. 33	Gannoruwa Arie	Asirie	
Cucumber	1000m Upwards	RYB, NCB , RBE	5.5 - 7.5	L.Y. 58	Champion	Hody Green	
Pumpking	500m Upwards	RBL, RYL	5.5 - 7.5	N.K. Ruhunu	Padma	-	
Snake Cucumber	1000m Upwards	RYP, RYL	5.5 - 7.5	-	-	-	
Tomb Bitter Gourd	500m Upwards	Sandy Regosol	5.5 - 7.5	Cylindrical	Spherical	-	
Cabbage	750m Upwards	Low Humeic Gley	6.0 - 6.5	S.S. Cross	K.Y. Cross	Green Hot	
Radish	500m Upwards	RBE	6.0 - 7.5	Beer Radish	Japan Ball Radish	-	
Carrot	1300m Upwards	RYL, RYP	5.5 - 7.5	New Curroda	Lanka Carrot	-	
Beet	Within 500 - 1200m	RBE, RBL, RYL	6.3 - 7.3	Red Ace	Red Eagle	HT 1505	
Leeks	1300m Upwards	RYL, RYP	5.6 - 7.5	Large Long Summer	-	-	
Salad Leaves	1300m Upwards	RBL, RYL	5.5 - 7.5	Lactuca Sativa	Cichorium Endiva	C. Intybus	

Figure 37. Dataset For Providing Suitable Plant Types

6.2.2 Dataset For Providing The Compatible Districts & Time Of The Year

Suggesting suitable districts and compatible time of the year to grow the picked plant type is another functionality designed in the system to provide for users. Dataset for providing the suitable district is formed with considering the 24 districts in the country. Also the dataset for suggesting time of the year is formed by considering the 12 months in the year. Another fact considered on formatting the suitable growing time for selected plant is the agricultural calendar provided by the agricultural ministry. Sri Lanka has three main periods of time that farmers use to cultivate plants annually. So, most of the suitable times to planting is specifically capped into such periods.

Suitable Districts To Grow									
Gampaha	Kegalle	Polonnaruwa	Ampara	Ratnapura	Galle	Nuwara Eliya	Kurunegala	Kandy	Matara
✓	✓	✓	-	-	-	✓	✓	-	-
-	✓	-	-	-	✓	✓	-	✓	-
✓	✓	✓	-	-	✓	✓	-	✓	-
✓	✓	✓	-	✓	-	✓	-	✓	✓
-	✓	✓	✓	✓	-	✓	✓	✓	✓
-	✓	-	-	✓	✓	✓	✓	✓	-
-	✓	✓	✓	✓	-	-	-	-	-
-	✓	-	-	-	-	✓	✓	✓	-
✓	✓	✓	✓	✓	-	✓	✓	✓	✓
-	✓	-	-	-	-	✓	✓	-	✓
✓	✓	-	-	-	-	✓	✓	-	✓
-	-	-	-	-	-	✓	-	-	-
-	-	-	-	-	-	✓	✓	-	-

Figure 38. Dataset For Providing Compatible Locations

Suitable Month To Plant												
January	February	March	April	May	June	July	August	September	October	November	December	
-	-	-	✓	✓	-	-	-	-	✓	✓	-	
✓	✓	✓	-	-	-	-	✓	✓	-	-	-	
-	-	✓	✓	✓	-	-	-	-	✓	✓	✓	
-	✓	-	-	✓	✓	✓	✓	-	-	✓	-	
-	-	-	-	✓	✓	✓	✓	-	✓	✓	✓	
✓	✓	✓	✓	-	✓	✓	✓	-	-	✓	-	
-	-	✓	✓	-	-	-	-	✓	✓	-	-	
✓	✓	✓	-	✓	✓	✓	-	-	-	-	-	
-	-	✓	✓	✓	-	-	✓	✓	✓	-	-	
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
✓	✓	✓	-	-	-	-	✓	✓	✓	-	-	
-	✓	✓	-	-	-	-	-	-	✓	✓	-	
✓	✓	✓	-	-	-	-	-	-	✓	✓	-	
✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	

Figure 39. Dataset For Providing Compatible Time Of The Year

6.2.3 Dataset For Providing The Maintenance Guidelines

This functionality designed to provide the strategies for a user to continue gardening on farming field without facing to difficulties. Maintenance guidance functionality works in a weekly monitoring system where user uploads their weekly progress into the system. According to the progress inserted by the user, system provides the additional strategies to maintain the crop and it updates the user weekly. Facts considered for formatting the dataset are the water supply, fertilizer contribution and ground processing for the selected plant types. This varies in each week where system shuffles the datasets according to the progress inserted by user and provide the best strategies to farmer.

Plant	Weekly Maintenance Guidelines						
	Week 1						
	Water Supply (Litres/Ha)	Fertilizer Supply(Kg/Ha)			Vine/Bud/Stem/Pod Practision(Meters)	Ground Processing (Meters)	
		Yuriya	Thriple Phosphate	Miyuriete Potash			
Bitter Gourd	40	75	200	60	2m Height Pods	Sweeping 1m Radius	
Snake Gourd	40	75	200	60	2m Height Pods	Removing 1m Radius Grass	
Ridged Gourd	30	75	200	60	1m Height Pods	Sweeping 1m Radius	
Cucumber	40	55	80	60	2m Height Pods	Sweeping 1m Radius	
Pumpking	35	55	100	60	0.5m Stems	Soften 1m Radius Soil	
Snake Cucumber	35	50	60	50	2 X 1m Buddings	Removing 1m Radius Grass	
Tomb Bitter Gourd	40	60	60	60	1 X 1m Buddings	Removing 1m Radius Grass	

Figure 40. Week 1 - Maintenance Guidelines

Plant	Weekly Maintenance Guidelines						
	Week 2						
	Water Supply (Litres/Ha)	Fertilizer Supply(Kg/Ha)			Vine/Bud/Stem/Pod Practision(Meters)	Ground Processing (Meters)	
Bitter Gourd		Yuriya	Thriple Phosphate	Miyuriete Potash			
Bitter Gourd	45	70	150	70	Keep 2m Height Pods	Removing 1m Radius Grass	
Snake Gourd	45	70	150	70	Keep 2m Height Pods	Soften 1m Radius Soil	
Ridged Gourd	30	70	150	70	1m Height Pods	Sweeping 1m Radius	
Cucumber	45	60	100	45	2m Height Pods	Sweeping 1m Radius	
Pumpking	30	60	100	30	1 X 1m Stems	Ash Spraying 1m Radius	
Snake Cucumber	30	45	80	40	2 X 1m Buddings	Soften 1m Radius Soil	
Tomb Bitter Gourd	40	50	80	70	1 X 1m Buddings	Removing 1m Radius Grass	

Figure 41. Week 2 - Maintenance Guidelines

Plant	Weekly Maintenance Guidelines						
	Week 3						
	Water Supply (Litres/Ha)	Fertilizer Supply(Kg/Ha)			Vine/Bud/Stem/Pod Practision(Meters)	Ground Processing (Meters)	
Bitter Gourd		Yuriya	Thriple Phosphate	Miyuriete Potash			
Bitter Gourd	50	80	200	80	2m Height Pods	Mowing 1m Radius Grass	
Snake Gourd	50	80	200	80	2m Height Pods	Soften 1m Radius Soil	
Ridged Gourd	40	80	200	80	1.5m Height Pods	Sweeping 1m Radius Ground	
Cucumber	60	55	80	55	1.5m Height Pods	Sweeping 1m Radius Ground	
Pumpking	40	60	60	60	1 X 1m Stems	Soften 1m Radius Soil	
Snake Cucumber	35	50	100	50	2 X 1m Buddings	Soften 1m Radius Soil	
Tomb Bitter Gourd	45	60	120	60	1 X 1m Buddings	Sweeping 1m Radius Ground	

Figure 42. Week 3 - Maintenance Guidelines

6.2.4 Dataset For Recommending The Disease Prevention Strategies

The system recommends suitable prevention strategies for identified diseases by considering the symptoms entered by the user. Datasets for this functionality are formatted with a pool of planting diseases caused for short term crops in the present timeline of agricultural industry. Basic datasets are formed with both identified disease and suitable chemical treatments preferred by agricultural department along with the relative dosages. Plant disease treatment dataset acts in a transparent manner where user can retrieve both prevention strategy as well as the compatible treatment type from the system.

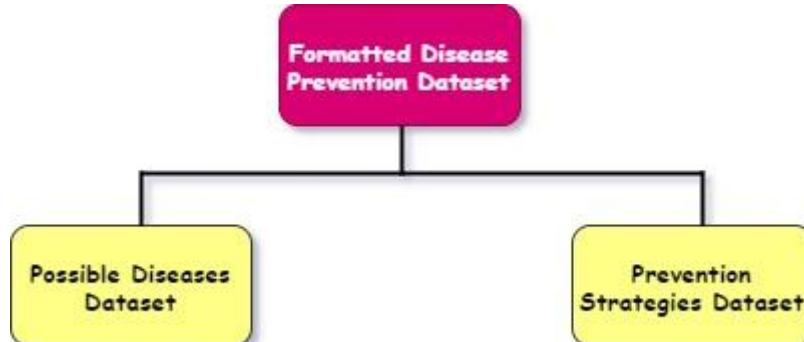


Figure 43. Filtering System Of Dataset

Diseases									
ill Fly	Gadu Fly	Yati Puss Disease	White Fly	Mitovans	Bacteria Diseases	Fungs Diseases	Predator Worms	Virus Diseases	
✓	✓	✓	-	-	✓	✓	-	-	
✓	-	✓	✓	✓	-	✓	✓	✓	
✓	-	-	-	-	✓	✓	✓	✓	
✓	-	-	✓	✓	-	-	✓	-	
✓	✓	✓	-	-	✓	-	-	✓	
✓	-	✓	✓	-	✓	-	✓	✓	
-	-	-	-	✓	✓	✓	✓	-	
-	✓	✓	✓	-	-	✓	✓	-	
-	-	-	-	✓	-	-	-	✓	
-	✓	-	-	-	✓	✓	✓	-	
-	✓	-	✓	✓	✓	✓	✓	✓	
-	✓	✓	✓	-	-	✓	✓	-	
-	-	-	-	✓	-	-	-	✓	
-	✓	-	-	-	✓	✓	✓	-	
-	✓	-	✓	✓	✓	✓	✓	✓	

Figure 45. Possible Diseases Dataset

Treatment Chemicals (Grams/Millies Per 10 Litres)											
Flutripol	KHCO3	Kabiriyotop	Krescxrim Methyl	Metalexyl	Dynotofuran	Tri-Chlorophone	Mancoseb	Captane	Sulphoxolone	Thiosyclaim	Carbosulphun
10ml	15g	20g	14ml	12.5g	-	-	-	-	10-15g	-	10ml
10ml	-	-	-	-	12.5g	15g	10g	14g	10-15g	20g	-
10ml	10g	-	-	-	12.5g	15g	10g	14g	-	20g	-
10ml	15g	20g	12ml	12.5g	-	10g	10g	-	12-15g	-	5ml
10ml	15g	20g	-	-	-	-	-	-	12-15g	-	5ml
10ml	15g	20g	-	-	7.25g	-	-	5g	-	12g	-
-	-	-	10ml	-	7.25g	20g	5g	-	-	12g	-
-	-	20g	10ml	-	-	-	7.5g	-	20-25g	-	10ml
-	15g	-	-	12.5g	-	20g	7.5g	-	20-25g	10g	10ml
-	-	-	-	11.5g	-	-	-	12g	-	-	-
-	-		8ml	-	11.5g	-	12g	10g	7-10g	15g	-
-	10g	-	-	-	11.5g	20g	12g	-	7-10g	15g	12-15ml
-	-	-	-	12.5g	-	-	-	12g	-	-	-
-	-	-	14ml	11.5g	-	12.5g	10g	-	1-15g	25g	10ml
-	15g	12g	-	-	-	12.5g	10g	10g	-	-	-

Figure 44. Plant Treatment Dataset

6.2.5 Dataset For Calculating The Predicted Harvest

System has another functionality that produces the predicted harvest output according to the planting extension of the field. Farmer needs to input the variables such as the size of the growing area, seeds planted and amount of plants in the field. System uses a dataset that represents the average annual productivity records of the selected plant type for performing the equation of this special feature. Resource for collecting the dataset was the annual plant productivity charts published by the agricultural department. Developing team went through the reports of last five years to make this prediction more accurate. For use.

