

Software Requirements Specification

Land Vitality Management System

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Revision History

Name	Date	Reason For Changes	Version
PROTTOY SAHA	24.01.25	Both functional and non-functional requirements were covered in the first revision of this SRS document.	1.0
PROTTOY SAHA	28.01.25	The database, performance, and security requirements were updated in accordance with comments.	1.1
MD SAFWAN BHUIYAN SOHAN	29.01.25	Additional assistance with internationalization details and API integration have been improved.	1.2
MD SAFWAN BHUIYAN SOHAN	01.02.25	Modified the requirements for system availability and scalability.	1.3

1. Introduction

1.1 Purpose

This document is about the Land vitality management system, and its goal is to find the challenges and objectives of this project by ensuring that all stakeholders can have a shared understanding of what needs to be achieved. The land vitality management system is developing to find challenges in the agricultural field by analyzing the soil health by using its sensor based biochemical reactions. This system is developed to identify the nutrient deficiencies in the cultivatable soil of the farmers and as a result it can provide recommendation with suitable fertilizers. Moreover, this software provides a platform which can connect the farmers with expert consultants. This software requirement specification (SRS) documents the functional, non-functional and technical requirements which are aligned with the stakeholder's need and project objectives to develop this system.

1.2 Intended Audience and Reading Suggestions

This SRS document is intended for several key audiences are:

- **Developers:** To gain a clear understanding of the systems requirement including both functional and non-functional requirement the developers will use this document. This document will effectively give guidance to them while designing and developing the features.
- **Testers:** When the testers will develop the test cases they will use this document to ensure that the system is working as expected by identifying and addressing the issues before the software is being launched.
- **Project Manager:** The project manager will depend on this document to track the progress to manage the deliverables and to ensure that the project is staying on schedule and meets the project objectives.
- **End Users:** The End users include the farmers and the consultants who can review this document to understand how the system features are placed with their needs and to ensure that the software is practical, user friendly and can provide a valuable result.

1.3 Project Scope

The land vitality management system is designed to make a change in the agriculture field by offering a complete solution for managing soil health. This system works by analyzing soil samples, detecting nutrient deficiencies and by recommending the right fertilizers based on the soil's specific needs. This system will also help the farmers by connecting them with the expert consultants for personalized advice. Also, for the farmers to get a consultancy service through this software the system has a secure payment option. This system uses advanced sensors and a simple user-friendly interface as a result it ensures efficient use of resources, improves crop yields and promotes

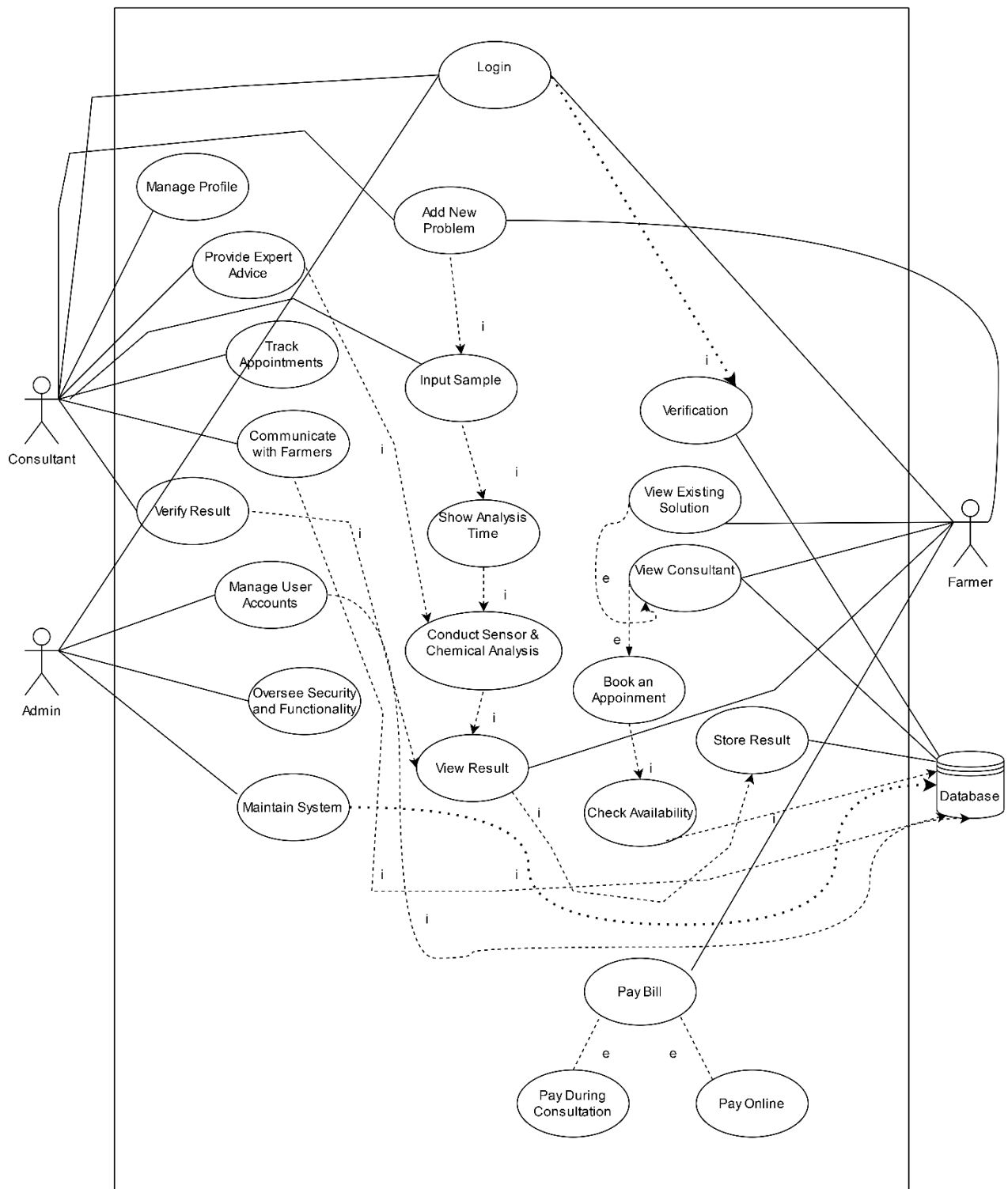
sustainable farming practices. Ultimately this software aims to support economic growth and food security by securing cultivating land health and productivity for long term.