Annual Productivity Record On Short Term Crops In Sri Lanka(2018)			
DISTRICT	CULTIVATION EXTENT (Ha.)	ANNUAL PRODUCTION(Mt.)	EXPORT(Mt.)
Gampaha District	859.31	2390.2	941.3
Kegalle District	198.23	544.37	191.24
Polonnaruwa District	362.71	1785.39	519.3
Ampara District	99.43	1699.7	700.15
Ratnapura District	1423.39	3600.31	1223.46
Galle District	295.47	791.34	135.36
Nuwara Eliya District	373.79	420.74	95.85
Kurunegala District	617.32	980.34	259.43
Kandy District	392.38	785.31	279.68
Matara District	469.51	317.73	143.5
Badulla District	329.43	2780.48	812.54

Figure 46. Annual Productivity Records - Dataset

Crops	2016 Annual			2016/17 MAHA		
	Extent (ha)	Production (t)	Average yield (t/ha)	Extent (ha)	Production (t)	Average yield (t/ha)
Kurakkan	6,151	8,656	1.39	3,440	4,468	1.3
Maize	67,630	243,960	3.61	44,515	163,733	3.68
Sorghum	78	161	2.06	272	1,229	4.52
Meneri	32	25	0.78	13	12	0.92
Green gram	11,302	14,546	1.29	4,061	4,869	1.21
Cowpea	8,220	13,740	1.67	4,001	4,937	1.23
Soya bean	6,301	7,946	1.26	3,095	5,207	1.68
Blackgram	11,159	11,197	1	6,077	5,247	0.86
Gingelly	14,044	12,414	0.88	2,464	2,054	0.83
Ground nut	19,975	24,200	1.21	8,099	14,152	1.75
Red onion	4,994	63,675	12.75	2,295	33,407	14.56
Big onion	3,984	65,223	16.37	288	3,226	11.2
Chilli(Green)	15,267	72,311	4.74	6,636	30,690	4.62
Total	169,137	537,963	29.76	85,256	273,258	26.78

Figure 47. Cultivation Extent Records - Dataset

6.3 Legal, Social, Ethical & Professional Issues

It is essential to make sure all the legal, social, ethical and professional issues are handled during the software development group project. The ethical clearance forms were also carefully read and filled as well. This web application needs a considerable professional clearance as the content of entire project produces a new improvement in agricultural sector. This was successfully discussed and clarified while the meeting with subject experts regarding the project data collection was happened. All the legal, social, ethical and professional issues related to this guiding web application on modern home gardening is detailed separately in below.

6.3.1 Legal Issues

When developing any system that interacts the use of human interaction, there will be several issues regarding legality. Major contradiction is the copyright to work on the selected subject. As this web application's mechanism runs through agriculture, developing team works with several areas, which affects to maintain a prolific garden environment without facing to plant related issues. Specifically, while developing team collected the dataset for providing the suitable plant types to grow in the selected environment, all those plant types needed to be officially registered in the agricultural department. Otherwise, system cannot have the responsibility for providing the accurate recommendation for the client.

Most of the treatments recommended for prevent the identified planting diseases are also went through authorisation process when the datasets has been collected. Agricultural department has a separate division for authorising the farming treatments where users can receive protected services for any plantation issues. Considerable amount of datasets for multiple functionalities in the system was explored through online sources. The respective publishers and authors who provide them into the web represent accuracy and confidentiality of these datasets.

Gathered data were treated confidentially and privacy of the users were also protected. Details of the community who answered the questionnaire were kept anonymous.

6.3.2 Social Issues

Content of this web application does not consists any cultural affect in the agricultural domain. One of the purposes detailed in the introduction chapter as the purpose of this project is to combine both professional and domestic level farmers into a single community and share their knowledge between each other. In that point of view, it can be marked as a positive outcome of this project. However, it is noted that the specific references to gardening in domestic environment could not be filtered out. Therefore, the project could have a very low level of social impact.

The project prototype will be implemented in only English and it might affect the people who do not understand the English language. Multilanguage support will be added later in later as a future enhancement.

6.3.3 Ethical Issues

Before conducting the interviews and evaluations for the project, a specific permission was requested first from the evaluators. The objective of the interview conducted was told and how it will be used was clearly mentioned to the interviewee. Some of them mentioned that they wish to remain anonymous.

Therefore, on the interpretation of the results the term “undisclosed” was used to signify such user in the system requirement specification chapter. The dataset collected through online sources in this project was released under the public domain licensing law. The publisher of all the datasets have provided full permission to use this dataset for any activity.

6.3.4 Professional Issues

The dataset was gathered professionally and the owner of the dataset was informed about usage of the dataset for this project and consent of the initial author of the dataset was taken. The people who filled the questionnaire and the evaluation were informed in good time to allow them with sufficient deadlines enabling them to fully prepare for answer them. They were also informed about how the data will be used in this project and the permission was requested first.

6.4 Plans For Implementation

- ✓ Planning & sketching the workflow
- ✓ Wire framing/prototyping
- ✓ Seeking early validation
- ✓ Architect/build database
- ✓ Building frontend
- ✓ Building backend

6.4.1 Planning & Sketching The Workflow

Sketching up the web application’s user interface is the best way to initiate implementation. This gives a specific idea about the basic structure of system and how its going to look like. Main factors for consideration while sketching is listed below.

- ✓ Navigation
- ✓ Branding
- ✓ Forms
- ✓ Buttons
- ✓ Other Interactive Elements

It is always essential for a developer to look at the project in a user’s point of view for betterment. This strategy helps to planning the ideal workflow for the designed concepts. This is where the utilities provided by a web application becomes more crucial than a typical mobile application. Here are the common utilities included in a web application.

- ✓ User signup and login
- ✓ Receiving a verification Email
- ✓ Changing the password
- ✓ Navigation through application
- ✓ Inserting data to the application

6.4.2 Wire Framing/Prototyping

Wire framing is the process of designing a blueprint of the web application. Prototyping is taking wireframing a step further by giving a simple interaction to the design. These processes are known as pre-design mechanisms where developer can establish an exact image about how the final product looks like. This makes the progress of the developer much easier when seeking early validation. Following tools can be used for wireframing/prototyping.

- ✓ Sketch (macOS)
- ✓ InVision Studio (macOS)
- ✓ Adobe XD (Windows, macOS)

6.4.3 Seeking Early Validation

Seeking early validation is connected to wireframing and prototyping as it's used as a tool for validating the designed solution of the identified problem in the entire project. Developer can pick small amount of representative users to show the designed web application. Essential to choose these representative users from the target audience of the project where they see whether it's the exact product they expected. Attempting to build a small fully working section and combining the other functionalities piece by piece is the most valuable outcome of this strategy.

6.4.4 Architect/Build Database

SQL database will use to build the database for the project. SQL databases have an extremely powerful query language that allows developers to present data in all sorts of useful ways. Each of the users in the application has their own private dataset. Developer needs to design a solid strategy for segregating client's data without shuffling. Few logical steps to make it done is listed below.

- ✓ When adding a new client, developer need to create new database and populate it with any seed data.
- ✓ Developer needs to keep record of all the clients.
- ✓ Developer needs to code separately when upgrading databases.

6.4.5 Building The Front End

Front end is the visual element of web application. It defines what people see and interact with. The frontend is developed with HTML, CSS and JavaScript. Getting started is easy when using the server pages. Then application's backend framework is all setup and ready to start building. Here are the steps to setting up the developing environment for front end.

- ✓ Setting up a code editor software. (VS Code, Sublime Text)
- ✓ A compilation and packaging framework (Webpack, Gulp)
- ✓ A frontend framework (React, Ember)
- ✓ Configuring the packaging tool to communicate with backend

6.4.6 Building The Backend

The backend typically manages the data. This refers to databases, servers and everything user cannot see within the web application. Building the backend is one of the toughest part of entire web application. This gardening web application will mainly work as a multiple page application. Basic mechanism of the backend in any web application is listed below.

- ✓ Providing HTTP endpoints to the frontend which allow to operate on the data
- ✓ Authenticate users
- ✓ Authorization
- ✓ Serving frontend

References

- Bogoda, J. (2020) ‘*Growth Of Domestic Gardening During Pandemic In Sri Lanka*’ Daily Mirror News Paper. (Online) Available At: <http://www.dailymirror.lk/international/Covid-19-pandemic-will-not-be-the-last:-WHO-chief/107-202629> (Accessed: 12 October 2020)
- Clayton, M. (2011). *The Onion Model Resistance For Change - Developing The Onion Model*. (Online) Available At: <https://mikeclayton.co.uk/2011/09/creating-the-onion-model-2/> (Accessed: 28 November 2020)
- Clin, E. (2020) ‘*Impact Of The Coronavirus Pandemic On The Global Economy*’. Statista Research Department. (Online) Available At: <https://www.statista.com/topics/6139/covid-19-impact-on-the-global-economy/> (Accessed: 12 October 2020)
- Cunningham, C. (2020) ‘*New Features Of BCPC Pesticide Guide*’ The Crops Magazine. (Online) Available At: <http://www.cpm-magazine.co.uk/2020/12/14/new-features-for-bcpc-online-uk-pesticide-guide/> (Accessed: 15 October 2020)
- Dayananda C.M. (2008) HARTI Crop Statistics In Sri Lanka, Available At <http://harti.gov.lk> (Downloaded: 01 October 2020)
- Diagrams & Flowchart Maker (2020) *UML Diagram Creator* [Online] Available At: <https://app.diagrams.net/> (Accessed: 28 November 2020)
- Dillard, John (2017) *The Data Analysis Process: 5 Steps To Better Decision Making* [Online] Big Sky Associates. Available At: <https://www.bigskyassociates.com/blog/bid/372186/The-Data-Analysis-Process-5-Steps-To-Better-Decision-Making> (Accessed: 25 November 2020)
- Ding, N.Z. & Mei, H. (2017) ‘*General Defenses Of Land Plant*’ Plant Abiotic Stress. (Online) Available At: <https://www.frontiersin.org/articles/10.3389/fpls.2018.01771/full#:~:text=Abiotic> (Accessed: 13 October 2020)
- Eriksson, U. (2012) *Why Is The Difference Between Functional & Non-Functional Requirement Is Important* [Online] Available At: <https://reqtest.com/requirements-blog/functional-vs-non-functional-requirements/> (Accessed: 29 November 2020)
- Gotterbarn, G. and Miller, K. (2017) *Ethical Considerations In Software Engineering*. Available At: <http://csciwww.etsu.edu/gotterbarn/artge2.htm#> (Accessed: 06 December 2020)
- Gunawardene L.L.N. and Wijewickrama P. (2012) Pests Of Crop & Their Management. Available At <http://sliate.lk> (Downloaded: 27 September 2020)
- Haynes, C.M. and Specter L.G.(2016). *Product Management – What Is Stakeholder Analysis*. (Online) Available At: <https://www.productplan.com/glossary/stakeholder-analysis/c43#> (Accessed: 28 November 2010)
- International Institute Of Horticultural Science. (2020) ‘Division In Tropical & Sub-Tropical Fruit & Nuts’ (Online) Available At: <https://www.ishs.org/tropical-and-subtropical-fruit-and-nuts> (Accessed: 10 October 2020)
- Jayakumara M. (2014) Social Geography In Sri Lanka, Available At <http://arts.pdn.ac.lk/geography/> (Downloaded: 28 September 2020)
- Jayawardene, S.S.B.D.G. & Weerasena, L.L. (2016) *Crop Diversification Of Sri Lanka*. (Online) Faculty Of Agriculture, Sri Lanka. Available At: <http://www.fao.org/3/x6906e/x6906e0b.htm> (Accessed: 20 November 2020)

- Johnston, J. (2019) *How To Build A Web Application: A Beginners Guide* Available At: <https://www.budibase.com/blog/how-to-make-a-web-app/> (Accessed: 07 December, 2020)
- Keshnar, A. (2020) ‘Amid Lockdown-Sri Lankans Nurture Their Own Oases Through Home Gardening’. *Mongabay*. (Online) Available At: <https://news.mongabay.com/2020/05/amid-lockdown-sri-lankans-nurture-their-own-oases-through-home-gardening/> (Accessed: 10 October 2020)
- Kieser, M. (2018). *Introduction To Natural Language Processing (NLP) – Algorithmia Blog*. [Online] Algorithmia Blog. Available At: <https://blog.algorithmia.com/introduction-natural-language-processing> (Accessed: 15 November 2020)
- Lecun, Y. and Hinton, G. (2015) *Deep Learning*. *Nature*, 521. Nature Publishing Group, A Division Of Macmillan Publishers Limited. All Rights Reserved. 436. Available From: <http://dx.doi.org/10.138/nature14569> (Accessed: 13 November 2020)
- Lynch, Warren (2019) *School Management System – Use Case Description Example* (Online) Available At: <https://medium.com/@warren2lynch/use-case-description-example-4b04280d6435> (Accessed: 28 November 2020)
- Manjaree D.A. and Nanayakkara M.M. (2013) *Short Term Crop Plantation*. 3rd Edition. Peradeniya University Press.
- Mohanam, A. (2020) ‘Economic Analysis Of Short Term Crop Cultivation In Kerala’ International Journal Of Current Research. (Online) Available At: <https://www.journalcra.com/article/economic-analysis-crop-cultivation-kerala> (Accessed: 09 October 2020)
- Manning, C. Schutze, H. and Raghavan, P. (2019). *Introduction To Information Retrieval*. Pp.Section.6.2.
- Nandadasa, C.M. and Gunawansa P.S.J. (2016) ‘Short Term Crops In Sri Lanka’, *Plantation Statistics In Sri Lanka*, Available At <https://plantationindustries.gov.lk/web/index.php?lang=en> (Accessed: 29 September 2020)
- Online Diagram Maker (2019) *Online Diagramming Software & Visual Solutions* (Online) Available At: <https://lucid.app/lucidchart/33725373-749b-466e-bbf1-3e8bc8cec9c6/edit> (Accessed: 27 November 2020)
- Pokunuwita M.C. (2007) *Vegetable Planting In Sri Lanka* 4th Edition. Peradeniya, Gannoruwa: Agricultural Research Institute Press.
- Powell-Morse, A. (2017). *What Is Iterative Model & When To Use It*. (Online) Airbrake Blog. Available At: <https://airbrake.io/blog/sdlc/iterative-model> (Accessed: 14 November 2020)
- Rowan, C.G. (2020) ‘The World After Covid-19 World Pandemic’, World Health Organisation. (Online) Available At: <https://www.who.int/news-room/commentaries/detail/world-s-after-covid-19-global-pandemic-increasing-superbugs> (Accessed: 11 October 2020)
- Russ, Cox. (2017) *Regular Expression Matching Can Be Simple & Fast*. (Online) Available At: <https://swtch.com/regpx/cc> (Accessed: 13 November 2020)
- Sharfuddin, C.C. (2020) ‘Asia’s Economy After Pandemic Outbreak’. Interactive Women’s Circle. (Online) Available At: <https://interactive.unwomen.org/multimedia/explainer/covid19> (Accessed: 09 October 2020)
- Sharma, N. (2020) ‘Lockdown Slashed Global Emissions; World Economic Forum. (Online) Available At: <https://www.weforum.org/agenda/2020/11/nasa-lockdown-reduced-global-pollution/> (Accessed: 12 October 2020)

- Sharma, N. and Shrivastau, K.S. (2020) ‘The Impact Of Covid-19 Lockdown’, *The Epidemic Global Economy*, 14 July. Available At <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7358172/> (Accessed: 10 October 2020)
- Shaw, A. (1979). *Software Specification Languages Based On Regular Expressions*. Hans Marcus Shaw. Country Publications. Pp409
- Shivaprasad. T. and Shetty, J. (2017). *Sentiment Analysis Of Product Reviews*. Dharma Publications. Pp209-219
- Sirinivasan C.J. and Soyza T.L.M. (2015) ‘Fruits In Sri Lanka’, *Short Term Long Fruits Plants* Available At <https://lakpura.com/fruits> (Accessed: 15 October 2020)
- Sugathapala, C.M. (2020) ‘Flowers In Sri Lanka’ Daily News-Letter. (Online) <https://english.lankaviews.com/> (Accessed: 22 October 2020)
- Susskind, N.S. (2020) ‘Lockdowns Start To Limit Covid-19 Spread In Europe’, The Guardian. (Online) Available At: <https://www.theguardian.com/world/2020/nov/12/global-report-lockdowns-start-to-limit-covid-19-spread-in-europe> (Accessed: 11 October 2020)
- Spinellis, D. (2017) *The Social Responsibility Of Software Development*. IEEE Computer Society. Digital Library. Available At: <https://www.computer.org/cslm/magazine> (Accessed: 06 December 2020)
- Sri Lanka, Department Of Census & Statistics (2019) ‘Live Stock & Crop Plantation’, *Agricultural Statistics In Sri Lanka*, Available At <http://www.statistics.gov.lk/Agriculture/StatisticalInformation/new> (Accessed: 11 October 2020)
- Sri Lanka, Department Of Meteorology (2018) ‘Annual Rainfall Of Sri Lanka’, *Climate Seasons In Sri Lanka*, Available At <http://www.meteo.gov.lk/index.php?lang=en> (Accessed: 07 October 2020)
- Sri Lanka, Department Of Census & Statistics (2019) ‘Live Stock & Crop Plantation’, *Agricultural Statistics In Sri Lanka*, Available At <http://www.statistics.gov.lk/Agriculture/StatisticalInformation/new> (Accessed: 11 October 2020)
- Sri Lanka, Department Of Meteorology (2018) ‘Annual Rainfall Of Sri Lanka’, *Climate Seasons In Sri Lanka*, Available At <http://www.meteo.gov.lk/index.php?lang=en> (Accessed: 07 October 2020)

Bibliography

- Al-Abdullatif, W. and Kotb, Y. (2014). Using Home Gardening Strategies to Prevent the Insect Attacks Process. *International Journal of Agriculture*, 97(16), pp.13-20.
- Agilack (2018) *A Survey Of Short Term Home Gardening In Sri Lanka*. 3rd Edition. Socio Economic & Planning Centre, Peradeniya. Pages 224
- AgStat. (2015) *Pocket Book Of Agricultural Statistics In Sri Lanka*. 2nd Edition. Faculty Of Agriculture, Peradeniya. Pages 95
- Brighthub Project Management. (2018). *10 Essential Business Requirements Gathering Techniques*. [Online] Available at: <https://www.brighthubpm.com/project-planning/60264-techniques-used-in-business-requirements-gathering/> (Accessed: 29 November 2020)
- Department Of Census & Statistics (2017) *Agricultural Statistics In Sri Lanka*. (Online) Available At <http://www.statistics.gov.lk/> (Accessed 10 October 2020)
- Department Of Meteorology (2011) *Climate In Sri Lanka* (Online) Available At http://www.meteo.gov.lk/index.php?option=com_content&view=article&id=94&Itemid (Accessed: 23 September 2020)
- Gao, W and Huang, H. and Yang, T. (2016) *Vlogging: A Survey Of Video Blogging Technology On The Web* [Online] Available At <https://researchgate.net/videoblogging/survey> (Accessed: 17 October 2020)
- Galhena, D.H. and Freed, R. (2013) *A Promising Approach To Enhance House Hold Food Security*. [Online] Available At <https://agricultureandfoodsecurity.biomedcentral.com/articles/10.1186/2048-7010-2-8> (Accessed: 25 October 2020)
- Jayawardene, S.S.N. (2006) *Crop Diversification In Sri Lanka*. 2nd Edition. University Of Peradeniya. Pages 71
- Neville, B.M. and Graeme, C.S.D (2014) Compost Versus Chemical Fertilizers. *Modern Home Gardening*. [Online] Available At <https://www.gardeningchannel.com/compost-vs-fertilizer-explained/> (Accessed: 30 October 2020)
- Palamkumbure, L. (2010) *Sea Level Inundation In Sri Lanka* (Online) Available At <https://geoenvironmental-disasters.springeropen.com/articles/10.1186/s40677-020-00154-y> (Accessed 13 September 2020)
- Pelczar, R.M. (2016) General Consideration Of Disease Prevention. *Insect & Bug Attacks On Harvest* (Online) Available At <https://www.britannica.com/science/plant-disease> (Accessed: 17 October 2020)
- Perera A.M. (2014) Annual Harvesting Records Of Sri Lanka. *Total Harvest Lost By Bug Attacks*. [Online] Available At <https://reliefweb.int/report/sri-lanka/record-harvest-loss-food-shortages-hit-dry-sri-lanka> (Accessed: 28 October 2020)
- Seneviratne, M. (2009) *Agricultural Diversification Of Sri Lanka*. (Online) Department Of Agriculture. Available At <https://www.doa.gov.lk/index.php/en/> (Accessed: 10 October 2020)
- Smith, L.C. (1998) *Aerial Application Of Agricultural Chemicals*. 7th Edition. National Agricultural Library, United States. Pages 69

Bibliography

- The Market-Watch Journal (2020) ‘*Growth Of Domestic Means In Businesses During Pandemic*’ (Online) Available At: https://www.marketwatch.com/economy-politics/coronavirus?mod=top_nav (Accessed: 09 October 2020)
- Walisadeera L.N. and Muthukumaraka J.M. (2010) Crop Suitability In Sri Lanka. Available At <https://www.doa.gov.lk/index.php/en/> (Downloaded: 29 September 2020)
- Watling, B. & Remieres, L.P. (2017) ‘*Maintaining Short-Term Crops In Limited Conditions*’. Article. Research Gate. (Online) Available At: <https://www.researchgate.net> (Accessed: 09 October 2020)
- Westland, J. (2020). *Stakeholder Analysis 101: Identification, Mapping & More*. [Online] The Project Manager. Available At: <https://www.projectmanager.com/blog/stakeholder-analysis-101> (Accessed: 28 November 2020)
- Young, M. (2019) *Software Development Agreement: 10 Legal Issues To Cover*. Available At: <https://mikeyounglaw.com/software-development-agreement/> (Accessed: 05 December 2020)
- Statoids (2020) ‘*Division Of Sri Lanka*’ Journal (Online) Available At: <http://www.statoids.com/ylk.html> (Accessed: 15 October 2020)
- Talmage, J. and Vieties F. (2020) ‘Covid-19 & Unemployment Fear’, *The Pandemic Survey*, 12 August. Available At <https://www.ipso.com/ipsos-mori/en-uk/coronavirus-and-unemployment-fears-fuel-interest-life-insurance> (Accessed: 12 October 2020)
- Towards Data Science. (2018). *Logistic Regression Using Python – Towards Data Science* (Online) Available At: <https://towardsdatascience.com/logistic-regression-using-python> (Accessed: 14 November 2020)
- Tsuji, K., Tsuda, H and Takahashi, M. (2016). *Towards Extracting The Stakeholders & Project Management*. Proceedings-2015 IIAI 4th International Congress On Advanced Applied Informatics, IIAI-AAI, 2015. Pp 46-49
- The Digital Project Manager. (2017). *Project Management Methodologies Made Simple: The Complete Guide For Project Managers – The Digital Project Manager*. (Online) Available At: <https://www.thedigitalprojectmanager.com/project-management-methodologies-madesimple> (Accessed: 15 November 2020)