2. Overall Description

2.1 Product Overview

The land vitality management system is designed to solve issues related to soil health and for making advancements in sustainable farming. By using sensor-based analysis this software can identify nutrient deficiency. Also, this software can make recommendations on fertilizers based on the identification. Additionally, this software can make safe payment for consulting services and also, connects farmers with experienced consultants for further guidance. Although this solution does not belong to an existing family of systems, it interacts with third-party payment gateways, soil analysis sensors, and user-friendly interfaces for consultants and farmers. Subsystems for managing consultants, creating recommendations, processing payments, and testing soil are all part of the system. These elements work together to provide a smooth and effective land management solution.

Use case Diagram for Land Vitality Management system

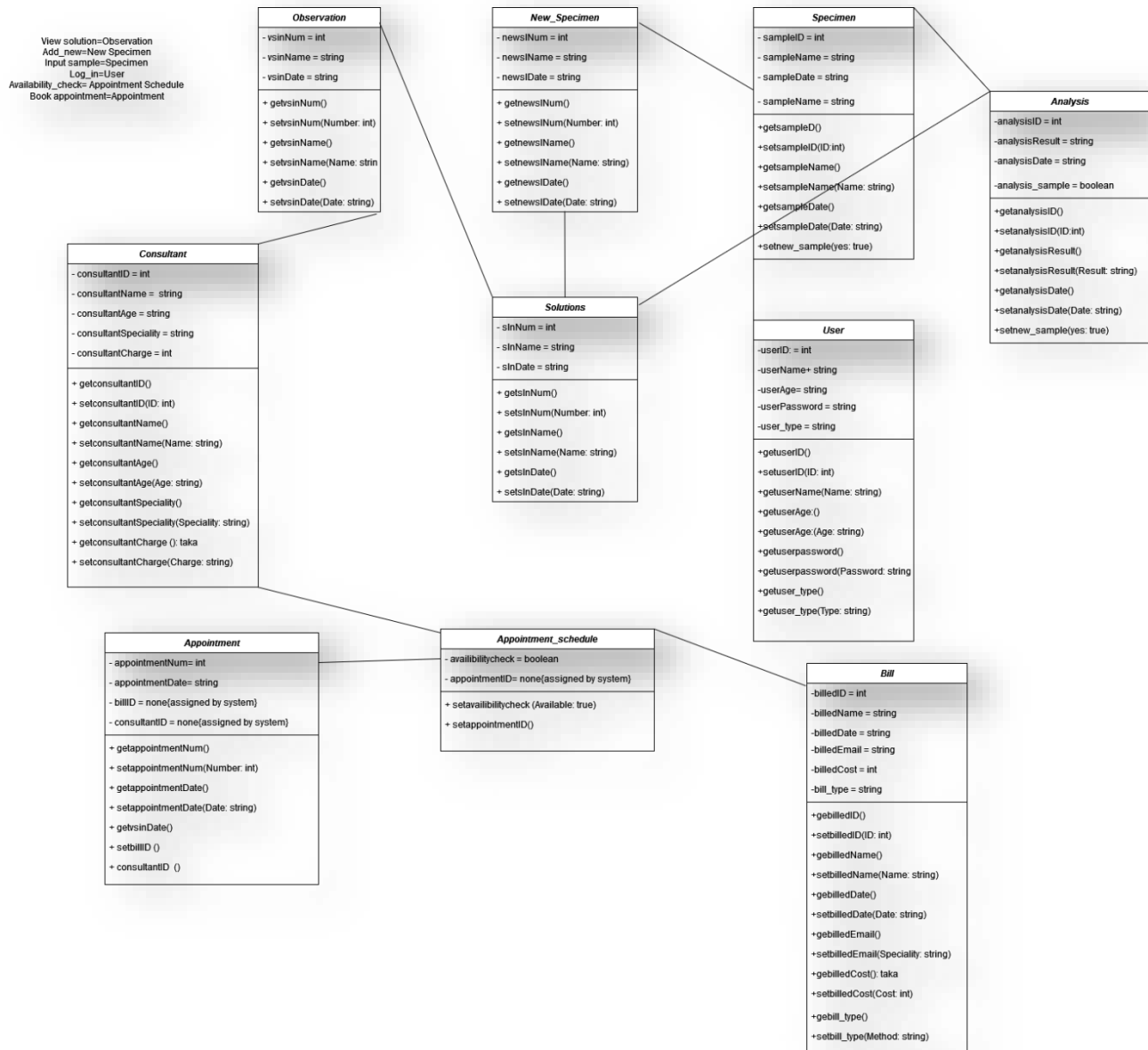


2.2 Product Features

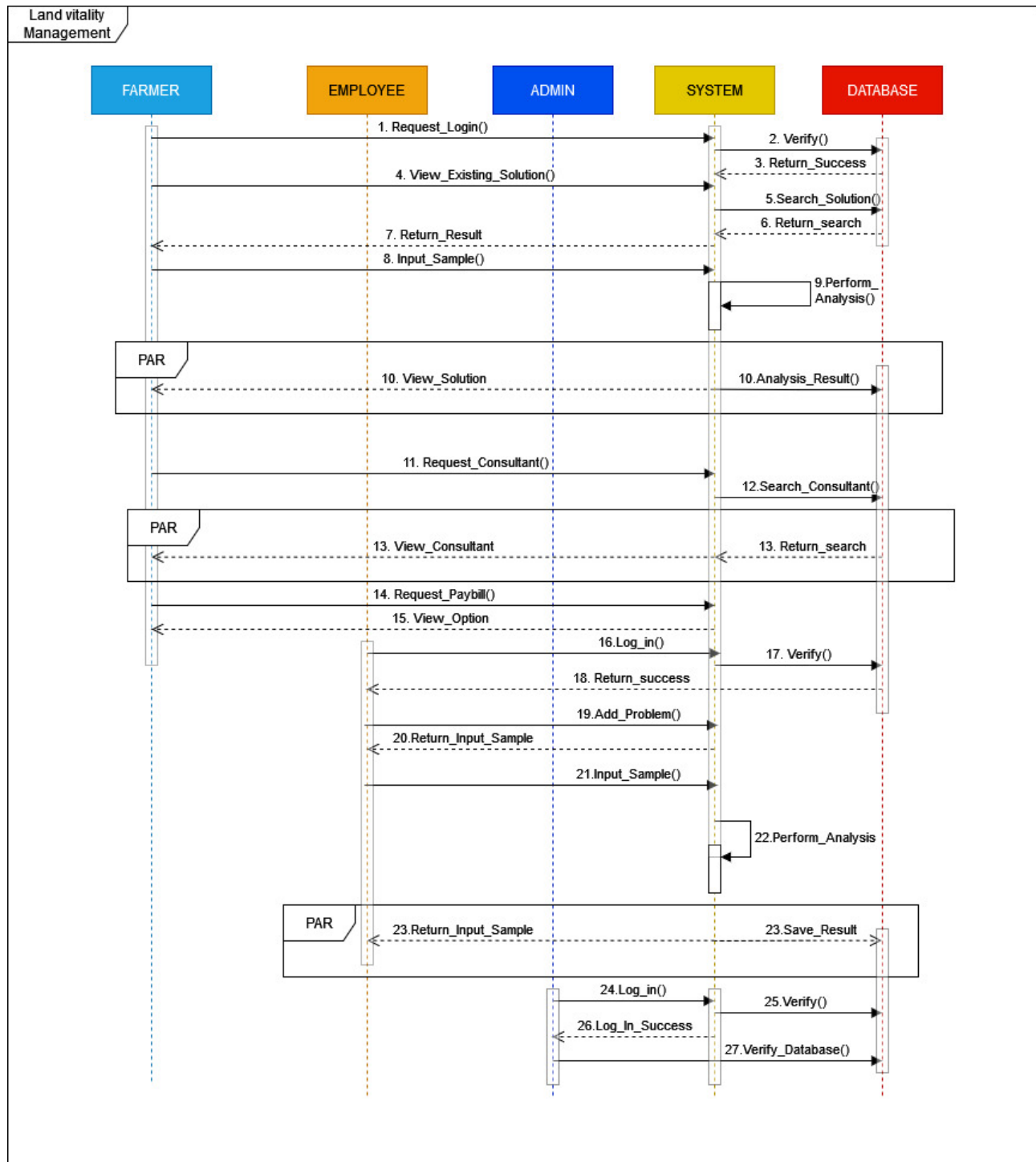
The core features of the land vitality management system is providing below:

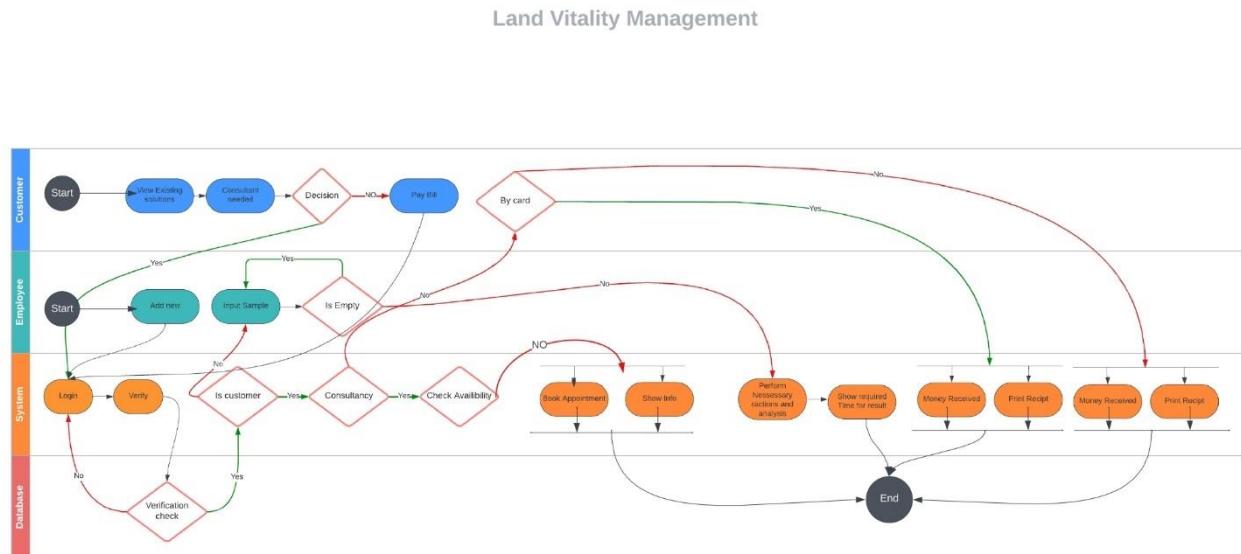
- **Soil Analysis:** By using its integrated sensors, this system analyzes soil samples to determine the pH levels, moisture, and nutrient deficiencies.
- **Fertilizer Recommendations:** Based on the soil analysis results this system can provide customizable fertilizer suggestions.
- **Consultant Management:** Enables users to view consultant profiles, check consultants availability and book their appointments.
- **Secure Payment Processing:** This software provides a secure online payment for getting consultancy services.
- **Result Visualization:** This software is able to display analysis results into an easy-to-understand format for every end-user by including charts and summaries.
- **User Management:** It Allows role-based access for farmers, consultants, and administrators.
- **Data Storage:** For future reference this software can store securely soil analysis data, user information, and transaction records.
- **Notifications and Alerts:** Software can send alerts for appointment confirmations, analysis results, and payment updates.

Class Diagram for Land Vitality Management System



Sequence Diagram for Land Vitality Management System





- **Hardware Platform:** This software is able to be operated on any standard computing hardware such as: Desktop computers, laptops, and mobile devices with standard configurations.

- **Operating Systems:** The software will be Compatible with Windows, macOS, Linux, iOS, and Android.
- **Software Requirements:** Web browsers such as: Chrome and Firefox need to be used for accessing the system and APIs for sensor integration and payment processing.
- **External Components:** Sensor devices for soil analysis and third-party payment gateways.

2.5 Design and Implementation Constraints

- **Hardware Limitations:** The system must support integration with specific soil sensors and ensure compatibility with commonly used devices.
- **Regulatory Compliance:** For the security of user data the system must follow data protection regulations like the GDPR.
- **Technology Stack:** MySQL will be used for the database, React.js for the user interface, and Python for the backend services.
- **Memory Requirements:** Effective methods for storing and retrieving data in order to manage big datasets.
- **Communication Protocols:** HTTPS and encrypted APIs can provide secure data transport.

2.6 Assumptions and Dependencies

The development and functionality of the system depends on the following assumptions and dependencies:

1. **Third-Party Sensors:** Need useful and appropriate sensors for soil analysis.
2. **Payment Gateways:** It depends on communication with external payment systems to carry out transactions securely.
3. **Internet Connectivity:** The system needs reliable access to the internet in order to provide online services and move data.
4. **User Technical Skills:** In order to operate the system farmers and consultants are required to have a basic level of digital literacy.
5. **Development Tools:** In order to produce work on schedule, certain programming languages and frameworks must be utilized.
6. **Database Dependencies:** MySQL is necessary for secure, efficient data storage and retrieval.

3. System Features

• 3.1 Soil Analysis

3.1.1 Description and Priority

Users can enter soil samples into the soil analysis function, and sensor-based biochemical reactions are used to examine the samples. This function measures pH, moisture content, and nutritional deficits.

Priority: High.

Benefit: High.

Penalty: High.

Cost: Medium.

Risk: Low.

3.1.2 Functional Requirements

- **REQ-1:** To analyze soil pH, moisture, and nutrient content the system shall take input from the connected sensors
- **REQ-2:** Results of the soil analysis shall display by the system in a user-friendly format (e.g., charts or tables).
- **REQ-3:** For any kind of sensor errors or invalid data inputs during the analysis process the system shall notify users about that.

3.1.3 Business Rules to be Collected

- Soil analysis data must be securely stored by the system.
- The analysis must be comply with agricultural standards for soil testing and reporting.

• 3.2 Fertilizer Recommendation

3.2.1 Description and Priority

Based on the results of soil tests, this approach provides specific fertilizer recommendations for treating identified nutrient deficiencies.

Priority: High

Benefit: High.

Penalty: High.

Cost: Low.

Risk: Medium.

3.2.2 Functional Requirements

- **REQ-1:** To suggest suitable fertilizers the system shall use soil analysis data.
- **REQ-2:** To apply the fertilizer the system shall provide a detailed instruction (e.g., quantity and frequency).
- **REQ-3:** If no suitable fertilizers are available for the identified deficiencies the system shall notify the users.

3.2.3 Business Rules to be Collected

- Recommendations must align with local agricultural practices and environmental guidelines.
- Fertilizer options should be changed on a regular basis depending on the market availability.

• 3.3 Consultant Management

3.3.1 Description and Priority

The farmers can access consultant profiles, verify their availability, and schedule appointments with the consultant management feature.

Priority: Medium.

Benefit: Medium.

Penalty: Medium.

Cost: Medium.

Risk: Low.

3.3.2 Functional Requirements

- **REQ-1:** The system shall allow consultants to update their profiles, including qualifications and areas of expertise.
- **REQ-2:** The system shall display consultant availability in by an interactive calendar.
- **REQ-3:** The system shall enable users to book, reschedule, or cancel appointments.