Appendix – Section A – Project Management

Appendix - Section A.1 – Work Break-Down Structure

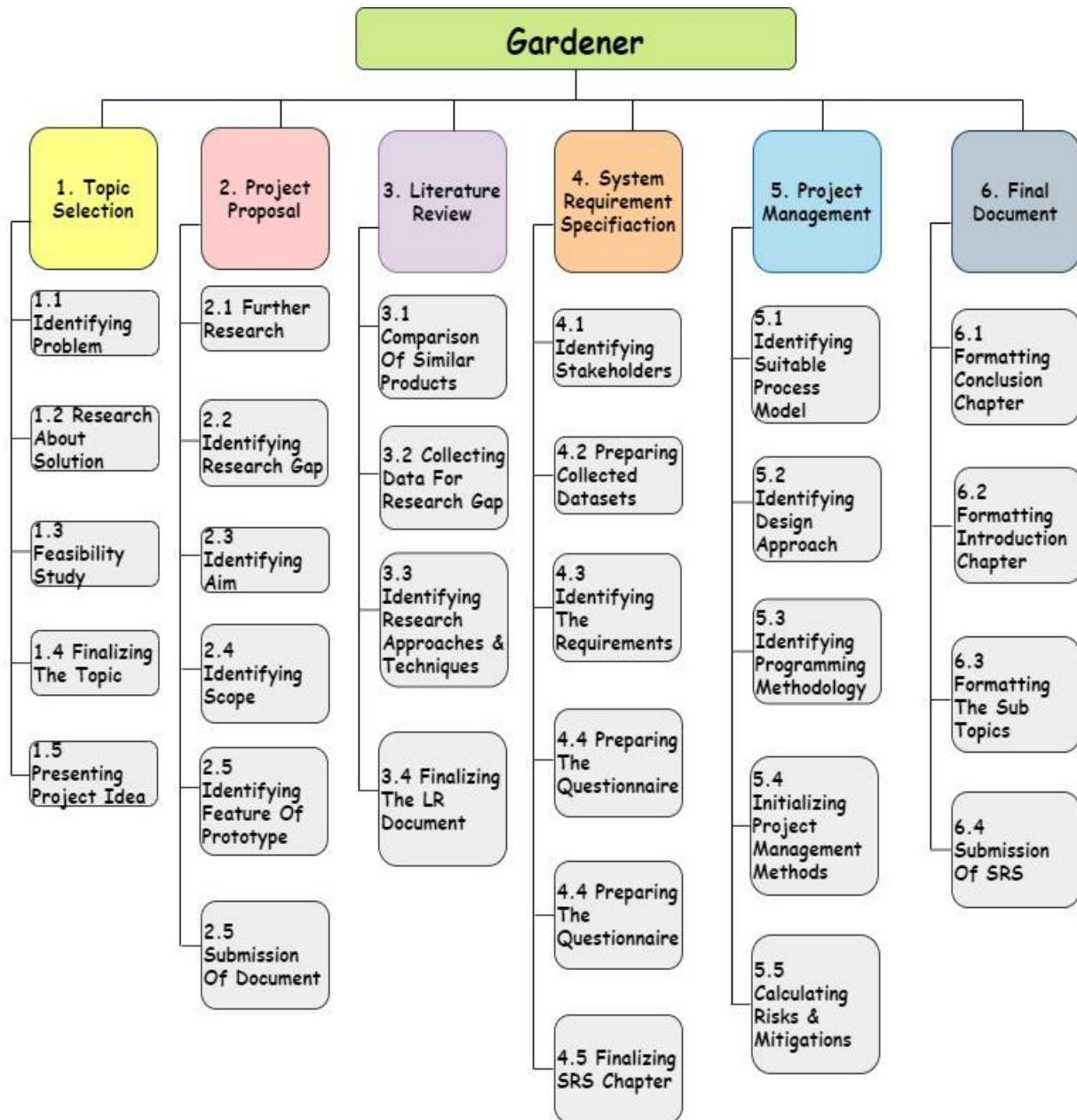


Figure 48. Work Break-Down Structure

Appendix – Section A.2 – Gantt-Chart Diagram

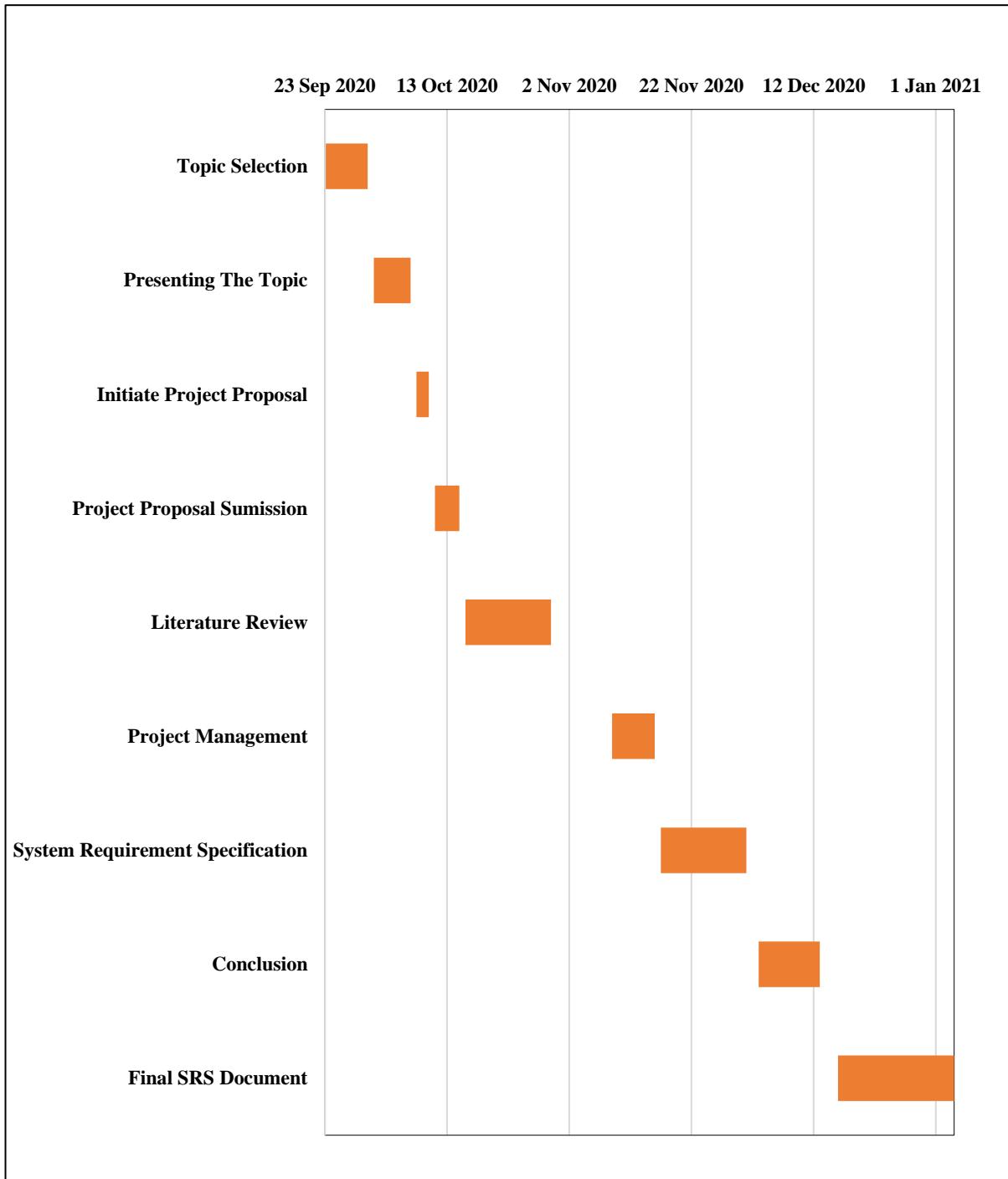


Figure 49. Gantt-Chart Diagram

Appendix – Section B – System Requirement Specification

Appendix – Section B.1 – Onion Model

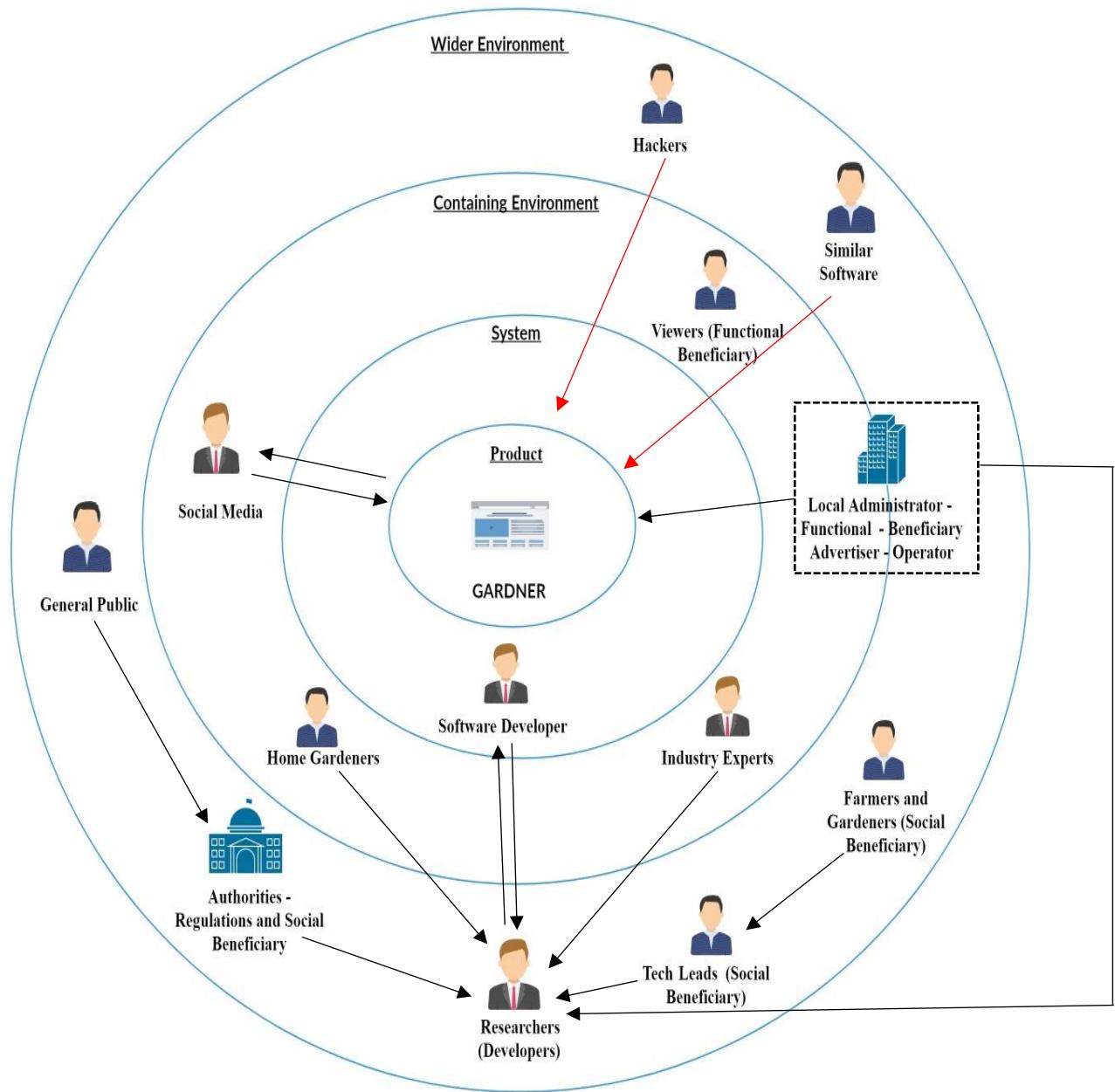


Figure 50. Onion Model

Appendix – Section B.2 – Questionnaire

**Questionnaire For Our SDGP Project -
Guiding Website On Modern Plantation
Sector**

In order to collect data for this, we prepare this Google form to gather data from common people. So please kindly give us your valuable time and data in order to go further with this Project. Your participation in this is highly valuable for us.

In this web, we guide you in many ways. Such as how to do and manage your garden or even your plantation farm furthermore according to the geographical, climate differences, and harvest percentages form the past five years in Sri Lanka (District wise) through the videos and documents of the experts in this field.