3.3.3 Business Rules to be Collected

- In order to maintain correct data, consultants need to confirm their availability and profiles.
- Appointments must be confirmed or canceled at least 24 hours before the scheduled time.

• 3.4 Secure Payment Processing

3.4.1 Description and Priority

The payment processing feature allows a user to pay securely for the consultant services.

Priority: High

Benefit: High.

Penalty: High.

Cost: Medium.

Risk: Medium.

3.4.2 Functional Requirements

- **REQ-1:** The system shall integrate with third-party payment gateways for example: Bkash, Nagad etc.
- **REQ-2:** The system shall securely process transactions also shall issue a digital receipt.
- **REQ-3:** The system shall notify users about failed transactions and shall allow users to retry the payment.

3.4.3 Business Rules to be Collected

- Payments must align with the industry standards for a secure transaction.
- In order to finalize the payments, an users must have to provide proper billing information to the system.

• 3.5 User Management

3.5.1 Description and Priority

The user management feature allows users to create, manage, and update their accounts, which ensures a customized experience throughout the system.

Priority: High

Benefit: High.

Penalty: High.

Cost: Medium.

Risk: Medium.

3.5.2 Functional Requirements

- **REQ-1:** The system shall allow users to create and manage their accounts with unique usernames and passwords.
- **REQ-2:** The system shall provide an administrators with tools to monitor and manage all user accounts.
- **REQ-3:** The system shall allow the users to reset their passwords via email or mobile verification.
- **REQ-4:** The system shall notify users of any suspicious login attempts or unauthorized access.
- **REQ-6:** The system shall allow users to deactivate or delete their accounts and download associated data securely.

3.5.3 Business Rules to be Collected

- Administrators must verify consultant profiles before they are activated on the platform.
- To enhance the account security for the users, they must follow a standard complex password policy.

• 3.6 Notifications and Alerts

3.6.1 Description and Priority

The notifications and alert feature keep users informed about important updates, results, and appointments.

Priority: Medium

Benefit: High.

Penalty: Medium.

Cost: Low.

Risk: Medium.

3.6.2 Functional Requirements

- **REQ-1:** The system shall send an alert to the user when soil analysis reports are ready for review.
- **REQ-2:** The system shall notify users about upcoming appointments.
- **REQ-3:** For any kinds of critical soil health issues the system shall provide an alert to take immediate action.
- **REQ-4:** The system shall allow a user to customize their notification preferences (e.g., email, SMS, or in-app).
- **REQ-5:** The system shall maintain a notification log for users to review past alerts.

3.6.3 Business Rules to be Collected

- Notifications must follow a predefined schedule for regular updates such as: appointment reminders must be sent 24 hours before.
- Real-time data must be used in alerts related for the soil health.

• 3.7 Reporting and Insights

3.7.1 Description and Priority

The reporting and insights feature provides a detailed analysis, and trends based on the soil health and user interactions.

Priority: Medium

Benefit: High.
Penalty: Medium.
Cost: Medium.
Risk: Medium.

3.7.2 Functional Requirements

- **REQ-1:** Based on repeated analysis the system shall generate a soil health trend report.
- **REQ-2:** The system shall allow users to generate custom reports based on selected data points and timeframes.
- **REQ-3:** The system shall provide financial impact reports on implementing recommended fertilizers.
- **REQ-4:** The system shall integrate with GIS tools to create visual maps of land profiles.
- **REQ-5:** The system shall support to export a report in multiple formats such as: PDF Docx and Excel.

3.7.3 Business Rules to be Collected

- For clarity and readability, a report must be created in an organized way.
- For suggested action financial reports must be provide precise cost breakdowns.

• 3.8 Help and Support

3.8.1 Description and Priority

The help and support feature provides users with resources such as: FAQs, user guides, and access to customer support for resolving their issues.

Priority: Low
Benefit: Medium.
Penalty: Low.
Cost: Low.
Risk: Low.

3.8.2 Functional Requirements

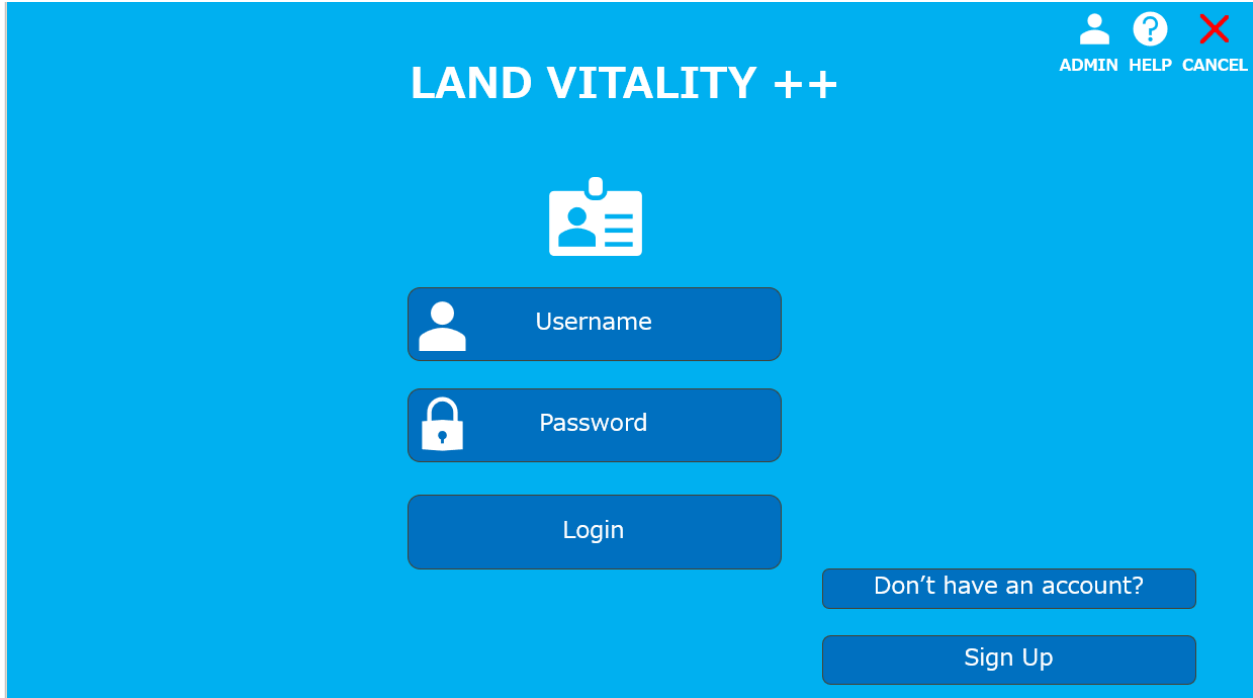
- **REQ-1:** To address the common user issues the system shall provide an FAQ section.
- **REQ-2:** The system shall include a searchable user guide for navigating system features.
- **REQ-3:** The system shall allow users to contact customer support through a form or email link.
- **REQ-4:** The system shall provide basic troubleshooting steps for sensor or connection issues.

3.8.3 Business Rules to be Collected

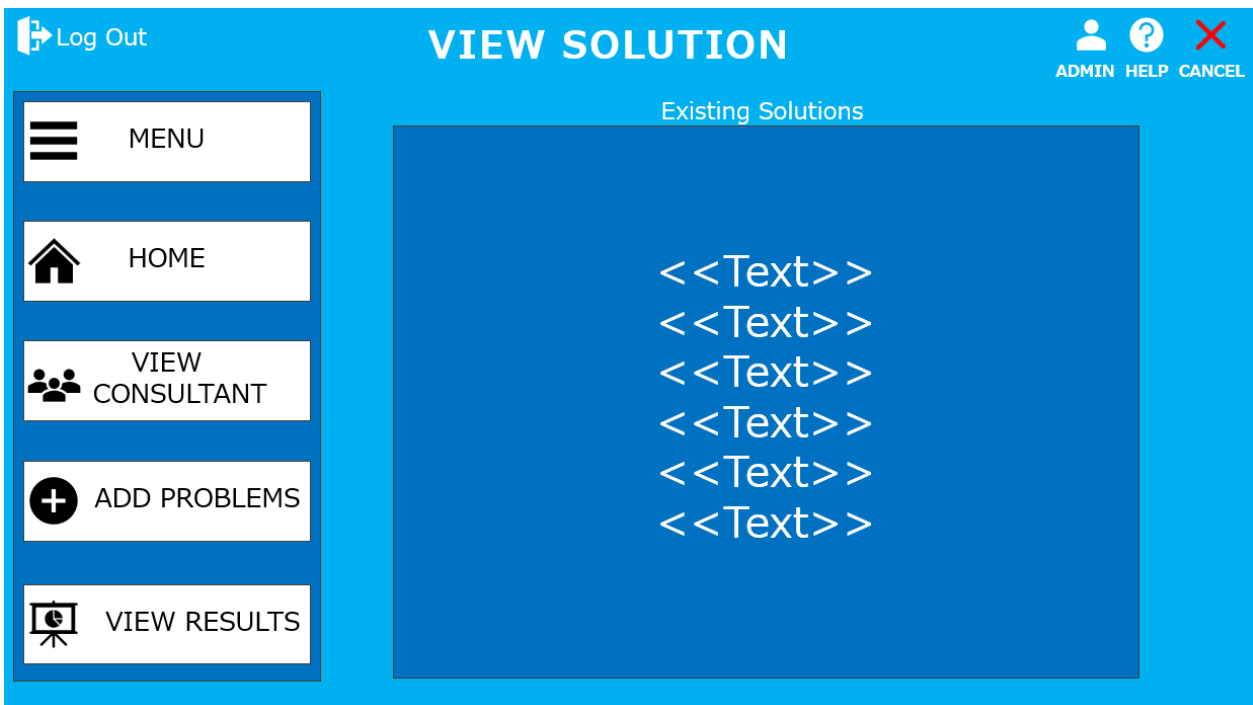
- Based on user feedback and frequently reported issues the help content must be updated regularly.
- Supporting inquiries must be answered within 48 hours on business days,.

4. External Interface Requirements


4.1 User Interfaces






The login screen for LAND VITALITY ++ features a blue background. At the top right, there are three icons: a user, a question mark, and a red X, with labels ADMIN, HELP, and CANCEL below them. The title LAND VITALITY ++ is centered at the top. Below the title is a white icon of a person with a document. The login form consists of three blue input fields: Username (with a person icon), Password (with a lock icon), and a Login button. To the right of the Login button are two more buttons: Don't have an account? and Sign Up.