* Required

Email address *

Your email

Your age; *

Your answer

Which district do you belong to? *

Your answer

Are you doing gardening? *

Yes
 No
 Maybe

When did you start gardening?

At the time of lockdown.
 Way before lockdown.

If the answer to the second question is Yes, what have you plant mostly in your garden?(Multiple answers are allowed.)

- Flowers
- Fruits
- Vegetables
- Herbs
- Green leaves (Mukunuwanna, Gotukola, etc.)
- Other: _____

If the answer to the second question is No, what are the reasons for it?(Multiple answers are allowed.)

- No time. Too busy.
- Not interested.
- Don't have the required knowledge.
- Do not have resources.
- Other: _____

Are you still doing gardening?

- Yes
- No

If No, what are the reasons?(Multiple answers are allowed.)

- No time.
- Not interested.
- Do not know how to go further.
- Other: _____

What are the problems you faced while you do plantation? (Multiple answers are allowed.)

Financial Problems.
 Bugs attacks.
 Less fertilizers and chemicals.
 Fungus and bacterial infections.
 Other: _____

How do you find answers to them normally?

Your answer _____

If you use any kind of digital platform for it please mentioned them below.

Your answer _____

If you use any kind of digital platform for it please mentioned them below.

Your answer _____

Would you like to have a guiding web site for this not only to continue from where you stop but to start as a beginner and find solutions for the plantation problems you face?

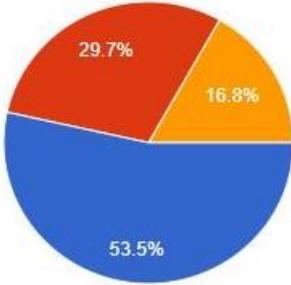
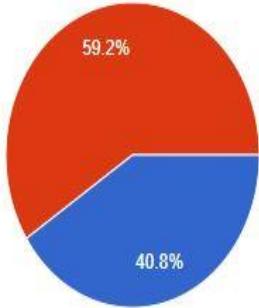
Yes
 No
 May be

Send me a copy of my responses.

Submit

Table 28. Online Questionnaire

Appendix – Section B.3 – Analysis Of Gathered Data

Questionnaire Result	Analysis								
<p>Are you doing gardening?</p> <p>101 responses</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Yes</td> <td>53.5%</td> </tr> <tr> <td>No</td> <td>29.7%</td> </tr> <tr> <td>Maybe</td> <td>16.8%</td> </tr> </tbody> </table> <p>● Yes ● No ● Maybe</p>	Response	Percentage	Yes	53.5%	No	29.7%	Maybe	16.8%	53.5% have voted for yes, which means majority of the selected community have started gardening in their homes
Response	Percentage								
Yes	53.5%								
No	29.7%								
Maybe	16.8%								
<p>When did you start gardening?</p> <p>76 responses</p>  <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>At the time of lockdown.</td> <td>40.8%</td> </tr> <tr> <td>Way before lockdown.</td> <td>59.2%</td> </tr> </tbody> </table> <p>● At the time of lockdown. ● Way before lockdown.</p>	Response	Percentage	At the time of lockdown.	40.8%	Way before lockdown.	59.2%	40.8% have voted for at the time of lockdown, this justifies considerable amount of people in community have started gardening during the time of lockdown		
Response	Percentage								
At the time of lockdown.	40.8%								
Way before lockdown.	59.2%								

<p>If the answer to the second question is Yes, what have you plant mostly in your garden? (Multiple answers are allowed.)</p> <p>76 responses</p> <table border="1"> <thead> <tr> <th>Plant Type</th> <th>Count</th> <th>Percentage</th> </tr> </thead> <tbody> <tr><td>Flowers</td><td>40</td><td>52.6%</td></tr> <tr><td>Fruits</td><td>31</td><td>40.8%</td></tr> <tr><td>Vegetables</td><td>50</td><td>65.8%</td></tr> <tr><td>Herbs</td><td>21</td><td>27.6%</td></tr> <tr><td>Tubers :- ගාස් ඇල, ගුණ් ඇල</td><td>1</td><td>1.3%</td></tr> <tr><td>Some potatos</td><td>1</td><td>1.3%</td></tr> <tr><td>I don't do gardening</td><td>1</td><td>1.3%</td></tr> <tr><td>Greenary</td><td>1</td><td>1.3%</td></tr> <tr><td>Decorative plants</td><td>1</td><td>1.3%</td></tr> <tr><td>None</td><td>1</td><td>1.3%</td></tr> <tr><td>Others</td><td>1</td><td>1.3%</td></tr> <tr><td>Bonsaai</td><td>1</td><td>1.3%</td></tr> </tbody> </table>	Plant Type	Count	Percentage	Flowers	40	52.6%	Fruits	31	40.8%	Vegetables	50	65.8%	Herbs	21	27.6%	Tubers :- ගාස් ඇල, ගුණ් ඇල	1	1.3%	Some potatos	1	1.3%	I don't do gardening	1	1.3%	Greenary	1	1.3%	Decorative plants	1	1.3%	None	1	1.3%	Others	1	1.3%	Bonsaai	1	1.3%	<p>Out of the entire scale, 76 people have put the type of plant they are growing in their home gardens. Flowers, fruits, vegetables and herbs are the major type of plant types feature in most of the gardens. That's how these plant types reserved a major space in featured plants section</p>
Plant Type	Count	Percentage																																						
Flowers	40	52.6%																																						
Fruits	31	40.8%																																						
Vegetables	50	65.8%																																						
Herbs	21	27.6%																																						
Tubers :- ගාස් ඇල, ගුණ් ඇල	1	1.3%																																						
Some potatos	1	1.3%																																						
I don't do gardening	1	1.3%																																						
Greenary	1	1.3%																																						
Decorative plants	1	1.3%																																						
None	1	1.3%																																						
Others	1	1.3%																																						
Bonsaai	1	1.3%																																						
<p>If the answer to the second question is No, what are the reasons for it?(Multiple answers are allowed.)</p> <p>33 responses</p> <table border="1"> <thead> <tr> <th>Reason</th> <th>Count</th> <th>Percentage</th> </tr> </thead> <tbody> <tr><td>No time. Too busy.</td><td>11</td><td>33.3%</td></tr> <tr><td>Not interested.</td><td>21</td><td>63.6%</td></tr> <tr><td>Don't have the required knowledge.</td><td>6</td><td>18.2%</td></tr> <tr><td>Do not have resources.</td><td>4</td><td>12.1%</td></tr> <tr><td>I am living in a flat. So we don't have...</td><td>1</td><td>3%</td></tr> <tr><td>N/A</td><td>1</td><td>3%</td></tr> </tbody> </table>	Reason	Count	Percentage	No time. Too busy.	11	33.3%	Not interested.	21	63.6%	Don't have the required knowledge.	6	18.2%	Do not have resources.	4	12.1%	I am living in a flat. So we don't have...	1	3%	N/A	1	3%	<p>18.2% have responded that they do not have required knowledge for continue the gardening. This is where the developed solution for the entire project was justified from community responses.</p>																		
Reason	Count	Percentage																																						
No time. Too busy.	11	33.3%																																						
Not interested.	21	63.6%																																						
Don't have the required knowledge.	6	18.2%																																						
Do not have resources.	4	12.1%																																						
I am living in a flat. So we don't have...	1	3%																																						
N/A	1	3%																																						
<p>Are you still doing gardening?</p> <p>88 responses</p> <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr><td>Yes</td><td>58%</td></tr> <tr><td>No</td><td>42%</td></tr> </tbody> </table>	Response	Percentage	Yes	58%	No	42%	<p>58% have responded that they are still not gardening. This percentage justifies even community started gardening, from a while they have given up on it. This is where to find the issues</p>																																	
Response	Percentage																																							
Yes	58%																																							
No	42%																																							

<p>If No, what are the reasons?(Multiple answers are allowed.)</p> <p>40 responses</p> <table border="1"> <thead> <tr> <th>Reason</th> <th>Count</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>No time.</td> <td>25</td> <td>62.5%</td> </tr> <tr> <td>Not interested.</td> <td>18</td> <td>45%</td> </tr> <tr> <td>Do not know how to go further.</td> <td>7</td> <td>17.5%</td> </tr> <tr> <td>Same reason</td> <td>1</td> <td>2.5%</td> </tr> <tr> <td>N/A</td> <td>1</td> <td>2.5%</td> </tr> </tbody> </table>	Reason	Count	Percentage	No time.	25	62.5%	Not interested.	18	45%	Do not know how to go further.	7	17.5%	Same reason	1	2.5%	N/A	1	2.5%	<p>Out of the entire scale 40 responses have provided why people have given up on gardening. Justification point was 17.5% of answers where “don’t know how to go further” answer checked in.</p>						
Reason	Count	Percentage																							
No time.	25	62.5%																							
Not interested.	18	45%																							
Do not know how to go further.	7	17.5%																							
Same reason	1	2.5%																							
N/A	1	2.5%																							
<p>What are the problems you faced while you do plantation? (Multiple answers are allowed.)</p> <p>72 responses</p> <table border="1"> <thead> <tr> <th>Problem</th> <th>Count</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Financial Problems.</td> <td>5</td> <td>6.9%</td> </tr> <tr> <td>Bugs attacks.</td> <td>52</td> <td>72.2%</td> </tr> <tr> <td>Less fertilizers and chemicals.</td> <td>18</td> <td>25%</td> </tr> <tr> <td>Fungus and bacterial infections.</td> <td>47</td> <td>65.3%</td> </tr> <tr> <td>Do not have enough place to gardening a...</td> <td>1</td> <td>1.4%</td> </tr> <tr> <td>Less time to maintain...</td> <td>1</td> <td>1.4%</td> </tr> <tr> <td>It is hard to find coconut pluckers the...</td> <td>1</td> <td>1.4%</td> </tr> </tbody> </table>	Problem	Count	Percentage	Financial Problems.	5	6.9%	Bugs attacks.	52	72.2%	Less fertilizers and chemicals.	18	25%	Fungus and bacterial infections.	47	65.3%	Do not have enough place to gardening a...	1	1.4%	Less time to maintain...	1	1.4%	It is hard to find coconut pluckers the...	1	1.4%	<p>Out of the entire scale, 72 responses have provided for gardening issues of community. 72.2% responses are on the bug attacks. Another pile has responded for possible issues like less fertilizers and bacteria, fungus infections</p>
Problem	Count	Percentage																							
Financial Problems.	5	6.9%																							
Bugs attacks.	52	72.2%																							
Less fertilizers and chemicals.	18	25%																							
Fungus and bacterial infections.	47	65.3%																							
Do not have enough place to gardening a...	1	1.4%																							
Less time to maintain...	1	1.4%																							
It is hard to find coconut pluckers the...	1	1.4%																							

<p>If you use any kind of digital platform for it please mention them below.</p> <p>22 responses</p> <table border="1"> <thead> <tr> <th>Digital Platform</th> <th>Responses</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>No</td> <td>7</td> <td>31.8%</td> </tr> <tr> <td>No, I don't use</td> <td>2</td> <td>9.1%</td> </tr> <tr> <td>Using some techniques regarding...</td> <td>1</td> <td>4.5%</td> </tr> <tr> <td>YouTube</td> <td>1</td> <td>4.5%</td> </tr> <tr> <td>Youtube</td> <td>2</td> <td>9.1%</td> </tr> <tr> <td>google</td> <td>2</td> <td>9.1%</td> </tr> <tr> <td>Coconut pluckers should have a...</td> <td>1</td> <td>4.5%</td> </tr> <tr> <td>Coconut pluckers should have a...</td> <td>1</td> <td>4.5%</td> </tr> </tbody> </table>	Digital Platform	Responses	Percentage	No	7	31.8%	No, I don't use	2	9.1%	Using some techniques regarding...	1	4.5%	YouTube	1	4.5%	Youtube	2	9.1%	google	2	9.1%	Coconut pluckers should have a...	1	4.5%	Coconut pluckers should have a...	1	4.5%	<p>This question was added to make sure the target audience uses any software tool for overcome these in the present time line. Only 22 responses provided out of the entire scale for this question</p>
Digital Platform	Responses	Percentage																										
No	7	31.8%																										
No, I don't use	2	9.1%																										
Using some techniques regarding...	1	4.5%																										
YouTube	1	4.5%																										
Youtube	2	9.1%																										
google	2	9.1%																										
Coconut pluckers should have a...	1	4.5%																										
Coconut pluckers should have a...	1	4.5%																										
<p>Would you like to have a guiding web site for this not only to continue from where you stop but to start as a beginner and find solutions for the plantation problems you face?</p> <p>97 responses</p> <table border="1"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Yes</td> <td>62.9%</td> </tr> <tr> <td>No</td> <td>11.3%</td> </tr> <tr> <td>May be</td> <td>25.8%</td> </tr> </tbody> </table>	Response	Percentage	Yes	62.9%	No	11.3%	May be	25.8%	<p>62% have voted for having a web application for inspiring the people who are interested in gardening sector. This is where the developed solution for project was justified from community</p>																			
Response	Percentage																											
Yes	62.9%																											
No	11.3%																											
May be	25.8%																											

Table 29. Analysis Of Gathered Data

Appendix – Section B.4 – Use Case Descriptions

Appendix – Section B.4.1 – Receives The Location

Use Case Name	Receives The Location	
Use Case Id	UC-001	
Description	Receives The Location From User	
Priority	High Level	
Primary Actor	Web Application	
Supporting Actors	-	
Pre-Conditions	Needs To Come Through Basic Log In Protocol	
Trigger	User Inputs The Location To System For Receive Guidance	
Main Flow	Actors	System
	User Opens Web Application	System Displays Main Menu
	User Selects The Input Details Option	System Loads The Input Details Page
	User Submits Details On The Menu	System Filters The Data And Display Compatible Options
Exception Flow	Actors	System
	User Enters The Details	System Doesn't Display Results Page Due To Low Internet Connection
	User Reconnects The Internet	Results Page Displays With Compatible Options Menu
Alternate Flow	Actors	System
	User Doesn't Fill All The Data Fields	System Warns And Disallows The User To Continue
	User Fill All The Details Again	System Catches All The Data Fields And Continue To Display Results Page
Exclusions	Matching The Rainfall And Plant Compatibility	
Post Conditions	Search Suitable Plant Types	

Table 30. Use Case 01 - Receives The Location

Appendix – Section B.4.2 – Analyse Conditions

Use Case Name	Analyse Conditions	
Use Case Id	UC-002	
Description	Analyses The Conditions Entered By User	
Priority	High Level	
Primary Actor	Web Application	
Supporting Actors	-	
Pre-Conditions	Has To Move Through The Data Entered By The User	
Trigger	User Needs To View The Compatible Plant Types	
Main Flow	Actors	System
	User Opens Web Application	System Displays The Main Menu
	User Enters The Location	System Loads The Available Options
	User Chooses The Compatible Plant Types Option	System Analyses The Entered Data Set And Displays The Suitable Plant Types
Exception Flow	Actors	System
	User Enters The Location	System Doesn't Load Due To Low Broadband Connection
	User Reconnects The Internet Connection	System Displays The Compatible Plant Types
Alternate Flow	Actors	System
	User Keeps The Location Field Empty	System Displays Warning For Non-Inserted Data Field
	User Refills The Location Field	System Analyses Input And Displays The Compatible Plant Type
Exclusions	Matching Rainfall	
Post Conditions	Suitability Conditions Will Be Analysed	

Table 31. Use Case 02 - Analyse Conditions

Appendix – Section B.4.3 – View Suitable Plant Types

Use Case Name	View Suitable Plant Types	
Use Case Id	UC-003	
Description	View The Suitable Plant Types For Inserted Location	
Priority	High Level	
Primary Actor	Web Application	
Supporting Actors	-	
Pre-Conditions	Has To Enter The User Details Into System	
Trigger	The User Needs To View The Supported Plant Types In Their Location	
Main Flow	Actors	System
	User Opens Web Application	System Displays Main Menu
	User Enters Details On Input Details Section	System Loads The Compatible Options Page
	User Selects The Desired Plant Type On The Options Menu	System Displays The Compatible Plant Types
Exception Flow	Actors	System
	User Enters The Location On Options Menu	Electricity Breaks Down
	User Reopens The Web Application And Enters The Location	System Displays The Compatible Plant Types
Alternate Flow	Actors	System
	User Keeps One Field Empty And Click Continue	System Displays An Error Message Saying Fill All The Data Fields
	User Fill All The Necessary Data Fields	System Displays The Compatible Plant Types
Exclusions	-	
Post Conditions	Filters The Various Plant Types In The Database	

Table 32. Use Case 03 – View Suitable Plant Types

Appendix – Section B.4.4 – Providing Maintenance Guidelines

Use Case Name	Providing Maintenance Guidance	
Use Case Id	UC-004	
Description	Provide The Weekly Guidance For Plants	
Priority	High Level	
Primary Actor	Farmer	
Supporting Actors	Administrator	
Pre-Conditions	Needs To Insert Farmer Details Into The Web Application	
Trigger	The Farmer Needs To Receive Guidance For Plantation	
Main Flow	Actors	System
	User Opens The Web Application	System Displays The Main Menu
	User Chooses The Guidance Menu	System Loads The Guidance Menu
	User Inputs The Details On Guidance Menu	System Analyses The Details And Displays The User Feedback Menu
	User Inputs A Plant Disease	System Compares Disease With Treatment Library And Displays The Suitable Treatments
Exception Flow	Actors	System
	User Opens The Web Application	System Displays The Main Menu
	User Chooses The Guidance Menu	System Loads The Guidance Menu
	User Having A Unstable Internet Connection	System Displays An Error Message Saying Connection Is Unstable
	User Switches The Network	System Get Backs To Normal
Alternate Flow	Actors	System
	User Enters Invalid Inputs In Feedback Form	System Displays An Error Message Saying Invalid Inputs
	User Enters Valid Inputs In Feedback Form	System Displays Suitable Response

Table 33. Use Case 04 - Maintenance Guidelines

Appendix – Section B.4.5 – Identifying Possible Plant Diseases

Use Case Name	Identifying Possible Plant Diseases	
Use Case Id	UC-005	
Description	Identifying The Diseases Causing To Crops	
Priority	High Level	
Primary Actor	Farmer	
Supporting Actors	Administrator	
Pre-Conditions	Needs To Input The Farmer Details And Then Direct Into Disease Control Optional Menu	
Trigger	The Web Application Needs To Identify The Disease Affected To Plant	
Main Flow	Actors	System
	User Chooses The Disease Prevention Menu	System Loads The Disease Prevention Menu
	User Inputs The Disease Symptoms	System Analyses Symptoms With Database And Provide Disease Name
	User Selects The Treatment Option	System Provides The Treatments For Entered Disease
Exception Flow	Actors	System
	User Chooses The Disease Prevention Menu	System Unexpectedly Crashes
	User Refreshes The Web Page	System Refreshes And Displays The Disease Prevention Menu
Alternate Flow	Actors	System
	User Inputs A Number In The Symptoms Field	System Loads And Displays An Error Message Saying Invalid Input
	User Inputs The Symptoms In Valid Format In The Field	System Loads And Provides The Disease Name
Exclusions	-	
Post Conditions	Providing Suitable Treatments	

Table 34. Use Case 05 - Identifying Possible Plant Diseases

Appendix – Section B.4.6 – Recommending Disease Prevention Strategies

Use Case Name	Recommending Disease Prevention Strategies	
Use Case Id	UC-006	
Description	Recommending Strategies To Prevent Plant Diseases	
Priority	High Level	
Primary Actor	Farmer	
Supporting Actors	Administrator	
Pre-Conditions	Needs To Input Farmer Details And Insert The Disease Name In Farmer Feedback Option	
Trigger	The Web Application Needs To Provide Disease Prevention Strategies	
Main Flow	Actors	System
	User Opens The Web Application	System Displays The Main Menu
	User Chooses The Disease Prevention Menu	System Loads The Disease Prevention Menu
	User Inputs The Disease Name	System Analyses The Inserted Disease Name And Provide Prevention Strategies
Exception Flow	Actors	System
	User Inputs The Disease Name In Disease Prevention Menu But Connection Times Off	System Displays An Error Message Saying Connection Time Is Out.
	User Reconnect The Network And Input The Disease Name Again In The Menu	System Refreshes, Analyse Inserted Disease Name And Provide Prevention Strategies
Alternate Flow	Actors	System
	User Inserts A Human Disease In Disease Prevention Menu	System Displays An Error Message Saying Invalid Disease Entered
	User Inserts A Plant Disease In Disease Prevention Menu	System Displays The Suitable Prevention Strategies According To Inserted Disease
Exclusions	-	
Post Conditions	Recommends The Suitable Prevention Strategies For Plants.	

Table 35. Use Case 06- Recommending Disease Prevention Strategies

Appendix – Section B.4.7 – Calculating Predicted Harvest

Use Case Name	Calculating predicted harvest	
Use Case ID	UC-007	
Description	Calculates the harvest according to planted resources	
Priority	High Level	
Primary Actor	Farmer	
Supporting Actors	Administrator	
Pre-Conditions	Needs to input plant details, planted seeds amount and number of plant in field into the calculations menu in the system	
Trigger	The web application needs to provide predicted harvest in the field	
Main Flow	Actors	System
	User opens the web application	System loads the main menu of web application
	User opens the farmer feedback option	System displays the farmer feedback option menu
	User inserts the planted amount of seeds, number of plants in the data fields	System receives the inserted data and syncs with the average harvest of selected plant type and provide the predicted harvest
Exception Flow	Actors	System
	User opens the farmer feedback option	System unexpectedly crashes due to low network bandwidth
	User switches the network and reopens the web application	System refreshes and displays the main menu
Alternate Flow	Actors	System
	User inserts string input in number of plants field	System identifies the data as an invalid input and displays invalid input error message
	User insert the valid input again in the number of plants field	System provides the predicted harvest of selected plant
Exclusions	-	
Post Conditions	Provides the average predicted harvest of the selected plant	