The VIEW SOLUTION dashboard has a blue background. At the top left is a Log Out button with a door icon. At the top right are the same three icons and labels as the login screen. The title VIEW SOLUTION is centered at the top. Below the title is the subtitle Existing Solutions. On the left is a vertical menu with five items: MENU (hamburger icon), HOME (house icon), VIEW CONSULTANT (group of people icon), ADD PROBLEMS (plus icon), and VIEW RESULTS (eye icon). The main content area is a large blue rectangle containing six lines of placeholder text: <<Text>>, <<Text>>, <<Text>>, <<Text>>, <<Text>>, and <<Text>>.


 Log Out


ADD PROBLEM


  
ADMIN HELP CANCEL

 MENU

 HOME

 VIEW CONSULTANT

 ADD PROBLEMS


 VIEW RESULTS

Problem Id:

Problem Name:


Date:

Description:




 Add more info


Input Sample


Start Analysis


 Log Out


VIEW RESULTS


  
ADMIN HELP CANCEL

 MENU

 HOME

 VIEW CONSULTANT

 ADD PROBLEMS

 VIEW RESULTS

Selected Result Information


<<Text>>
<<Text>>
<<Text>>
<<Text>>
<<Text>>
<<Text>>
<<Text>>

Results List

<<Text>>
<<Text>>
<<Text>>


In Progress

<<Status By
Progress Bars>>

 Log Out

CONSULTING

ADMIN HELP CANCEL

 MENU

 HOME

 VIEW CONSULTANT

 ADD PROBLEMS

 VIEW RESULTS

Consultant Id:

Consultant Name:

Select Schedule:


V

Problem Information:

+ Add more info


Book Appointment


Pay bill


 Log Out


BILL PAYMENT


ADMIN HELP CANCEL

 MENU

 HOME

 VIEW CONSULTANT

 ADD PROBLEMS

 VIEW RESULTS

Bill Id:

Customer Name:

Consultant ID:

V

Amount:

By Cash

By Online

Confirm

4.2 Hardware Interfaces

4.2.1 Description:

To ensure smooth data collection and processing, The Land Vitality Management System connects with various hardware devices such as: soil sensors, servers, and user devices.

4.2.3 Supported Devices:

Several devices will be supported by this system to ensure an effective data collection process which are:

- **Soil Sensors:** These sensors will detect the soil's pH, moisture content, and nutrient levels.
- **User Devices:** Users can use any of their desktop, laptop, tablet, or smartphone devices to access the system.
- **Servers:** On-site or cloud-based servers will be utilized for data processing and storage

4.2.4 Data and Control Interactions:

- The system can receive real-time data from the soil sensors via cable, Bluetooth, or Wi-Fi connections
- If required then the system can also transmit data.
- Every piece of information collected will be examined. Additionally, the data will be safely saved in the system's database for later use and analysis.

4.2.5 Communication Protocols: The system will make use of the following to ensure a safe and effective data transmission:

- **Wi-Fi/Bluetooth:** To connect and transfer data from soil sensors to the system.
- **HTTPS:** To provide a secure connection between user devices and cloud-based servers.
- **RESTful APIs:** To ensure a smooth connection between the system and external devices or third-party apps.

4.3 Software Interfaces

4.3.1 Description:

The Land Vitality Management System interacts with various software components, such as: databases, operating systems, tools, and third-party payment services.

4.3.2 Software Components and their Roles

The system will integrate with the following software components:

- **Operating Systems:** The system will support Windows, macOS, Linux, and Android/iOS.
- **Database Management System (DBMS):** MySQL or PostgreSQL will be used to store transaction data, soil analysis data, user profiles, and consultant records.
- **Web Frameworks & Backend Services:**
 - Data processing and business logic will be handled by Django (Python) or Node.js (JavaScript).
 - React.js or Vue.js will be used by the system for the web in order to guarantee excellent user experience.

- **Frontend Technologies:**
To ensure a seamless user experience, the system will use React.js or Vue.js for the web interface.
- **Cloud Services & Hosting:** AWS, Azure, or Google Cloud will host the database, API services, and application front-end.
- **Third-Party Services:**
 - **Sensor SDKs/APIs:** IoT-based sensors may gather soil data through using sensor SDKs and APIs.
 - **Payment Gateway APIs:** Processing payments securely via integrating with Bkash, Nagad, or a similar service.

- **4.3.3 Data Flow and Shared Information**

The system processes and shares different types of data between its components which are shown into the table:

Data Type	Source	Destination	Purpose
Soil Analysis Data	Sensors	Database, User Dashboard	provide information on the health of the soil.
User Data	Registration Form	Database	keep track of user data
Consultant Appointments	User Booking	Database, Notification Service	arranges appointments and alerts users about it
Payment Transactions	User Payment	Payment Gateway, Database	handles payments for the services
Recommendations	System AI	User Dashboard	shows suggested fertilizers and professional advice.

Figure: An Overview of the system Data Flow and Processing

4.4 Communications Interfaces

4.4.1 Description:

The Land Vitality Management System depends on a number of communication capabilities to enable seamless interaction between users, sensors, and external services which are:

4.4.2 Communication Functions and Requirements

1. **Web-Based Communication**
 - **Protocol:** HTTPS (Hypertext Transfer Protocol Secure)
 - **Purpose:** Ensures secure, encrypted communication between users and the web application.

- **Message Formatting:** The standard JSON or XML format could be used by the system for structured data exchange.
- **Security Measures:** The system uses TLS 1.2+ encryption to protect itself against data interception.