Table 36. Use Case 07 - Calculating Predicted Harvest

Appendix – Section C – Design

Appendix – Section C.1 – Sequence Diagrams

Appendix – Section C.1.1 – Log In

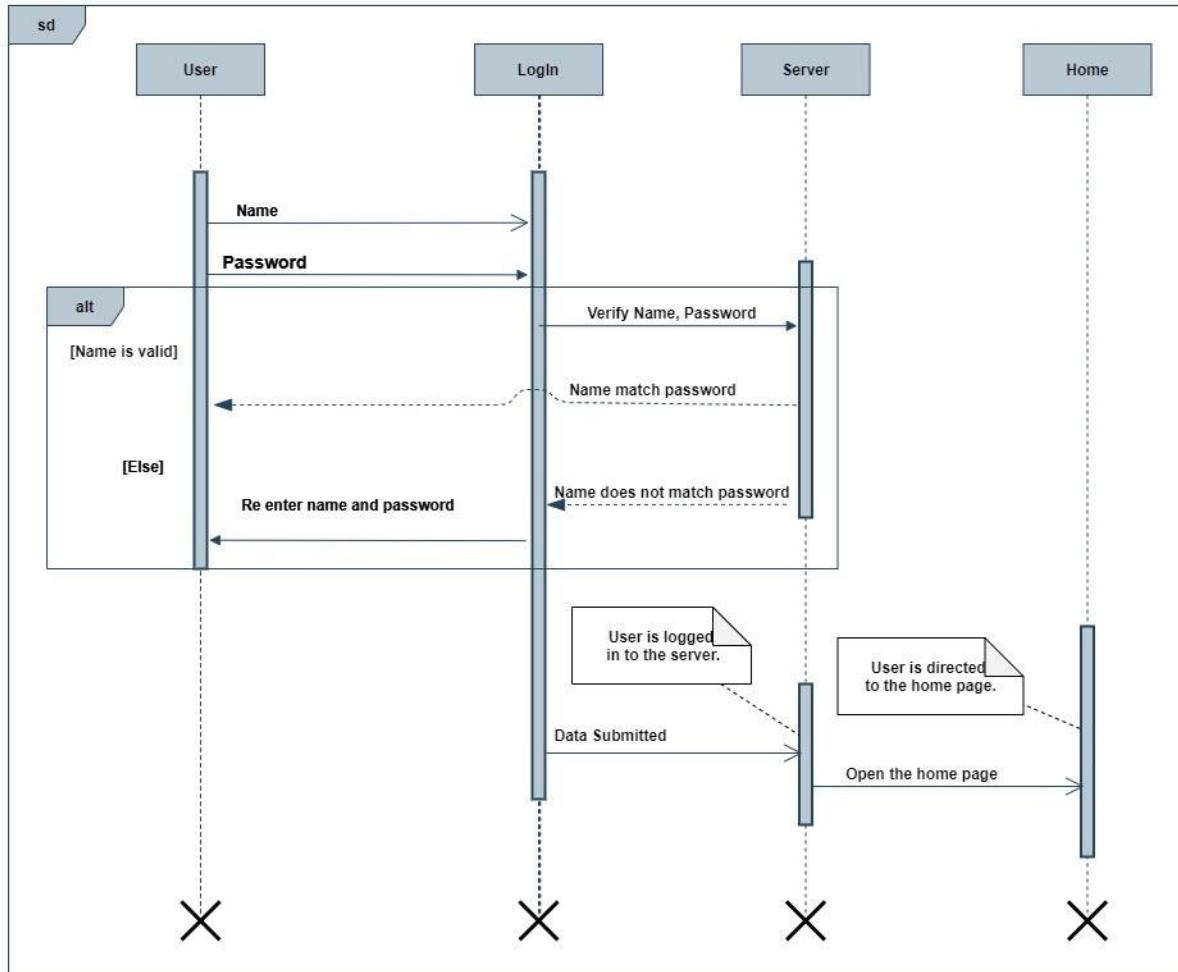


Figure 51. Sequence Diagram - Log In

Appendix – Section C.1.2 – Registered User

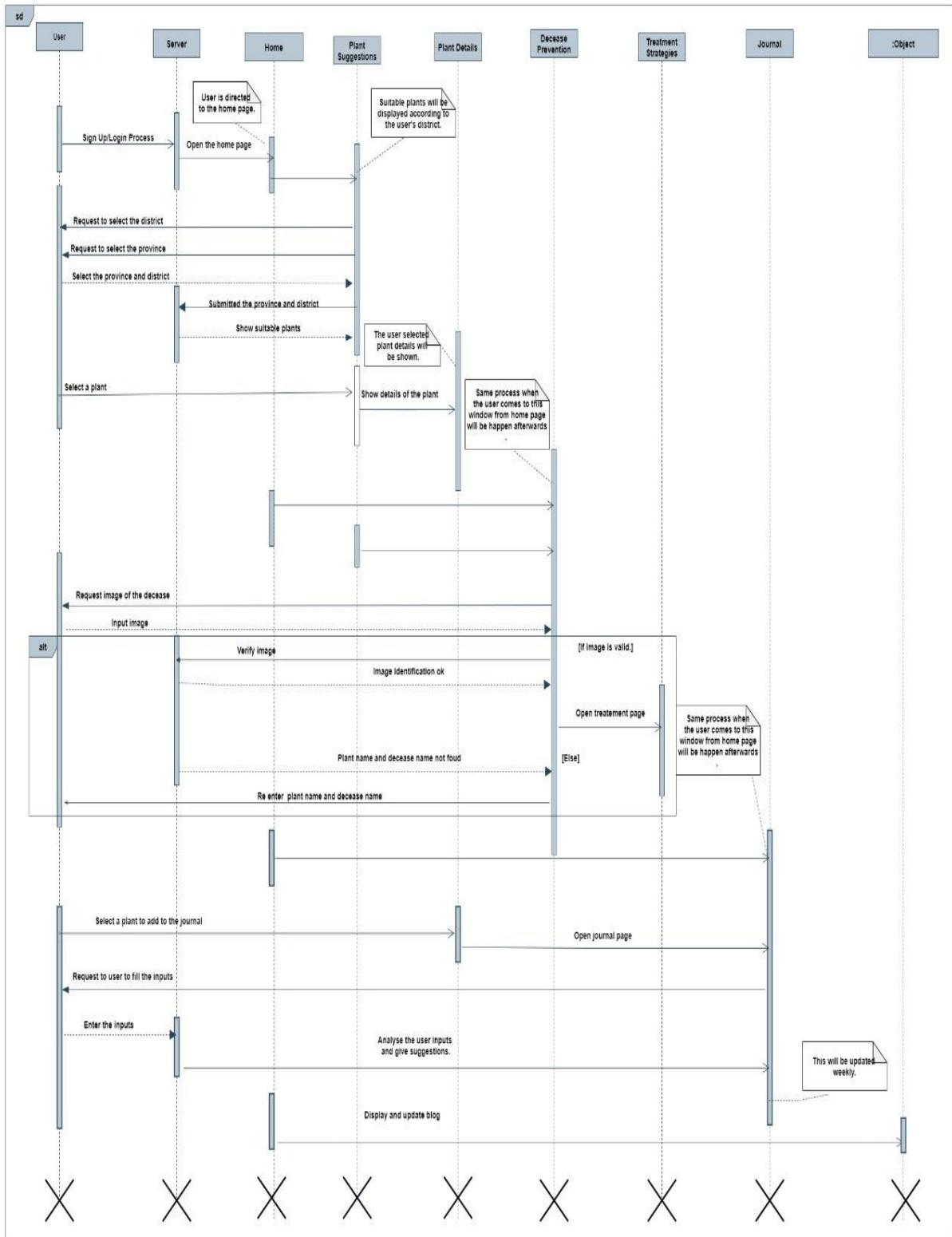


Figure 52. Sequence Diagram - Registered User

Appendix – Section C.1.3 – Sign In

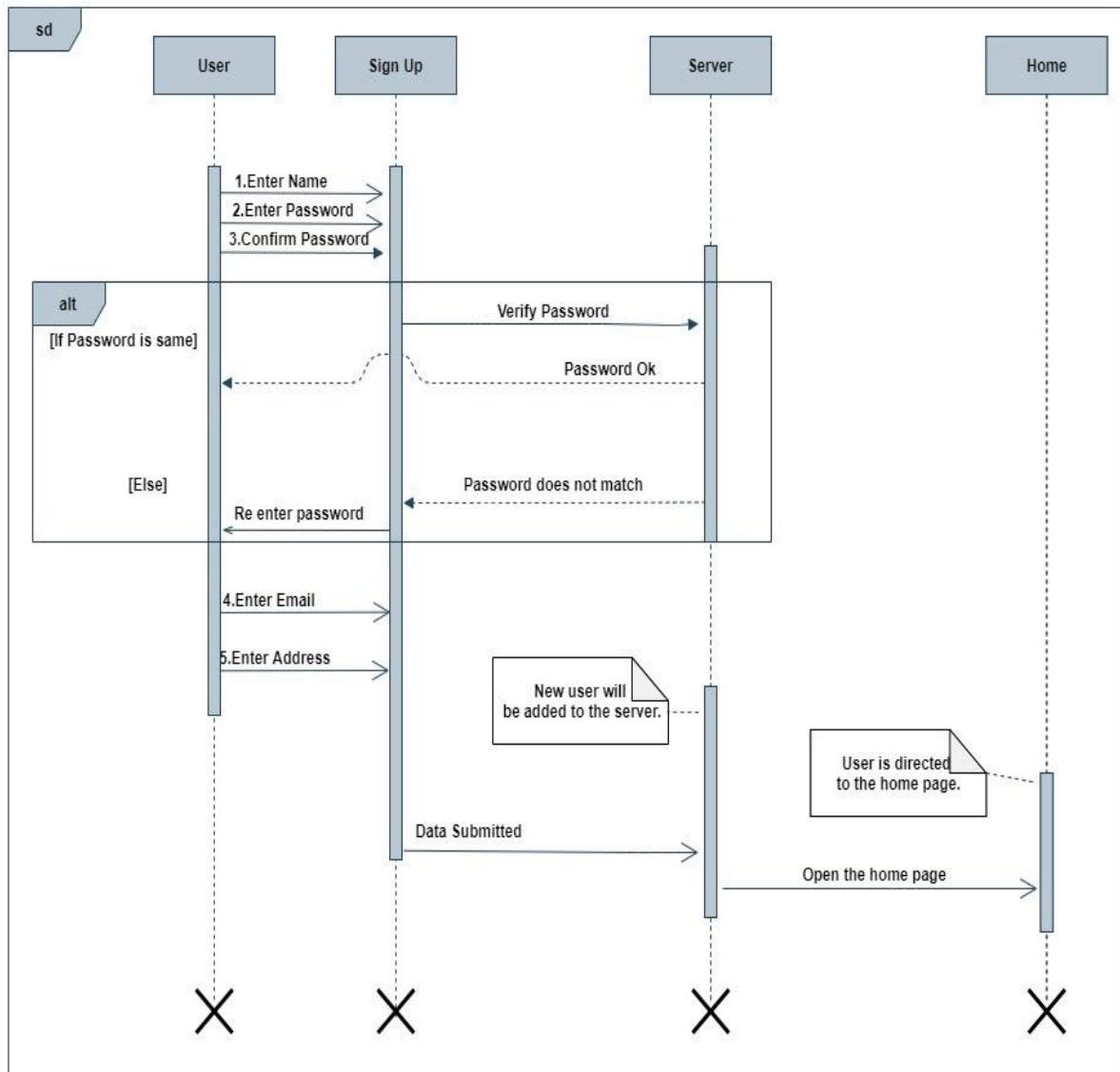


Figure 53. Sign In - Sequence Diagram

Appendix – Section C.1.4 – Un-Registered User

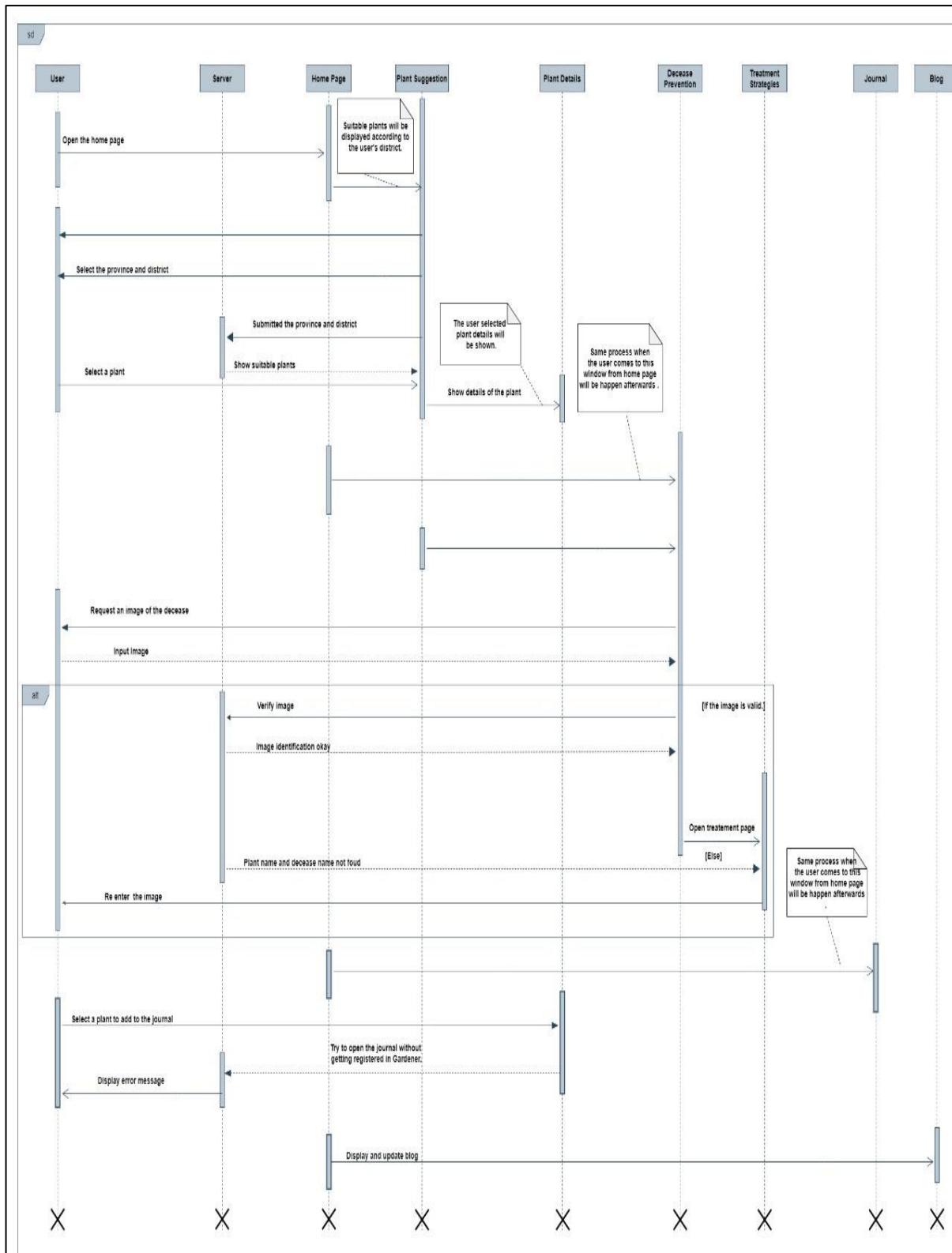


Figure 54. Sequence Diagram - Unregistered User

Appendix – Section C.2 – Wireframes

Appendix – Section C.2.1 – Plant Suggestion

The wireframe illustrates the layout of the 'Plant Suggestion' section. At the top, there's a header bar with a 'Page 1' button, a search bar containing 'https://www.default.com', and three colored circles (orange, yellow, blue). Below the header is a navigation bar with links: HOME, FARMER JOURNAL, PLANT PREVENTION, REVIEWS, THE GARDNER BLOG, and REGISTER. A logo for 'GARDNER' is also present. The main content area starts with a 'PLANT SUGGESTIONS' button. Below it are two input fields: 'Enter your district' and 'Enter your province'. A large 'Show Plant' button is positioned below these fields. A green box above the plant suggestions states: 'Suitable Plants Types According To The Inserted Details Will Display Below'. Below this box is a grid of 15 green rectangular boxes, each labeled with a plant name: Plant 01 through Plant 15. A green box below the grid states: 'User Can Select Each Of The Suggested Plants & View The Compatible Conditions To Grow It'. At the bottom, there's a 'Contact Us' section listing six email addresses for team members. To the right, there's a sidebar with links to Home, Plant Suggestions, Farmer Journal, Plant Prevention, Reviews, and The Gardner Blog, along with social media icons for LinkedIn, Facebook, and Twitter.

Figure 55. Wireframe - Plant Suggestions

Appendix – Section C.2.2 – Plant Suggestion – Conditions

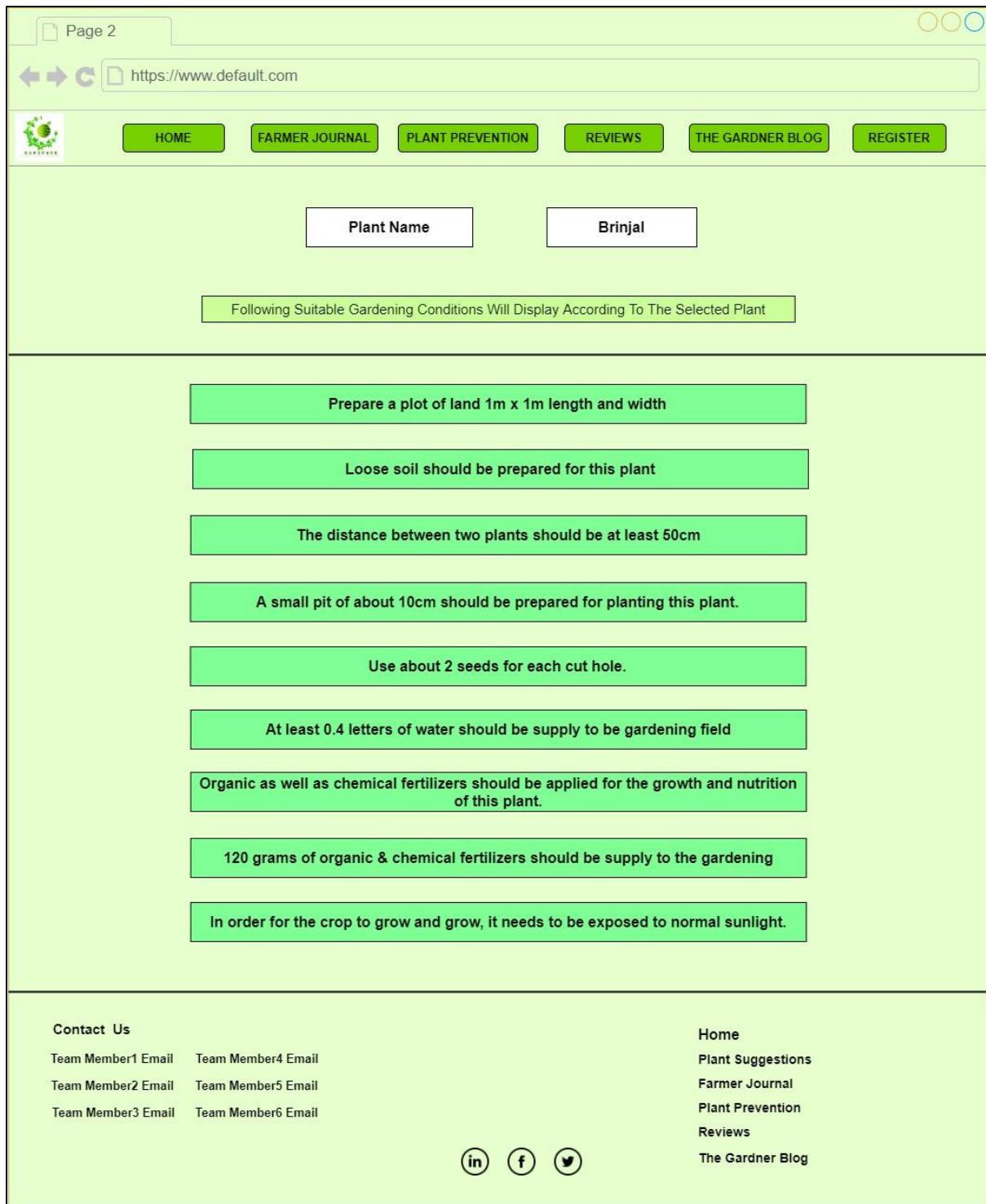


Figure 56. Wireframe - Plant Suggestion Conditions

Appendix – Section C.2.3 – Disease Prevention**Figure 57. Wireframe - Disease Prevention**

Appendix – Section C.2.4 – Weekly Journal

The wireframe illustrates the user interface for the Weekly Journal application, divided into three main sections:

- Step 01:** A login form titled "Farmer Journal" with fields for "Enter your Username" and "Enter your Password". A "Proceed to journal" button is located below the password field. The text "User Can Select Any Of The Short Term Crop That Will Provide The Harvest Within 60 Days As Listed Below." is displayed above the crop selection grid.
- Step 02:** A grid of nine crop names: Brinjal, Tomato, Okra, Cucumber, Chillie, Pumpkin, Elabatu, Cabbage, Pepper, Carrot, Beet, Leeks, Nivithi, Kohila, and Dragon fruit. The text "User Can Select Each Of The provided Plants & proceed to The gardener Journal" is displayed below the grid.
- Contact Us:** A section containing email addresses for team members and links to various website sections: Home, Plant Suggestions, Farmer Journal, Plant Prevention, Reviews, and The Gardner Blog. Social media icons for LinkedIn, Facebook, and Twitter are also present.

Figure 58. Wireframe - Weekly Journal

Appendix – Section C.2.5 – Weekly Journal - Guidelines

The wireframe illustrates the layout of the 'Weekly Journal Guidelines' page. At the top, there's a header bar with a back/forward button, a search bar containing 'https://www.default.com', and a logo for 'GARDNER'. Below the header are navigation links for 'HOME', 'FARMER JOURNAL', 'PLANT PREVENTION', 'REVIEWS', 'THE GARDNER BLOG', and 'REGISTER'. The main content area starts with input fields for 'Week Number' (set to '01') and 'Plant Name' ('Tomato'). A note below these fields states: 'Following Suitable Gardening Conditions Will Display According To The Week 01'. The central part of the page lists nine green-bordered boxes, each containing a gardening tip: 'Prepare a plot of land 1m x 1m length and width', 'Smooth soil should be prepared for this plant', 'The distance between two plants should be at least 40cm', 'A small pit of about 15cm should be prepared for planting this plant.', 'Use about 3 seeds for each cut hole.', 'At least 0.5 liters of water should be supply to be gardening field', 'Organic fertilizers should be applied for the growth and nutrition of this plant.', '120 grams of organic & chemical fertilizers should be supply to the gardening', and 'In order for the crop to grow and grow, it needs to be exposed to normal sunlight.' At the bottom, there's a 'Contact Us' section with email addresses for six team members and social media icons for LinkedIn, Facebook, and Twitter. To the right, there's a sidebar with links to 'Home', 'Plant Suggestions', 'Farmer Journal', 'Plant Prevention', 'Reviews', and 'The Gardner Blog'.

Figure 59. Wireframe - Weekly Journal Guidelines

Appendix – Section D – Group Members Contribution Table

Chapter	Sub-Chapter	Completed Member	Student ID
Introduction	Project Background	Chanka Sonnadara	W1790805
	Introduction To Problem	Chanka Sonnadara	W1790805
	Problem Boundary	Chanka Sonnadara	W1790805
	Examples In The Problem	Amila Fernando	W1761914
	Attempted Solutions Of Competitors	Naduni Kaveesha	W1790036
	Problem Definition	Naduni Kaveesha	W1790036
	Research Questions	Naduni Kaveesha	W1790036
	Aim	Rushelle Clement	W1790166
	Scope	Rushelle Clement	W1790166
	Objectives	Rushelle Clement	W1790166
	Proposed Solution	Amila Fernando	W1761914
	Rich Picture Diagram	Ranama Perera	W1790164
Literature Review	Resource Requirements	Ashen Induwara	W1761741
	Comparison Of Similar Research Products	Naduni Kaveesha	W1790036
	Research Gap	Amila Fernando	W1761914
Project Management	Research Techniques	Ranma Perera	W1790164
	Methodologies	Amila Fernando	W1761914
	Risks & Mitigations	Rushelle Clement	W1790166
	Activity Schedule	Naduni Kaveesha	W1790036
	WBS	Naduni Kaveesha	W1790036
System Requirement Specification	Gantt-Chart Diagram	Amila Fernando	W1761914
	Onion Model	Ranma Perera	W1790164
	Stakeholder Descriptions	Ranma Perera	W1790164
	Requirement Gathering Techniques	Amila Fernando	W1761914
	Questionnaire Design	Ranma Perera	W1790164
	Meeting Subject Experts	Amila Fernando	W1761914
	Analysis Of Gathered Data	Naduni Kaveesha	W1790036
	Use-Case Diagram	Amila Fernando	W1761914
	Use-Case Descriptions	Amila Fernando	W1761914
	Domain Model	Amila Fernando	W1761914
	Functional Requirements	Rushelle Clement	W1790166

	Non-Functional Requirements	Rushelle Clement	W1790166
Design	High-Level Architecture Diagram	Ranma Perera	W1790164
	Sequence Diagrams	Rushelle Clement	W1790166
	Class Diagram	Amila Fernando	W1761914
	Activity Diagram	Naduni Kaveesha	W1790036
	Wireframes	Plans For Implementation	W1790805
Conclusion	Dataset	Naduni Kaveesha	W1790036
	Legal, Social, Ethical & Professional Issues	Rushelle Clement	W1790166
	Plans For Implementation	Chanka Sonnadara	W1790805

Table 37. Group Contribution Table