2. Sensor Data Transmission

- **Protocol:** Wi-Fi, Bluetooth, or MQTT may be utilized, depending on the type of soil sensor being used.
- **Purpose:** Enables real-time data collection and transmission of soil health information to the system using IoT-based sensors.
- **Message Formatting:** Sensor data will be stored in JSON for ease of processing.
- **Security Measures:** Data is updated every 10 seconds when connected, and it is saved locally and synced upon reconnecting when disconnected.

3. Email and Notification Services

- **Protocol:** SMTP or Simple Mail Transfer Protocol will be used.
- **Purpose:** Transmits all alert emails produced by the system (such as confirmations of appointments, payment receipts, and soil analysis reports).
- **Message Formatting:** Emails will be delivered in both HTML and plain text formats for security reasons.
- **Security Measures:** To guard against phishing emails and to guarantee safe delivery, security measures must include TLS encryption, SPF, and DKIM.

5. Other Nonfunctional Requirements

5.1 Performance Requirements

To handle real-time data from soil analysis sensors, control user interactions, and guarantee a seamless experience for consultants and farmers, the system must have effective processing capabilities. The following performance requirements define expected system behavior:

- **5.1.1 Response Time**
 1. Within five seconds of sensor data retrieval, the system must process and present the results of the soil analysis.
 2. In normal network conditions, the user dashboard should load in two seconds.
 3. Bookings for regular appointments must be verified within three seconds of being submitted.
- **5.1.2 Throughput**
 1. At least 500 concurrent users must be supported by the system without facing any performance issues.
 2. One hundred sensor data entries per second must be processed by the backend.
- **5.1.3 Scalability**
 1. When user traffic increases, more cloud instances can be deployed because of to the system architecture's support for horizontal scaling.
 2. Without affecting query speed at least one million soil analysis records must be handled by the database effectively
- **5.1.4 Availability**
 1. To ensure consistency for the users, the system must have an uptime of at-least 99.5% time.
- **5.1.5 Network Performance**
 1. Even at 2 Mbps network rates, the system should function successfully.
- **5.1.6 Constraints**

1. Devices with a minimum of 4GB of RAM and a 1.5 GHz processor are needed to operate the system efficiently.
2. To guarantee accessibility, mobile versions of the program must not be greater than 50MB.

5.2 Safety Requirements

User safety, data integrity, and system stability must be given top priority. The safety requirement are provided below:

- **5.2.1 Data Protection and Integrity**
 1. To avoid unauthorized access, the system must encrypt all sensitive user data, such as payment information and consultant records.
 2. In order to prevent erroneous suggestions data from soil analyses must be verified before processing.
- **5.2.2 Secure Payment Processing**
 1. For safe payment processing, all financial transactions have to comply to PCI-DSS requirements.
 2. Transaction confirmation alerts will be sent to users in order to detect any illegal behavior.
- **5.2.3 Hardware and Sensor Safety**
 1. On every seven days the sensors must be calibrated automatically to avoid any false reading regarding the soil.
 2. The system shall notifyIf the sensor readings show unusual or dangerous conditions such as excessively high soil acidity.
- **5.2.5 Compliance and Regulations**
 1. In order to guarantee that data-driven recommendations are not harming crops or soil health, the system must comply with agricultural safety regulations.

5.3 Security Requirements

The security requirements are given below:

- **5.3.1 User Authentication and Access Control**
 1. To access the system, users will need to register using their own login information (password and email).
 2. Administrators and consultants must use MultiFactor Authentication (MFA) in order to prevent unwanted access.
 3. RBAC, or role-based access control shall be implemented.
- **5.3.4 System Security and Threat Mitigation**
 1. Intrusion detection systems (IDS) and firewalls shall be implemented by the system to keep an eye on to prevent online threats.
- **5.3.5 Compliance with Security Standards**
 1. Users will be given the opportunity to manage or remove their data, as well as information about privacy rules and data gathering procedures.

5.4 Software Quality Attributes

The Land Vitality Management System shall adhere to high software quality standards to ensure reliability, security, and usability. The following quality attributes define essential system characteristics:

- **5.4.1 Reliability**
To provide minimal service delay, the system must be able to recover from failures in less than two minutes.
- **5.4.2 Usability**
Both technologically adapted and non-technologically adapted users shall be able to utilize the system because it will stick to user-friendly UI/UX standards.
- **5.4.3 Maintainability**
Modular architecture shall be used in the system's development to allow for the updating of specific parts without impacting the system as a whole.
- **5.4.4 Interoperability**
The system will allow access to external agricultural databases, IoT-based soil sensors, and third-party payment gateways.
- **5.4.7 Portability**
The system shall work with web browsers on Windows, macOS, Linux, and Android/iOS (via mobile apps).
- **5.4.9 Testability**
User feedback shall be collected in a regular basis to improve the system functionality and usability.

6. Other Requirements

- **Internationalization Requirements:** The system shall support multiple languages such as: English and Bengali for future expansions of this software. The software must also be able to adjust the date, time, and measurement units according to local preferences.

Appendix A: Analysis Models

- RBAC: Role-Based Access Control
- MFA: Multi-Factor Authentication
- API: Application Programming Interface
- GDPR: General Data Protection Regulation
- ACID: Atomicity, Consistency, Isolation, Durability (database principles)

Appendix B: Analysis Models

Already provide in the document.

Appendix C: Issues List

- **TBD:** Finalize Complete the list of languages that will be supported for internationalization.
- **Pending Decision:** Choosing a cloud provider (AWS, Azure, or Google Cloud) is still up for question.
- **Conflicts:** Setting scalability-related maximum storage limitations for sensor data.